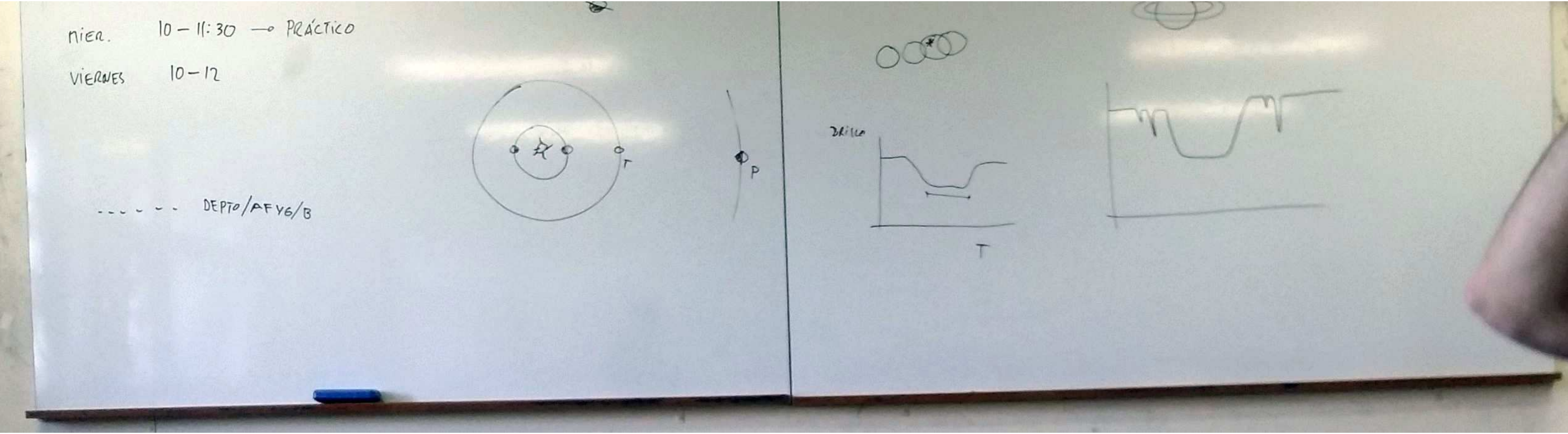
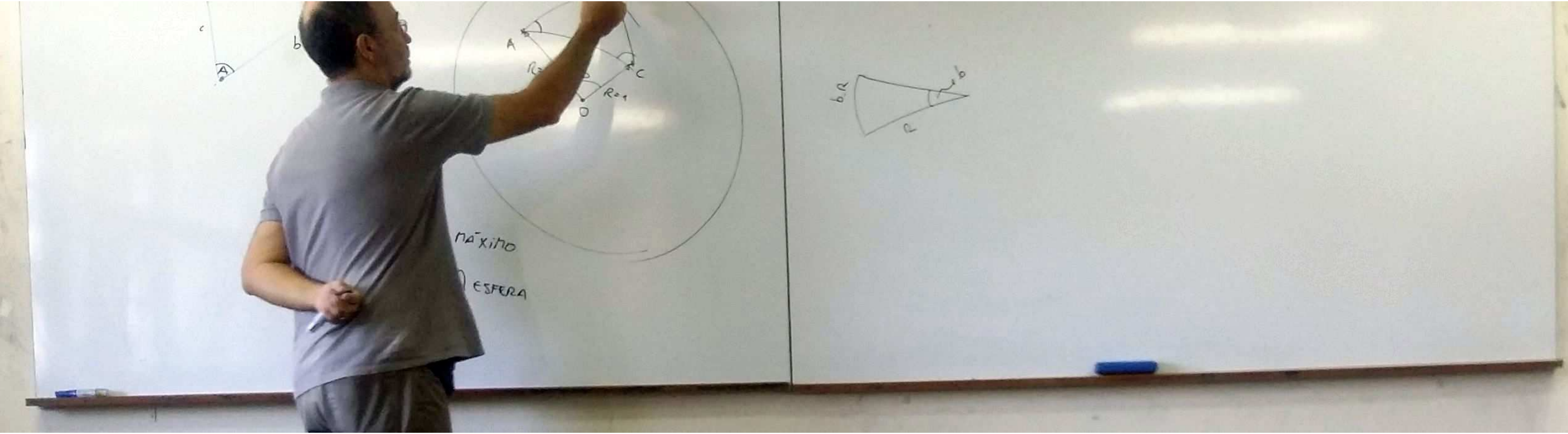
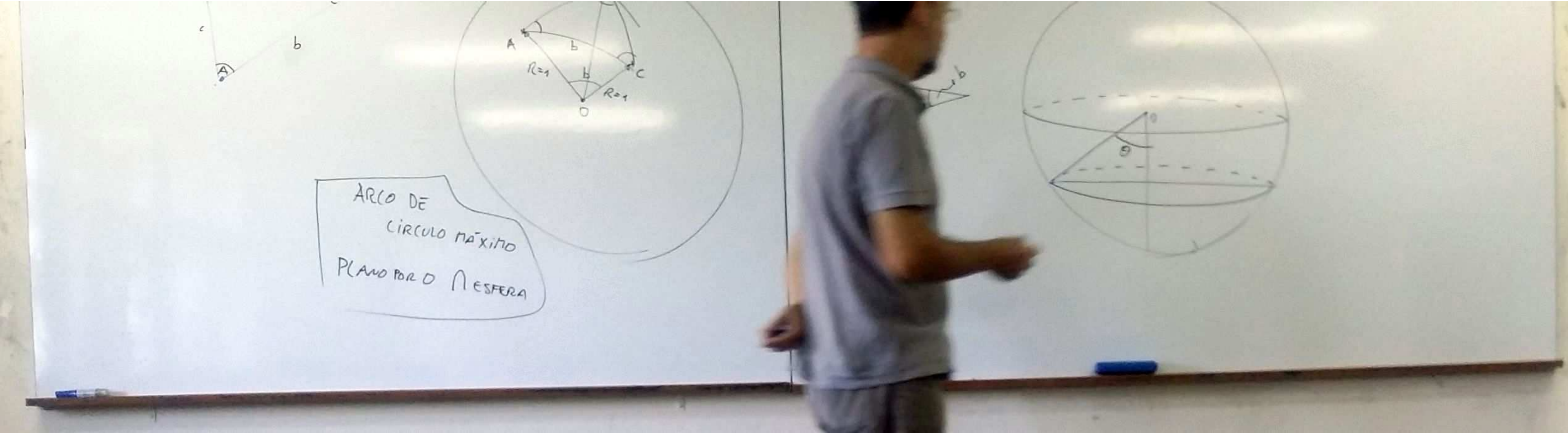
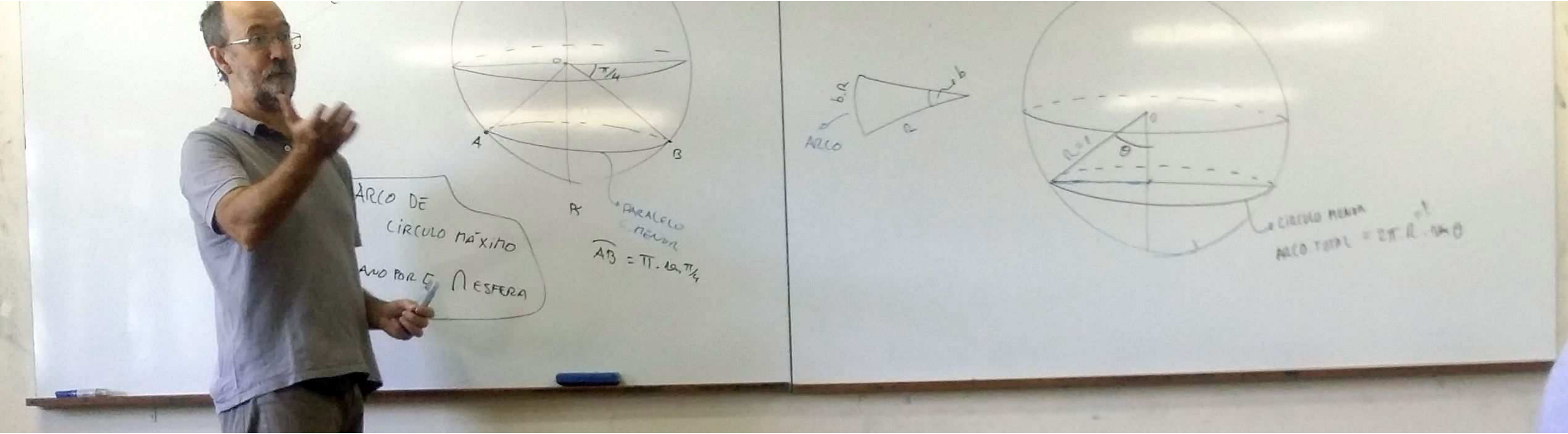
Astronomia Fundamental 2017



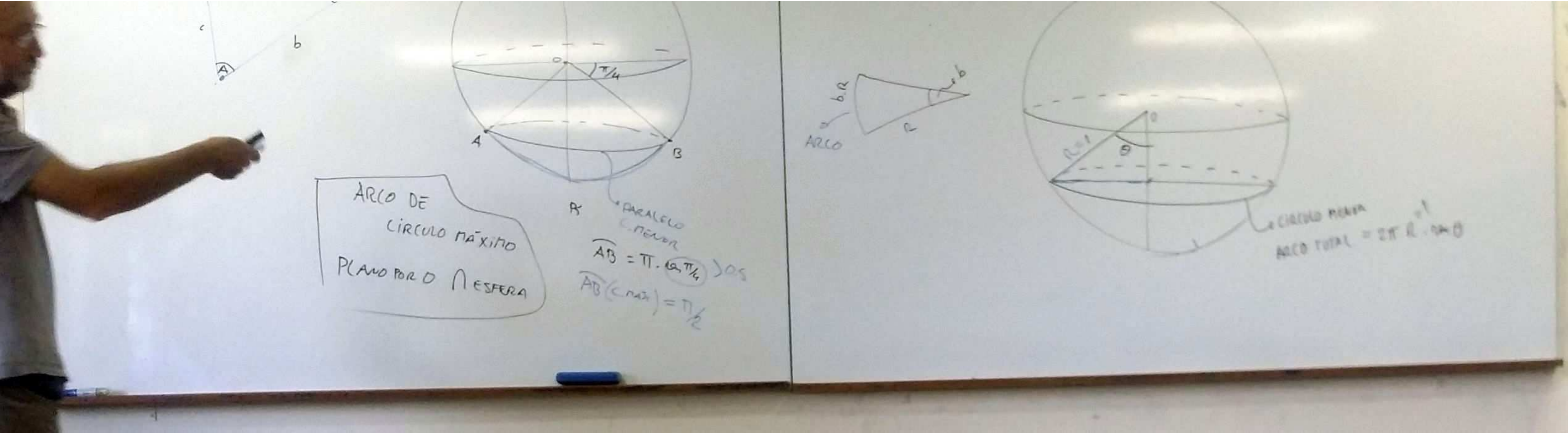

A
O
ARCO DE
CIRCULO MÁXIMO
PLANO POR O ∩ ESFERA

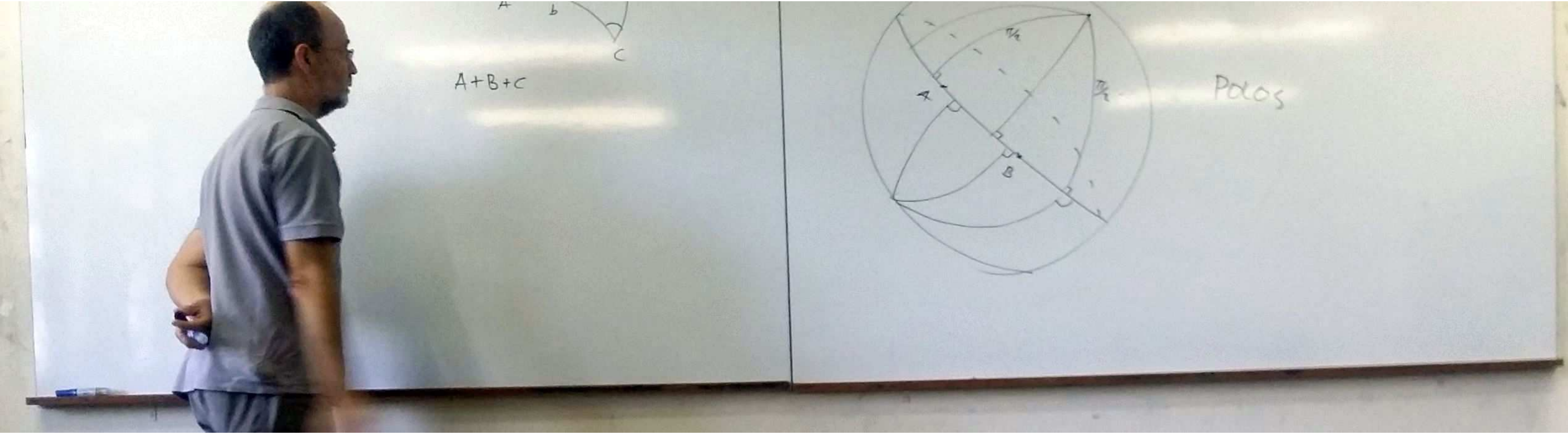

A
C
O
R=1
máximo
ESFERA
bR
R
b


A
b
A
b
C
R=1
b
R=1
O
ARCO DE
CIRCULO MÁXIMO
PLANO POR O ∩ ESFERA
b
θ

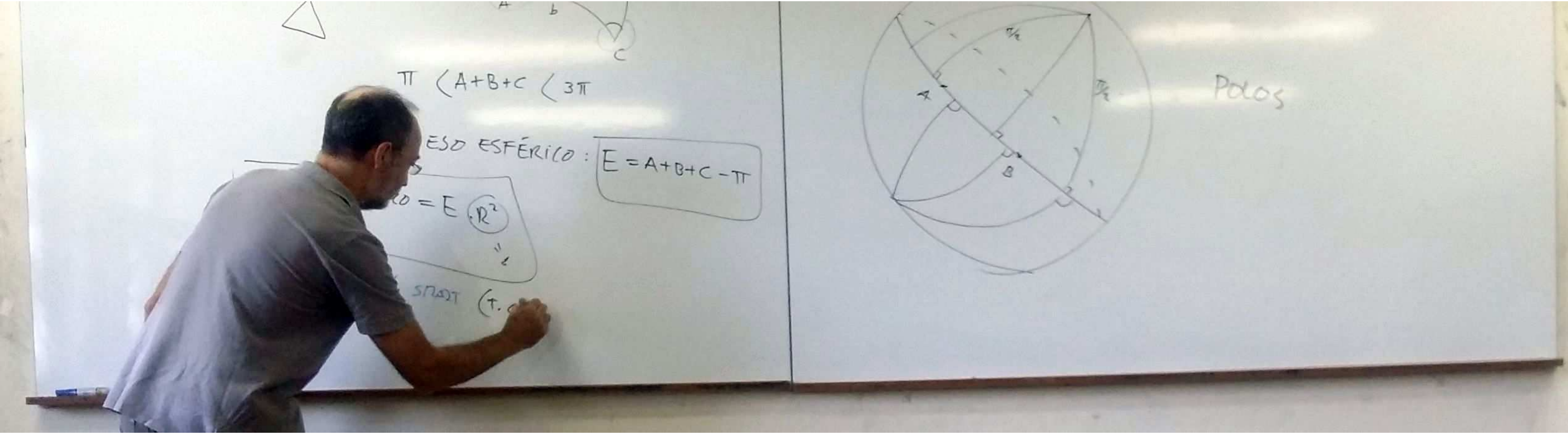

A
B
ARCO DE
CIRCULO MÁXIMO
ESFERA
PARALELO
MENOR
ARCO
CIRCULO MENOR
ARCO TOTAL

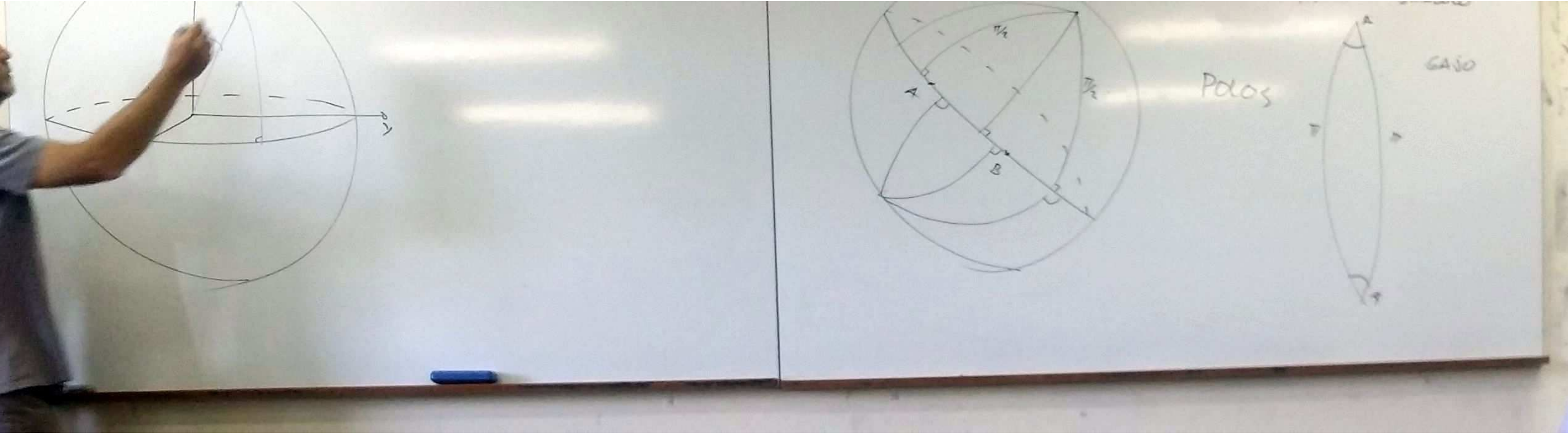
Astronomia Fundamental 2017



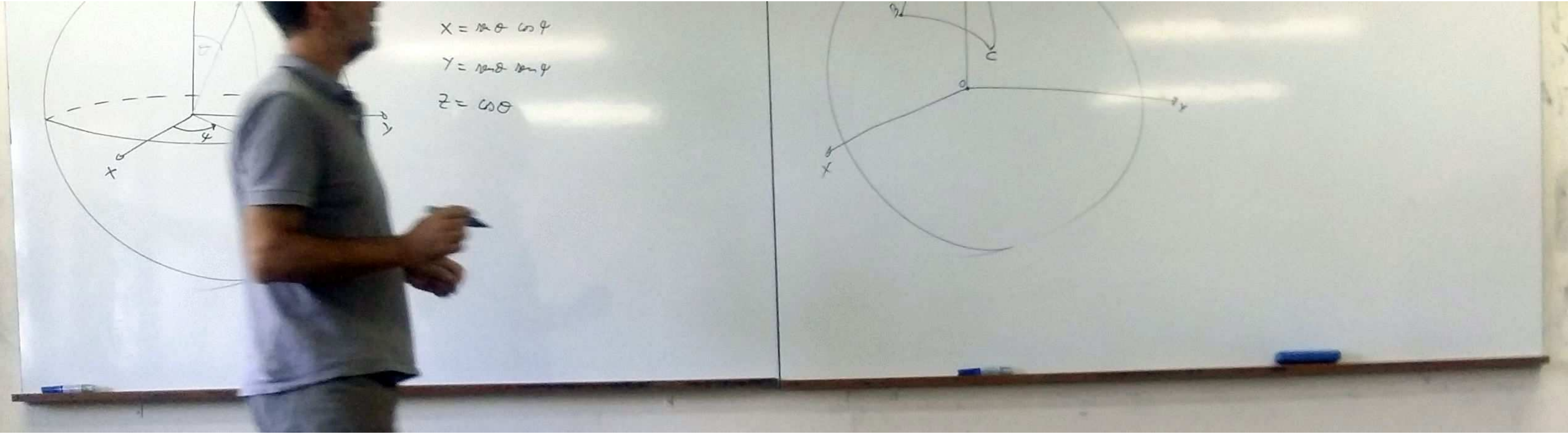

A
b
C
A+B+C
π/2
A
π/2
B
Polos

Astronomia Fundamental 2017



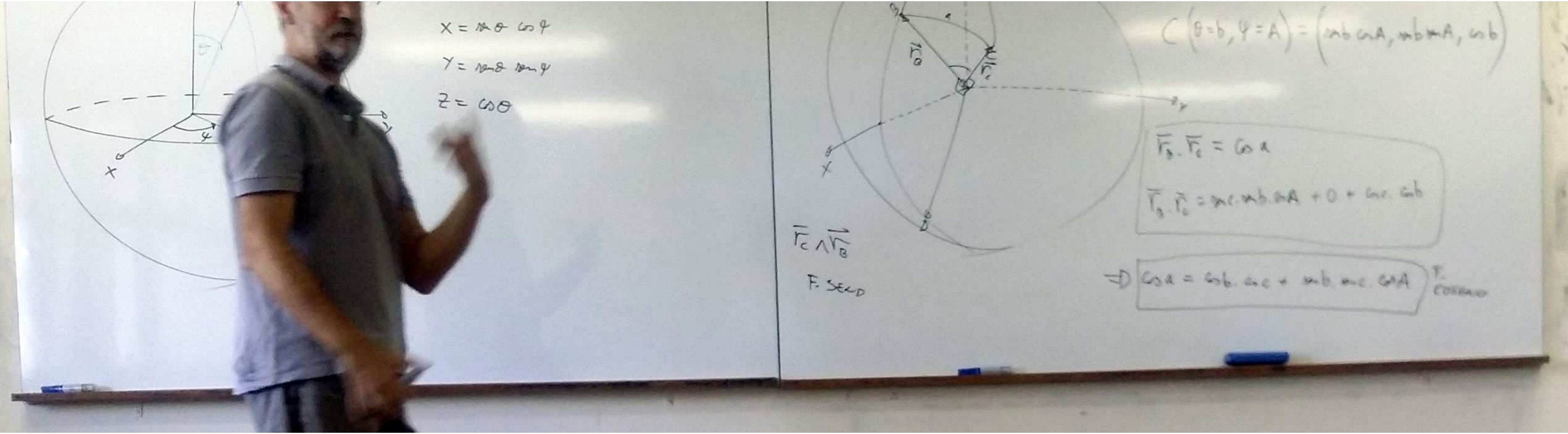

A
B
Polos
Caso

Astronomia Fundamental 2017

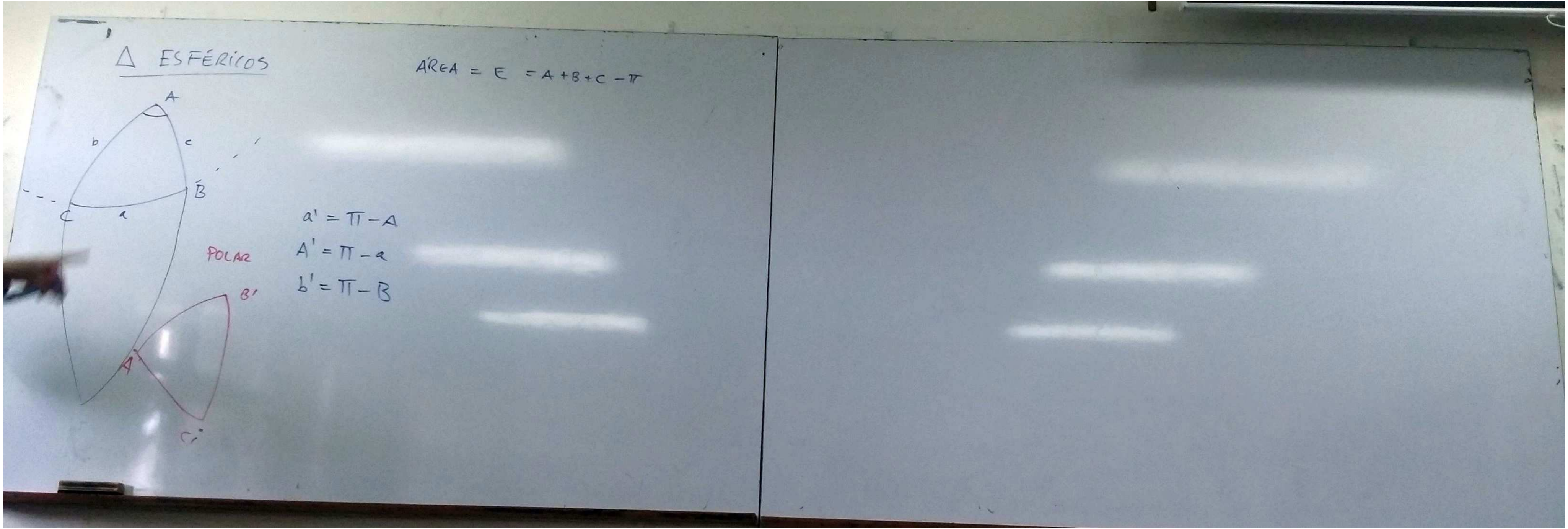


Astronomia Fundamental 2017

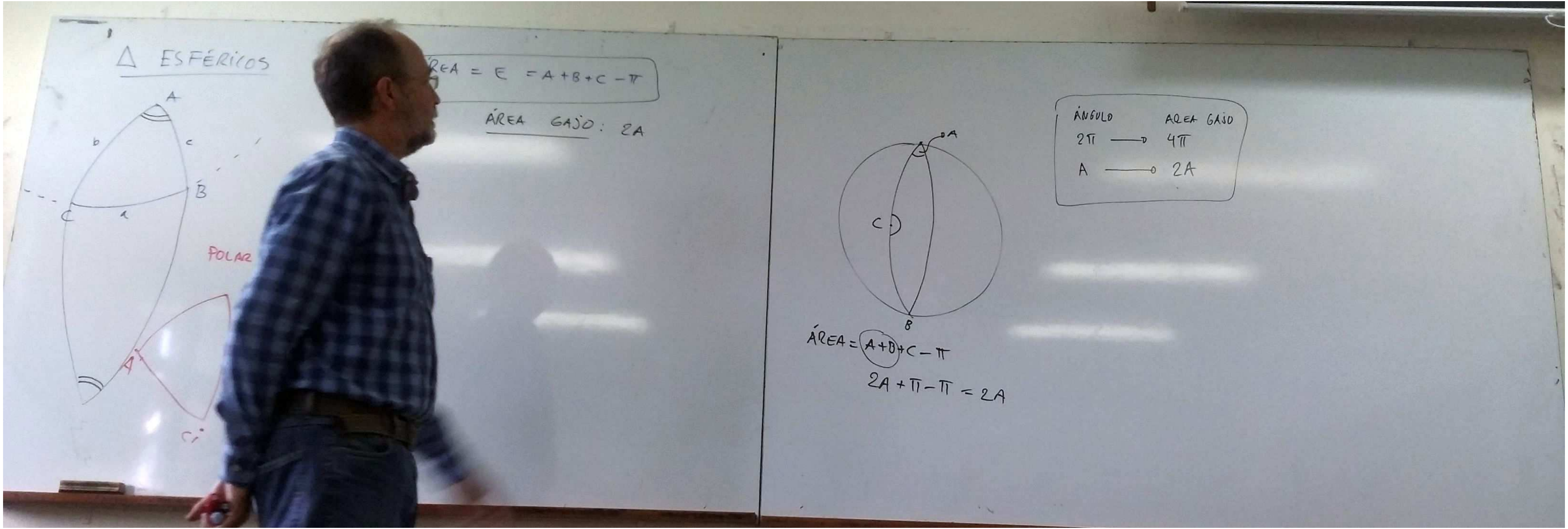
Astronomia Fundamental 2017

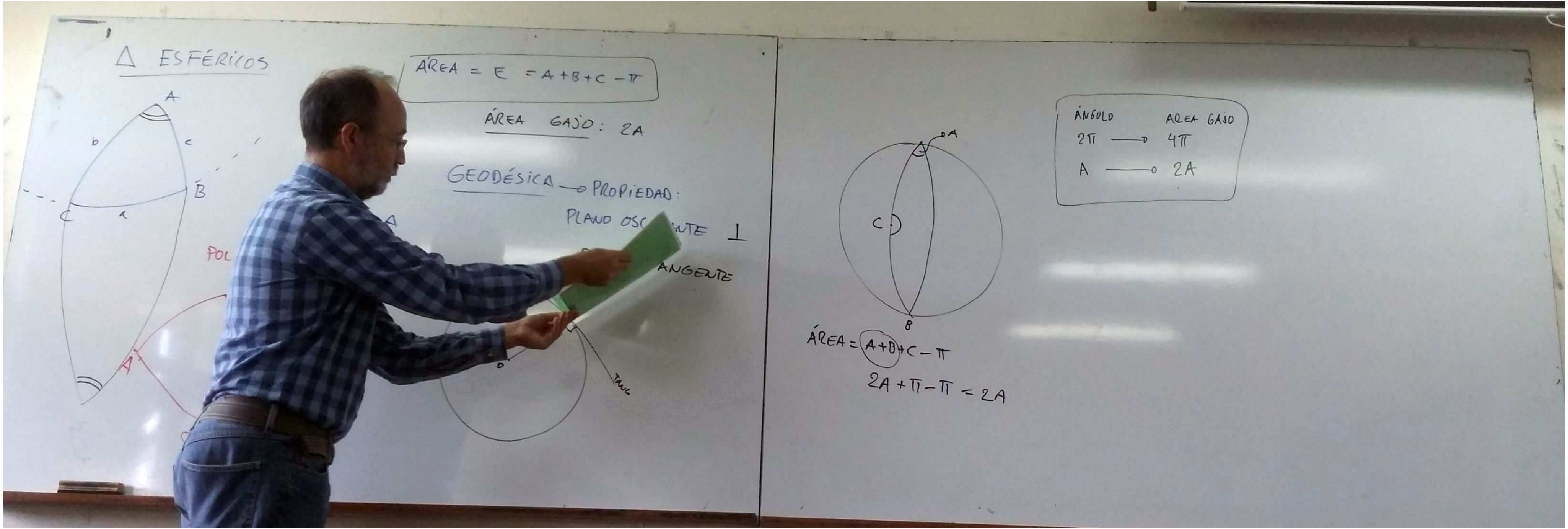


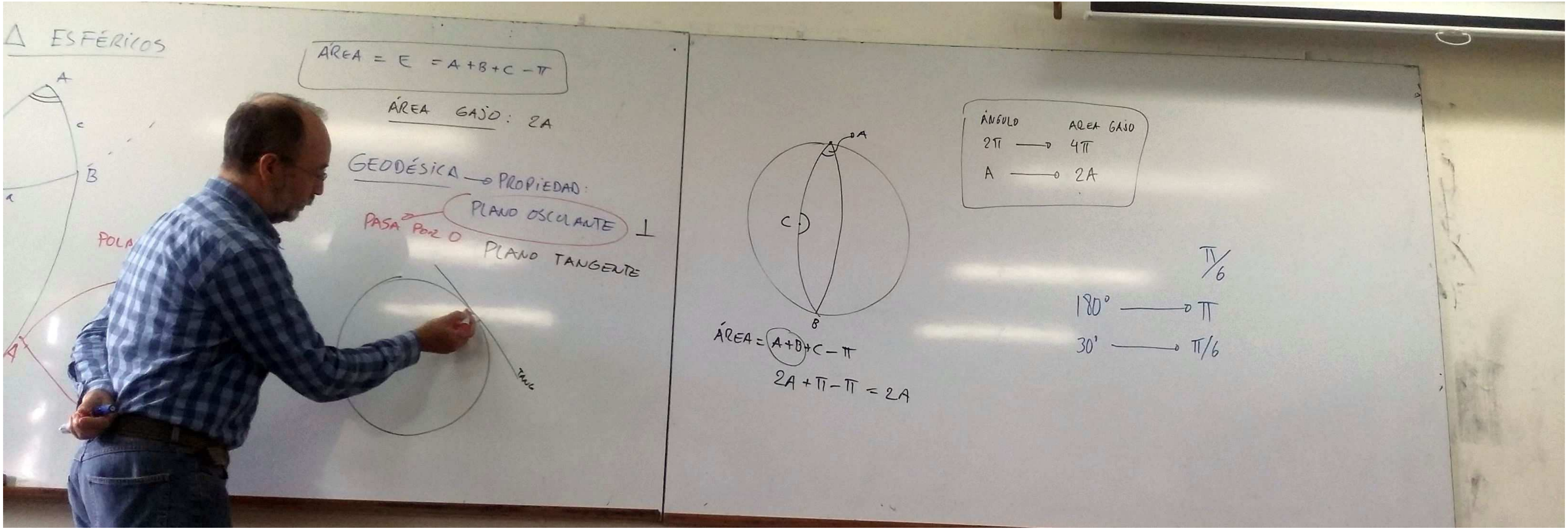

Δ ESFÉRICOS
A
b
c
B
C
a

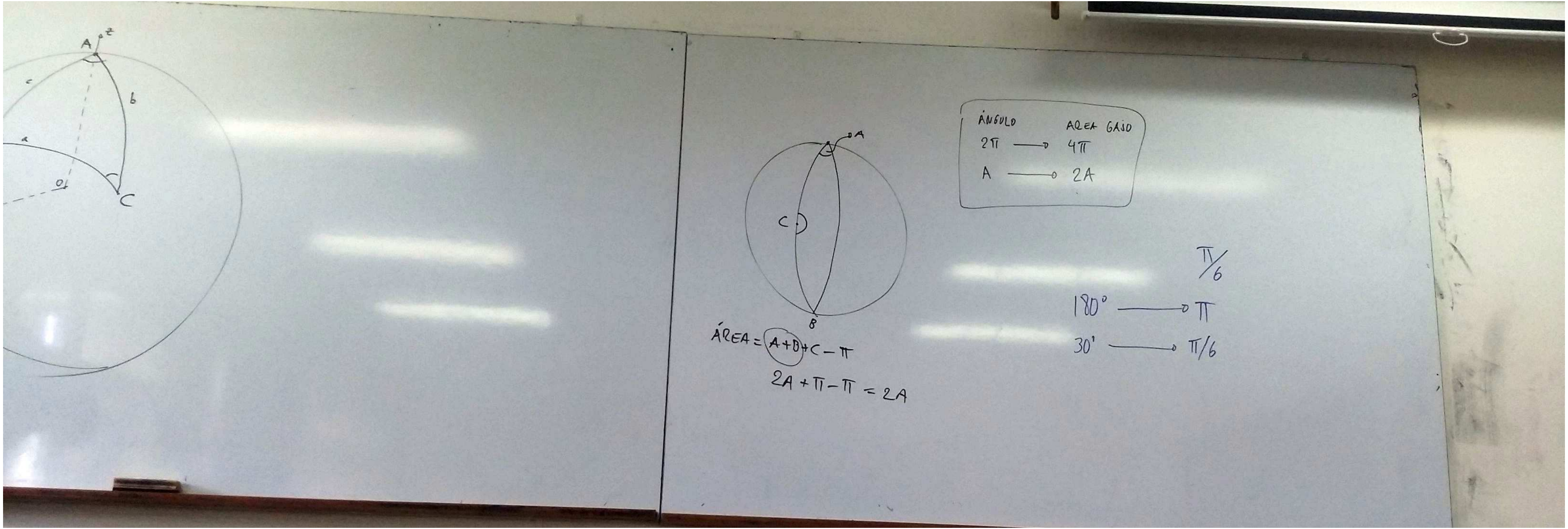

△ ESFÉRICOS
ÁREA = E = A + B + C − π
A
b
c
B
C
a
a' = π − A
A' = π − a
b' = π − B
POLAR
B'
A'
C'

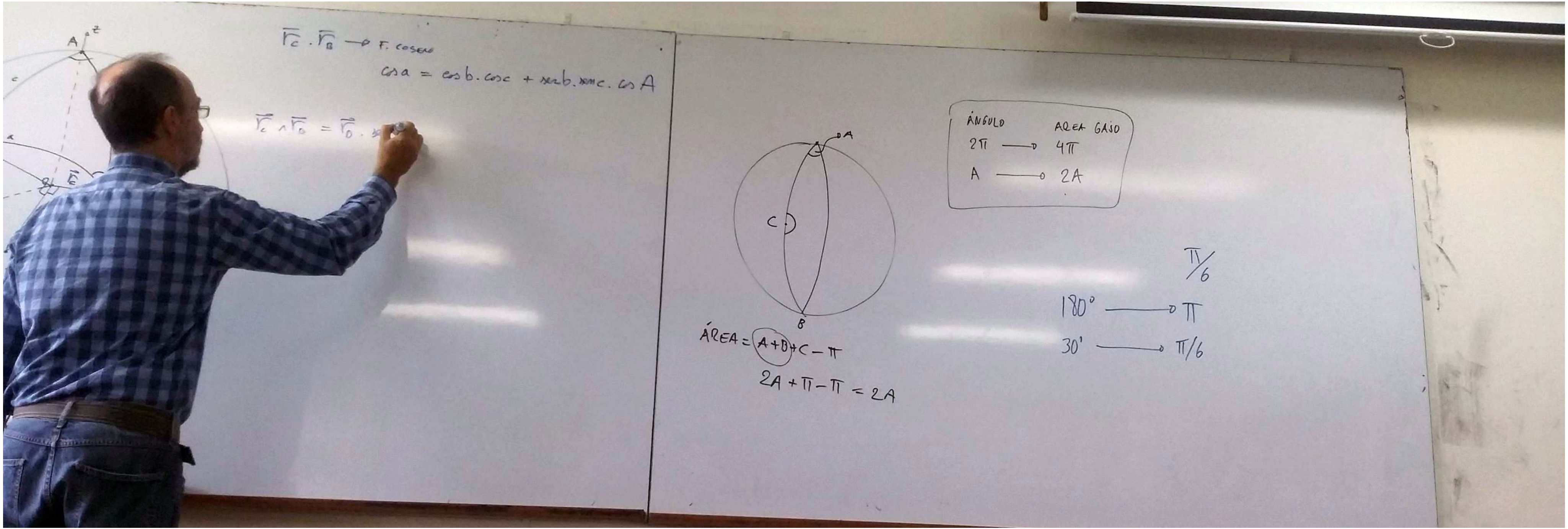
Astronomia Fundamental 2017

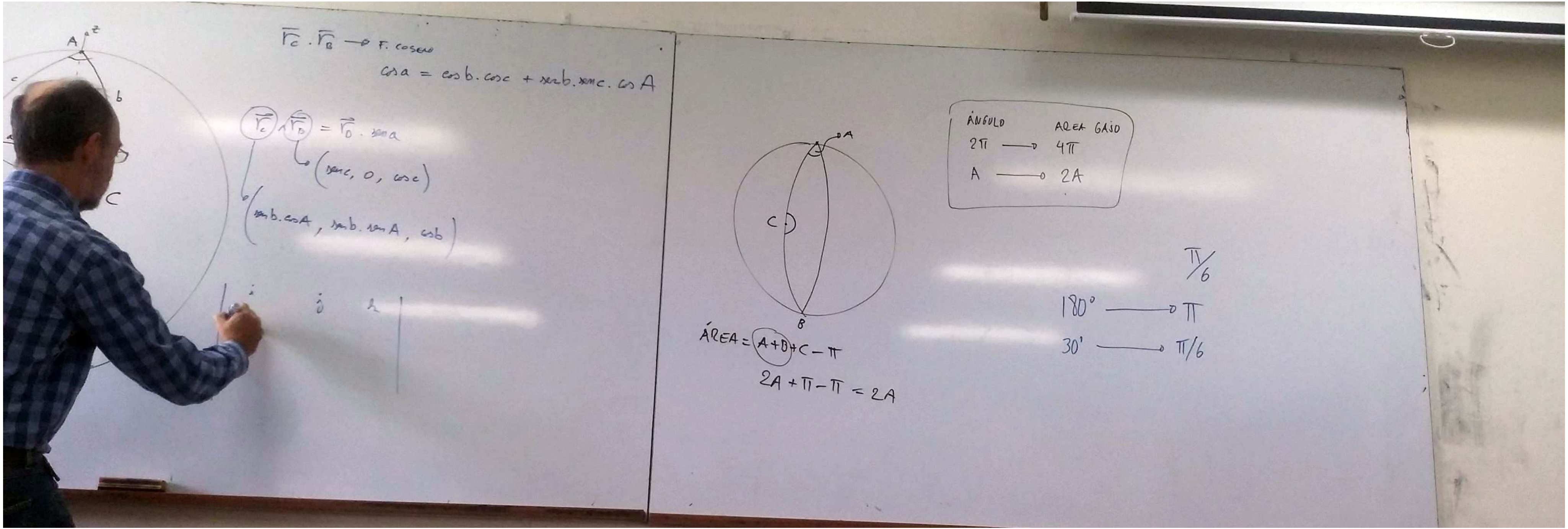



Δ ESFÉRICOS
ÁREA = E = A + B + C − π
ÁREA GAJO: 2A
GEODÉSICA → PROPIEDAD:
ÁNGULO
AREA GAJO
2π → 4π
A → 2A
ÁREA = A + B + C − π
2A + π − π = 2A

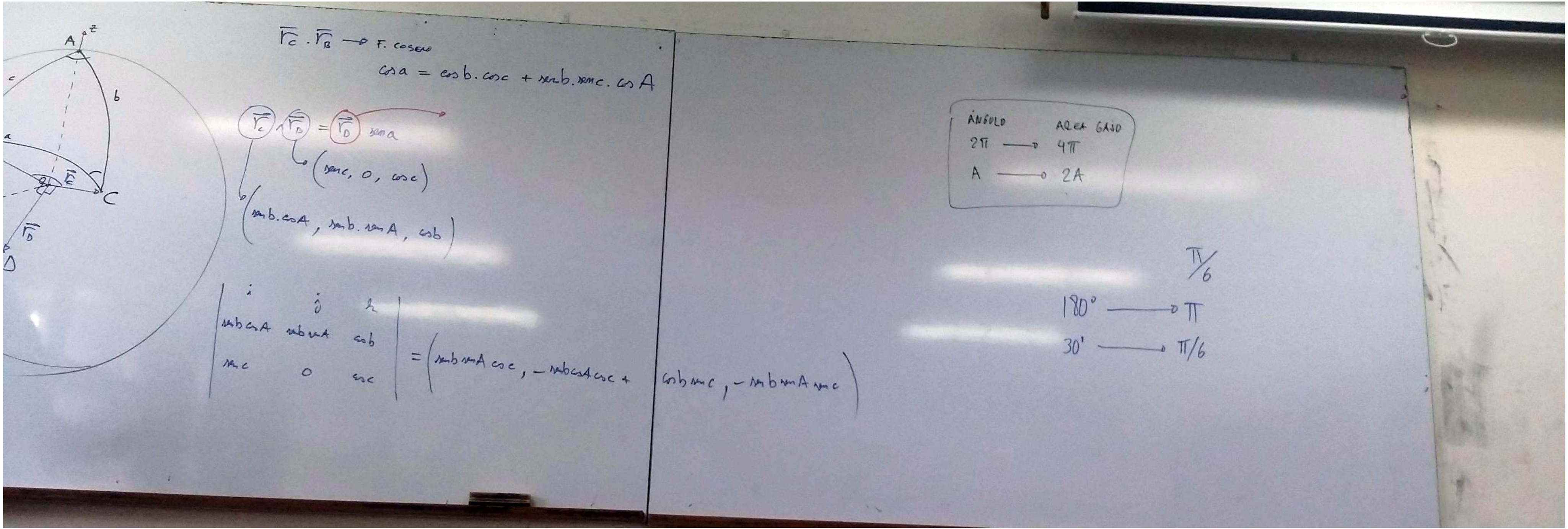

Δ ESFÉRICOS
ÁREA = E = A + B + C − π
ÁREA GAJO: 2A
GEODÉSICA → PROPIEDAD:
PLANO OSCULANTE ⊥
PASA POR O
PLANO TANGENTE
TANG
ÁREA = A + B + C − π
2A + π − π = 2A
ÁNGULO
ÁREA GAJO
2π → 4π
A → 2A
π/6
180° → π
30° → π/6


ÂNGULO
ÁREA GOMO
2π → 4π
A → 2A
ÁREA = A+B+C − π
2A + π − π = 2A
180° → π
30° → π/6
π/6

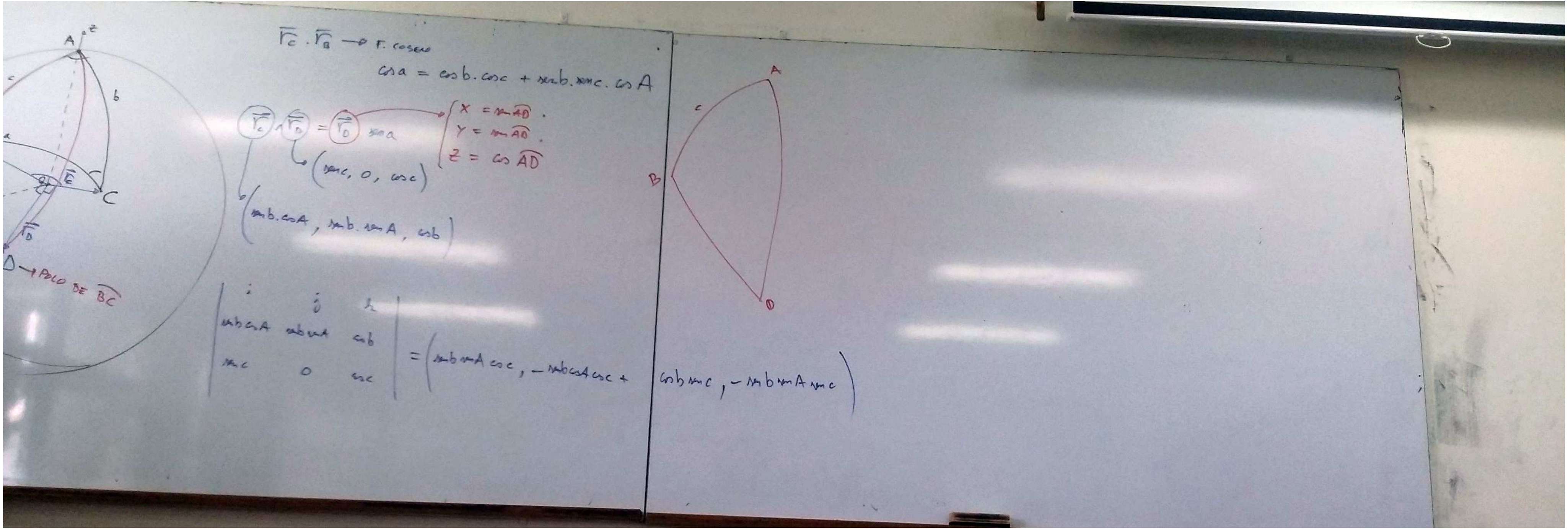

F. COSENO
cos a = cos b . cos c + sen b . sen c . cos A
ÁNGULO
ÁREA GAJO
2π → 4π
A → 2A
ÁREA = A+B+C − π
2A + π − π = 2A
π/6
180° → π
30° → π/6

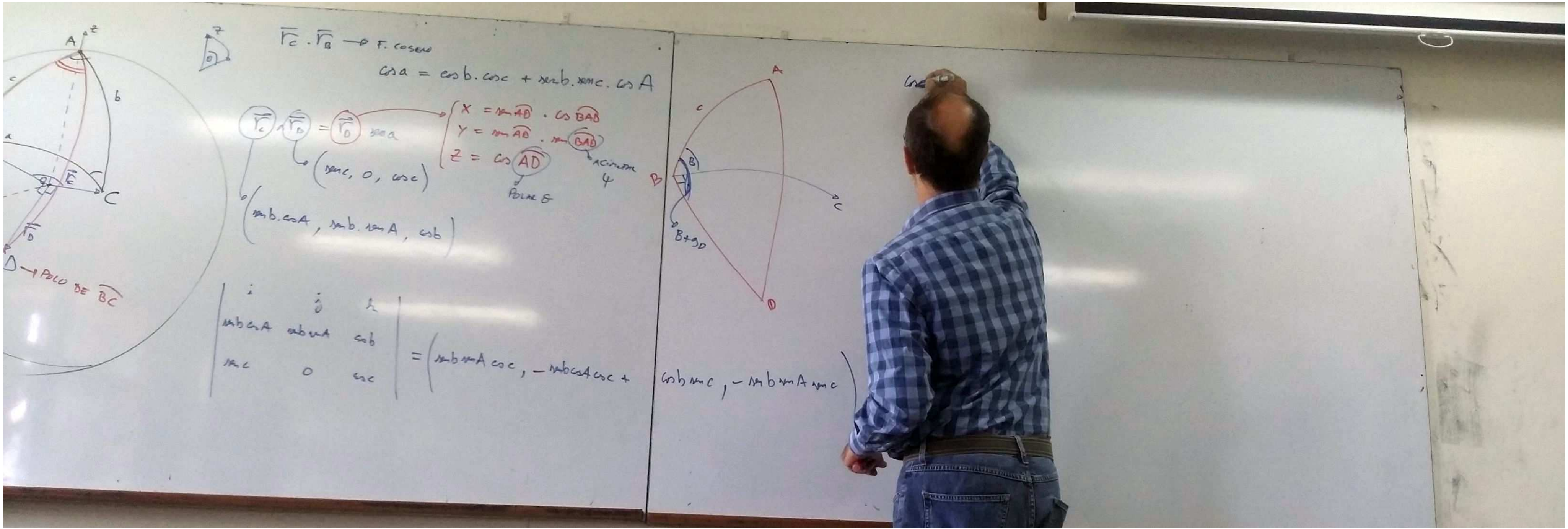

F. COSENO
ÁNGULO
AREA GAJO
2π → 4π
A → 2A
ÁREA = A+B+C−π
2A+π−π = 2A
180° → π
30° → π/6

Astronomia Fundamental 2017

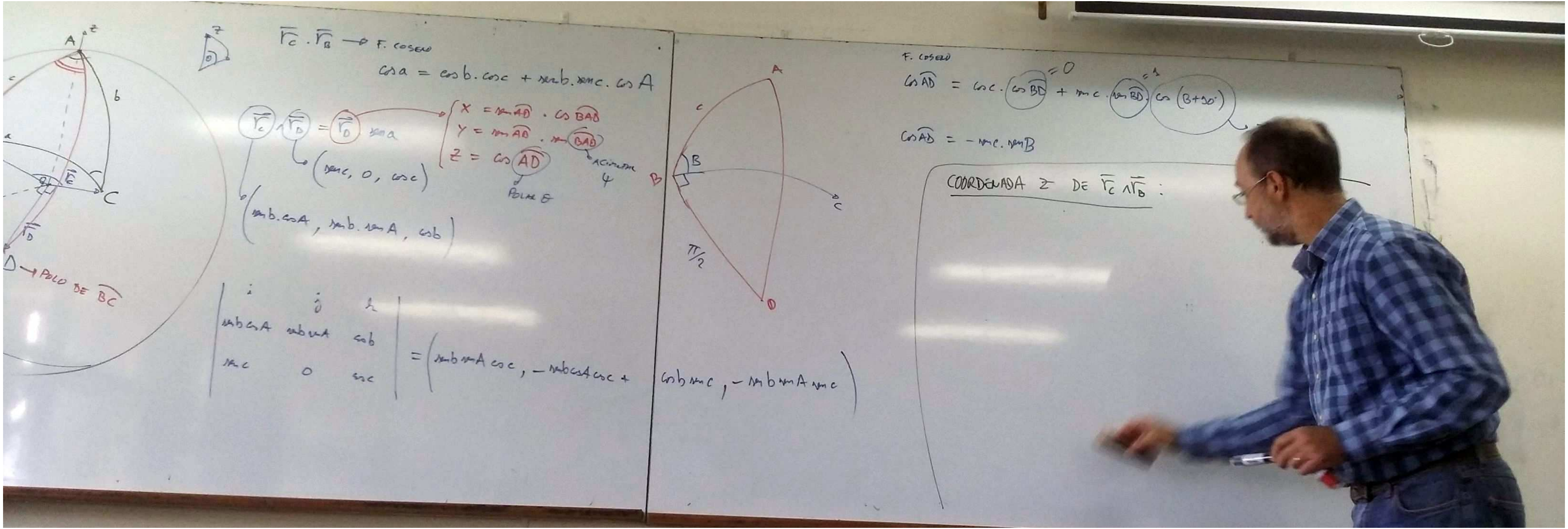


Astronomia Fundamental 2017

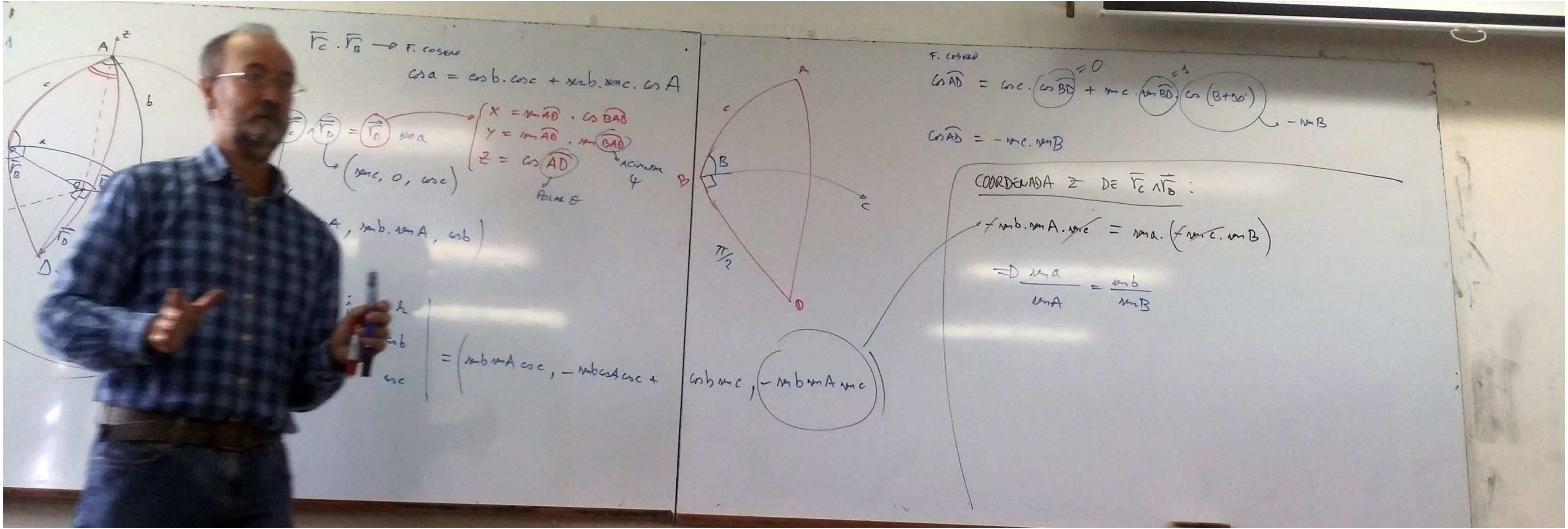


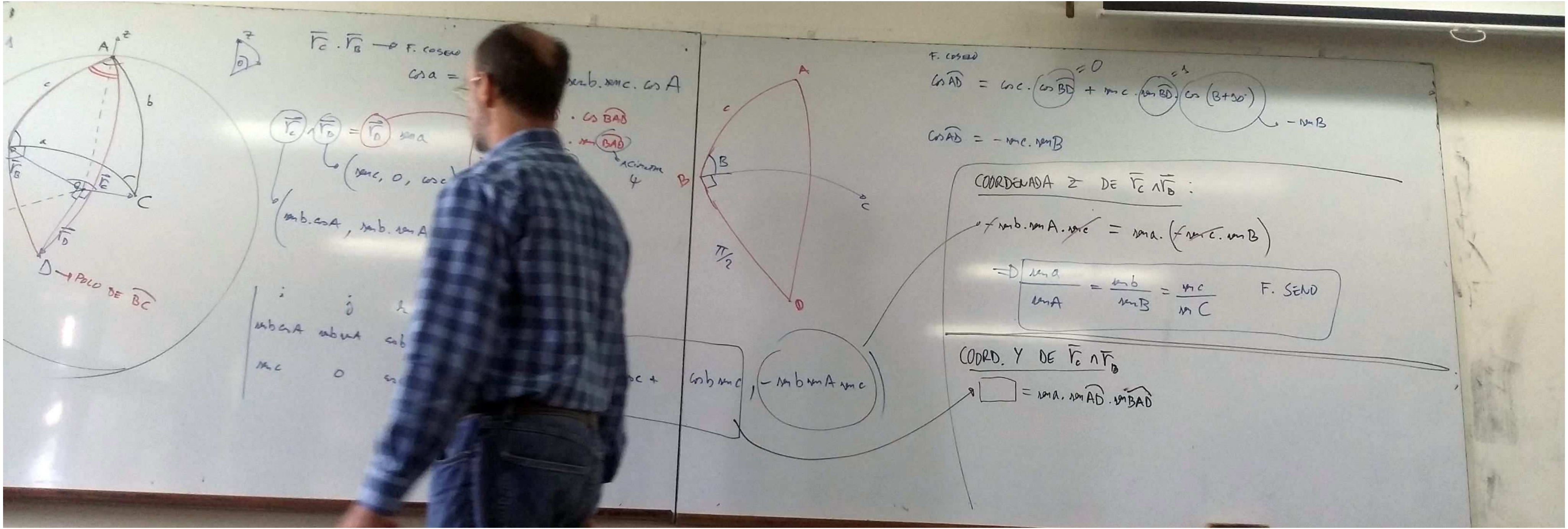

F. COSENO
cos a = cos b . cos c + sen b . sen c . cos A
POLO DE BC
ACIMUTE
POLAR θ

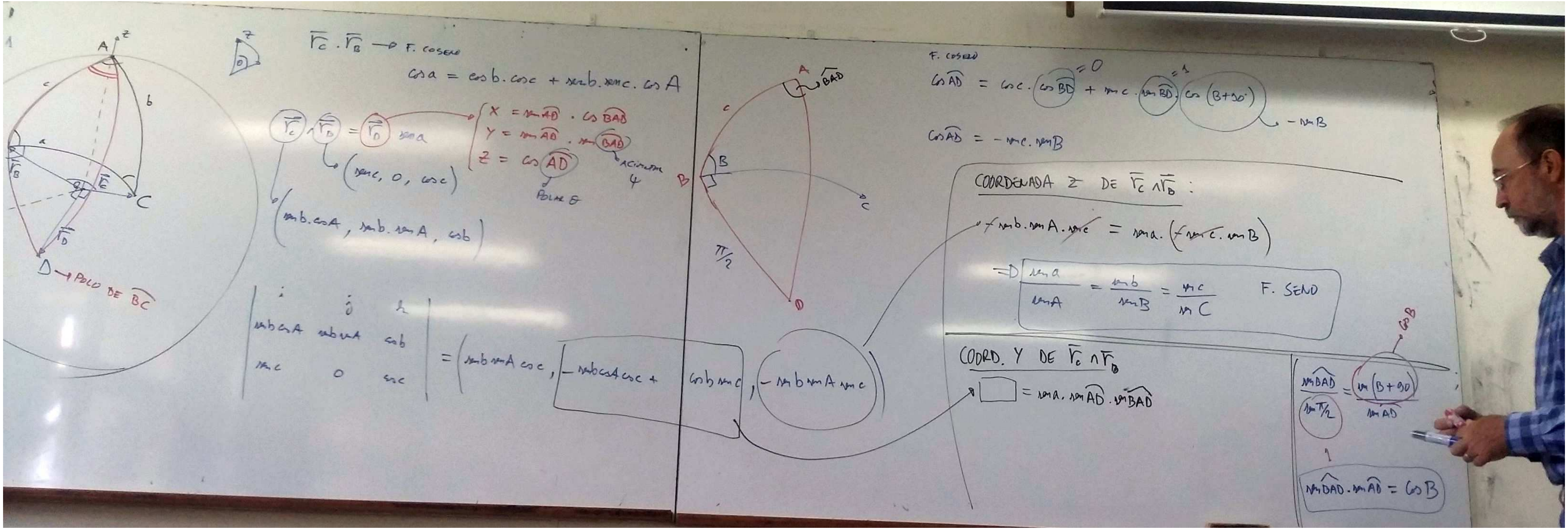
Astronomia Fundamental 2017



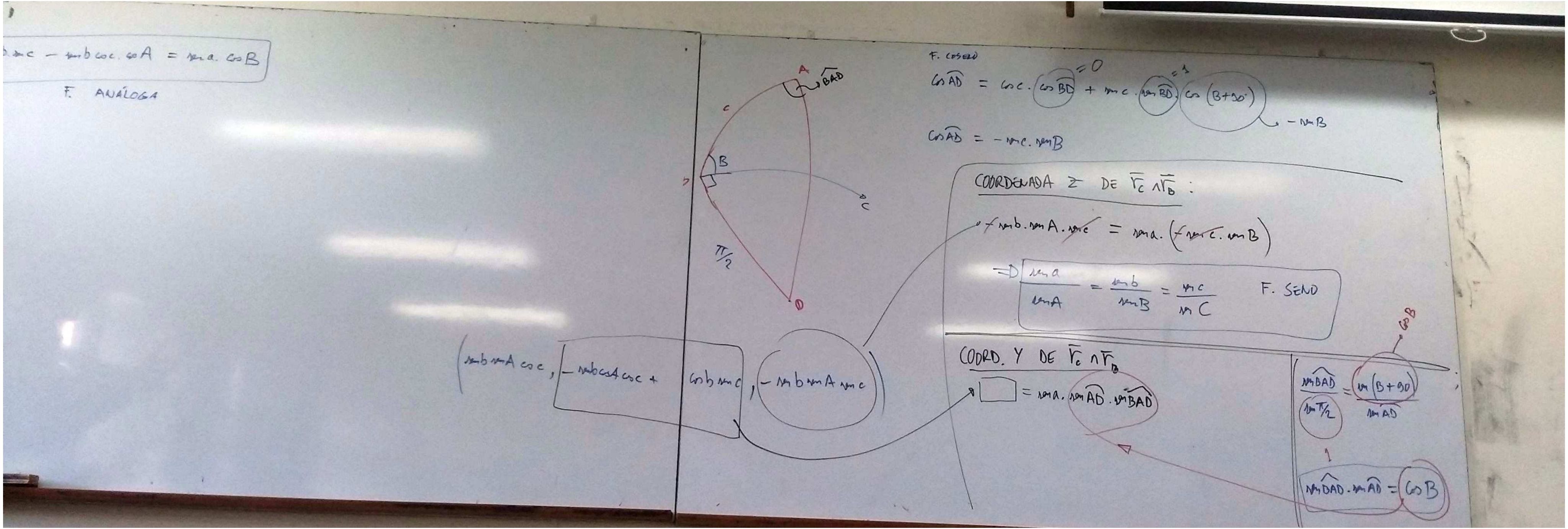
Astronomia Fundamental 2017



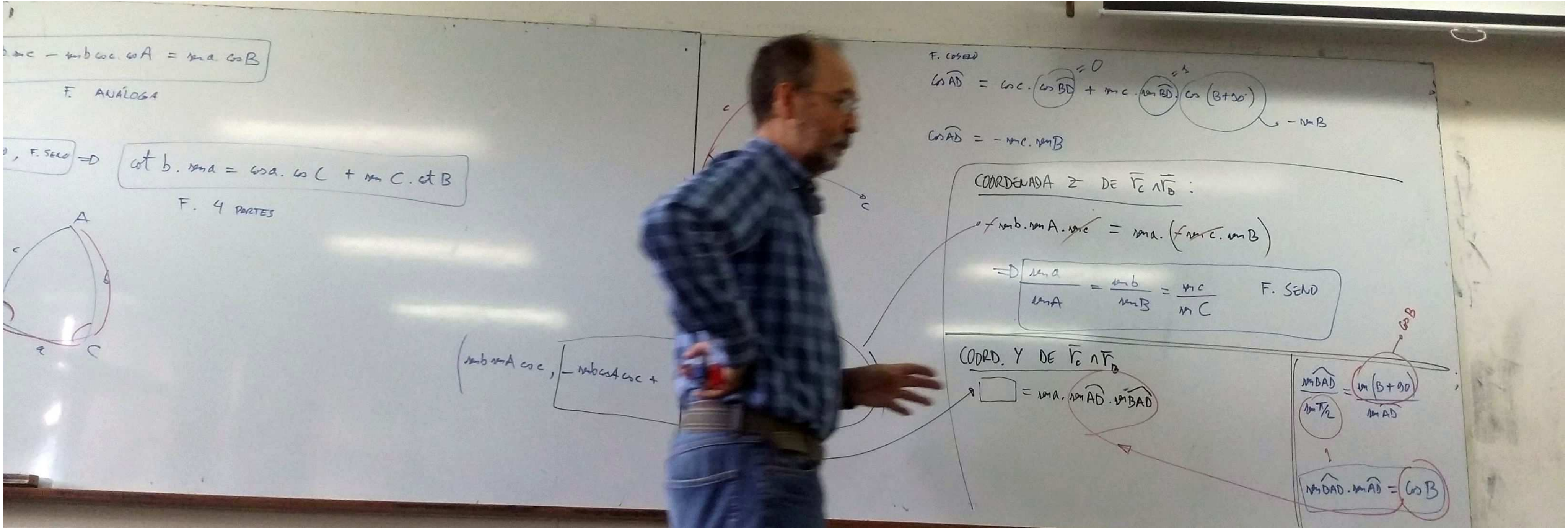

D → POLO DE BC
F. COSENO
F. COSENO
COORDENADA Z DE $\vec{r}_C \wedge \vec{r}_D$:
F. SENO
COORD. Y DE $\vec{r}_C \wedge \vec{r}_D$

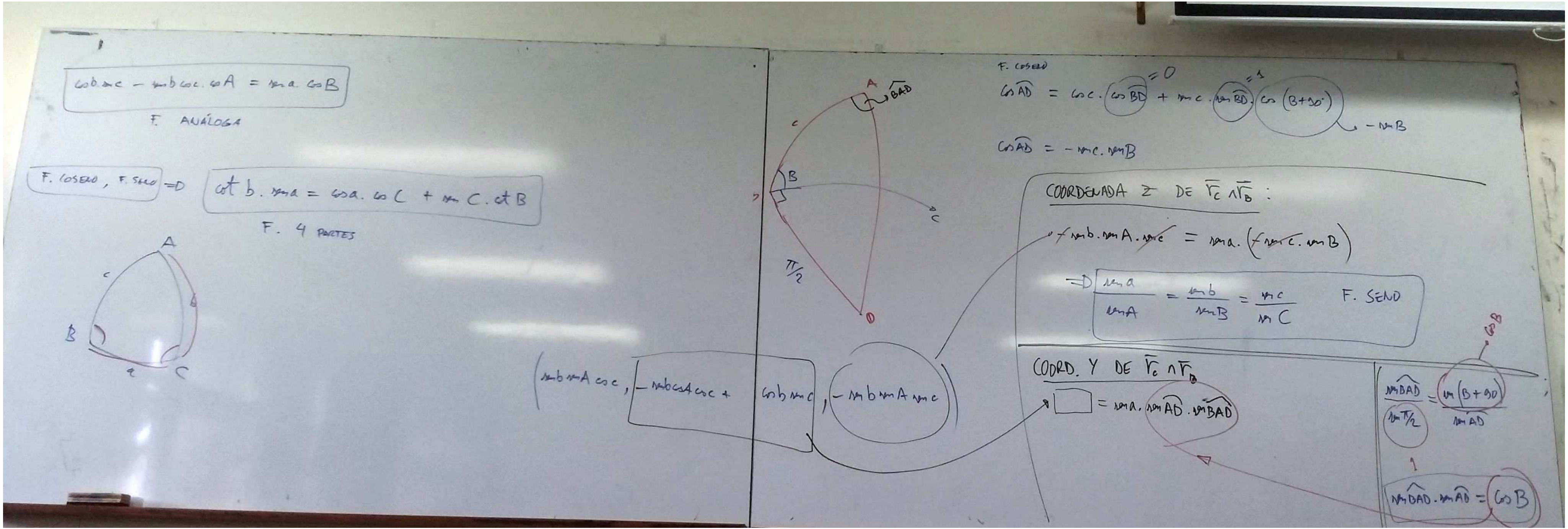

F. COSENO
F. SENO
COORDENADA Z DE $\vec{r}_c \wedge \vec{r}_D$:
COORD. Y DE $\vec{r}_c \wedge \vec{r}_D$
POLO DE $\widehat{BC}$
$\cos a = \cos b . \cos c + \operatorname{sen} b . \operatorname{sen} c . \cos A$
$\cos \widehat{AD} = - \operatorname{sen} c . \operatorname{sen} B$
$\frac{\operatorname{sen} a}{\operatorname{sen} A} = \frac{\operatorname{sen} b}{\operatorname{sen} B} = \frac{\operatorname{sen} c}{\operatorname{sen} C}$
$\operatorname{sen} \widehat{DAD} . \operatorname{sen} \widehat{AD} = \cos B$

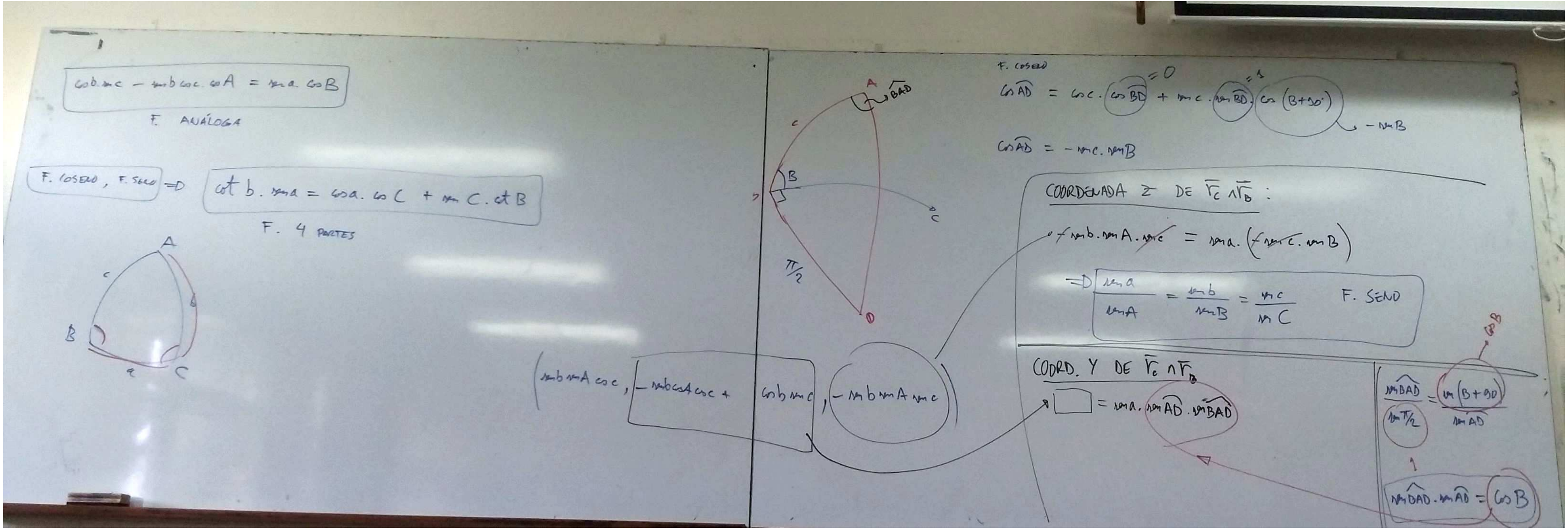
Astronomia Fundamental 2017

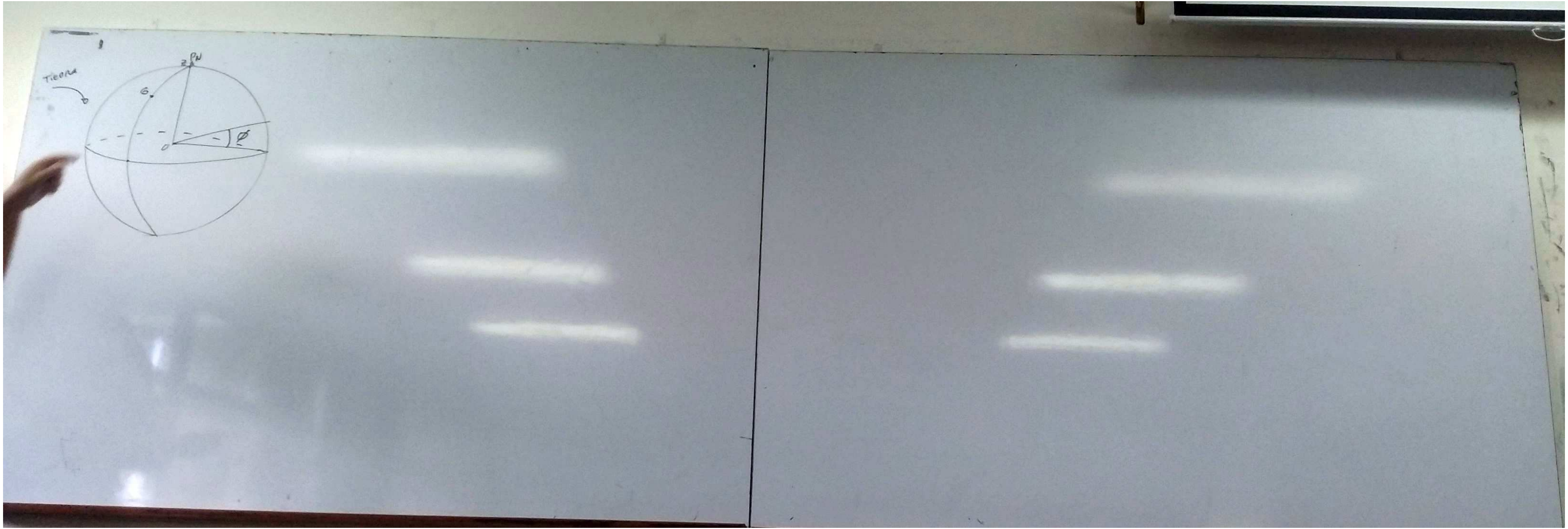


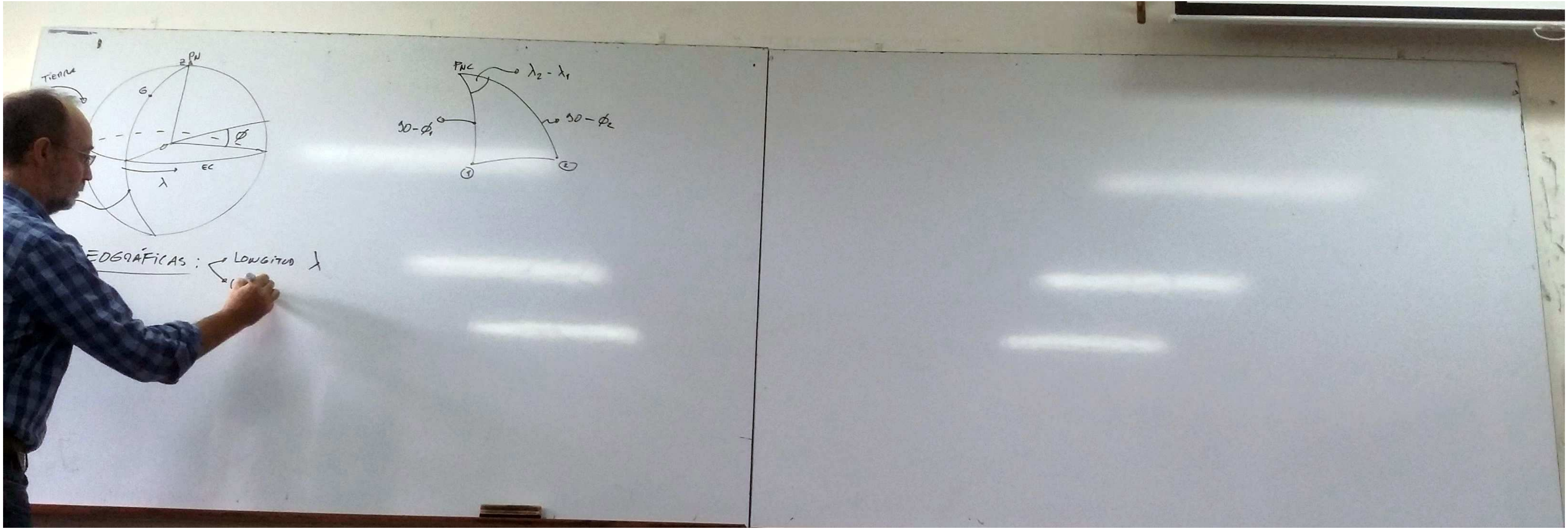
Astronomia Fundamental 2017

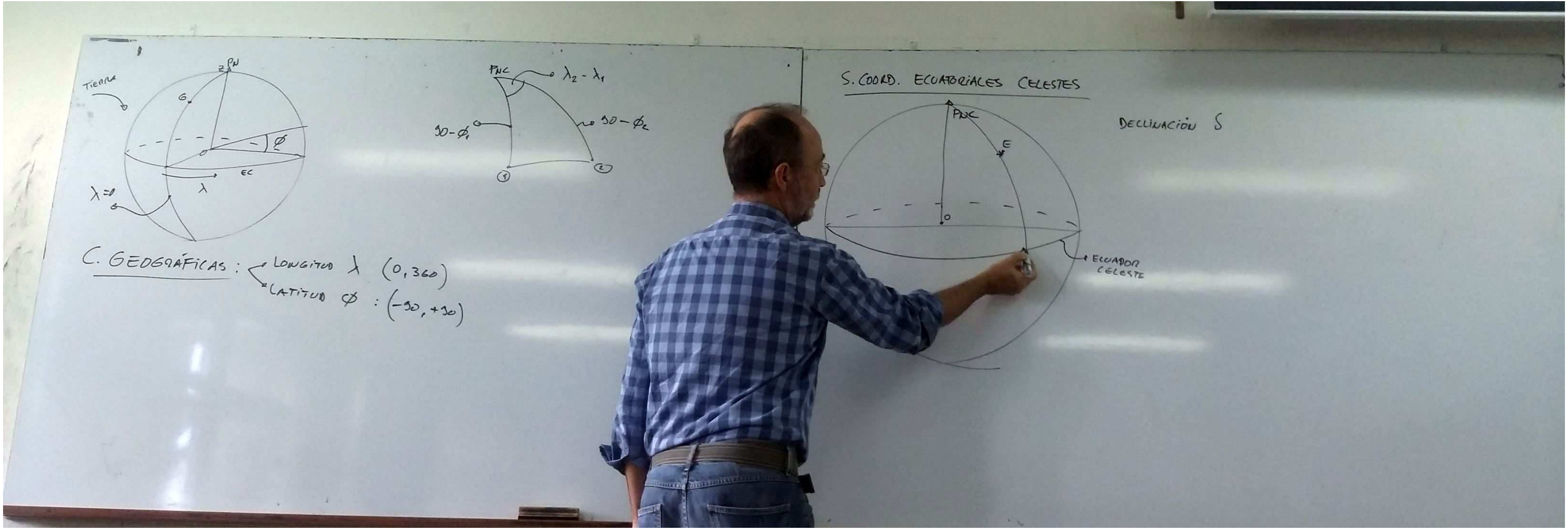



F. ANÁLOGA
F. COSENO , F. SENO
F. 4 PARTES
F. COSENO
COORDENADA Z DE
F. SENO
COORD. Y DE

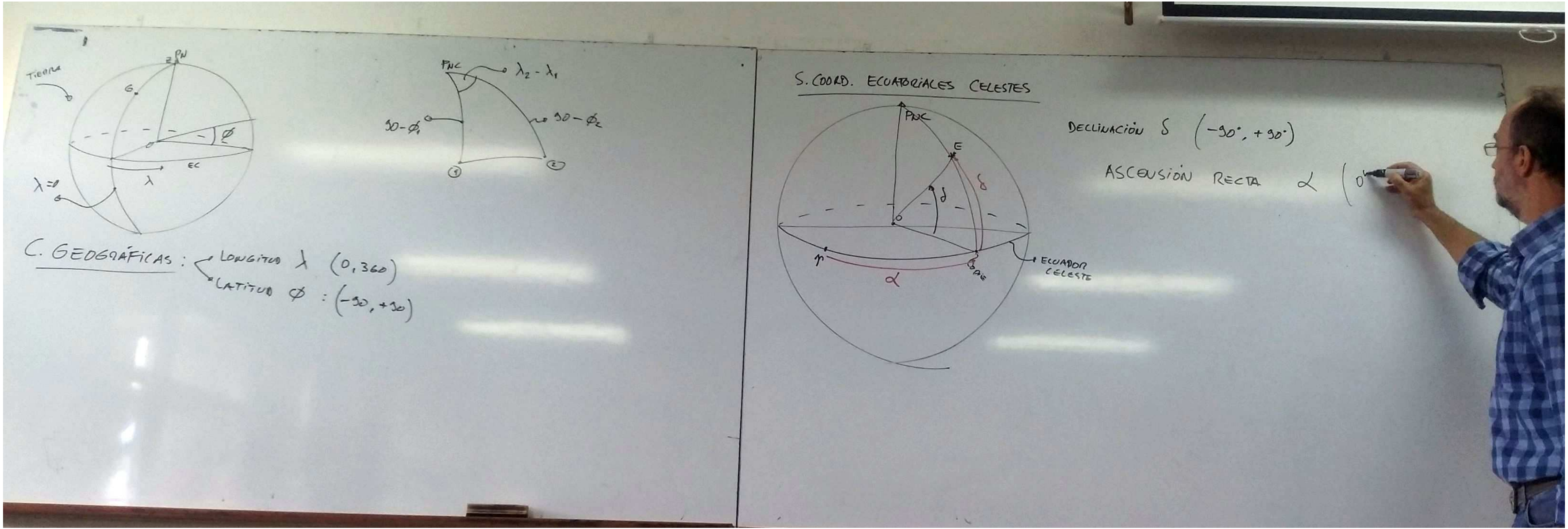

F. ANÁLOGA
F. COSENO , F. SENO
F. 4 PARTES
F. COSENO
COORDENADA Z DE $\bar{r}_c \wedge \bar{r}_D$:
F. SENO
COORD. Y DE $\bar{r}_c \wedge \bar{r}_D$

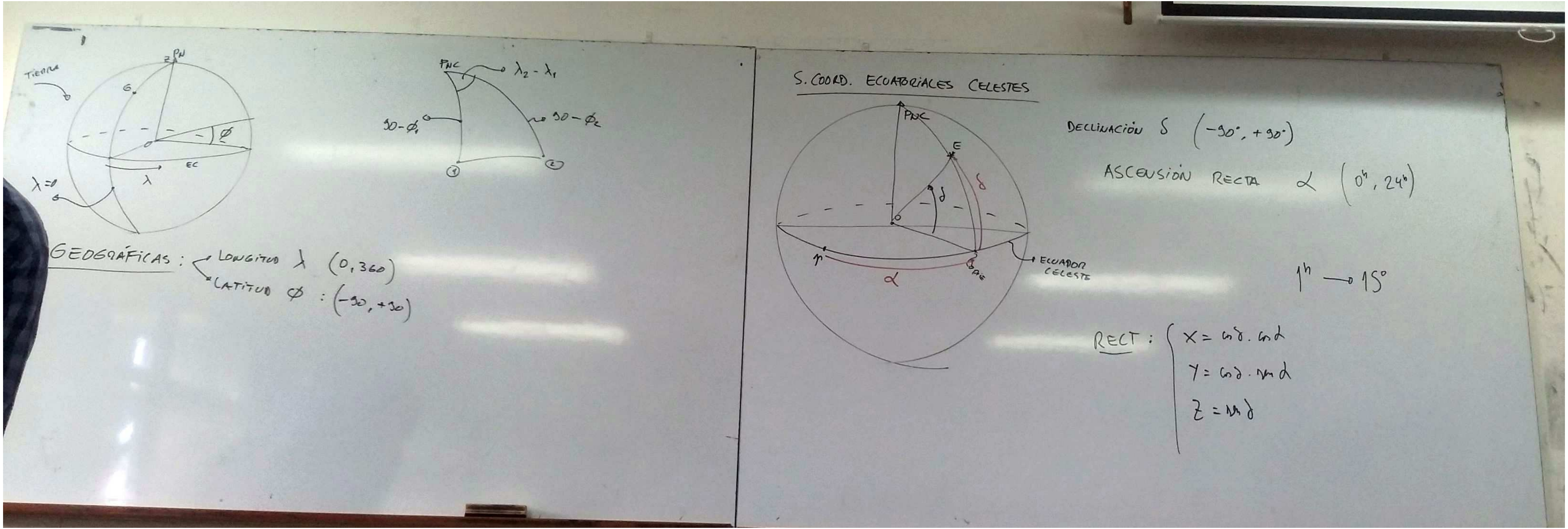

TIERRA
Z
PN
G
O
ϕ

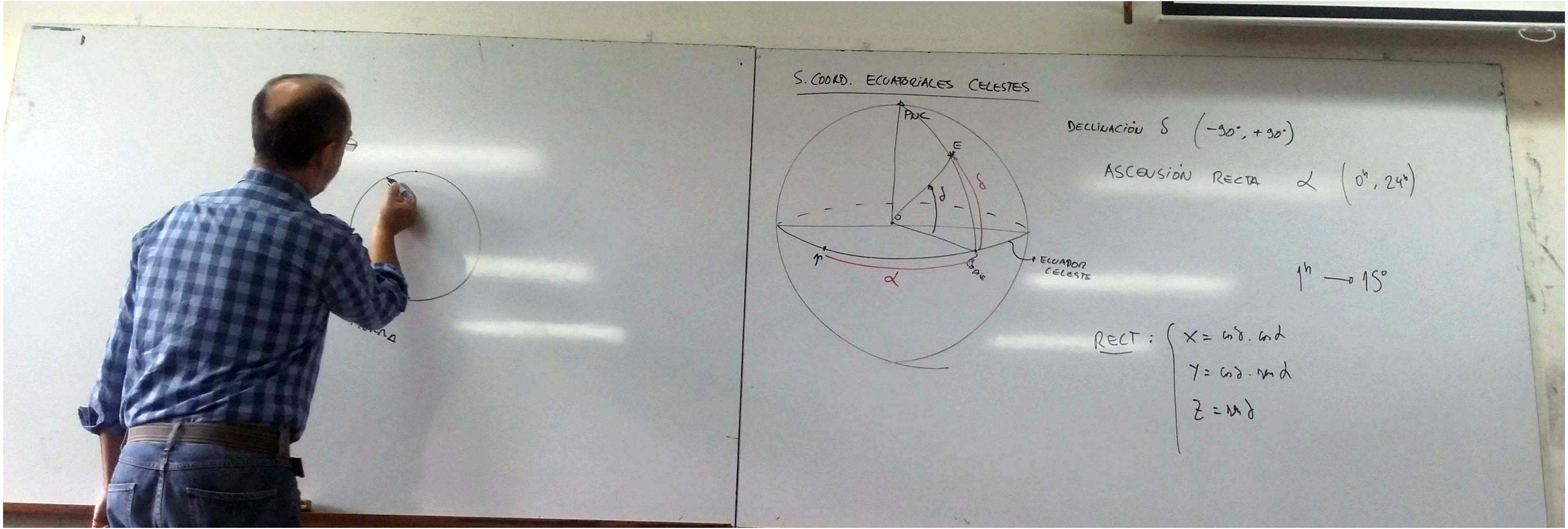

Tierra
PN
G
Ø
EC
λ
PNC
$\lambda_2 - \lambda_1$
$90 - \phi_1$
$90 - \phi_2$
EOGRÁFICAS : Longitud λ


TIERRA
PN
G
EC
λ=0
λ
λ2 - λ1
90 - φ1
90 - φ2
C. GEOGRÁFICAS : LONGITUD λ (0, 360)
LATITUD φ : (-90, +90)
S. COORD. ECUATORIALES CELESTES
PNC
E
ECUADOR CELESTE
DECLINACIÓN δ

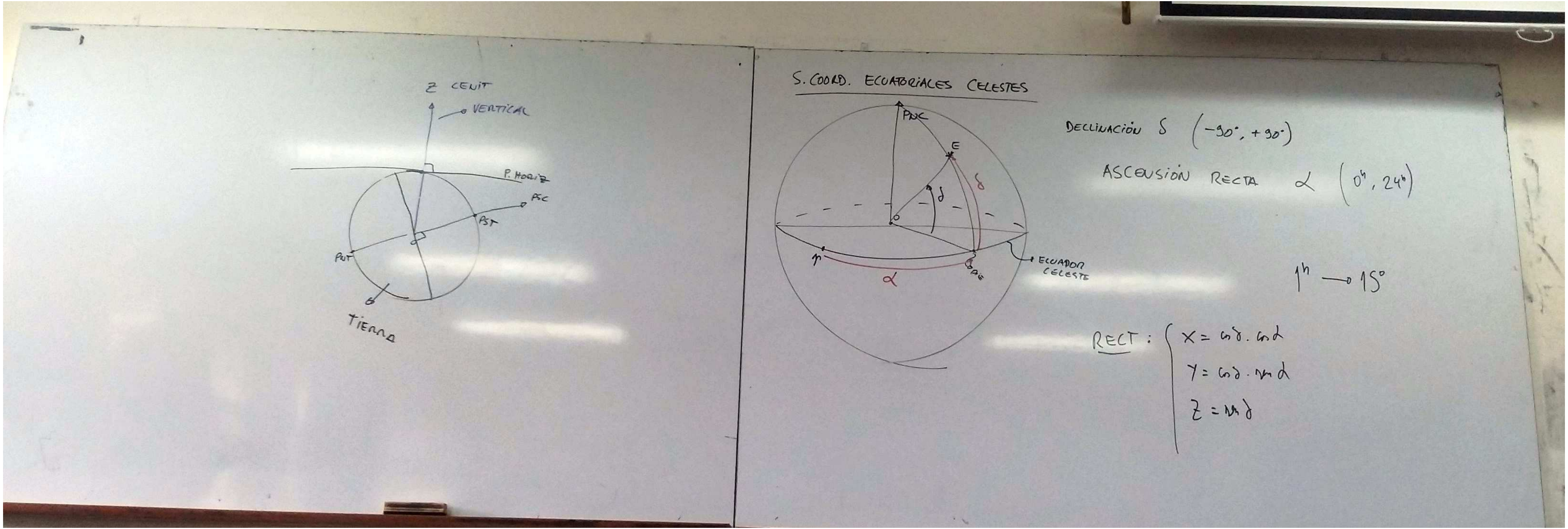
Astronomia Fundamental 2017

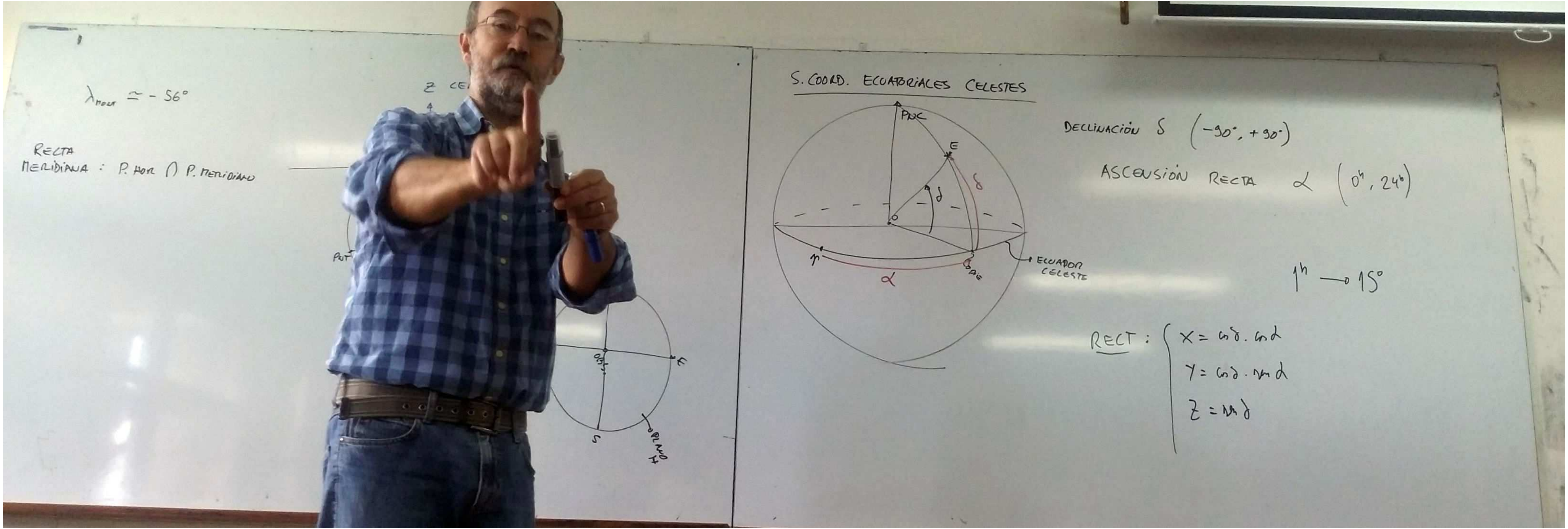


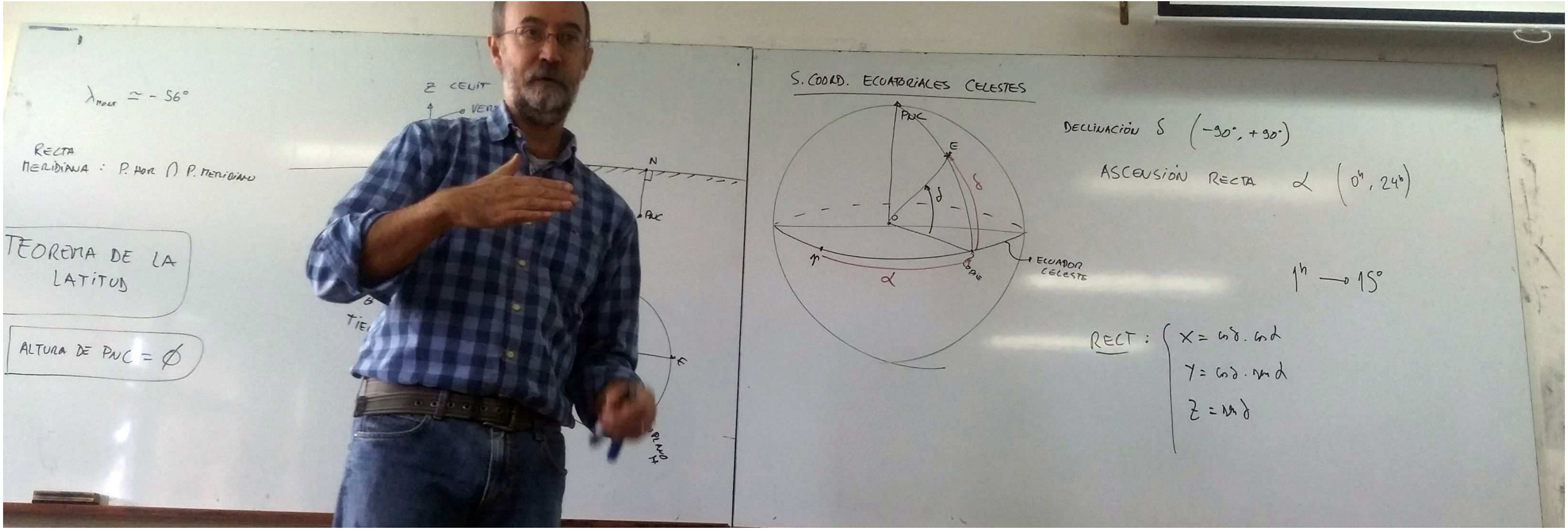

Tierra
PN
G
Ø
EC
λ
λ=0
PNC
λ2 - λ1
90-φ1
90-φ2
GEOGRÁFICAS :
LONGITUD λ (0, 360)
LATITUD Ø : (-90, +90)
S. COORD. ECUATORIALES CELESTES
PNC
E
δ
α
ECUADOR CELESTE
DECLINACIÓN δ (-90°, +90°)
ASCENSIÓN RECTA α (0h, 24h)
1h → 15°
RECT :
X = cos δ . cos α
Y = cos δ . sen α
Z = sen δ


S. COORD. ECUATORIALES CELESTES
PNC
E
δ
α
ECUADOR CELESTE
DECLINACIÓN δ (-90°, +90°)
ASCENSIÓN RECTA α (0h, 24h)
1h → 15°
RECT: X = cos δ . cos α
Y = cos δ . sen α
Z = sen δ

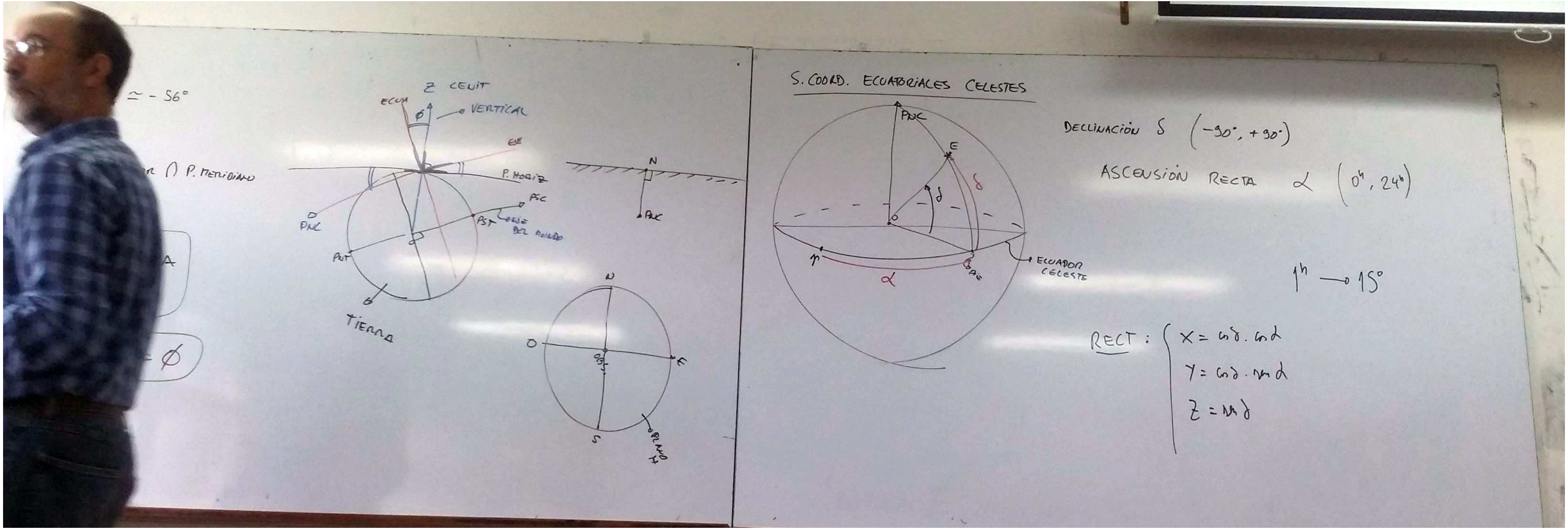
Astronomia Fundamental 2017

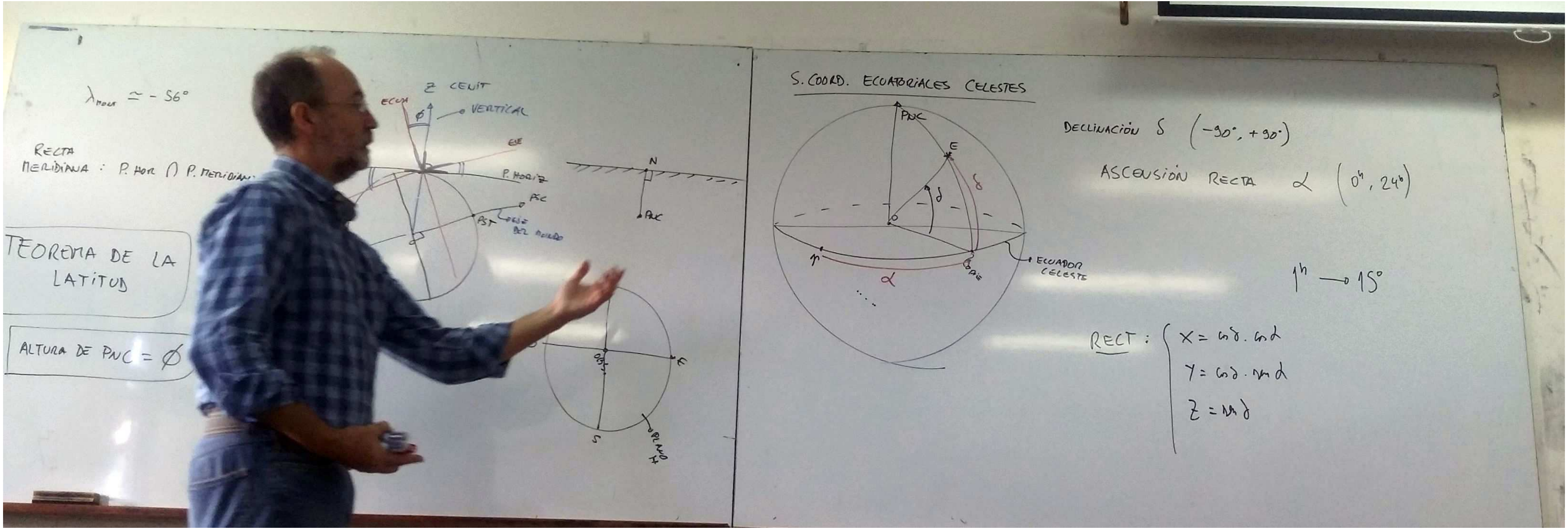



λ_MONT ≃ - 56°
RECTA MERIDIANA : P. HOR ∩ P. MERIDIANO
S. COORD. ECUATORIALES CELESTES
PNC
E
δ
α
ECUADOR CELESTE
DECLINACIÓN δ (-90°, +90°)
ASCENSIÓN RECTA α (0h, 24h)
1h → 15°
RECT : X = cos δ . cos α
Y = cos δ . sen α
Z = sen δ


S. COORD. ECUATORIALES CELESTES
PNC
E
ECUADOR CELESTE
DECLINACIÓN δ (−90°, +90°)
ASCENSIÓN RECTA α (0h, 24h)
1h ⟶ 15°
RECT :
X = cos δ . cos α
Y = cos δ . sen α
Z = sen δ
TEOREMA DE LA LATITUD
ALTURA DE PNC = ϕ
RECTA MERIDIANA : P. HOR ∩ P. MERIDIANO
Z CENIT
N

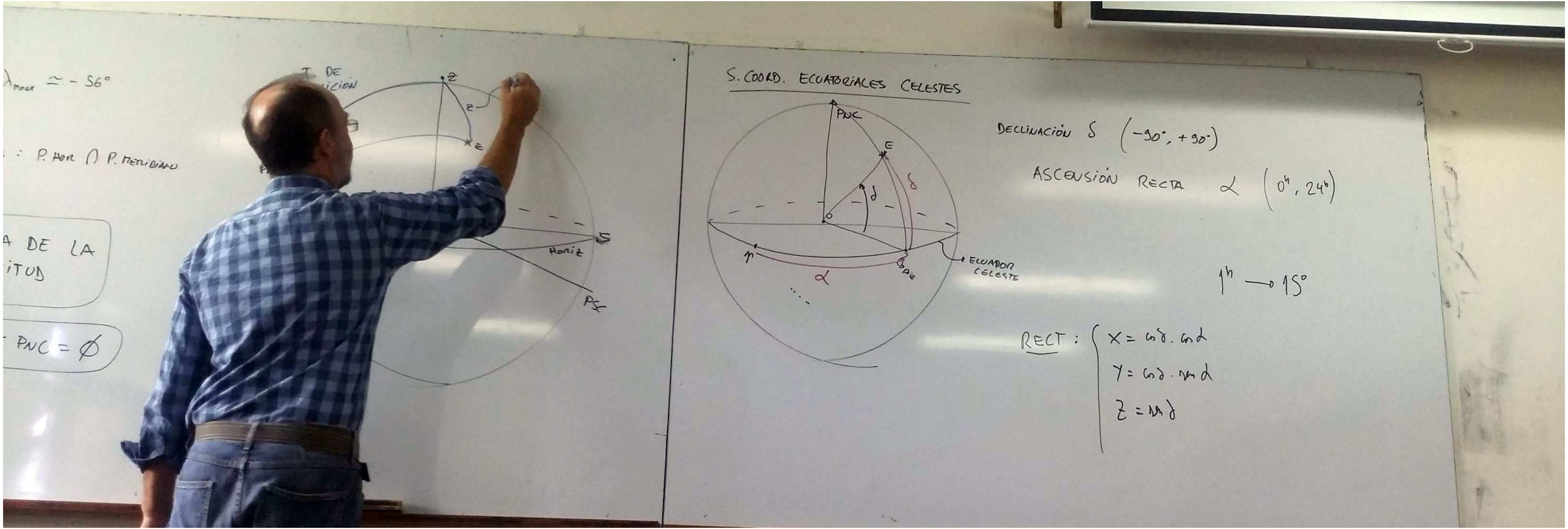
Astronomia Fundamental 2017



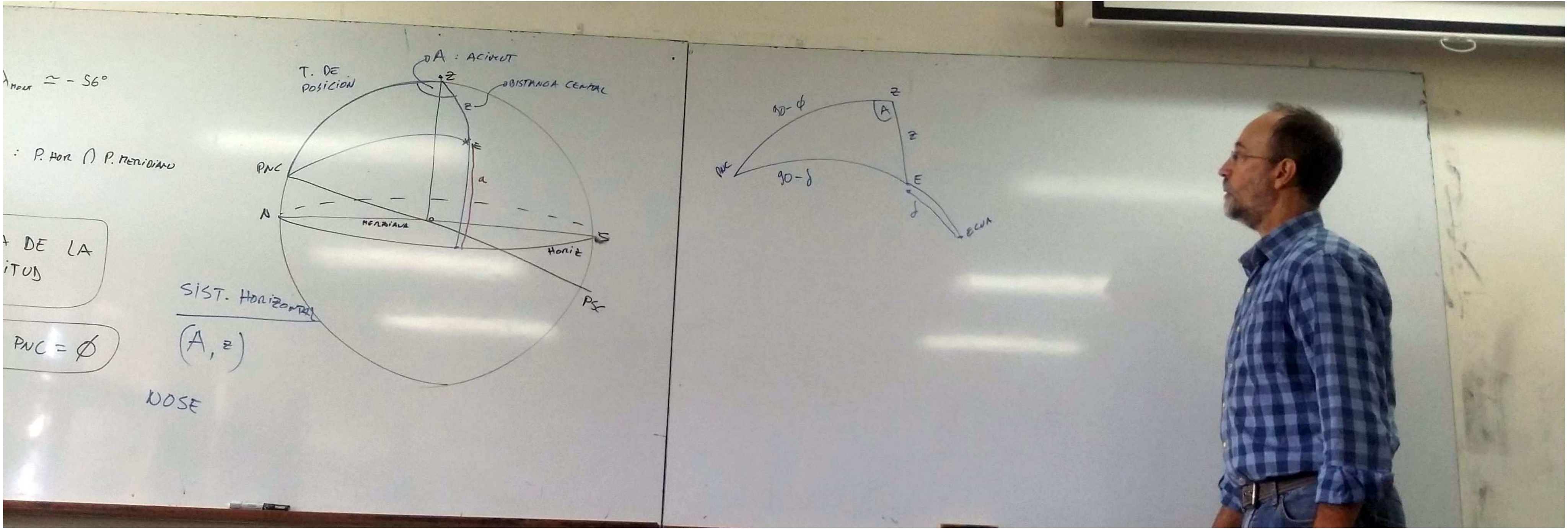


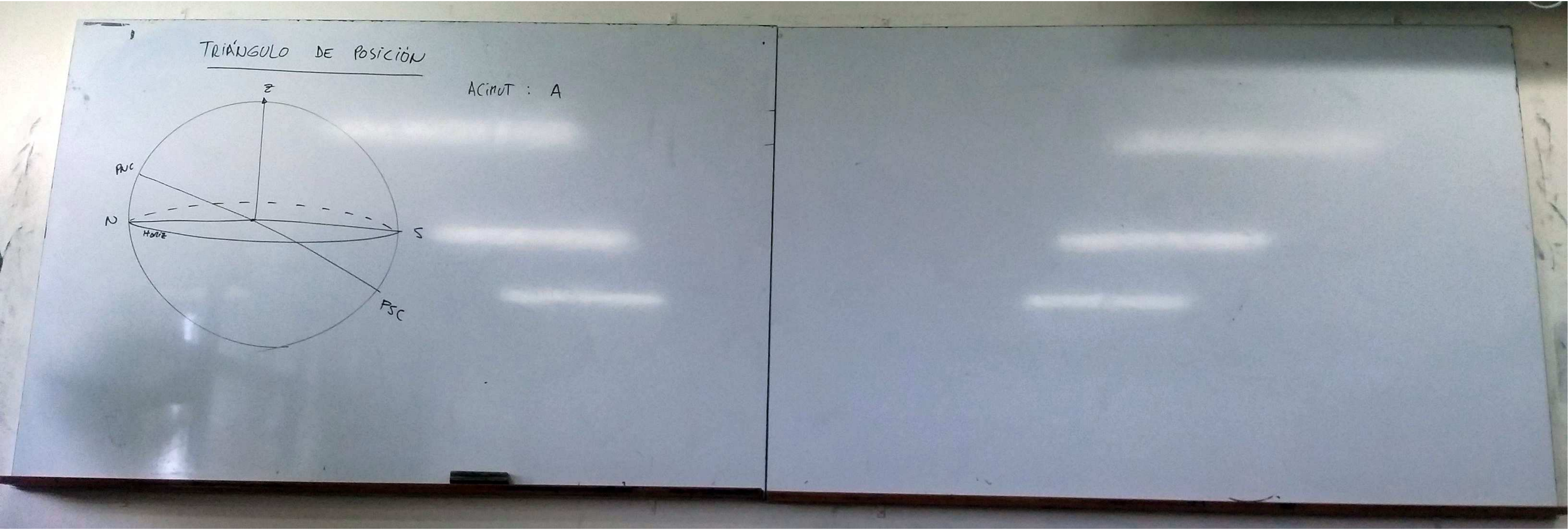
λ ≃ - 56°
RECTA MERIDIANA : P. HOR ∩ P. MERIDIANO
TEOREMA DE LA LATITUD
ALTURA DE PNC = φ
Z CENIT
VERTICAL
P. HORIZ
PSC
PST
N
PNC
E
S
S. COORD. ECUATORIALES CELESTES
PNC
E
δ
α
ECUADOR CELESTE
DECLINACIÓN δ (-90°, +90°)
ASCENSIÓN RECTA α (0h, 24h)
1h → 15°
RECT :
X = cos δ . cos α
Y = cos δ . sen α
Z = sen δ

Astronomia Fundamental 2017

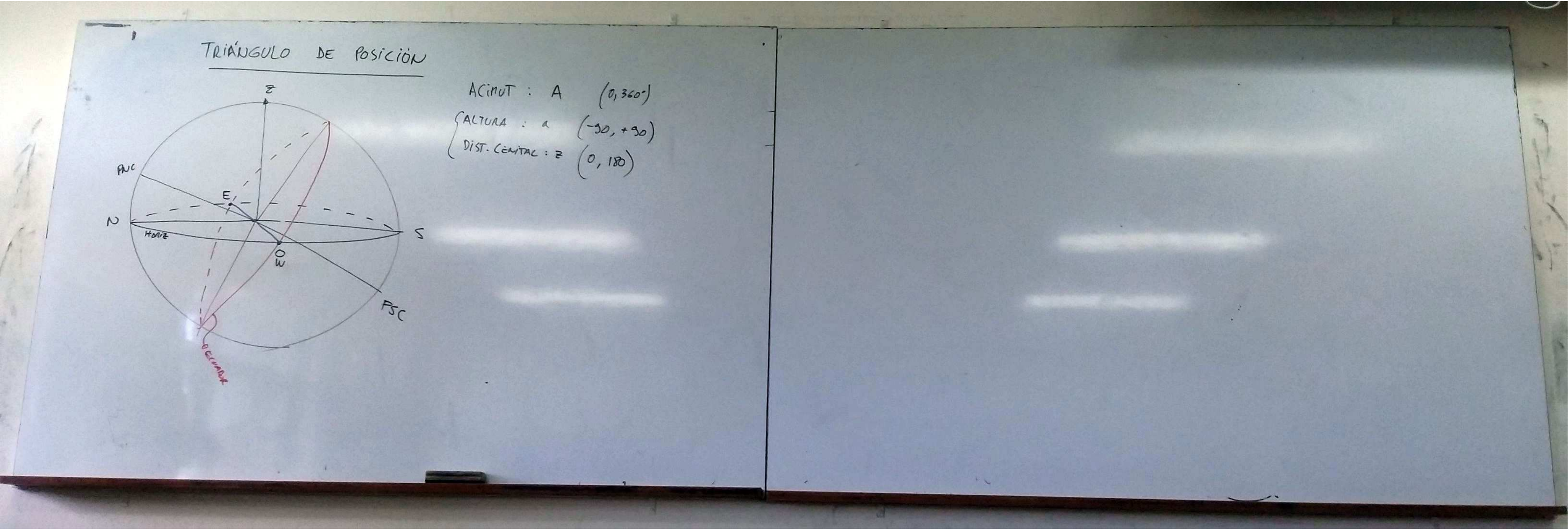


Astronomia Fundamental 2017

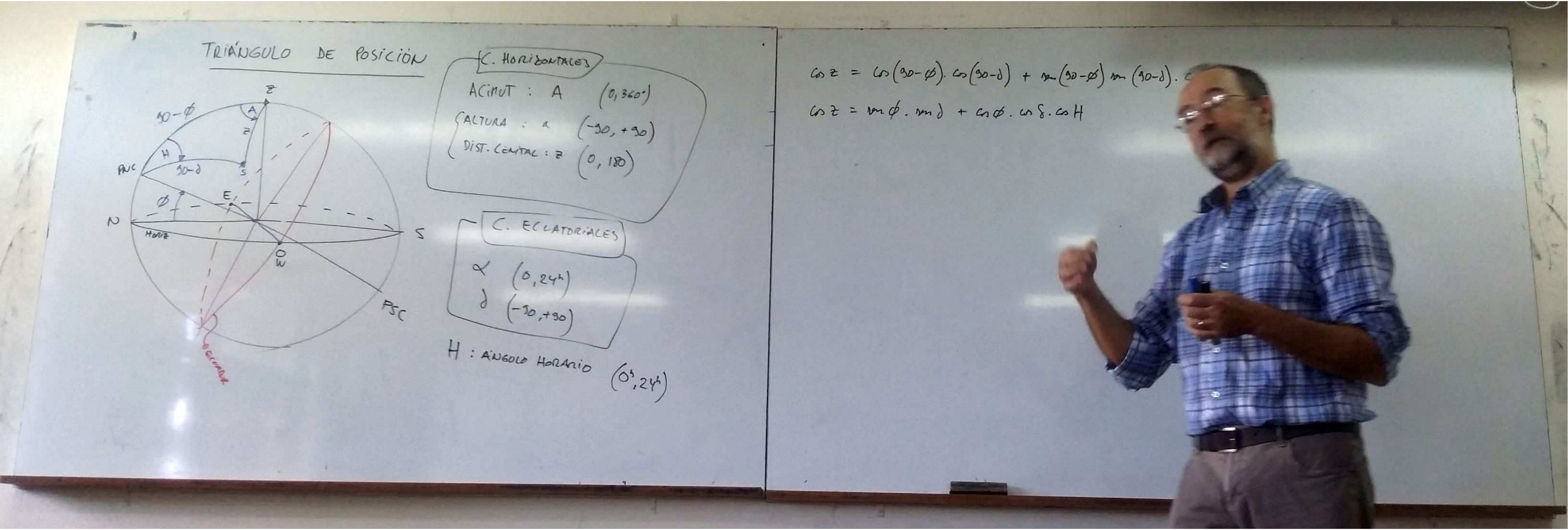


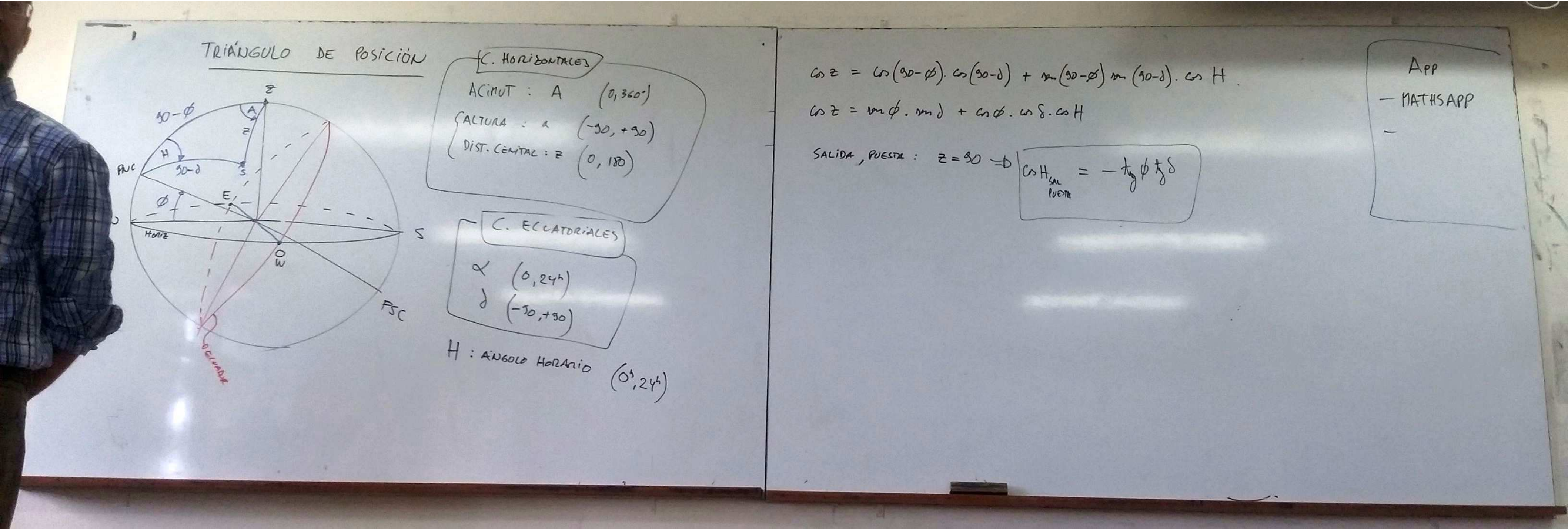

TRIÁNGULO DE POSICIÓN
ACIMUT : A
Z
PNC
N
Horiz
S
PSC

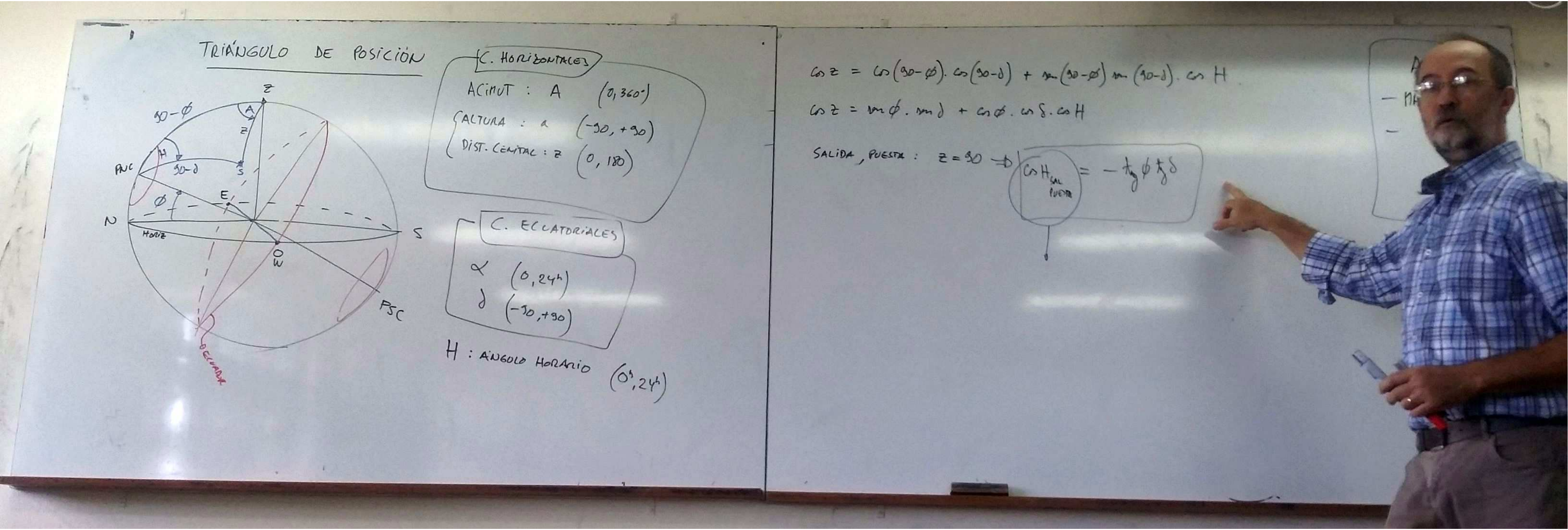
Astronomia Fundamental 2017

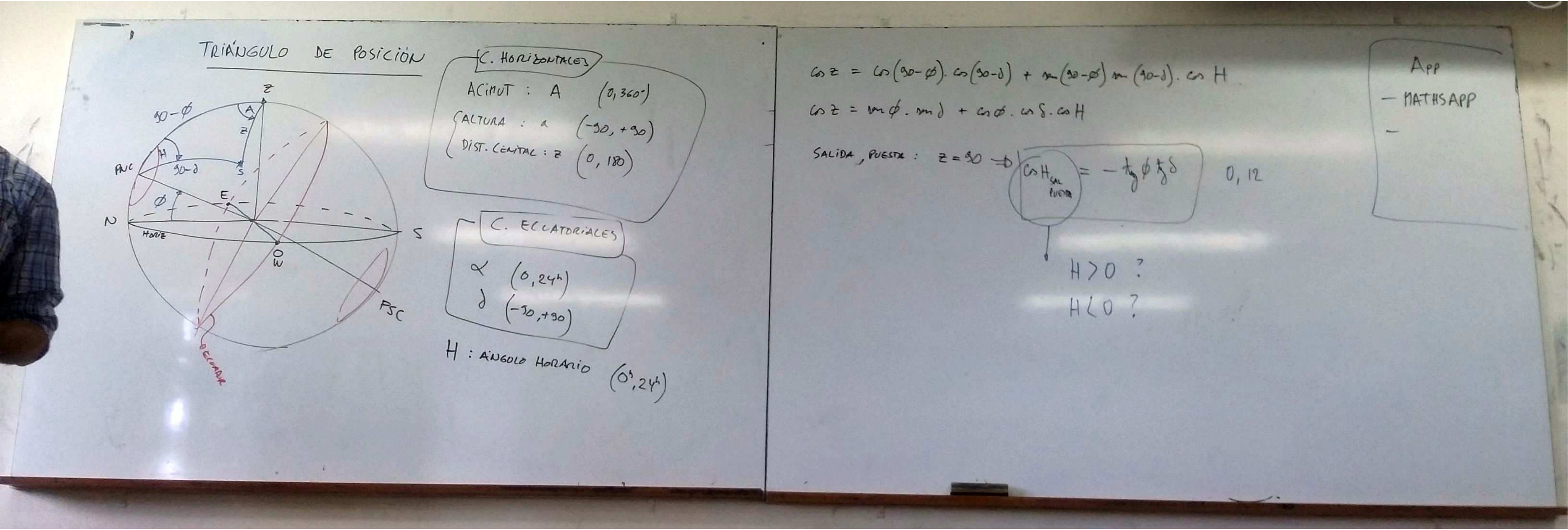


Astronomia Fundamental 2017

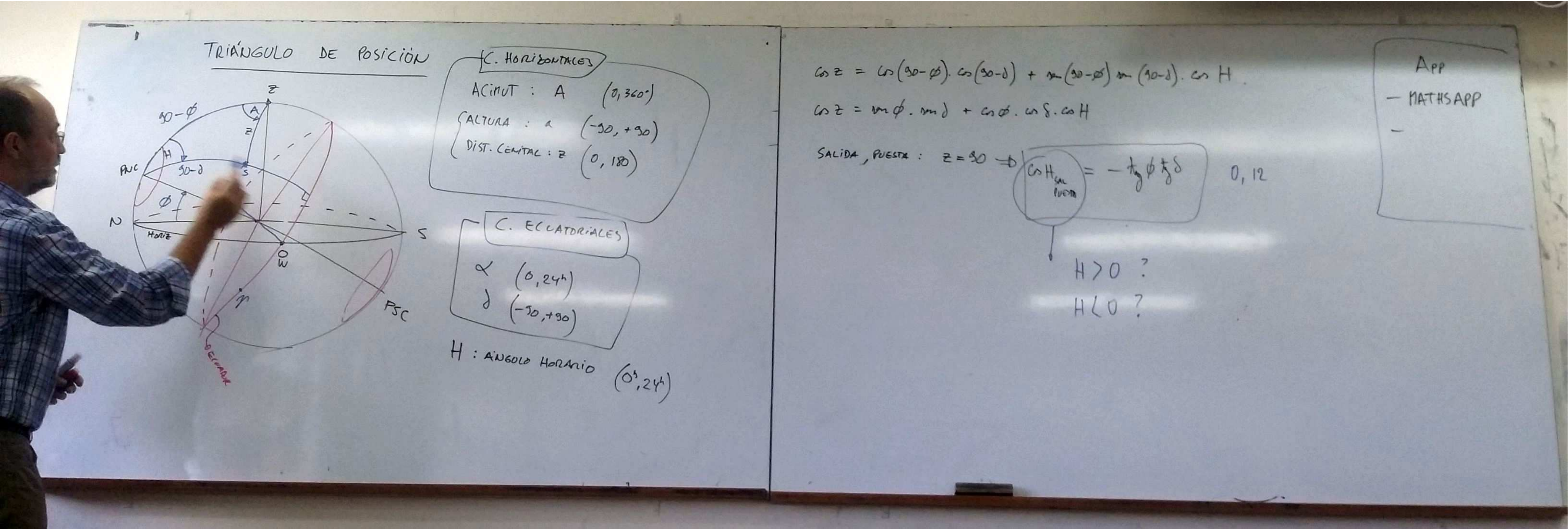

TRIÁNGULO DE POSICIÓN
C. HORIZONTALES
ACIMUT : A (0, 360°)
ALTURA : a (-90, +90)
DIST. CENITAL : z (0, 180)
C. ECUATORIALES
α (0, 24h)
δ (-90, +90)
H : ÁNGULO HORARIO (0h, 24h)
cos z = cos(90-φ).cos(90-δ) + sen(90-φ) sen(90-δ).
cos z = sen φ . sen δ + cos φ . cos δ . cos H

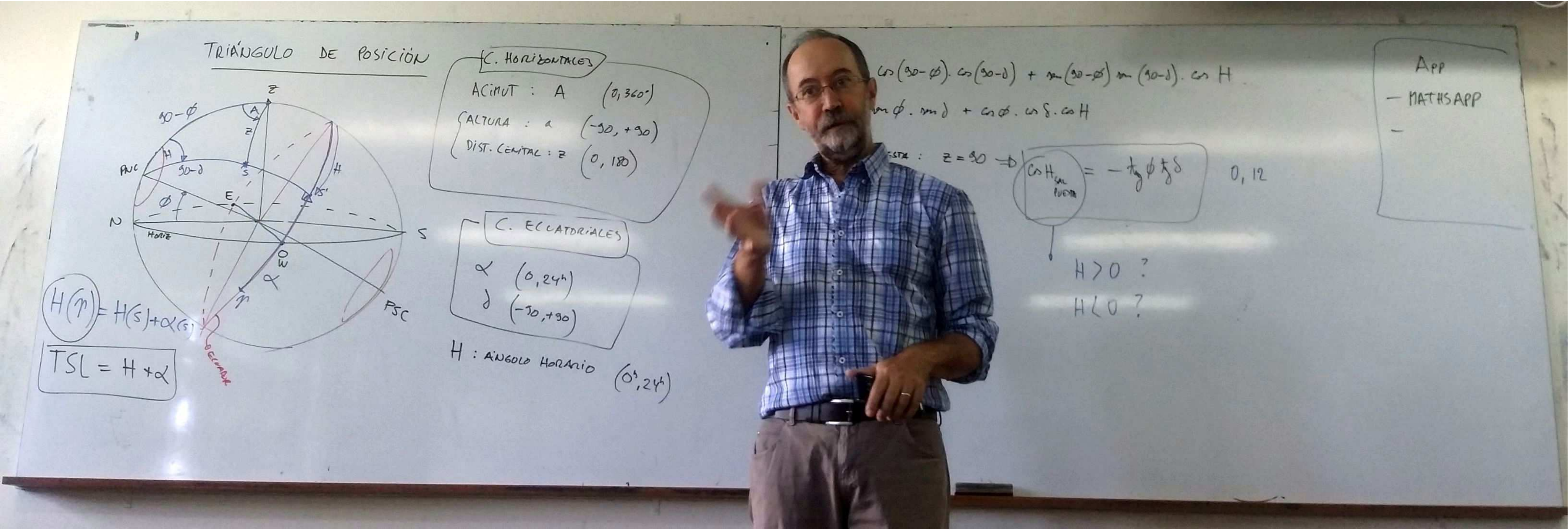

TRIÁNGULO DE POSICIÓN
Z
A
z
90 − ϕ
H
PNC
90 − δ
S
E
ϕ
Horiz
S
O
W
PSC
ECUADOR
C. HORIZONTALES
ACIMUT : A (0, 360°)
ALTURA : a (−90, +90)
DIST. CENITAL : z (0, 180)
C. ECUATORIALES
α (0, 24h)
δ (−90, +90)
H : ÁNGULO HORARIO (0h, 24h)
cos z = cos(90−ϕ).cos(90−δ) + sen(90−ϕ) sen(90−δ). cos H
cos z = sen ϕ . sen δ + cos ϕ . cos δ . cos H
SALIDA, PUESTA : z = 90 ⇒ cos H SAL PUESTA = − tg ϕ tg δ
App
— MATHSAPP
—


TRIÁNGULO DE POSICIÓN
Z
A
z
90 − φ
PNC
H
90 − δ
S
E
φ
N
HORIZ
W
S
PSC
ECUADOR
C. HORIZONTALES
ACIMUT : A (0, 360°)
ALTURA : a (−90, +90)
DIST. CENITAL : z (0, 180)
C. ECUATORIALES
α (0, 24h)
δ (−90, +90)
H : ÁNGULO HORARIO (0h, 24h)
cos z = cos(90−φ) . cos(90−δ) + sen(90−φ) sen(90−δ) . cos H
cos z = sen φ . sen δ + cos φ . cos δ . cos H
SALIDA, PUESTA : z = 90 ⇒ cos H = − tg φ tg δ

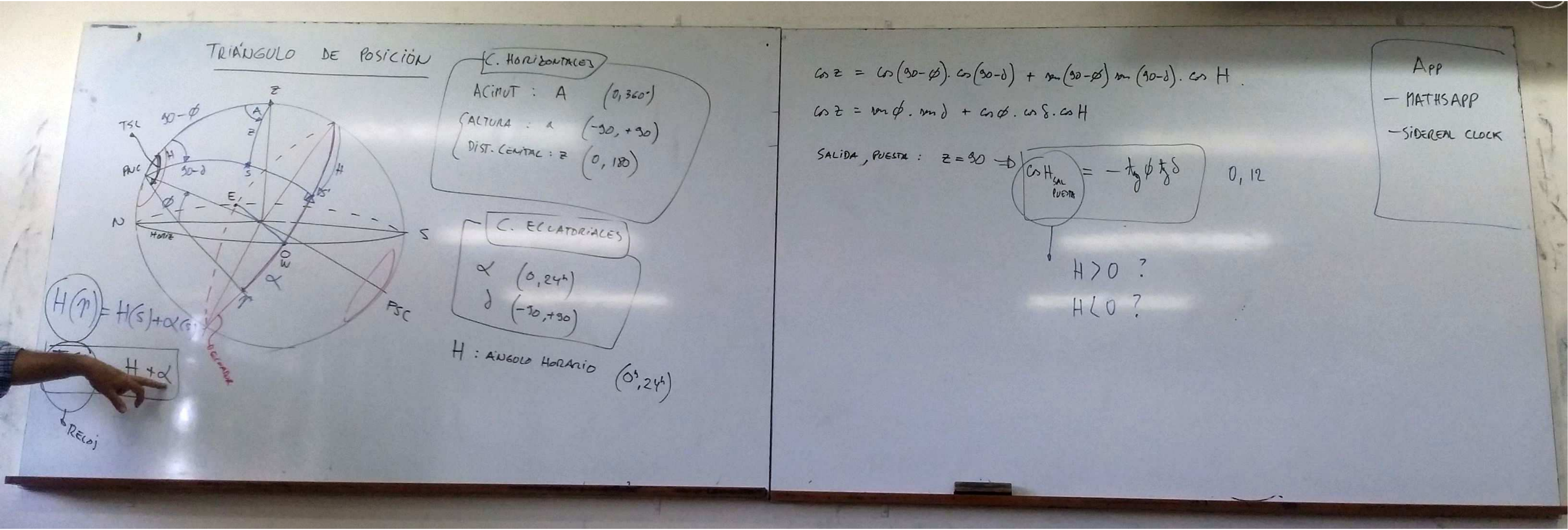

TRIÁNGULO DE POSICIÓN
Z
A
90 − ϕ
H
90 − δ
S
PNC
ϕ
E
N
Horiz
S
W
PSC
C. HORIZONTALES
ACIMUT : A (0, 360°)
ALTURA : a (−90, +90)
DIST. CENITAL : z (0, 180)
C. ECUATORIALES
α (0, 24h)
δ (−90, +90)
H : ÁNGULO HORARIO (0h, 24h)
cos z = cos(90−ϕ) . cos(90−δ) + sen(90−ϕ) sen(90−δ) . cos H
cos z = sen ϕ . sen δ + cos ϕ . cos δ . cos H
SALIDA, PUESTA : z = 90 ⇒ cos H = − tg ϕ tg δ
0, 12
H > 0 ?
H < 0 ?
App
— MATHSAPP
—

Astronomia Fundamental 2017

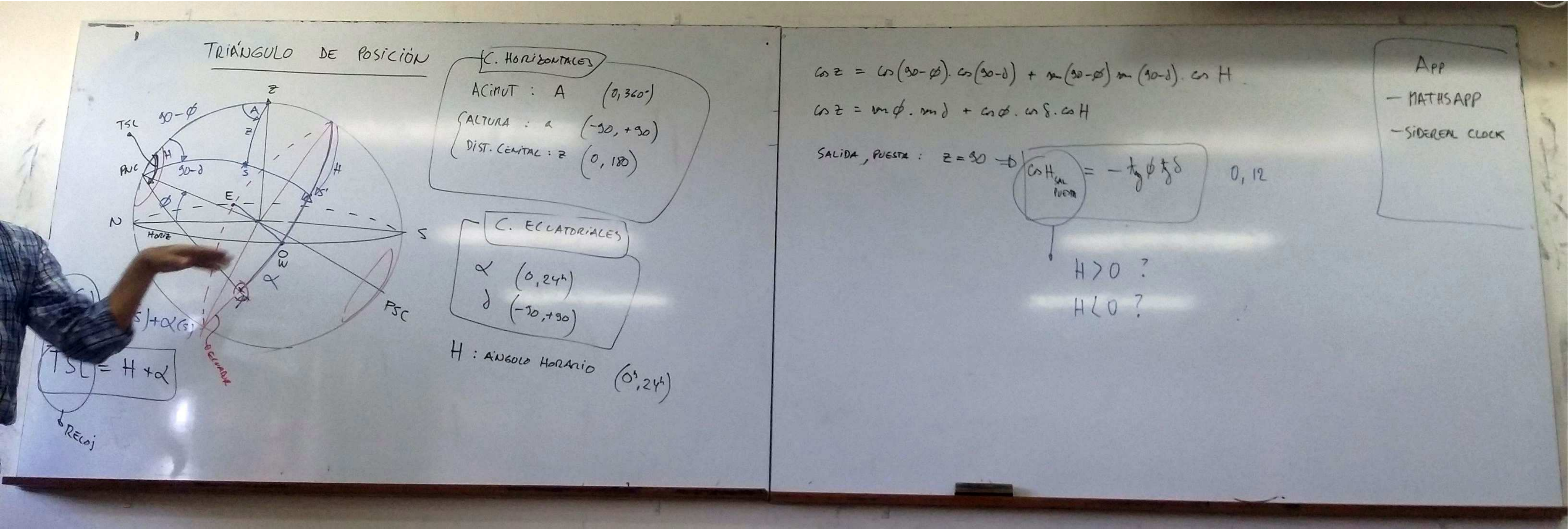



TRIÁNGULO DE POSICIÓN
C. HORIZONTALES
ACIMUT : A (0, 360°)
ALTURA : a (-90, +90)
DIST. CENITAL : z (0, 180)
C. ECUATORIALES
α (0, 24h)
δ (-90, +90)
H : ÁNGULO HORARIO (0h, 24h)
H(γ) = H(s) + α(s)
TSL = H + α
H > 0 ?
H < 0 ?
App
— MATHSAPP

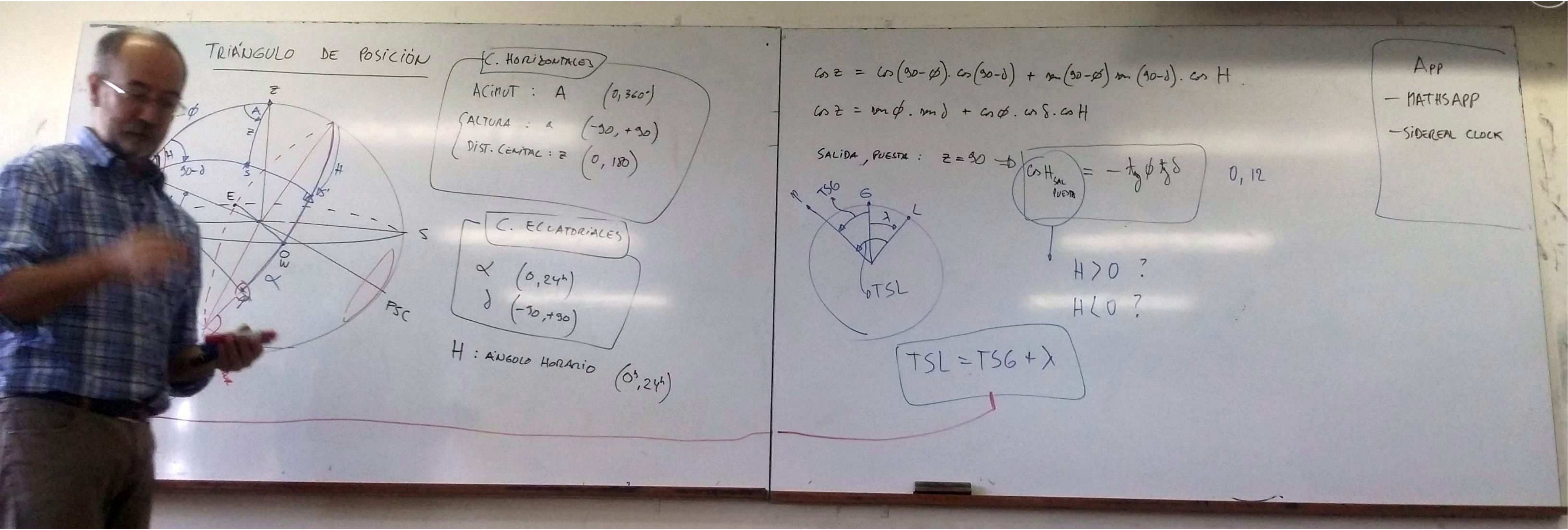
Astronomia Fundamental 2017



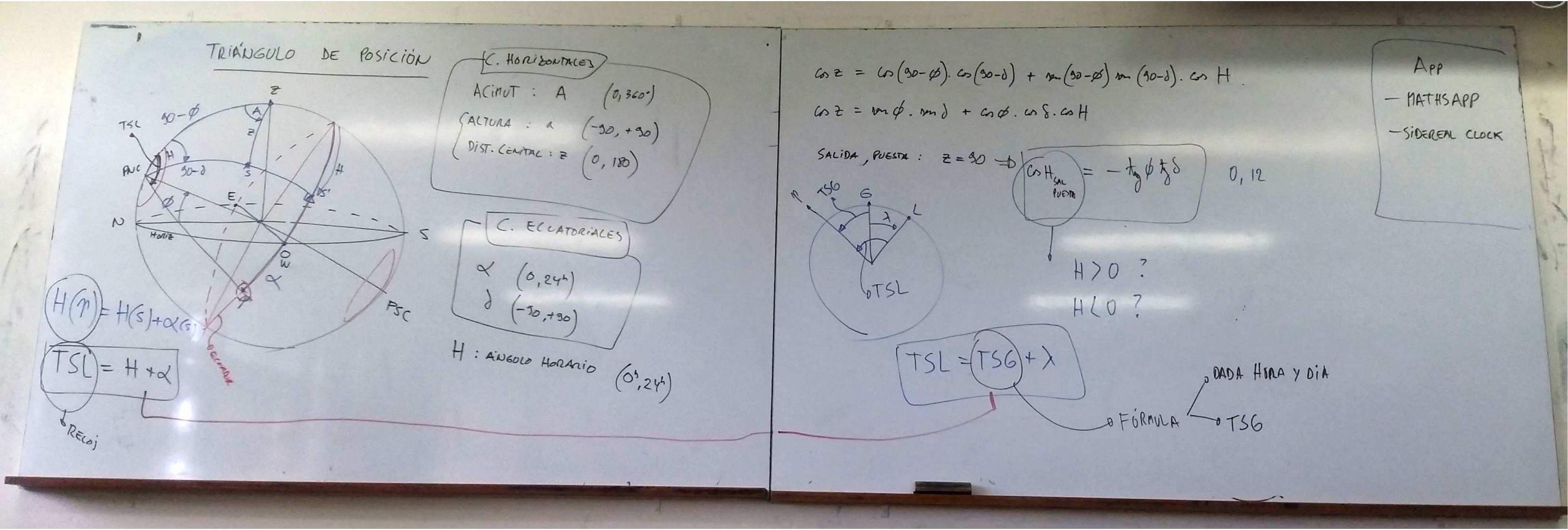
Astronomia Fundamental 2017



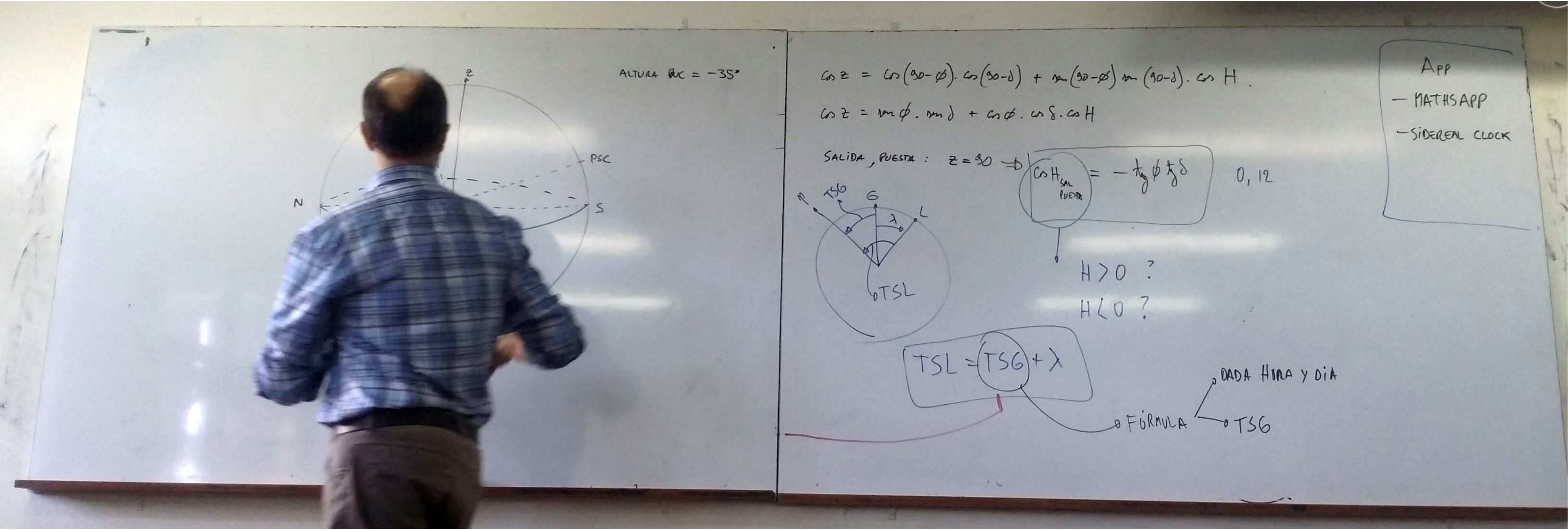
Astronomia Fundamental 2017



Astronomia Fundamental 2017



Astronomia Fundamental 2017



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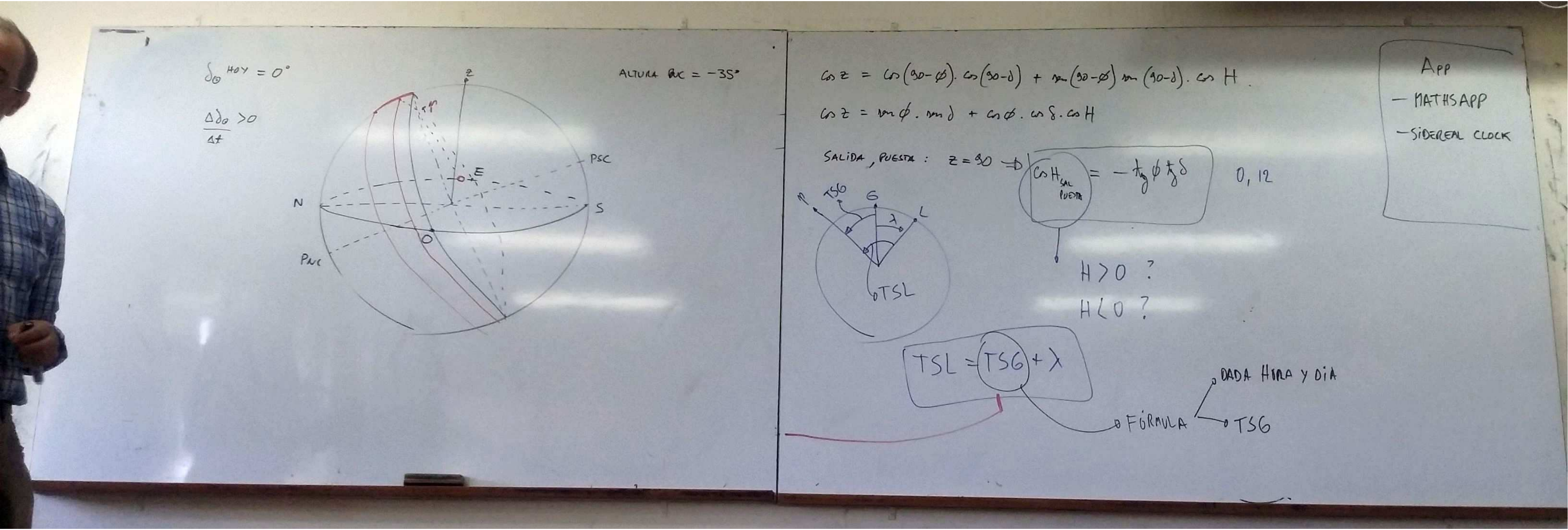
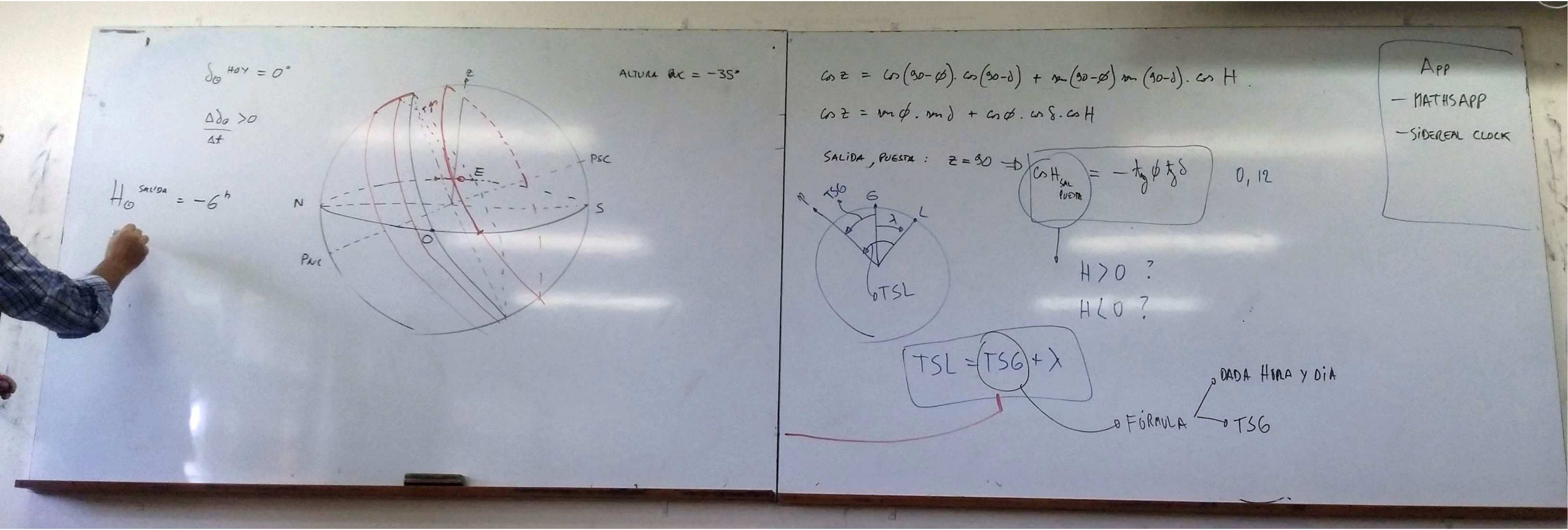
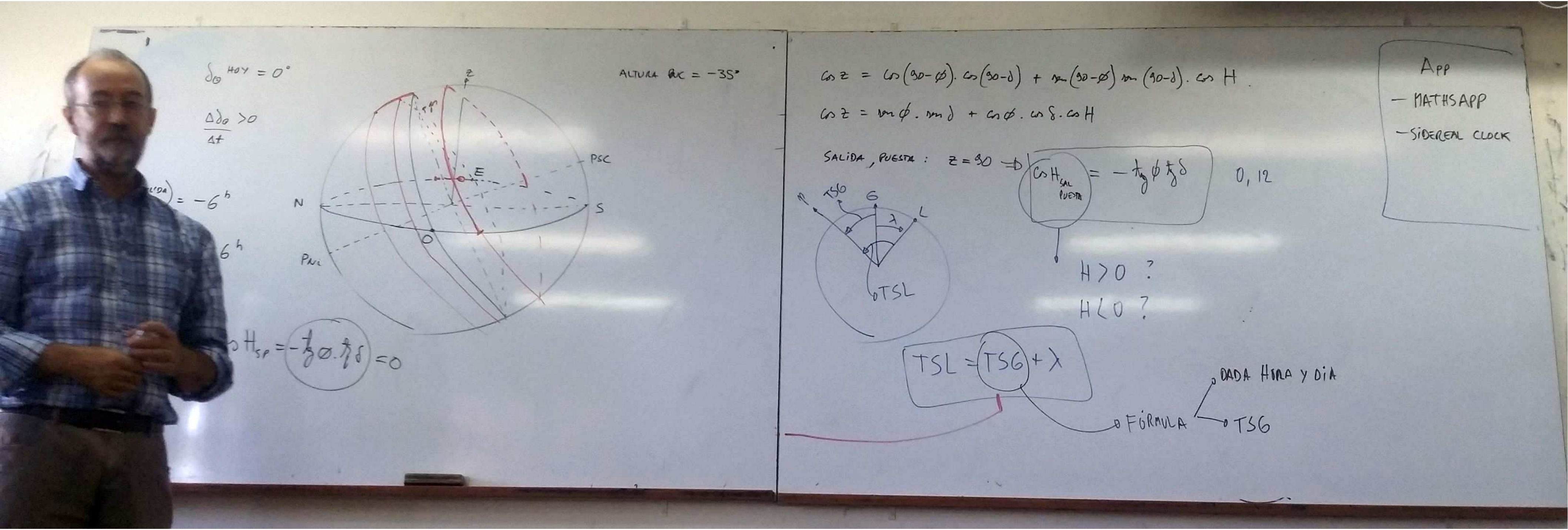
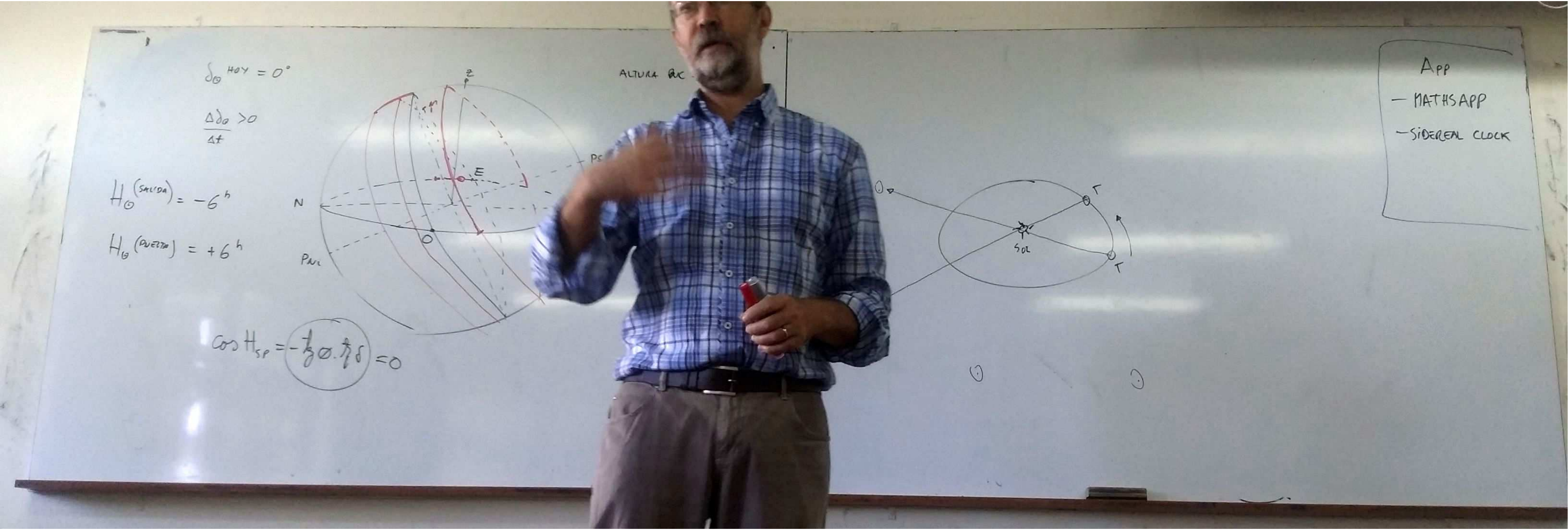


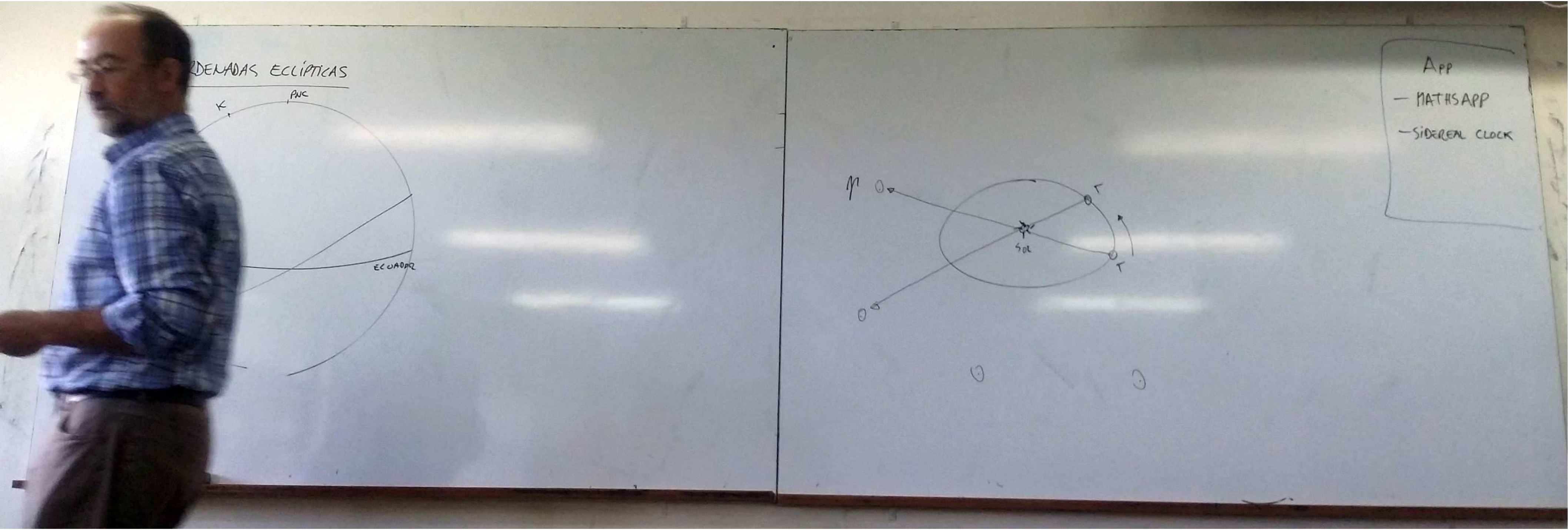

HOY = 0°
ALTURA = −35°
PSC
N
S
E
O
Z
H SALIDA = −6 h
cos z = cos(90−ϕ) . cos(90−δ) + sen(90−ϕ) sen(90−δ) . cos H
cos z = sen ϕ . sen δ + cos ϕ . cos δ . cos H
SALIDA, PUESTA : z = 90
cos H SAL PUESTA = − tg ϕ tg δ
0, 12
TSG
G
L
λ
TSL
H > 0 ?
H < 0 ?
TSL = TSG + λ
DADA HORA Y DIA
FÓRMULA
TSG
App
— MATHSAPP
— SIDEREAL CLOCK


ALTURA
= −35°
Z
PSC
E
N
S
O
cos z = cos(90−ϕ). cos(90−δ) + sen(90−ϕ) sen(90−δ). cos H
cos z = sen ϕ . sen δ + cos ϕ . cos δ . cos H
SALIDA, PUESTA : z = 90
= − tg ϕ tg δ
0, 12
H > 0 ?
H < 0 ?
TSG
G
L
λ
TSL
TSL = TSG + λ
DADA HORA Y DIA
FÓRMULA
TSG
App
— MATHSAPP
— SIDEREAL CLOCK

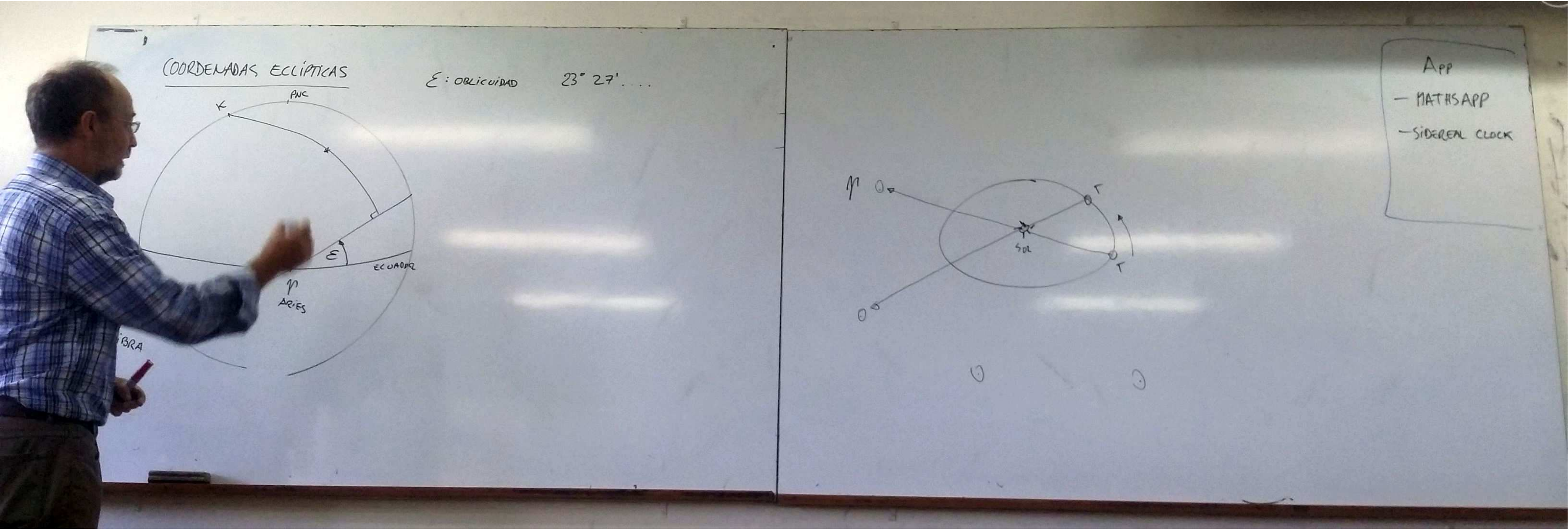


δ☉ HOY = 0°
Δδ☉/Δt > 0
H☉ (SALIDA) = −6h
H☉ (PUESTA) = +6h
cos Hsp = −tg ∅ . tg δ = 0
Z
E
N
O
PNC
ALTURA
O
T
T
SOL
App
— MATHSAPP
— SIDEREAL CLOCK

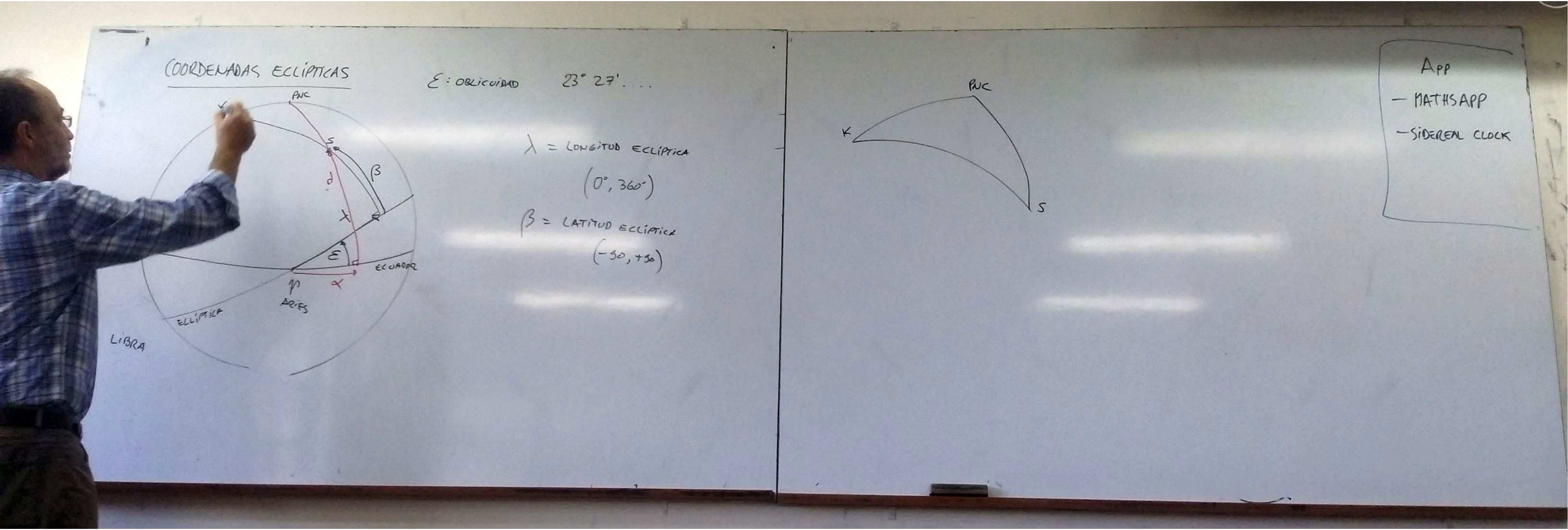
Astronomia Fundamental 2017



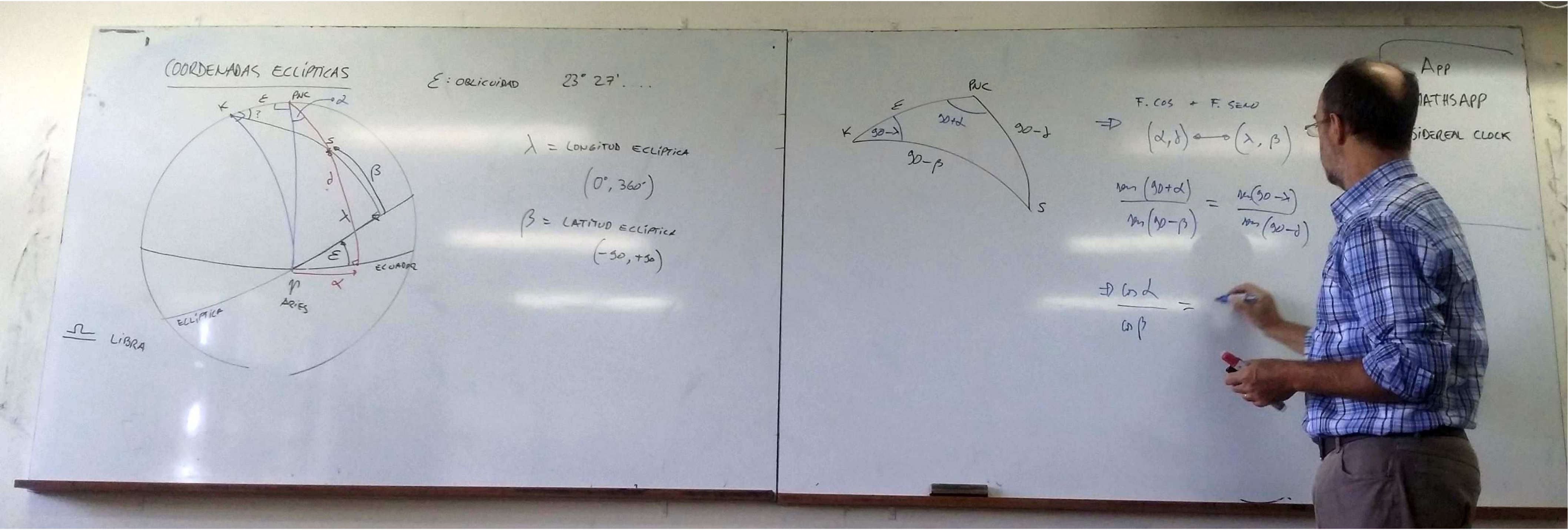
Astronomia Fundamental 2017

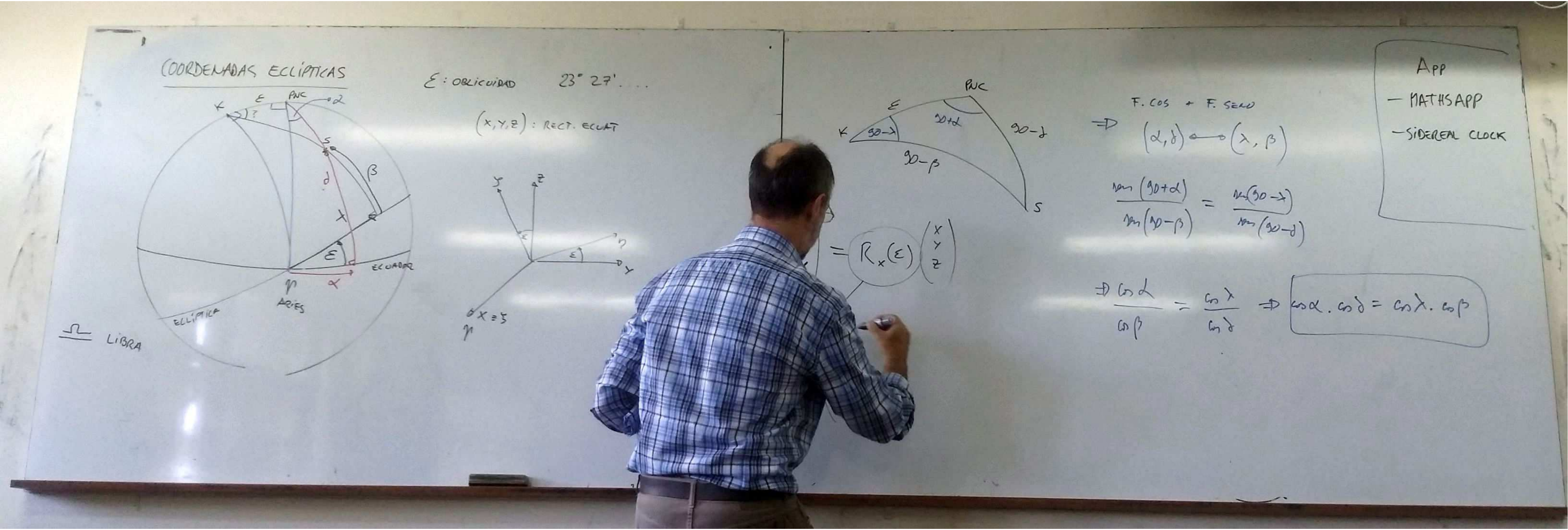


Astronomia Fundamental 2017

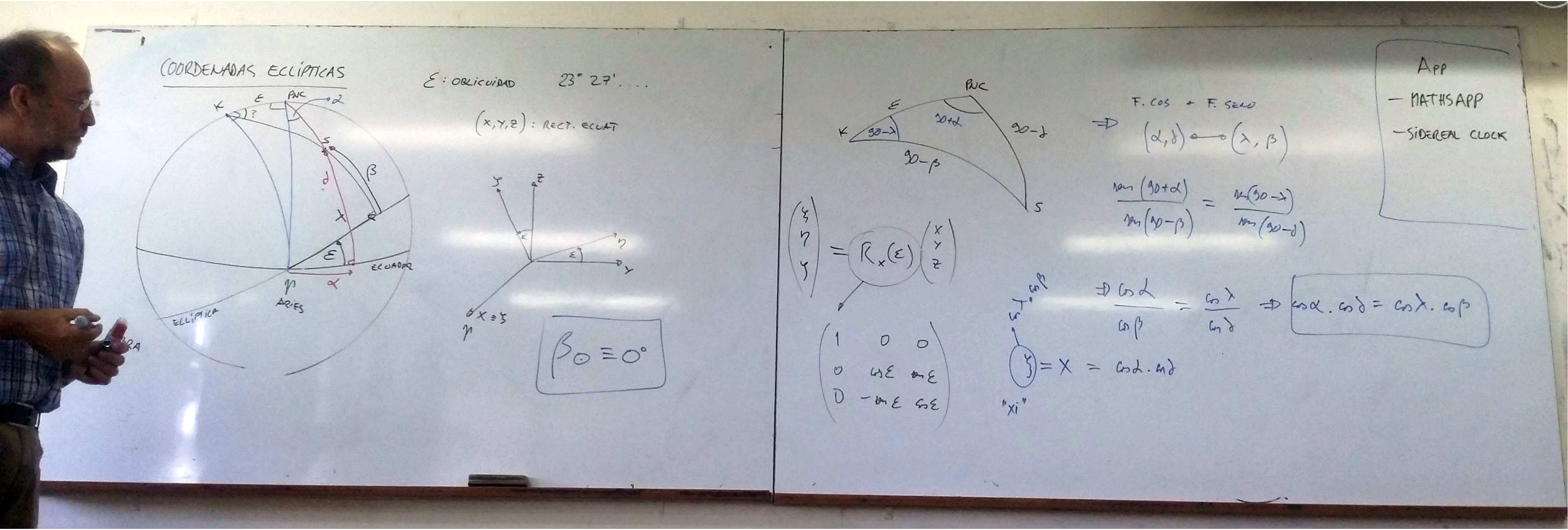


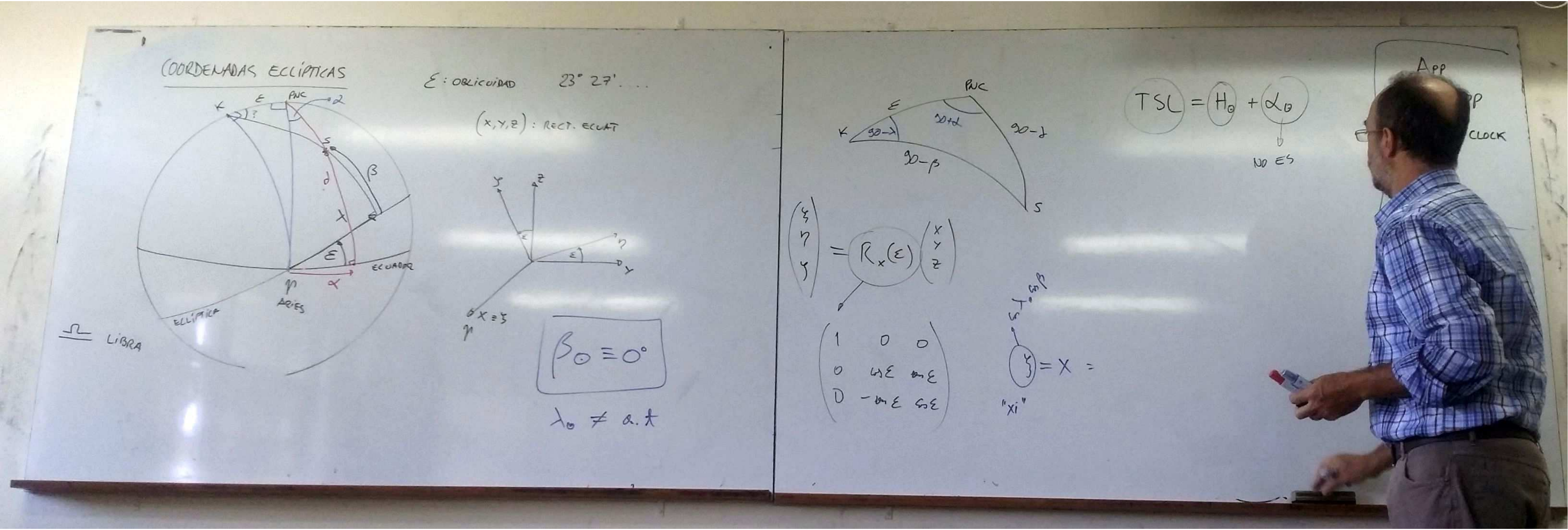
Astronomia Fundamental 2017



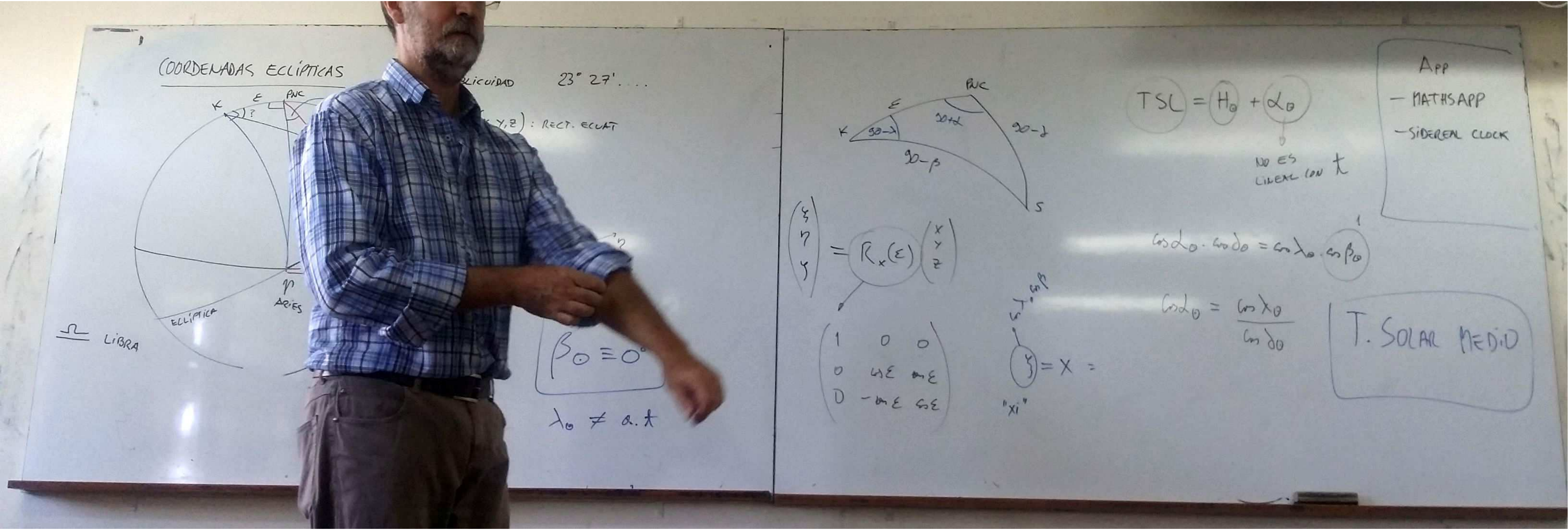

COORDENADAS ECLÍPTICAS
ε : OBLICUIDAD 23° 27' ....
(x, y, z) : RECT. ECUAT
ECUADOR
ECLÍPTICA
ARIES
LIBRA
PNC
F. COS + F. SENO
App
— MATHSAPP
— SIDEREAL CLOCK

Astronomia Fundamental 2017

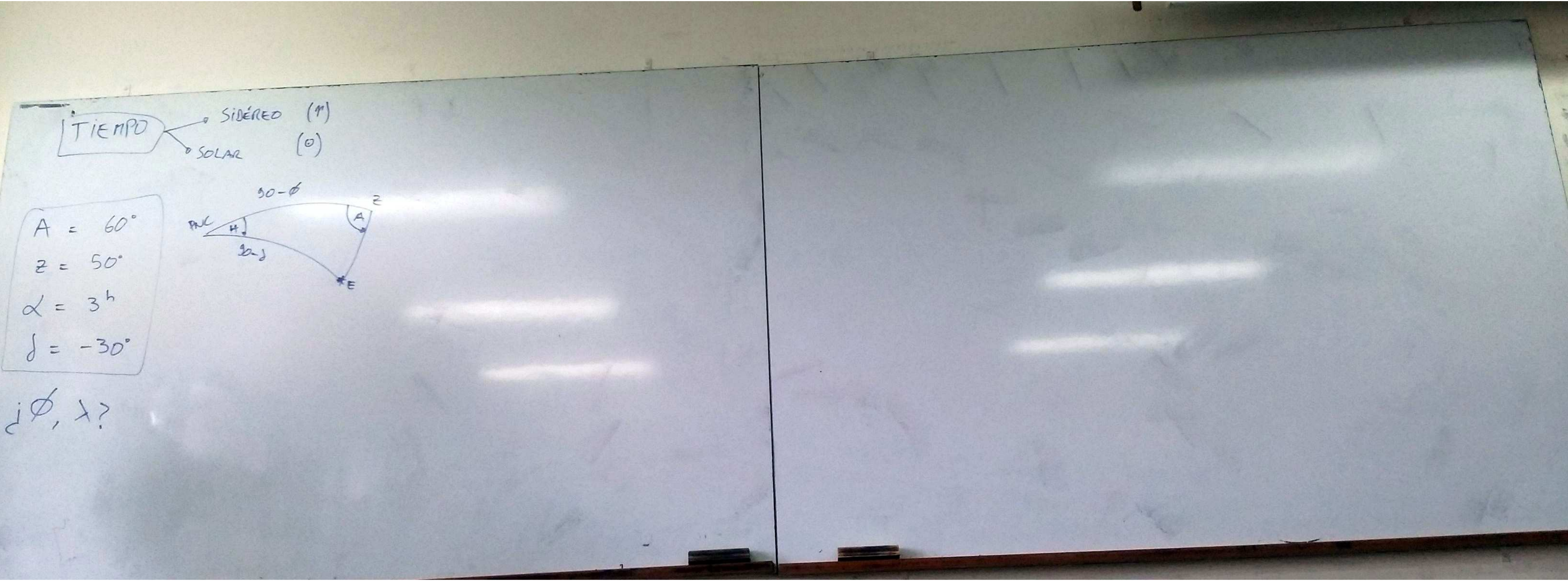



COORDENADAS ECLÍPTICAS
ε : OBLICUIDAD 23° 27'...
(x, y, z) : RECT. ECUAT.
PNC
ECUADOR
ECLÍPTICA
ARIES
LIBRA
β⊙ = 0°
λ⊙ ≠ a.t
90−λ
90+α
90−δ
90−β
Rx(ε)
"xi"
TSL = H⊙ + α⊙
NO ES
CLOCK

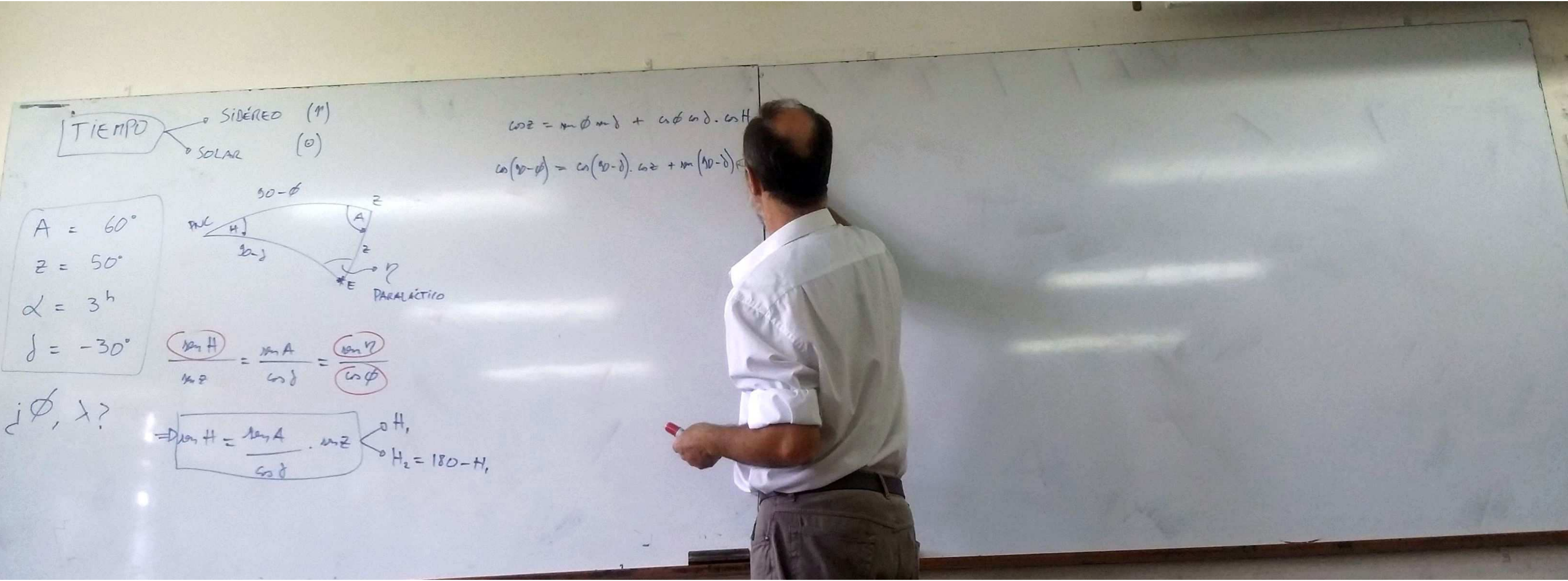
Astronomia Fundamental 2017



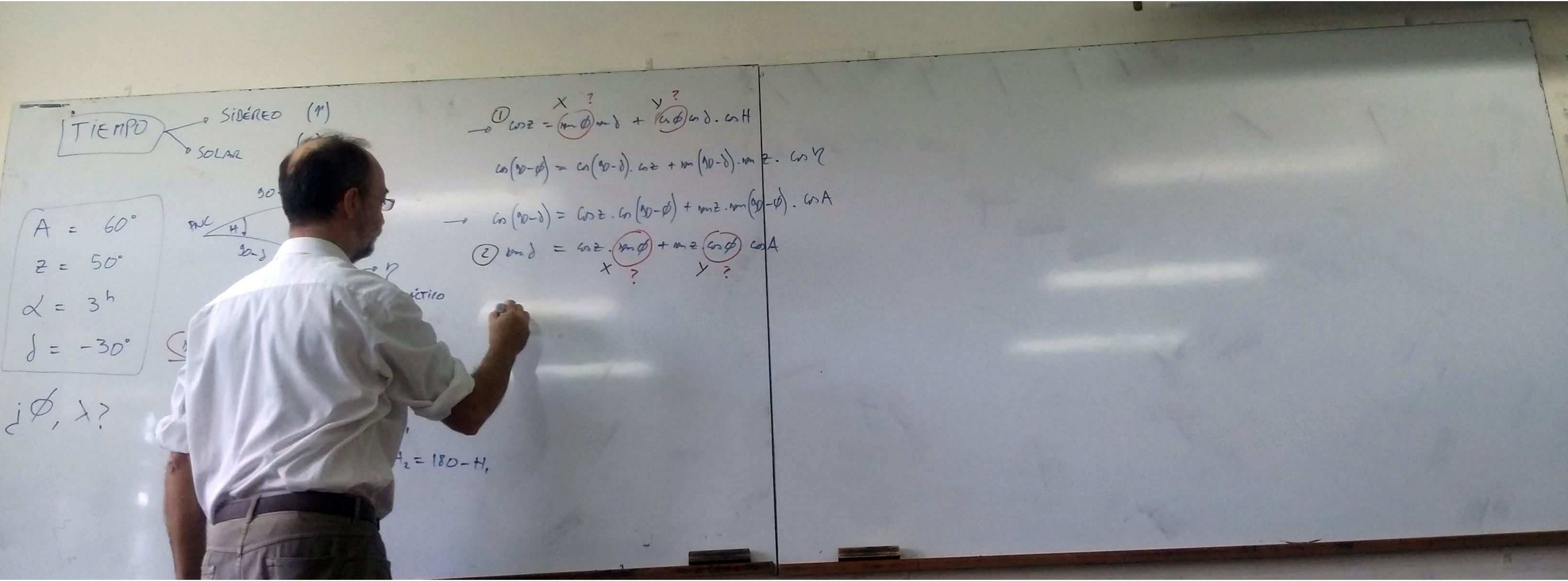

TIEMPO
SIDÉREO
SOLAR


TIEMPO
SIDÉREO (♈)
SOLAR (☉)
90 − ϕ
Z
A
H
90 − δ
E
A = 60°
z = 50°
α = 3h
δ = −30°
¿ϕ, λ?

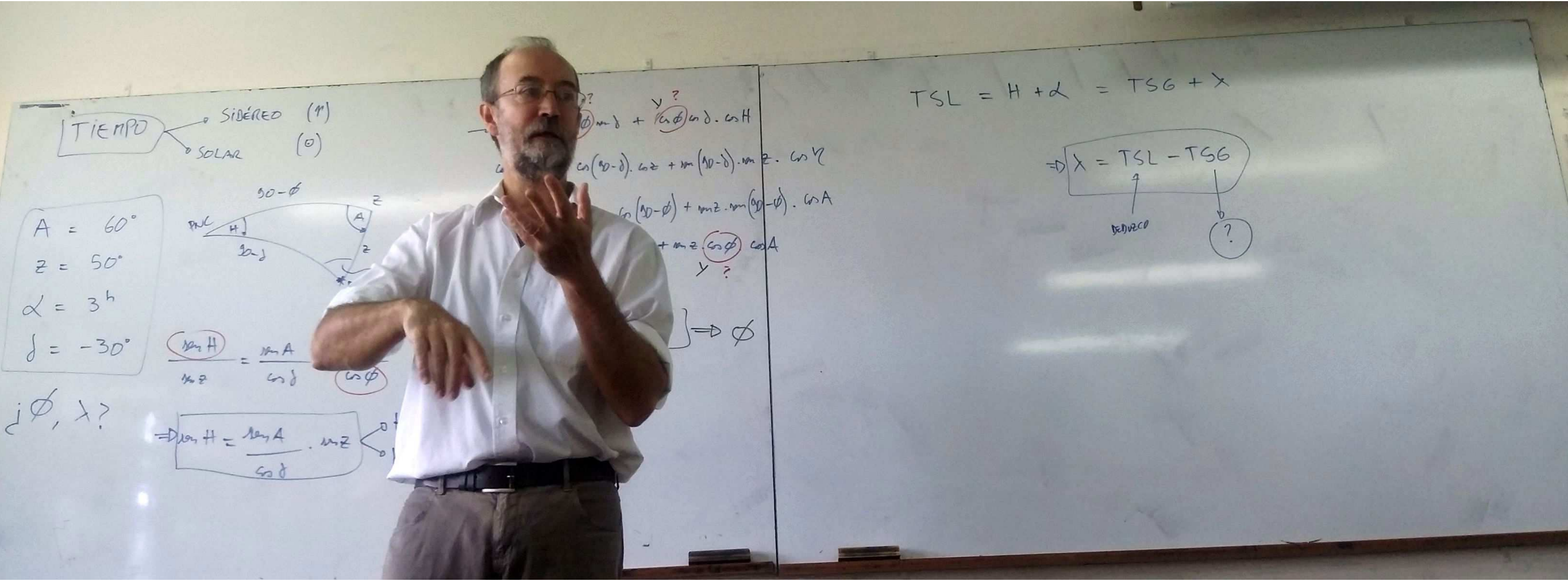

TIEMPO
SIDÉREO
SOLAR
90 − φ
Z
A
PNC
H
90−δ
z
η
E
PARALÁCTICO
sen H / sen z = sen A / cos δ = sen η / cos φ
sen H = sen A / cos δ . sen z


TIEMPO
SIDÉREO (γ)
SOLAR (⊙)
90 − φ
Z
A
PNC
H
90 − δ
z
E
η
PARALÁCTICO
A = 60°
z = 50°
α = 3h
δ = −30°
sen H / sen z = sen A / cos δ = sen η / cos φ
¿φ, λ?
⇒ sen H = sen A / cos δ . sen z
H1
H2 = 180 − H1
cos z = sen φ sen δ + cos φ cos δ . cos H
cos(90−φ) = cos(90−δ). cos z + sen(90−δ)

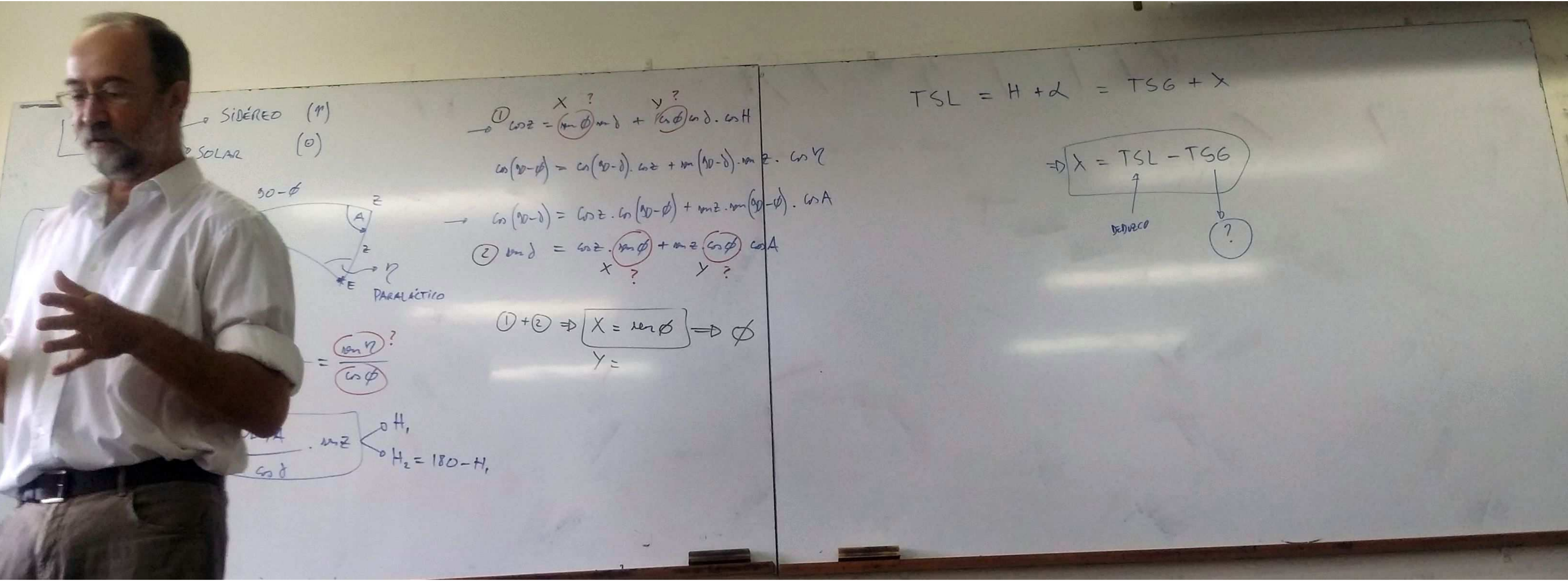
Astronomia Fundamental 2017

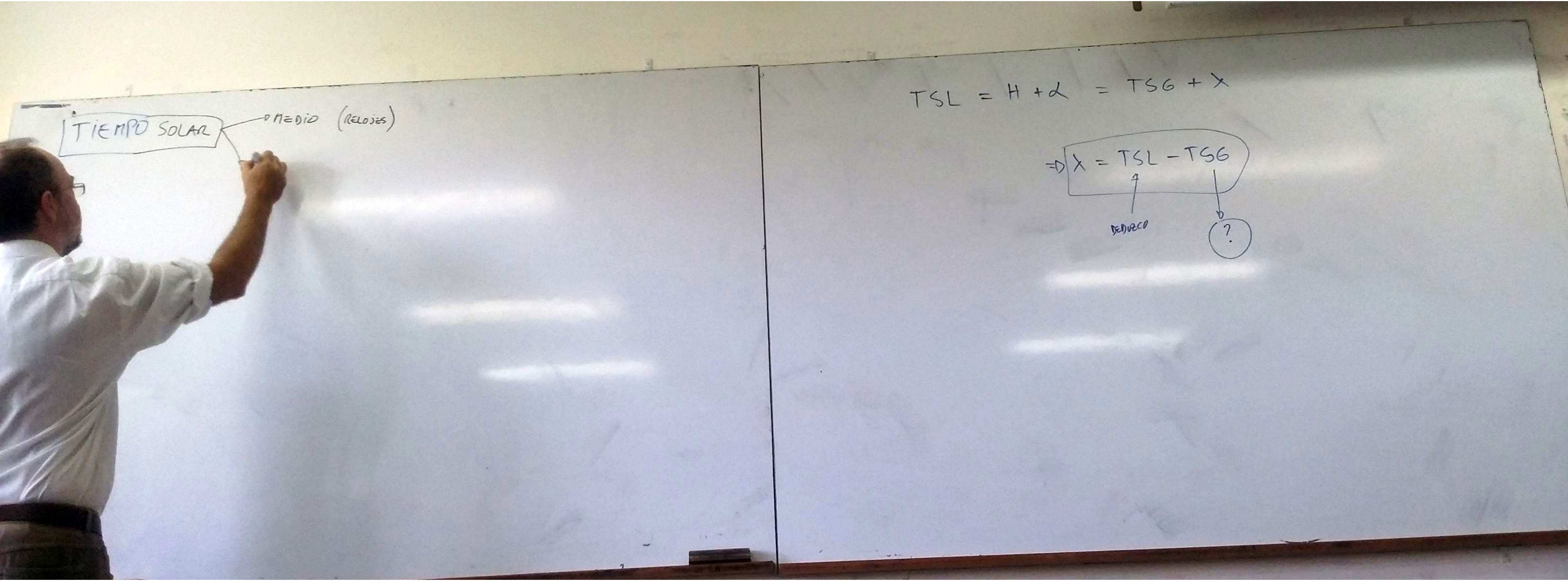


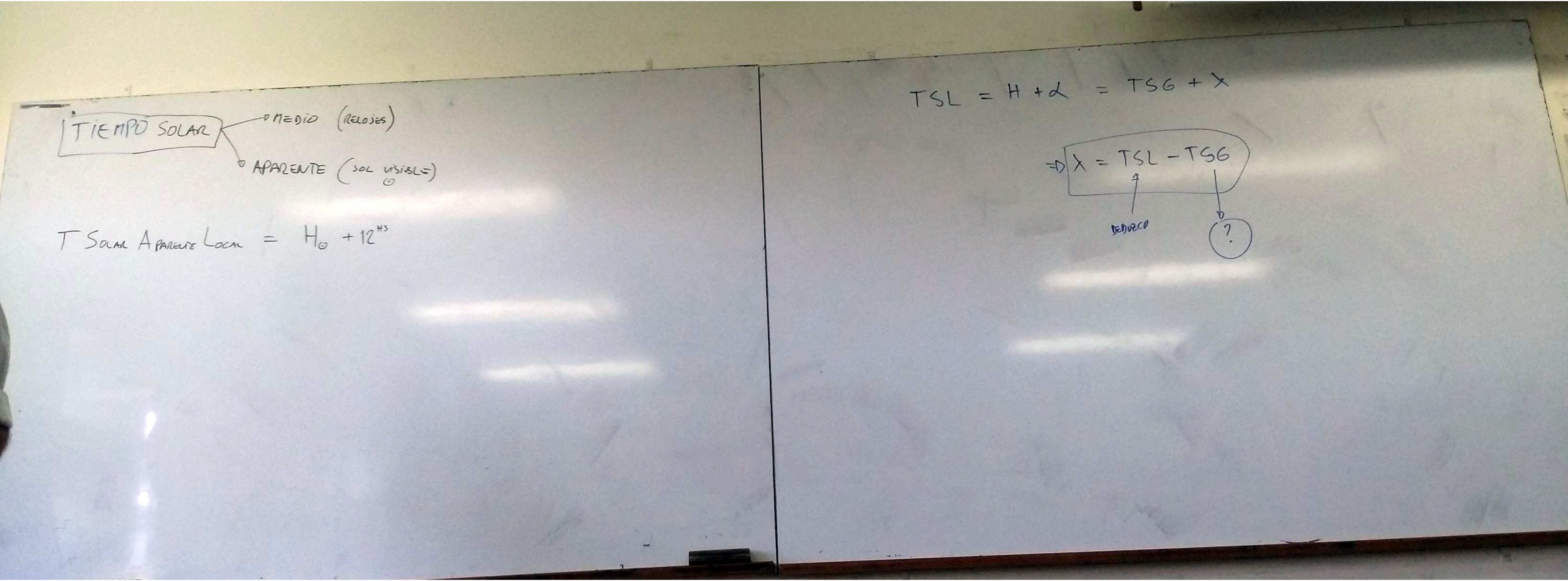
Astronomia Fundamental 2017

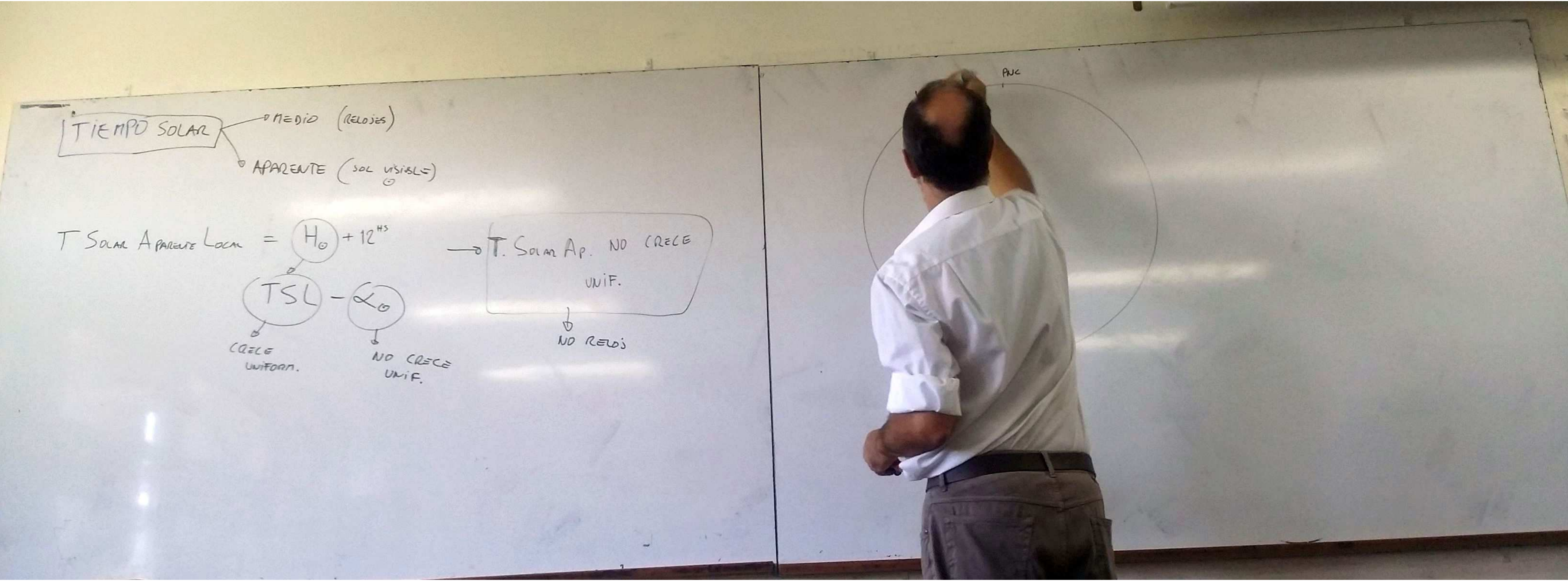


Astronomia Fundamental 2017

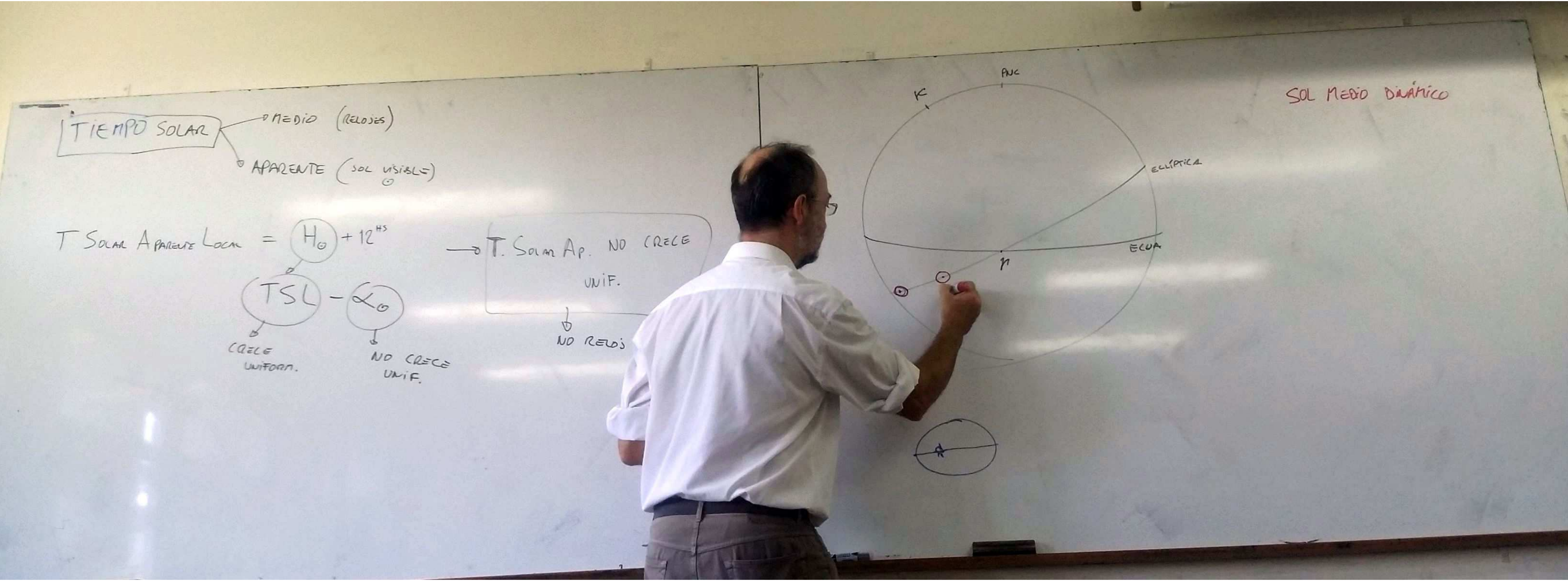


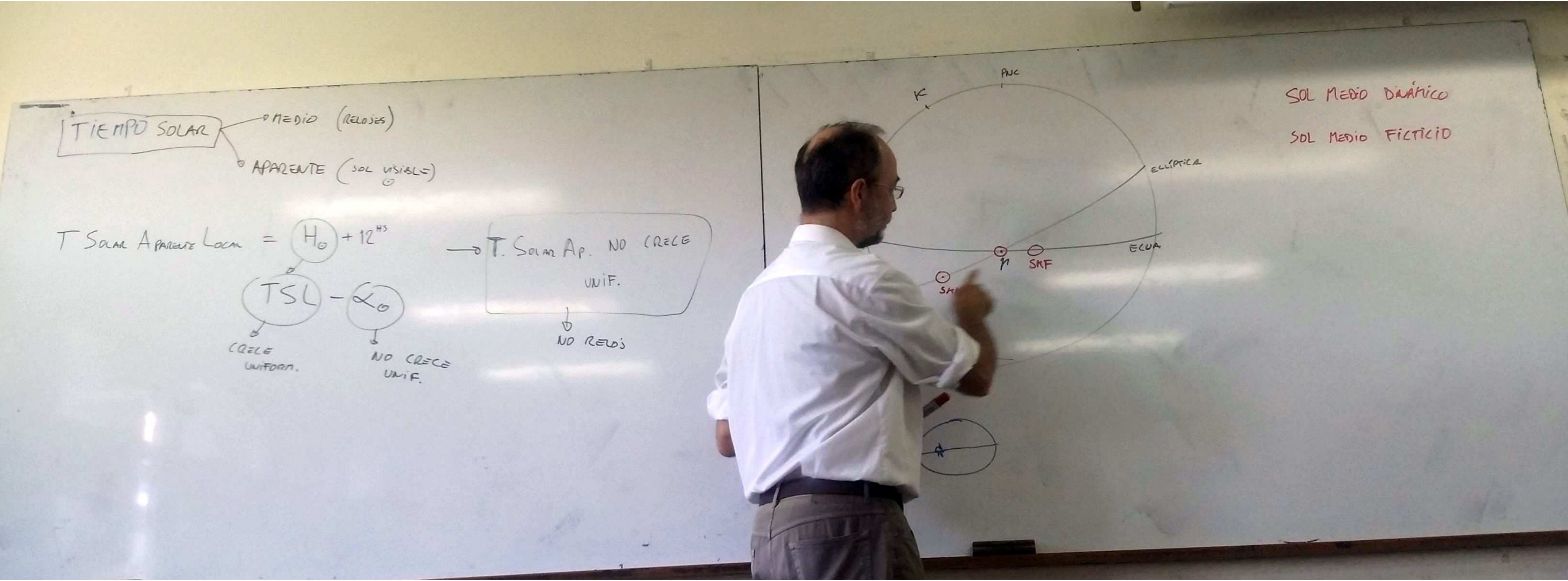

TIEMPO SOLAR
MEDIO (RELOJES)
TSL = H + α = TSG + λ
⇒ λ = TSL − TSG
DEDUZCO
?

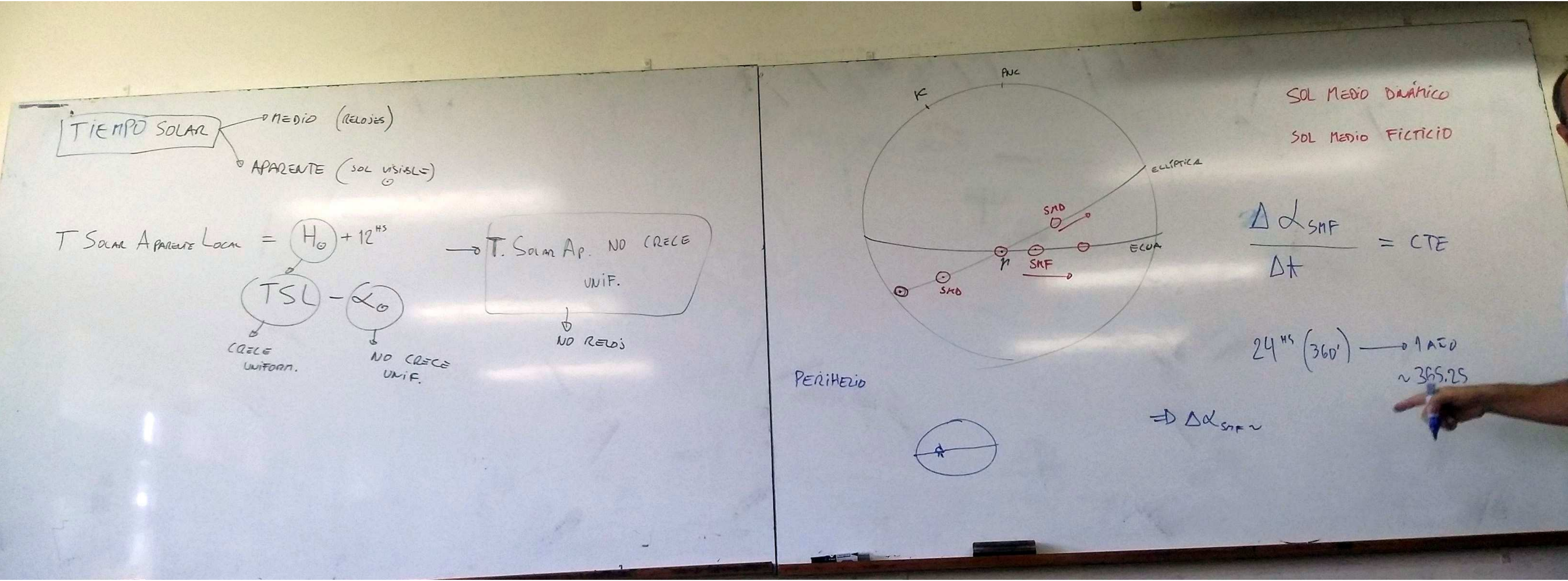

TIEMPO SOLAR
MEDIO (RELOJES)
APARENTE (SOL VISIBLE)
T SOLAR APARENTE LOCAL = H⊙ + 12 HS
TSL = H + α = TSG + λ
λ = TSL − TSG
DEDUZCO
?


TIEMPO SOLAR
MEDIO (RELOJES)
APARENTE (SOL VISIBLE)
T SOLAR APARENTE LOCAL = H☉ + 12HS
TSL − α☉
CRECE UNIFORM.
NO CRECE UNIF.
T. SOLAR AP. NO CRECE UNIF.
NO RELOJ
PNC

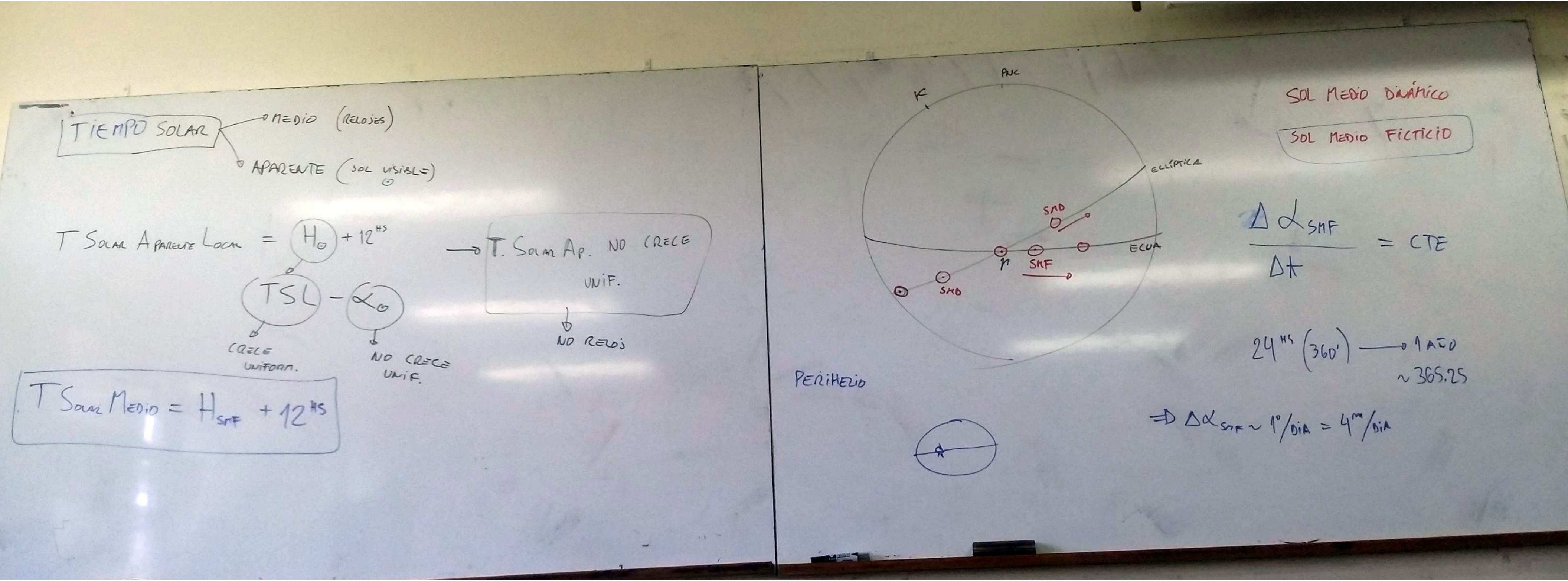
Astronomia Fundamental 2017

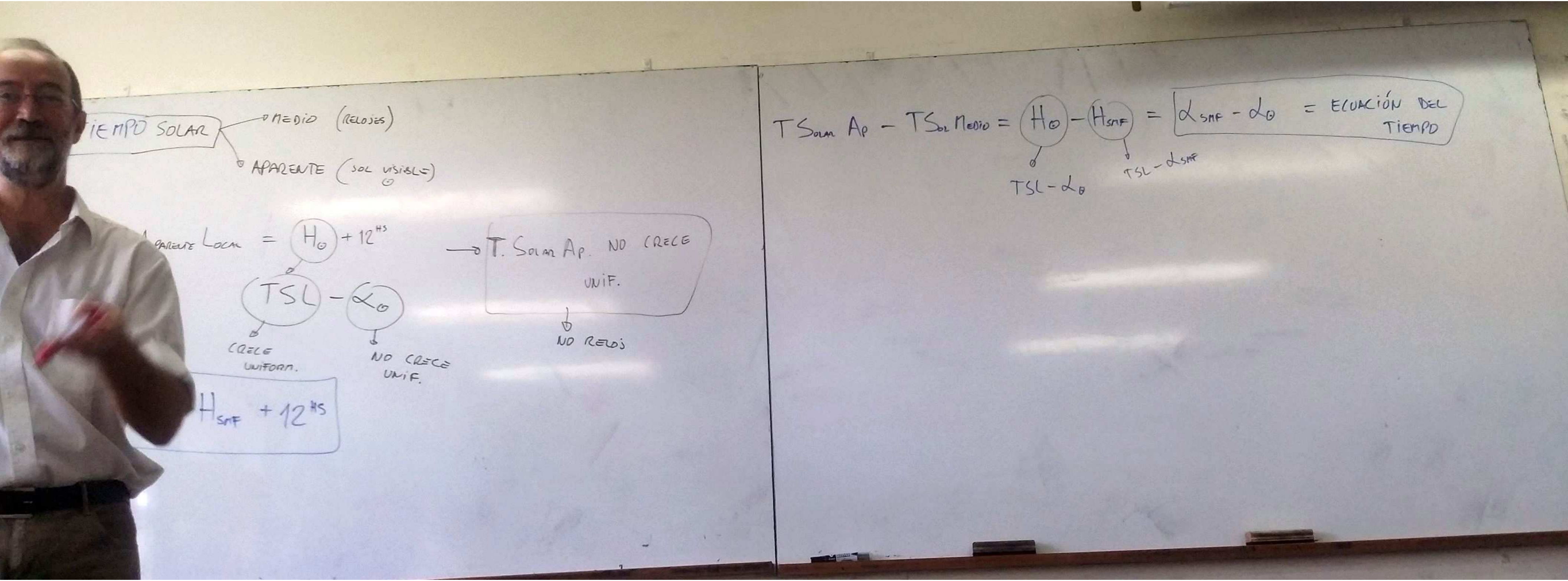



TIEMPO SOLAR
MEDIO (RELOJES)
APARENTE (SOL VISIBLE)
T SOLAR APARENTE LOCAL = H⊙ + 12HS
TSL - α⊙
CRECE UNIFORM.
NO CRECE UNIF.
T. SOLAR AP. NO CRECE UNIF.
NO RELOJ
PNC
K
ECLÍPTICA
ECUA
SMF
SOL MEDIO DINÁMICO
SOL MEDIO FICTICIO

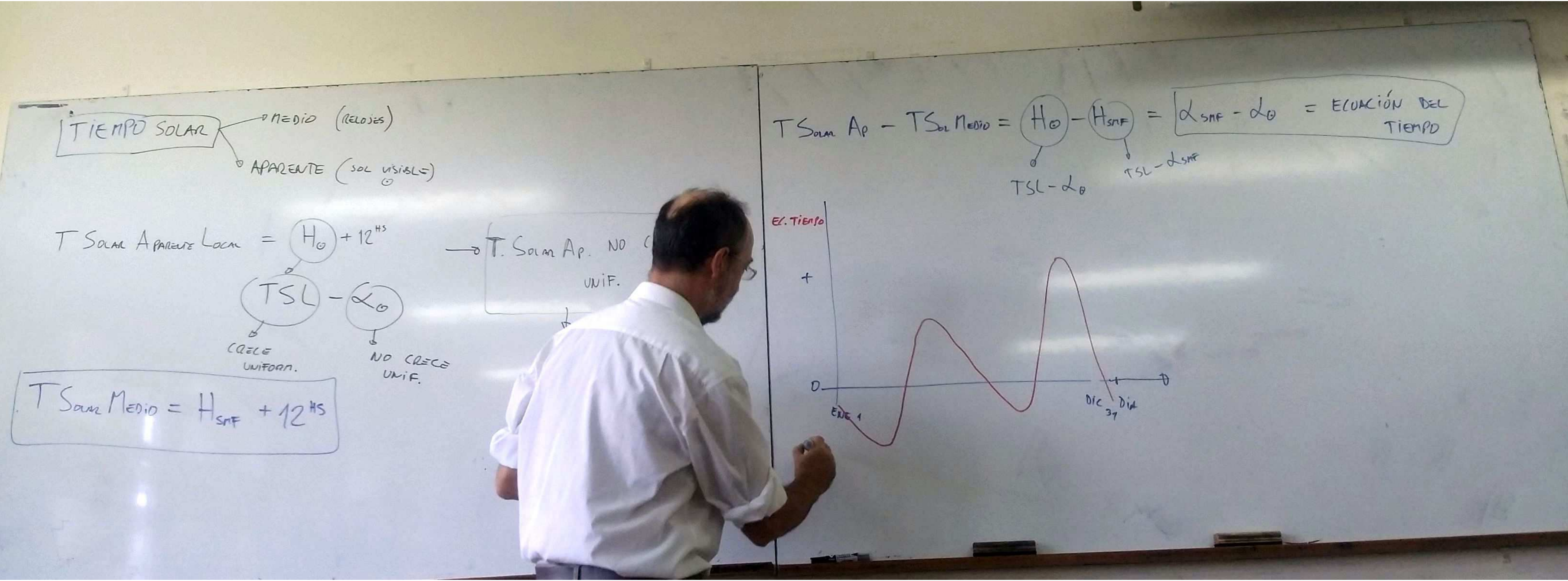

TIEMPO SOLAR
MEDIO (RELOJES)
APARENTE (SOL VISIBLE)
T SOLAR APARENTE LOCAL = H + 12HS
TSL − α
CRECE UNIFORM.
NO CRECE UNIF.
T. SOLAR AP. NO CRECE UNIF.
NO RELOJ
PNC
K
ELLÍPTICA
SMD
ECUA
SMF
PERIHELIO
SOL MEDIO DINÁMICO
SOL MEDIO FICTICIO
Δα SMF / Δt = CTE
24HS (360°) → 1 AÑO
~ 365.25
⇒ Δα SMF ~

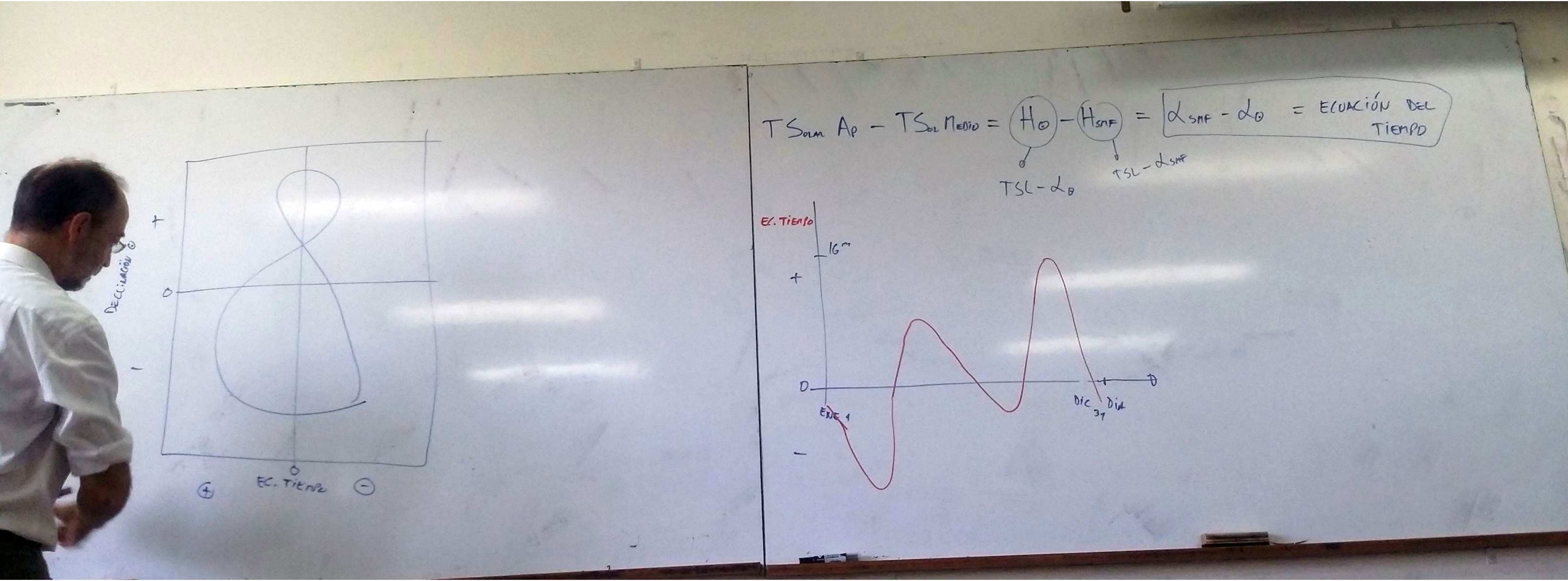

SOL MEDIO DINÁMICO
SOL MEDIO FICTICIO
ECLÍPTICA
SMD
ECUA
SMF
SMD
PERIHELIO
= CTE
24 HS (360°) → 1 AÑO
~ 365.25
⇒ Δα SMF ~ 1°/DIA = 4m/DIA


TIEMPO SOLAR
MEDIO (RELOJES)
APARENTE (SOL VISIBLE)
T SOLAR APARENTE LOCAL = H☉ + 12 HS
TSL − α☉
CRECE UNIFORM.
NO CRECE UNIF.
→ T. SOLAR AP. NO CRECE UNIF.
NO RELOJ
T SOLAR MEDIO = H SMF + 12 HS
PNC
K
ELÍPTICA
SMD
γ
SMF
ECUA
SMD
PERIHELIO
SOL MEDIO DINÁMICO
SOL MEDIO FICTICIO
Δα SMF / Δt = CTE
24 HS (360°) → 1 AÑO
~ 365.25
⇒ Δα SMF ~ 1°/DIA = 4m/DIA

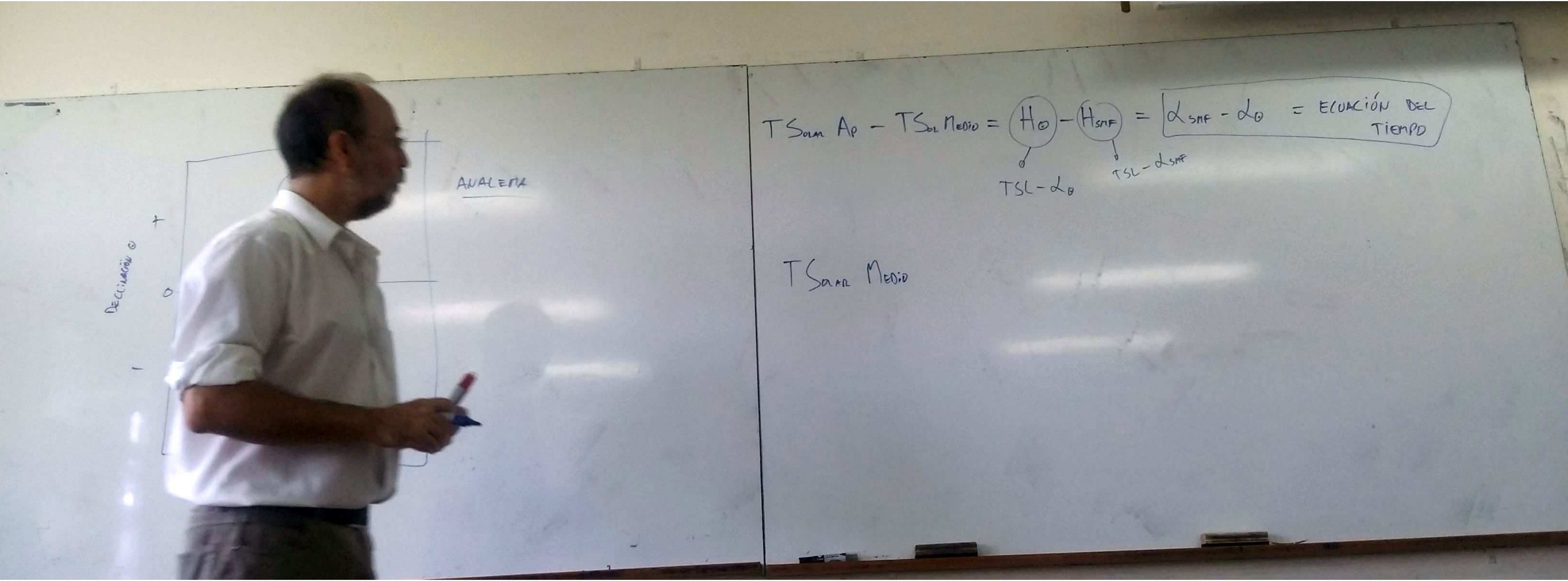

TIEMPO SOLAR
MEDIO (RELOJES)
APARENTE (SOL VISIBLE)
LOCAL = Hʘ + 12 HS
TSL - αʘ
CRECE UNIFORM.
NO CRECE UNIF.
T. SOLAR AP. NO CRECE UNIF.
NO RELOJ
HSMF + 12 HS
TSolar Ap - TSol Medio = Hʘ - HSMF = αSMF - αʘ = ECUACIÓN DEL TIEMPO
TSL - αʘ
TSL - αSMF

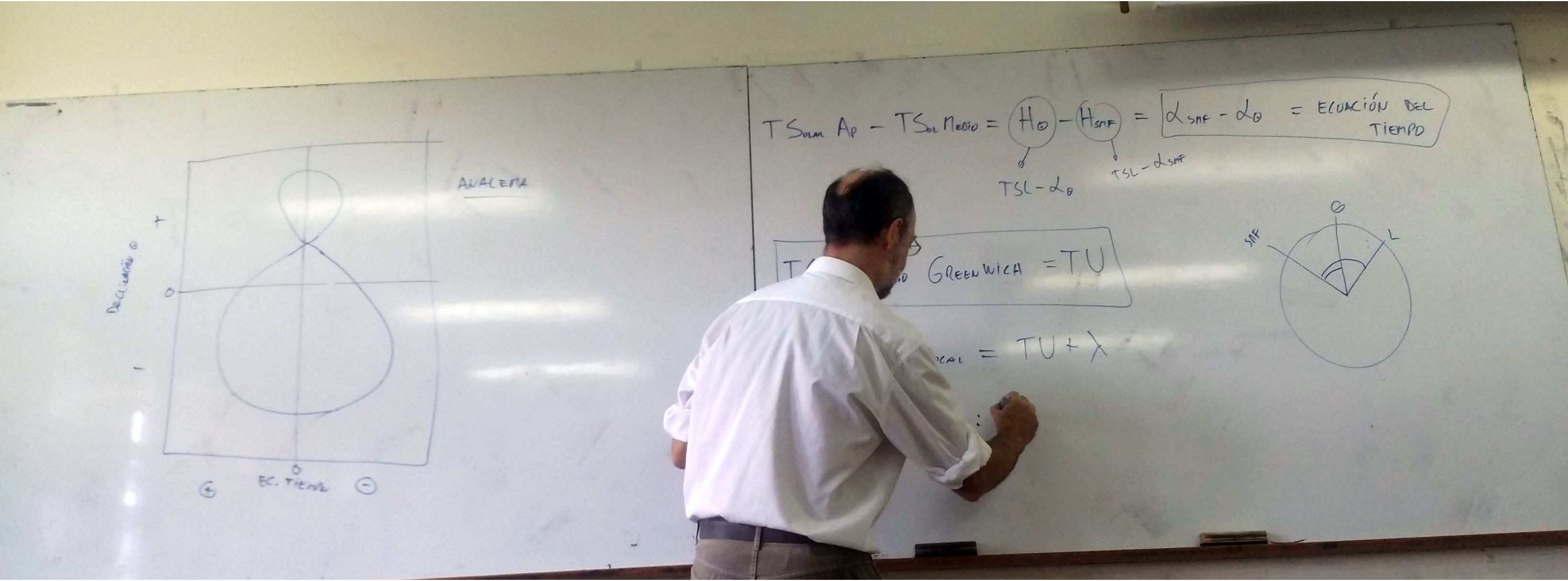
Astronomia Fundamental 2017



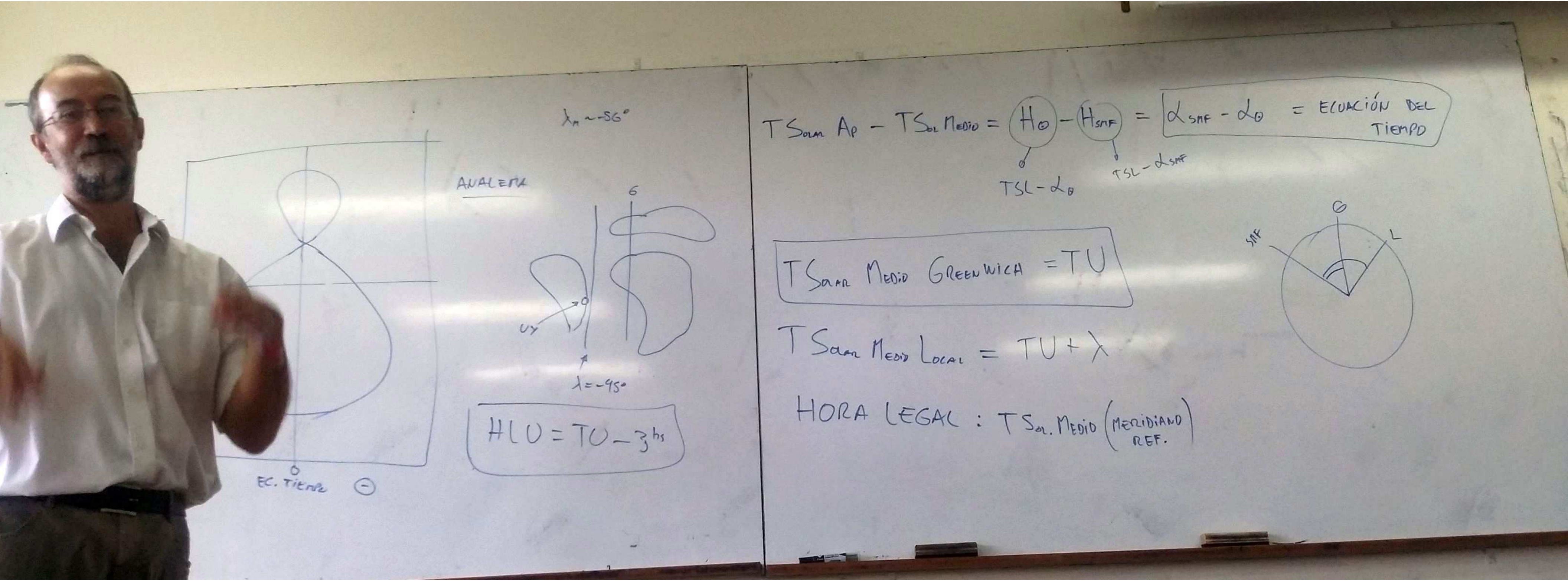


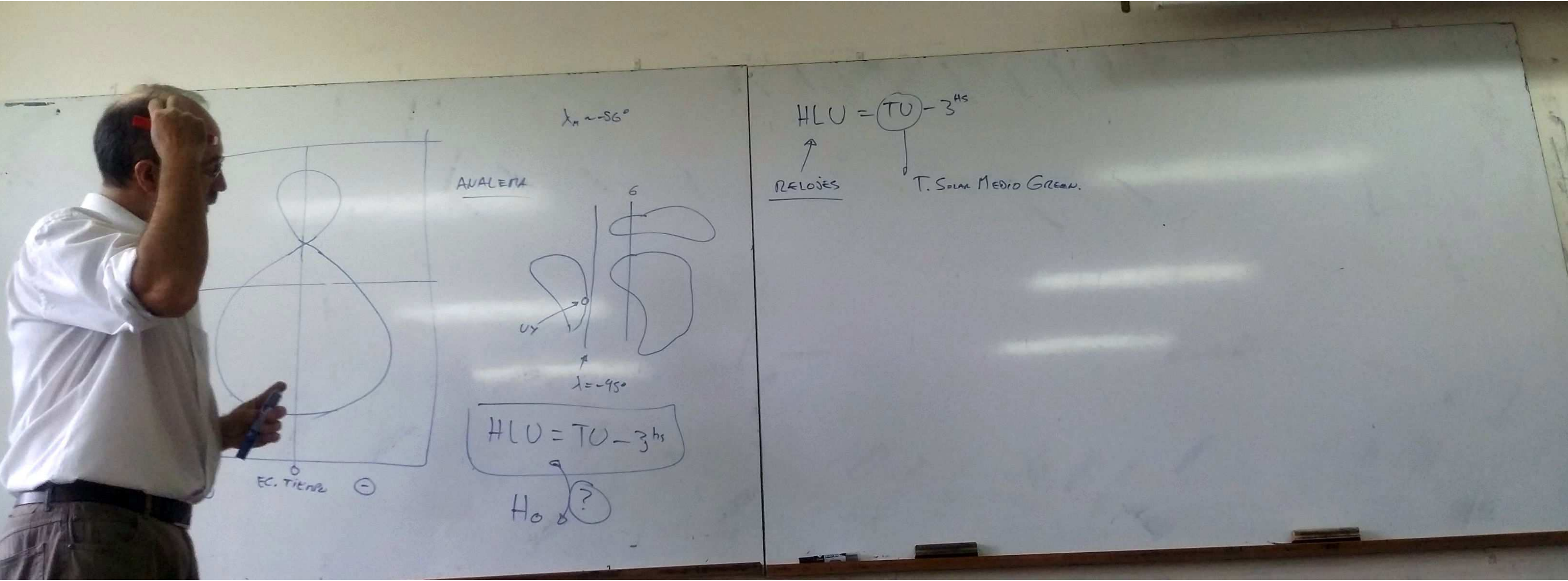
TS Sol Ap − TS Sol Medio = H⊙ − HSMF = αSMF − α⊙ = ECUACIÓN DEL TIEMPO
TSL − α⊙
TSL − αSMF
DECLINACIÓN ⊙
+
0
−
EC. TIEMPO
EC. TIEMPO
16m
ENE 1
DIC 31
DIA


ANALEMA
TSolar Ap − TSol Medio = H⊙ − HSMF = αSMF − α⊙ = ECUACIÓN DEL TIEMPO
TSL − α⊙
TSL − αSMF
TSolar Medio

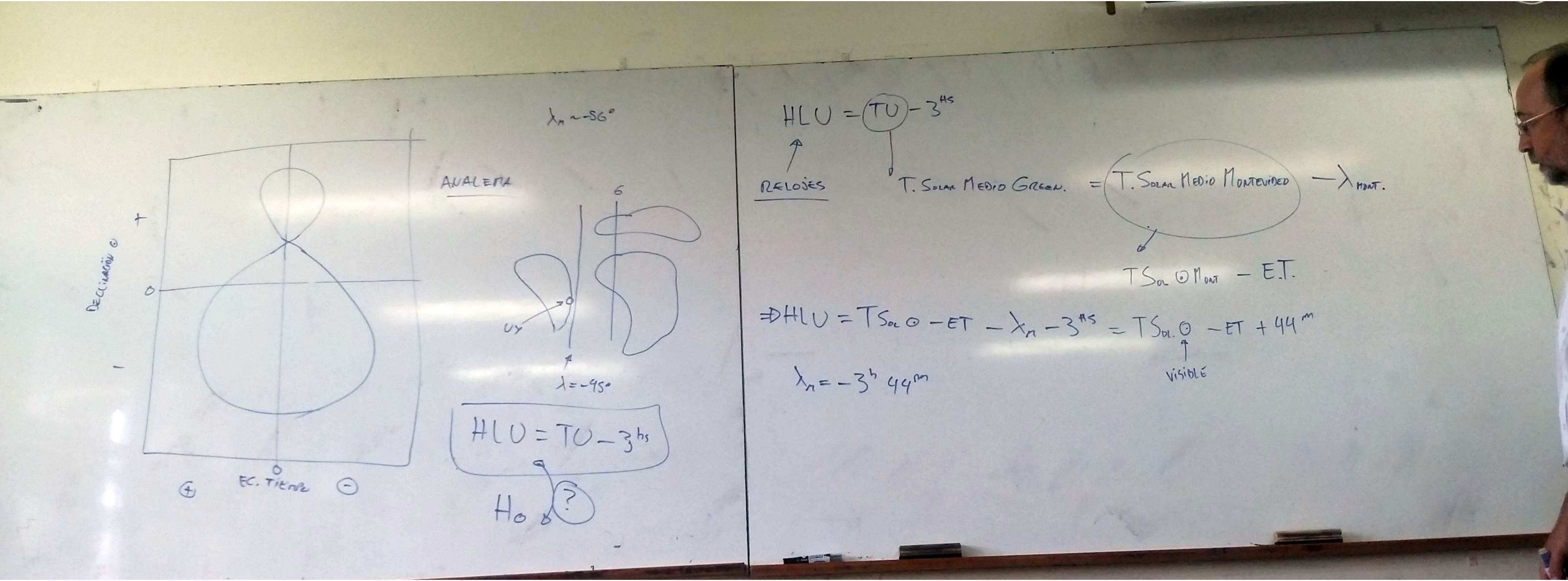


TSolar Ap − TSol Medio = H☉ − HSMF = αSMF − α☉ = ECUACIÓN DEL TIEMPO
TSL − α☉
TSL − αSMF
ANALEMA
DECLINACIÓN ☉
EC. TIEMPO
GREENWICH = TU
= TU + λ
SMF
G
L

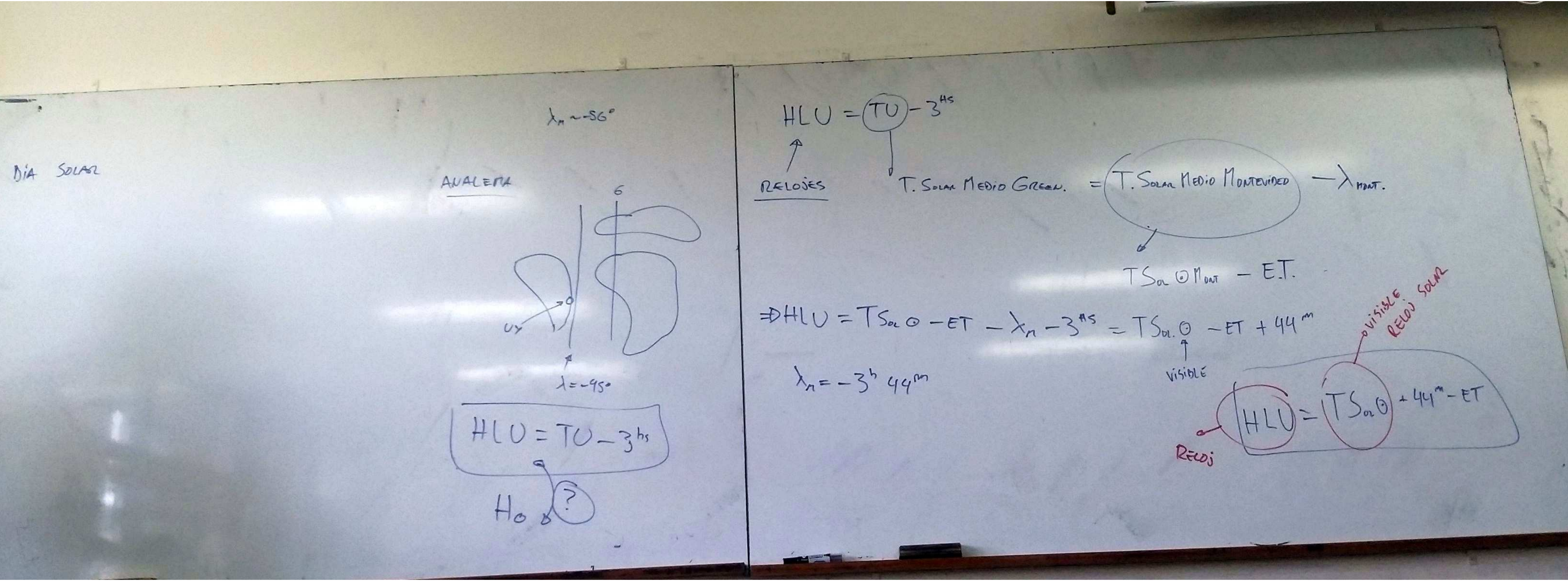

λM ~ -56°
ANALEMA
G
UY
λ = -45°
HLU = TU - 3hs
EC. TIEMPO
TSolar Ap - TSol Medio = H⊙ - HSMF = αSMF - α⊙ = ECUACIÓN DEL TIEMPO
TSL - α⊙
TSL - αSMF
TSolar Medio Greenwich = TU
TSolar Medio Local = TU + λ
HORA LEGAL : TSol. Medio (MERIDIANO REF.)
SMF
G
L

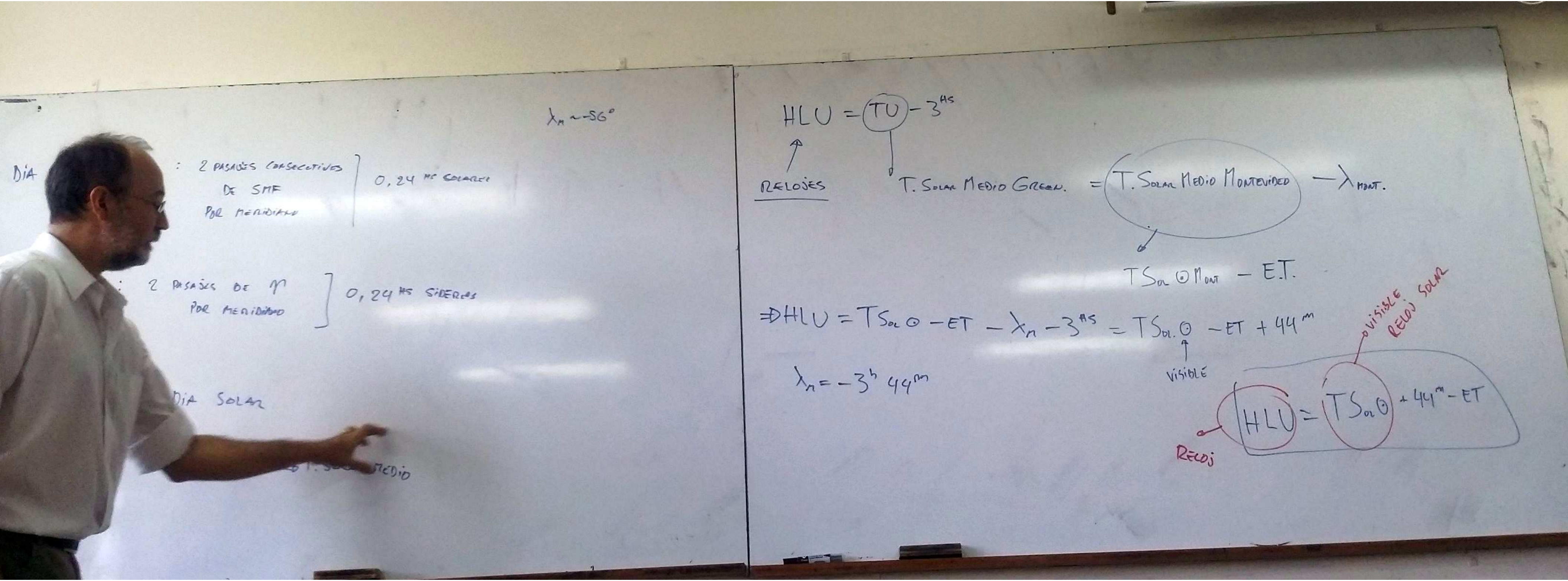


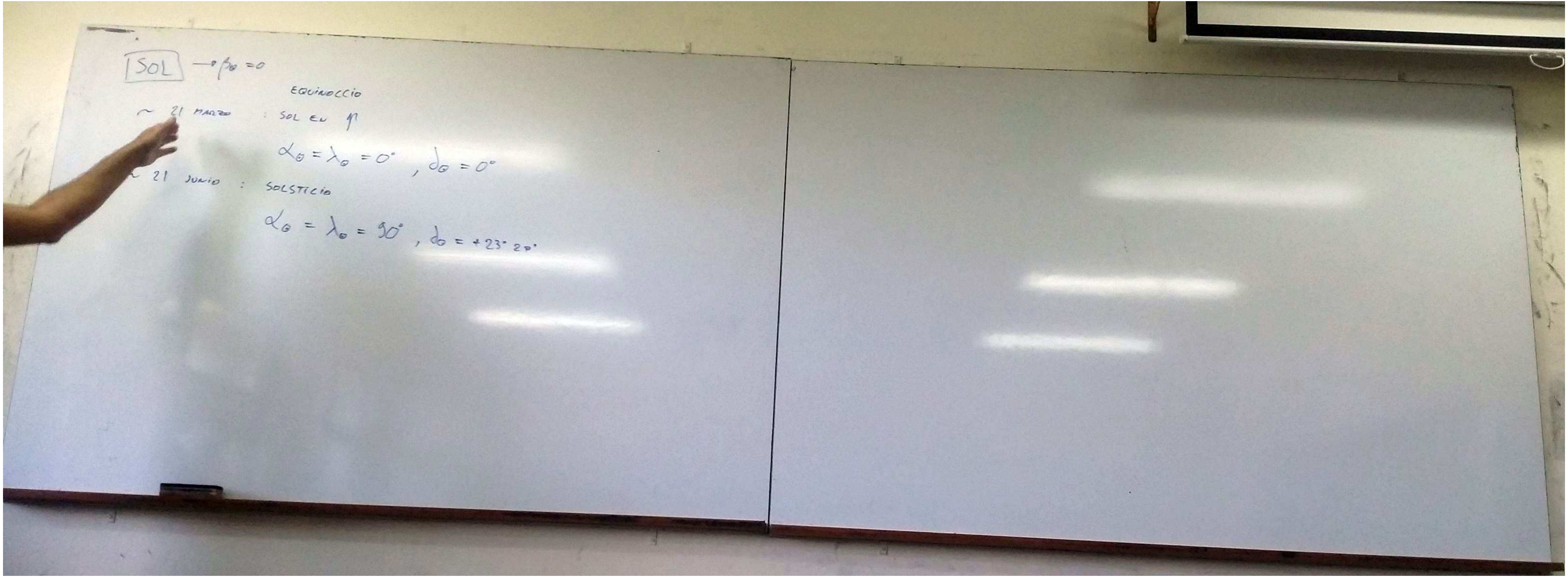
$\lambda_M \sim -56°$
ANALEMA
6
UY
$\lambda = -45°$
HLU = TU − 3hs
EC. TIEMPO
$H_\odot$
?
HLU = TU − 3hs
RELOJES
T. SOLAR MEDIO GREEN.

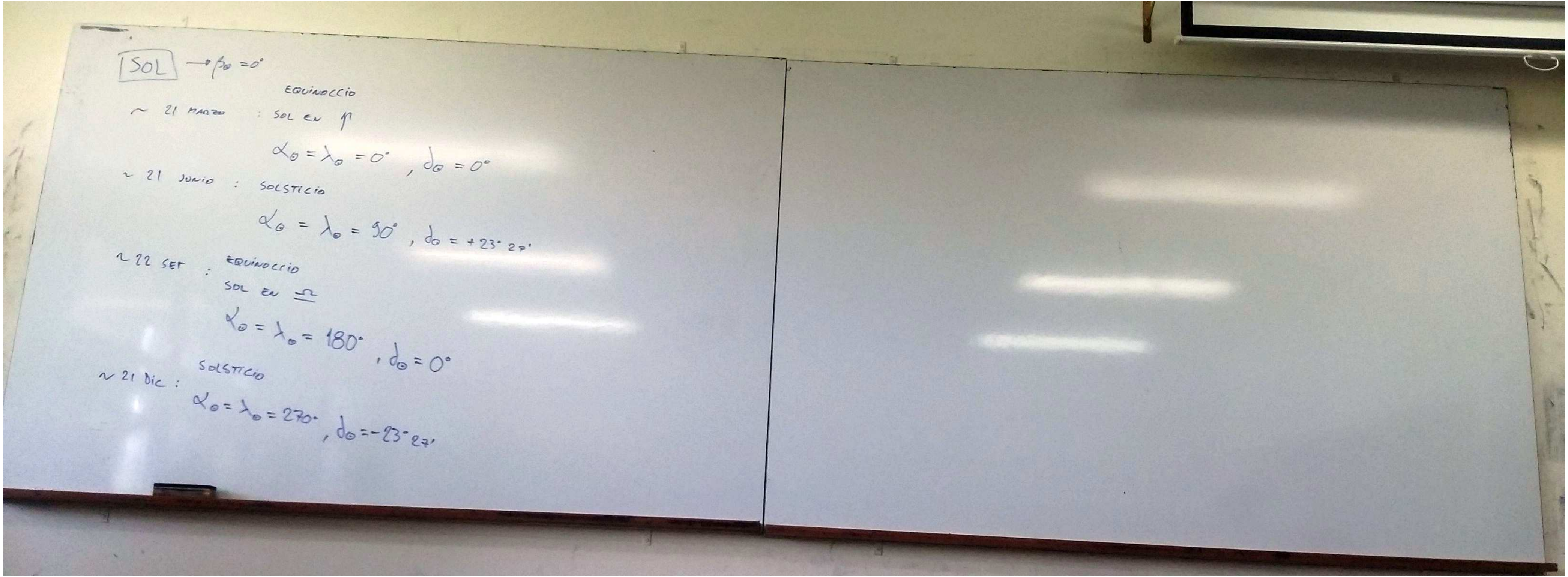


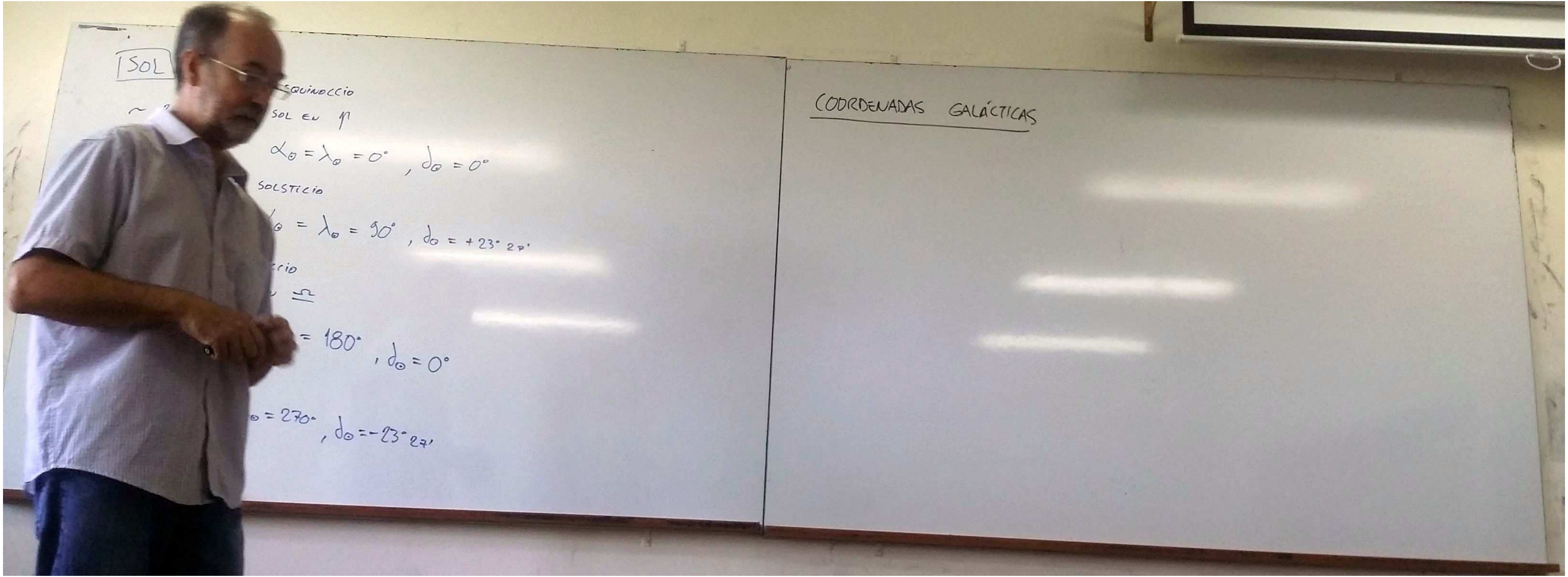
$\lambda_n \sim -56°$
ANALEMA
DECLINACIÓN ☉
+
0
–
0
EC. TIEMPO
⊕
⊖
6
UY
$\lambda = -45°$
HLU = TU − 3^hs
H_0
?
HLU = (TU) − 3^HS
RELOJES
T. SOLAR MEDIO GREEN. = T. SOLAR MEDIO MONTEVIDEO − $\lambda_{MONT.}$
T SOL ☉ MONT − E.T.
⇒ HLU = T SOL ☉ − ET − λ_n − 3^HS = T SOL. ☉ − ET + 44^m
VISIBLE
$\lambda_n = -3^h\, 44^m$

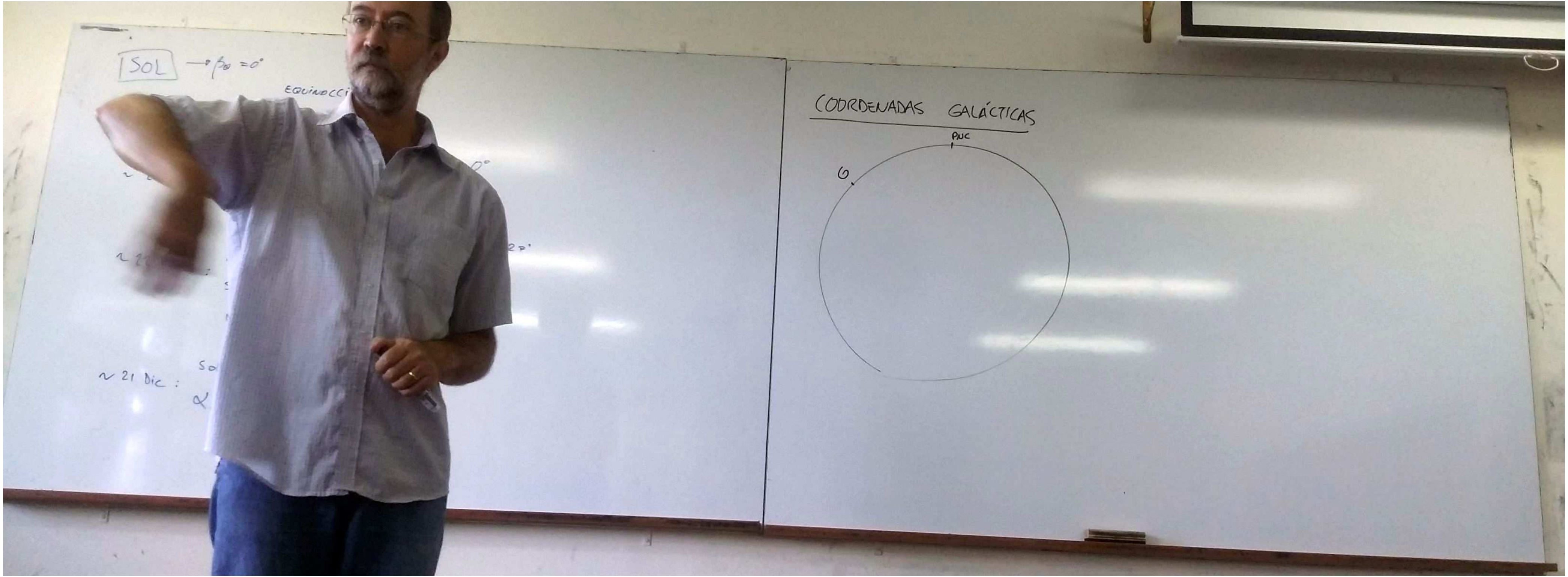

DÍA SOLAR
$\lambda_M \sim -56°$
ANALEMA
6
UY
$\lambda = -45°$
$HLU = TU - 3^{hs}$
$H_\odot$?
$HLU = TU - 3^{hs}$
RELOJES
T. Solar Medio Green. = T. Solar Medio Montevideo $- \lambda_{MONT.}$
TSol ⊙ Mont − E.T.
$\Rightarrow HLU = TSol\odot - ET - \lambda_M - 3^{hs} = TSol\odot - ET + 44^m$
VISIBLE
$\lambda_M = -3^h 44^m$
$HLU = TSol\odot + 44^m - ET$
VISIBLE RELOJ SOLAR
RELOJ

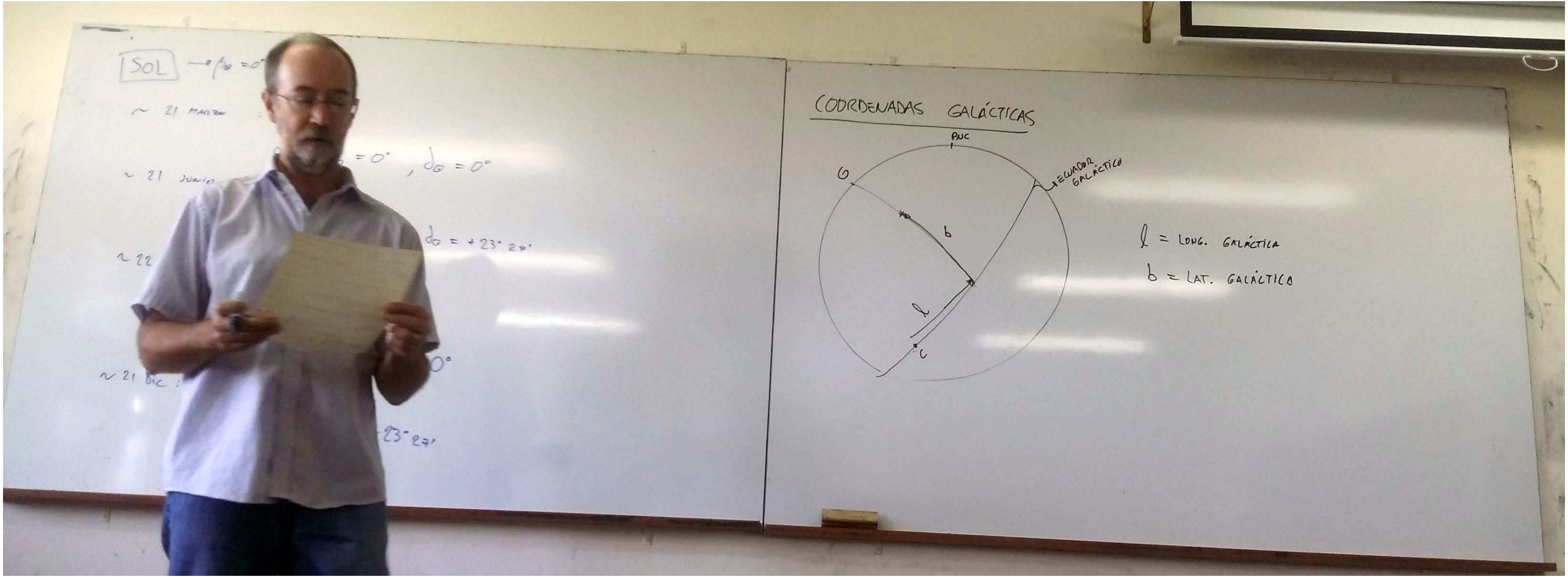

λm ~ -56°
DÍA
: 2 PASAJES CONSECUTIVOS
DE SMF
POR MERIDIANO
0,24 HS SOLARES
: 2 PASAJES DE γ
POR MERIDIANO
0,24 HS SIDEREOS
DÍA SOLAR
MEDIO
HLU = TU - 3HS
RELOJES
T. SOLAR MEDIO GREEN. = T. SOLAR MEDIO MONTEVIDEO - λMONT.
TSOL ⊙ MONT - E.T.
⇒ HLU = TSOL ⊙ - ET - λn - 3HS = TSOL. ⊙ - ET + 44m
VISIBLE
λn = -3h 44m
VISIBLE
RELOJ SOLAR
HLU = TSOL ⊙ + 44m - ET
RELOJ

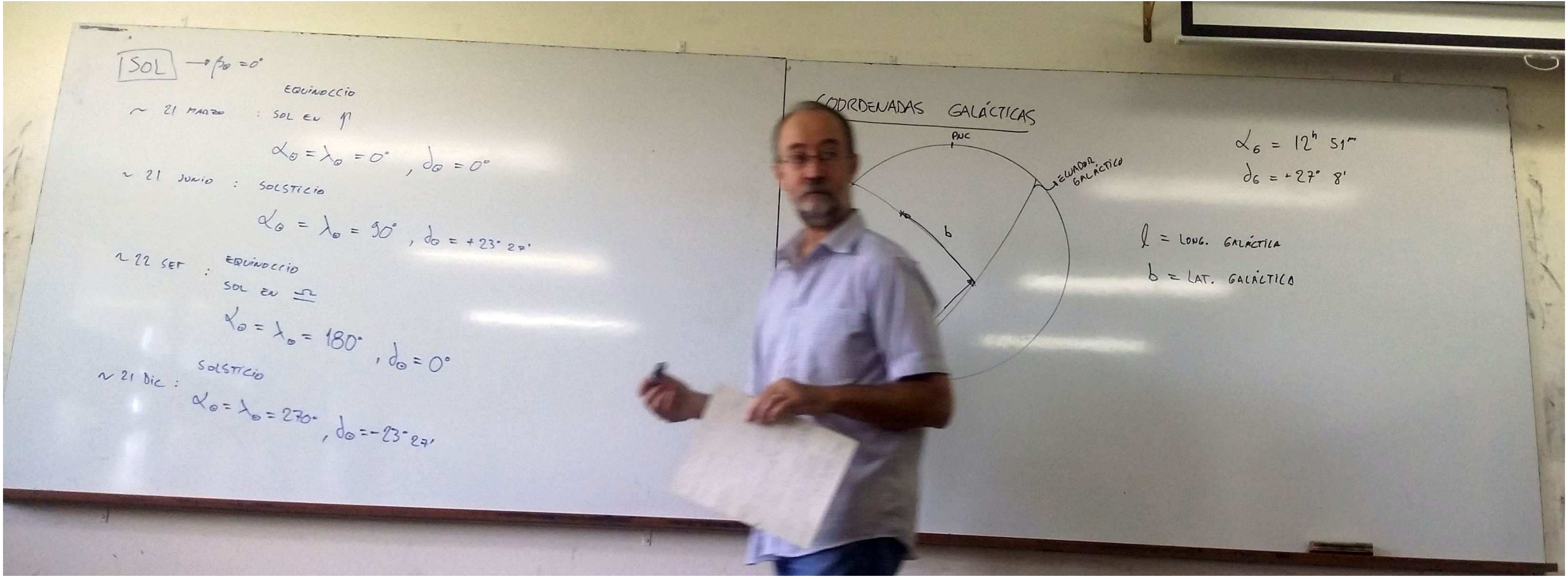

SOL → β☉ = 0
EQUINOCCIO
~ 21 MARZO : SOL EN ♈
α☉ = λ☉ = 0° , δ☉ = 0°
~ 21 JUNIO : SOLSTICIO
α☉ = λ☉ = 90° , δ☉ = +23° 27'

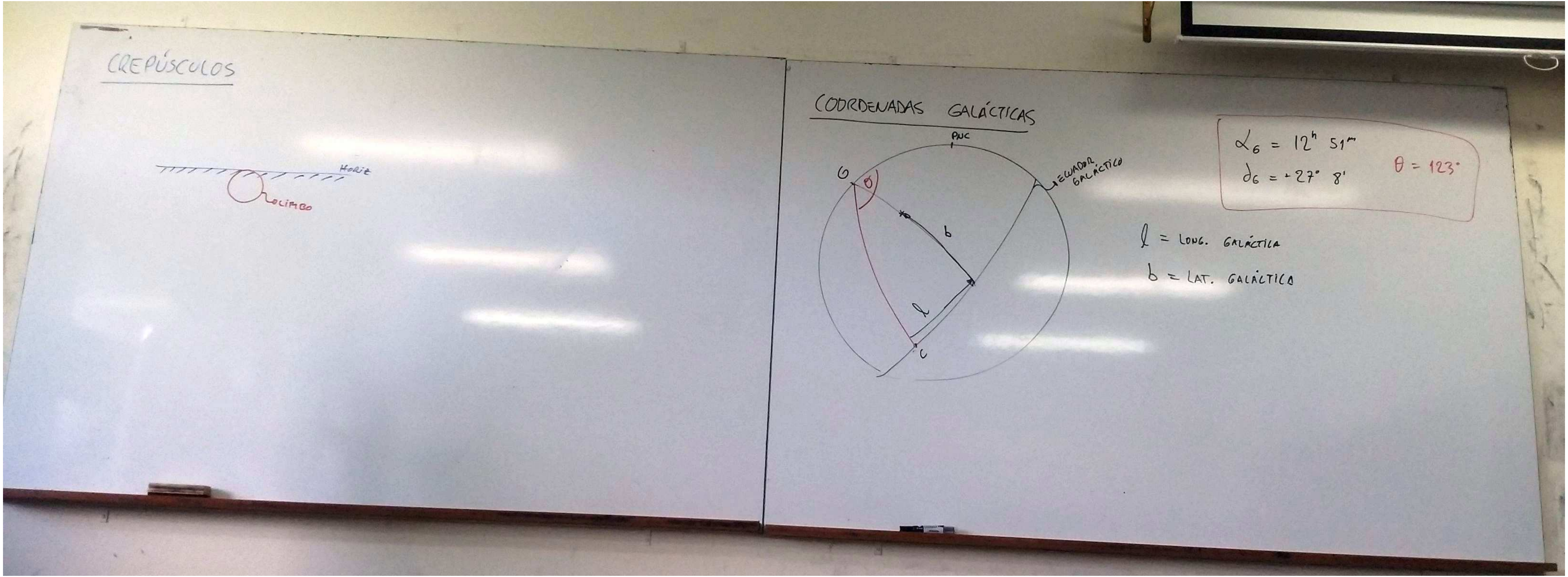

SOL → β☉ = 0°
EQUINOCCIO
~ 21 MARZO : SOL EN ♈
α☉ = λ☉ = 0° , δ☉ = 0°
~ 21 JUNIO : SOLSTICIO
α☉ = λ☉ = 90° , δ☉ = +23° 27'
~ 22 SET : EQUINOCCIO
SOL EN ♎
α☉ = λ☉ = 180° , δ☉ = 0°
SOLSTICIO
~ 21 DIC :
α☉ = λ☉ = 270° , δ☉ = -23° 27'


SOL
SOL EN ♈
α☉ = λ☉ = 0° , δ☉ = 0°
SOLSTICIO
= λ☉ = 90° , δ☉ = +23° 27'
♎
= 180° , δ☉ = 0°
= 270° , δ☉ = −23° 27'
COORDENADAS GALÁCTICAS

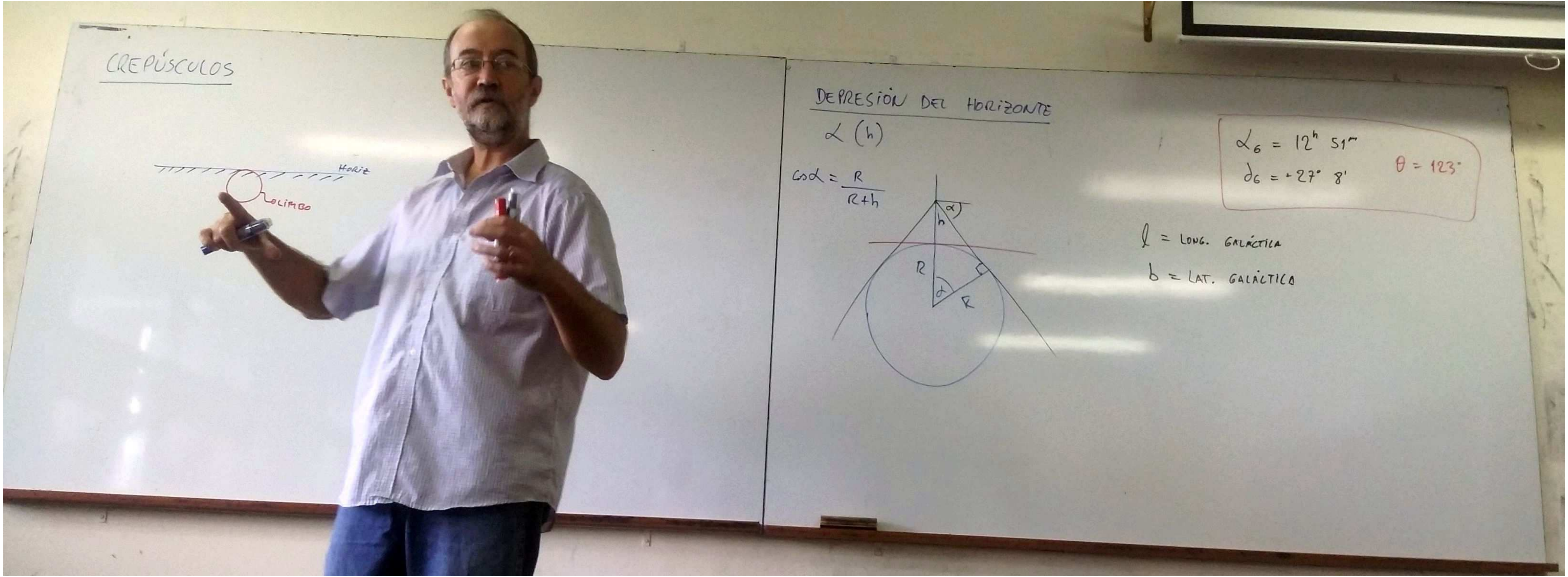

SOL
COORDENADAS GALÁCTICAS
PNC
G
~ 21 Dic :

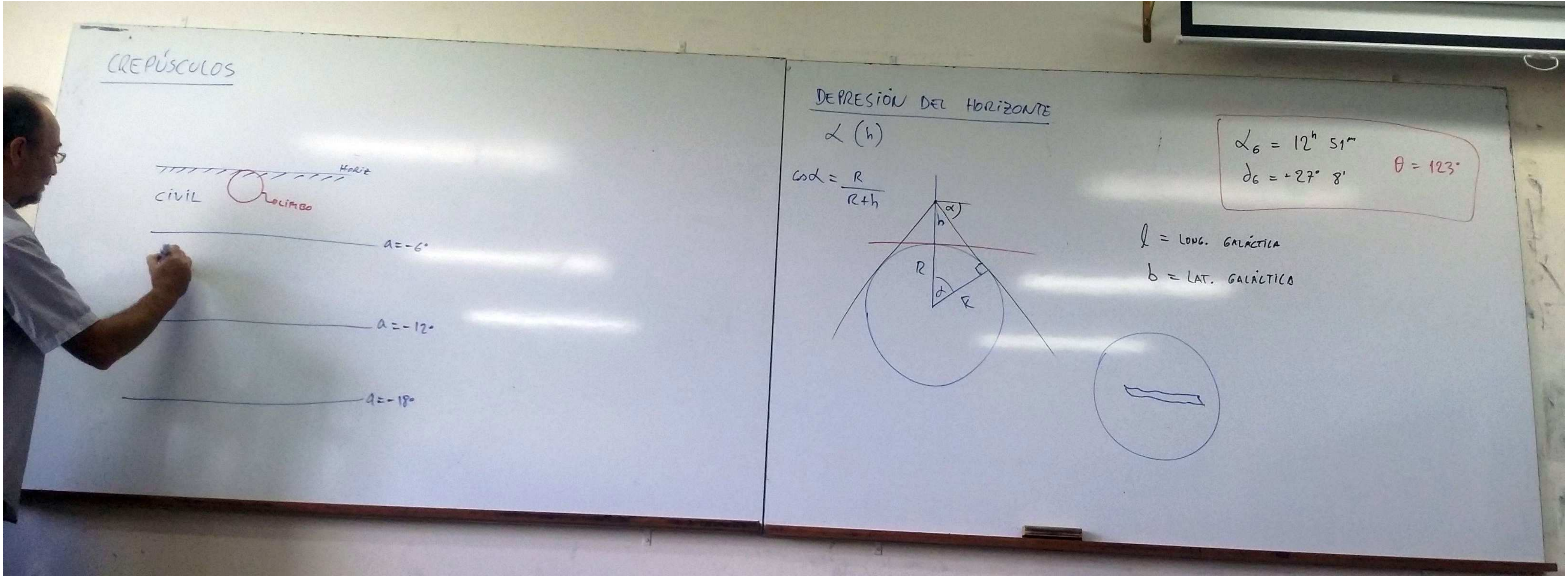

SOL
COORDENADAS GALÁCTICAS
PNC
G
ECUADOR GALÁCTICO
b
l
C
l = LONG. GALÁCTICA
b = LAT. GALÁCTICA

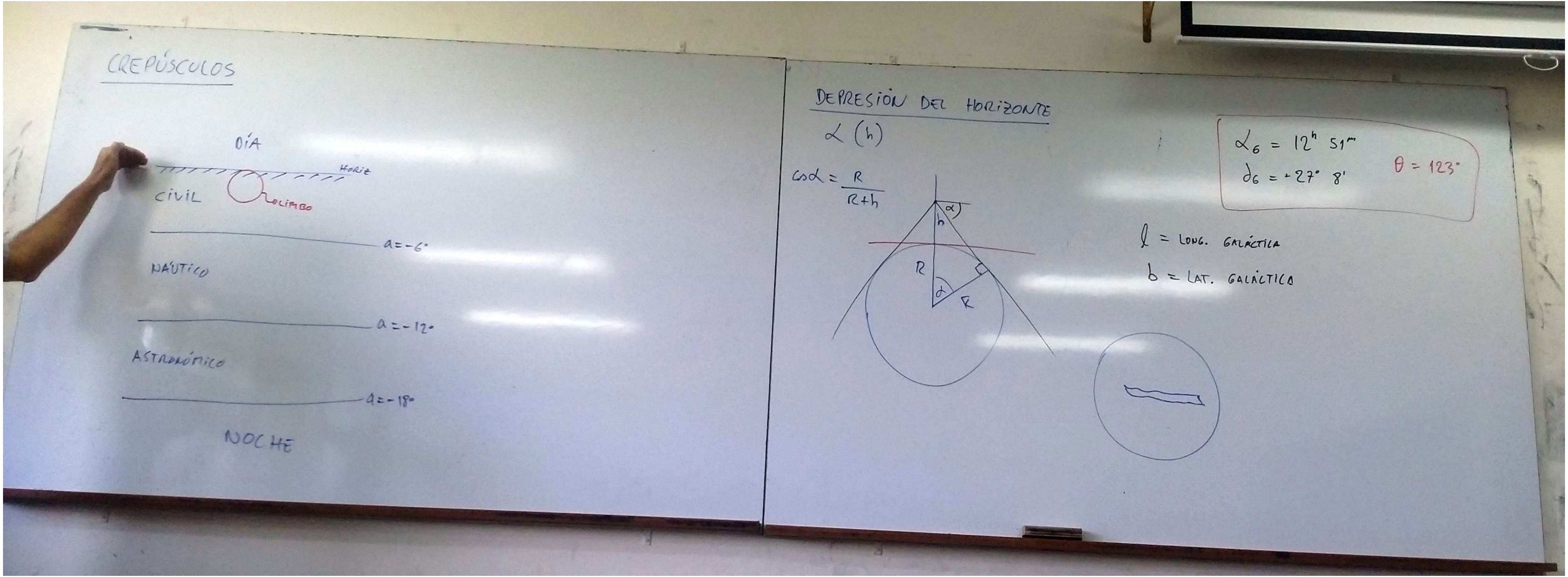

SOL → $\beta_\odot = 0°$
EQUINOCCIO
~ 21 MARZO : SOL EN ♈
$\alpha_\odot = \lambda_\odot = 0°$, $\delta_\odot = 0°$
~ 21 JUNIO : SOLSTICIO
$\alpha_\odot = \lambda_\odot = 90°$, $\delta_\odot = +23° 27'$
~ 22 SET : EQUINOCCIO
SOL EN ♎
$\alpha_\odot = \lambda_\odot = 180°$, $\delta_\odot = 0°$
SOLSTICIO
~ 21 DIC : $\alpha_\odot = \lambda_\odot = 270°$, $\delta_\odot = -23° 27'$
COORDENADAS GALÁCTICAS
PNG
ECUADOR GALÁCTICO
b
$\alpha_G = 12^h\ 51^m$
$\delta_G = +27°\ 8'$
l = LONG. GALÁCTICA
b = LAT. GALÁCTICA

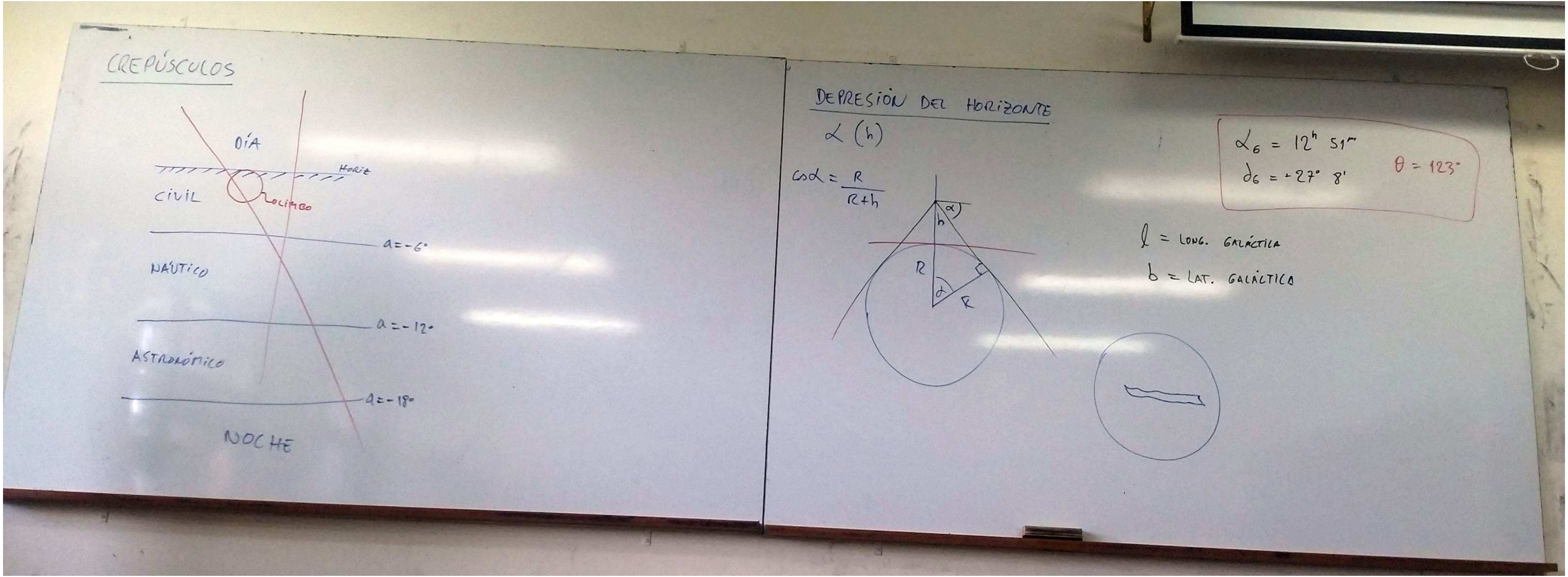

CREPÚSCULOS
Horiz
COORDENADAS GALÁCTICAS
PNC
G
θ
b
l
C
EQUADOR GALÁCTICO
α_G = 12h 51m
δ_G = +27° 8'
θ = 123°
l = LONG. GALÁCTICA
b = LAT. GALÁCTICA

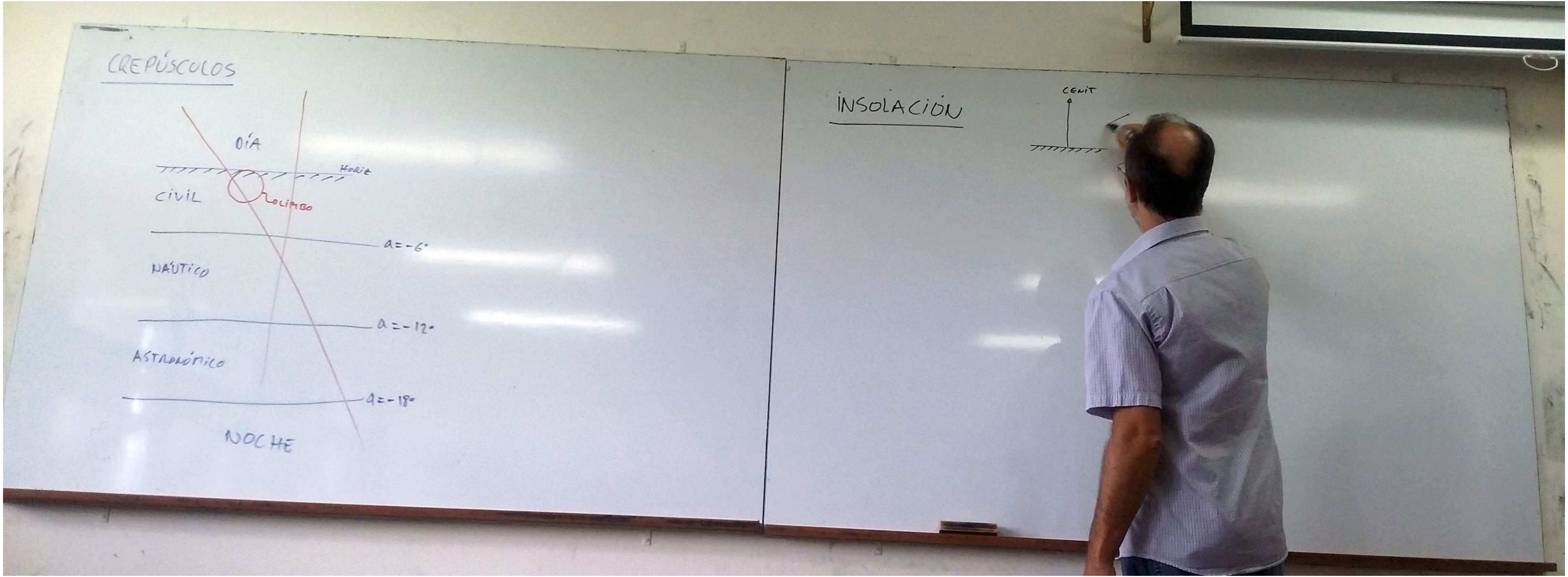

CREPÚSCULOS
HORIZ
LIMBO
DEPRESIÓN DEL HORIZONTE
n
α6 = 12h 51m
δ6 = +27° 8'
θ = 123°
l = LONG. GALÁCTICA
b = LAT. GALÁCTICA

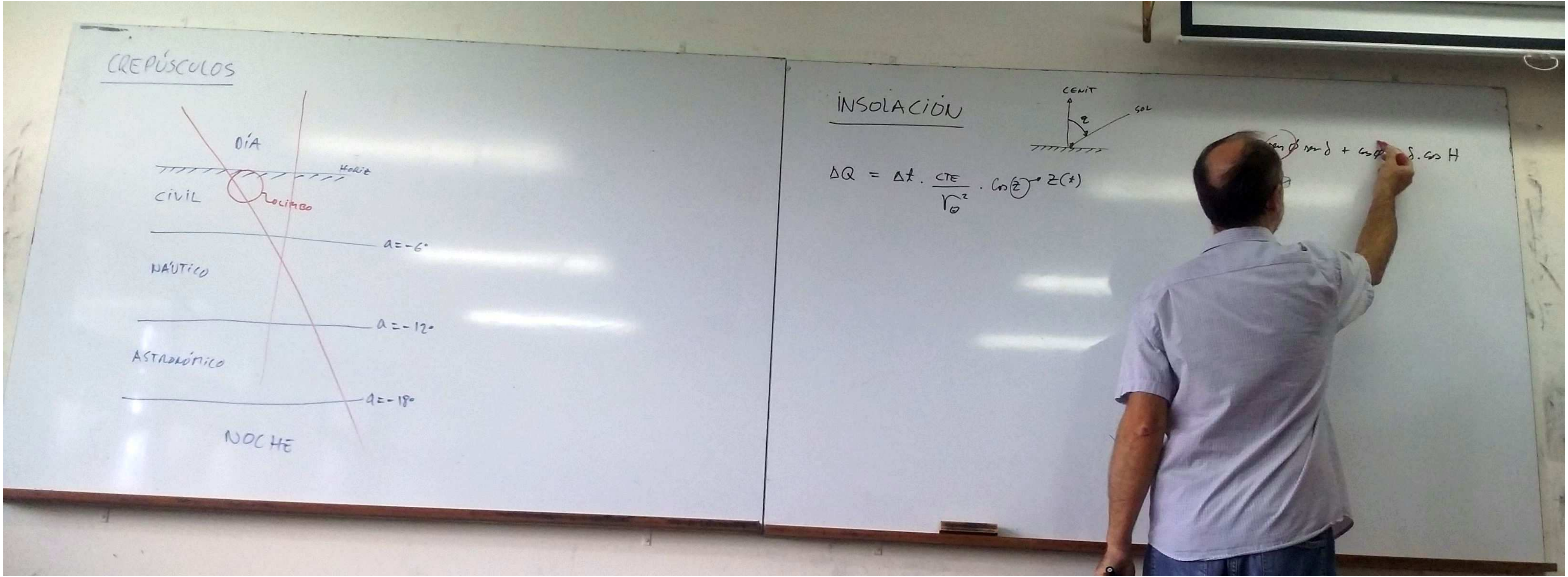

CREPÚSCULOS
HORIZ
LIMBO
DEPRESIÓN DEL HORIZONTE
α (h)
cos α = R / R+h
α
h
R
α
R
α6 = 12h 51m
δ6 = +27° 8'
θ = 123°
l = LONG. GALÁCTICA
b = LAT. GALÁCTICO

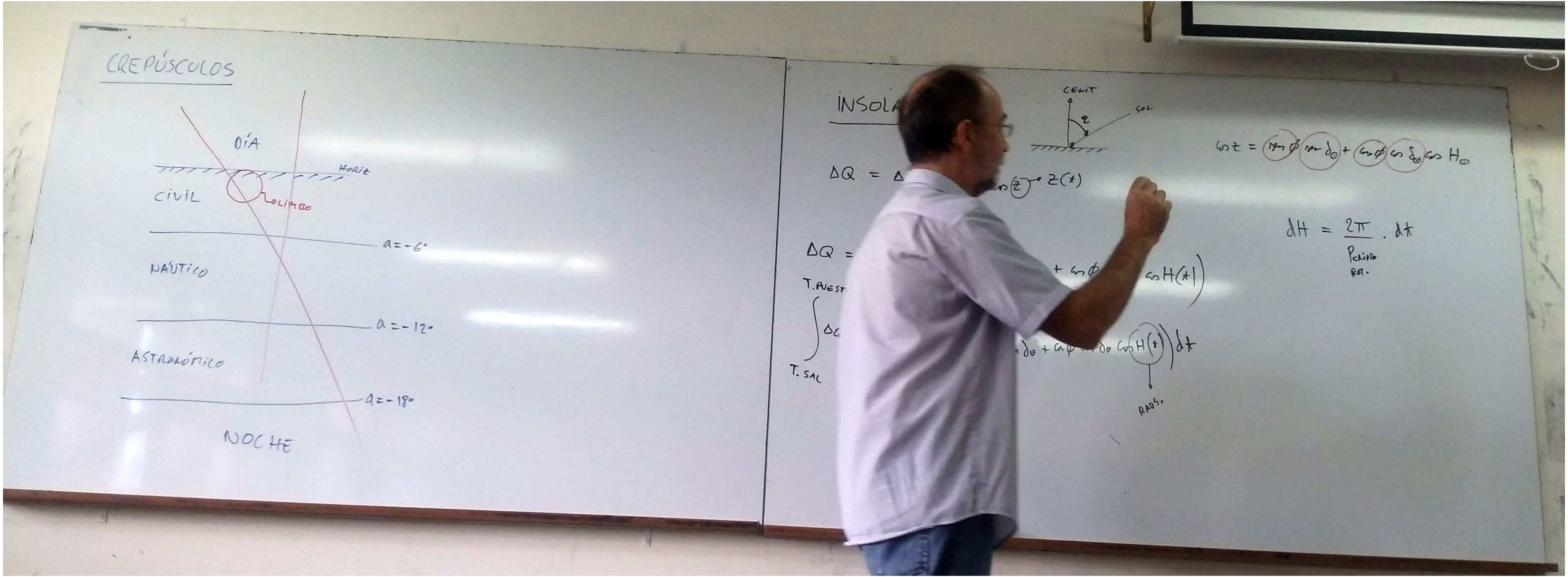

CREPÚSCULOS
HORIZ
CIVIL
LOCIMBO
a=-6°
a=-12°
a=-18°
DEPRESIÓN DEL HORIZONTE
α (h)
cos α = R / (R+h)
α
h
R
α
R
α6 = 12h 51m
δ6 = +27° 8'
θ = 123°
l = LONG. GALÁCTICA
b = LAT. GALÁCTICA

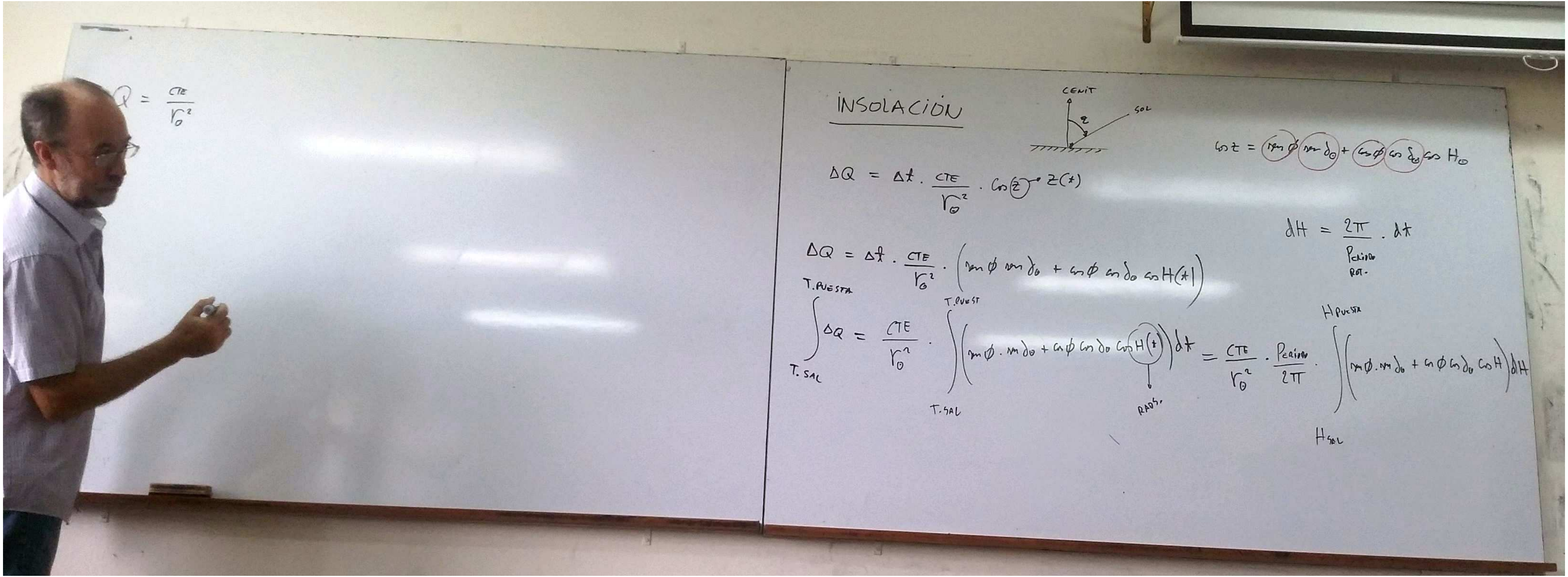

CREPÚSCULOS
DÍA
HORIZ
CIVIL
LOLIMBO
a=-6°
NÁUTICO
a=-12°
ASTRONÓMICO
a=-18°
NOCHE
DEPRESIÓN DEL HORIZONTE
α (h)
cos α = R / (R+h)
α
h
R
α
R
α_G = 12^h 51^m
δ_G = +27° 8'
θ = 123°
l = LONG. GALÁCTICA
b = LAT. GALÁCTICA

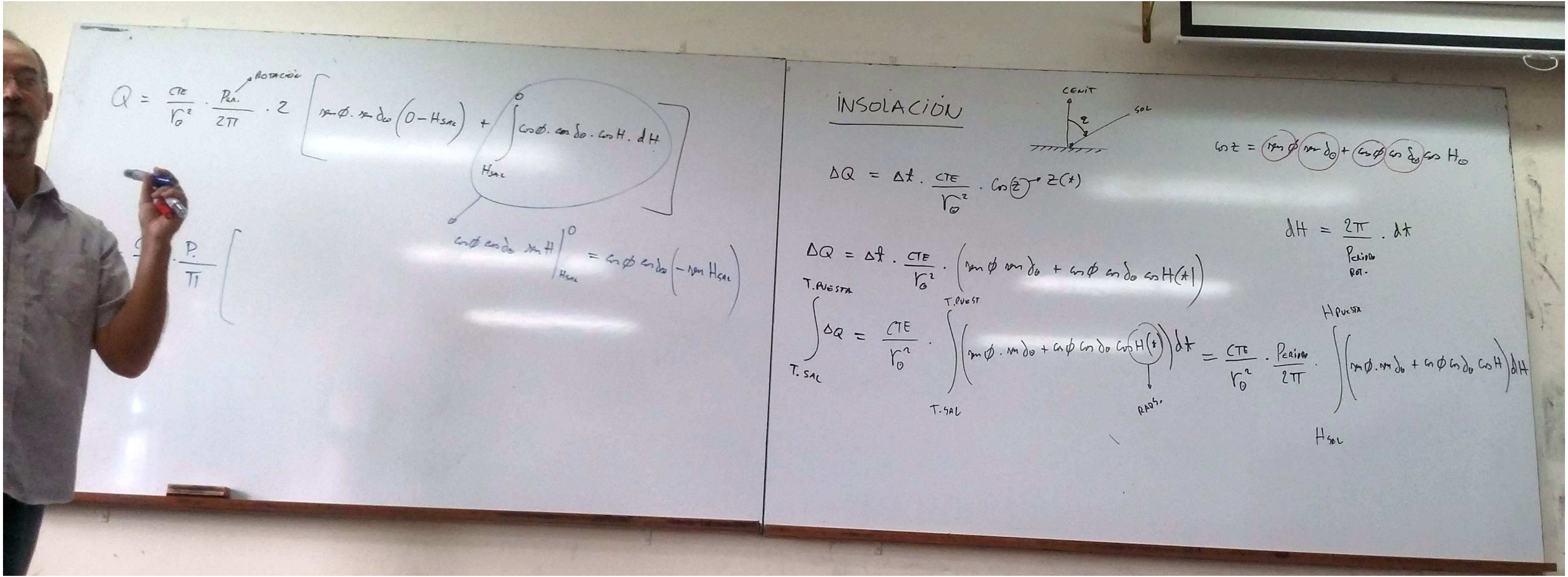

CREPÚSCULOS
DÍA
Horiz
CIVIL
LOLIMBO
a=-6°
NÁUTICO
a=-12°
ASTRONÓMICO
a=-18°
NOCHE
DEPRESIÓN DEL HORIZONTE
α (h)
cos α = R / (R+h)
α
h
R
α
R
α_G = 12^h 51^m
δ_G = +27° 8'
θ = 123°
l = LONG. GALÁCTICA
b = LAT. GALÁCTICA

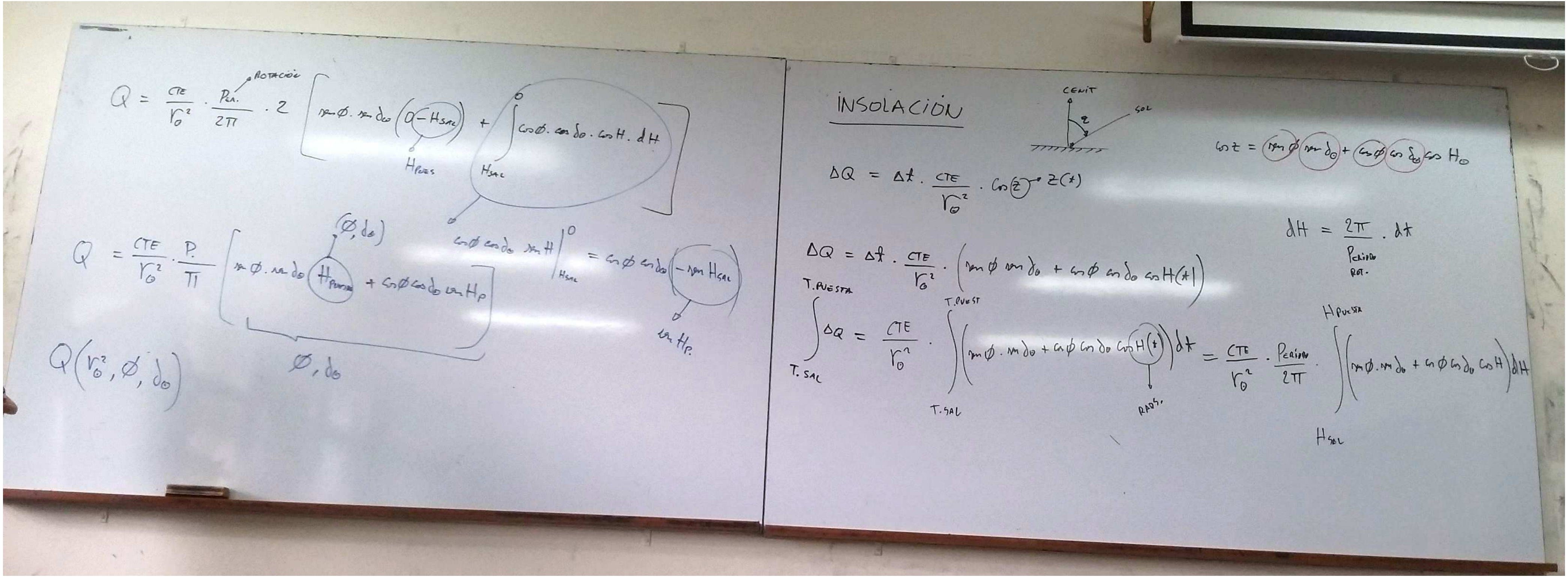

CREPÚSCULOS
DÍA
CIVIL
NAÚTICO
ASTRONÓMICO
NOCHE
a=-6°
a=-12°
a=-18°
INSOLACIÓN
CENIT

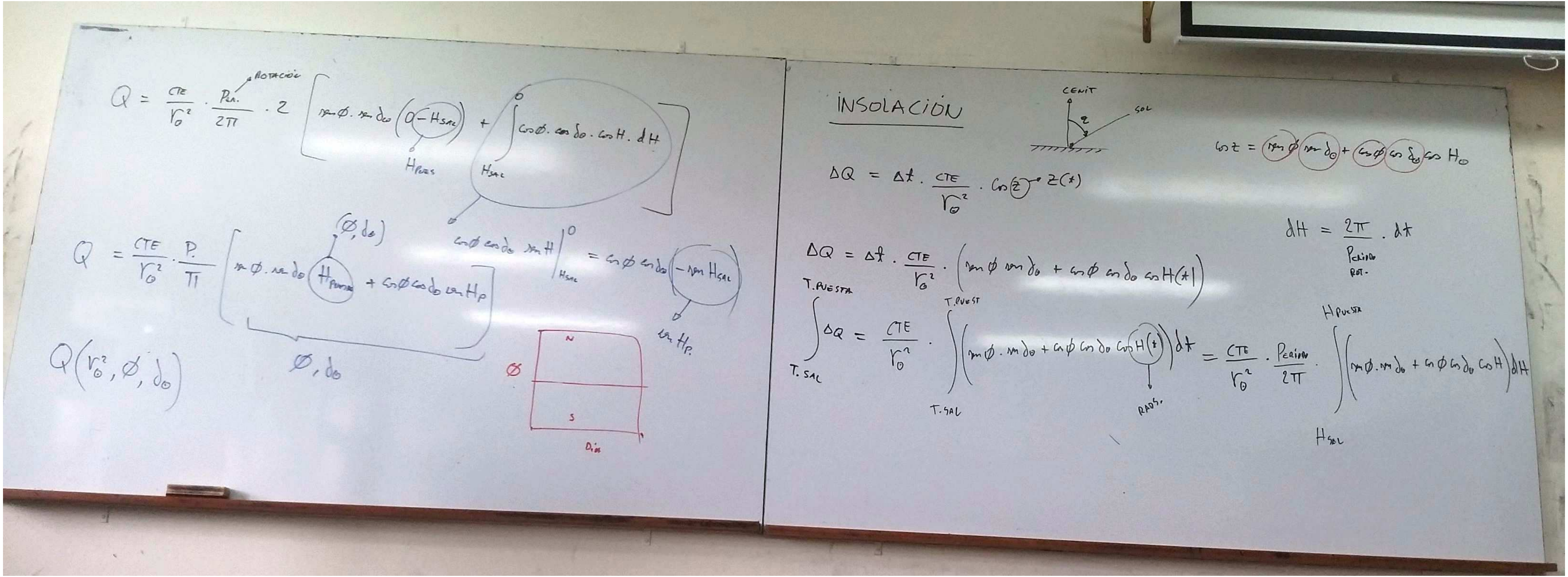

CREPÚSCULOS
DÍA
CIVIL
NÁUTICO
ASTRONÓMICO
NOCHE
a=-6°
a=-12°
a=-18°
INSOLACIÓN
CENIT
SOL
ΔQ = Δt . CTE / r² . cos(z)
z(t)

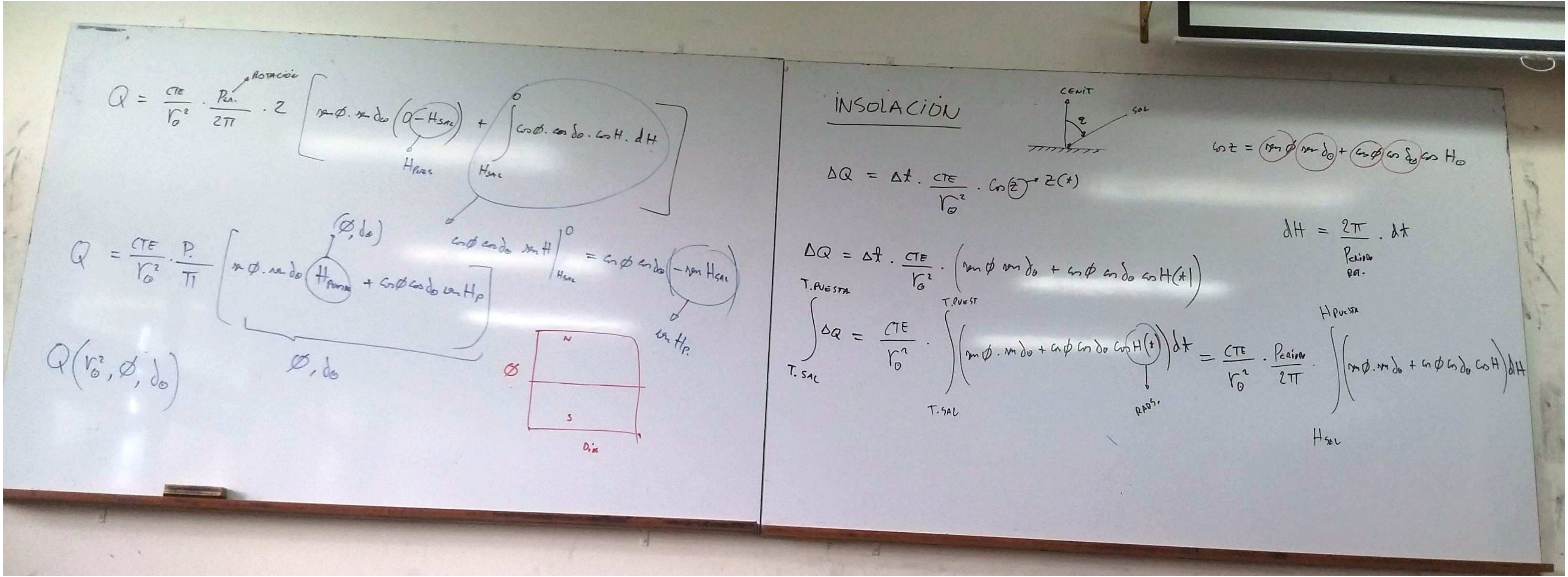

CREPÚSCULOS
DÍA
HORIZ
CIVIL
LOCIMBO
a=-6°
NÁUTICO
a=-12°
ASTRONÓMICO
a=-18°
NOCHE
INSOLA
CENIT
SOL
ΔQ
ΔQ =
T. PUEST
T. SAL
RADS.
dH = 2π / Periodo Rot. . dt


INSOLACIÓN
CENIT
SOL
z
ΔQ = Δt . CTE / r⊙² . cos(z) → z(t)
cos z = sen φ sen δ⊙ + cos φ cos δ⊙ cos H⊙
ΔQ = Δt . CTE / r⊙² . (sen φ sen δ⊙ + cos φ cos δ⊙ cos H(t))
dH = 2π / Periodo rot. . dt
T. PUESTA
T. SAL
∫ ΔQ = CTE / r⊙² . ∫ (sen φ . sen δ⊙ + cos φ cos δ⊙ cos H(t)) dt = CTE / r⊙² . Periodo / 2π . ∫ (sen φ . sen δ⊙ + cos φ cos δ⊙ cos H) dH
RADS.
H PUESTA
H SAL

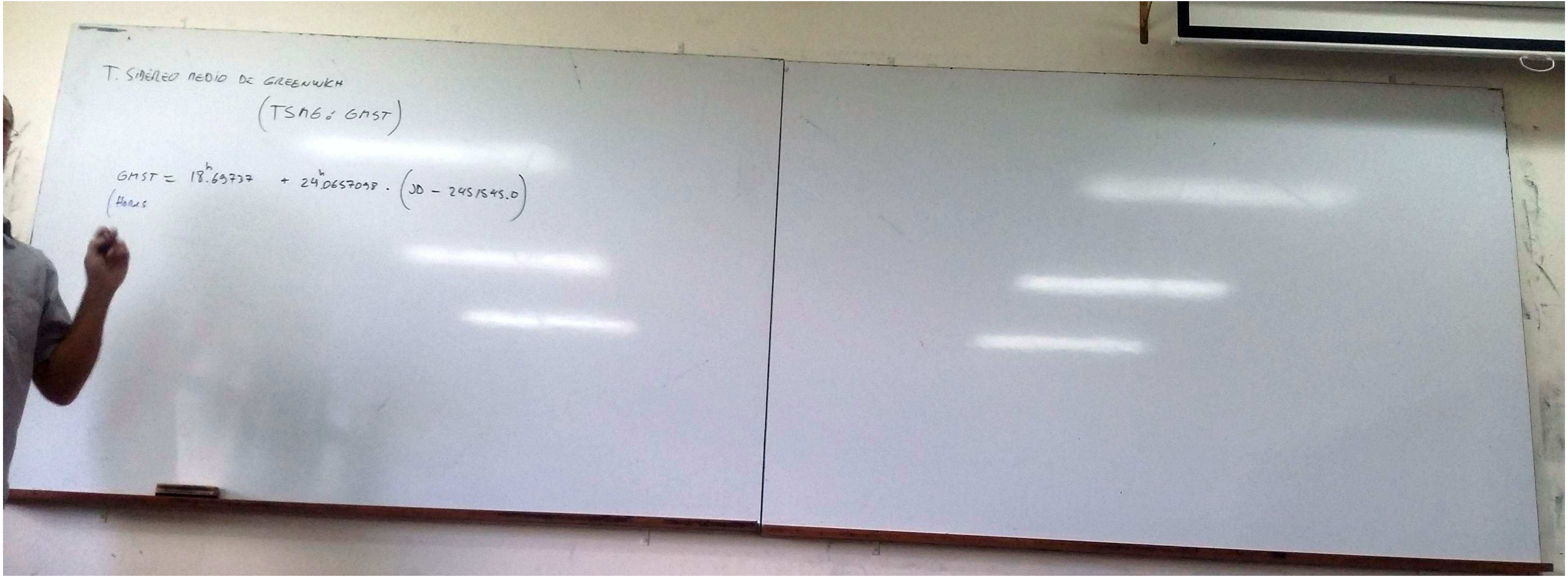

ROTACIÓN
INSOLACIÓN
CENIT
SOL
T. PUESTA
T. SAL
RAD/S
H PUESTA
H SAL
PERIODO ROT.


INSOLACIÓN
CENIT
SOL
z
ROTACIÓN
HPUES
HSAL
Q(r⊙², ϕ, δ⊙)
ϕ, δ⊙
ΔQ = Δt · CTE/r⊙² · cos(z) → z(t)
cos z = sen ϕ sen δ⊙ + cos ϕ cos δ⊙ cos H⊙
dH = 2π/PERIODO ROT. · dt
T.PUESTA
T.SAL
RADS.
HPUESTA
HSAL

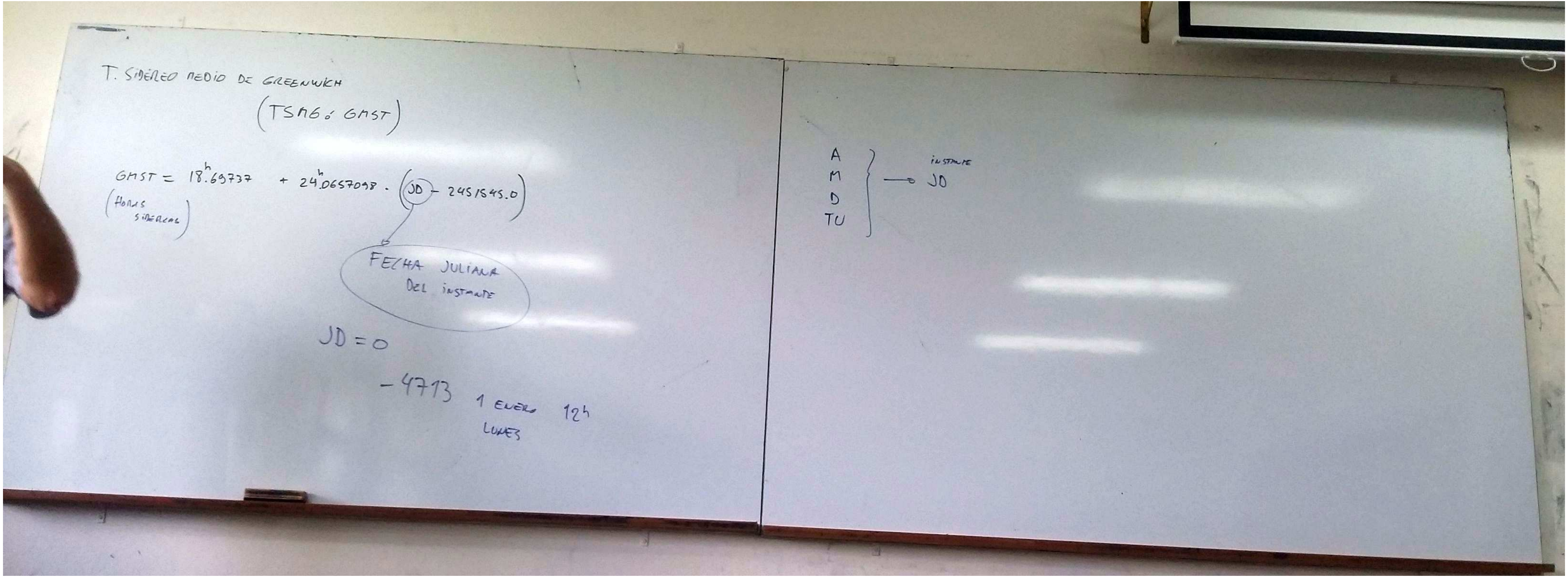

ROTACIÓN
INSOLACIÓN
CENIT
SOL
z
N
S
Días
T. PUESTA
T. SAL
H PUESTA
H SAL
RADS.


ROTACIÓN
Hsal
INSOLACIÓN
CENIT
SOL
T.PUESTA
T.SAL
RADS.
H PUESTA
N
S
Ø
Día

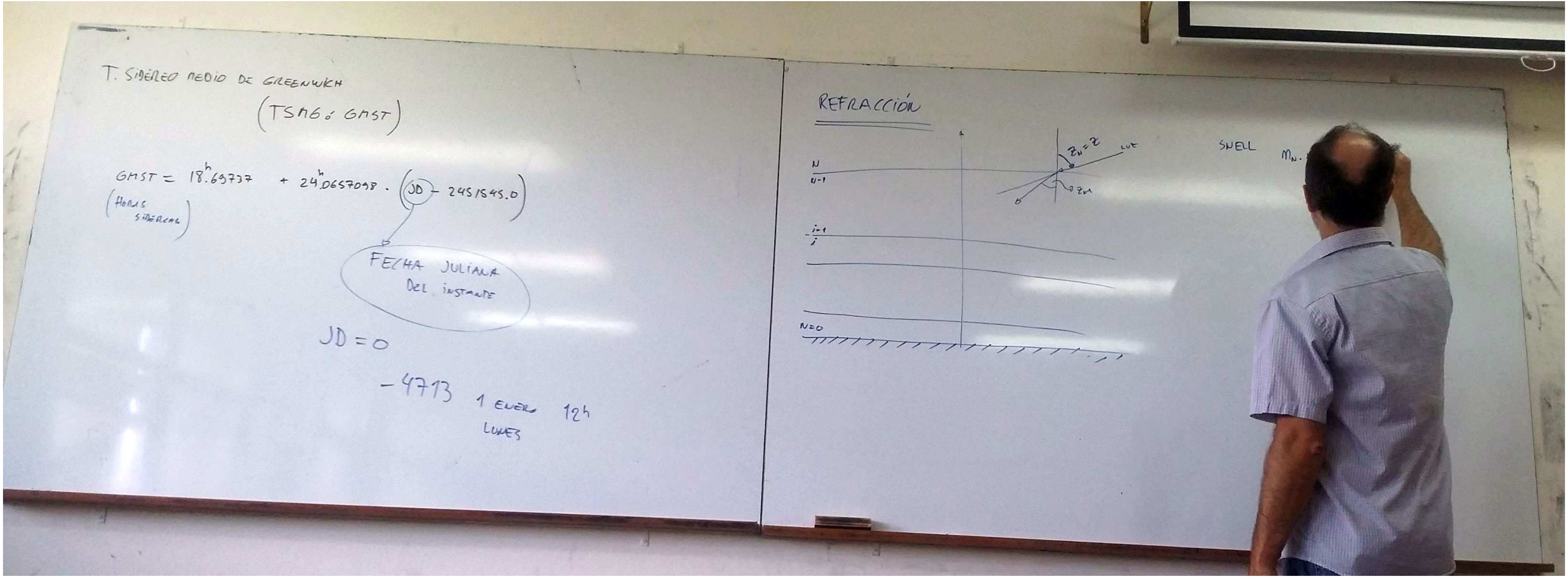

T. SIDÉREO MEDIO DE GREENWICH
(TSMG ó GMST)
GMST = 18.69

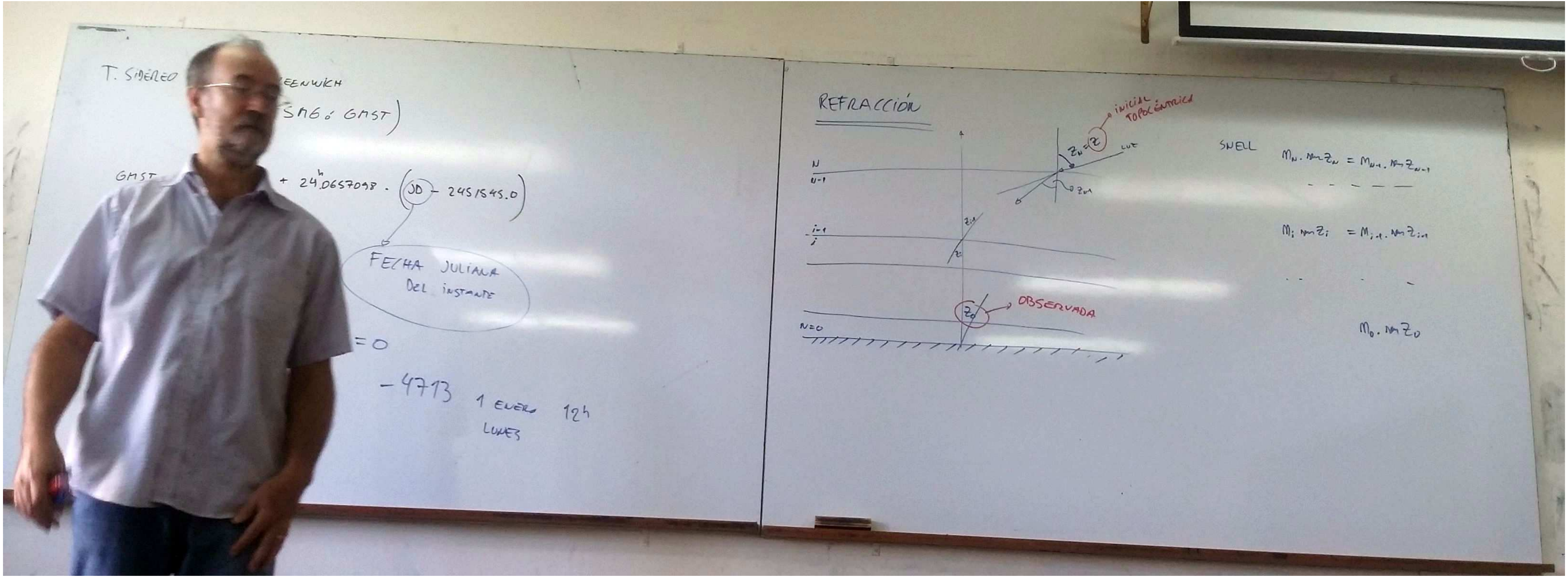

T. SIDÉREO MEDIO DE GREENWICH
(TSMG ó GMST)
GMST = 18.h69737 + 24.h0657098 · (JD − 2451545.0)
(Horas


T. SIDÉREO MEDIO DE GREENWICH
(TSMG ó GMST)
GMST = 18h.69737 + 24h.0657098 · (JD - 2451545.0)
(Horas siderеas)
FECHA JULIANA
DEL instante

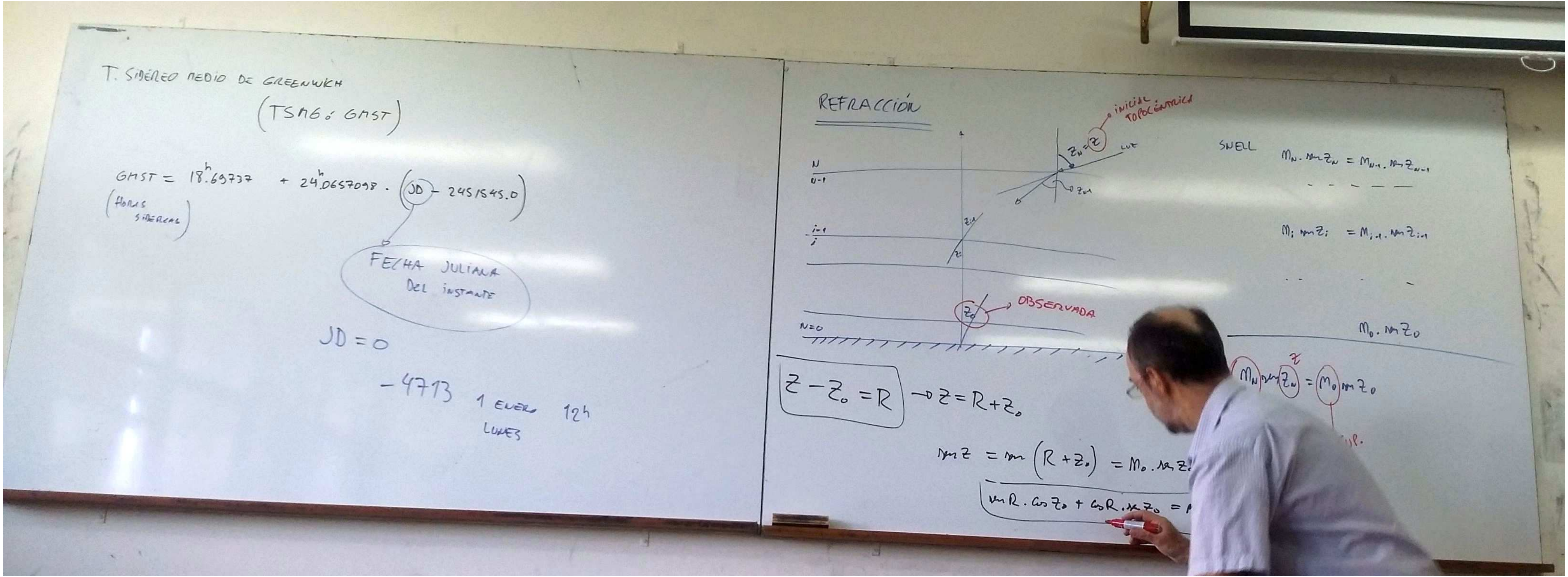

T. SIDEREO MEDIO DE GREENWICH
(TSMG ó GMST)
GMST = 18h.69737 + 24h.0657098 · (JD - 2451545.0)
(Horas sidereas)
FECHA JULIANA DEL INSTANTE
JD = 0
-4713
1 ENERO 12h
LUNES
A
M
D
TU
instante
JD

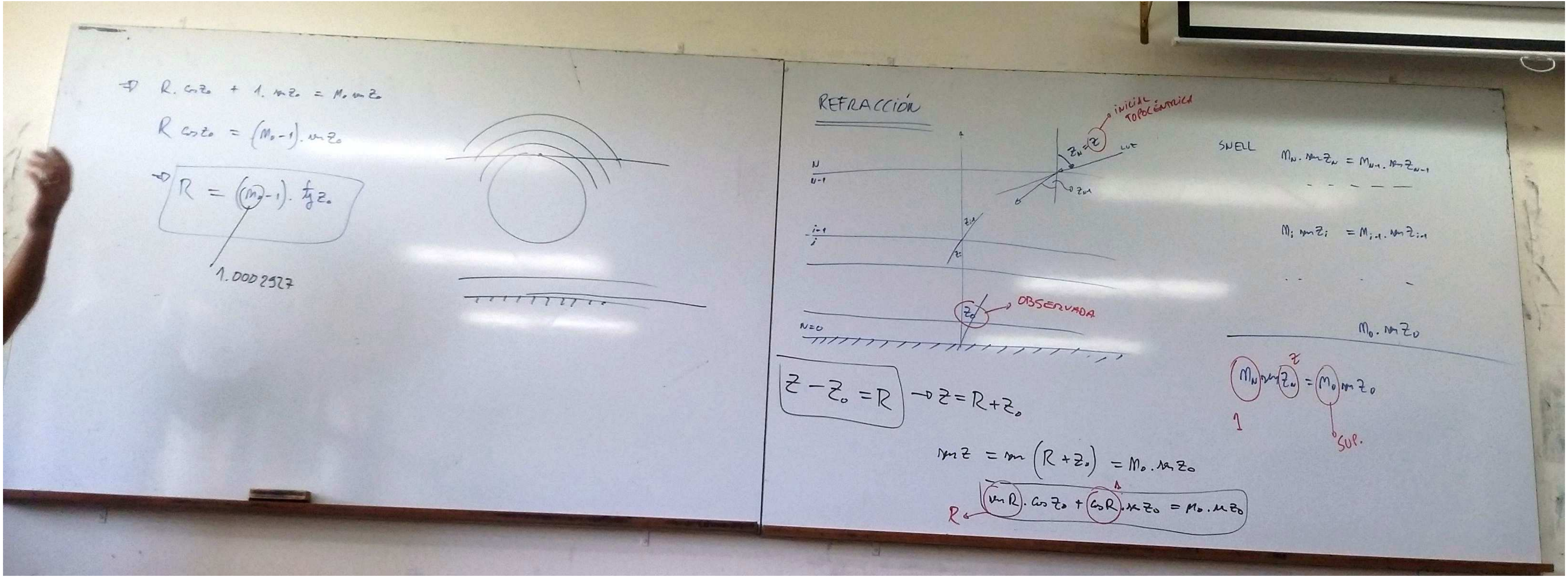

T. SIDÉREO MEDIO DE GREENWICH
(TSMG ó GMST)
GMST = 18h.69737 + 24h.0657098 · (JD
(Horas siderales)
FECHA JULIANA DEL INSTANTE
JD = 0
-4713
REFRACCIÓN


T. SIDÉREO MEDIO DE GREENWICH
(TSMG ó GMST)
GMST = 18h.69737 + 24h.0657098 · (JD − 2451545.0)
(Horas sidéreas)
FECHA JULIANA DEL INSTANTE
JD = 0
−4713
1 ENERO 12h
LUNES
REFRACCIÓN
N
N-1
i-1
i
N=0
SNELL

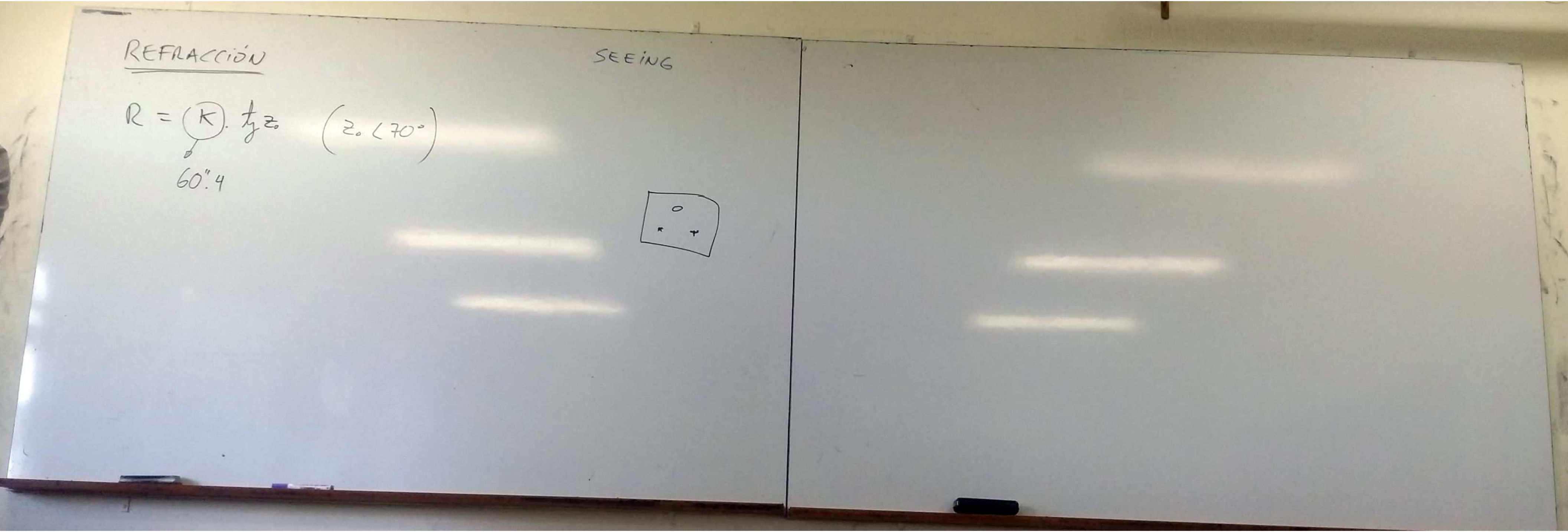


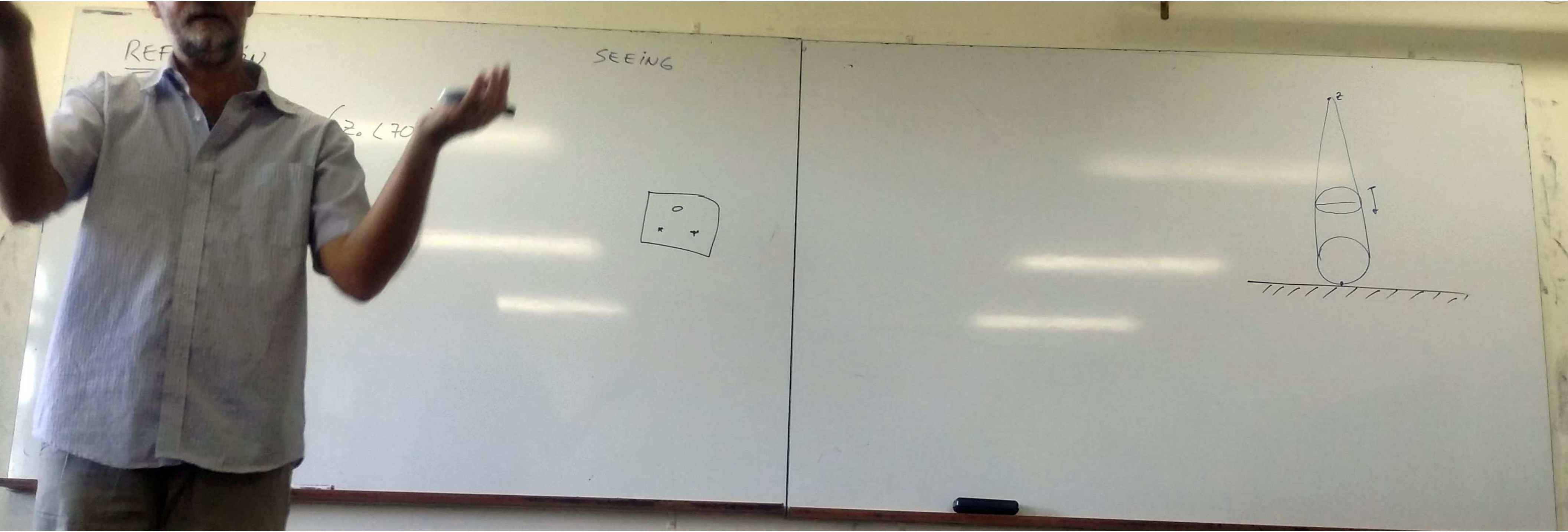
T. SIDEREO
SMG ó GMST
GMST
+ 24h.0657098 · (JD − 2451545.0)
FECHA JULIANA DEL INSTANTE
= 0
−4713
1 ENERO 12h
LUNES
REFRACCIÓN
INICIAL TOPOCÉNTRICA
OBSERVADA
SNELL


T. SIDÉREO MEDIO DE GREENWICH
(TSMG ó GMST)
GMST = 18h.69737 + 24h.0657098 · (JD − 2451545.0)
(HORAS SIDERALES)
FECHA JULIANA DEL INSTANTE
JD = 0
−4713
1 ENERO 12h
LUNES
REFRACCIÓN
INICIAL TOPOCÉNTRICA
OBSERVADA
SNELL
Z − Z0 = R
→ Z = R + Z0

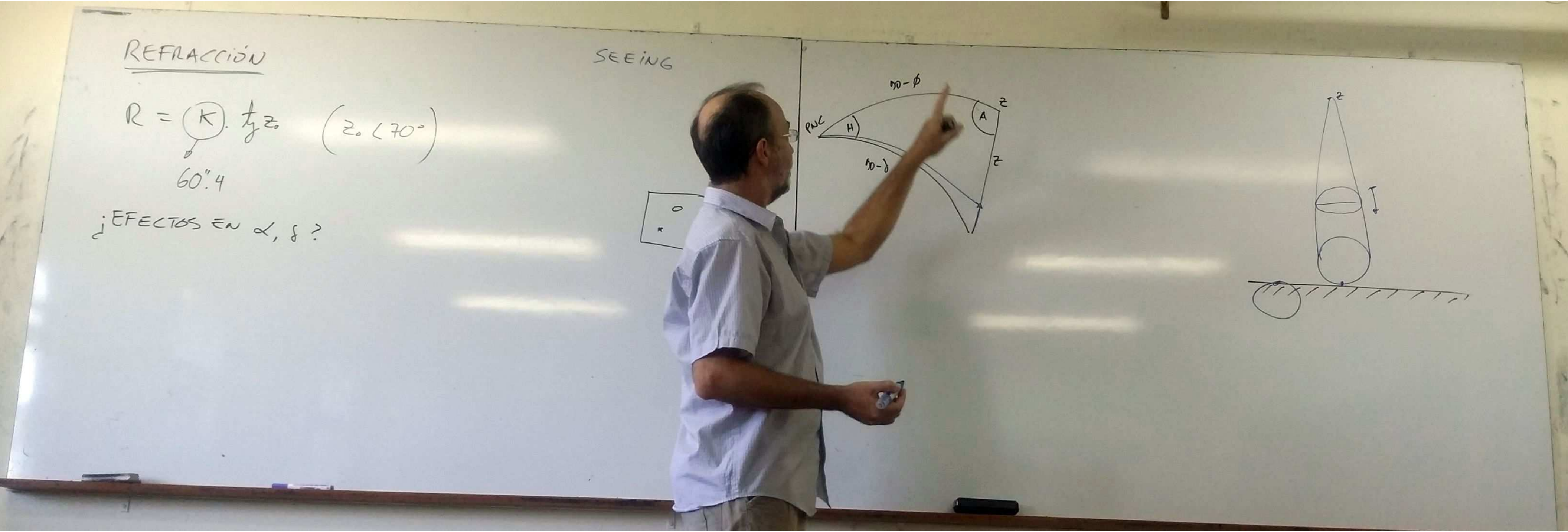

R . cos Z₀ + 1 . sen Z₀ = M₀ sen Z₀
R cos Z₀ = (M₀ - 1) . sen Z₀
R = (M₀ - 1) . tg Z₀
1.0002927
REFRACCIÓN
INICIAL TOPOCÉNTRICA
OBSERVADA
SNELL
Z - Z₀ = R
Z = R + Z₀
SUP.

R. cos z₀ + 1. sen z₀ = μ₀ sen z₀
R cos z₀ = (μ₀ − 1). sen z₀
R = (μ₀ − 1). tg z₀
RADIANES
1.0002927
R = (K). tg z₀
60".4
CONSTANTE DE REFRACCIÓN

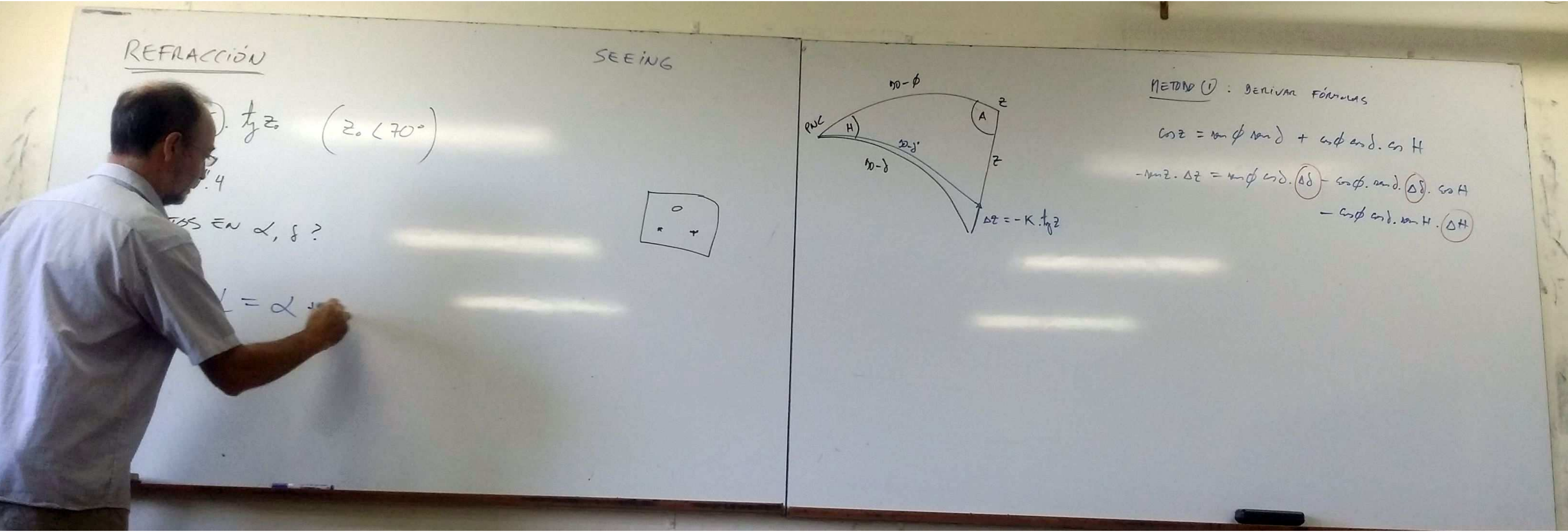

REFRACCIÓN
R = K . tg z₀
(z₀ < 70°)
60".4
SEEING


SEEING

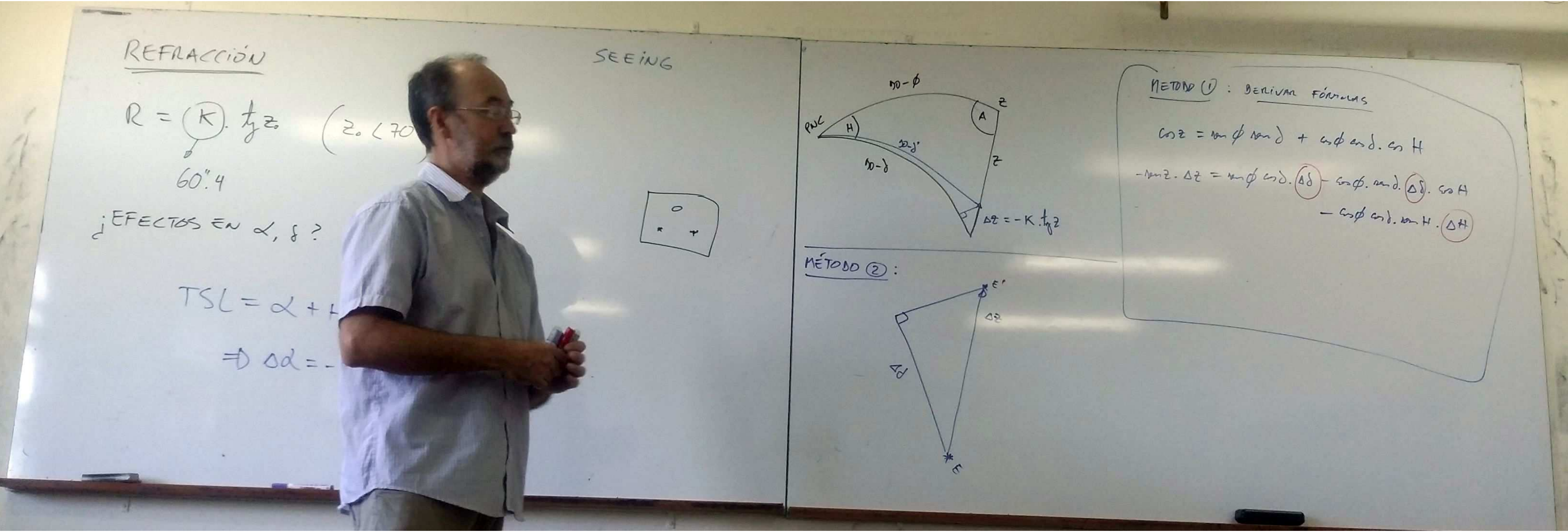
Astronomia Fundamental 2017

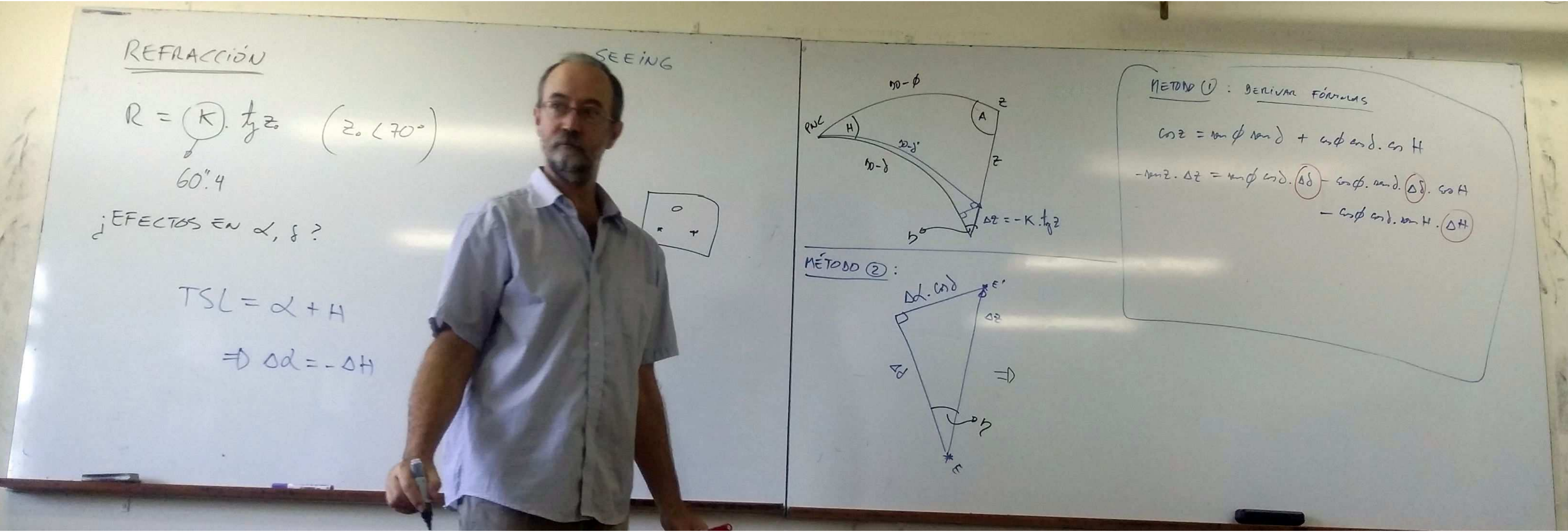


Astronomia Fundamental 2017

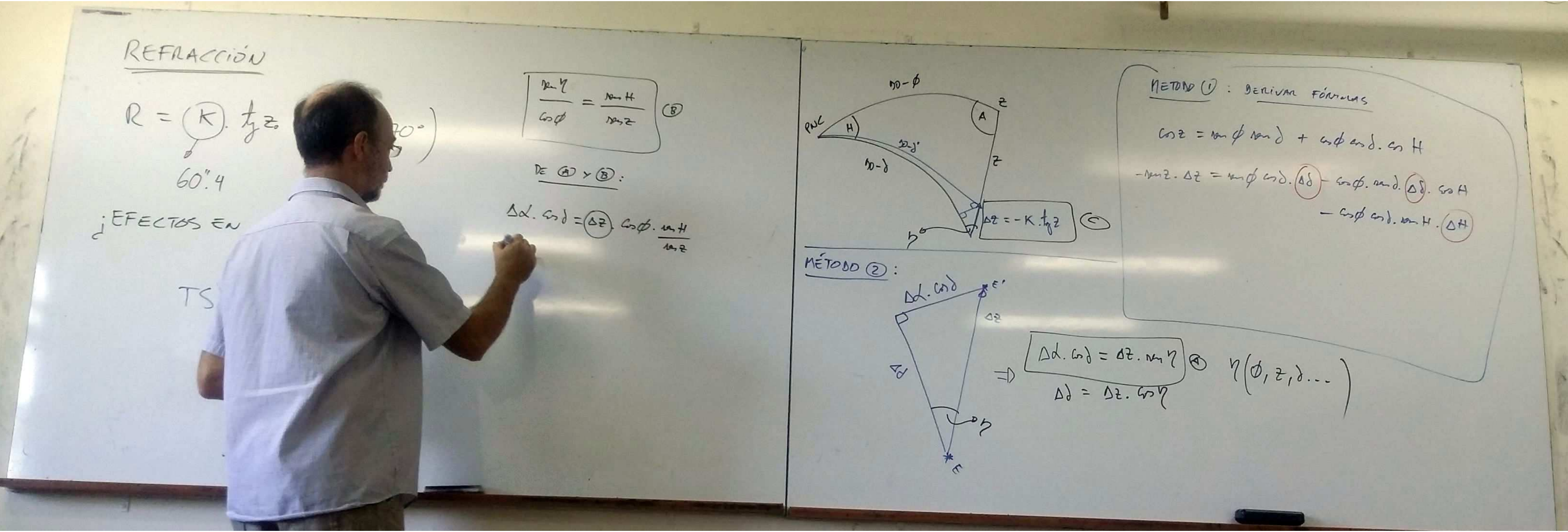


Astronomia Fundamental 2017

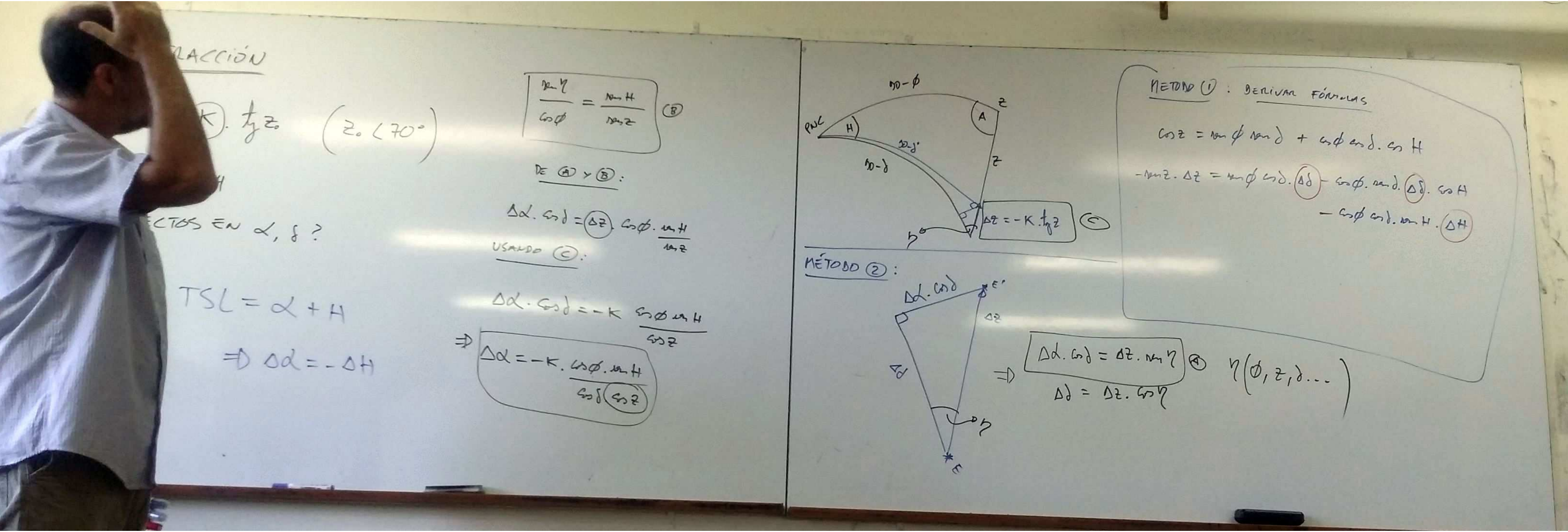


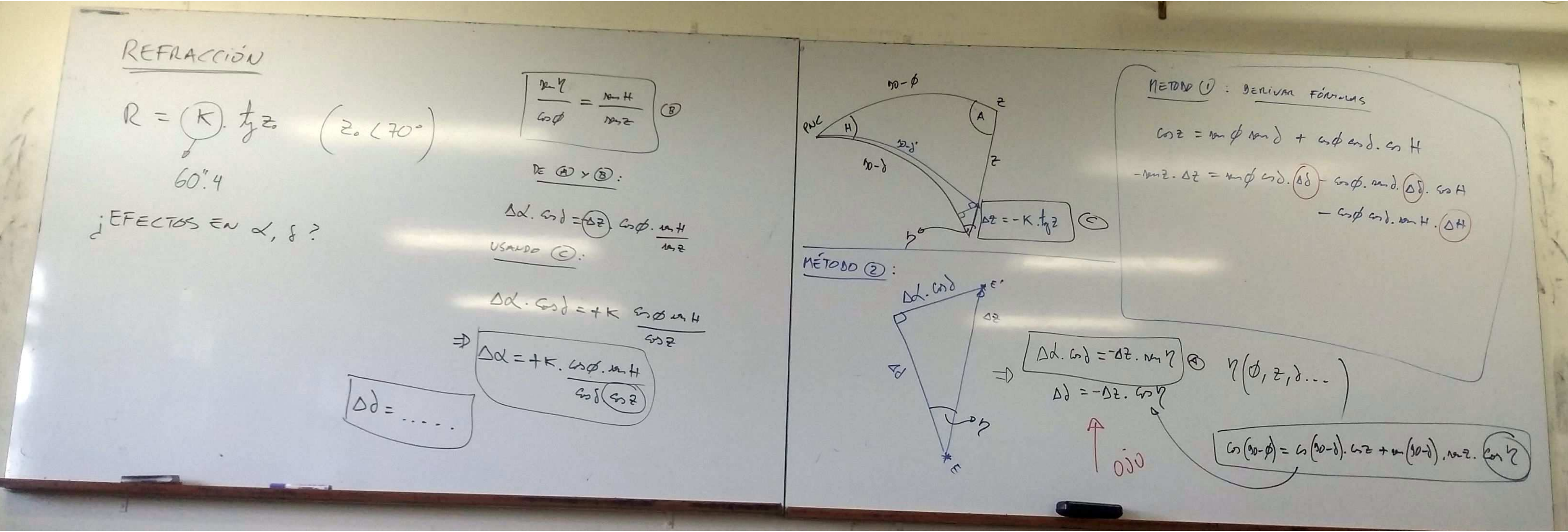

REFRACCIÓN
SEEING
R = K . tg z0
60".4
(z0 < 70°)
¿EFECTOS EN α, δ?
TSL = α + H
⇒ Δα = −ΔH
PNC
90 − φ
90 − δ
Z
A
H
Δz = −K . tg z
MÉTODO 2:
Δα . cos δ
Δz
Δδ
E'
E
η
MÉTODO 1: DERIVAR FÓRMULAS
cos z = sen φ sen δ + cos φ cos δ . cos H

Astronomia Fundamental 2017

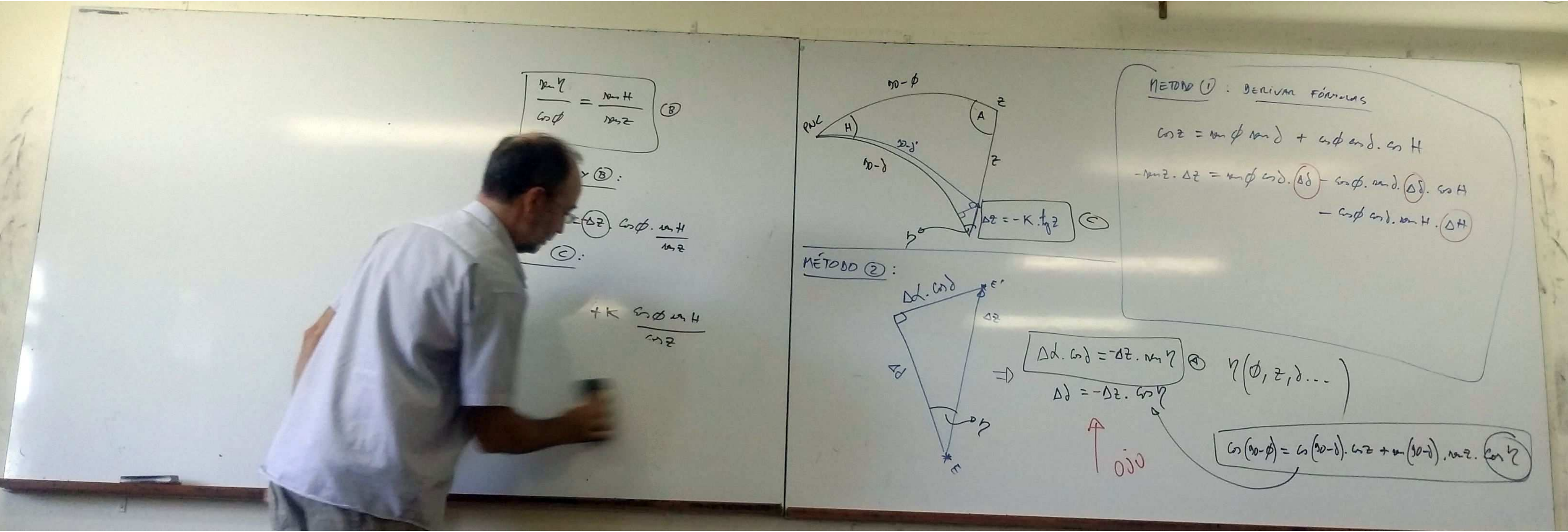


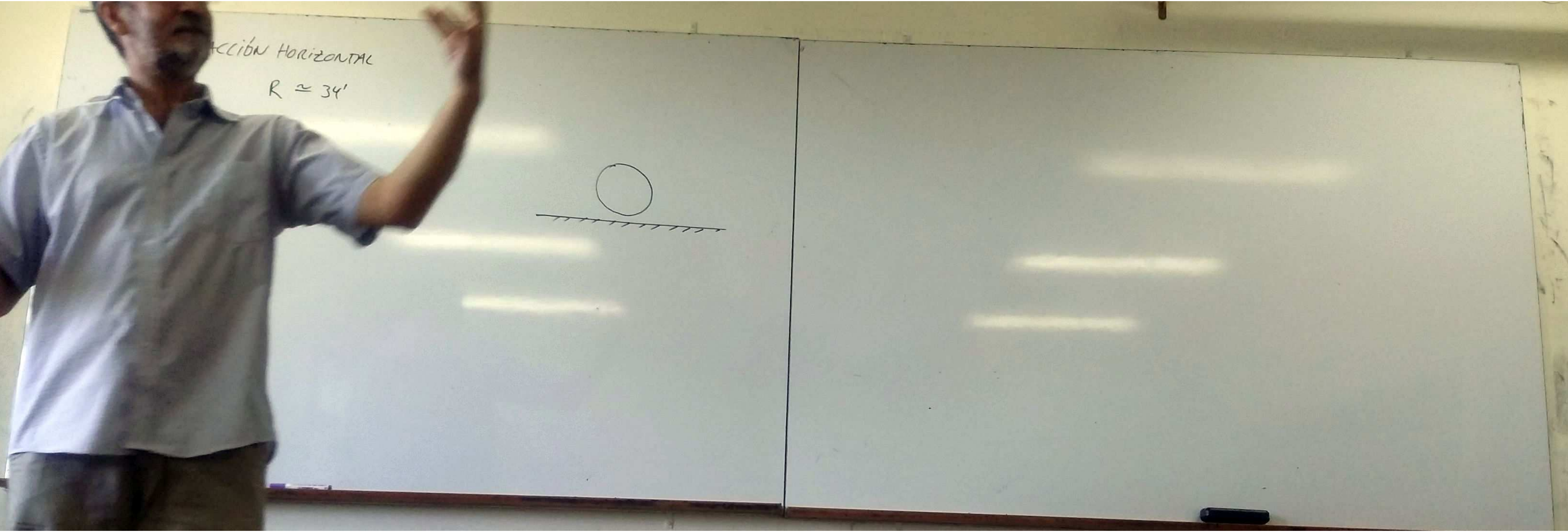
Astronomia Fundamental 2017

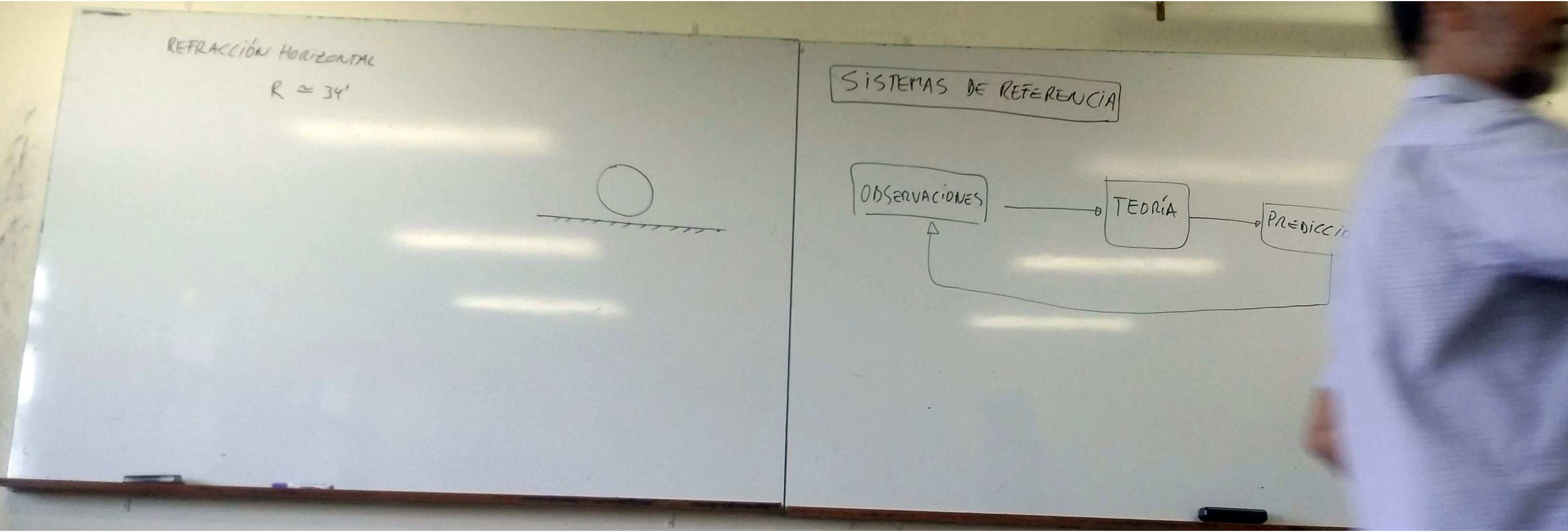


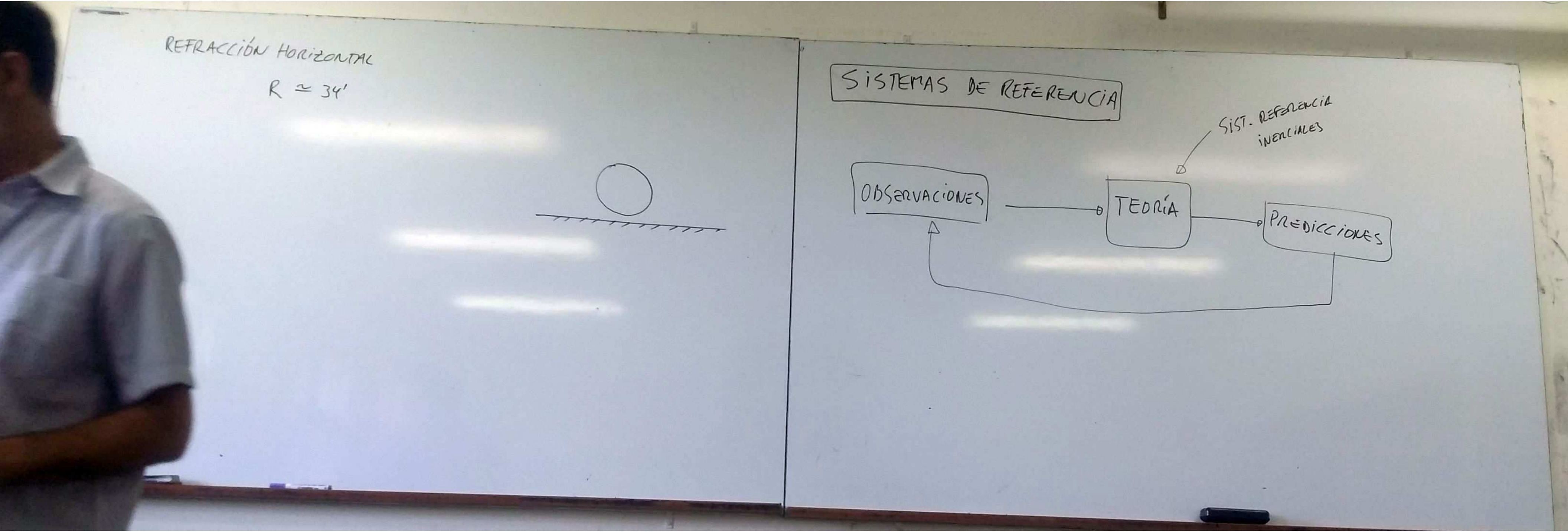

REFRACCIÓN
R = (K) . tg z₀
60".4
(z₀ < 70°)
¿EFECTOS EN α, δ ?
sen η / cos φ = sen H / sen z (B)
DE (A) y (B):
Δα . cos δ = -Δz . cos φ . sen H / sen z
USANDO (C):
Δα . cos δ = +K cos φ sen H / cos z
⇒ Δα = +K . cos φ . sen H / cos δ cos z
Δδ = ...
90-φ
PNC
H
A
Z
z
90-δ
90-δ'
η
Δz = -K . tg z (C)
MÉTODO (2):
Δα . cos δ
E'
Δz
Δδ
η
E
⇒ Δα . cos δ = -Δz . sen η (A)
Δδ = -Δz . cos η
η(φ, z, δ . . .)
OJO
cos(90-φ) = cos(90-δ) . cos z + sen(90-δ) . sen z . cos η
MÉTODO (1): DERIVAR FÓRMULAS
cos z = sen φ sen δ + cos φ cos δ . cos H
-sen z . Δz = sen φ cos δ . Δδ - cos φ . sen δ . Δδ . cos H
- cos φ cos δ . sen H . ΔH

Astronomia Fundamental 2017

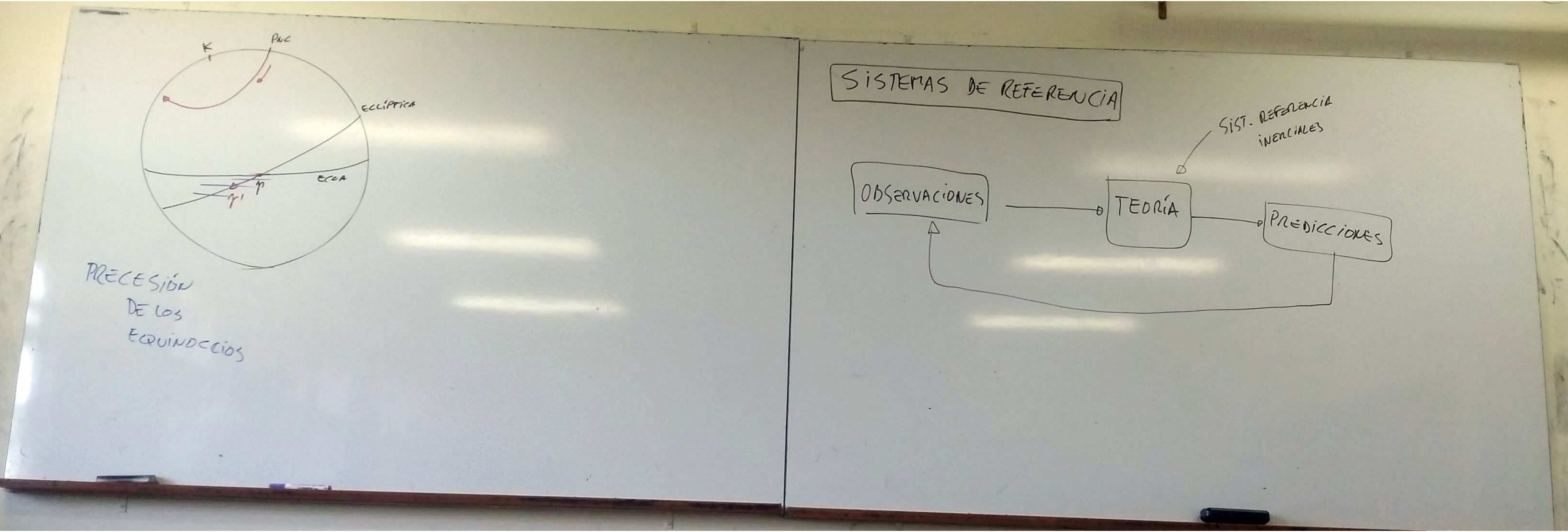


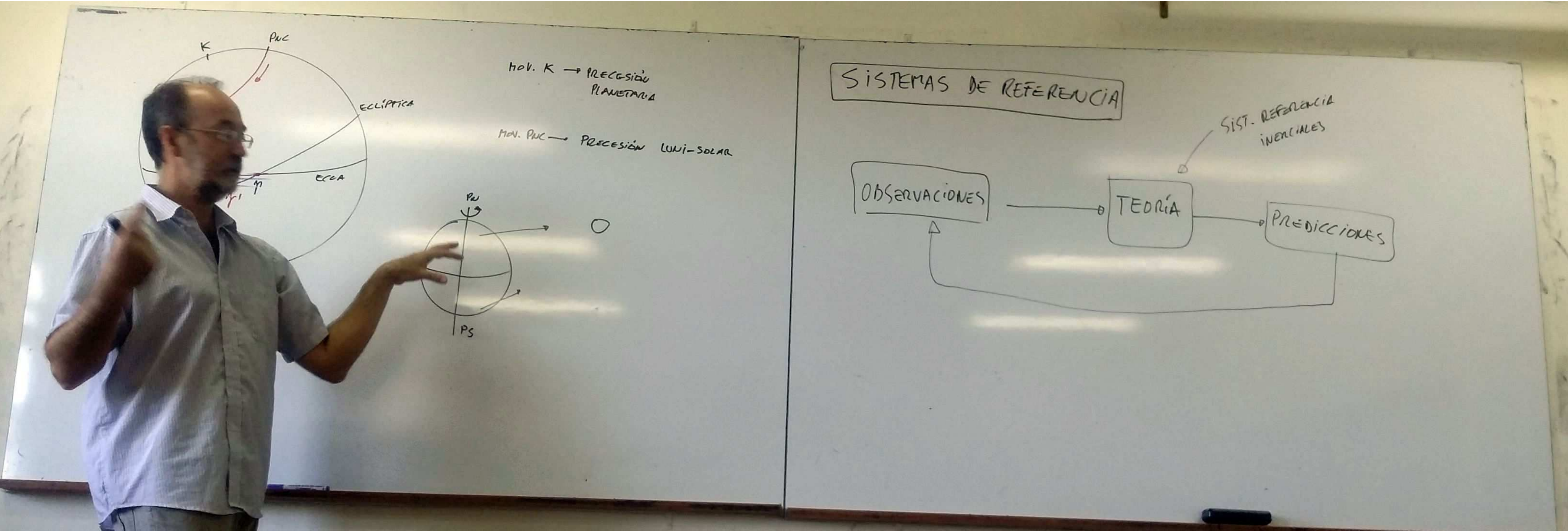

ACCIÓN HORIZONTAL
R ≃ 34'


REFRACCIÓN HORIZONTAL
R ≃ 34'
SISTEMAS DE REFERENCIA
OBSERVACIONES
TEORÍA

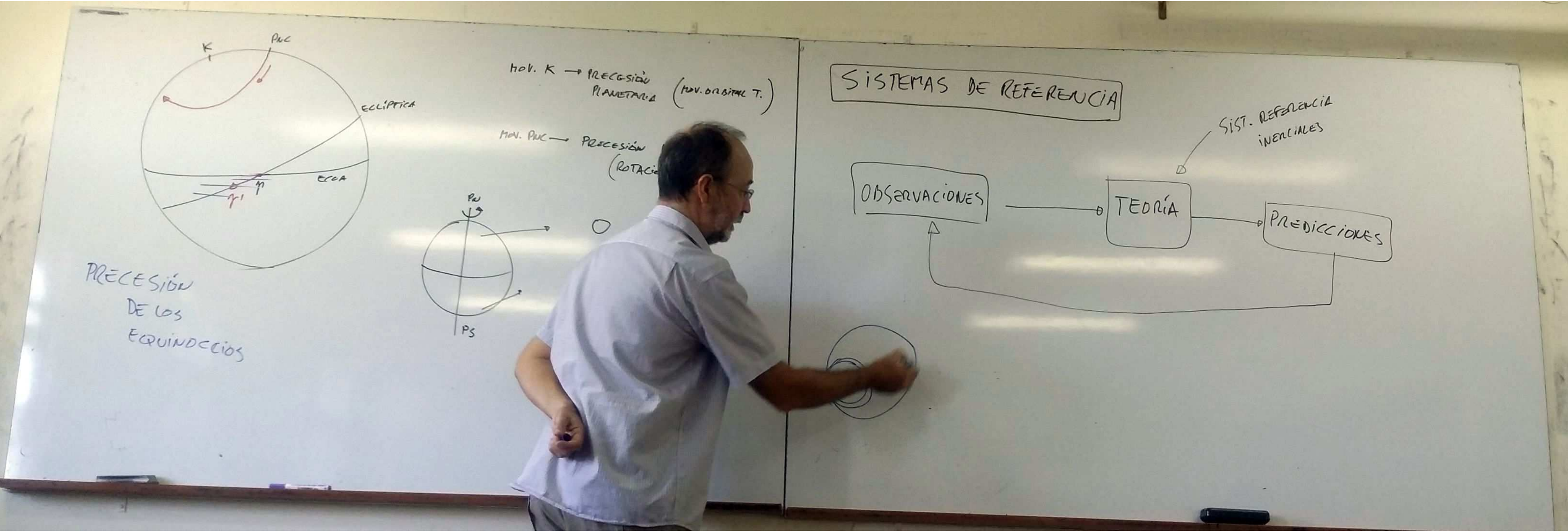

REFRACCIÓN HORIZONTAL
R ≃ 34'
SISTEMAS DE REFERENCIA
SIST. REFERENCIA INERCIALES
OBSERVACIONES
TEORÍA
PREDICCIONES

K
PNC
ECLÍPTICA
ECUA
SISTEMAS DE REFERENCIA
SIST. REFERENCIA INERCIALES
OBSERVACIONES
TEORÍA
PREDICCIONES

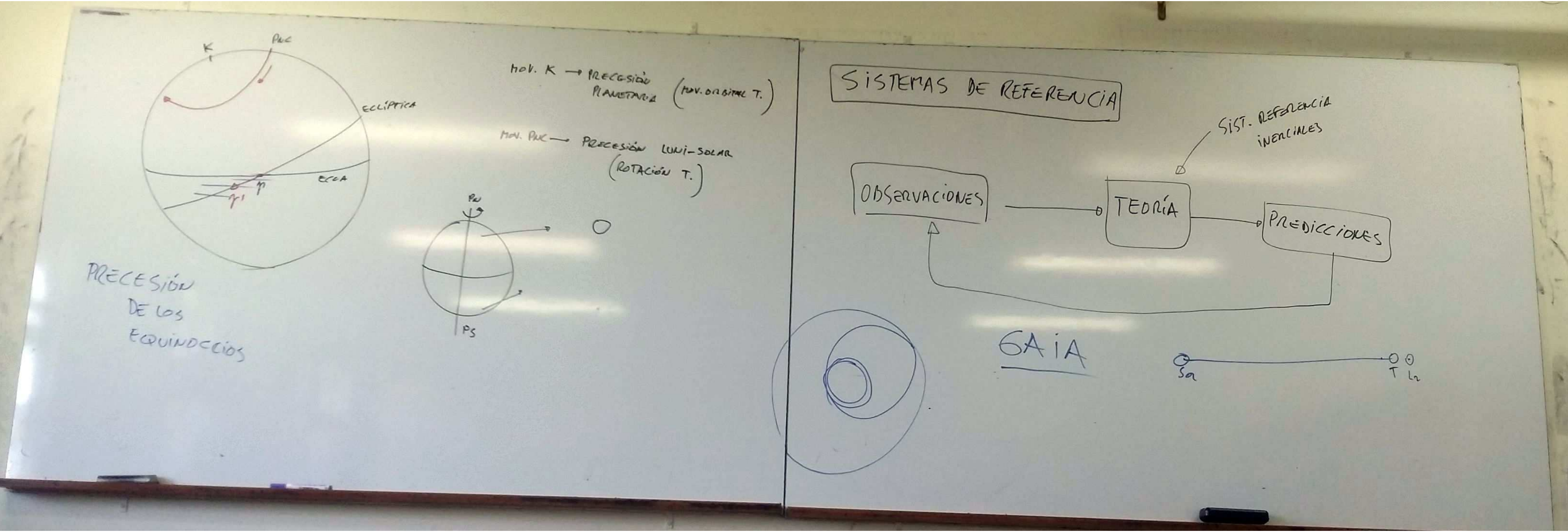

K
PNC
ECLÍPTICA
ECUA
PRECESIÓN
DE LOS
EQUINOCCIOS
SISTEMAS DE REFERENCIA
SIST. REFERENCIA
INERCIALES
OBSERVACIONES
TEORÍA
PREDICCIONES


K
PNC
ECLÍPTICA
ECUA
MOV. K → PRECESIÓN PLANETARIA
MOV. PNC → PRECESIÓN LUNI-SOLAR
PN
PS
SISTEMAS DE REFERENCIA
SIST. REFERENCIA INERCIALES
OBSERVACIONES
TEORÍA
PREDICCIONES

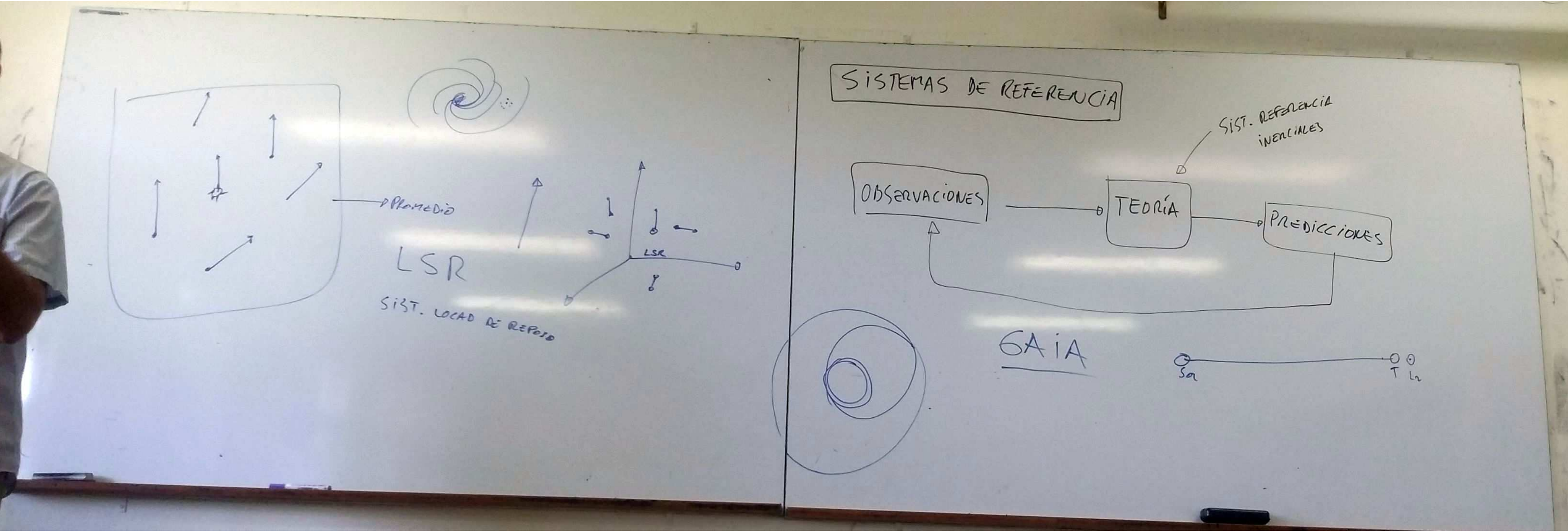
Astronomia Fundamental 2017

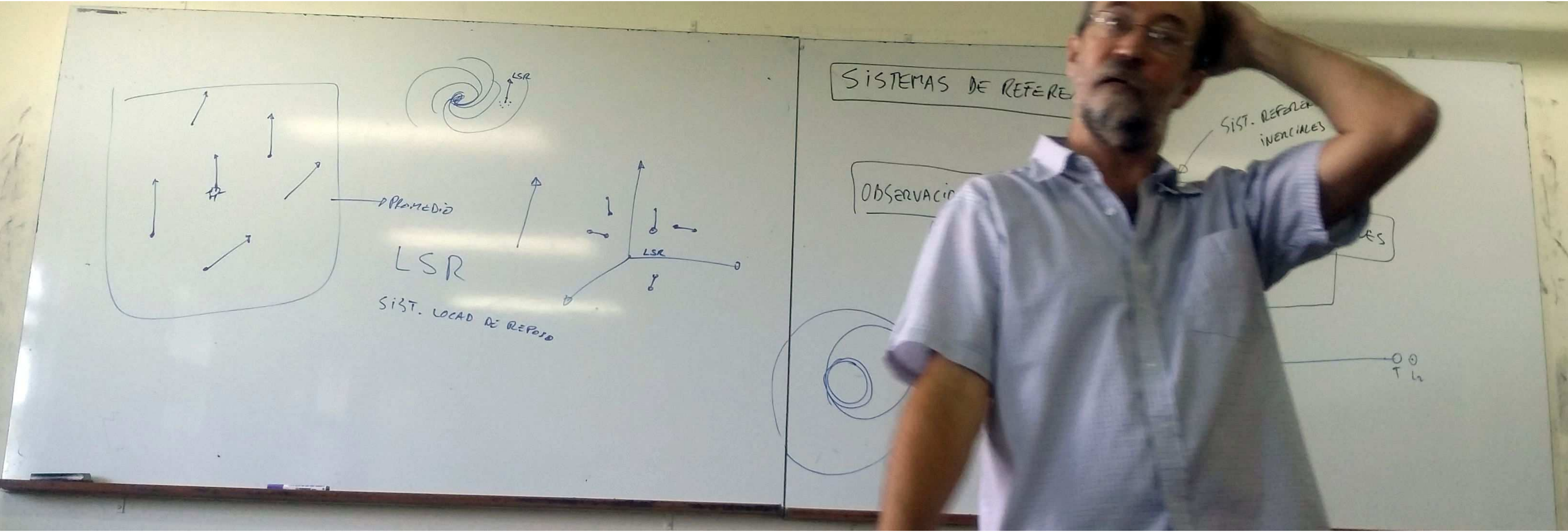


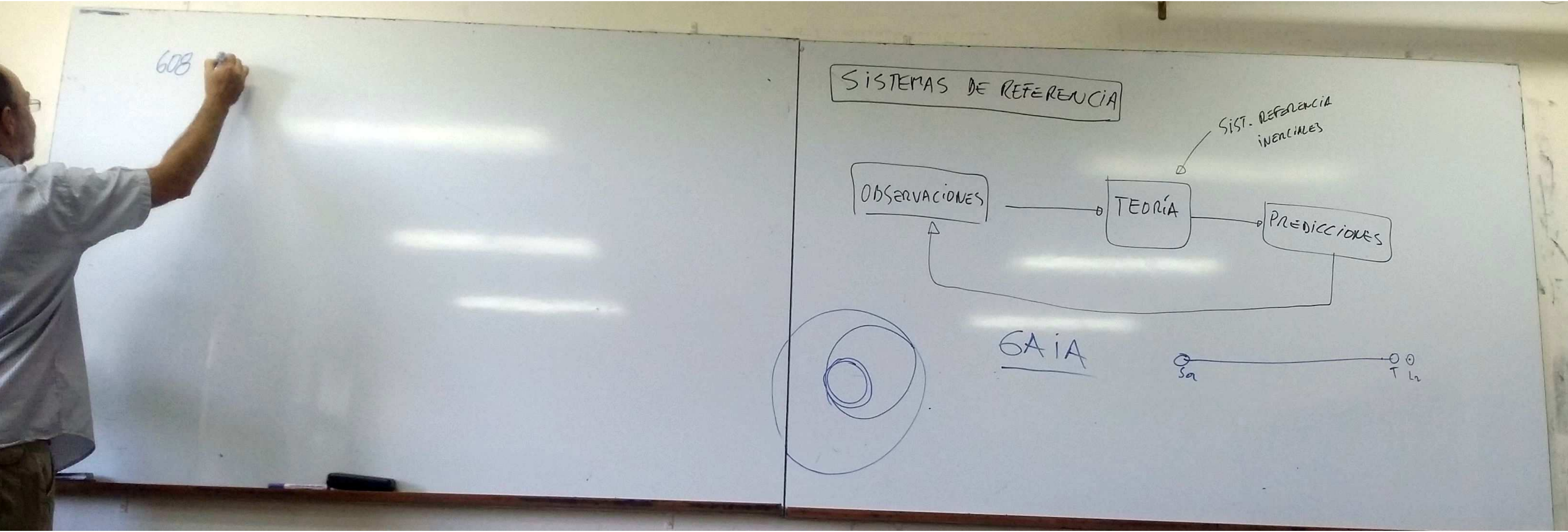
Astronomia Fundamental 2017

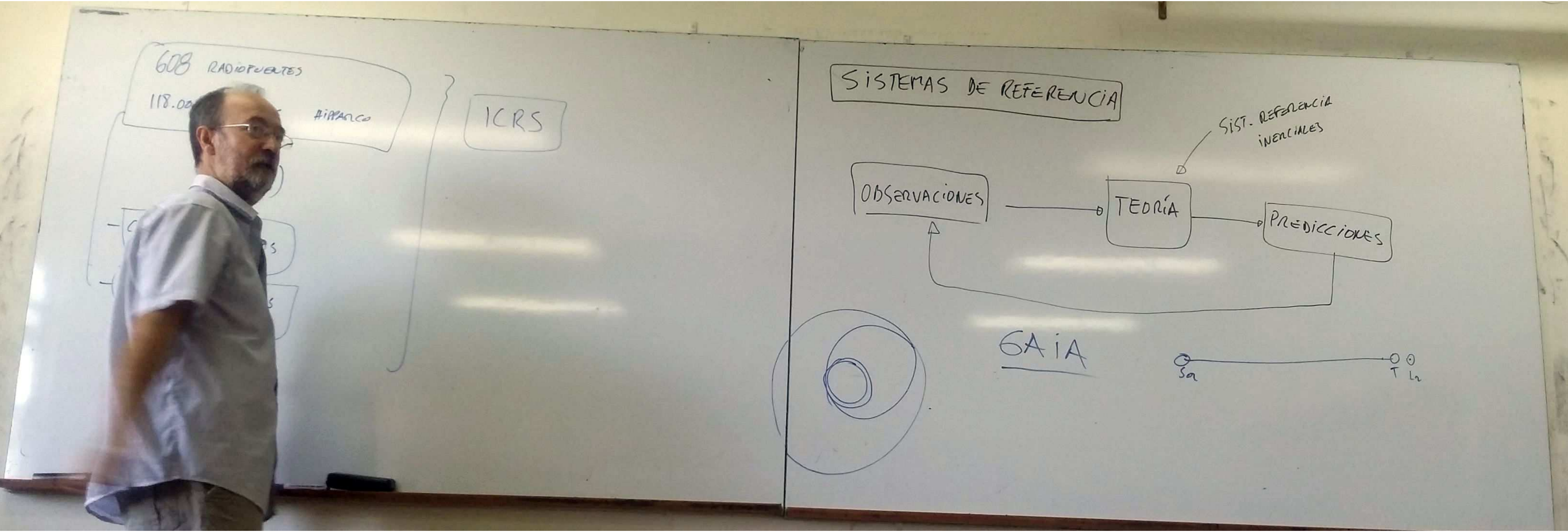


Astronomia Fundamental 2017

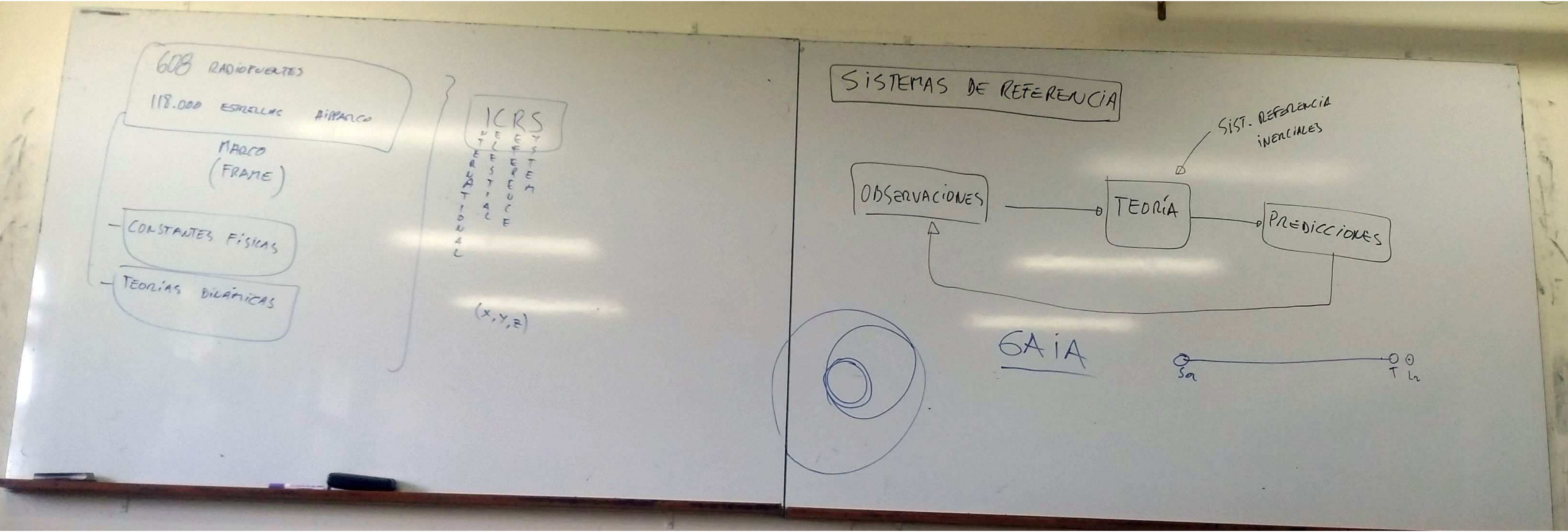


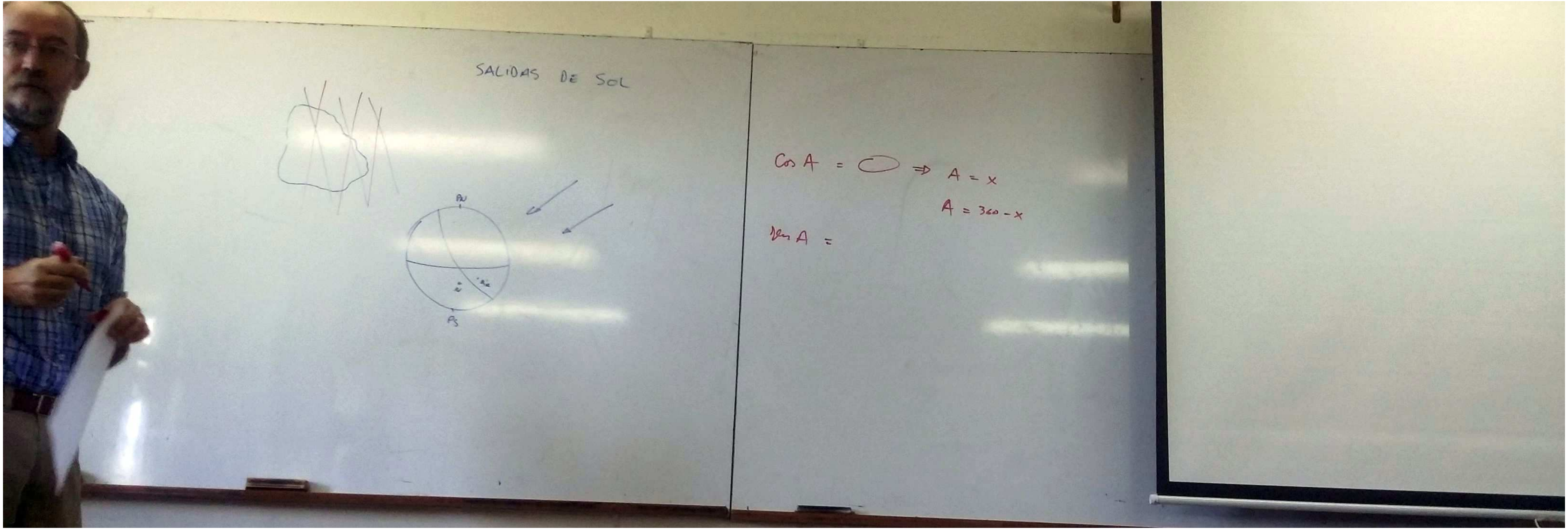

LSR
PROMEDIO
LSR
LSR
SIST. LOCAL DE REPOSO
INERCIALES

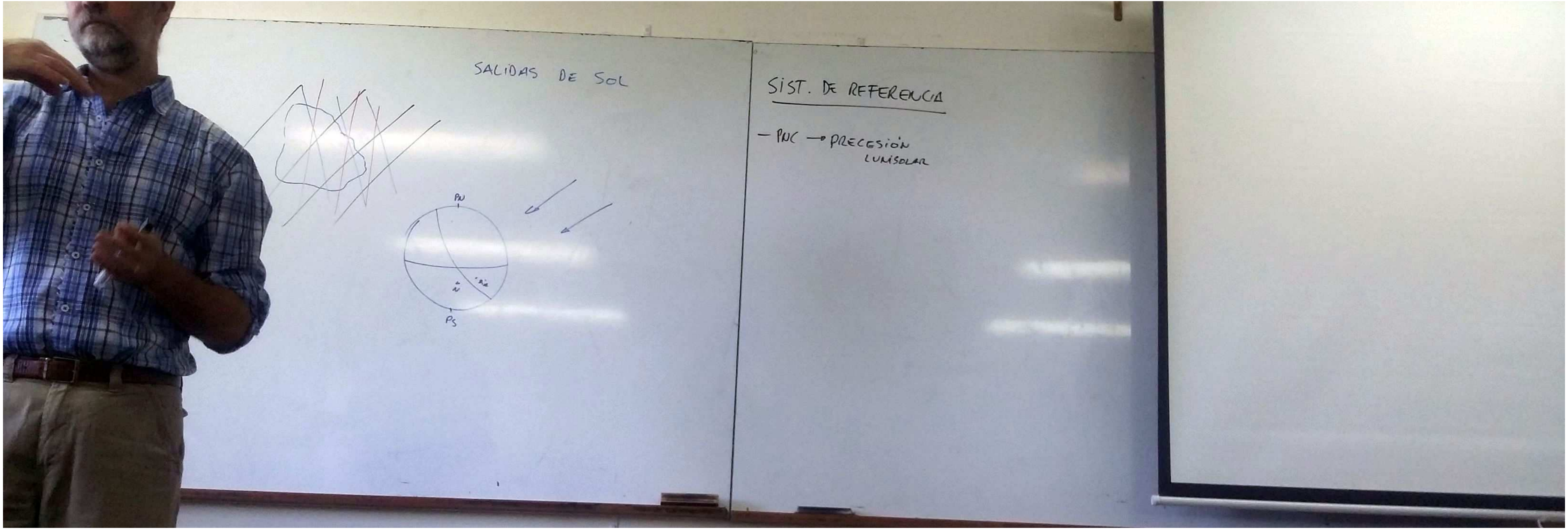

608
SISTEMAS DE REFERENCIA
SIST. REFERENCIA INERCIALES
OBSERVACIONES
TEORÍA
PREDICCIONES
GAIA
Sol
T
Lu

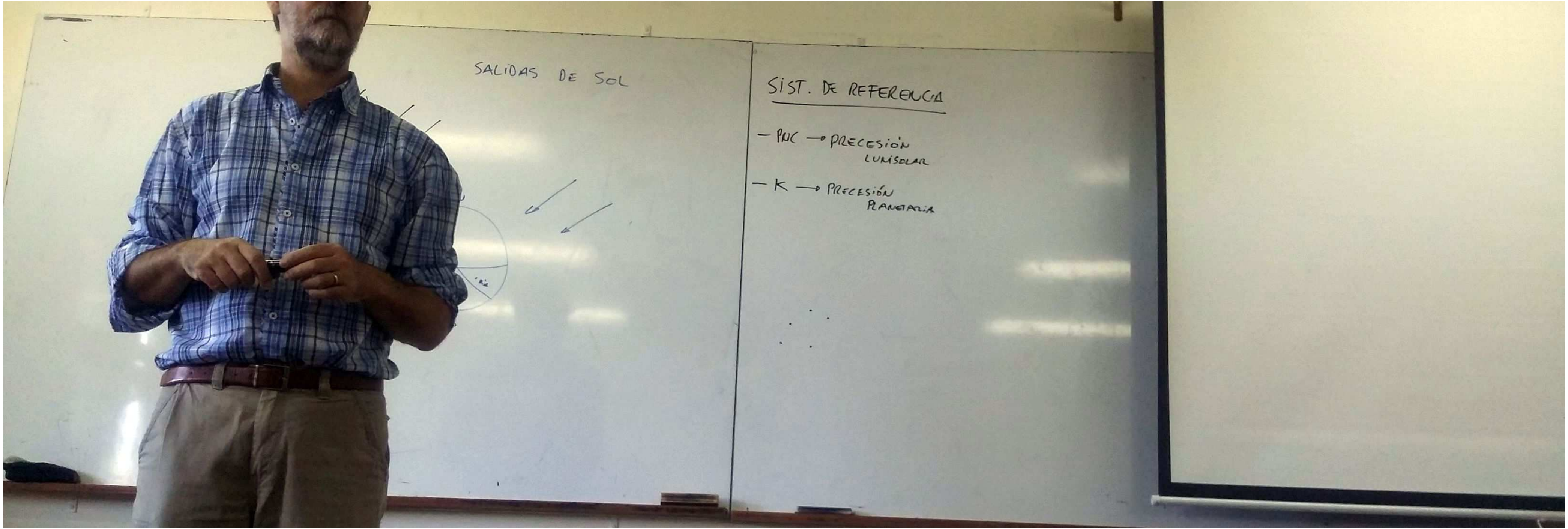

608 RADIOFUENTES
ICRS
SISTEMAS DE REFERENCIA
SIST. REFERENCIA INERCIALES
OBSERVACIONES
TEORÍA
PREDICCIONES
GAIA

Astronomia Fundamental 2017

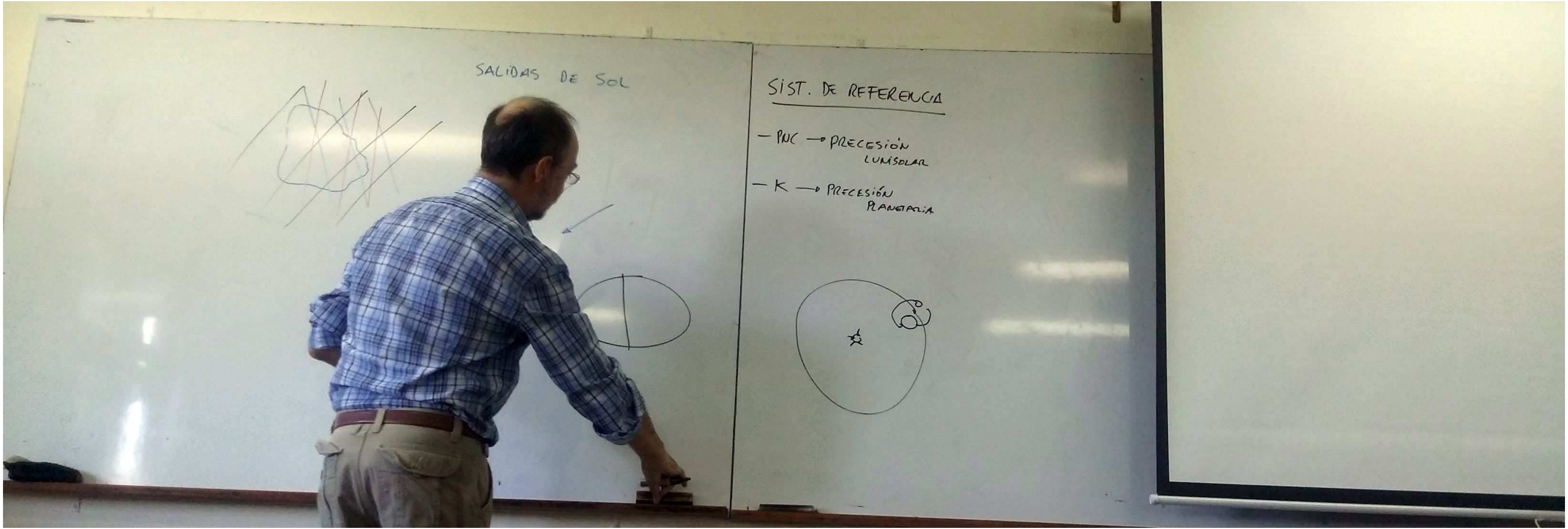



SALIDAS DE SOL
PN
PS
Cos A = 0 ⇒ A = x
A = 360 - x
Sen A =

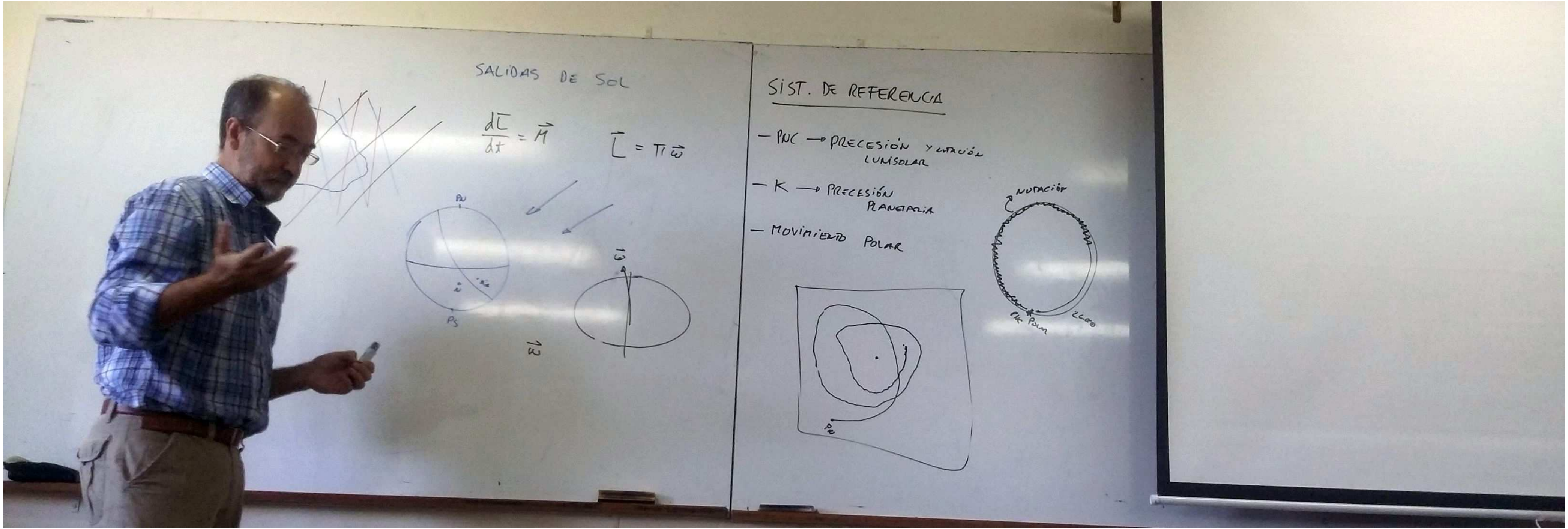

SALIDAS DE SOL
PN
PS
SIST. DE REFERENCIA
— PNC → PRECESIÓN
LUNISOLAR


SALIDAS DE SOL
SIST. DE REFERENCIA
— PNC → PRECESIÓN LUNISOLAR
— K → PRECESIÓN PLANETARIA

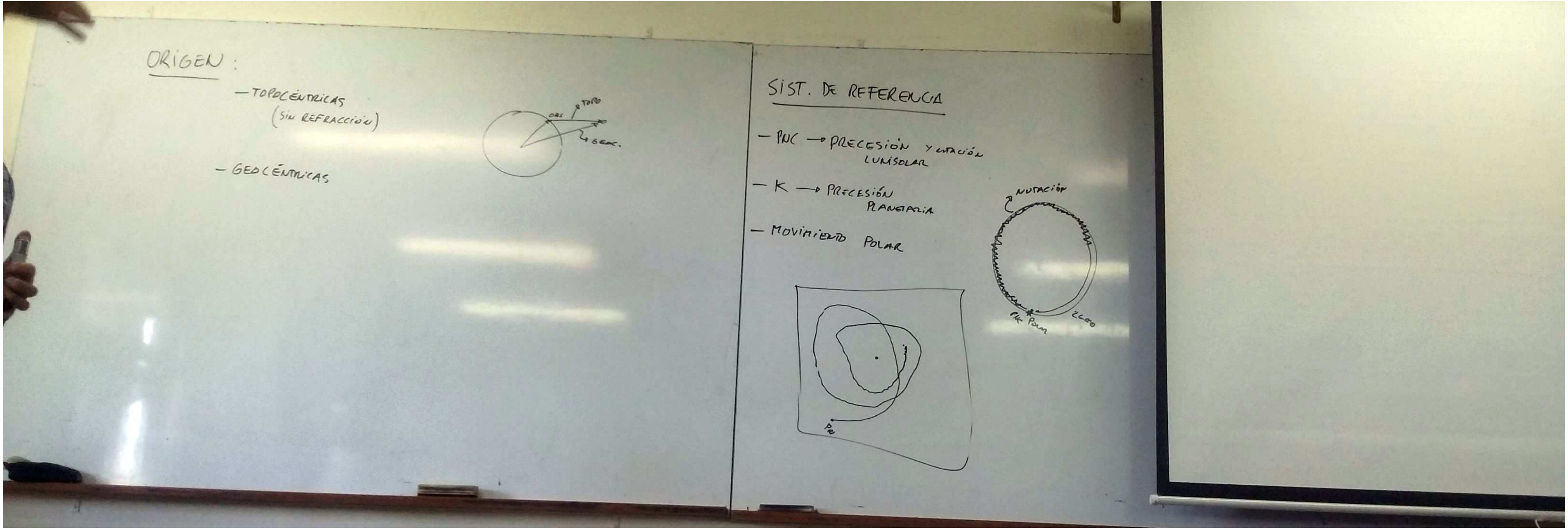
Astronomia Fundamental 2017

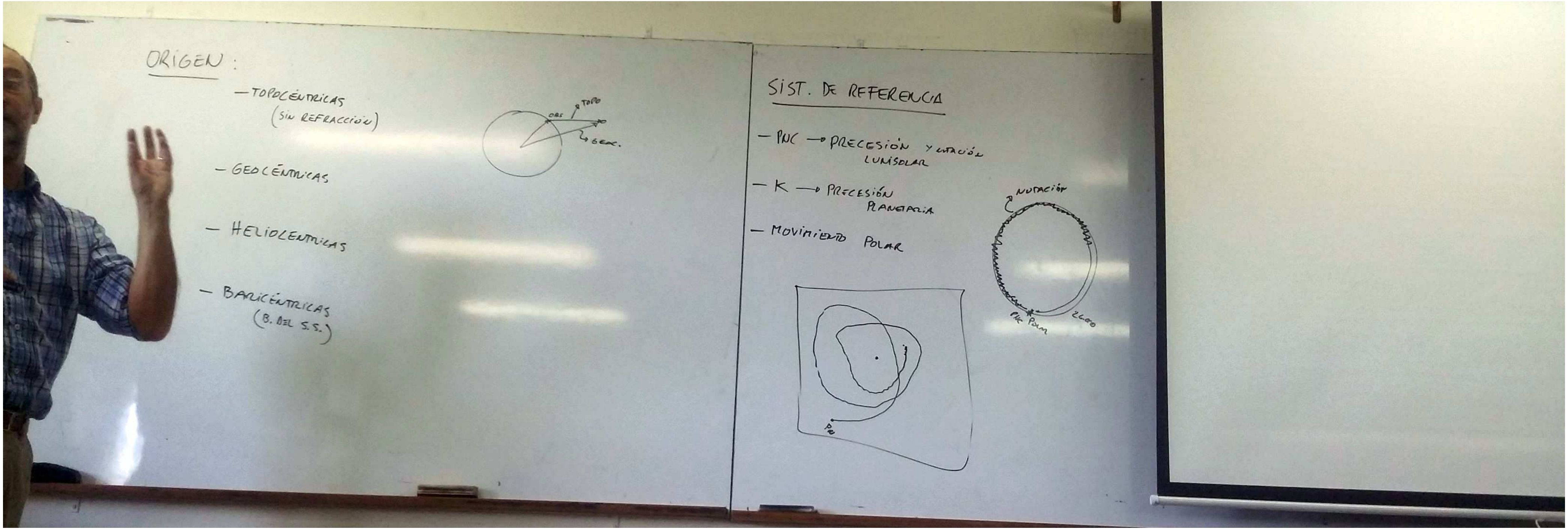


Astronomia Fundamental 2017

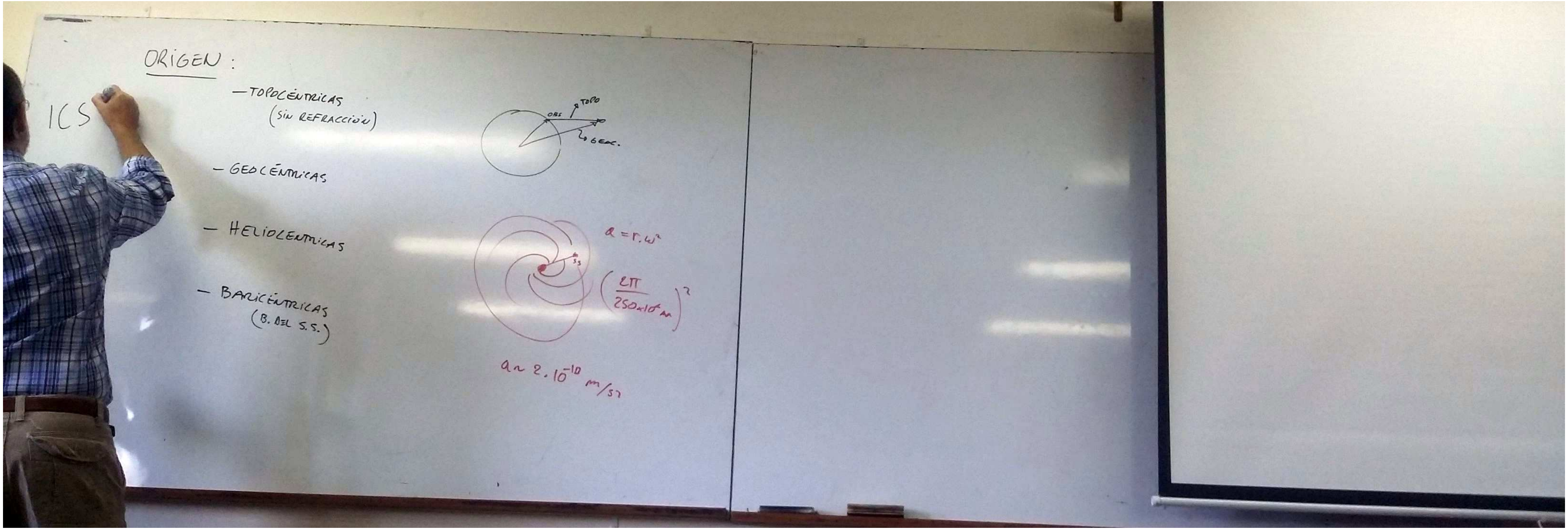


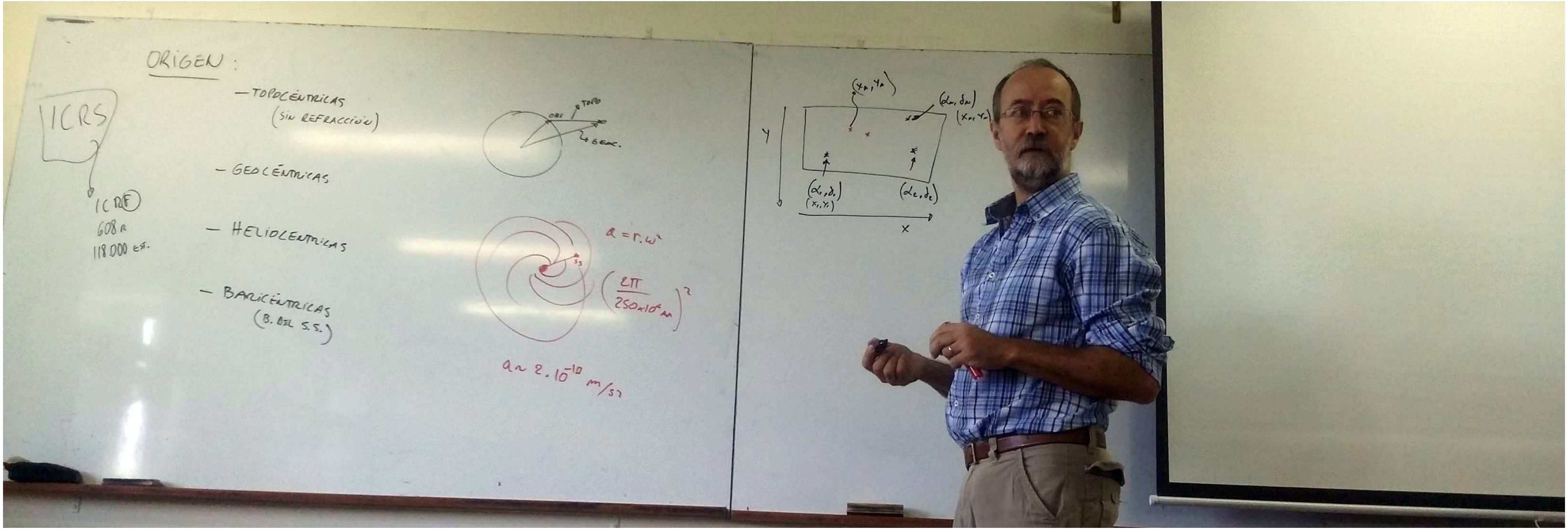
Astronomia Fundamental 2017

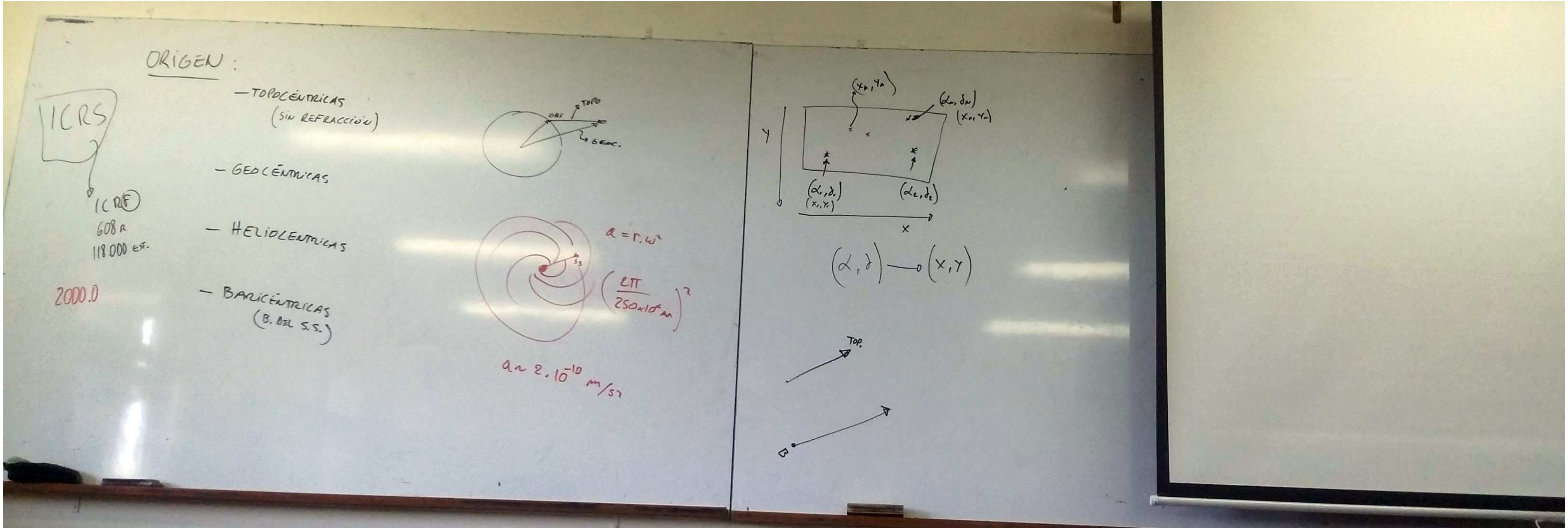



ORIGEN:
— TOPOCÉNTRICAS
(SIN REFRACCIÓN)
OBS
TOPO
GEOC.
— GEOCÉNTRICAS
— HELIOCÉNTRICAS
— BARICÉNTRICAS
(B. DEL S.S.)
SIST. DE REFERENCIA
— PNC → PRECESIÓN Y NUTACIÓN
LUNISOLAR
— K → PRECESIÓN
PLANETARIA
— MOVIMIENTO POLAR
NUTACIÓN

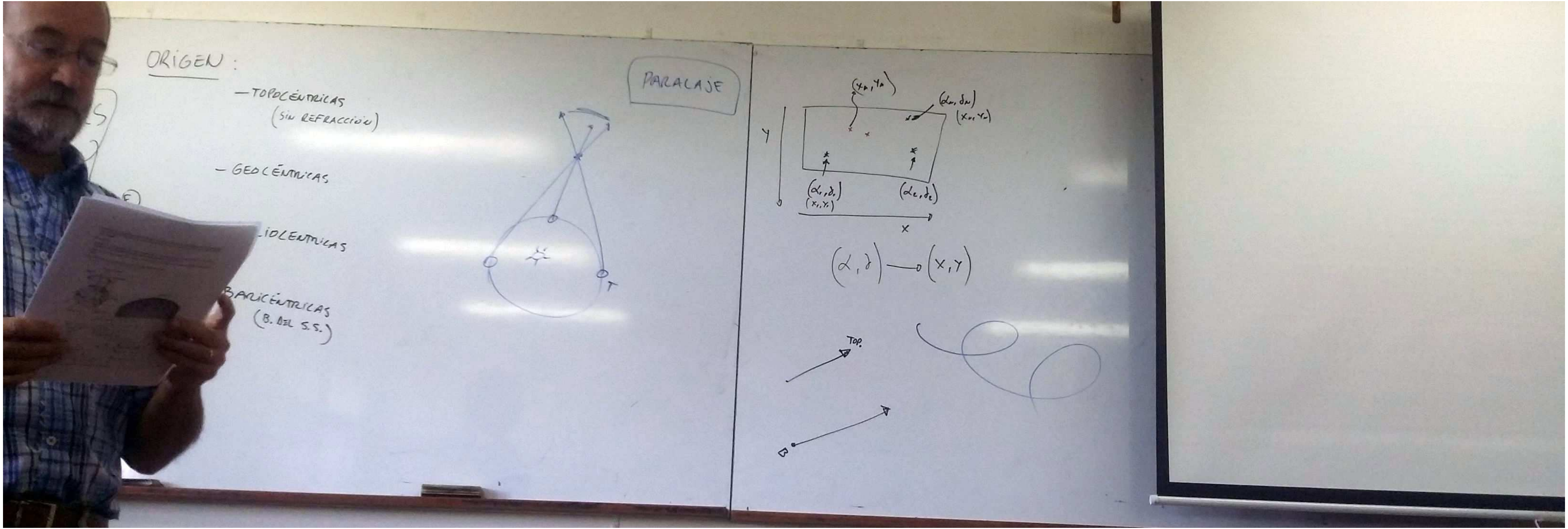
Astronomia Fundamental 2017

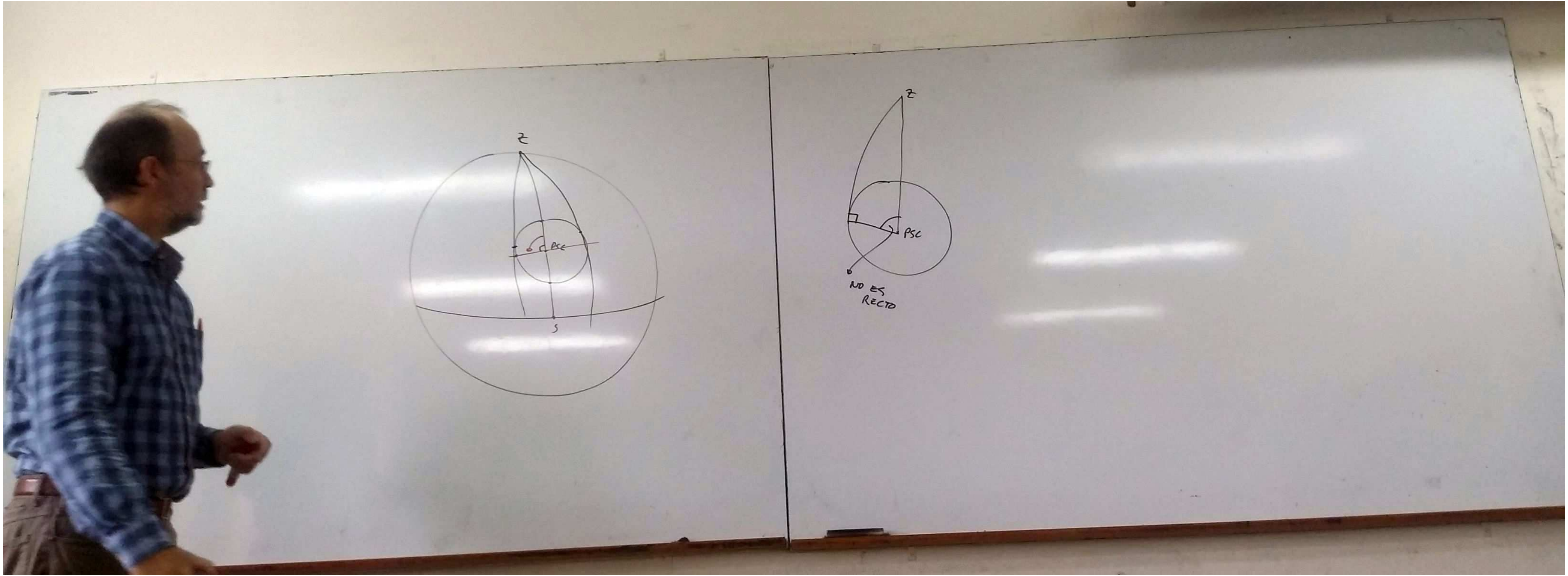


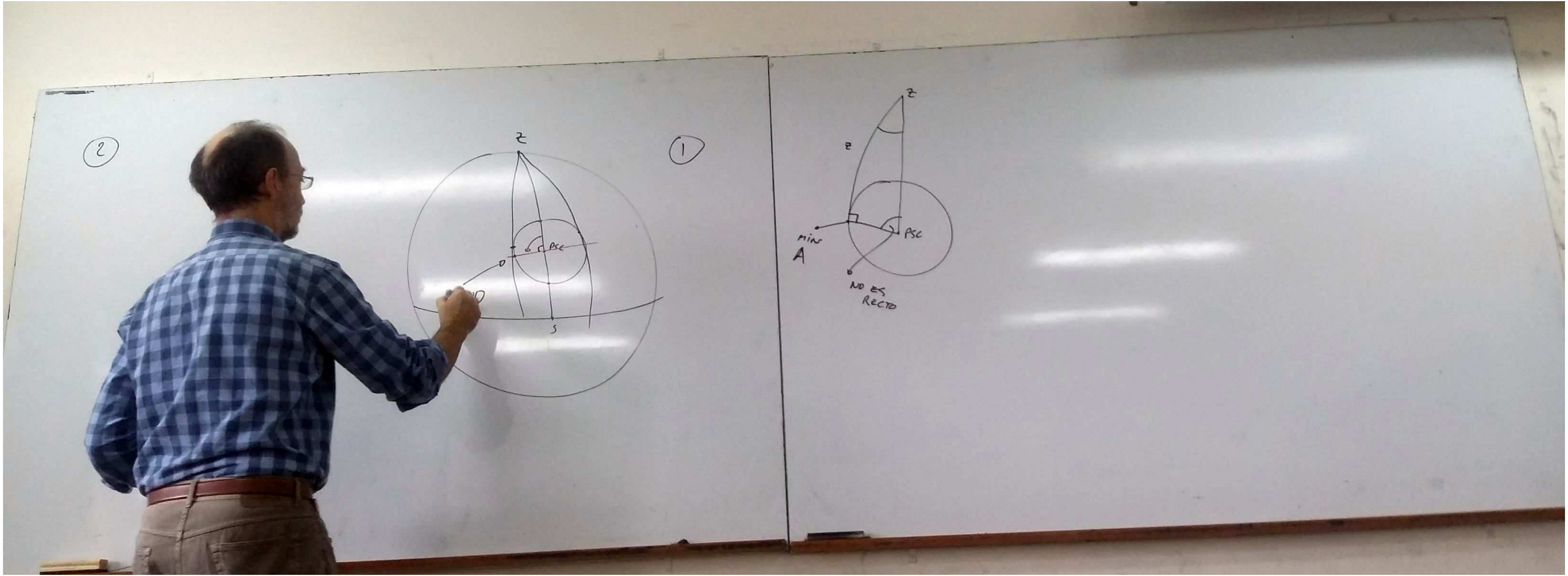

ORIGEN:
ICRS
ICRF
608 R
118.000 EST.
— TOPOCÉNTRICAS
(SIN REFRACCIÓN)
— GEOCÉNTRICAS
— HELIOCÉNTRICAS
— BARICÉNTRICAS
(B. DEL S.S.)
OBS
TOPO
GEOC.
a = r.ω²
a ~ 2.10⁻¹⁰ m/s²
Y
X


ORIGEN:
ICRS
ICRF
608 R
118.000 EST.
2000.0
— TOPOCÉNTRICAS
(SIN REFRACCIÓN)
— GEOCÉNTRICAS
— HELIOCÉNTRICAS
— BARICÉNTRICAS
(B. DEL S.S.)
OBS
TOPO
GEOC.
a = r.ω²
a ~ 2.10⁻¹⁰ m/s²
(α, δ) —o (X, Y)
TOP.
B

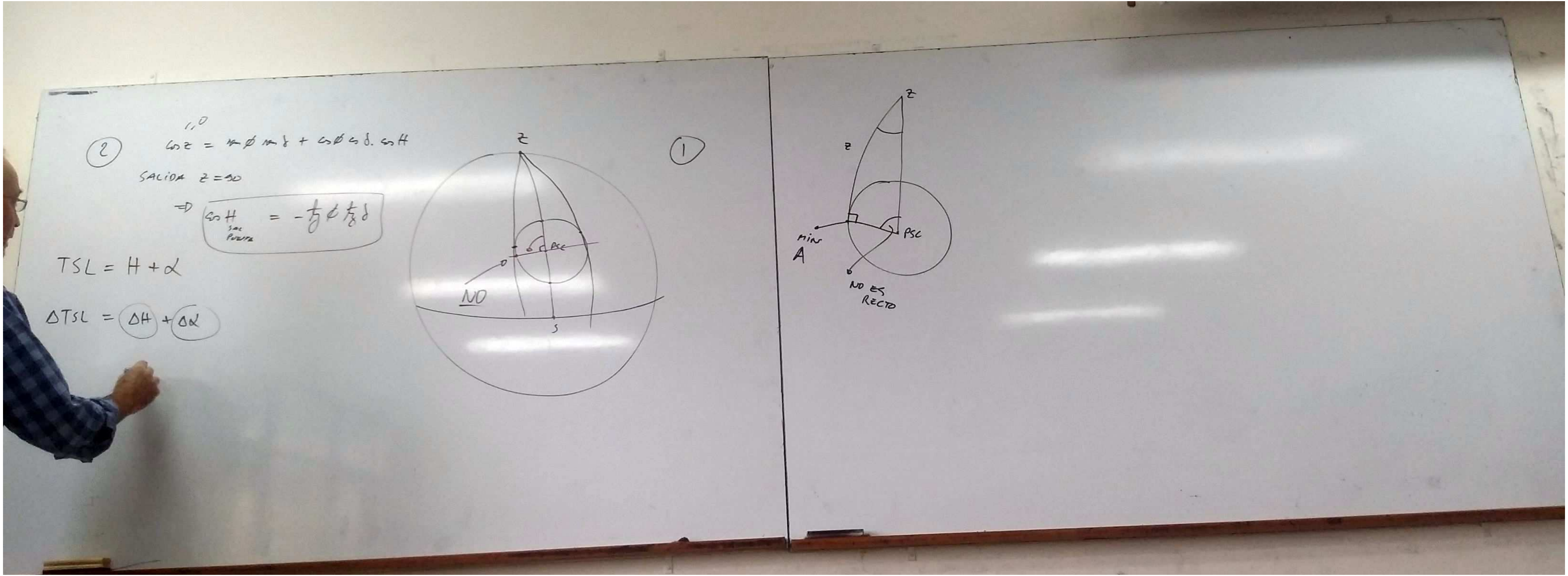
Astronomia Fundamental 2017

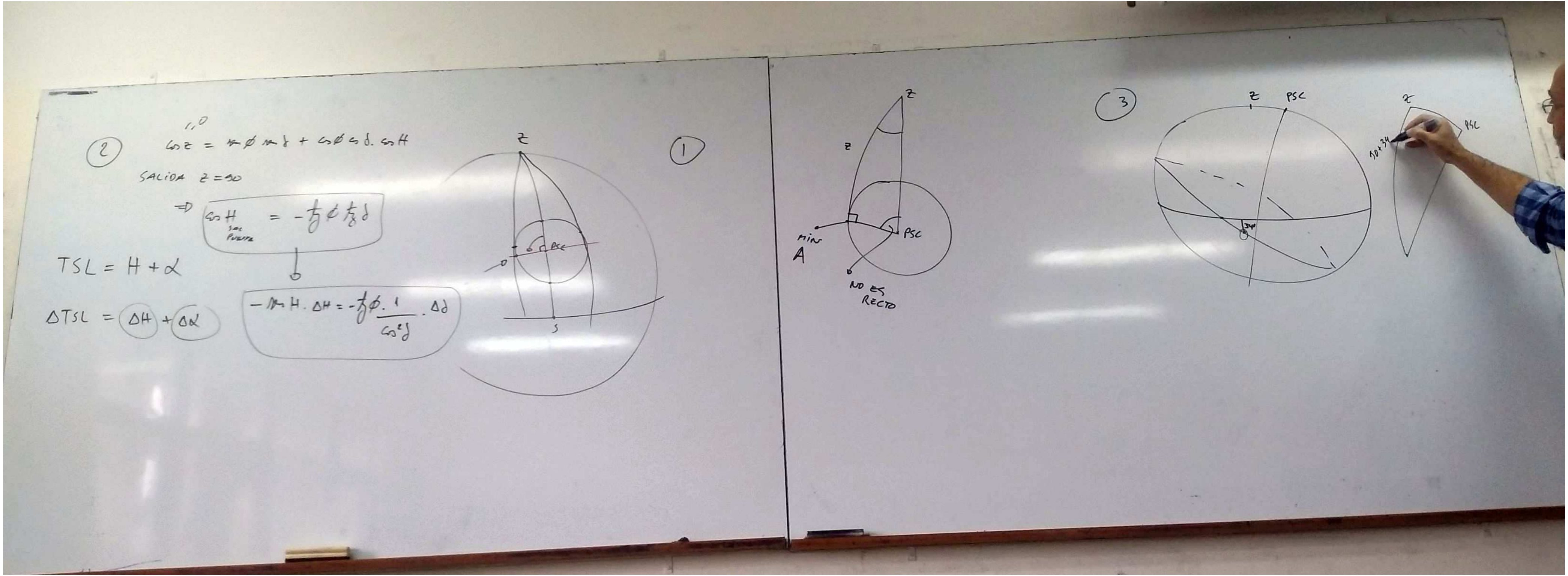



Z
PSC
S
Z
PSC
NO ES
RECTO

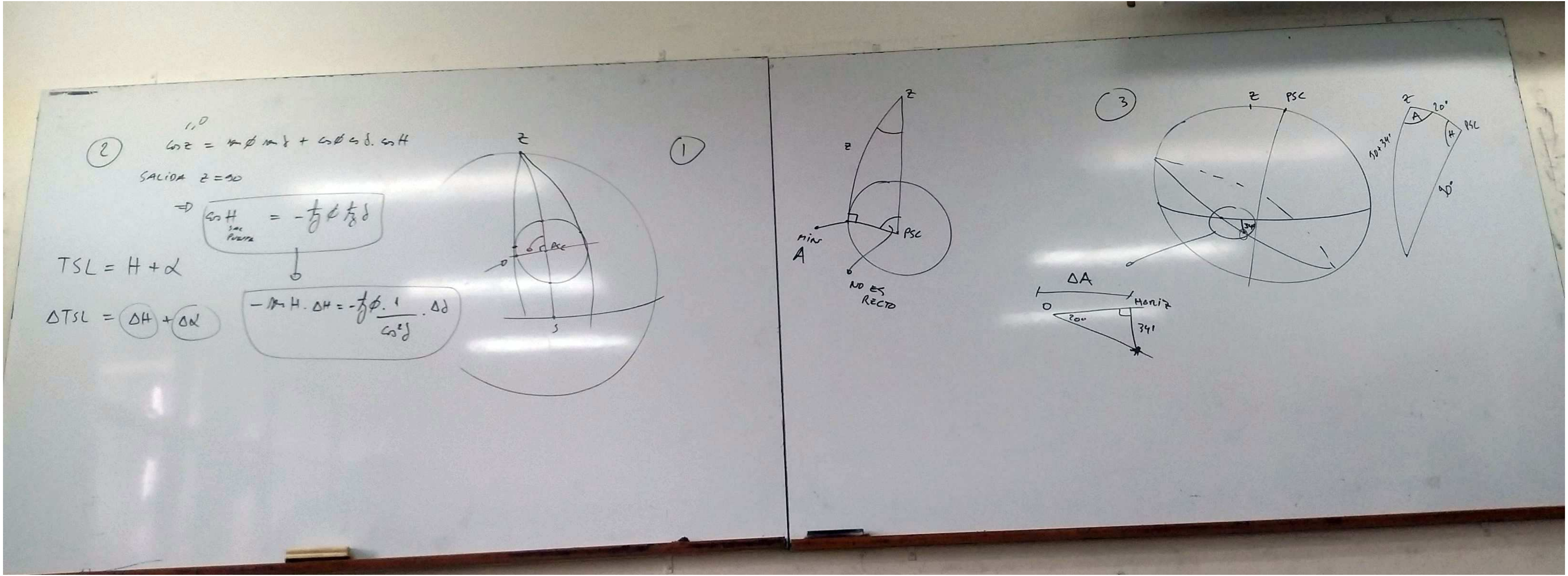


2
Z
PSC
S
1
Z
z
MIN
A
PSC
NO ES
RECTO

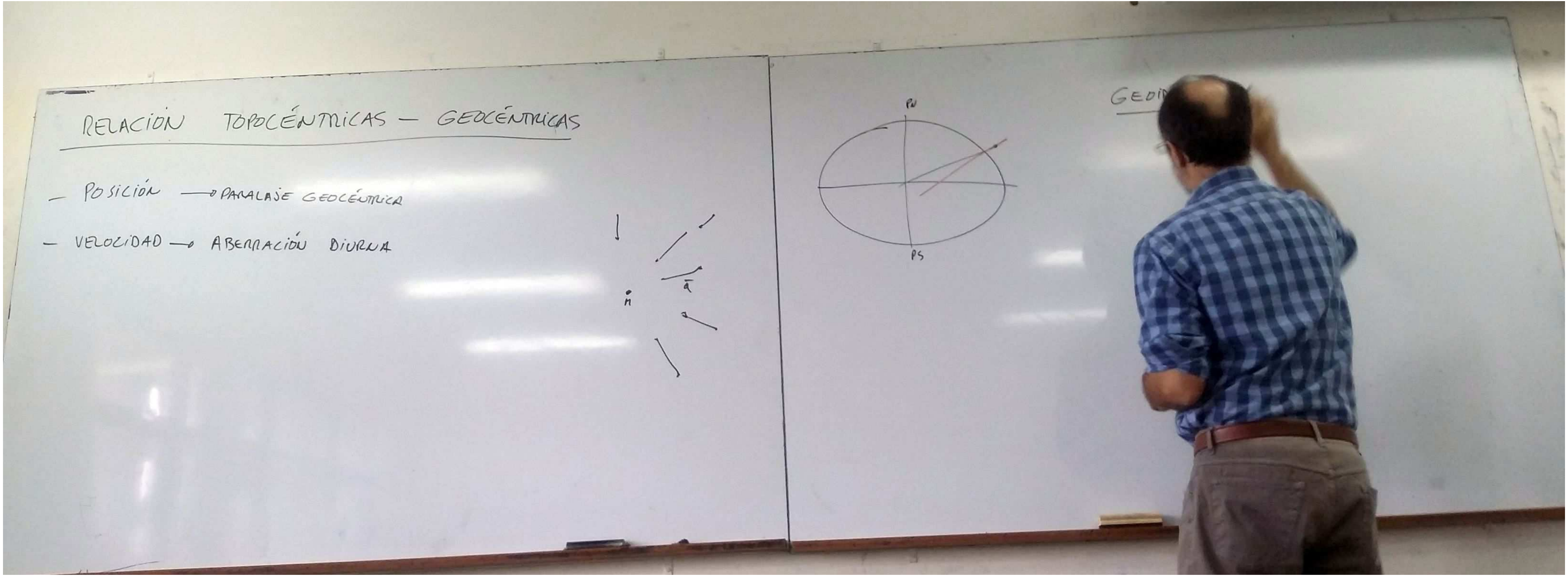

2
SALIDA z = 90
TSL = H + α
ΔTSL = ΔH + Δα
Z
PSC
NO
S
1
Z
z
PSC
A
NO ES
RECTO


SALIDA z = 90
TSL = H + α
ΔTSL = ΔH + Δα
Z
PSC
MIN
A
NO ES RECTO

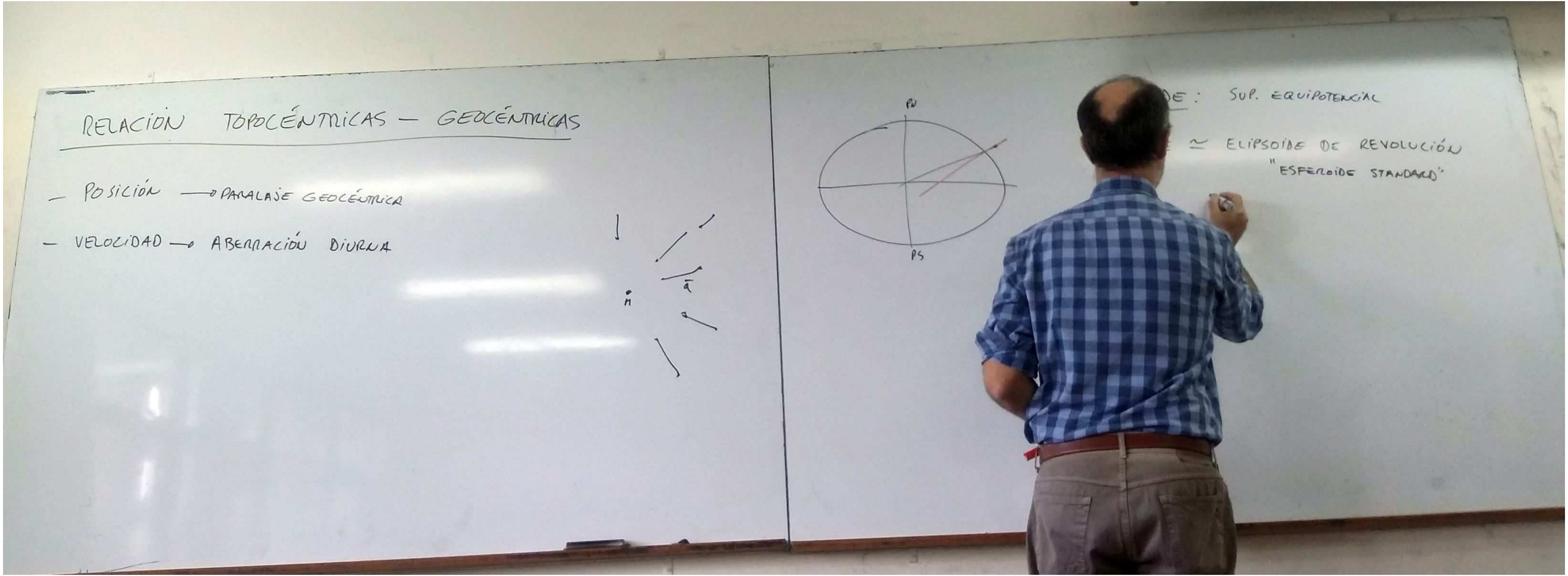
Astronomia Fundamental 2017

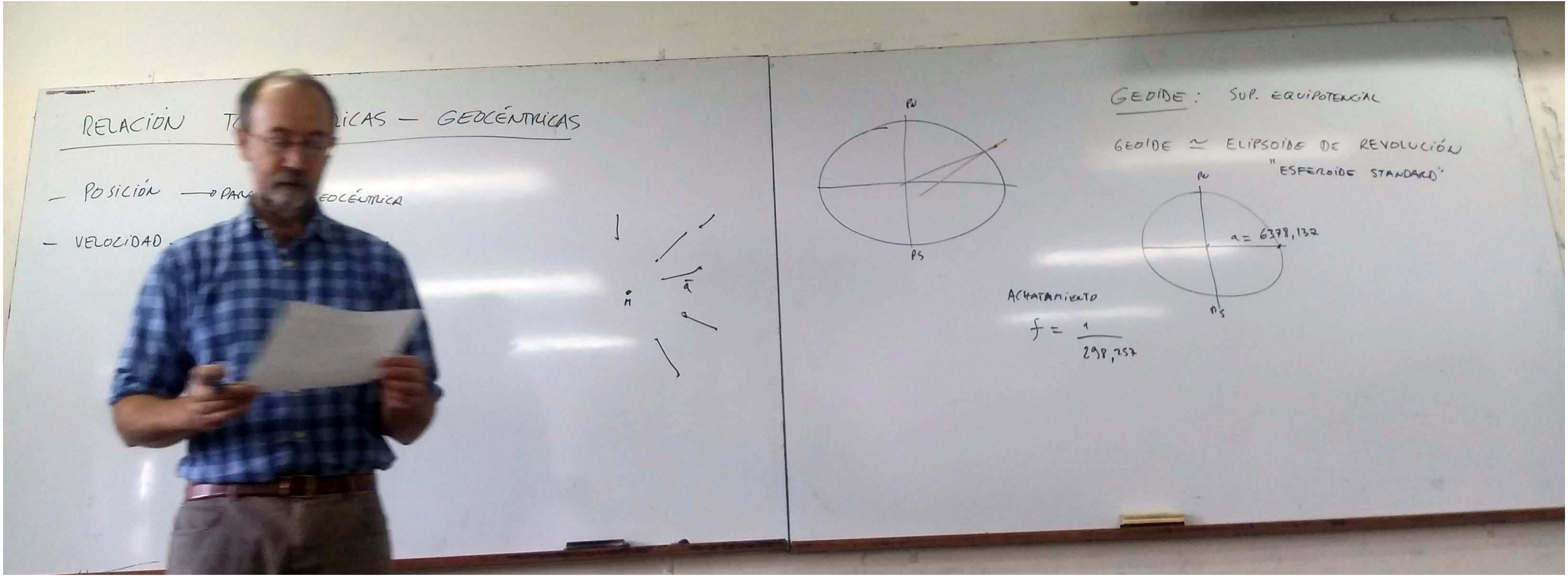


Astronomia Fundamental 2017

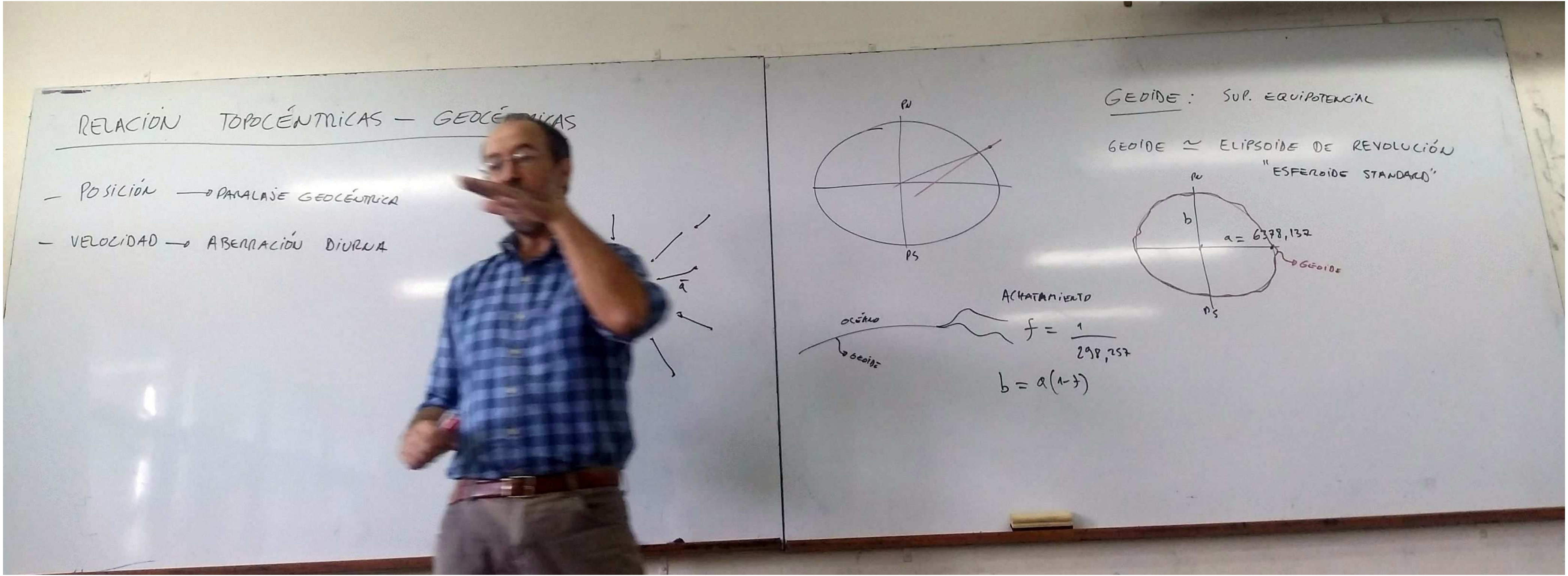

RELACIÓN TOPOCÉNTRICAS – GEOCÉNTRICAS
– POSICIÓN → PARALAJE GEOCÉNTRICA
– VELOCIDAD → ABERRACIÓN DIURNA
PN
PS

Astronomia Fundamental 2017

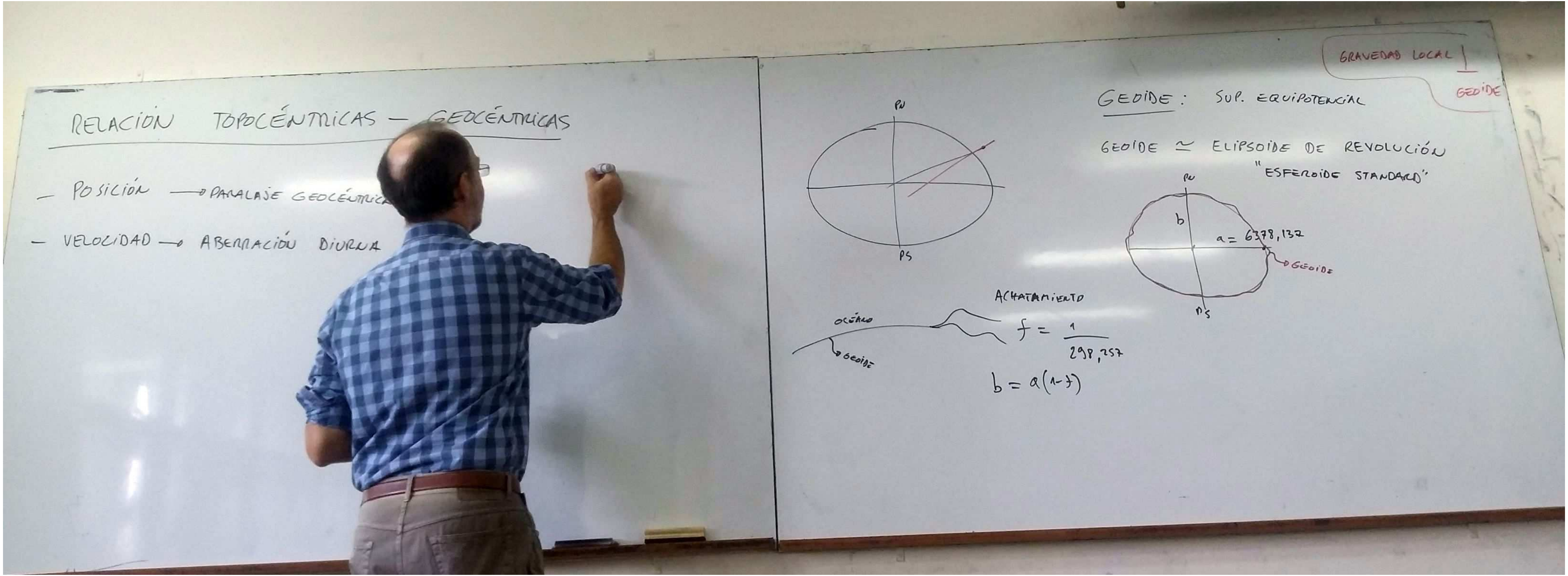


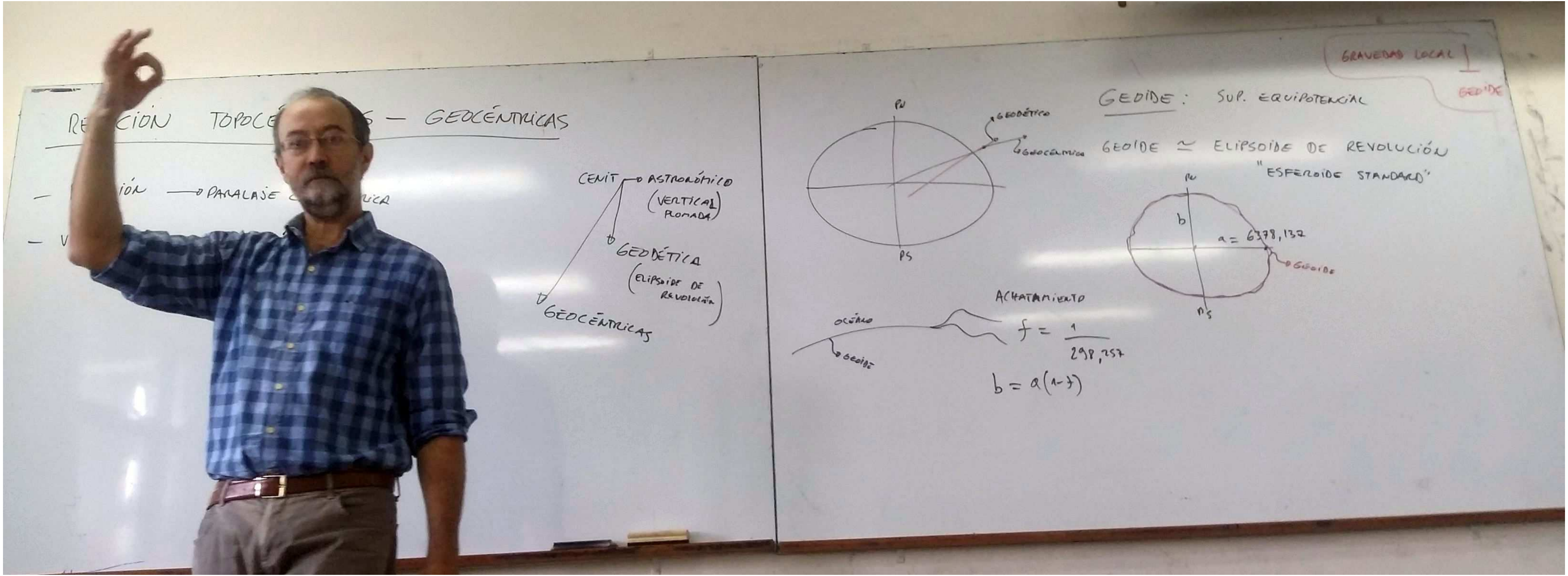

RELACIÓN
LICAS — GEOCÉNTRICAS
— POSICIÓN
— VELOCIDAD
PN
PS
GEOIDE: SUP. EQUIPOTENCIAL
GEOIDE ≃ ELIPSOIDE DE REVOLUCIÓN
"ESFEROIDE STANDARD"
a = 6378,137
ACHATAMIENTO
f = 1 / 298,257

Astronomia Fundamental 2017

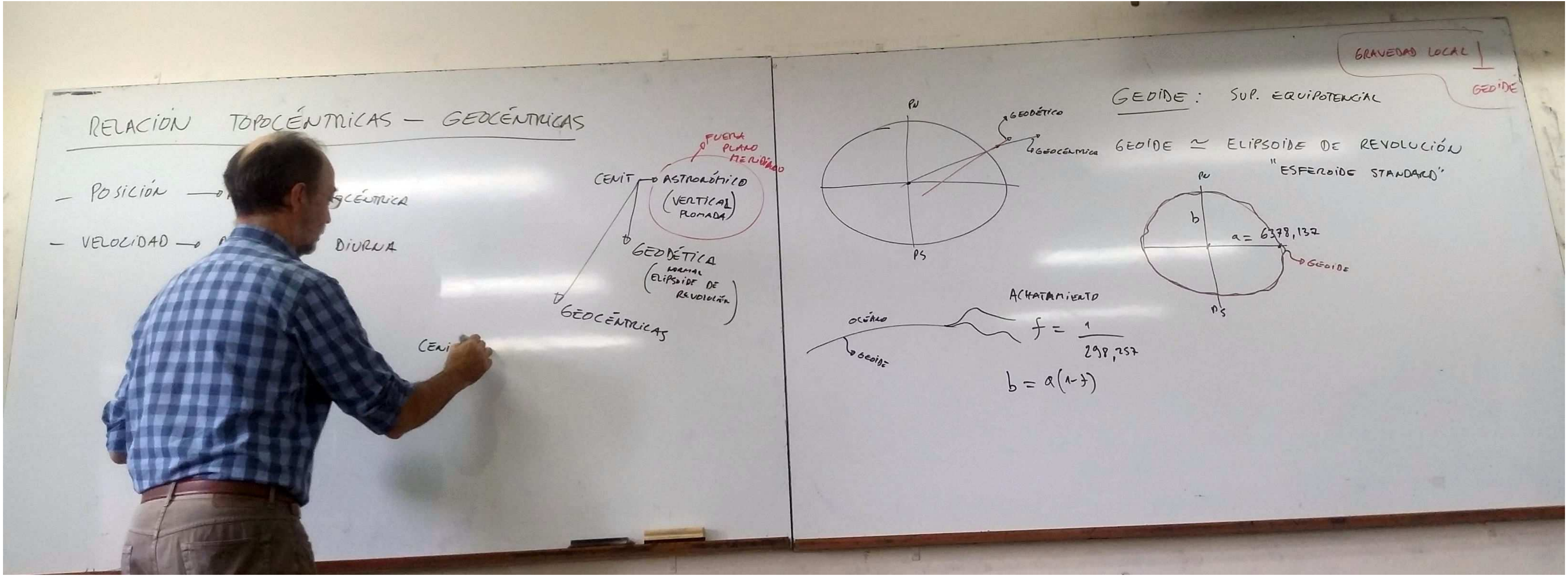


Astronomia Fundamental 2017

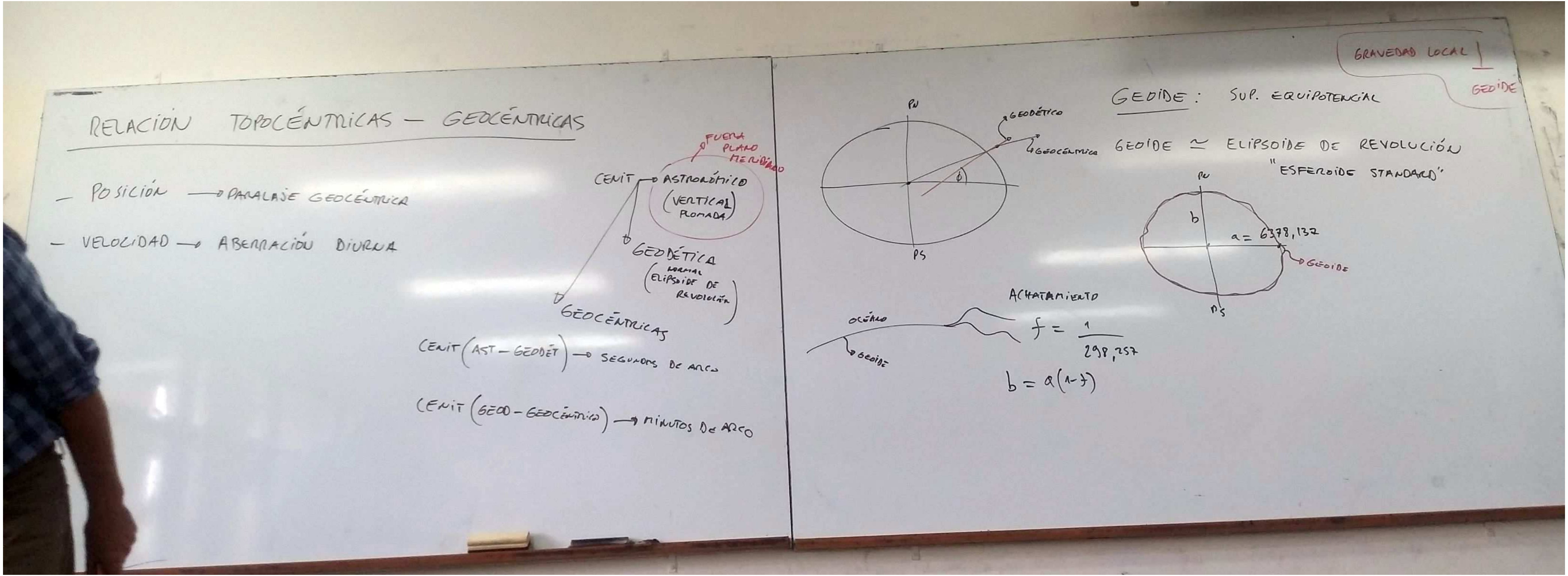



GEOCÉNTRICAS
PARALAJE
CENIT
ASTRONÓMICO
(VERTICAL PLOMADA)
GEODÉTICA
(ELIPSOIDE DE REVOLUCIÓN)
GEOCÉNTRICAS
PN
PS
GEODÉTICO
GRAVEDAD LOCAL
GEOIDE
GEOIDE: SUP. EQUIPOTENCIAL
GEOIDE ≃ ELIPSOIDE DE REVOLUCIÓN
"ESFEROIDE STANDARD"
b
GEOIDE
ACHATAMIENTO
OCÉANO
GEOIDE
f = 1/298,257
b = a(1-f)

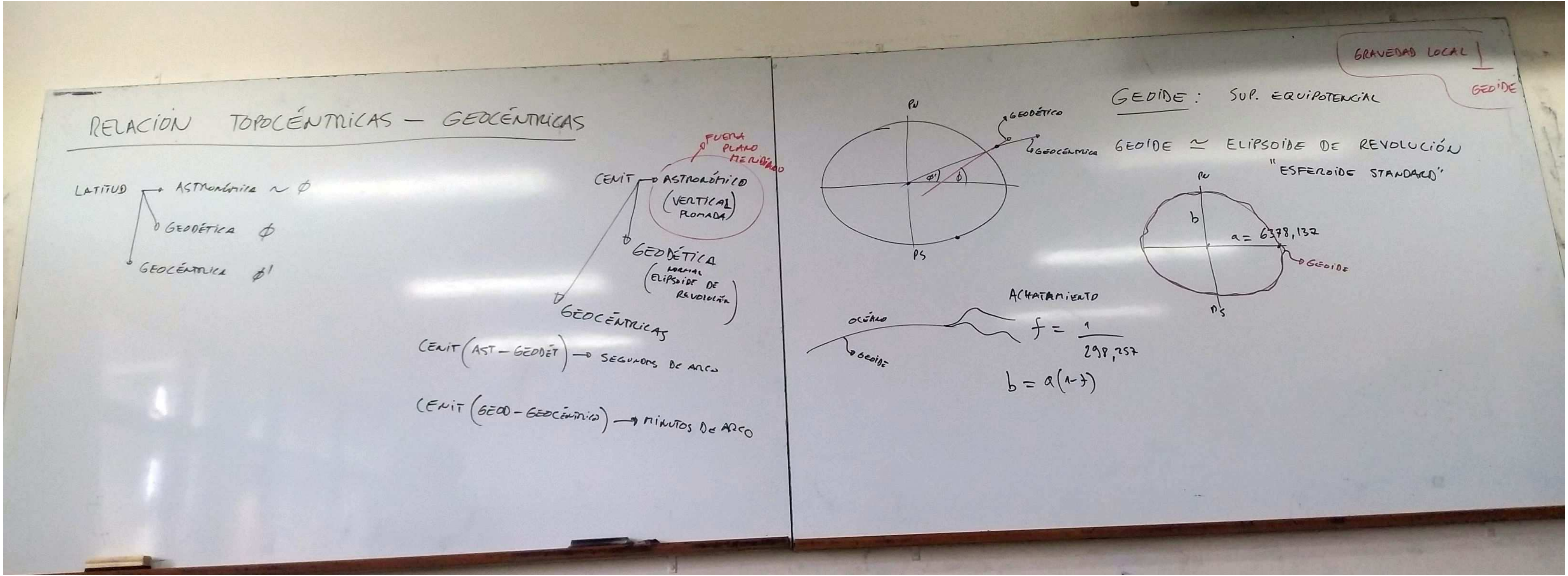
Astronomia Fundamental 2017



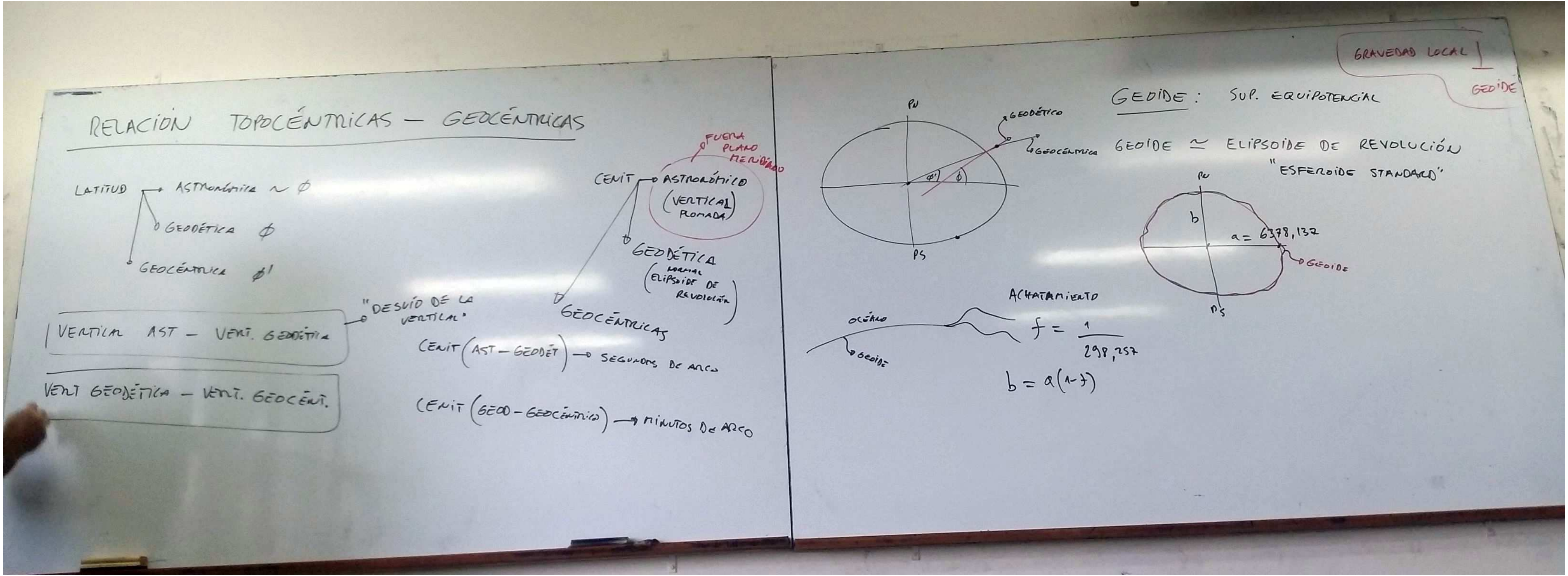
Astronomia Fundamental 2017



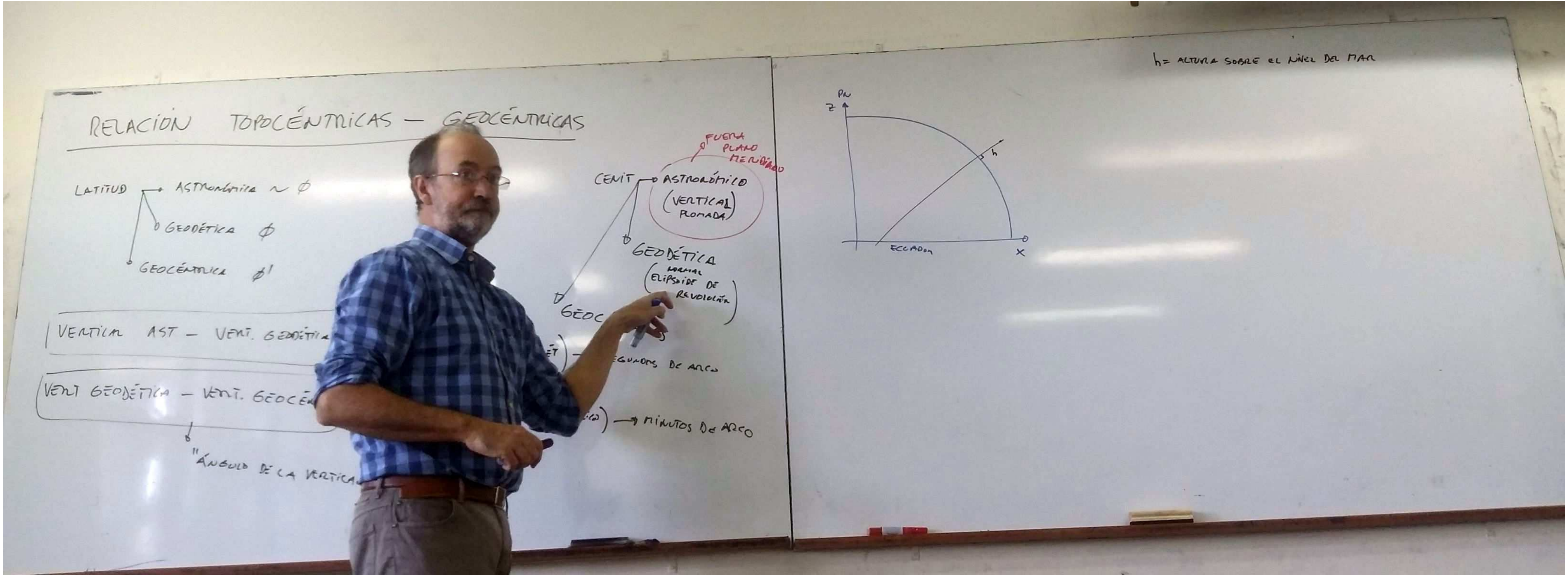
Astronomia Fundamental 2017



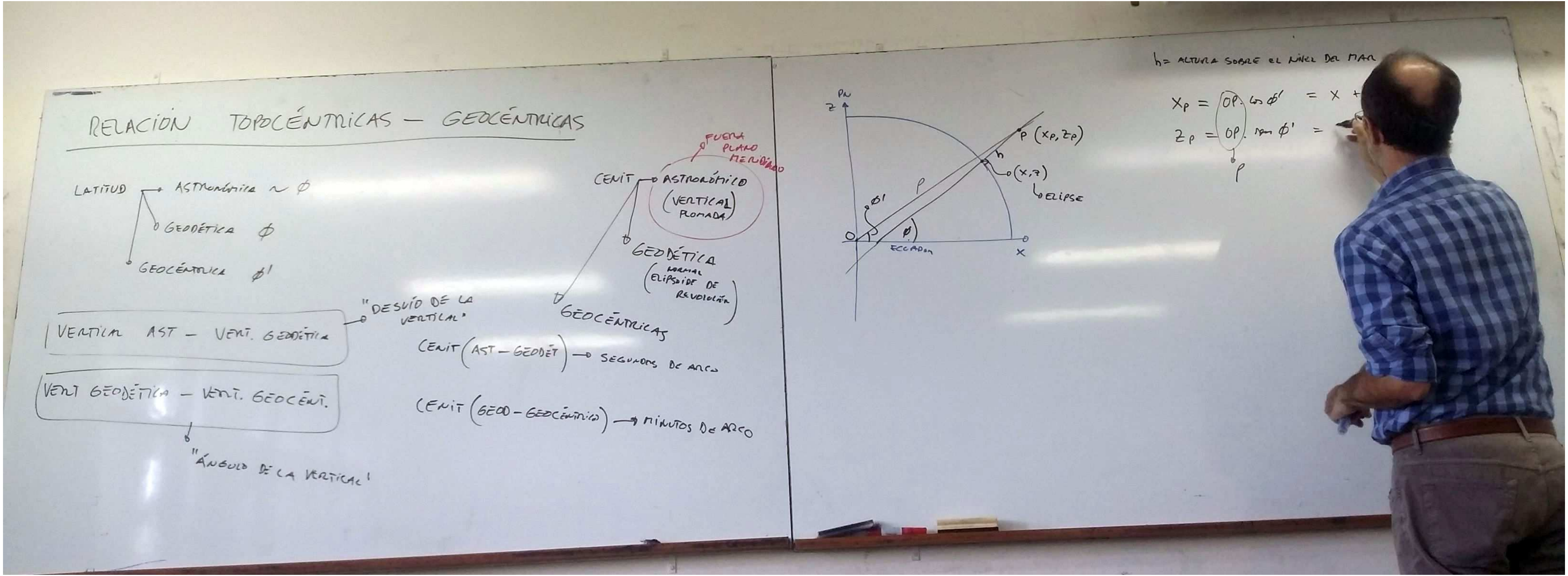
Astronomia Fundamental 2017



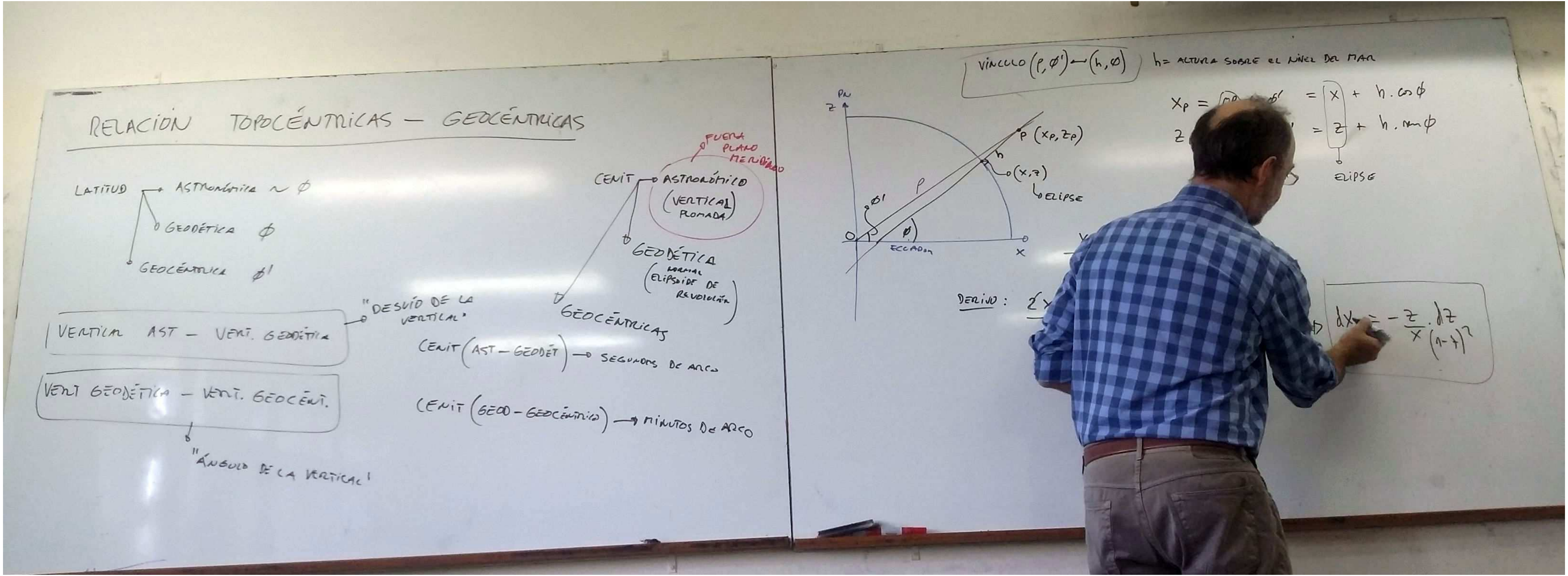
Astronomia Fundamental 2017



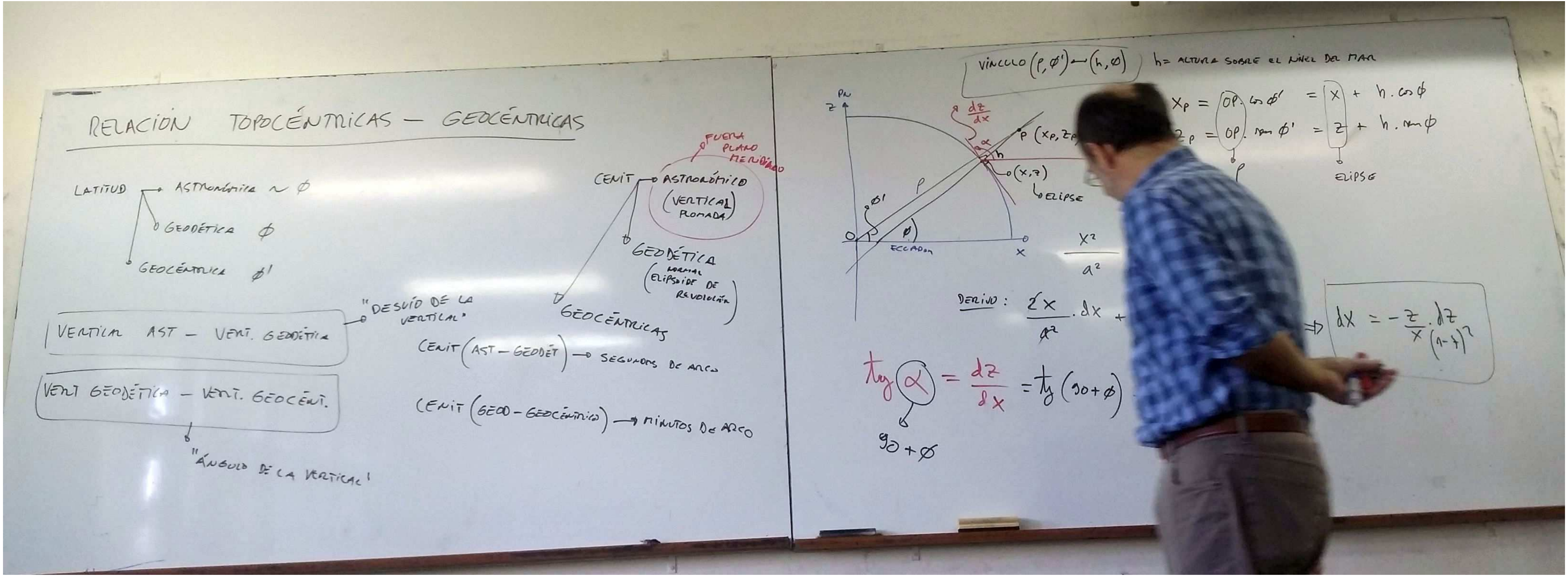
Astronomia Fundamental 2017



Astronomia Fundamental 2017



Astronomia Fundamental 2017



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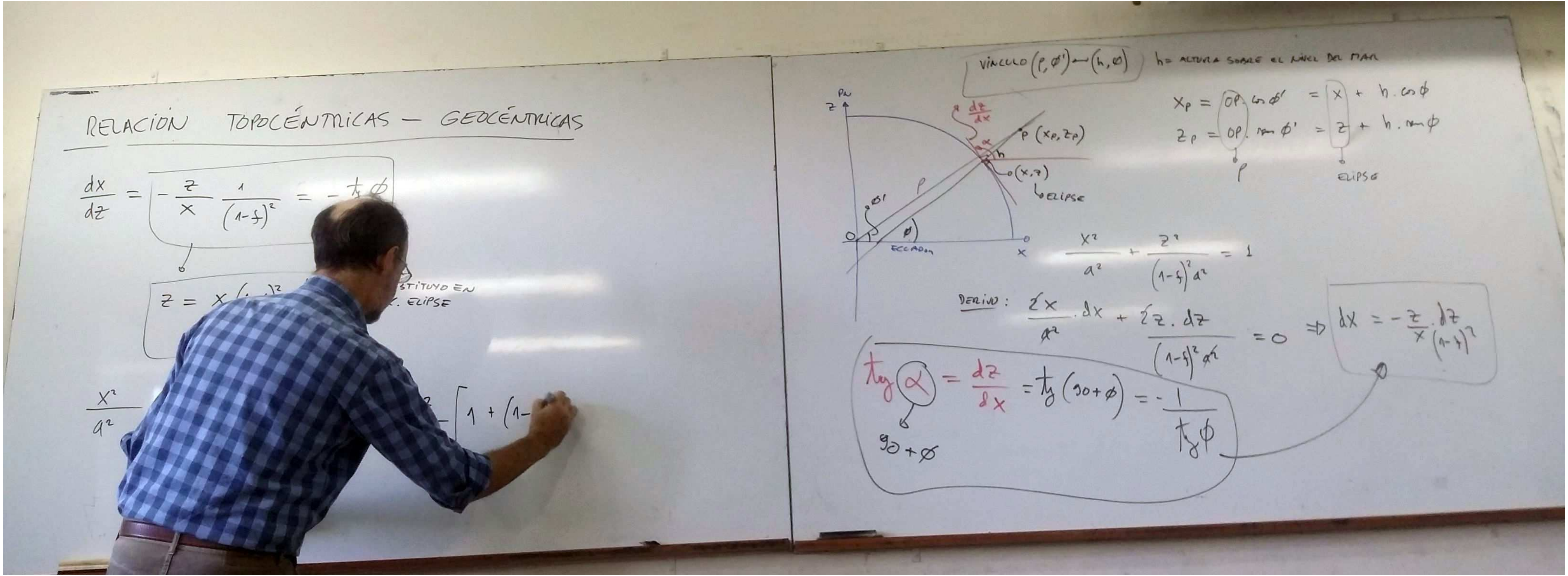
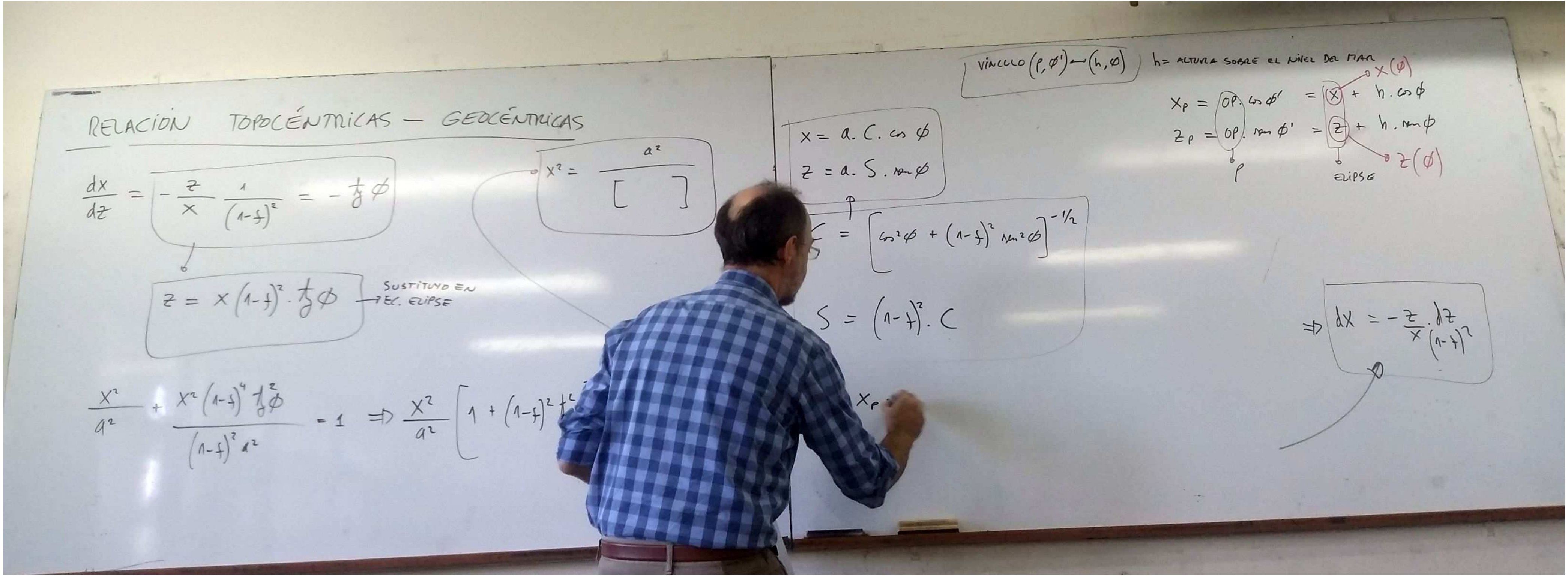
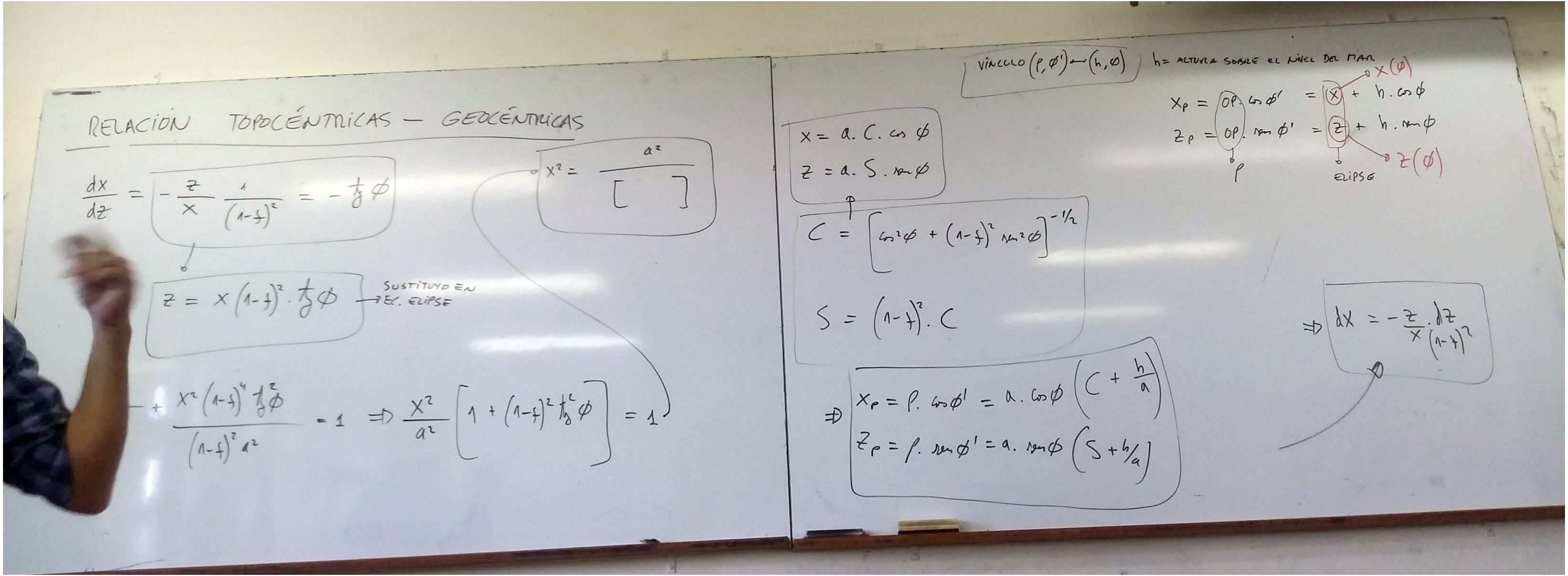
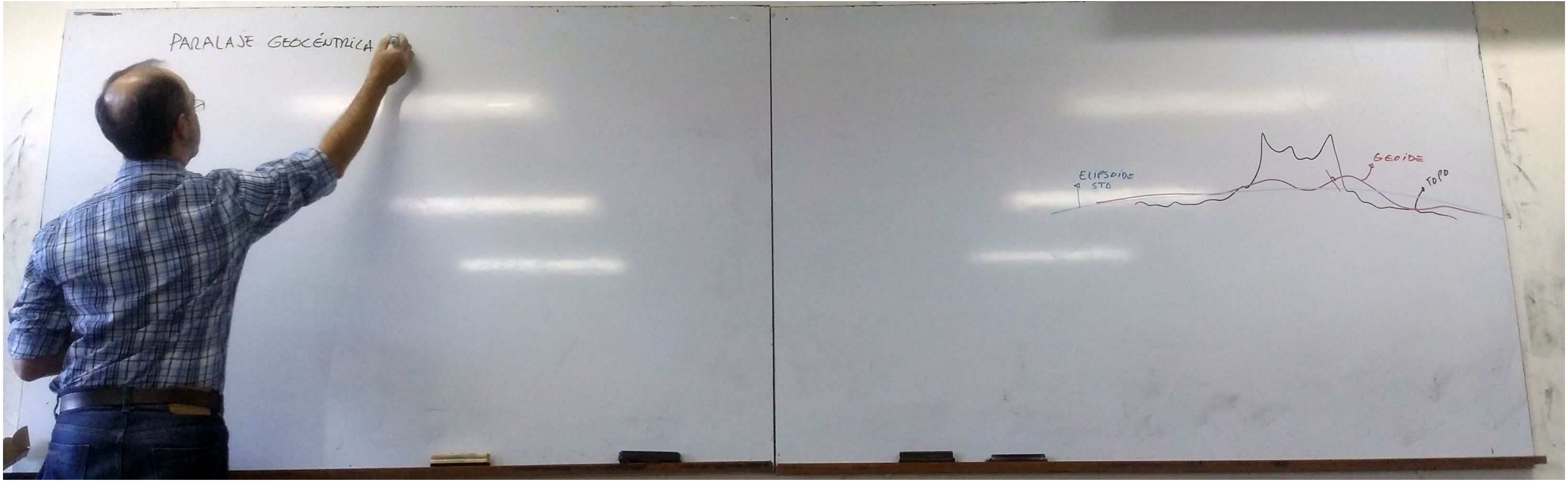
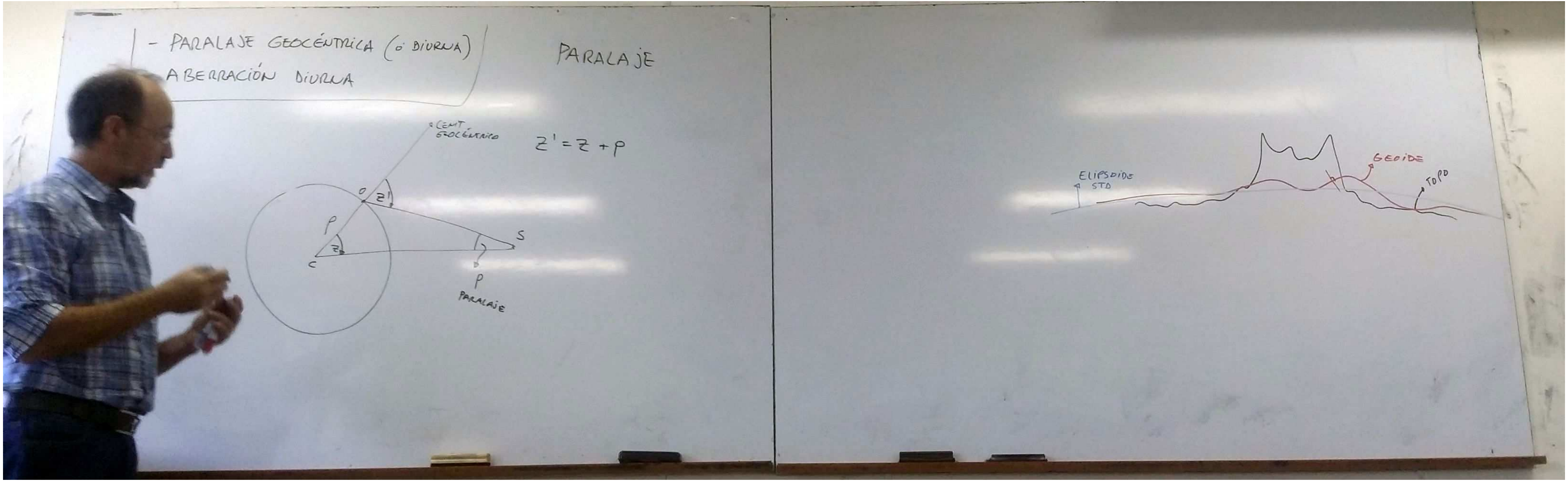


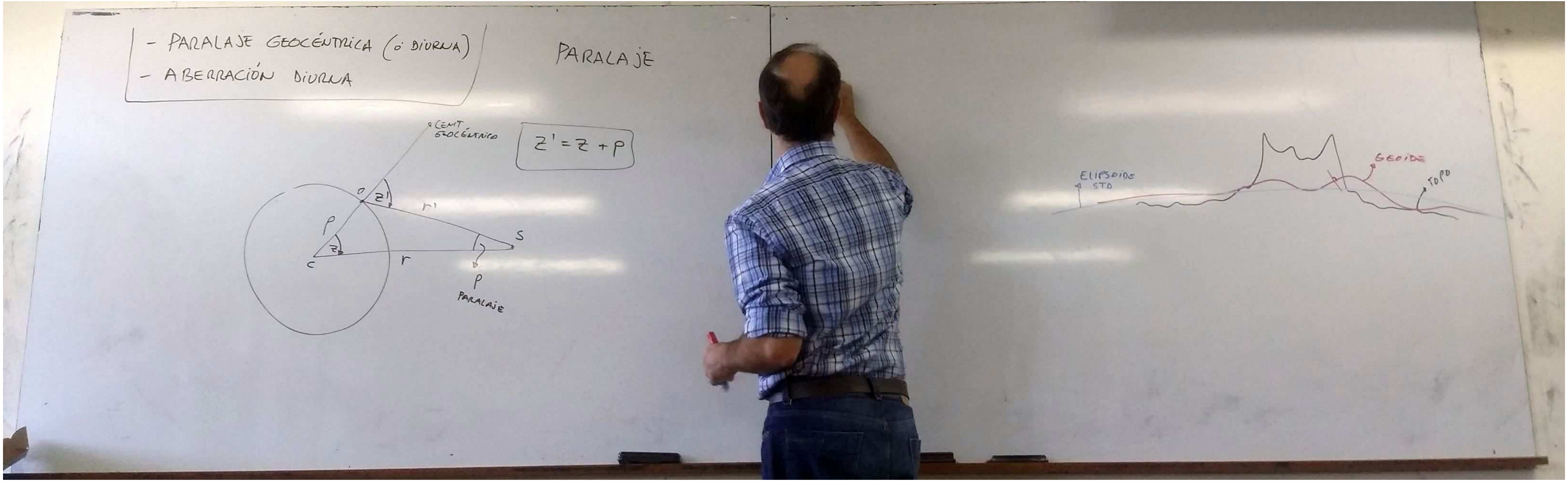
Astronomia Fundamental 2017

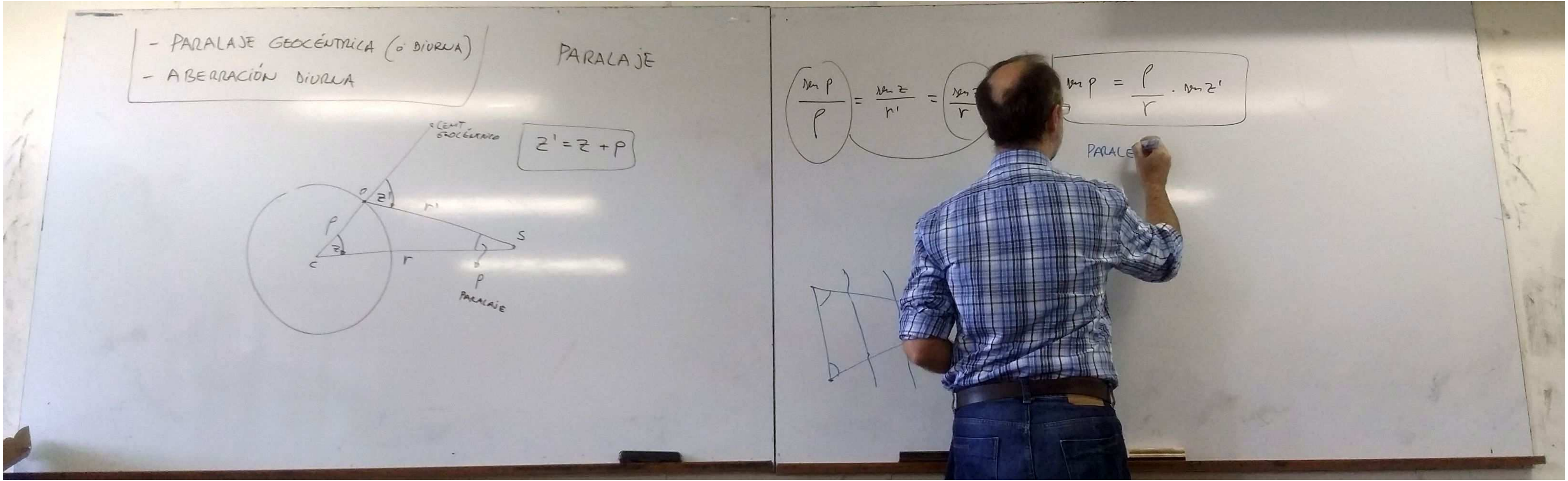



RELACIÓN TOPOCÉNTRICAS – GEOCÉNTRICAS
dx/dz = - z/x 1/(1-f)^2 = - tg φ
z = x (1-f)^2 · tg φ
SUSTITUYO EN EC. ELIPSE
x^2 = a^2 / [ ]
x^2 (1-f)^4 tg^2 φ / (1-f)^2 a^2 = 1 ⇒ X^2/a^2 [1 + (1-f)^2 tg^2 φ] = 1
VINCULO (ρ, φ') ⟷ (h, φ)
h= ALTURA SOBRE EL NIVEL DEL MAR
x = a. C. cos φ
z = a. S. sen φ
C = [cos^2 φ + (1-f)^2 sen^2 φ]^-1/2
S = (1-f)^2. C
Xp = ρ. cos φ' = a. cos φ (C + h/a)
Zp = ρ. sen φ' = a. sen φ (S + h/a)
Xp = OP. cos φ' = X + h. cos φ
Zp = OP. sen φ' = Z + h. sen φ
X(φ)
Z(φ)
ρ
ELIPSE
⇒ dX = - Z/X . dZ/(1-f)^2

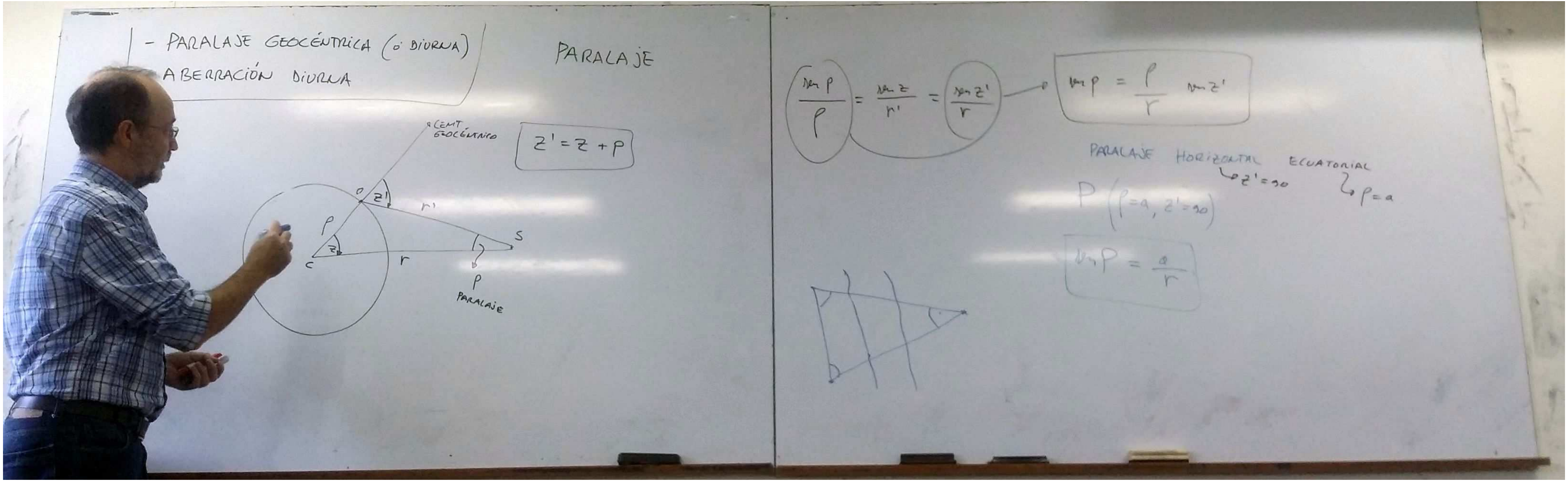

PARALAJE GEOCÉNTRICA
ELIPSOIDE
STD
GEOIDE
TOPO

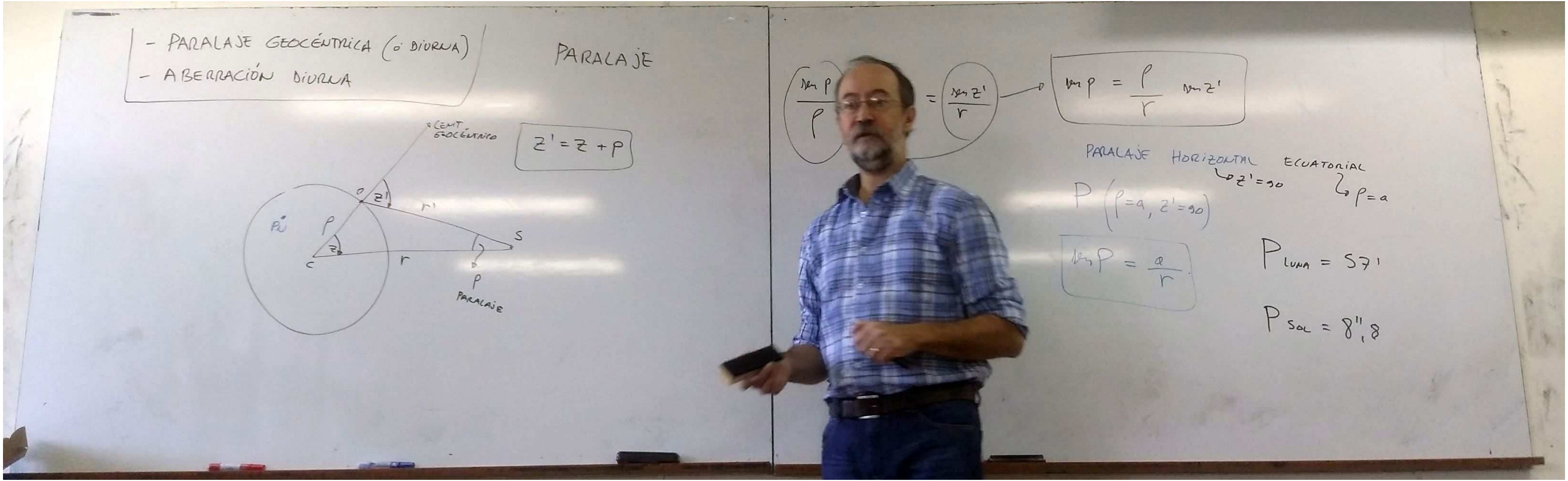

- PARALAJE GEOCÉNTRICA (ó DIURNA)
- ABERRACIÓN DIURNA
PARALAJE
CENT GEOCÉNTRICO
Z' = Z + P
O
Z'
P
Z
C
S
P
PARALAJE
ELIPSOIDE STD
GEOIDE
TOPO


- PARALAJE GEOCÉNTRICA (ó DIURNA)
- ABERRACIÓN DIURNA
PARALAJE
CENIT GEOCÉNTRICO
Z' = Z + P
O
Z'
r'
ρ
Z
C
r
S
P
PARALAJE
ELIPSOIDE STD
GEOIDE
TOPO

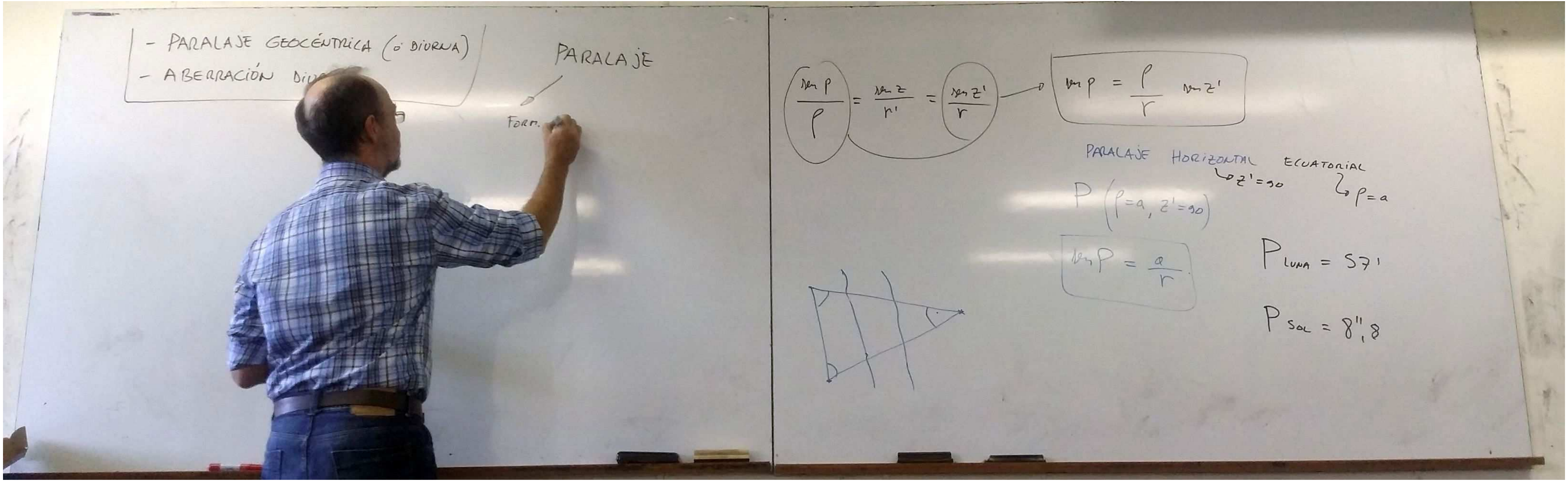

- PARALAJE GEOCÉNTRICA (ó DIURNA)
- ABERRACIÓN DIURNA
PARALAJE
Z' = Z + p
PARALAJE
PARALE

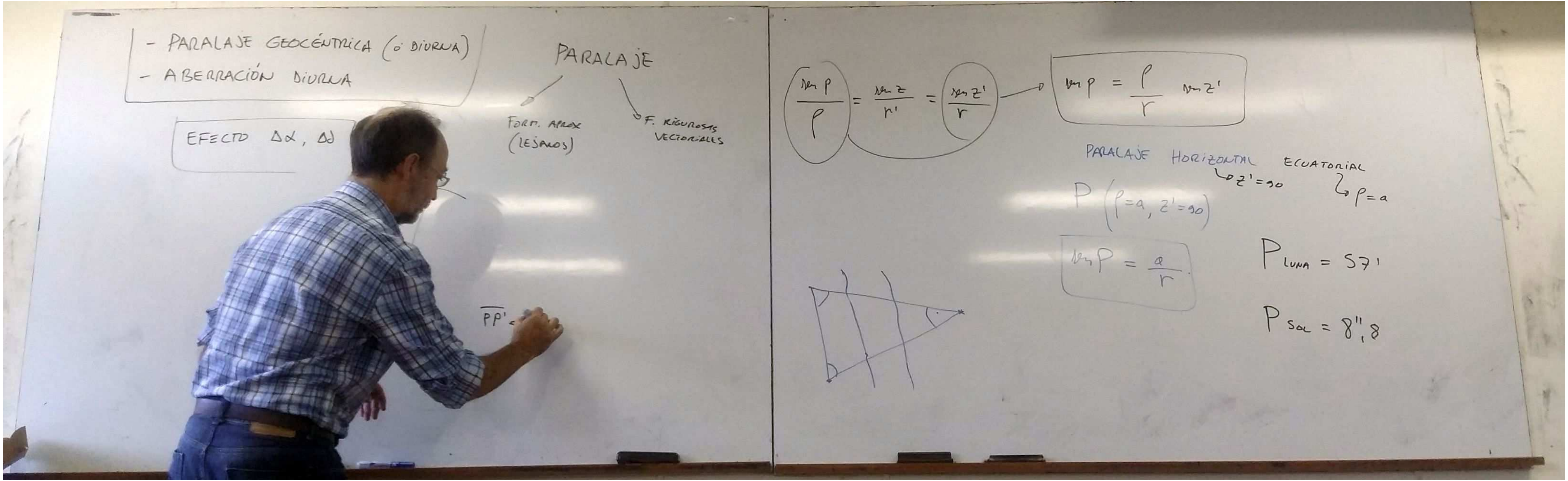
Astronomia Fundamental 2017

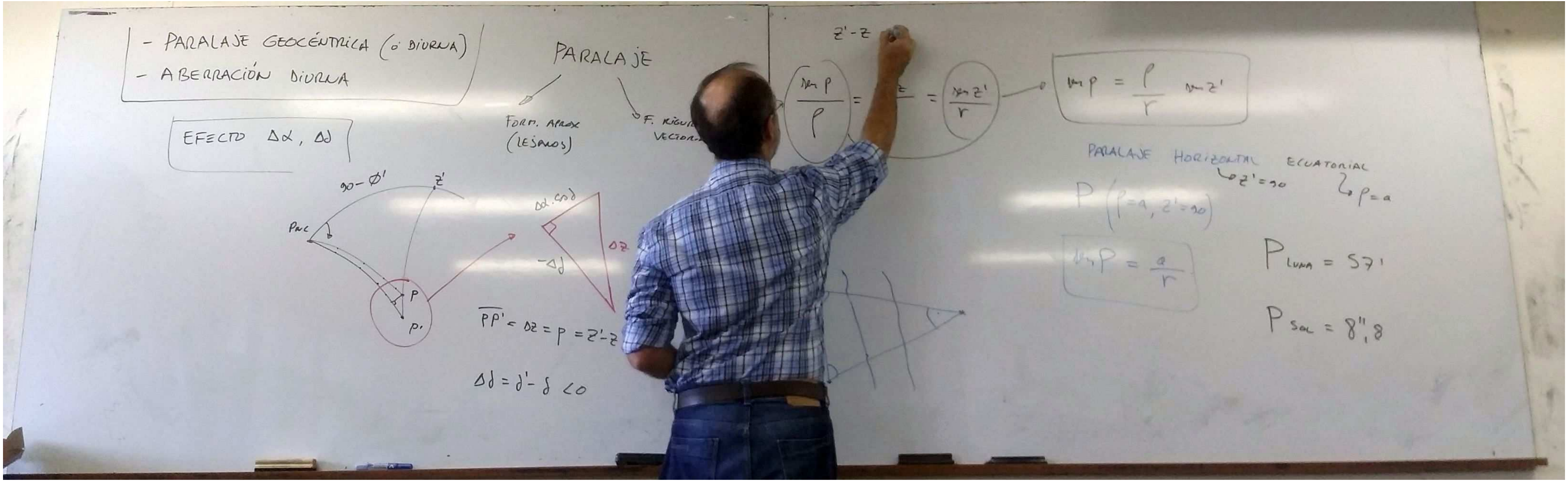


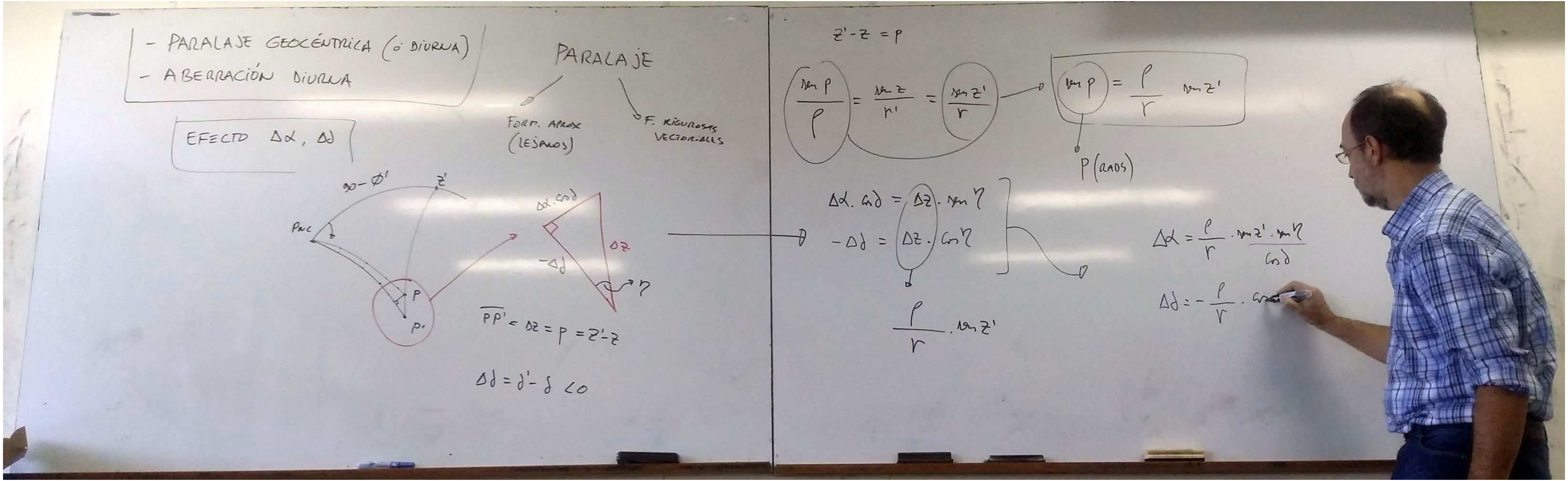

- PARALAJE GEOCÉNTRICA (o DIURNA)
- ABERRACIÓN DIURNA
PARALAJE
CENIT GEOCÉNTRICO
z' = z + p
PARALAJE
PARALAJE HORIZONTAL ECUATORIAL
P_LUNA = 57'
P_SOL = 8",8

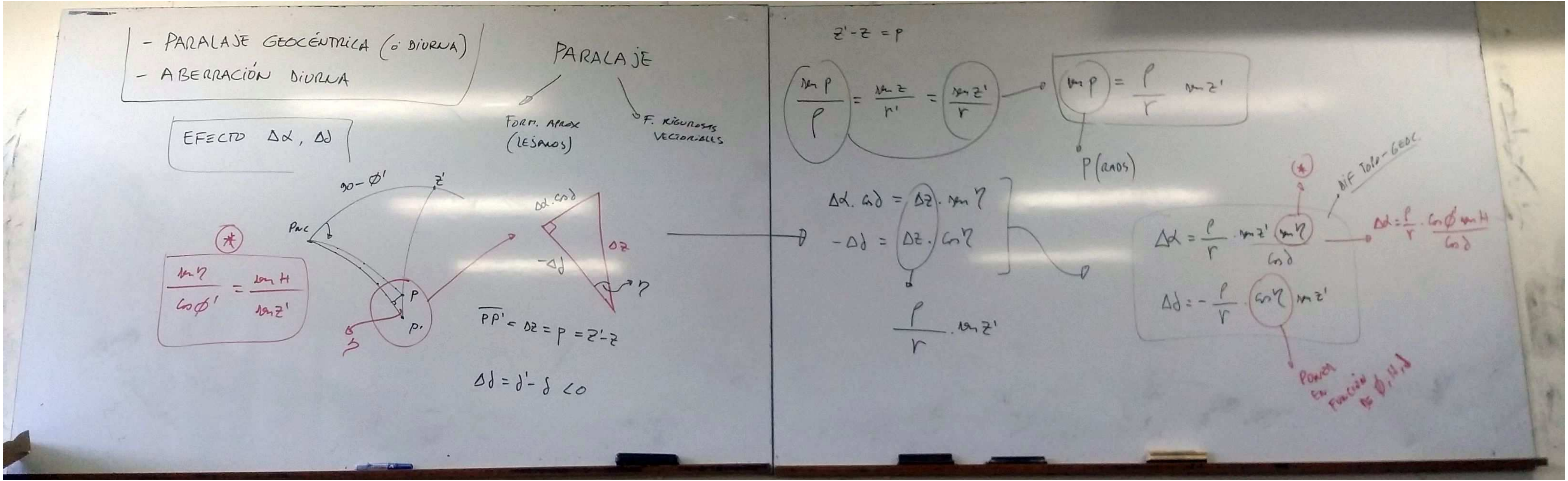
Astronomia Fundamental 2017



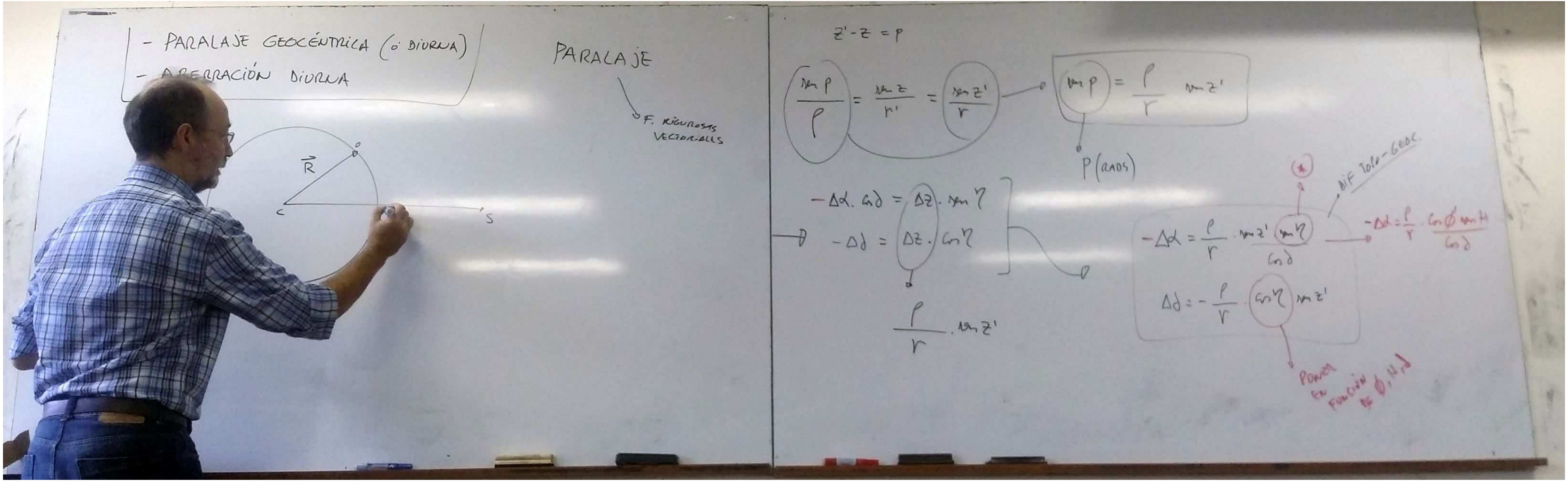

- PARALAJE GEOCÉNTRICA (ó DIURNA)
- ABERRACIÓN DIURNA
EFECTO Δα, Δδ
PARALAJE
FORM. APROX (LEJANOS)
F. RIGUROSAS VECTORIALES
PARALAJE HORIZONTAL ECUATORIAL
P LUNA = 57'
P SOL = 8",8


- PARALAJE GEOCÉNTRICA (ó DIURNA)
- ABERRACIÓN DIURNA
PARALAJE
FORM. APROX (LEJANOS)
EFECTO Δα, Δδ
90 − Φ'
z'
P
P'
Δα.cosδ
−Δδ
ΔZ
PP' = ΔZ = p = z'−z
Δδ = δ' − δ < 0
z' − z
PARALAJE HORIZONTAL ECUATORIAL
z' = 90
ρ = a
P (ρ = a, z' = 90)
P LUNA = 57'
P SOL = 8'',8

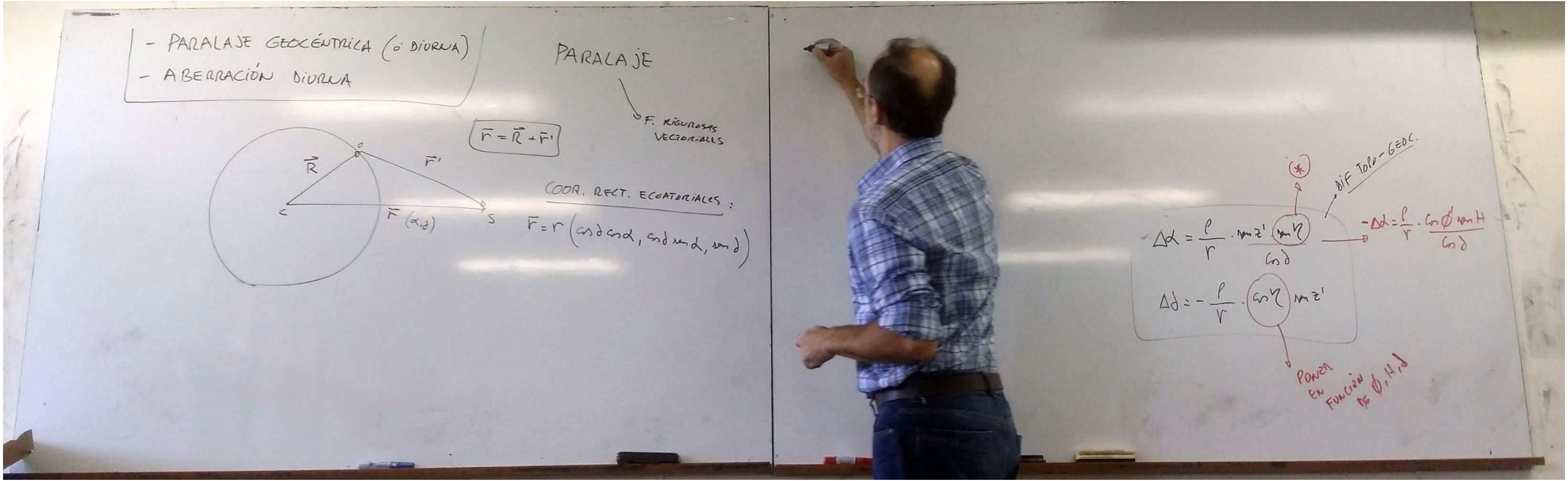

- PARALAJE GEOCÉNTRICA (ó DIURNA)
- ABERRACIÓN DIURNA
PARALAJE
FORM. APROX (LEJANOS)
F. RIGUROSAS VECTORIALES
EFECTO Δα, Δδ
90 − φ'
Z'
PNC
P
P'
Δα . cos δ
Δz
−Δδ
η
PP' = Δz = p = z' − z
Δδ = δ' − δ < 0
z' − z = p
Δα . cos δ = Δz . sen η
−Δδ = Δz . cos η
P (RADS)
Δα = ρ/r . sen z' . sen η / cos δ
Δδ = − ρ/r . cos

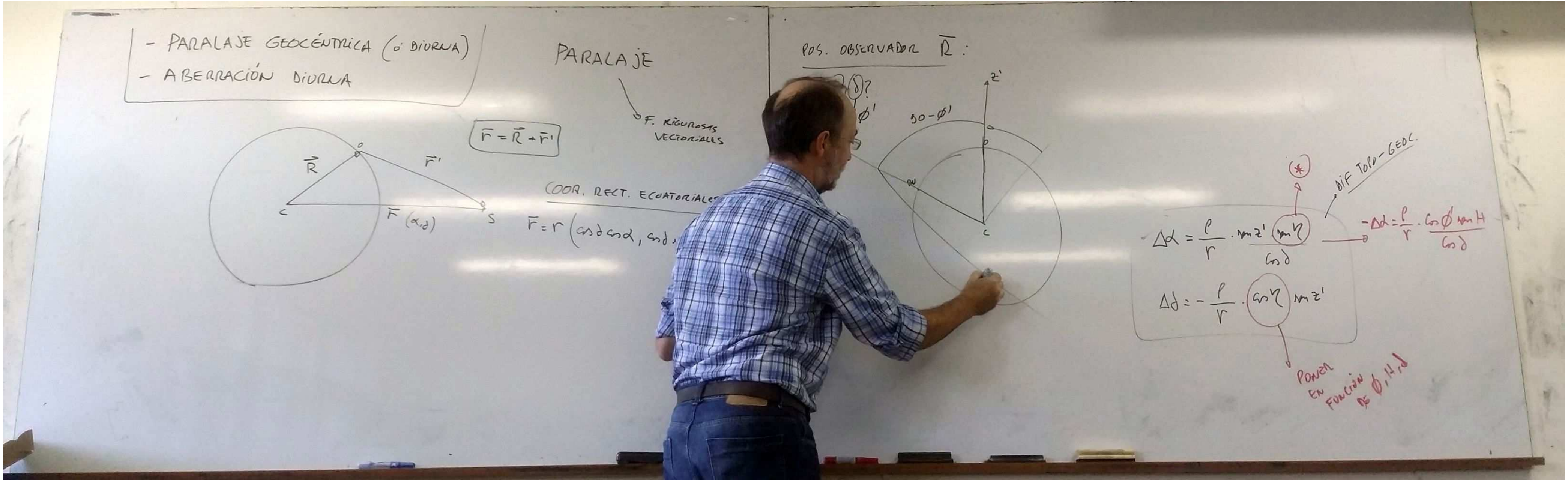

- PARALAJE GEOCÉNTRICA (ó DIURNA)
- ABERRACIÓN DIURNA
PARALAJE
F. RIGUROSAS VECTORIALES
EFECTO Δα, Δδ
z' - z = p
P (RADS)
DIF TOPO-GEOC
PONER EN FUNCIÓN DE φ, H, δ

Astronomia Fundamental 2017



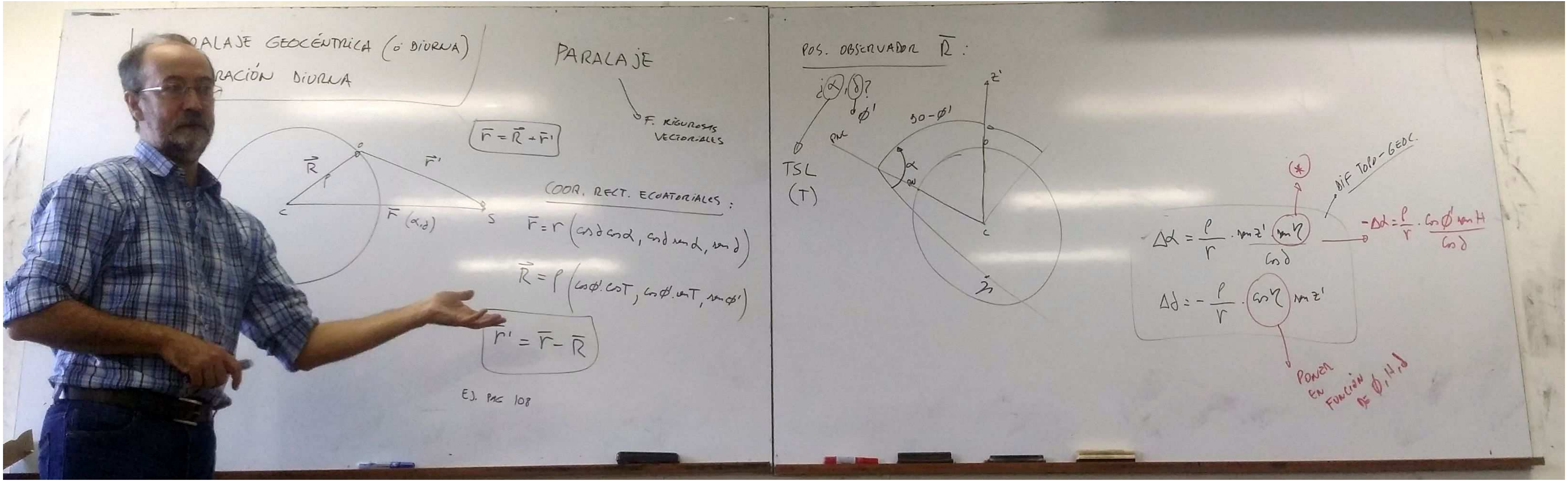
Astronomia Fundamental 2017



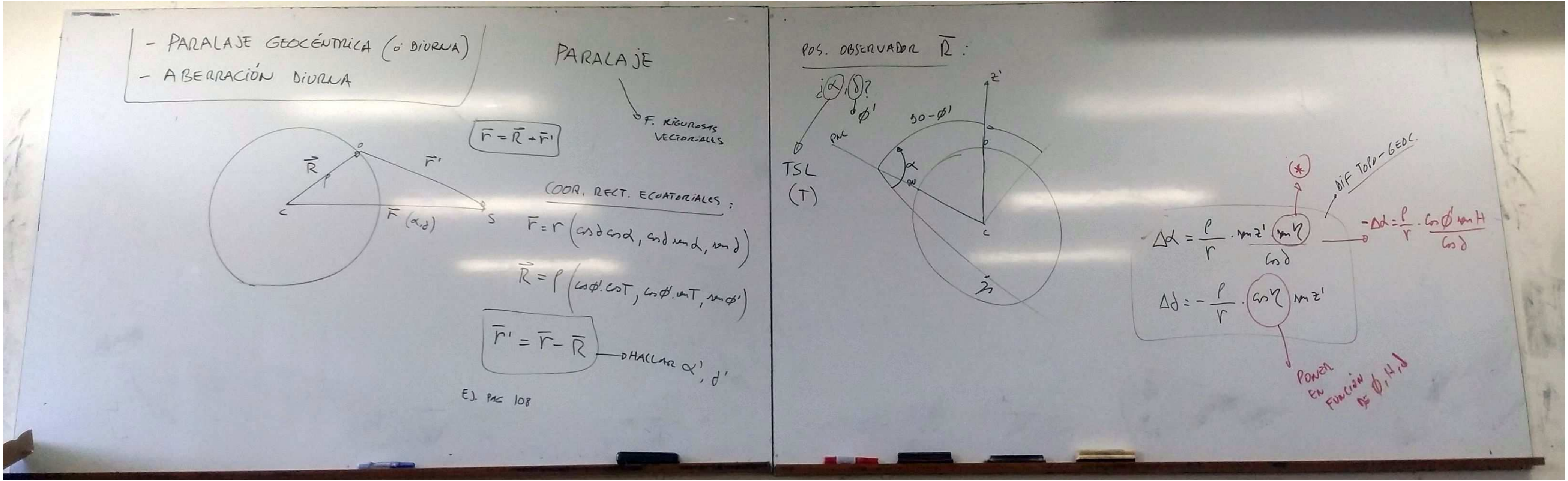


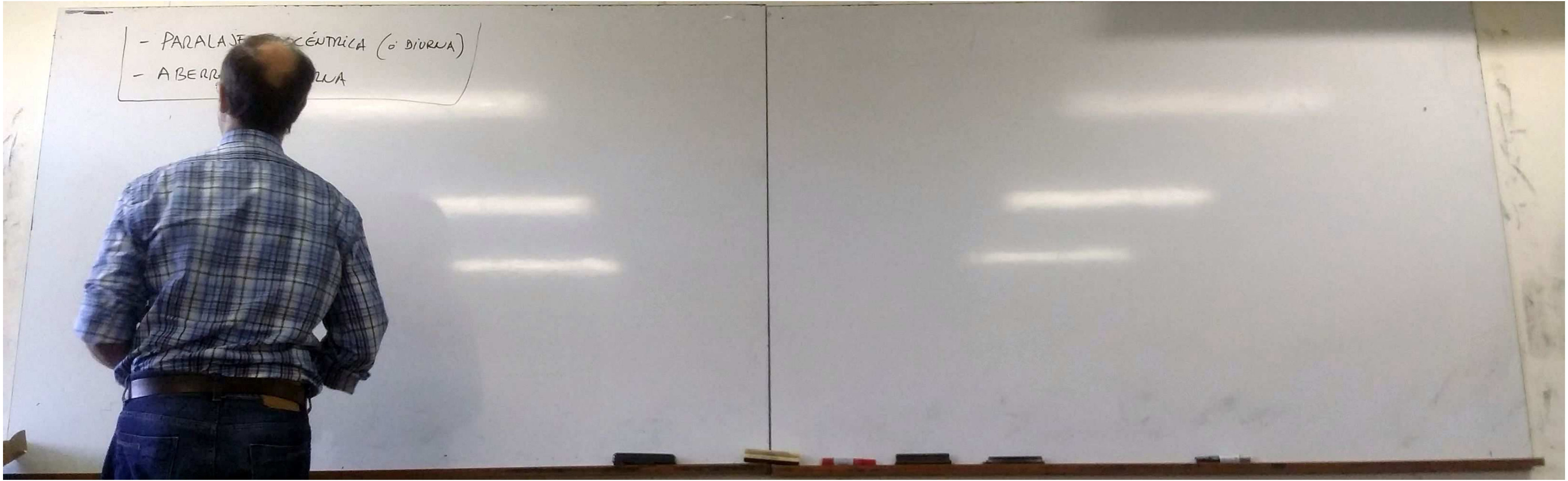
- PARALAJE GEOCÉNTRICA (ó DIURNA)
- ABERRACIÓN DIURNA
PARALAJE
F. RIGUROSAS VECTORIALES
$\vec{r} = \vec{R} + \vec{r}'$
COOR. RECT. ECUATORIALES
POS. OBSERVADOR $\vec{R}$:
DIF TOPO-GEOC.
PONER EN FUNCIÓN DE ϕ, H, δ

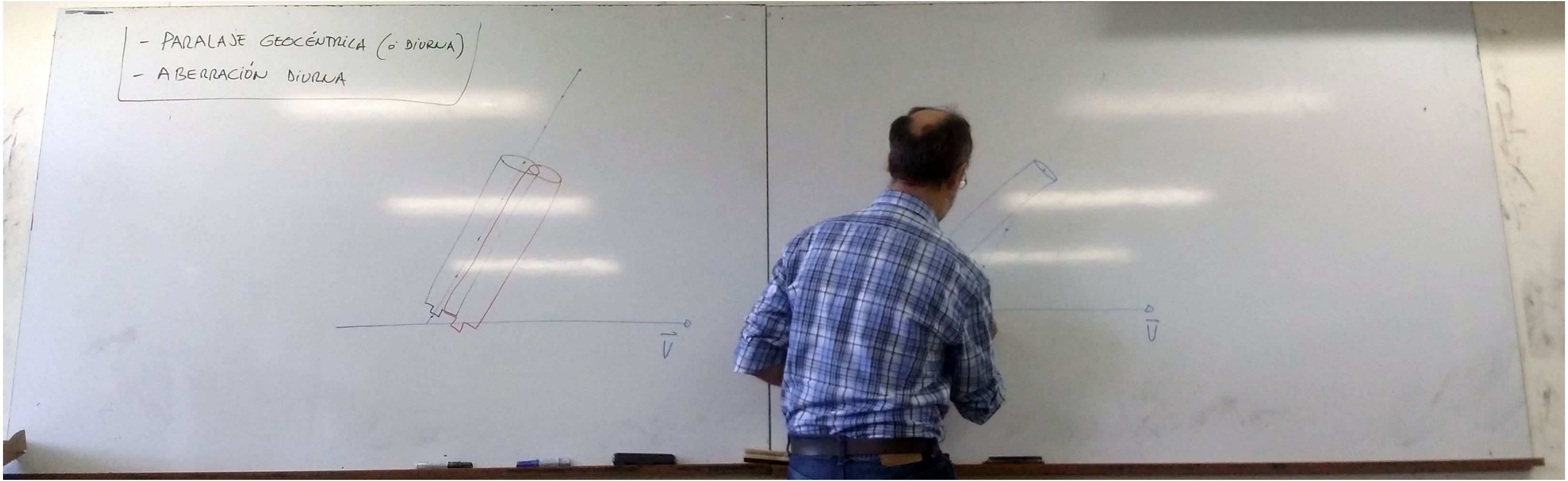
Astronomia Fundamental 2017

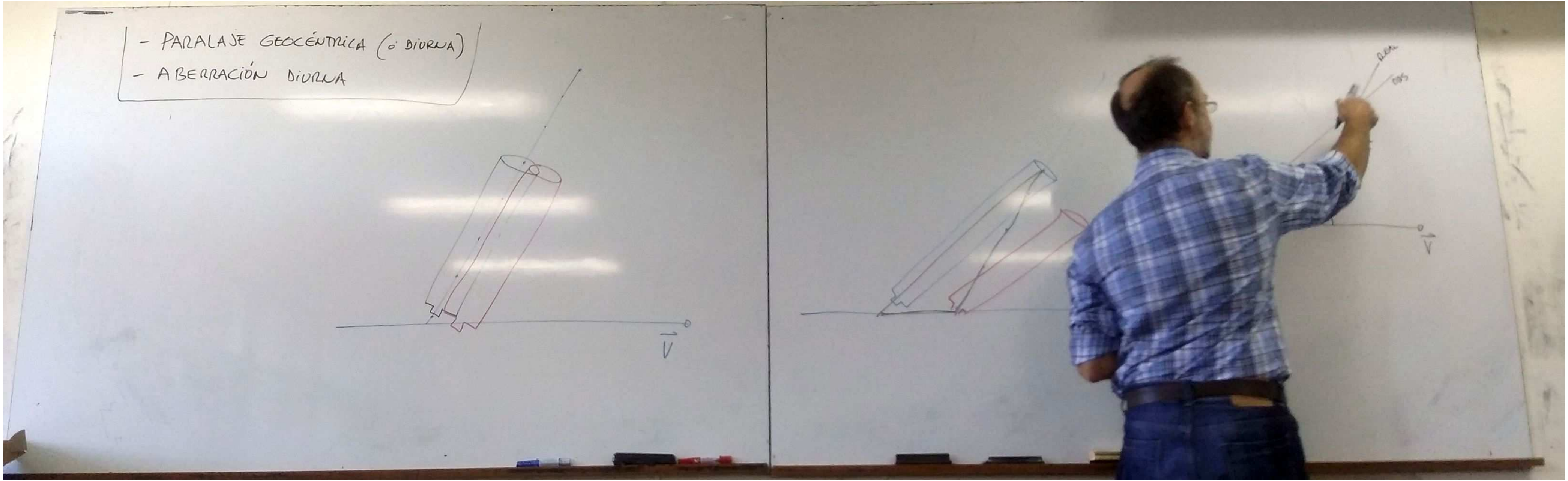


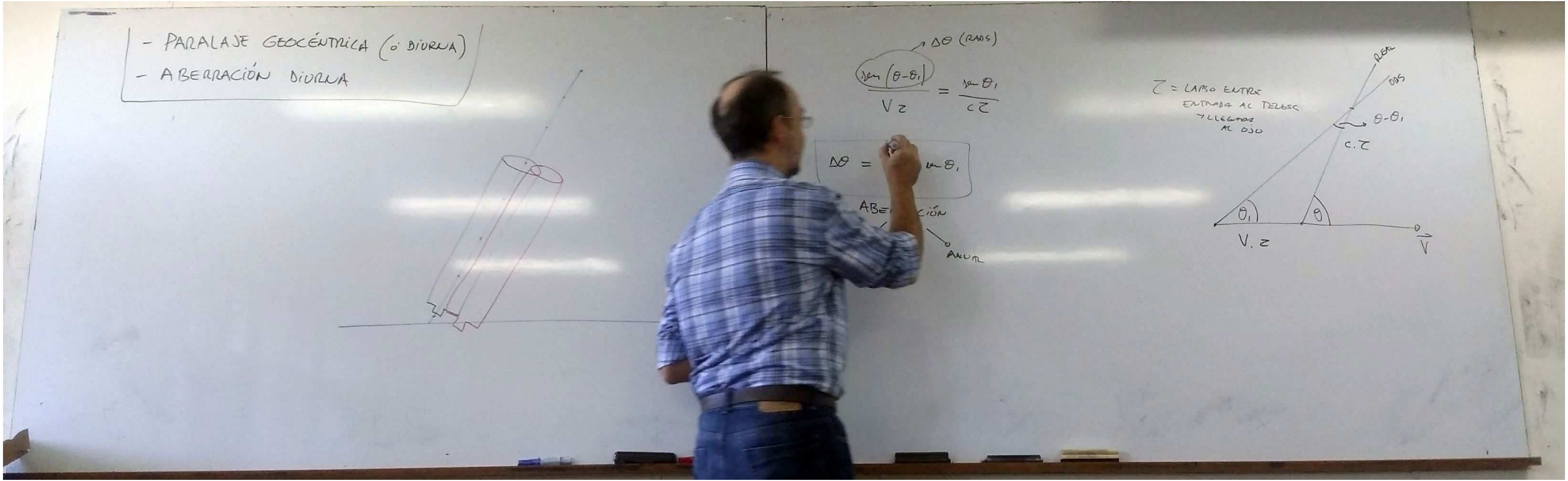
Astronomia Fundamental 2017



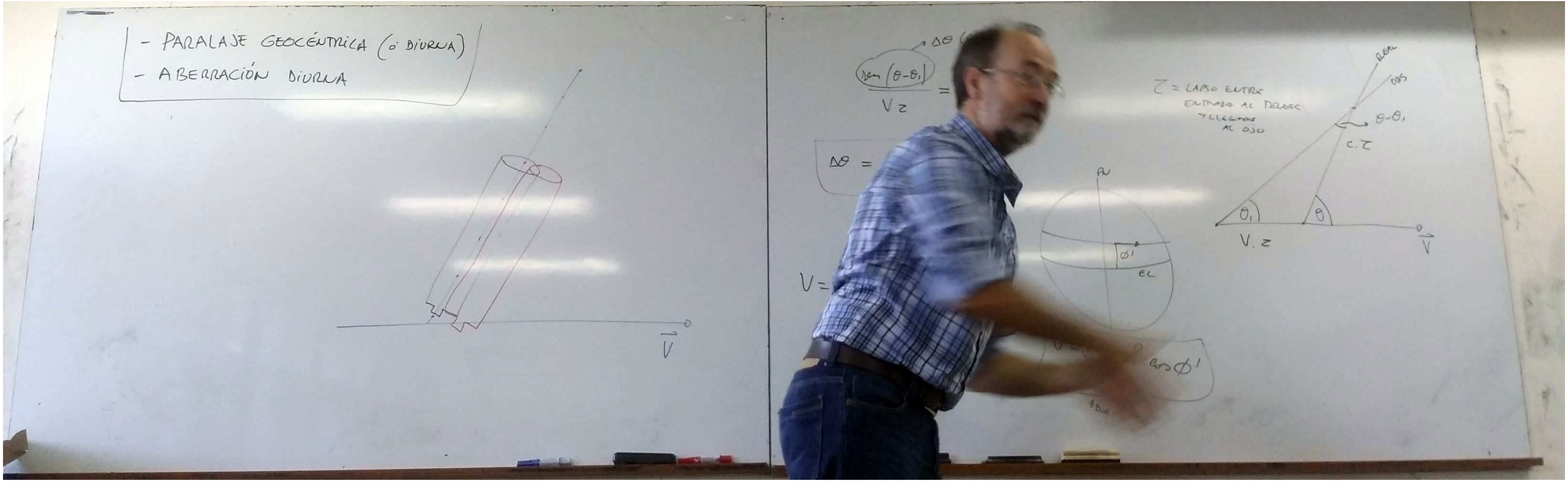

(ó DIURNA)


- PARALAJE GEOCÉNTRICA (ó DIURNA)
- ABERRACIÓN DIURNA
$\vec{V}$
$\vec{V}$

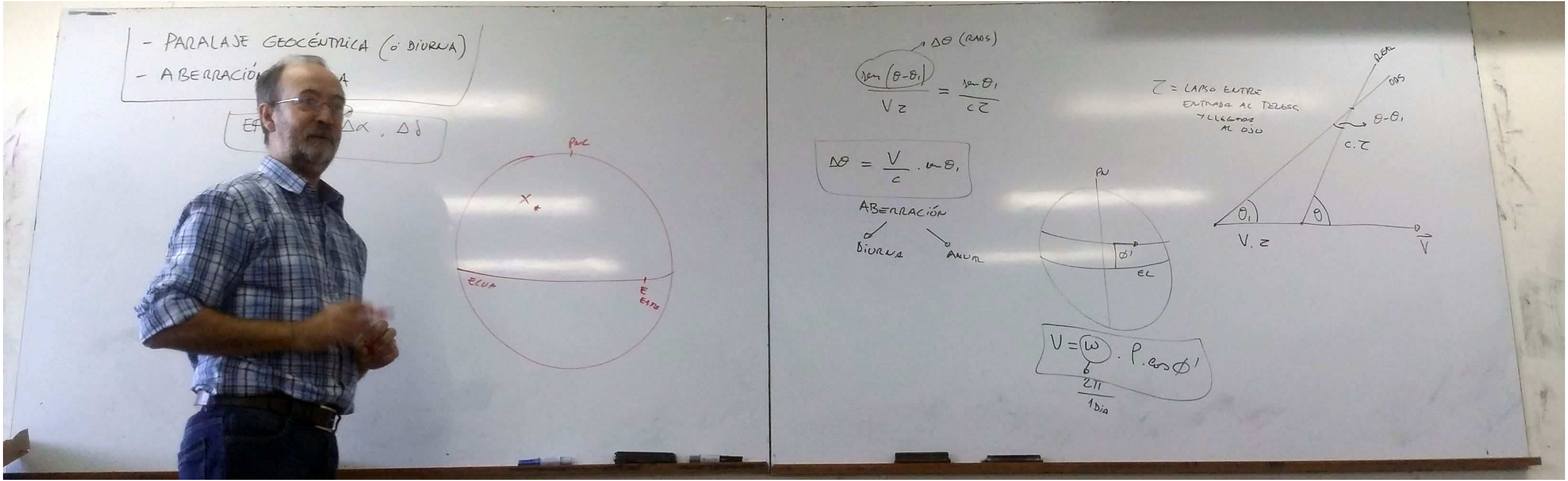

- PARALAJE GEOCÉNTRICA (ó DIURNA)
- ABERRACIÓN DIURNA
V
V


- PARALAJE GEOCÉNTRICA (ó DIURNA)
- ABERRACIÓN DIURNA
Δθ (RADS)
V z
c τ
Δθ =
τ = LAPSO ENTRE
REAL
OBS
θ-θ1
c.τ
θ1
θ
V. z
V

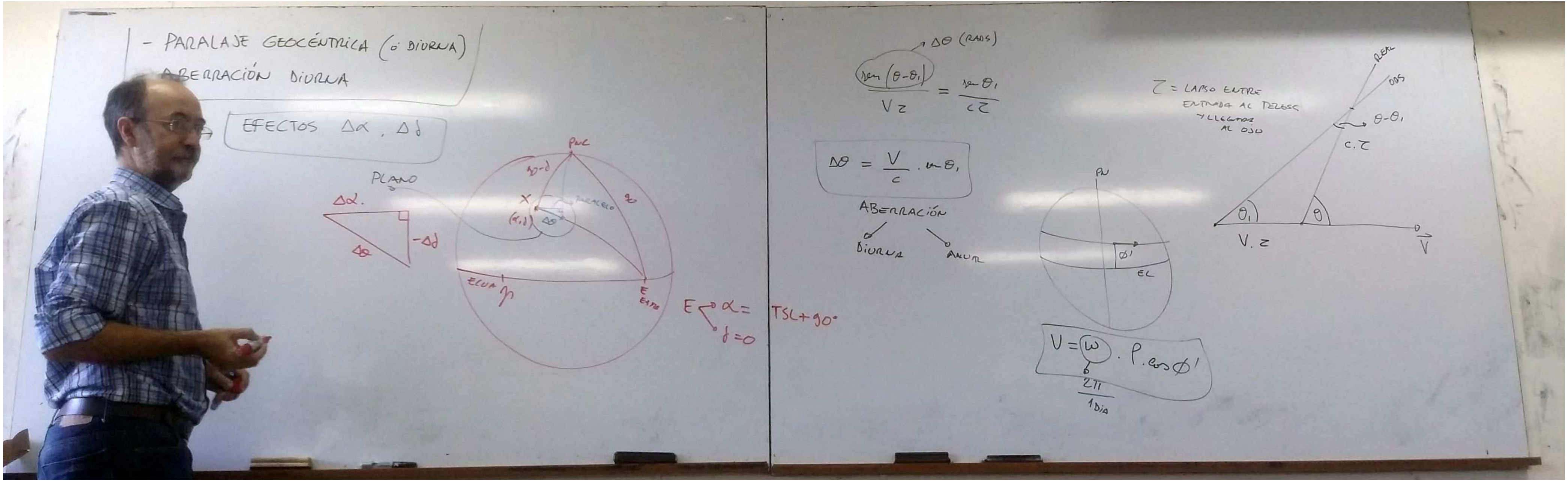
Astronomia Fundamental 2017

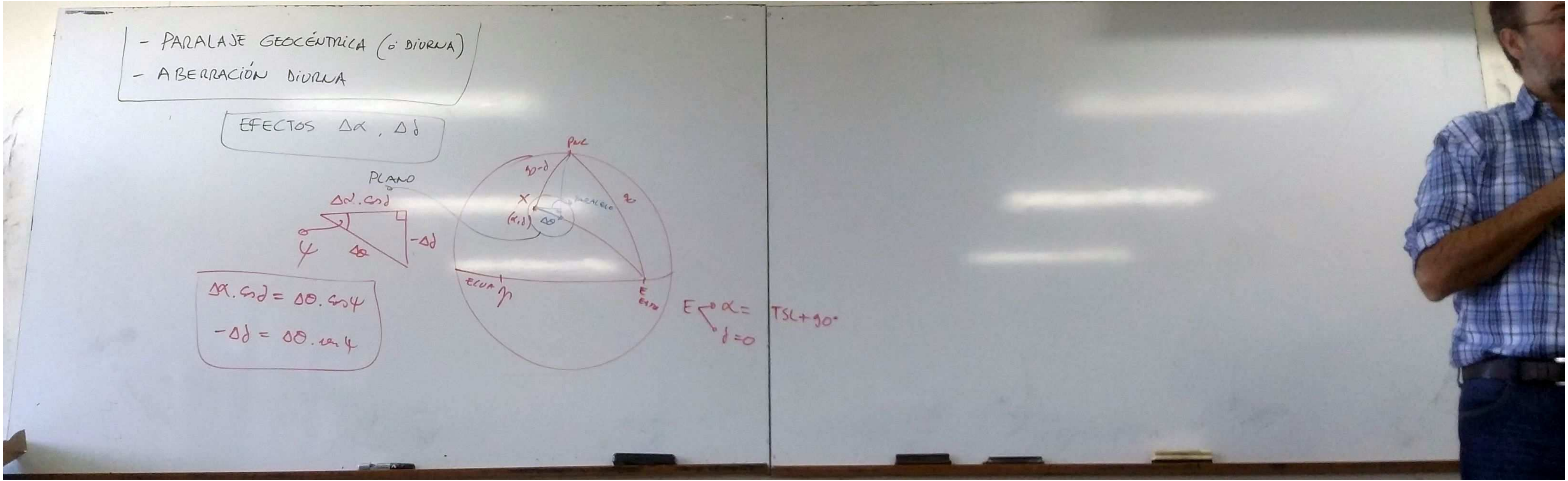


Astronomia Fundamental 2017

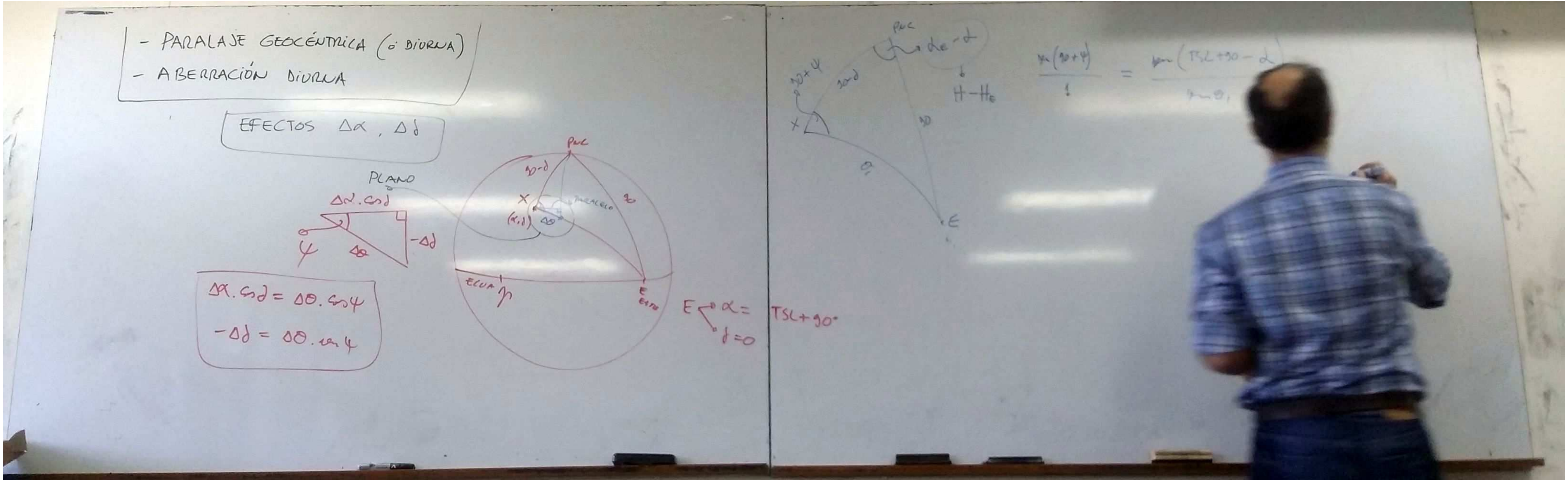


Astronomia Fundamental 2017

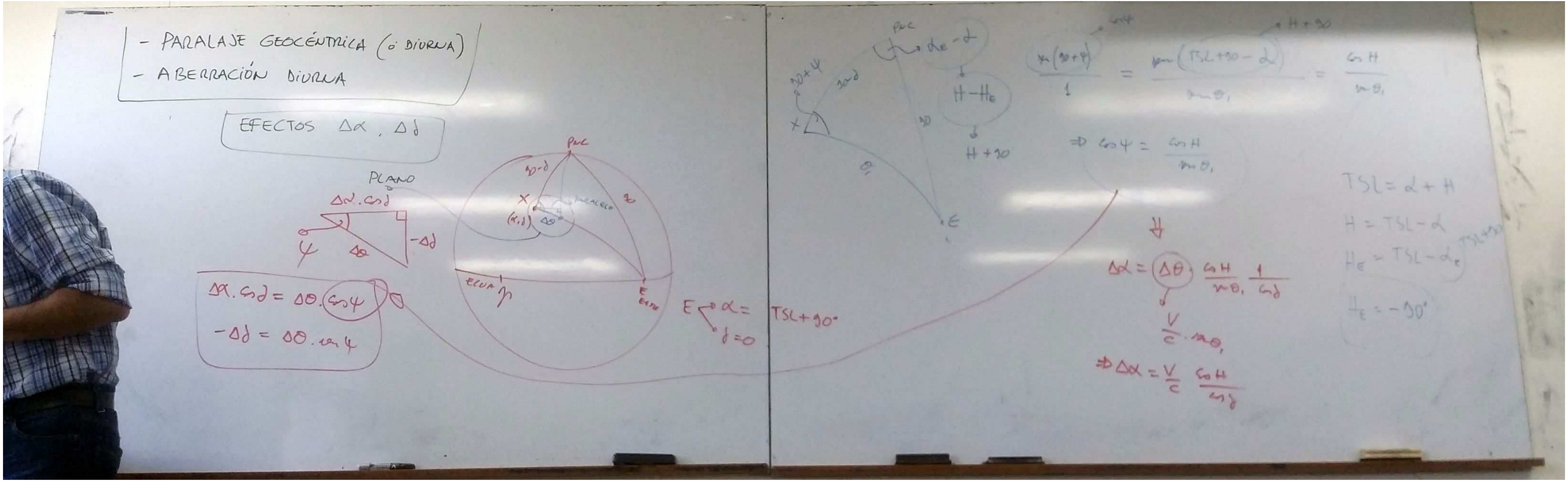


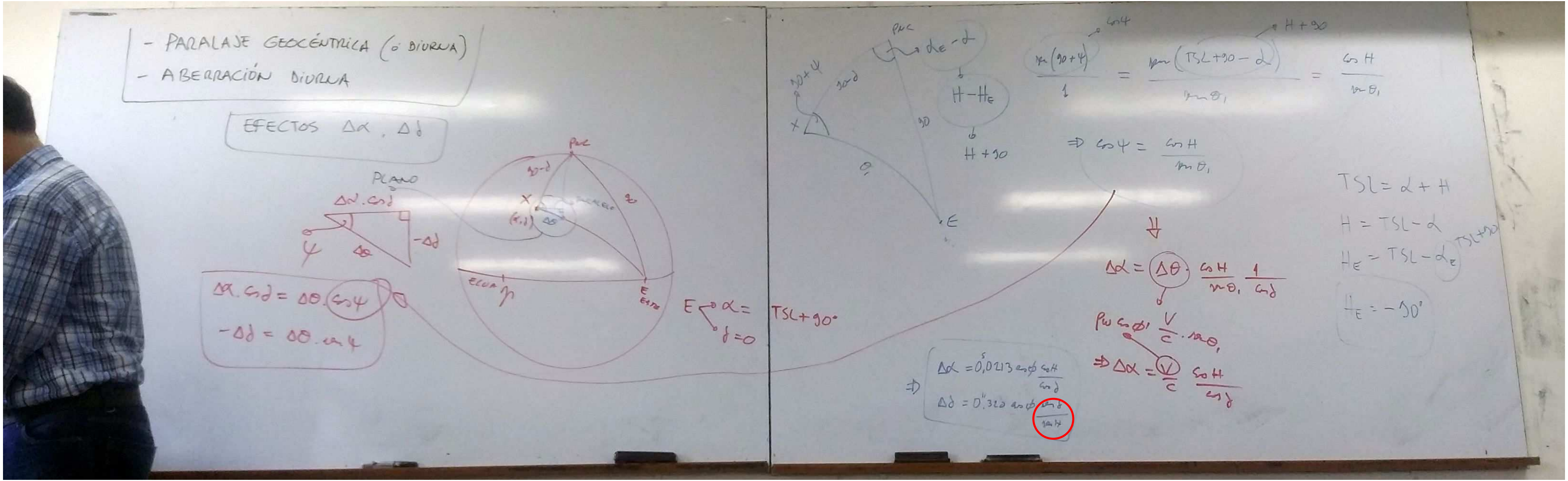

- PARALAJE GEOCÉNTRICA (ó DIURNA)
- ABERRACIÓN DIURNA
EFECTOS Δα , Δδ
PLANO
Δα.cosδ
-Δδ
ΔΘ
ψ
Δα.cosδ = ΔΘ.cosψ
-Δδ = ΔΘ.senψ
PNC
90-δ
X
(α,δ)
ECUA
E
α= TSL+90°
δ=0

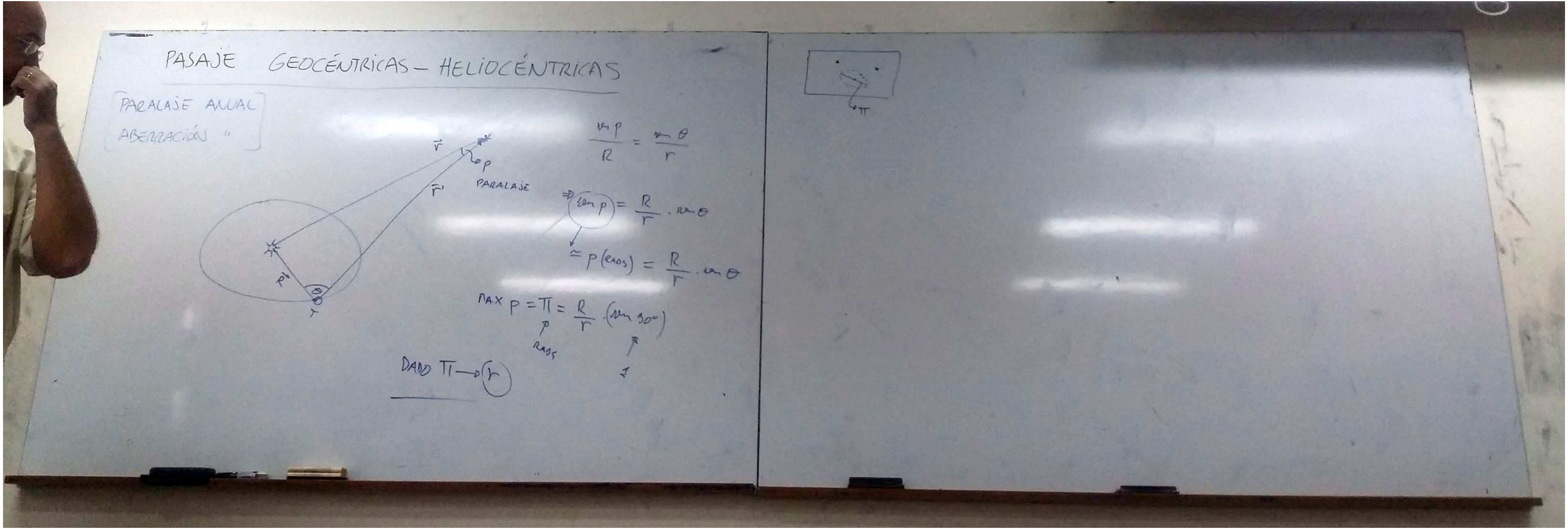
Astronomia Fundamental 2017

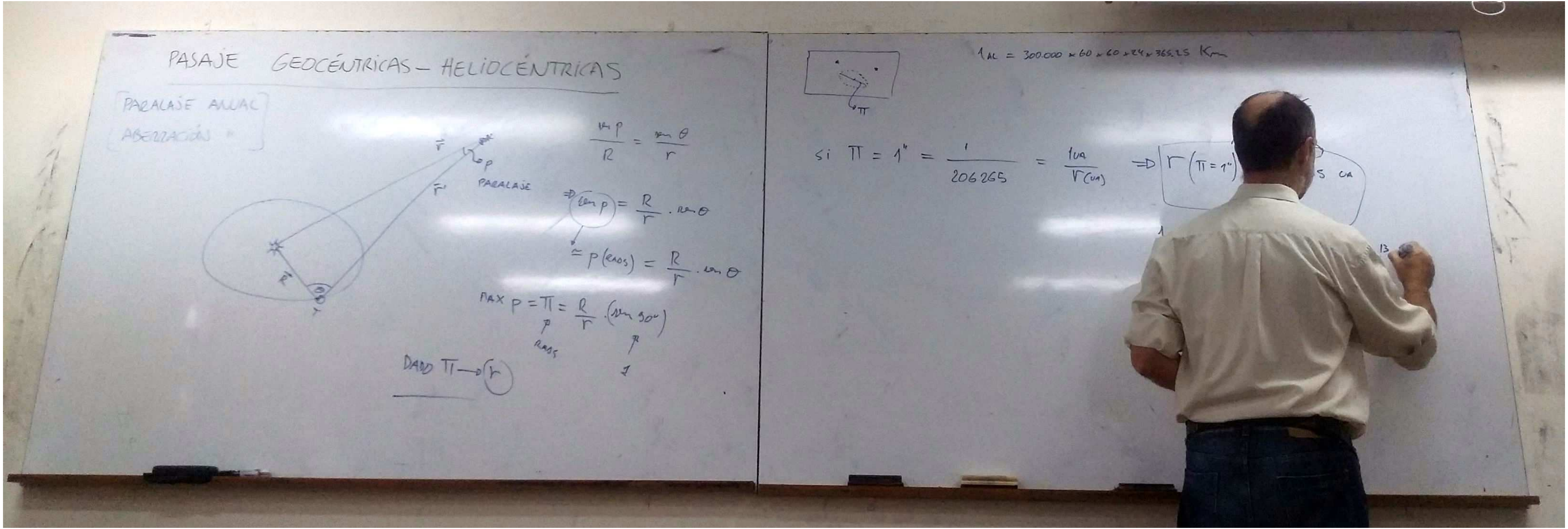


Astronomia Fundamental 2017

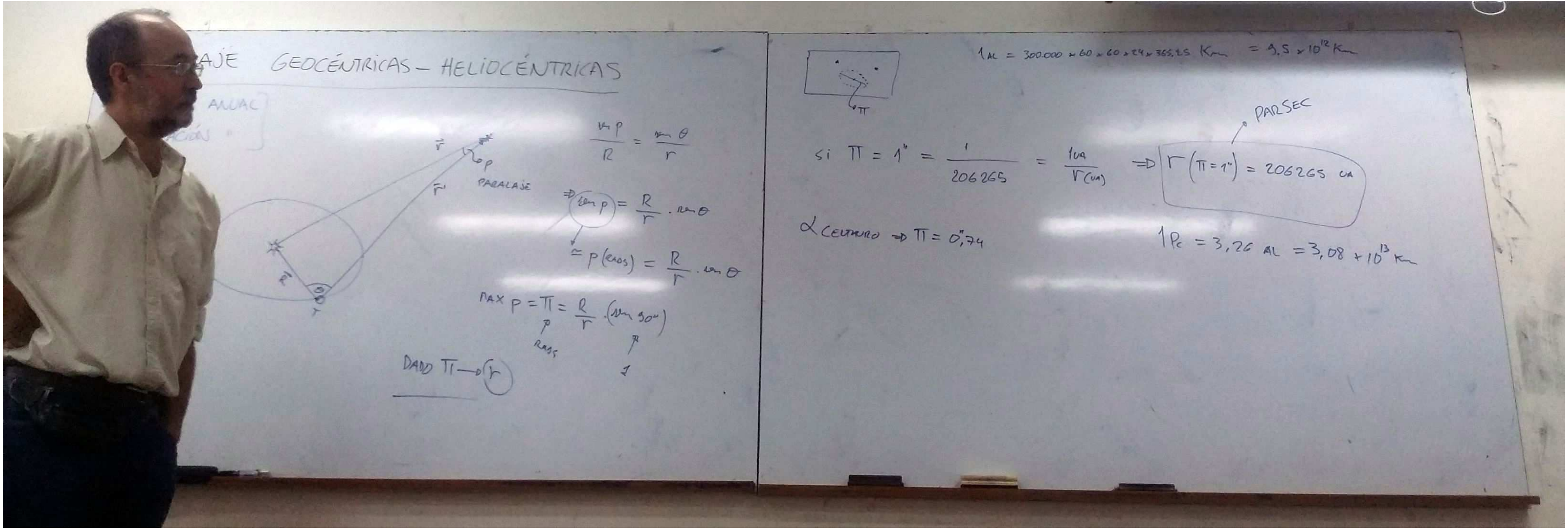



- PARALAJE GEOCÉNTRICA (ó DIURNA)
- ABERRACIÓN DIURNA
EFECTOS Δα , Δδ
PLANO
TSL = α + H
H = TSL − α
HE = −90°

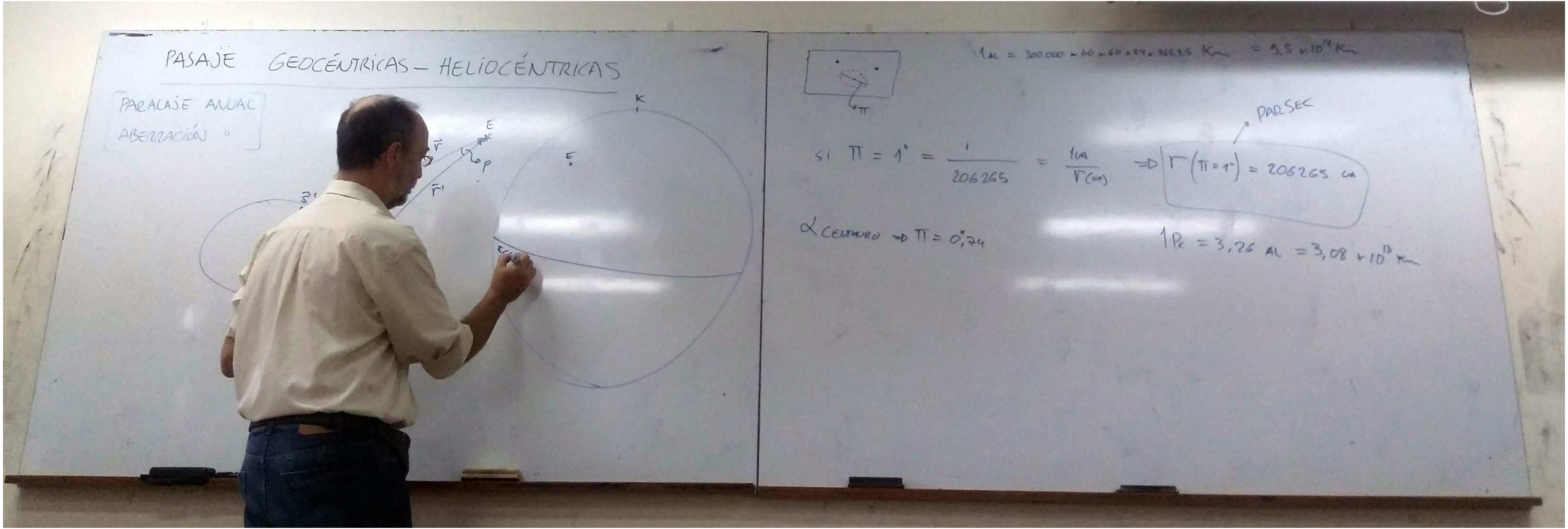

PASAJE GEOCÉNTRICAS – HELIOCÉNTRICAS
PARALAJE ANUAL
ABERRACIÓN "
PARALAJE
MAX p = π = R/r · (sen 90°)
DADO π → r


PASAJE GEOCÉNTRICAS – HELIOCÉNTRICAS
PARALAJE ANUAL
ABERRACIÓN
PARALAJE
DADO π → r
si π = 1" = 1/206265 = 1ua/r(ua)
1 AL = 300.000 x 60 x 60 x 24 x 365.25 Km

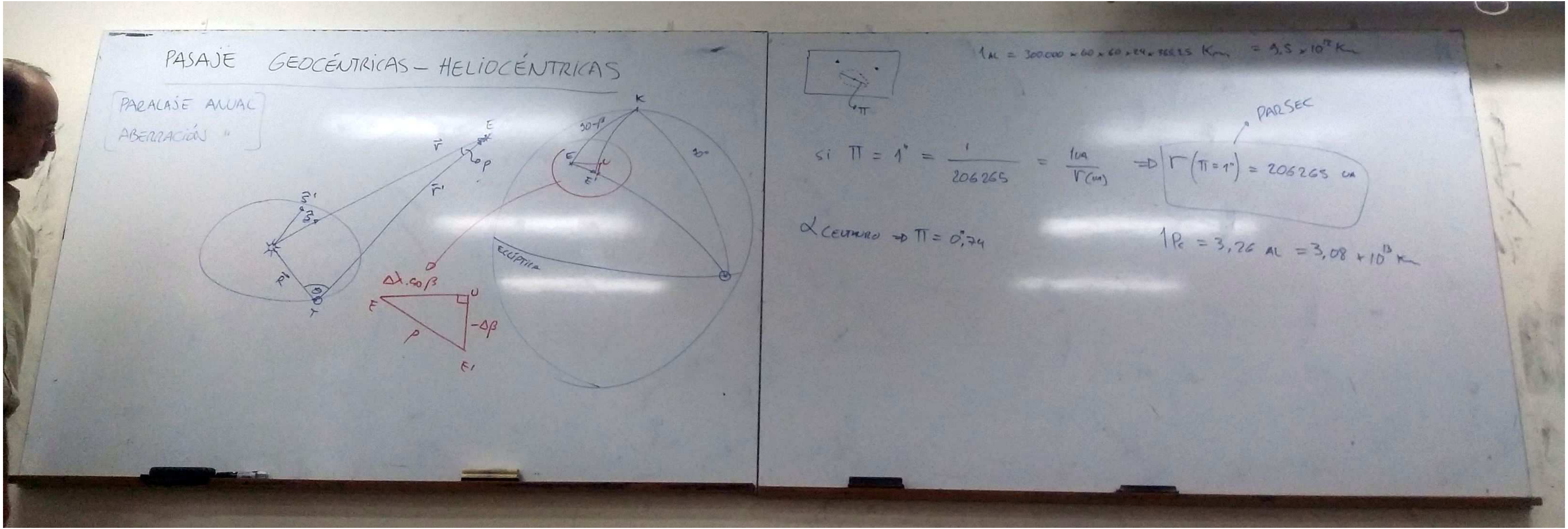
Astronomia Fundamental 2017

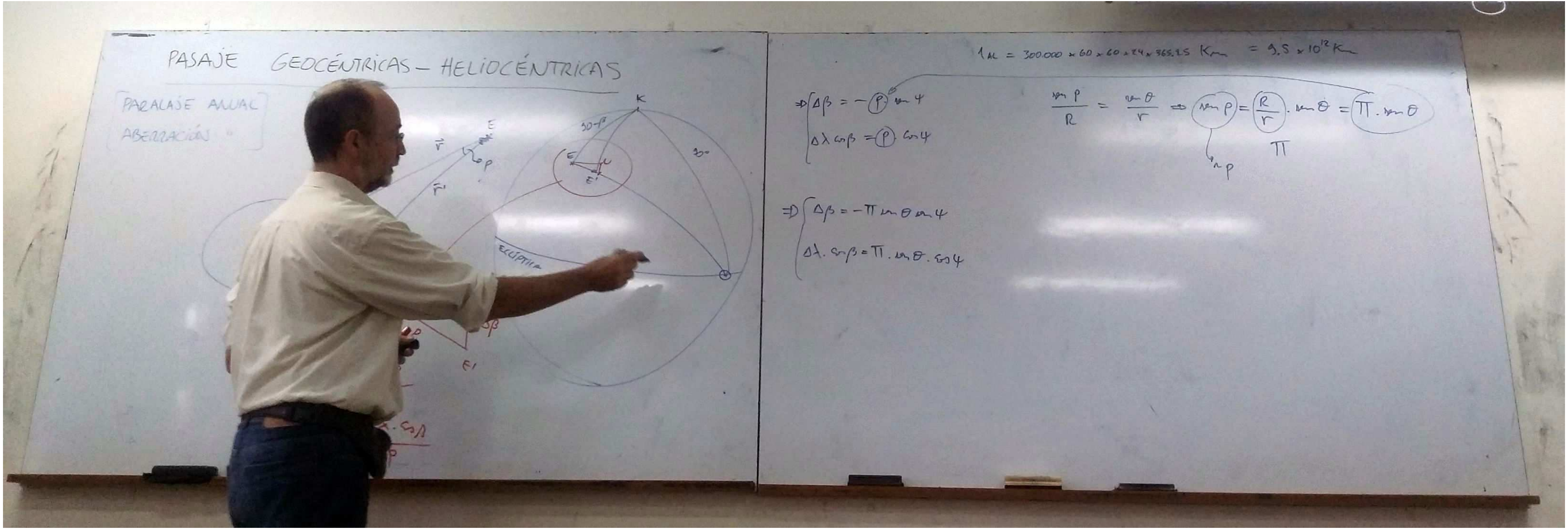


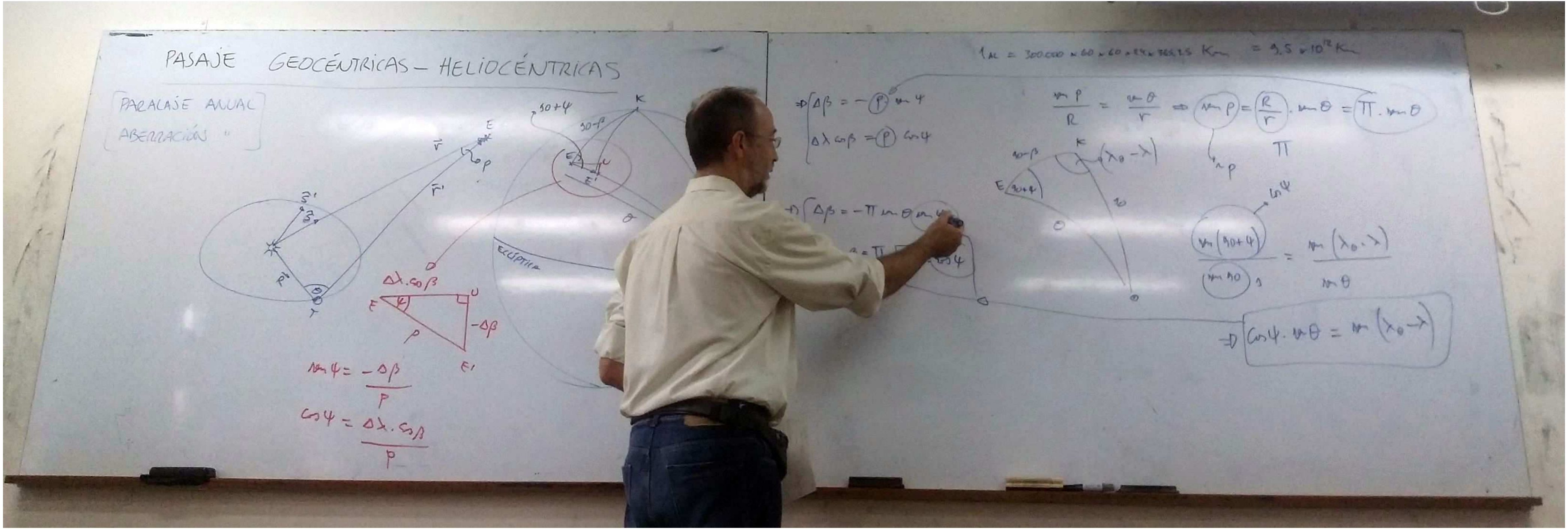
Astronomia Fundamental 2017



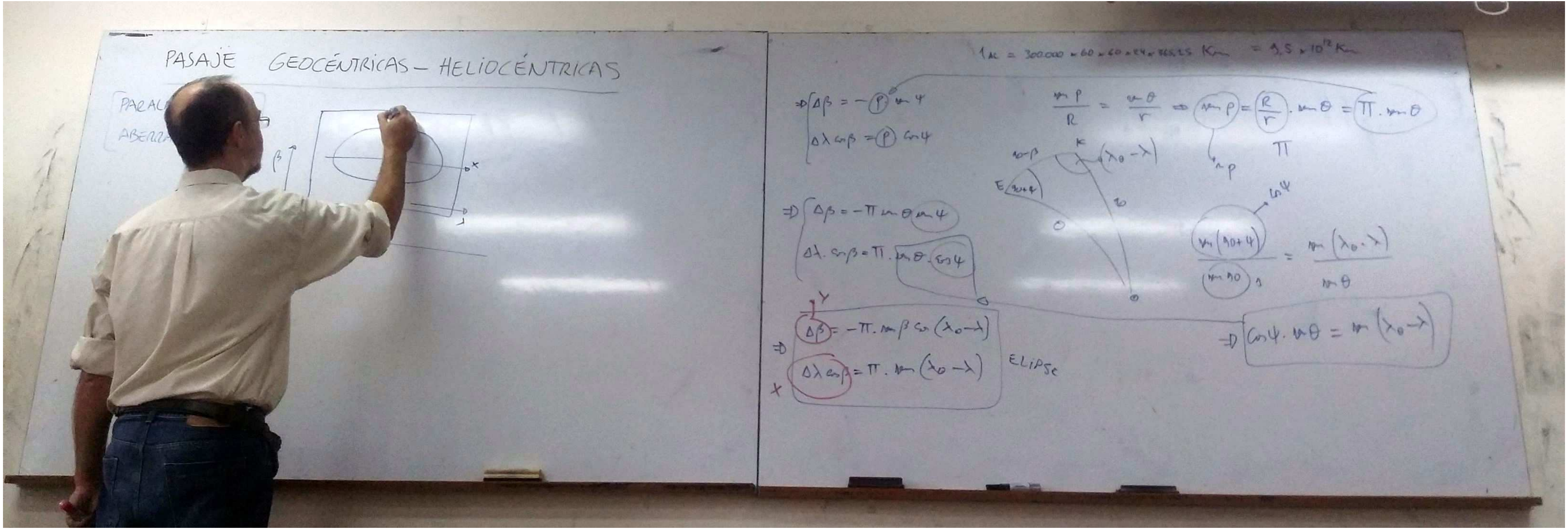
Astronomia Fundamental 2017



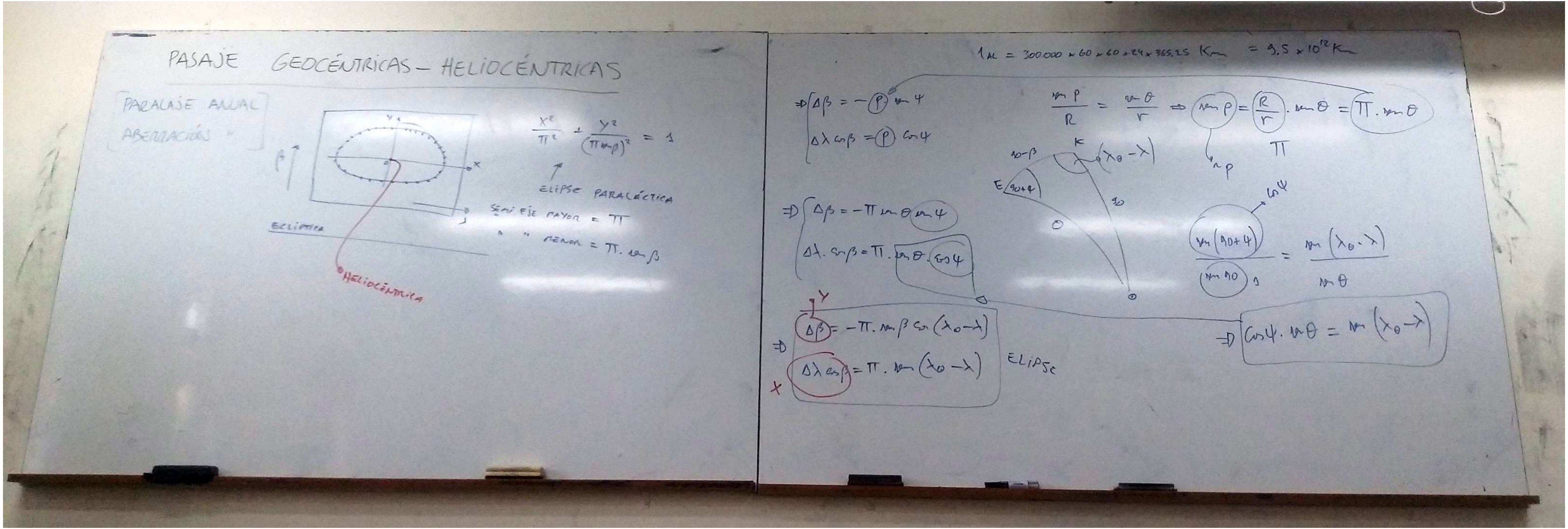

PASAJE GEOCÉNTRICAS – HELIOCÉNTRICAS
PARALAJE ANUAL
ABERRACIÓN
ECLÍPTICA
1 AL = 300.000 x 60 x 60 x 24 x 365.25 Km = 9.5 x 10^12 Km

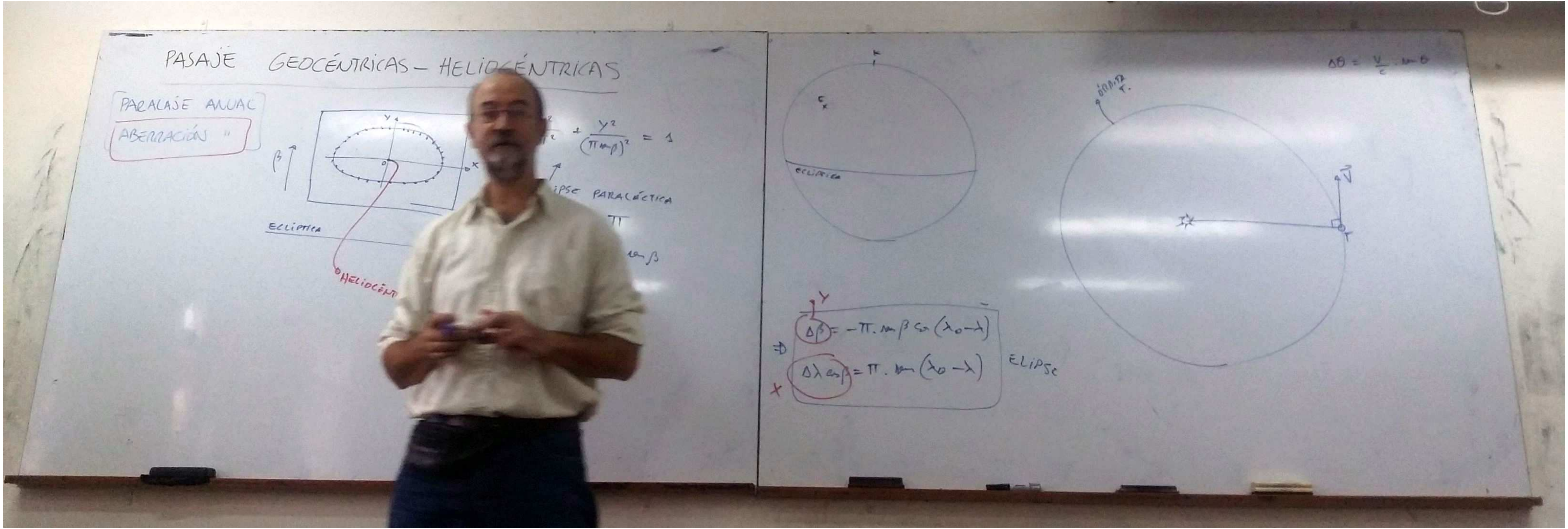

PASAJE GEOCÉNTRICAS – HELIOCÉNTRICAS
PARALAJE ANUAL
ABERRACIÓN "
ECLÍPTICA
sen ψ = −Δβ / p
cos ψ = Δλ . cos β / p
1 AL = 300.000 × 60 × 60 × 24 × 365.25 Km = 9.5 × 10^12 Km
cos ψ . sen θ = sen (λ☉ − λ)

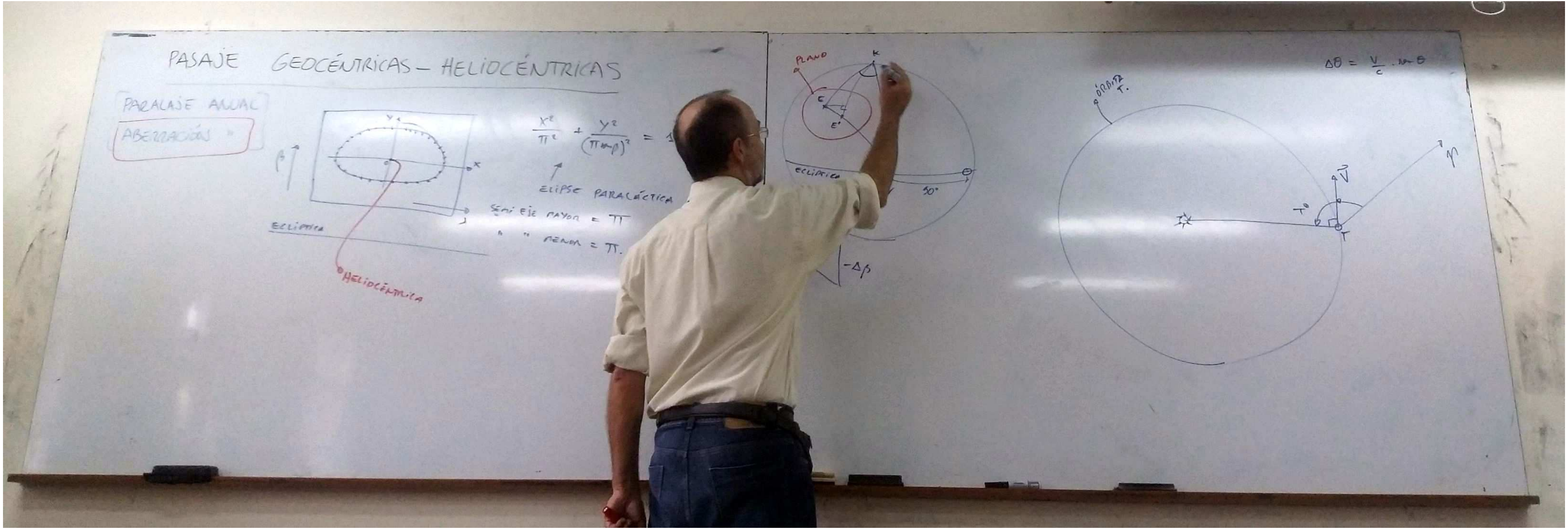
Astronomia Fundamental 2017



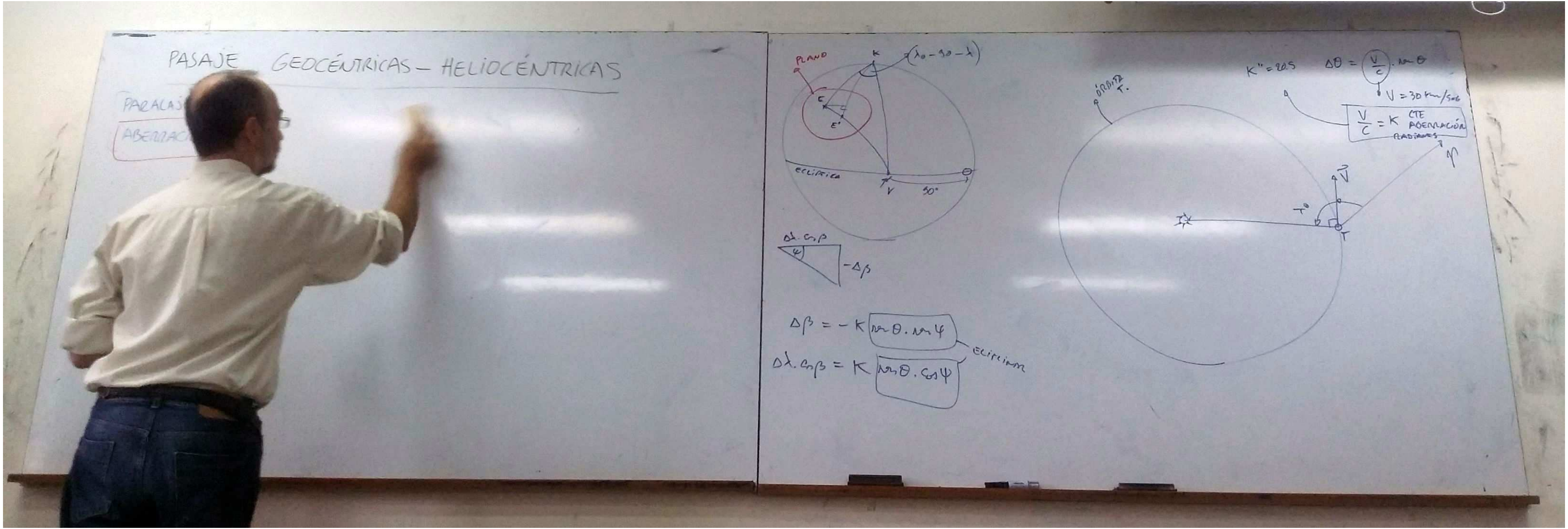
Astronomia Fundamental 2017




PASAJE GEOCÉNTRICAS – HELIOCÉNTRICAS
PARALAJE ANUAL
ABERRACIÓN "
ELIPSE PARALÁCTICA
ECLÍPTICA
HELIOCÉNT
ECLÍPTICA
ELIPSE
ÓRBITA T.


PASAJE GEOCÉNTRICAS – HELIOCÉNTRICAS
PARALAJE ANUAL
ABERRACIÓN
ECLIPTICA
HELIOCÉNTRICA
ELIPSE PARALÁCTICA
SEMI EJE MAYOR = π
PLANO
ECLIPTICA
50°
−Δβ
ÓRBITA T.

Astronomia Fundamental 2017



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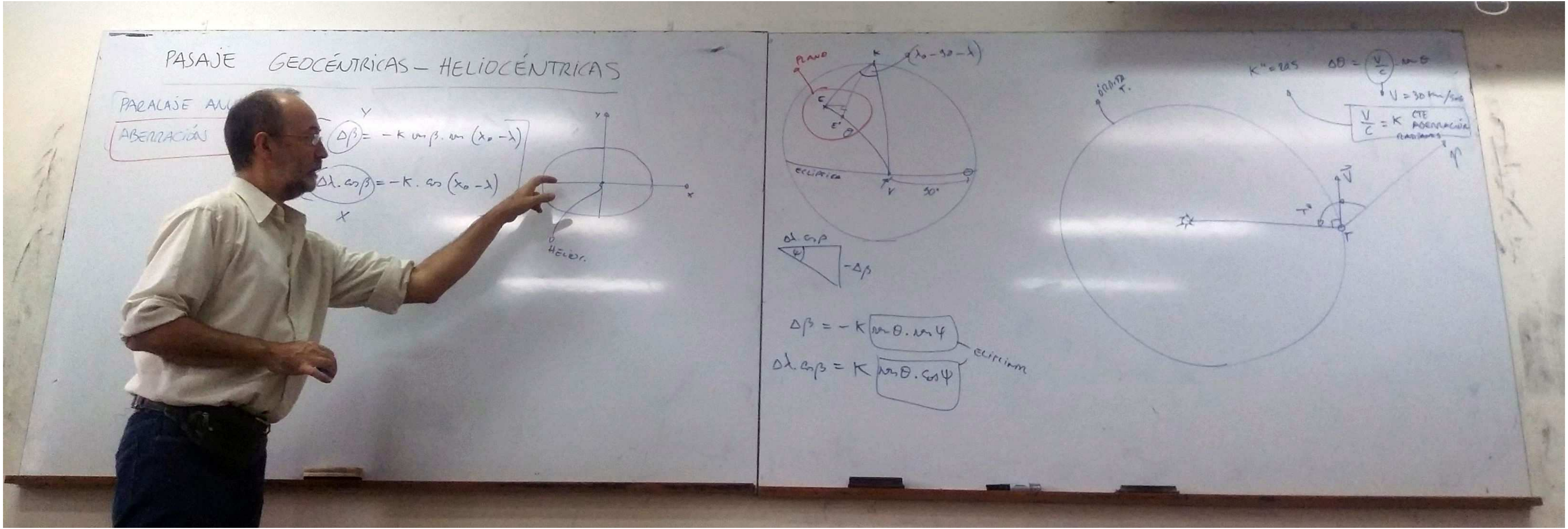

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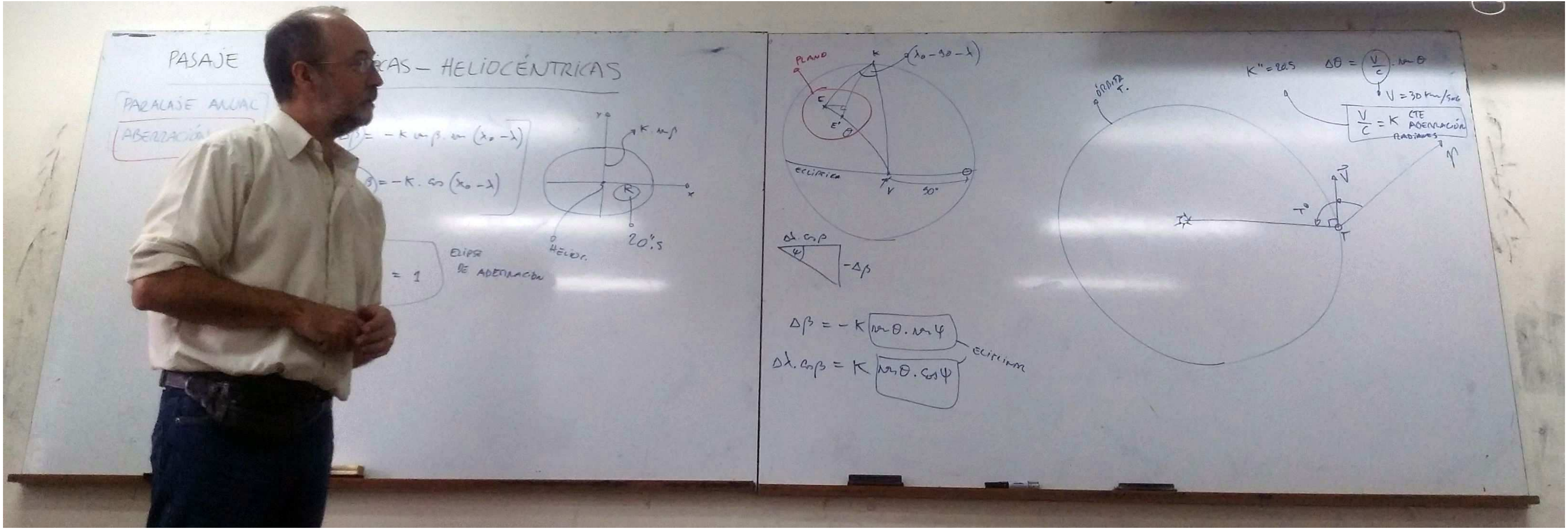

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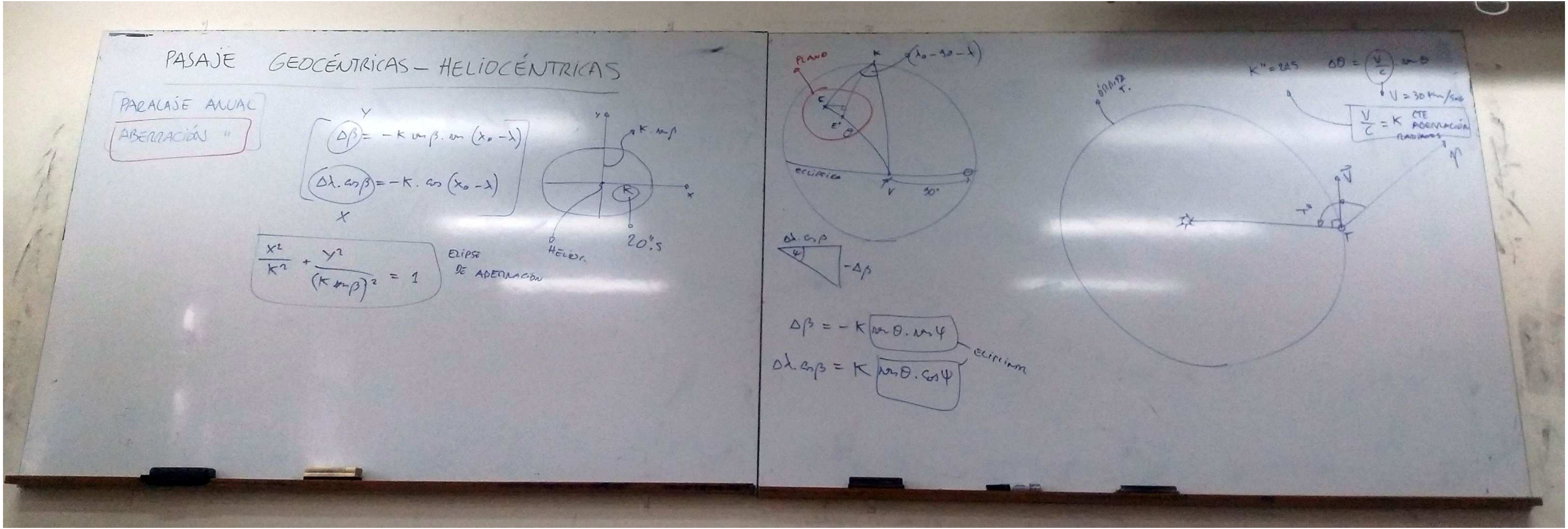
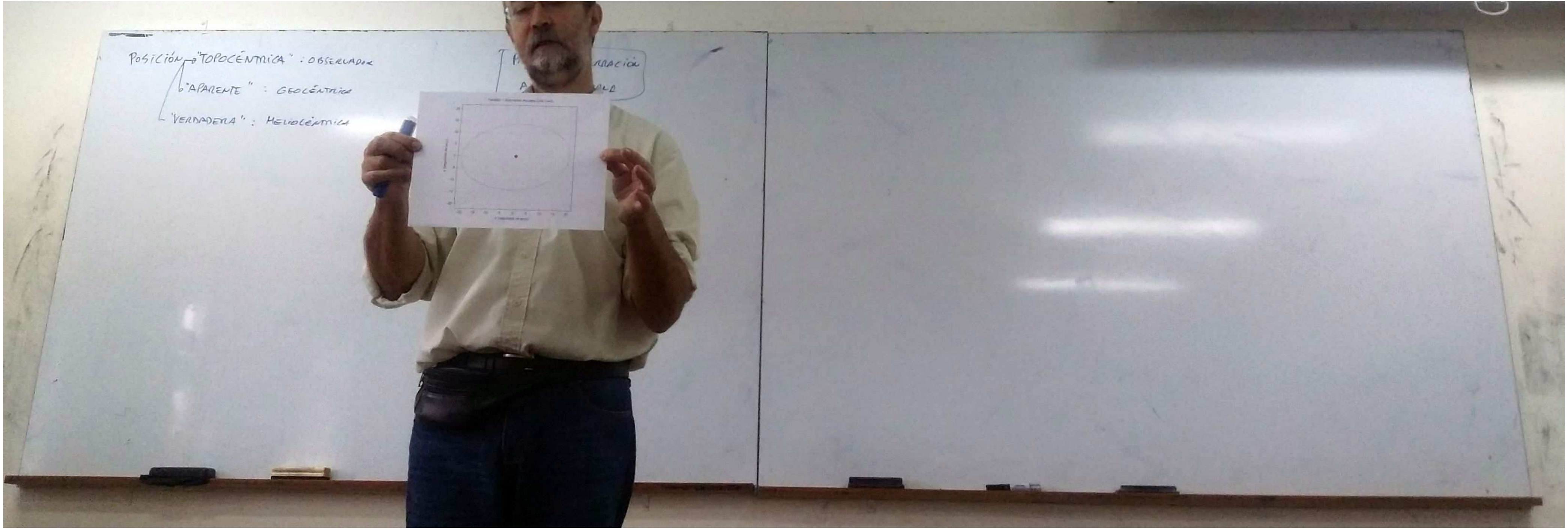
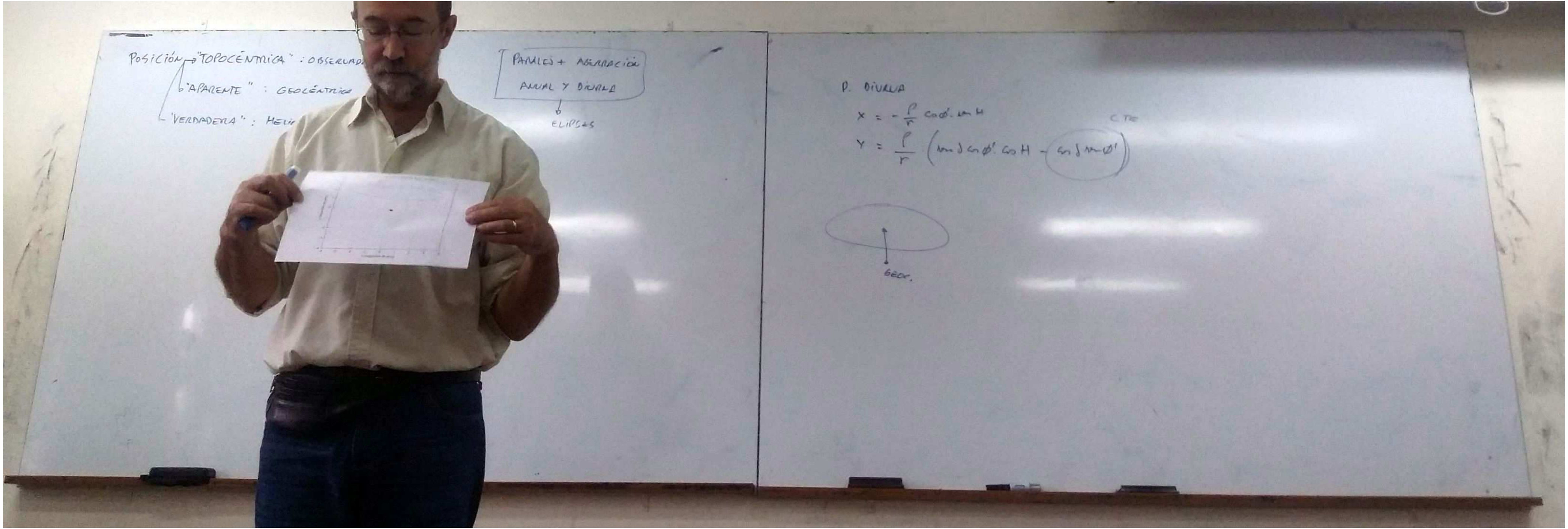
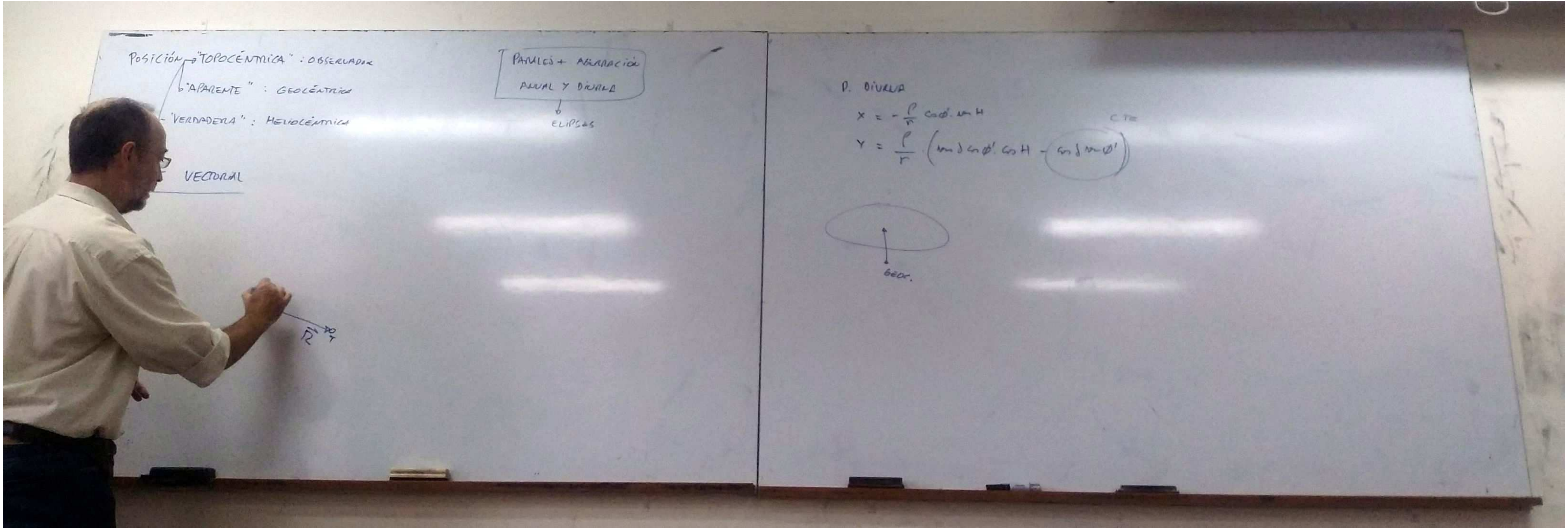
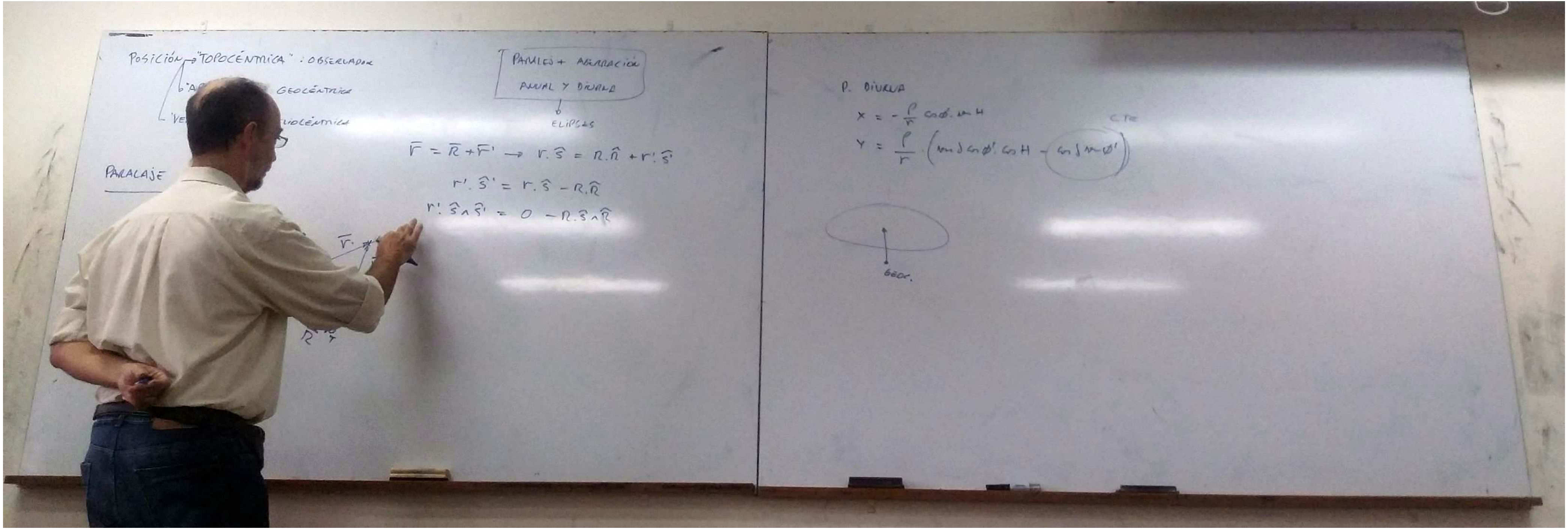



POSICIÓN "TOPOCÉNTRICA" : OBSERVADOR
"APARENTE" : GEOCÉNTRICA
"VERDADERA" : HELIOCÉNTRICA

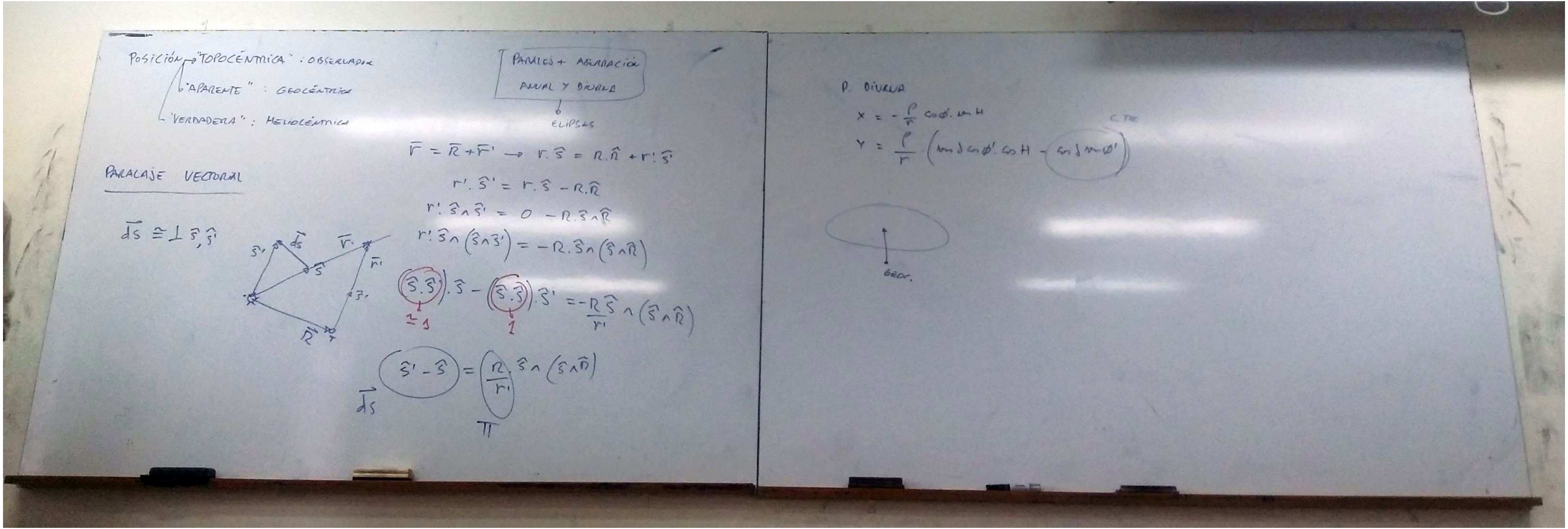

POSICIÓN "TOPOCÉNTRICA" : OBSERVADO
"APARENTE" : GEOCÉNTRICA
"VERDADERA" : HELI
PARALAJ + ABERRACIÓN
ANUAL Y DIURNA
ELIPSES
P. DIURNA
C TE
GEOC.

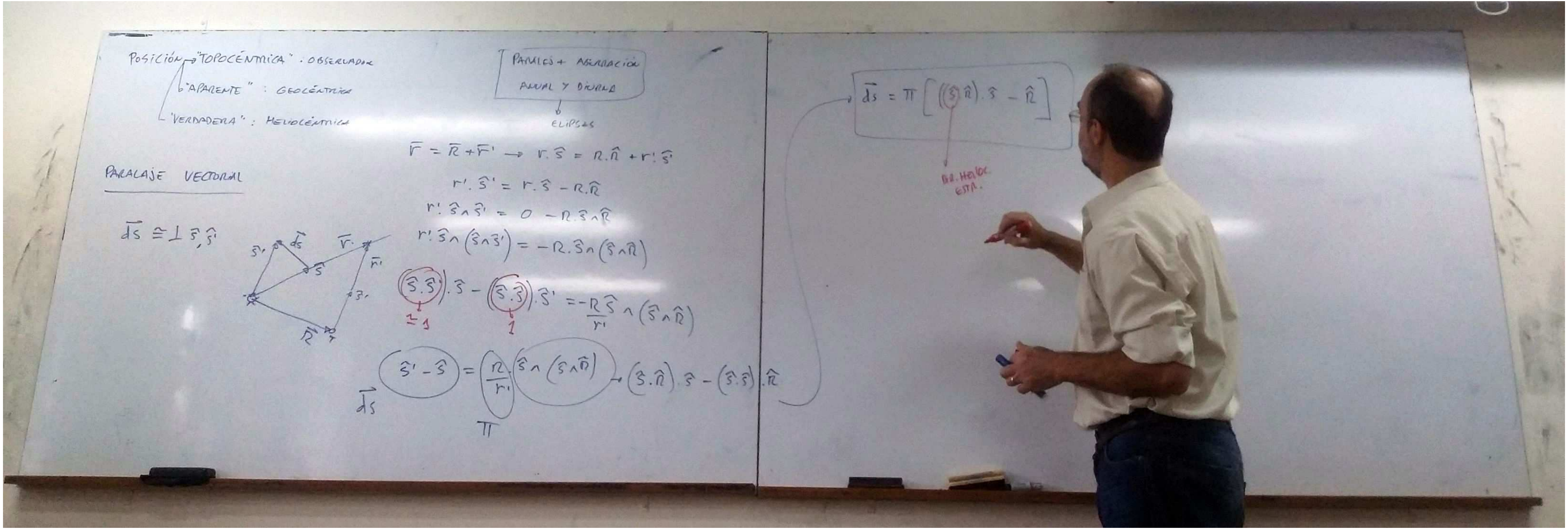
Astronomia Fundamental 2017



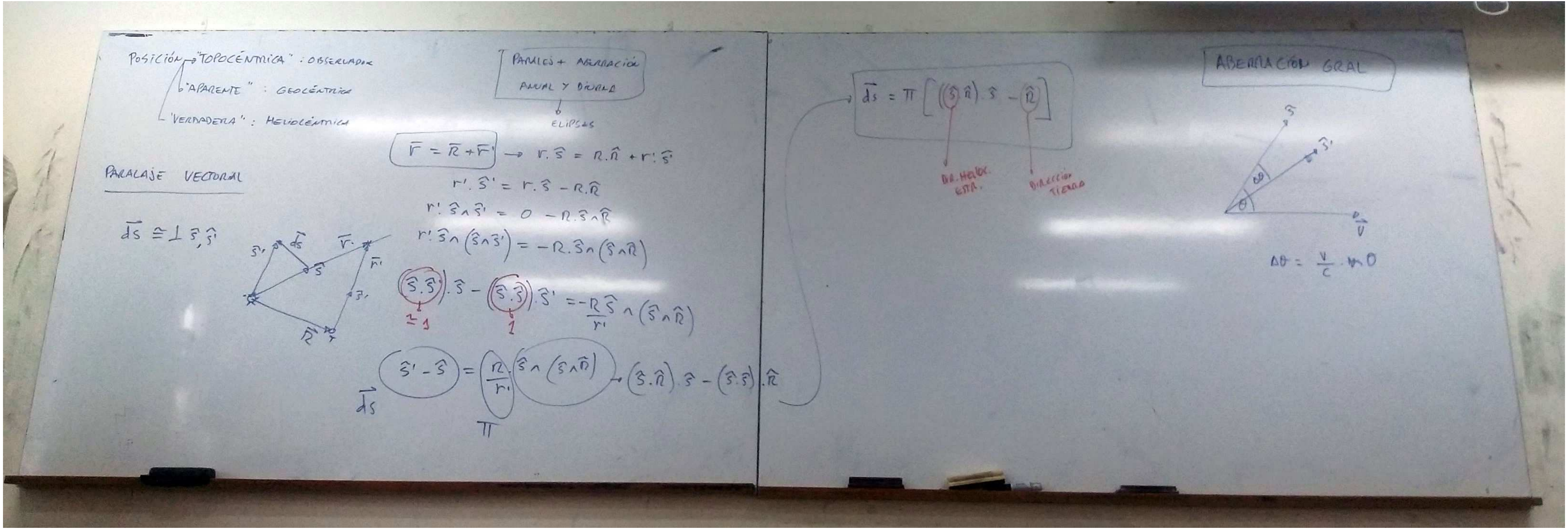

PARALAJE
ELIPSES
P. DIURNA
CTE
GEOC.

Astronomia Fundamental 2017

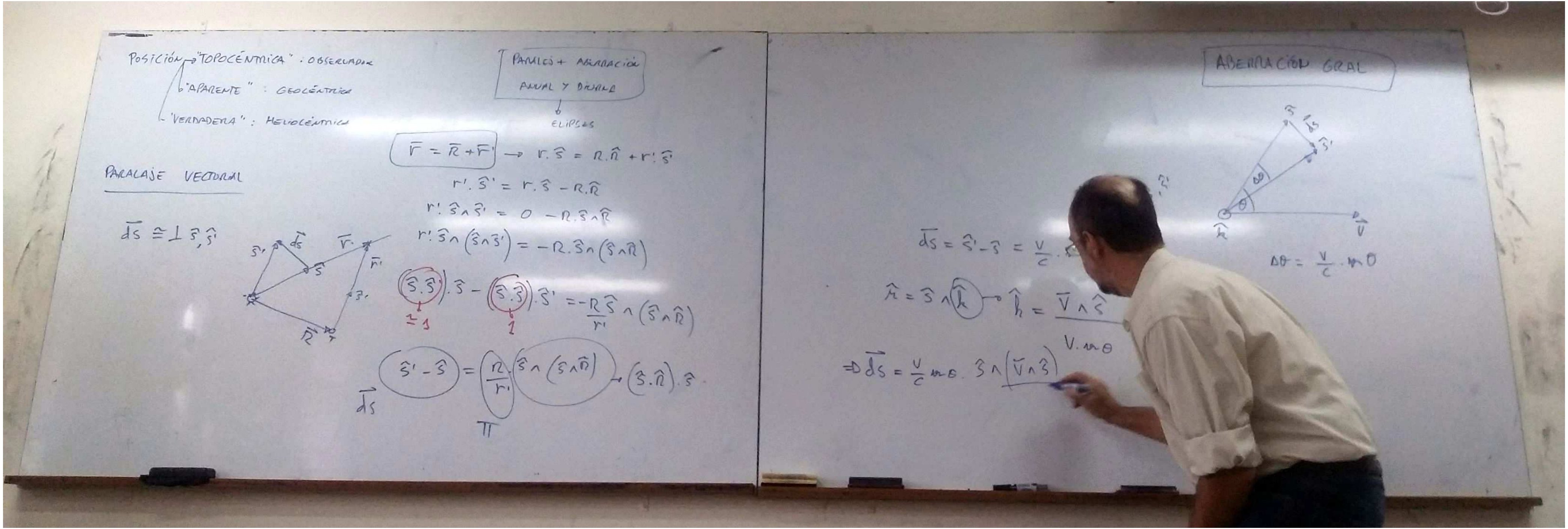



POSICIÓN "TOPOCÉNTRICA" : OBSERVADOR
"APARENTE" : GEOCÉNTRICA
"VERDADERA" : HELIOCÉNTRICA
PARALAJE + ABERRACIÓN ANUAL Y DIURNA
ELIPSES
PARALAJE VECTORIAL

Astronomia Fundamental 2017



Astronomia Fundamental 2017



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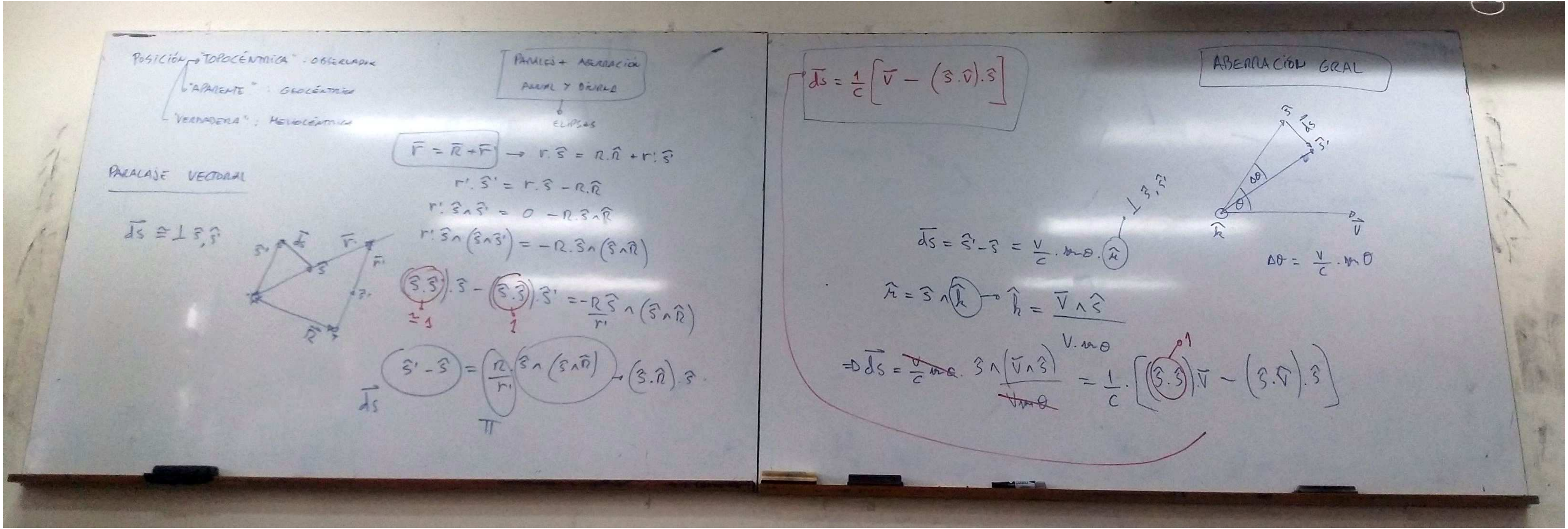

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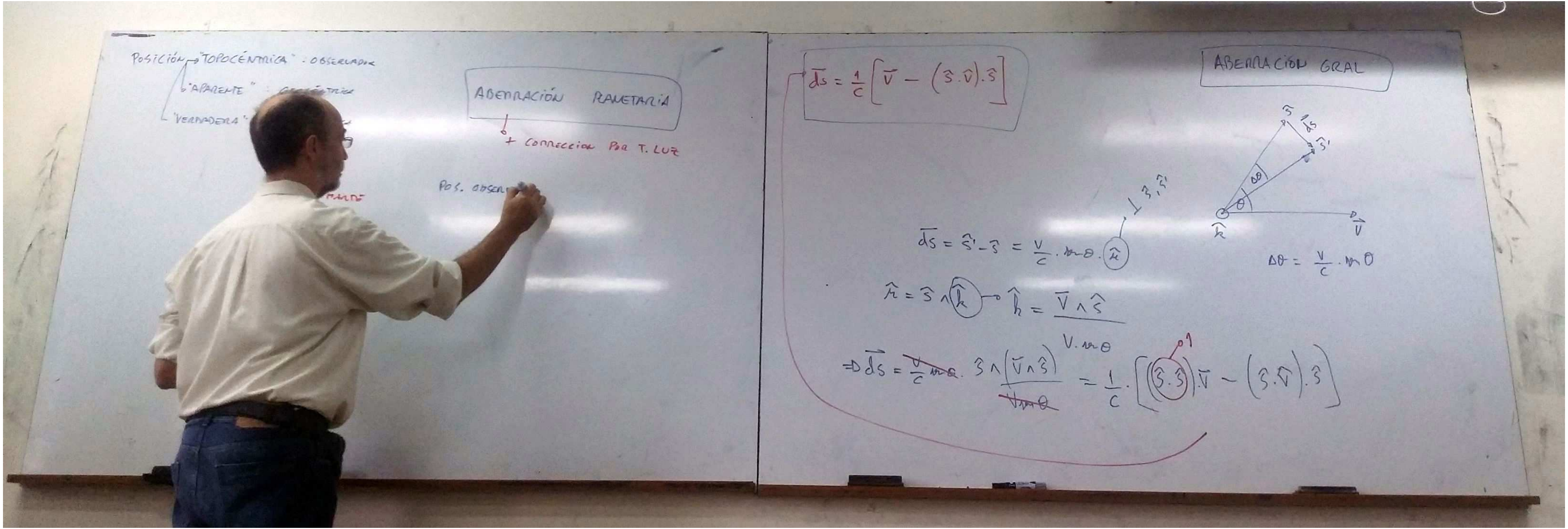

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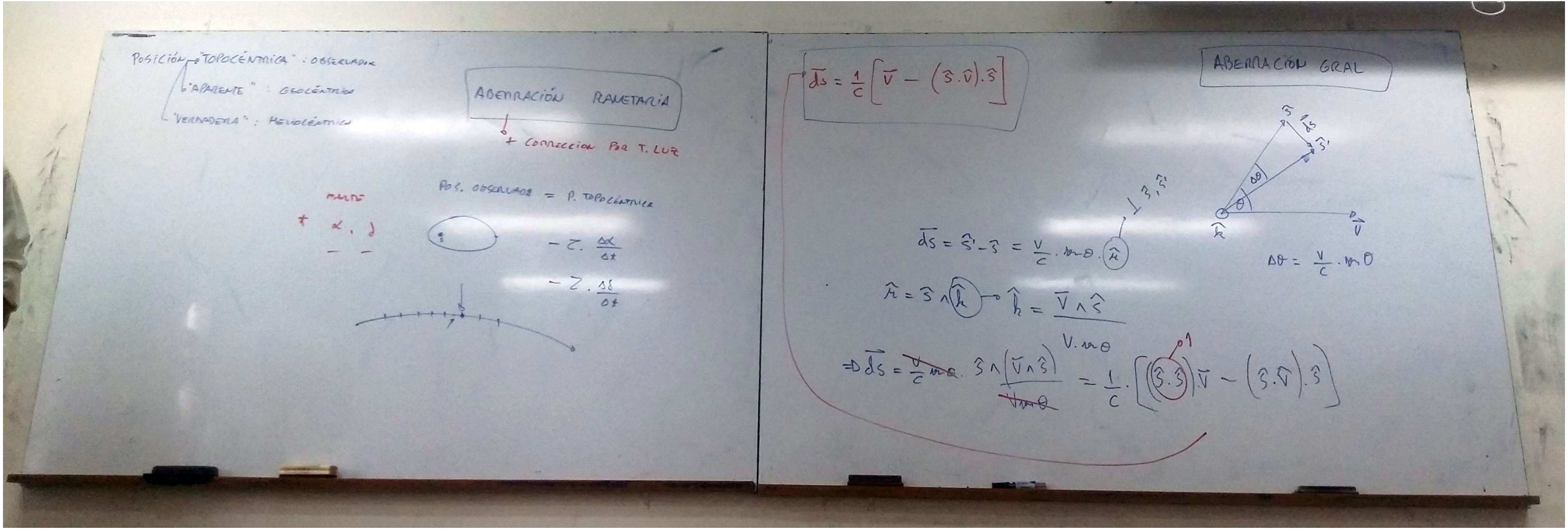

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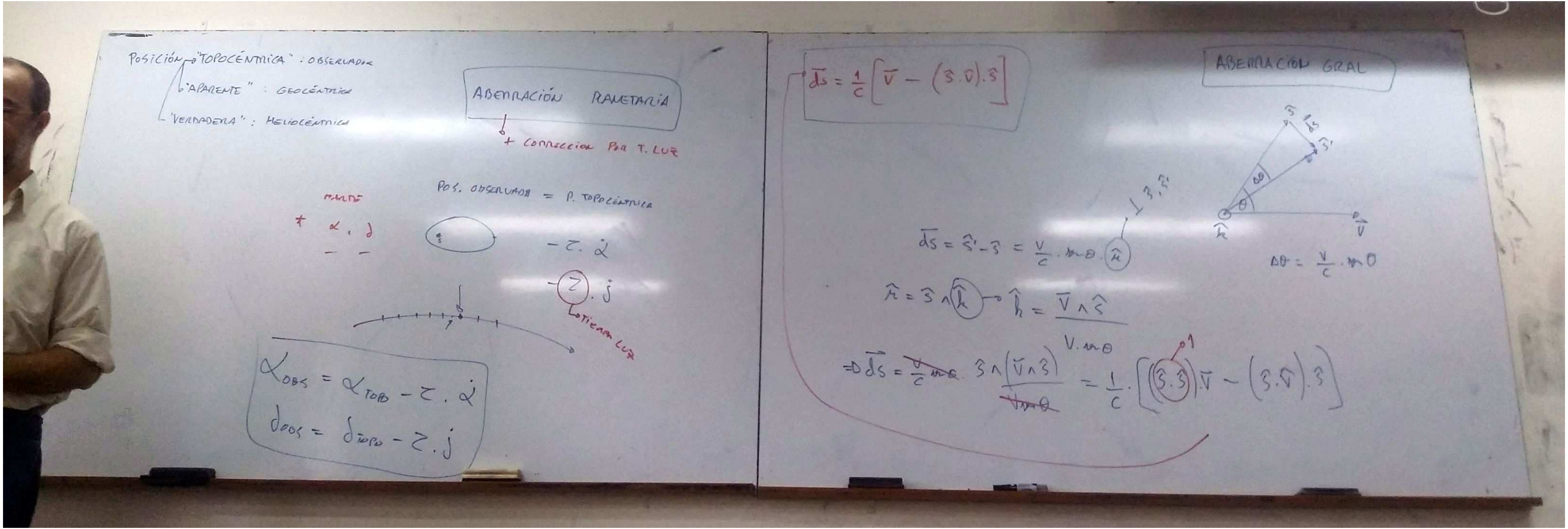

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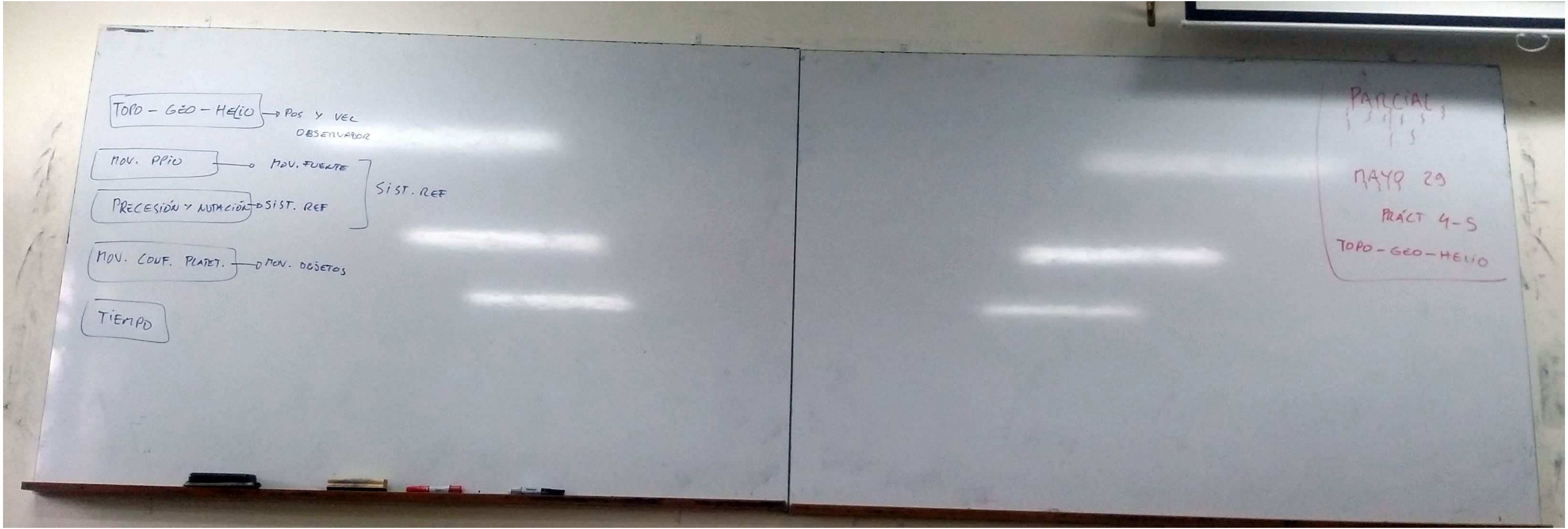

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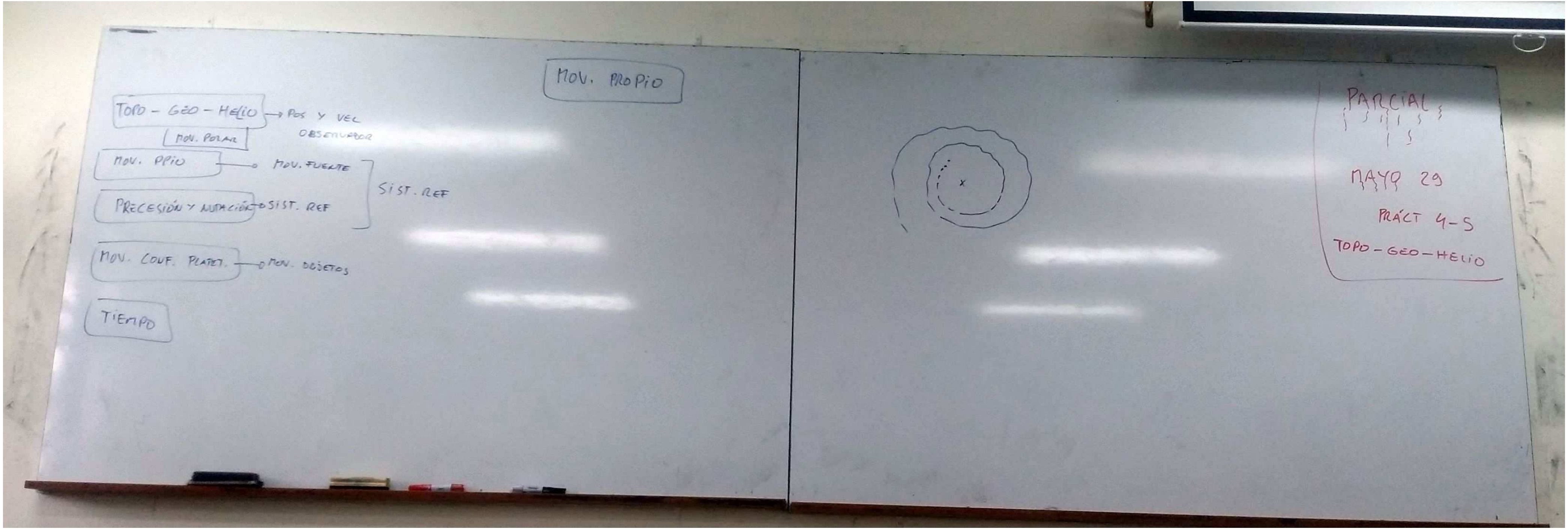
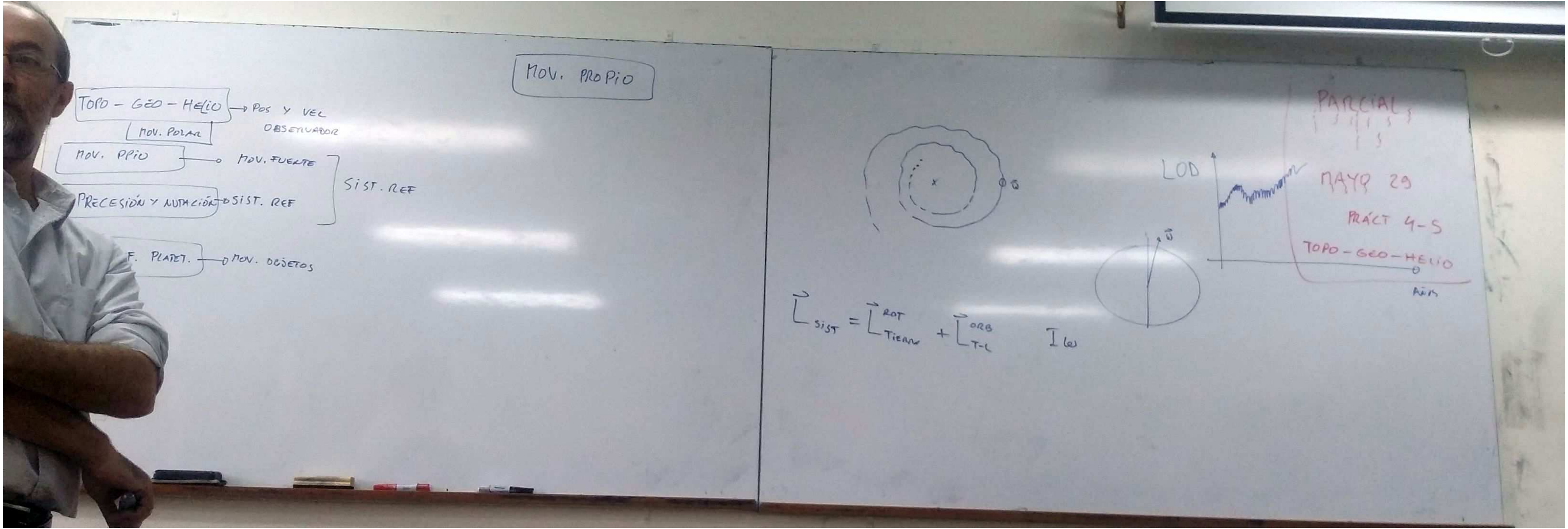


Astronomia Fundamental 2017



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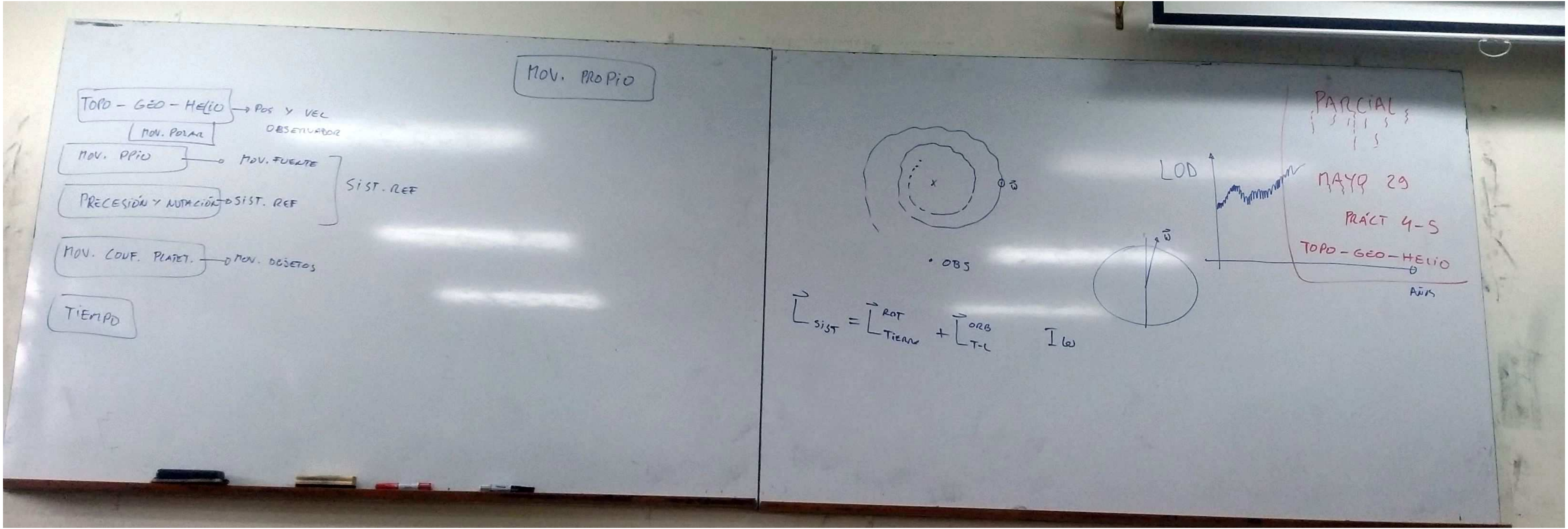
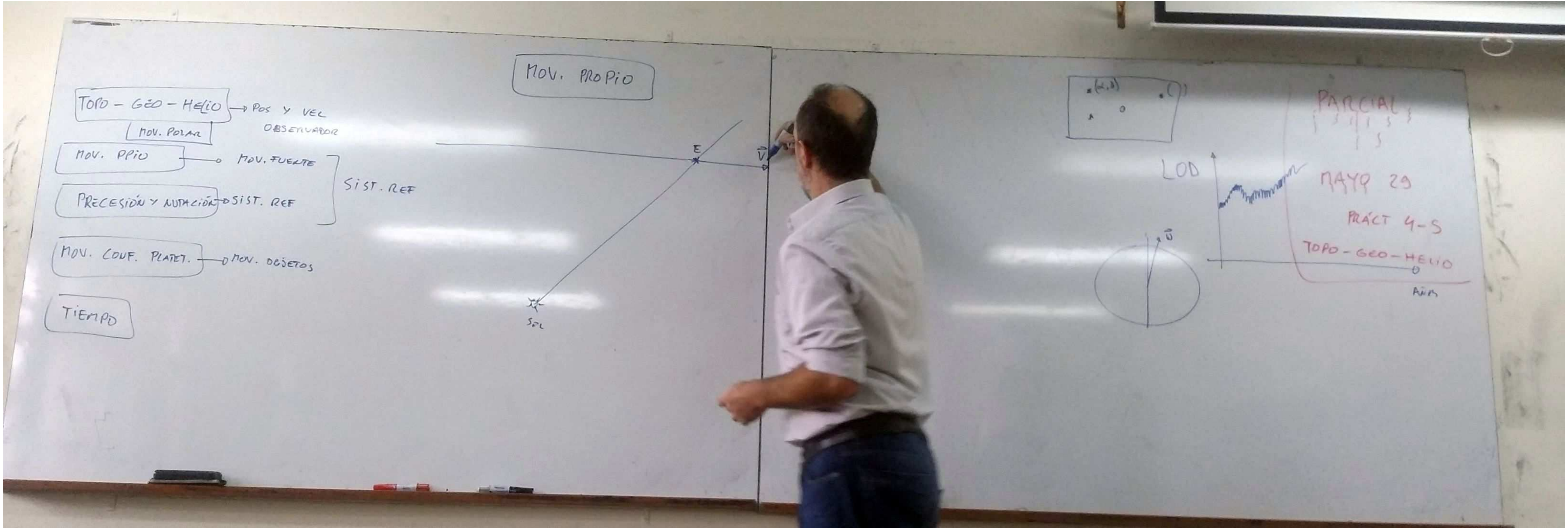
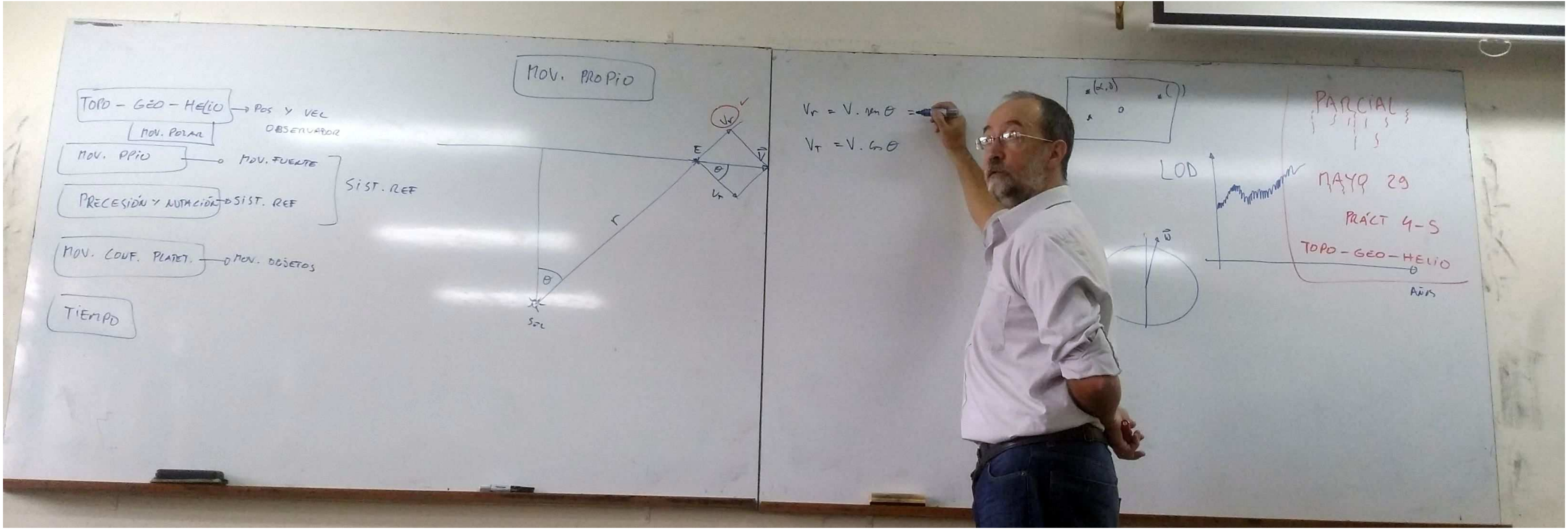



MOV. PROPIO
TOPO - GEO - HELIO
POS Y VEL OBSERVADOR
MOV. POLAR
MOV. PPIO
MOV. FUENTE
SIST. REF
PRECESIÓN Y NUTACIÓN
SIST. REF
MOV. CONF. PLANET.
MOV. OBJETOS
TIEMPO
E
SOL
LOD
PARCIAL
MAYO 29
PRÁCT 4-5
TOPO - GEO - HELIO

Astronomia Fundamental 2017



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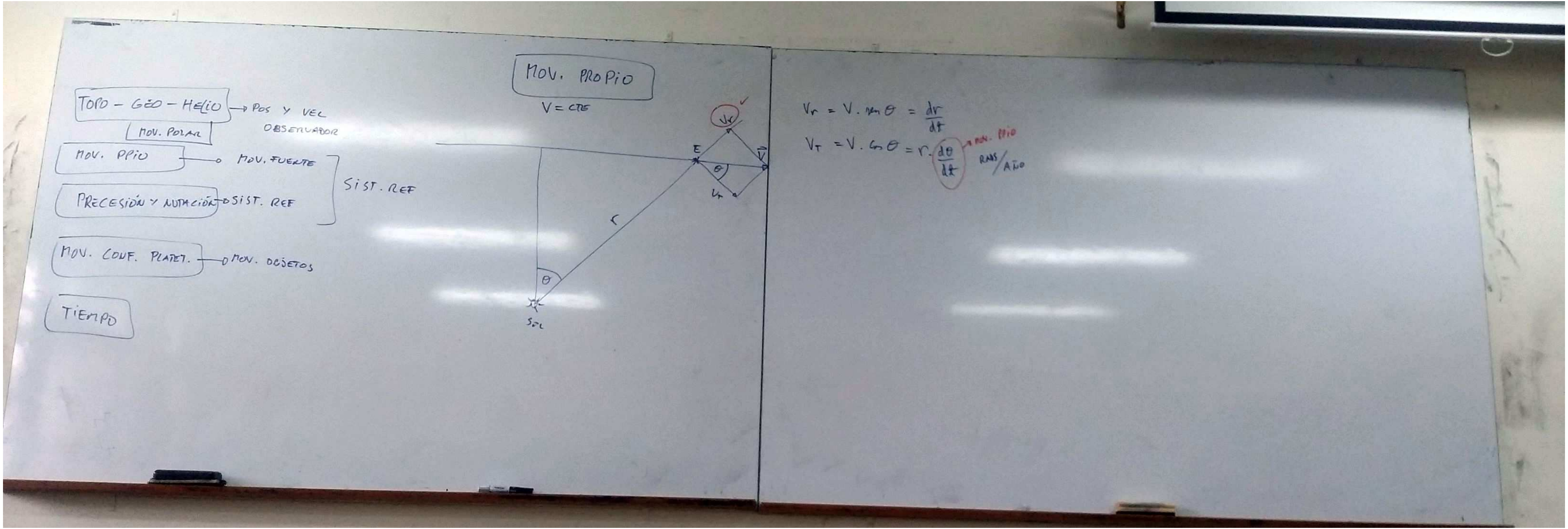
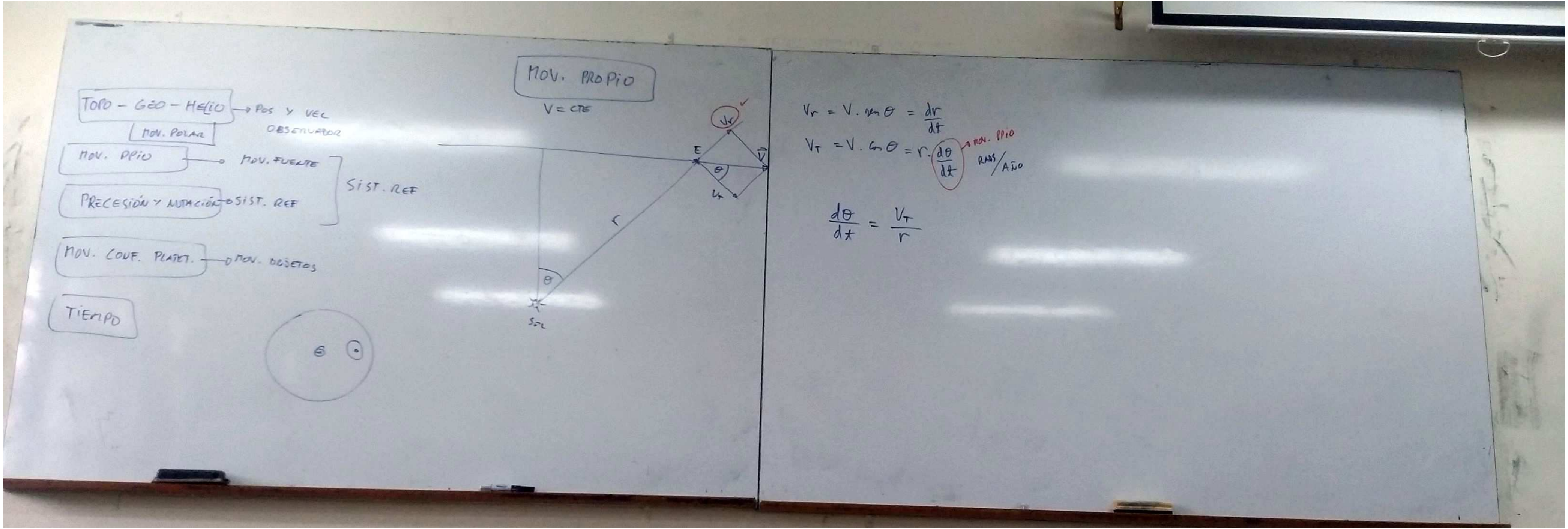
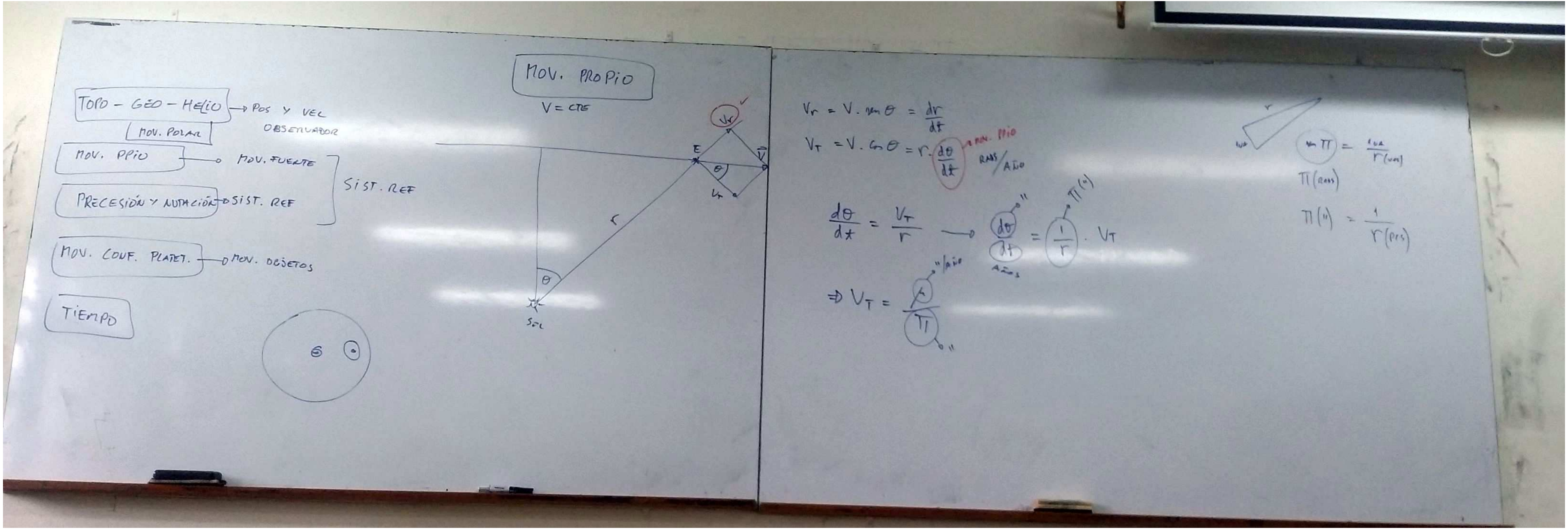


Astronomia Fundamental 2017



Astronomia Fundamental 2017



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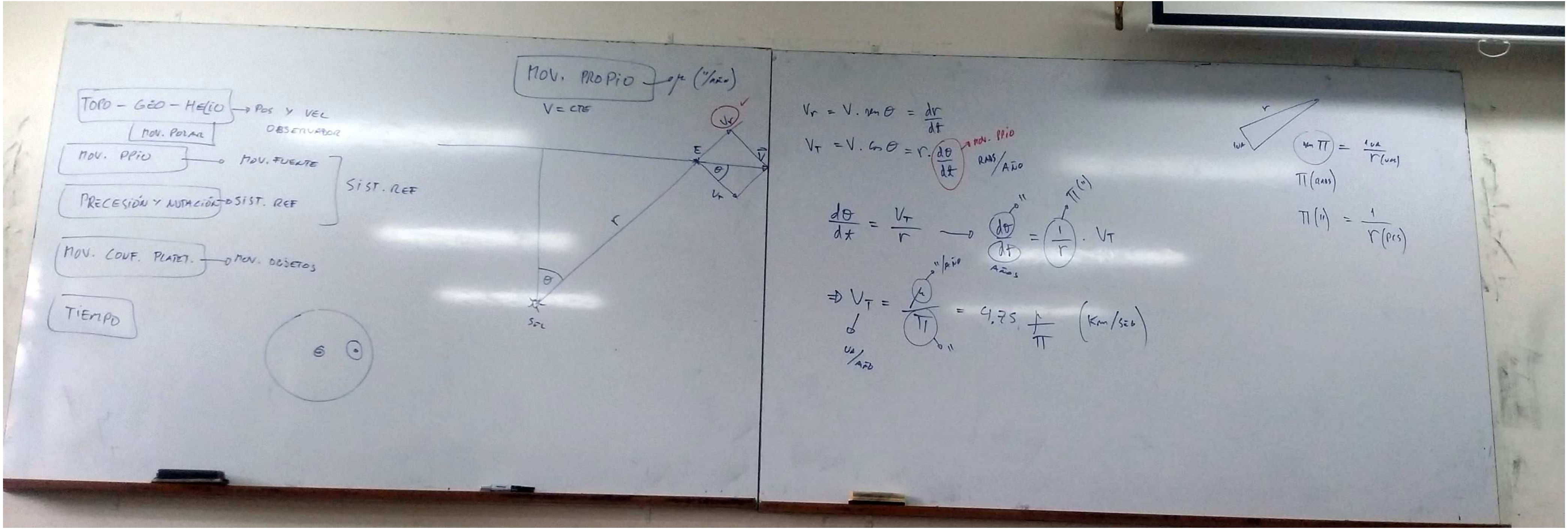
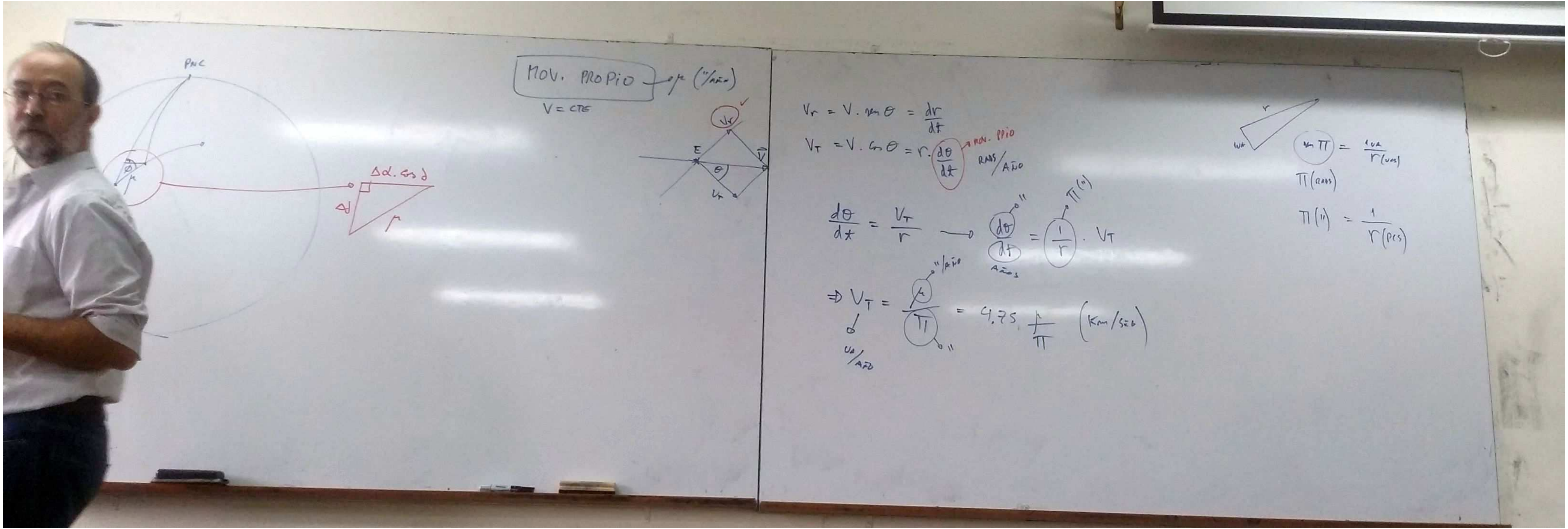
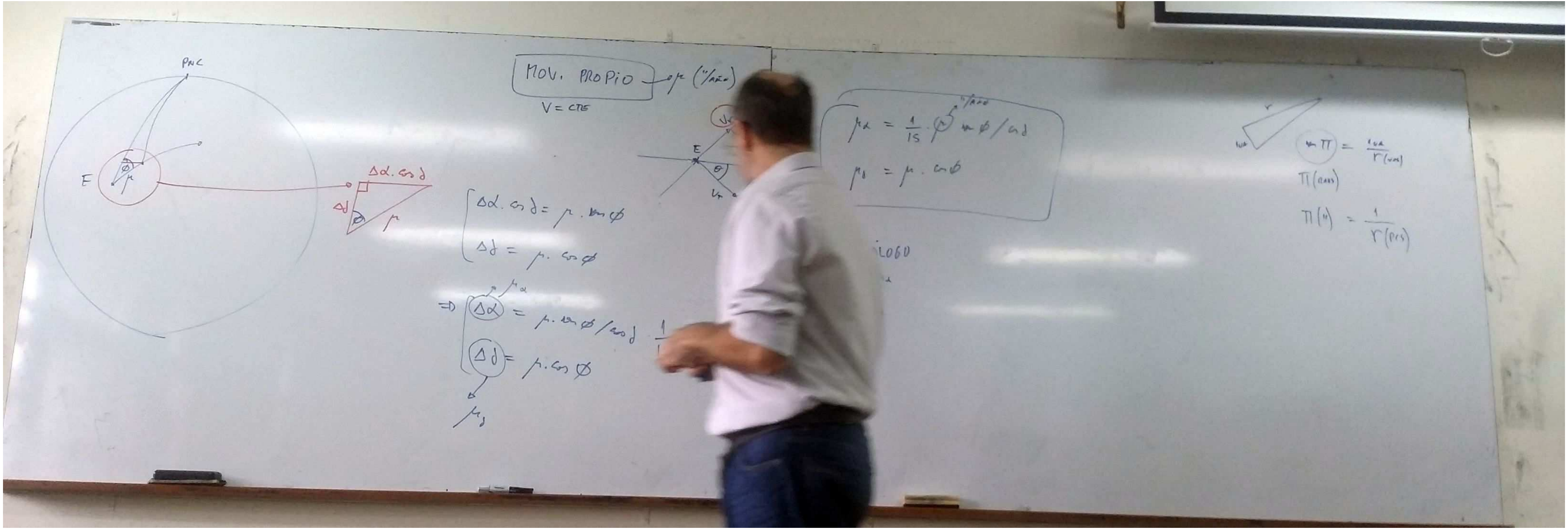


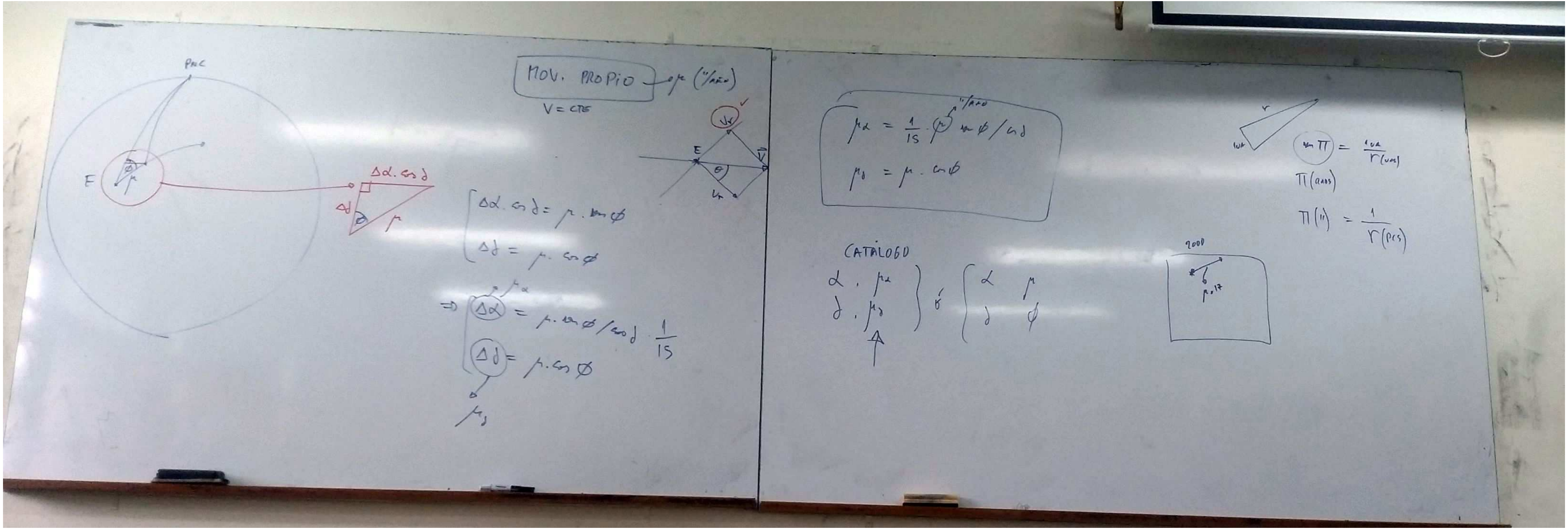
Astronomia Fundamental 2017

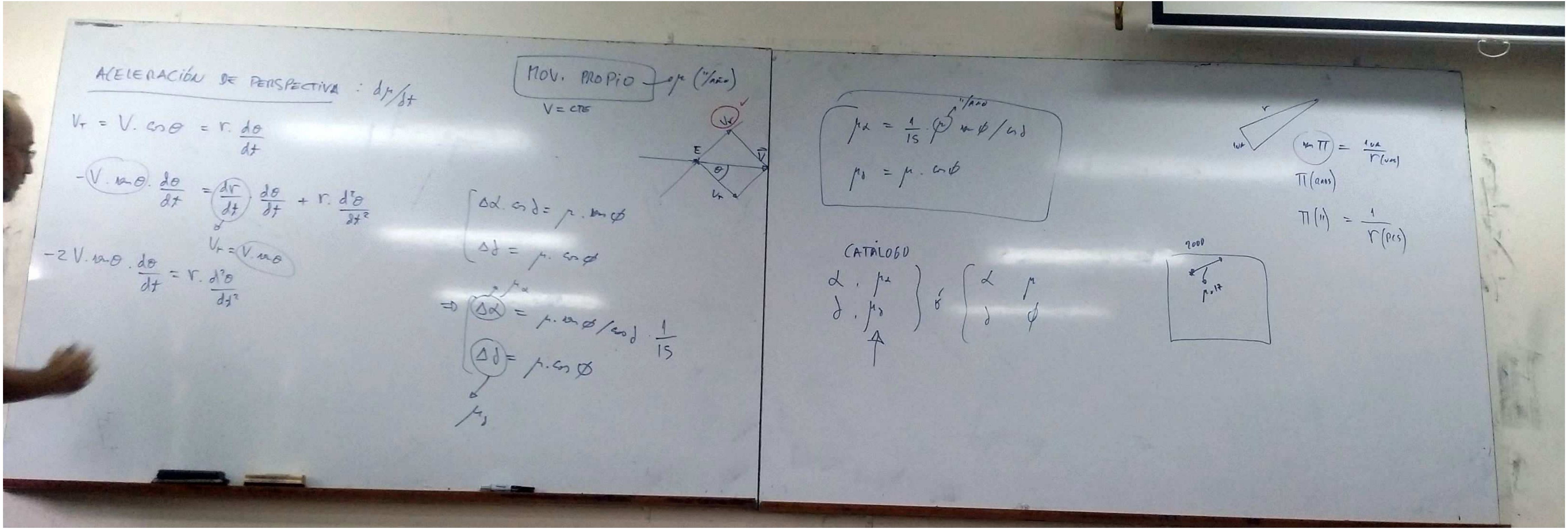


Astronomia Fundamental 2017

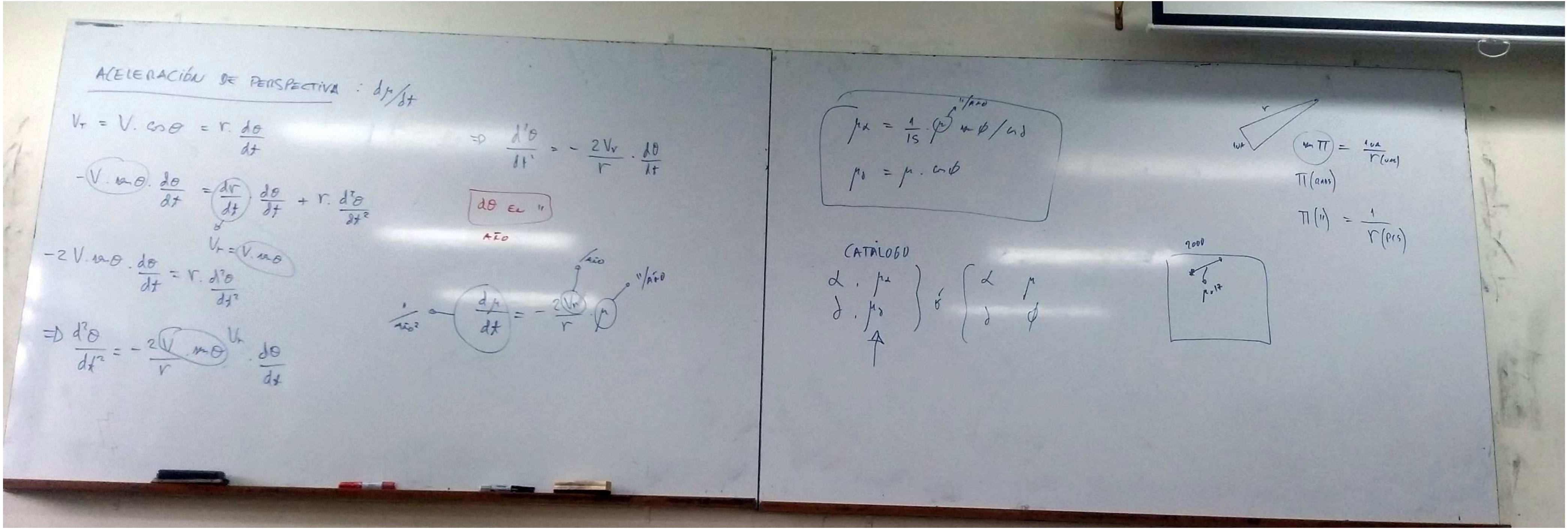


Astronomia Fundamental 2017

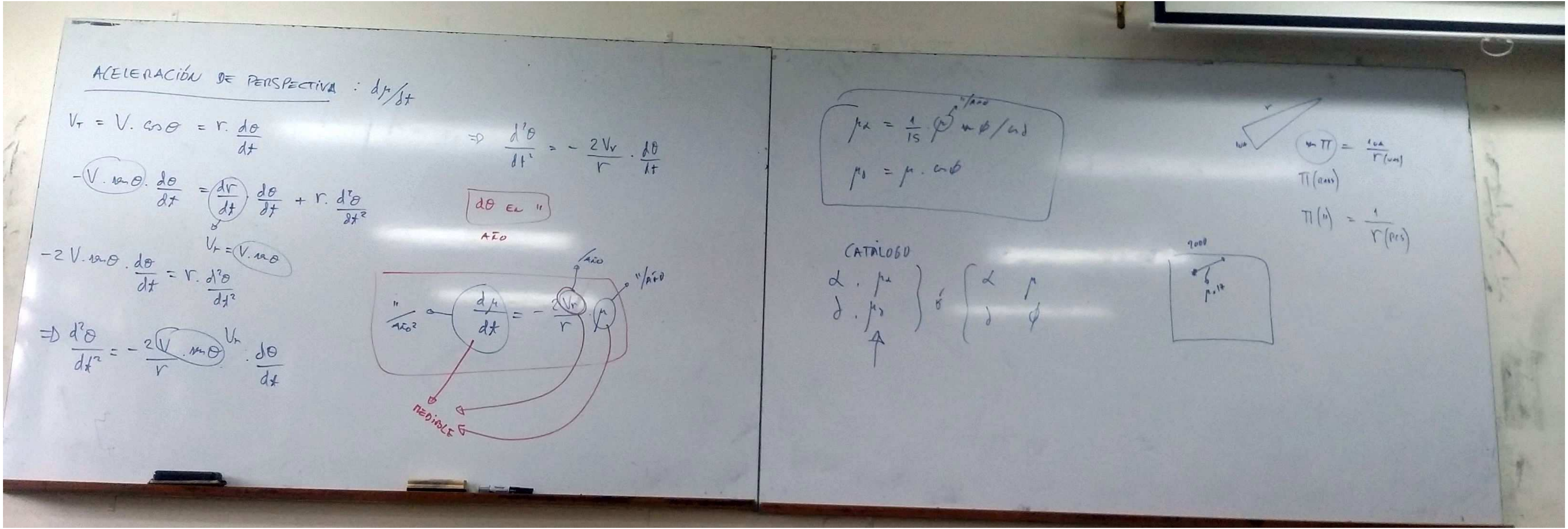



ACELERACIÓN DE PERSPECTIVA
MOV. PROPIO
V = CTE
CATÁLOGO

Astronomia Fundamental 2017

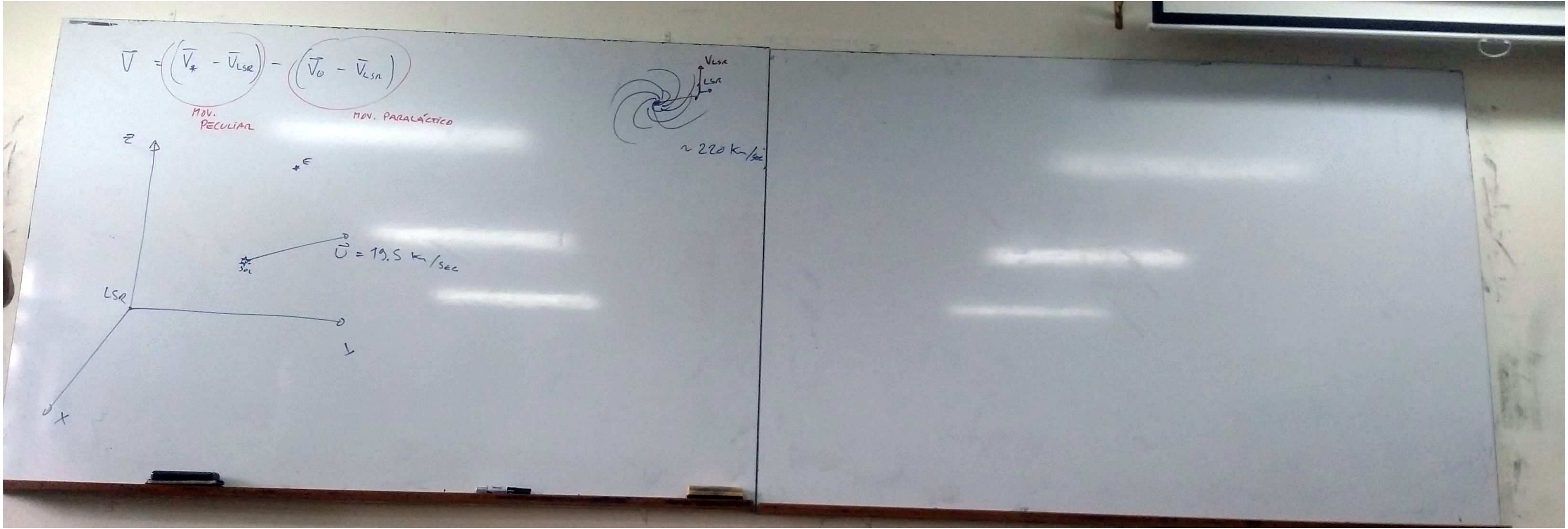


Astronomia Fundamental 2017

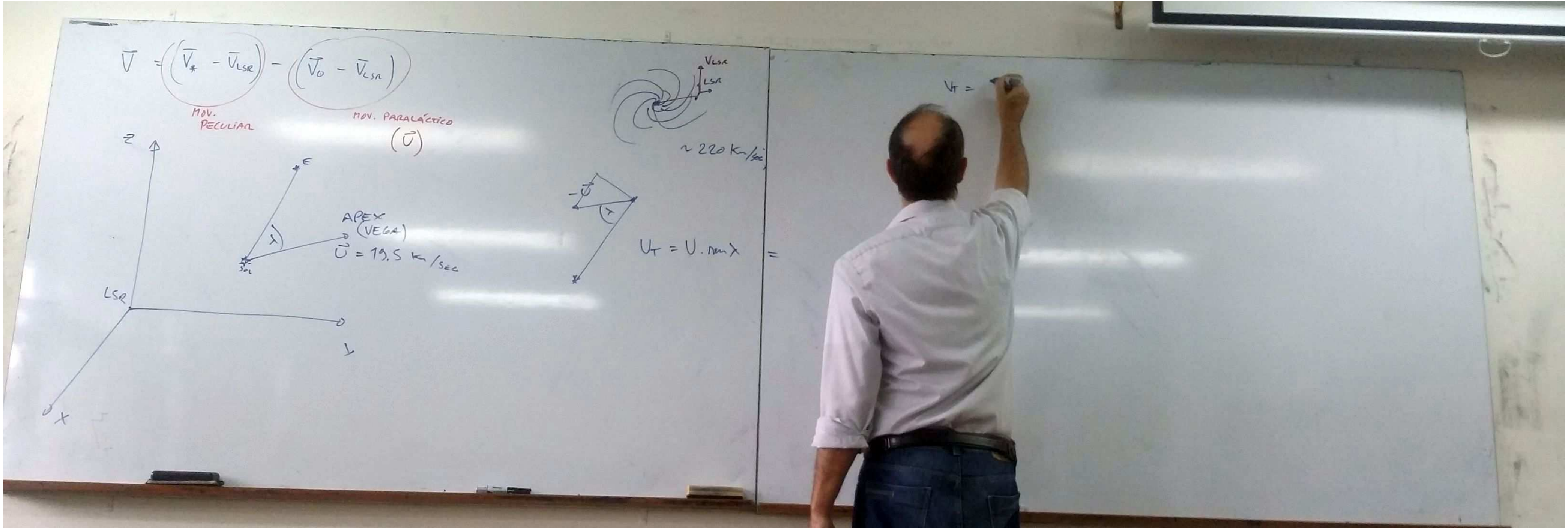


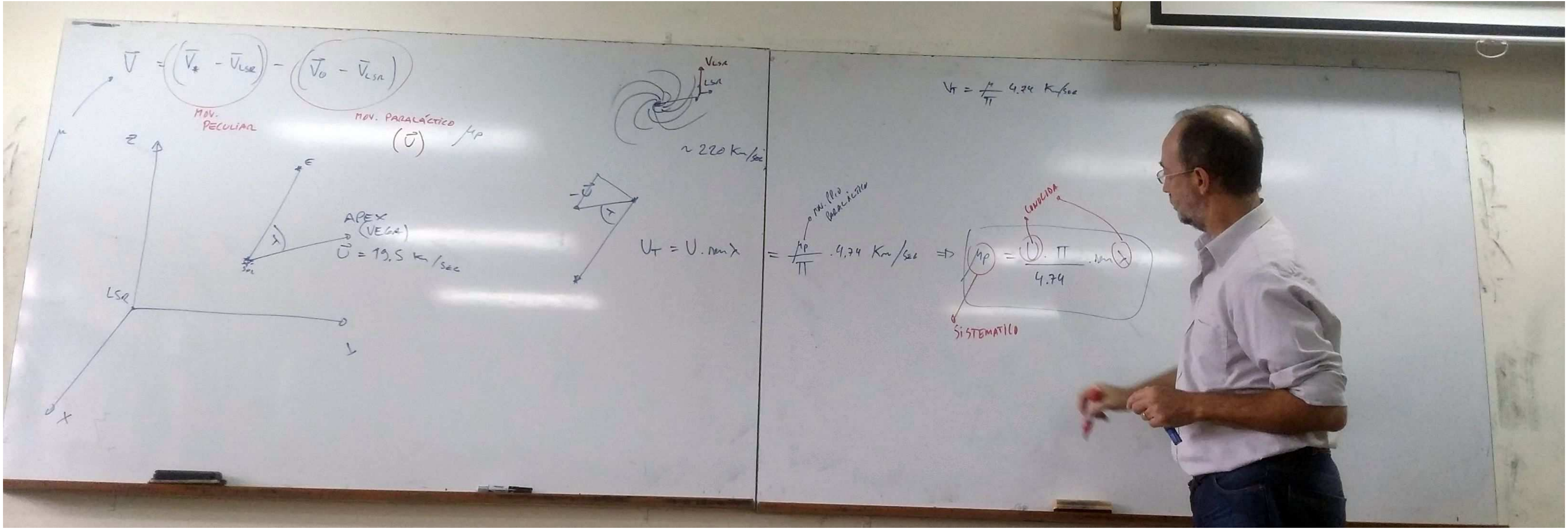

PECULIAR
MOV. PARALÁCTICO
LSR
SOL

Astronomia Fundamental 2017

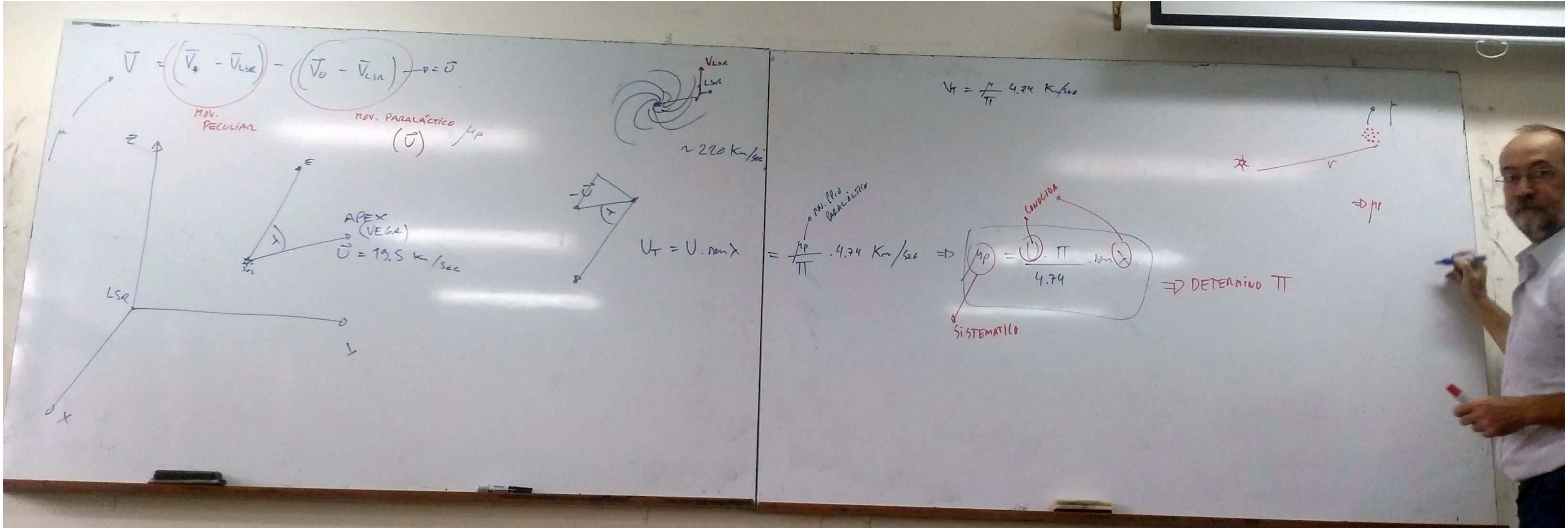


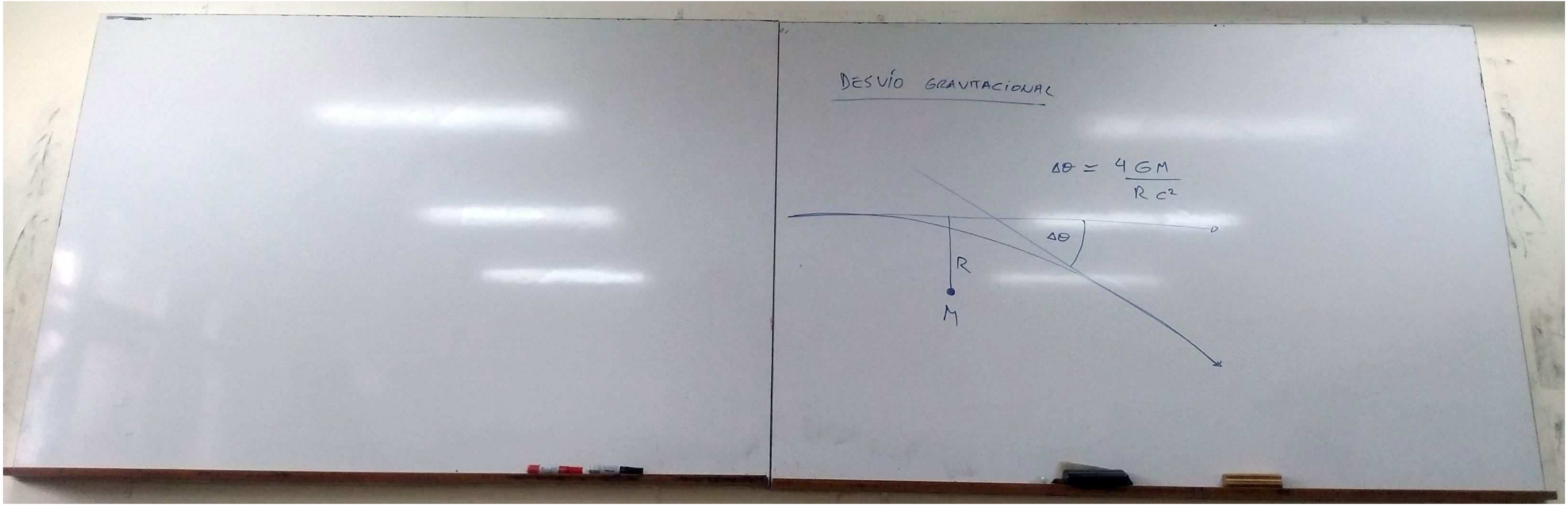
Astronomia Fundamental 2017

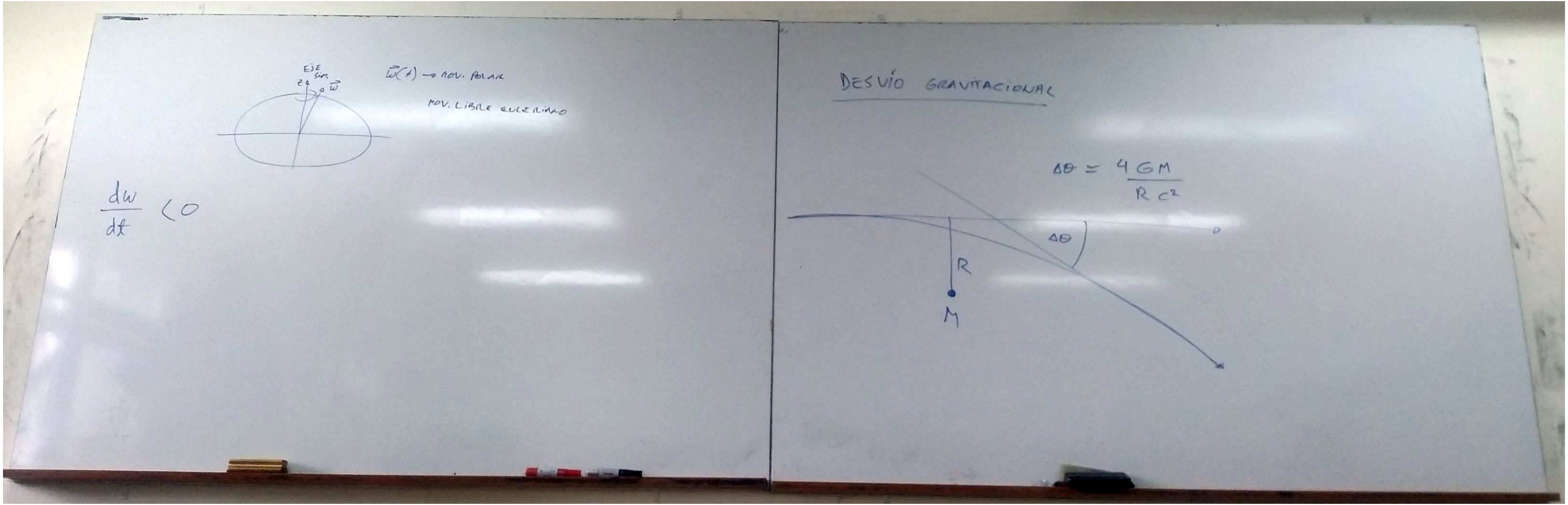




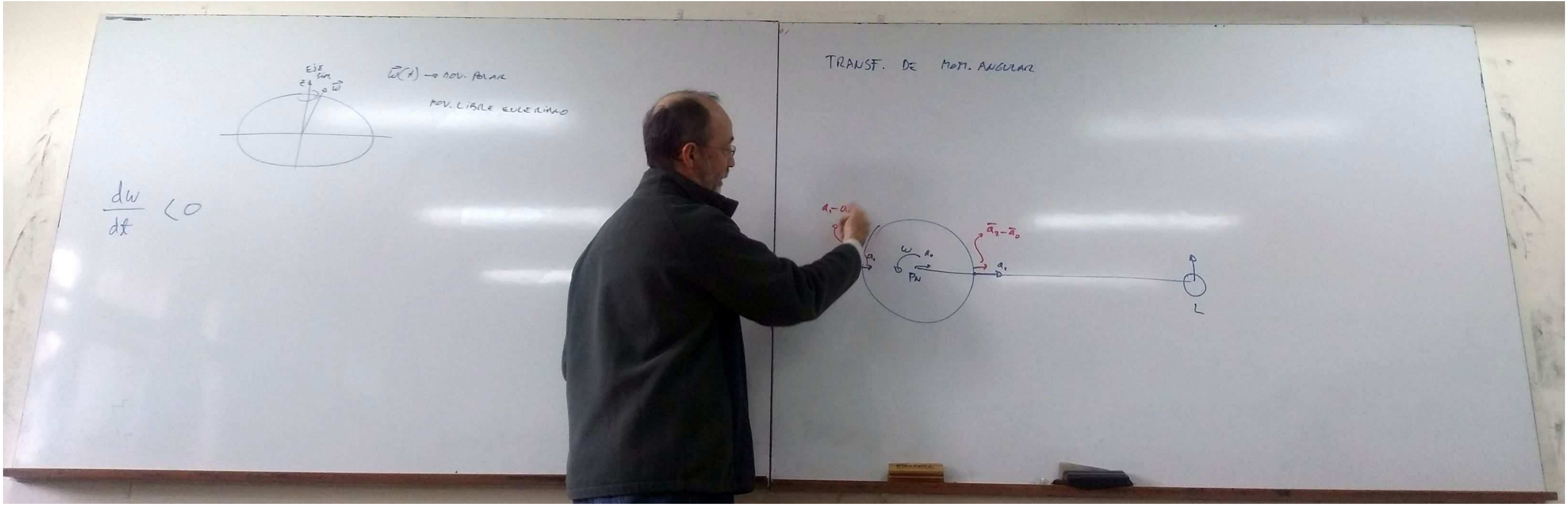
MOV. PECULIAR
MOV. PARALÁCTICO
APEX (VEGA)
~ 220 Km/sec
SISTEMATICO

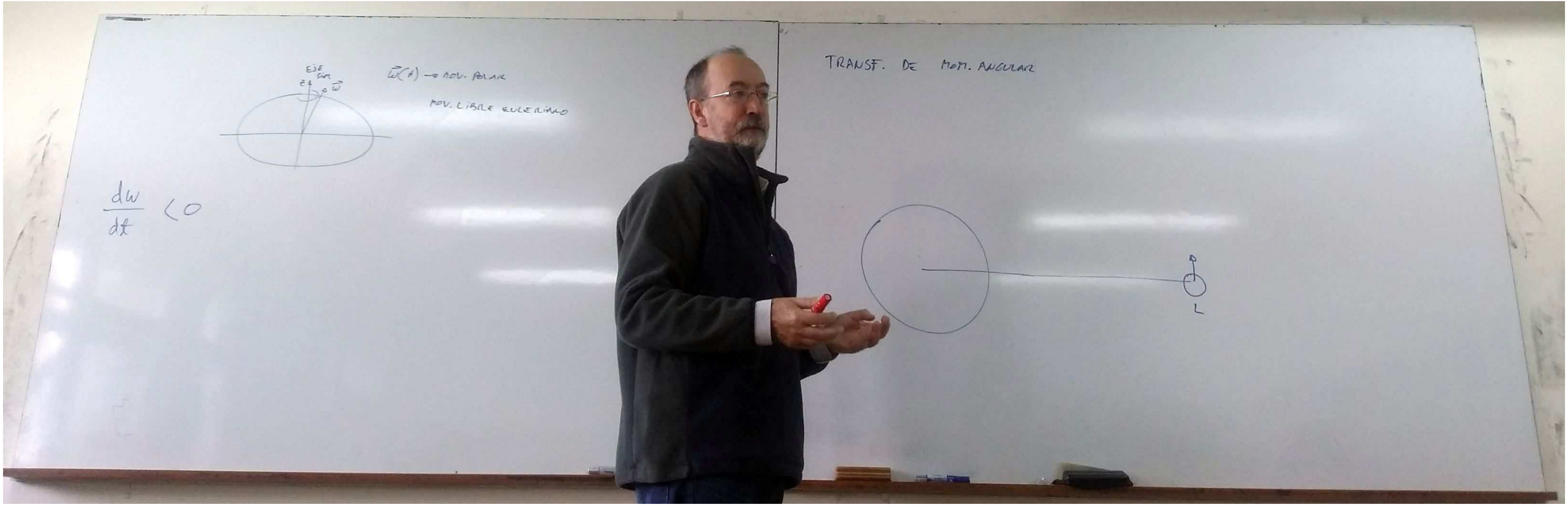

MOV. PECULIAR
MOV. PARALÁCTICO
APEX (VEGA)
~ 220 Km/sec
DETERMINO π
SISTEMATICO
CONOCIDA
4,74 Km/sec


DESVÍO GRAVITACIONAL
ΔΘ ≃ 4GM / Rc²
ΔΘ
R
M

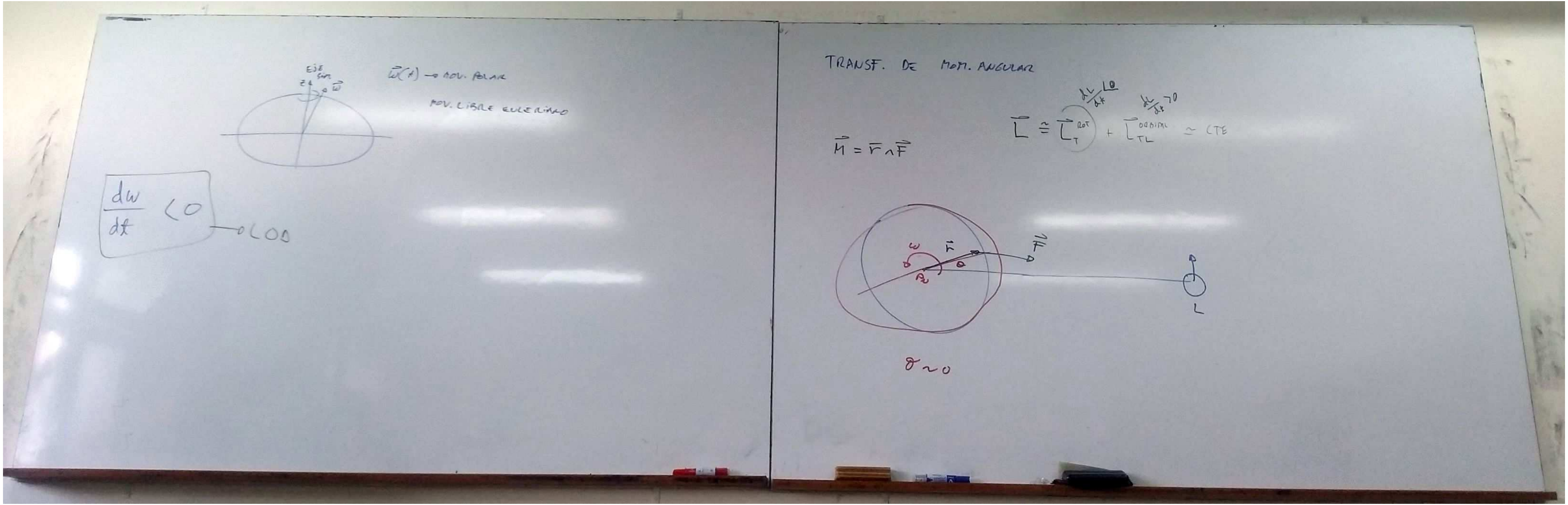

EJE SIM.
z
$\vec{\omega}$
$\vec{\omega}(t) \rightarrow$ MOV. POLAR
MOV. LIBRE EULERIANO
$\frac{d\omega}{dt} < 0$
DESVÍO GRAVITACIONAL
$\Delta\theta = \frac{4GM}{Rc^2}$
$\Delta\theta$
R
M


TRANSF. DE MOM. ANGULAR
MOV. LIBRE EULERIANO

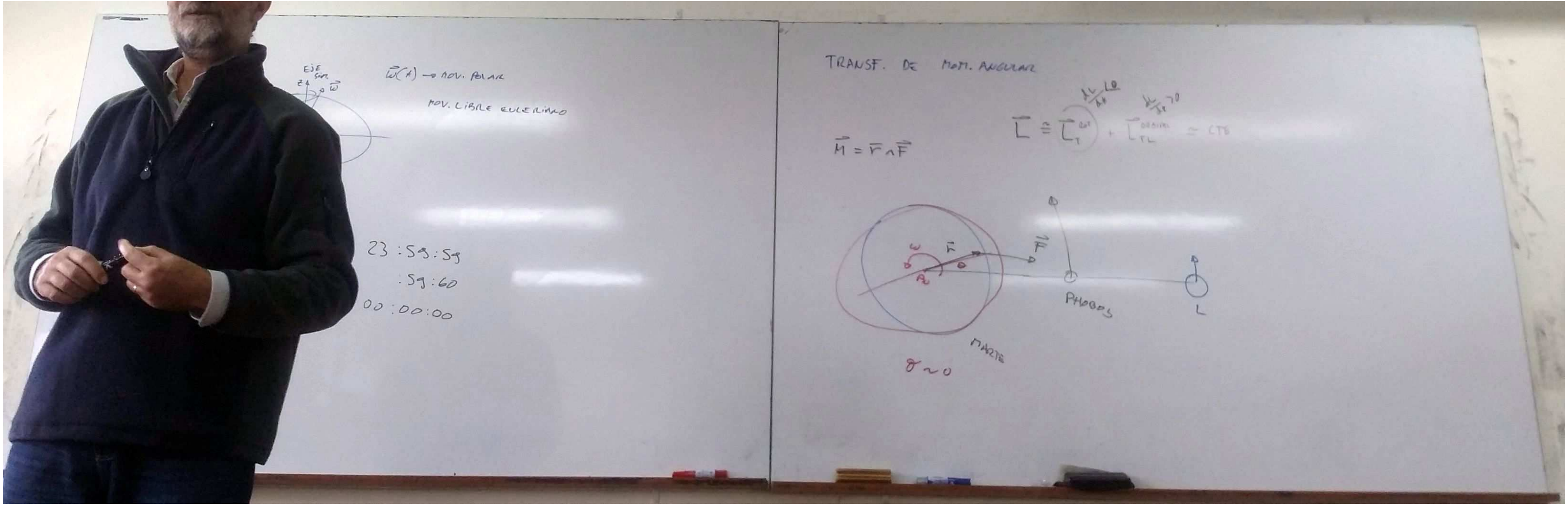

TRANSF. DE MOM. ANGULAR
MOV. LIBRE EULERIANO
PN
L

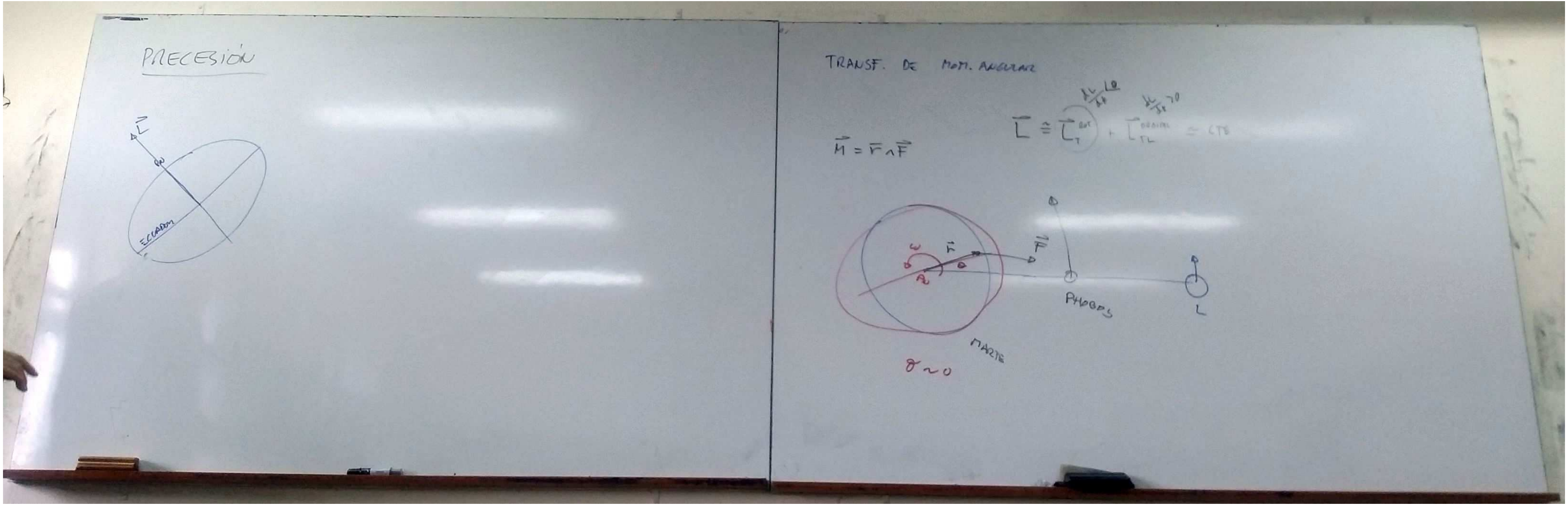

EJE
SIM
TRANSF. DE MOM. ANGULAR
L

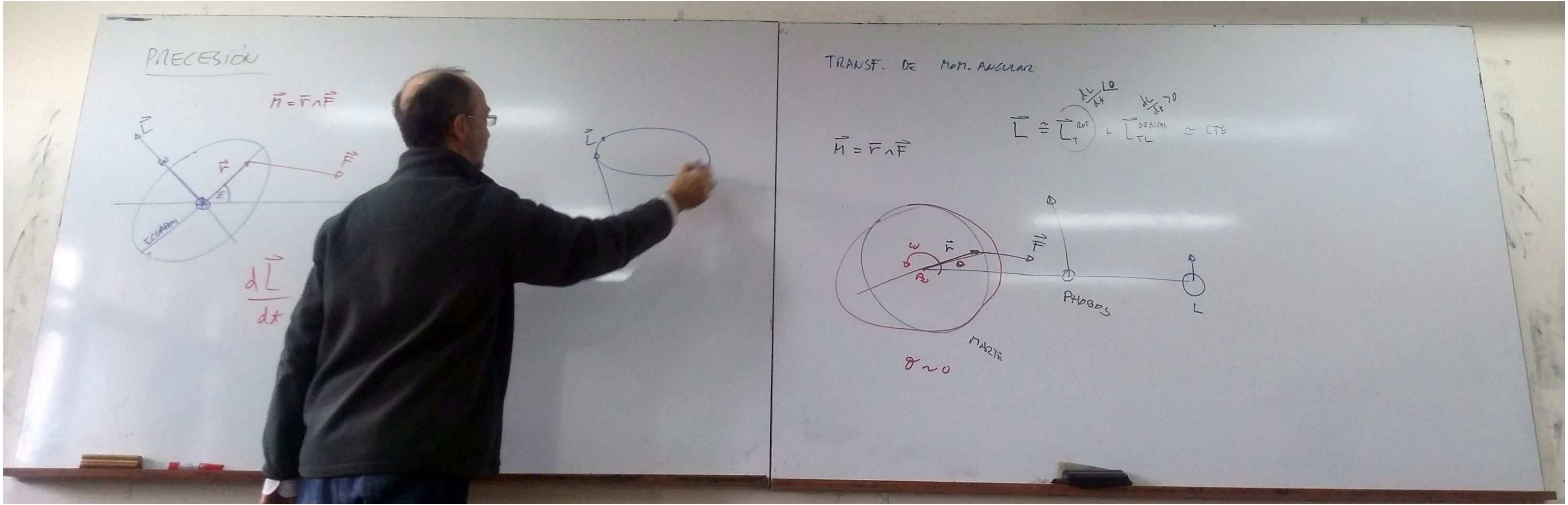

EJE SIM.
z
$\vec{\omega}$
$\vec{\omega}(t)$ → MOV. POLAR
MOV. LIBRE EULERIANO
$\frac{dw}{dt} < 0$
TRANSF. DE MOM. ANGULAR
ω
$\vec{r}$
θ
$\vec{F}$
L

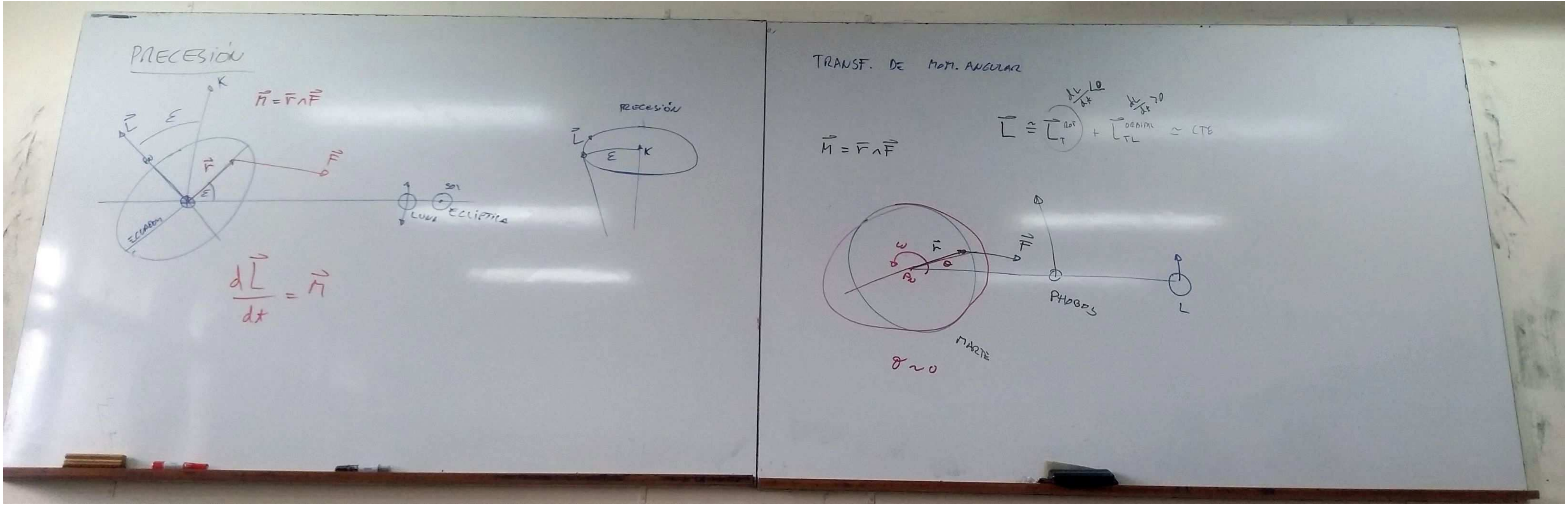

EJE SIM
TRANSF. DE MOM. ANGULAR
LOD
L

Astronomia Fundamental 2017

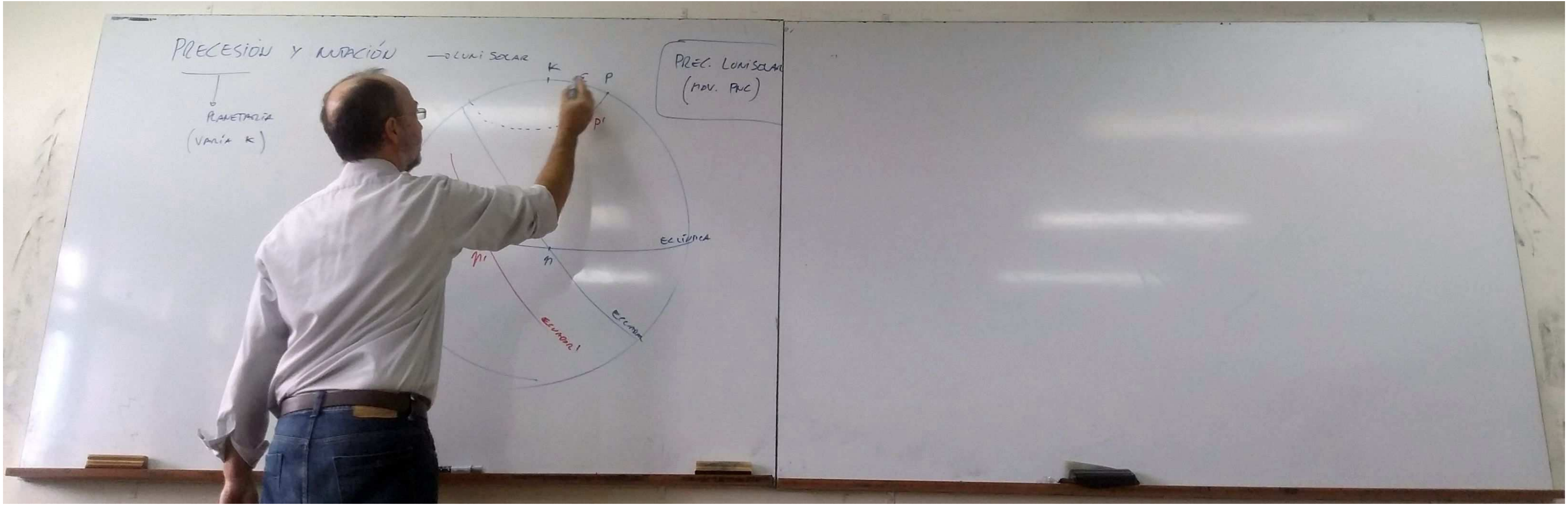



PRECESIÓN
ECUADOR
TRANSF. DE MOM. ANGULAR
PHOBOS
MARTE
L

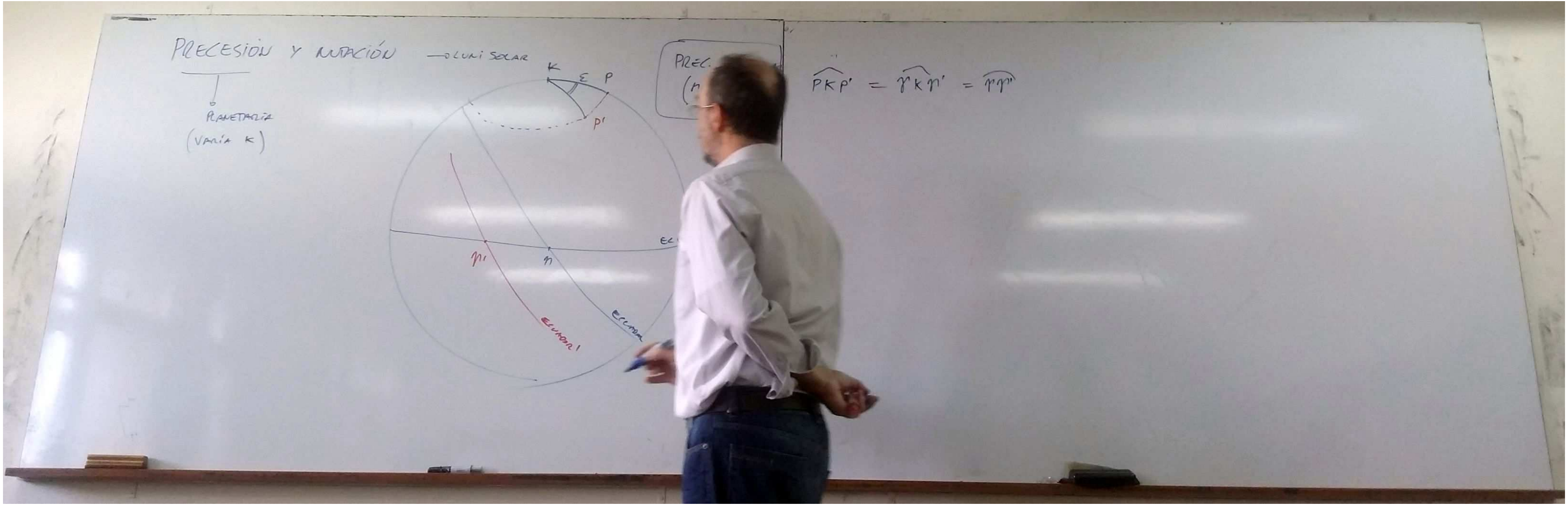

PRECESIÓN
M = r ∧ F
L
r
F
ε
ECUADOR
dL
dt
L
TRANSF. DE MOM. ANGULAR
M = r ∧ F
L ≃ L_T^ROT + L_TL^ORBITAL ≃ CTE
ω
r
F
θ
PHOBOS
L
MARTE
θ ~ 0


PRECESIÓN
K
$\vec{M} = \vec{r} \wedge \vec{F}$
$\vec{L}$
ε
$\vec{r}$
$\vec{F}$
ECUADOR
LUNA
SOL
ECLIPTICA
PRECESIÓN
$\frac{d\vec{L}}{dt} = \vec{M}$
TRANSF. DE MOM. ANGULAR
$\vec{M} = \vec{r} \wedge \vec{F}$
$\vec{L} \doteq \vec{L}_T^{ROT} + \vec{L}_{TL}^{ORBITAL} \simeq CTE$
ω
PHOBOS
L
MARTE
θ ∼ 0

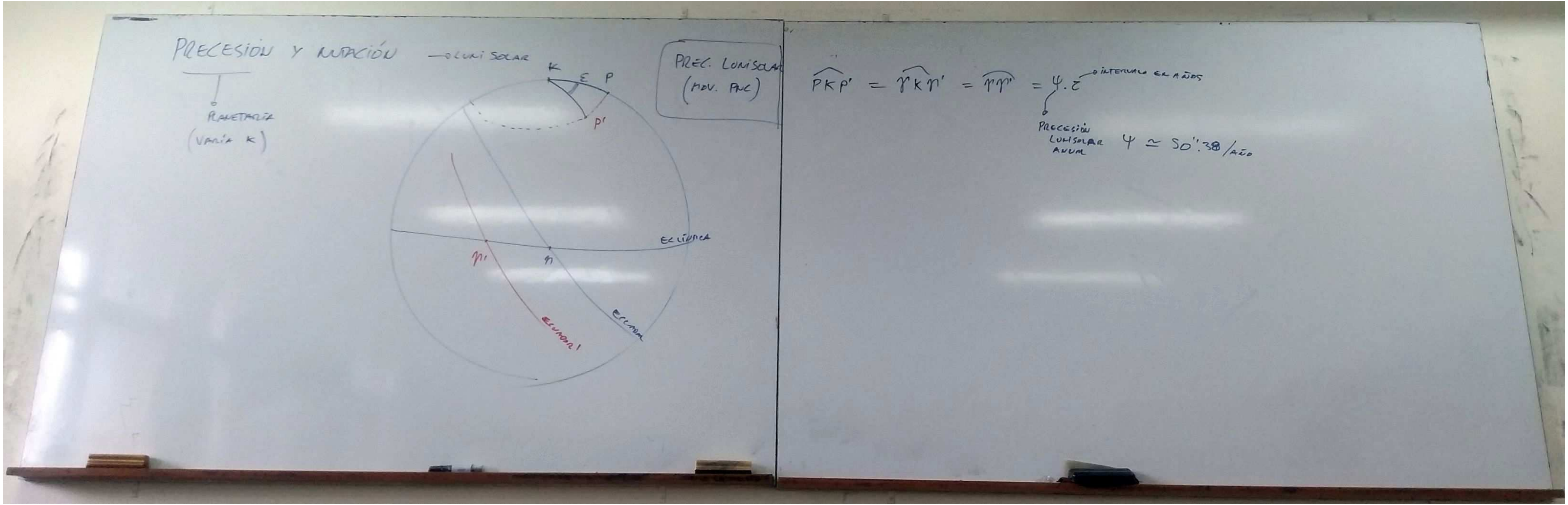
Astronomia Fundamental 2017

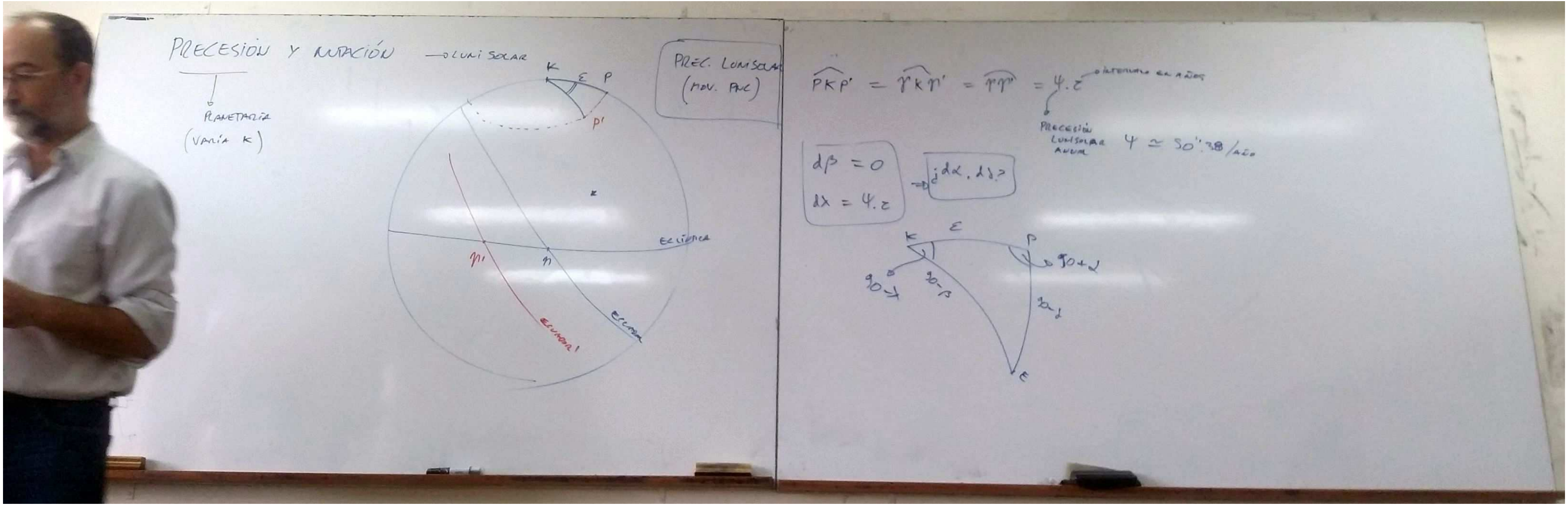


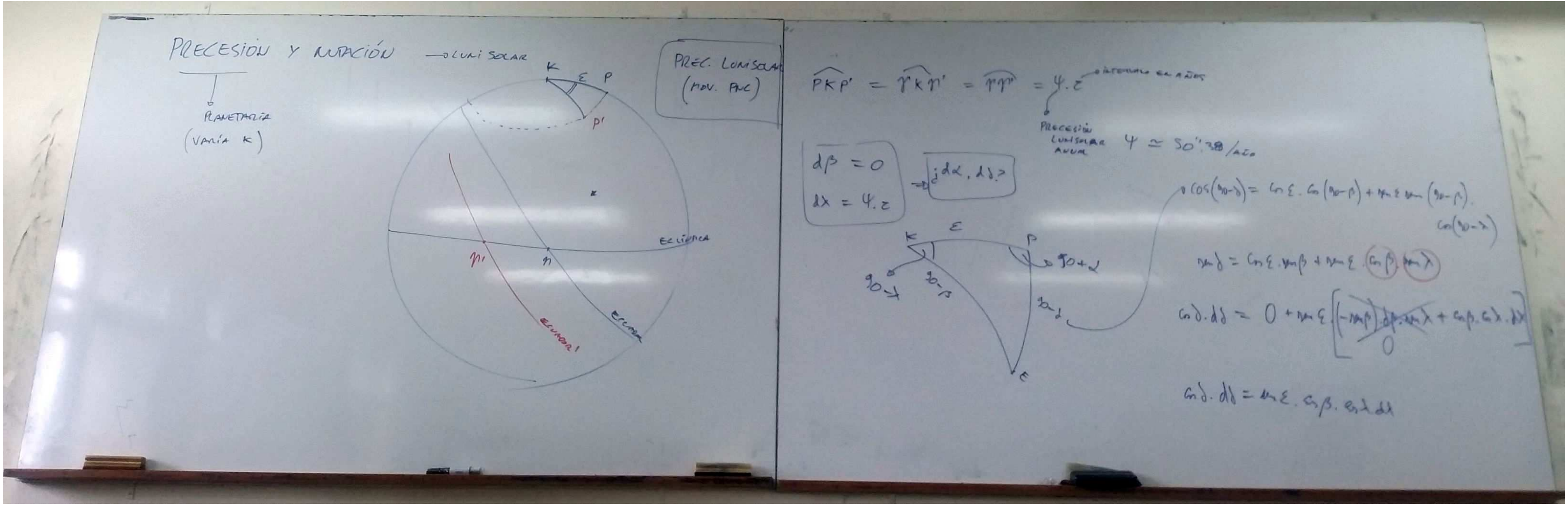
Astronomia Fundamental 2017



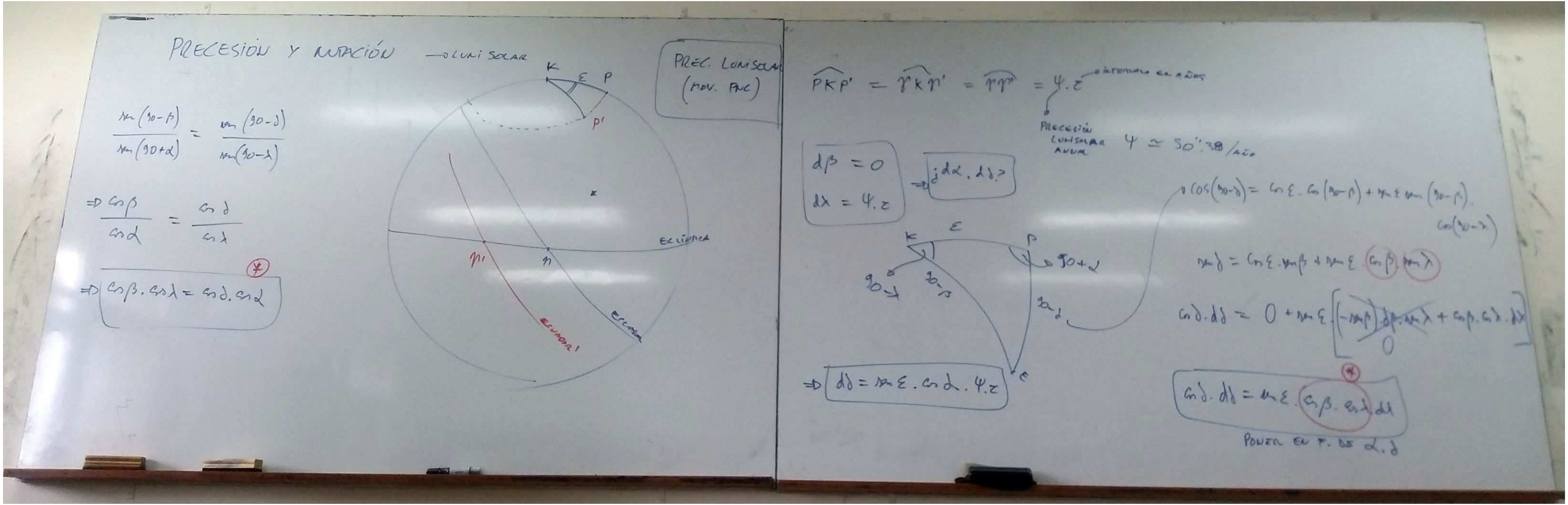
Astronomia Fundamental 2017



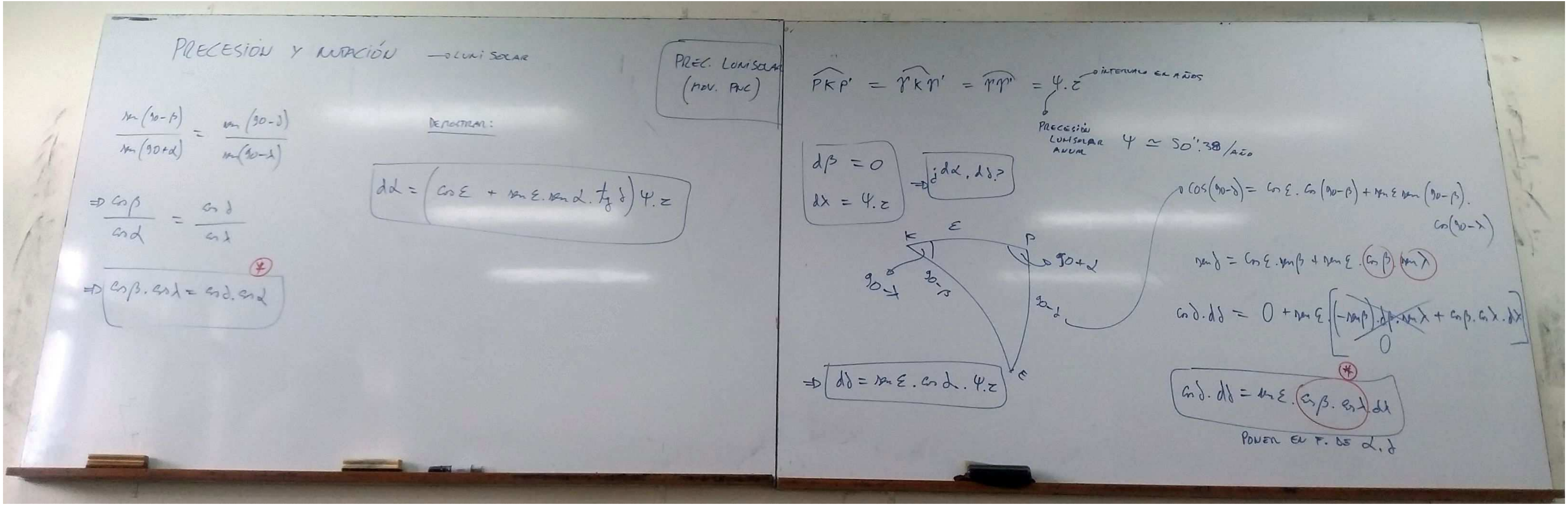

PRECESIÓN Y NUTACIÓN
LUNISOLAR
PLANETARIA
(VARÍA K)
PREC. LUNISOLAR
(MOV. PNC)
ECLÍPTICA
ECUADOR
ECUADOR'
dβ = 0
dλ = ψ.τ
¿dα, dδ?
PRECESIÓN LUNISOLAR ANUAL
ψ ≃ 50".38/año


PRECESIÓN Y NUTACIÓN
LUNISOLAR
PLANETARIA
(VARÍA K)
PREC. LUNISOLAR
(MOV. PNC)
K
ε
P
P'
ECLÍPTICA
ECUADOR
ECUADOR 1
PRECESIÓN LUNISOLAR ANUAL
dβ = 0
dλ = ψ.τ
ECUADOR
E

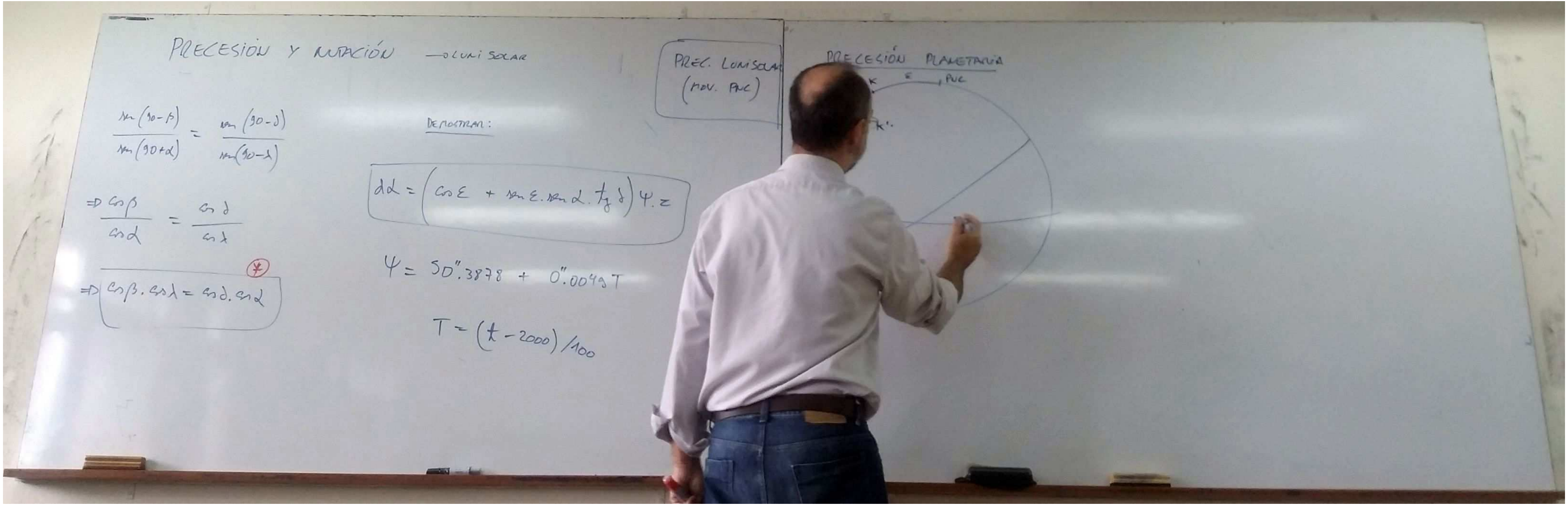
Astronomia Fundamental 2017

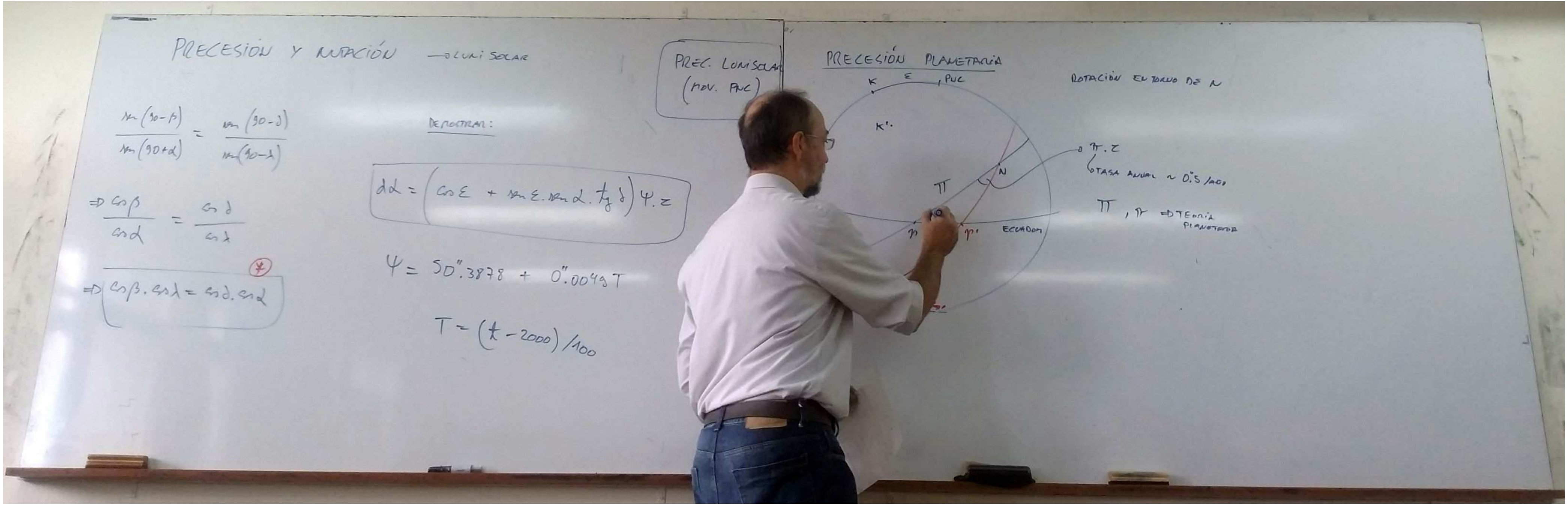


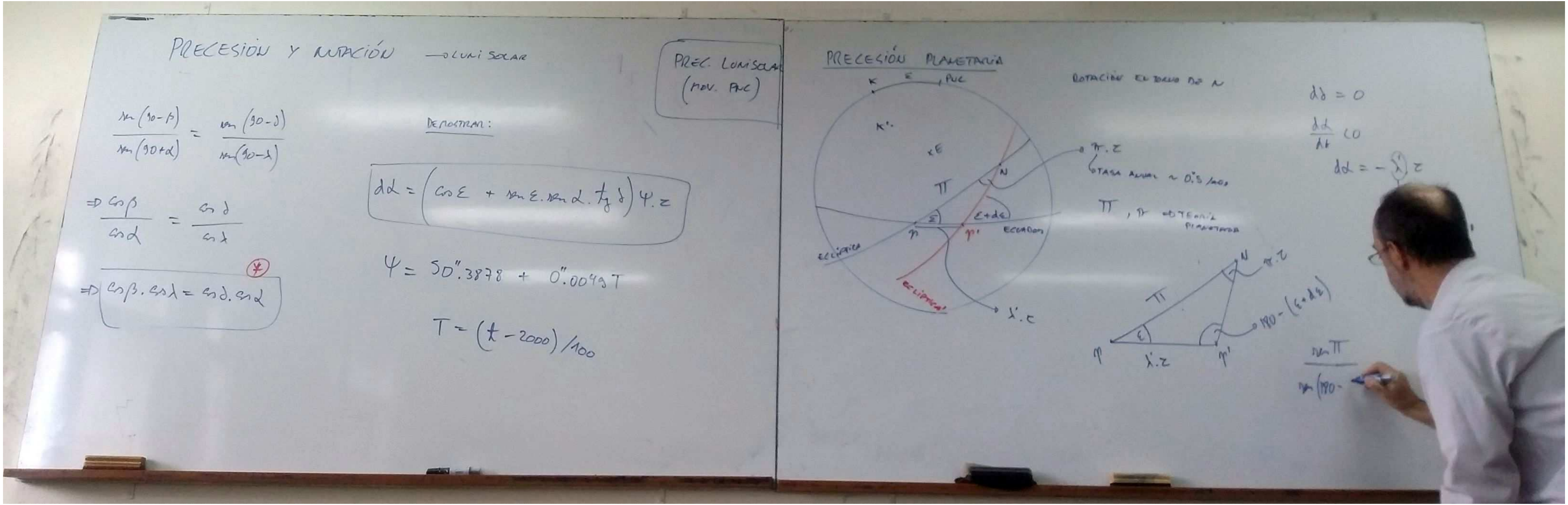
Astronomia Fundamental 2017



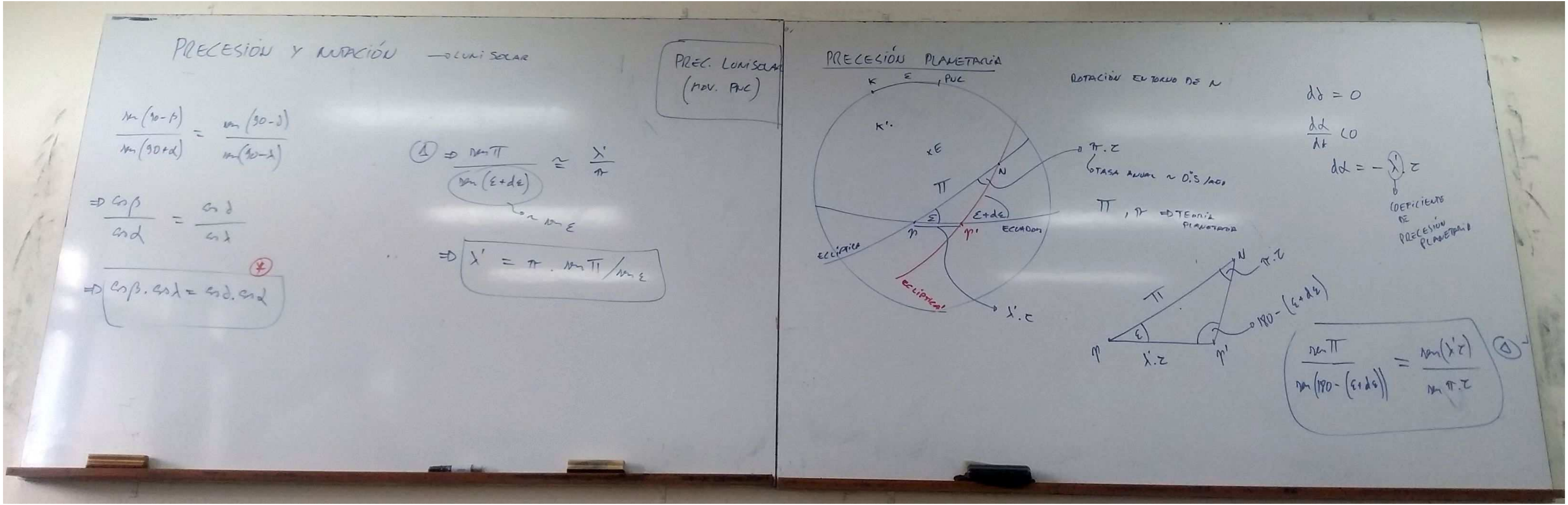
Astronomia Fundamental 2017



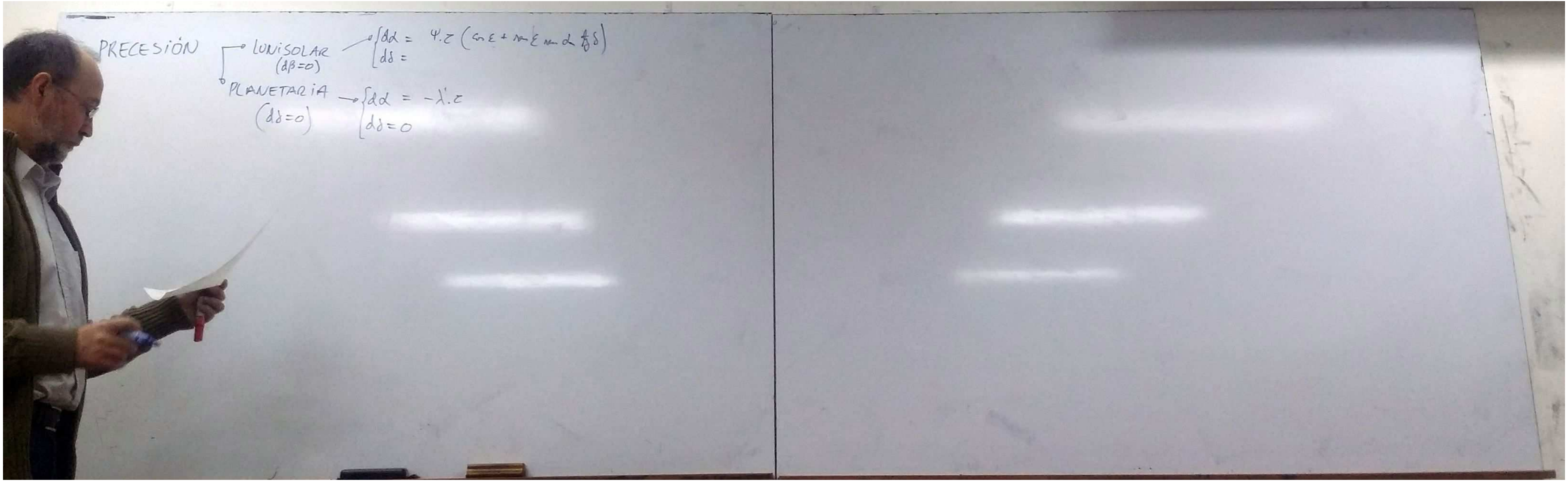

PRECESIÓN Y NUTACIÓN
→ LUNI SOLAR
PREC. LUNISOLAR
(MOV. PNC)
DEMOSTRAR:
Ψ = 50".3878 + 0".0049 T
T = (t − 2000) / 100
PRECESIÓN PLANETARIA
ROTACIÓN EN TORNO DE N
ECUADOR


PRECESIÓN Y NUTACIÓN
→ LUNISOLAR
PREC. LUNISOLAR (MOV. PNC)
DEMOSTRAR:
dα = (cos ε + sen ε . sen α . tg δ) ψ . τ
ψ = 50".3878 + 0".0049 T
T = (t − 2000)/100
⇒ cos β / cos α = cos δ / cos λ
⇒ cos β . cos λ = cos δ . cos α
PRECESIÓN PLANETARIA
ECLÍPTICA
ECUADOR
ROTACIÓN EN TORNO DE N
TASA ANUAL ~ 0."5 /año
dδ = 0
dα/dt < 0
dα = − λ' τ

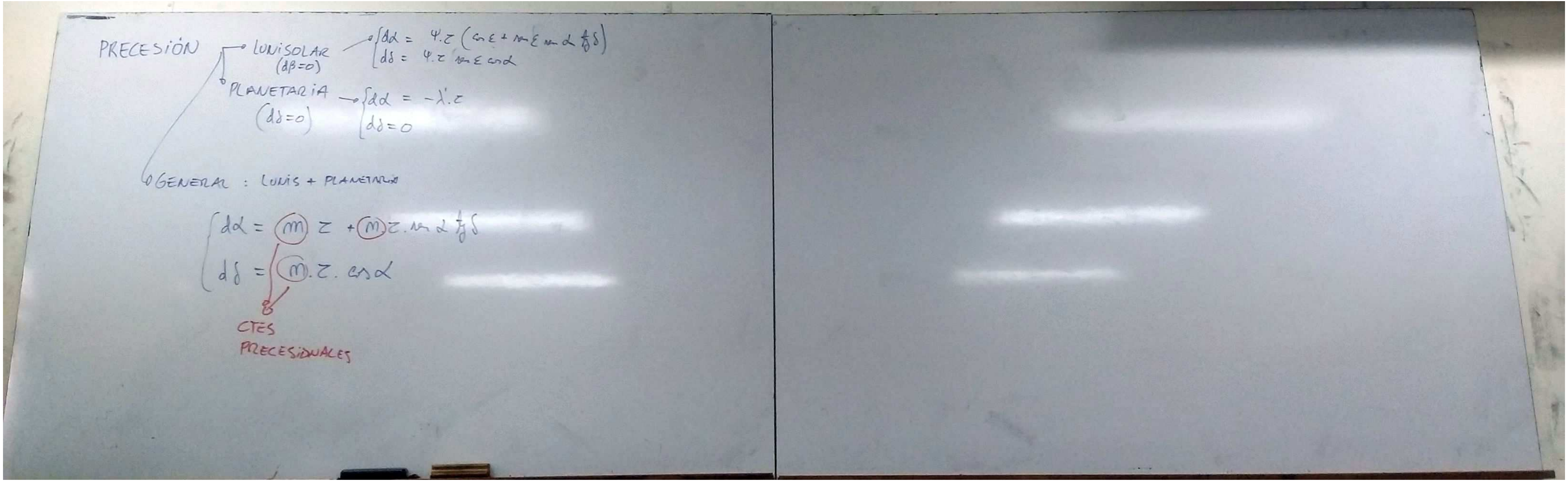
Astronomia Fundamental 2017

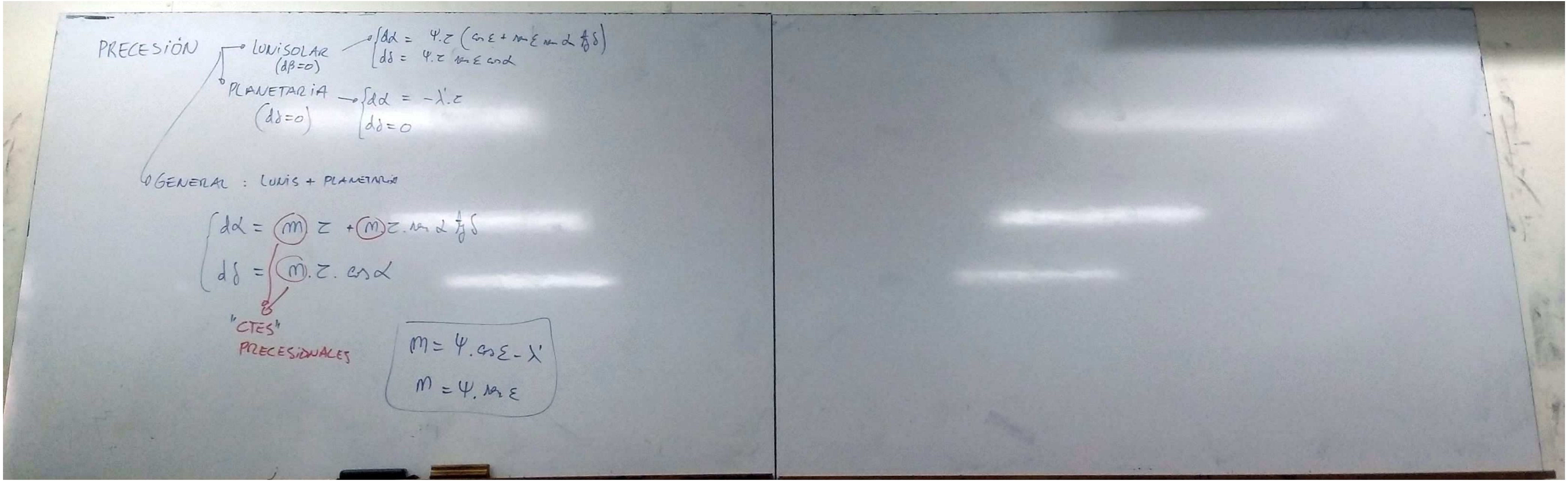


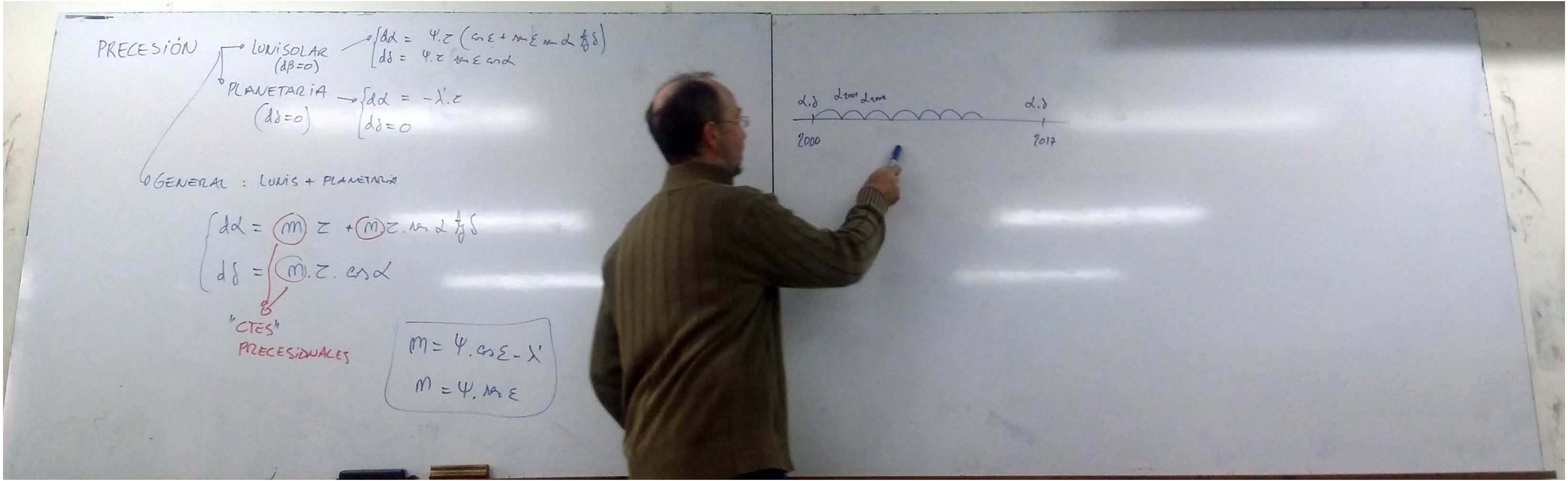

PRECESIÓN
LUNISOLAR
PLANETARIA

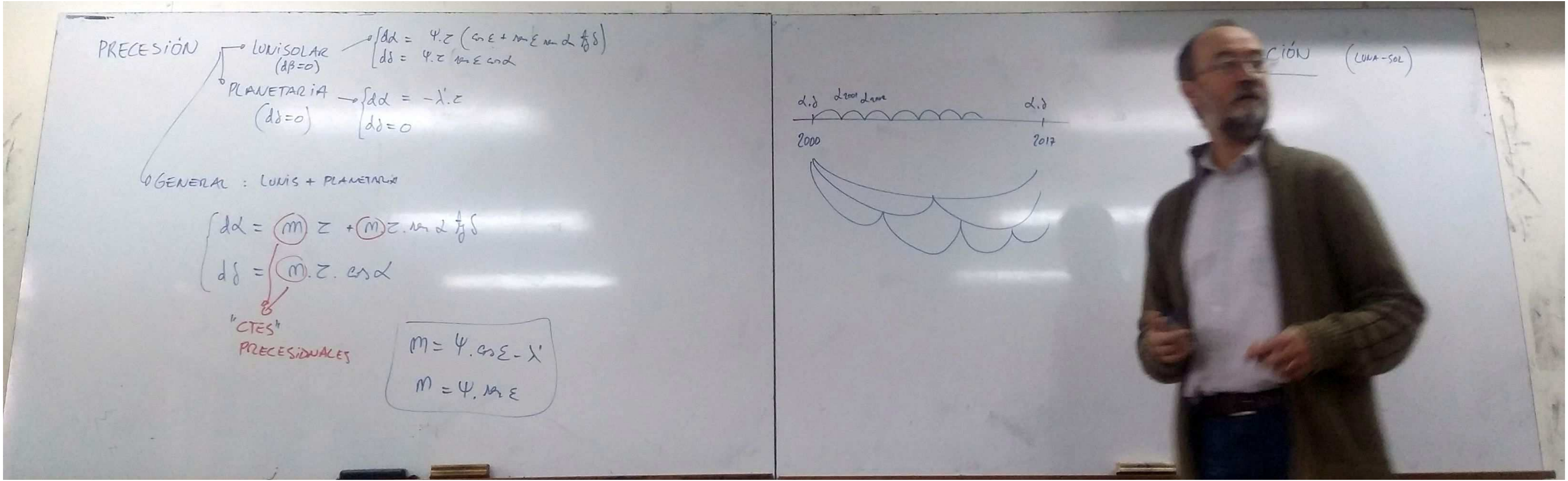

PRECESIÓN
LUNISOLAR
(dβ=0)
dα = Ψ.τ (cos ε + sen ε sen α tg δ)
dδ =
PLANETARIA
(dδ=0)
dα = −λ'.τ
dδ=0

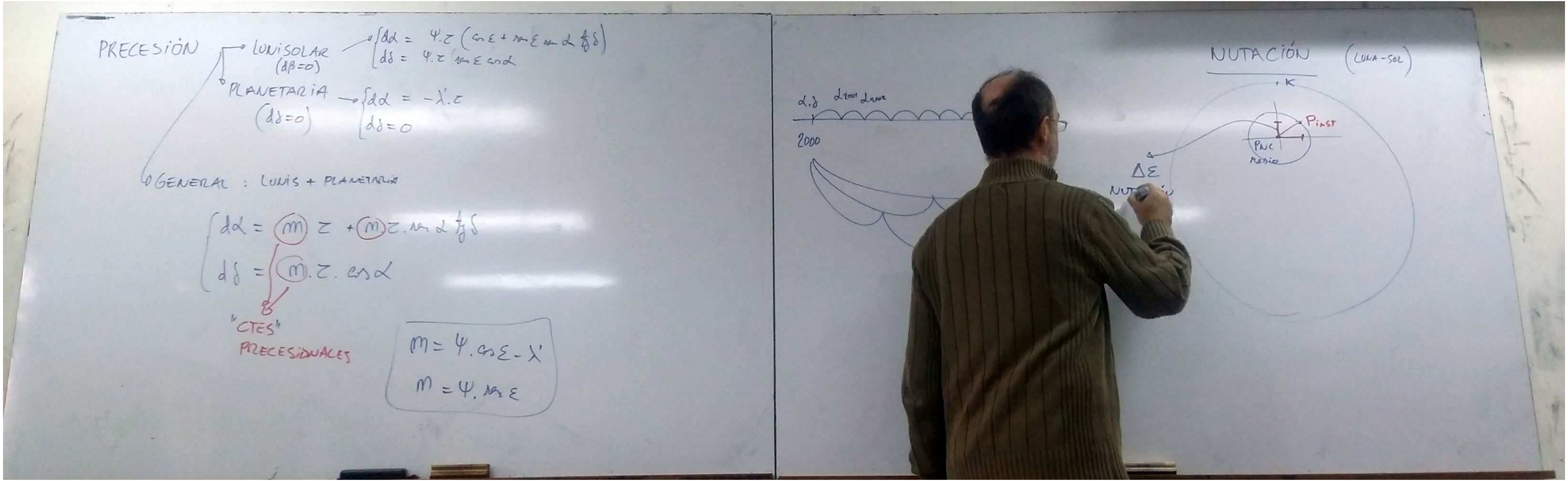
Astronomia Fundamental 2017



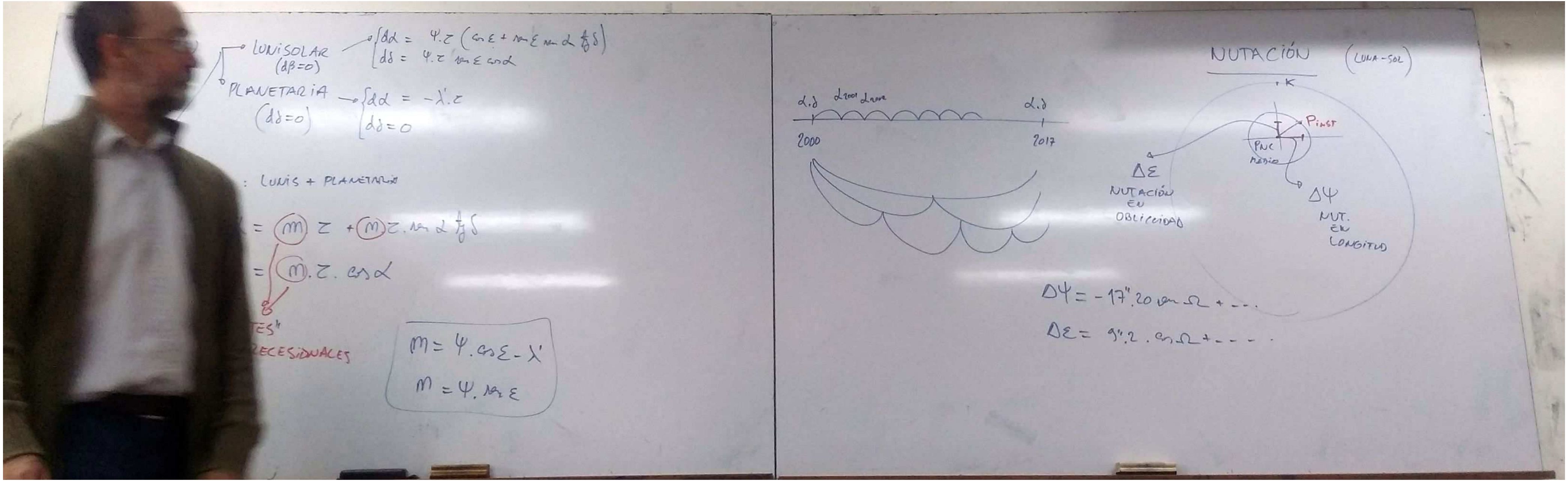

PRECESIÓN
LUNISOLAR
(dβ=0)
dα = Ψ.τ (cos ε + sen ε sen α tg δ)
dδ = Ψ.τ sen ε cos α
PLANETARIA
(dδ=0)
dα = −λ'.τ
dδ = 0
GENERAL : LUNIS + PLANETARIA
dα = m τ + n τ. sen α tg δ
dδ = n. τ. cos α
"CTES" PRECESIONALES
m = Ψ. cos ε − λ'
n = Ψ. sen ε

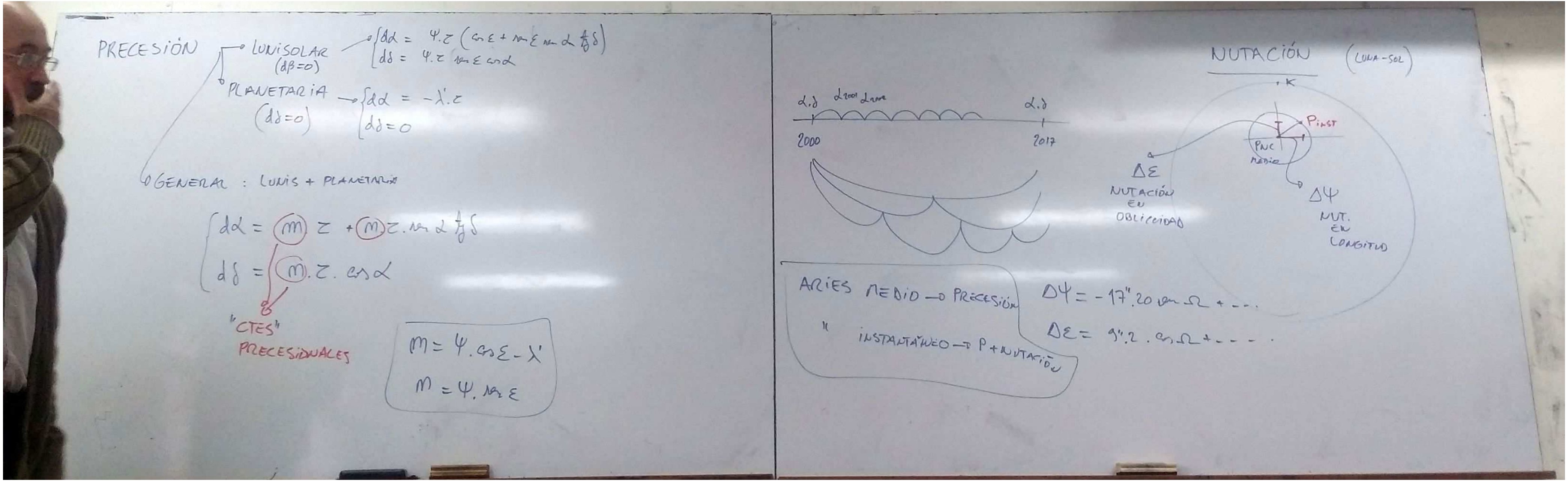

PRECESIÓN
LUNISOLAR (dβ=0)
PLANETARIA (dγ=0)
GENERAL : LUNIS + PLANETARIA
"CTES" PRECESIONALES
2000
2017


PRECESIÓN
LUNISOLAR (dβ=0)
dα = Ψ.τ (cos ε + sen ε sen α tg δ)
dδ = Ψ.τ sen ε cos α
PLANETARIA (dδ=0)
dα = −λ'.τ
dδ = 0
GENERAL : LUNIS + PLANETARIA
dα = m τ + n τ. sen α tg δ
dδ = n.τ. cos α
"CTES" PRECESIONALES
m = Ψ. cos ε − λ'
n = Ψ. sen ε
2000
2017
(LUNA-SOL)

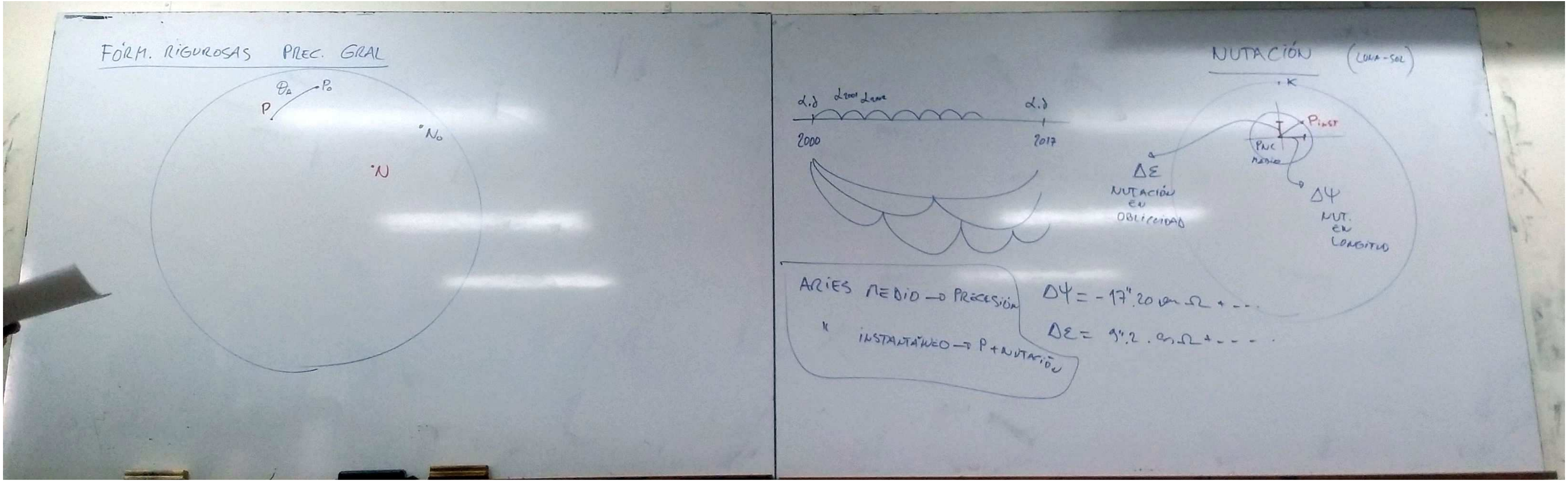

PRECESIÓN
LUNISOLAR
($d\beta = 0$)
PLANETARIA
($d\delta = 0$)
$d\alpha = -\lambda' . \tau$
$d\delta = 0$
GENERAL : LUNIS + PLANETARIA
"CTES" PRECESIONALES
$m = \Psi . \cos\varepsilon - \lambda'$
$n = \Psi . \sin\varepsilon$
NUTACIÓN
(LUNA-SOL)
2000
$\Delta\varepsilon$
K
P_{INST}

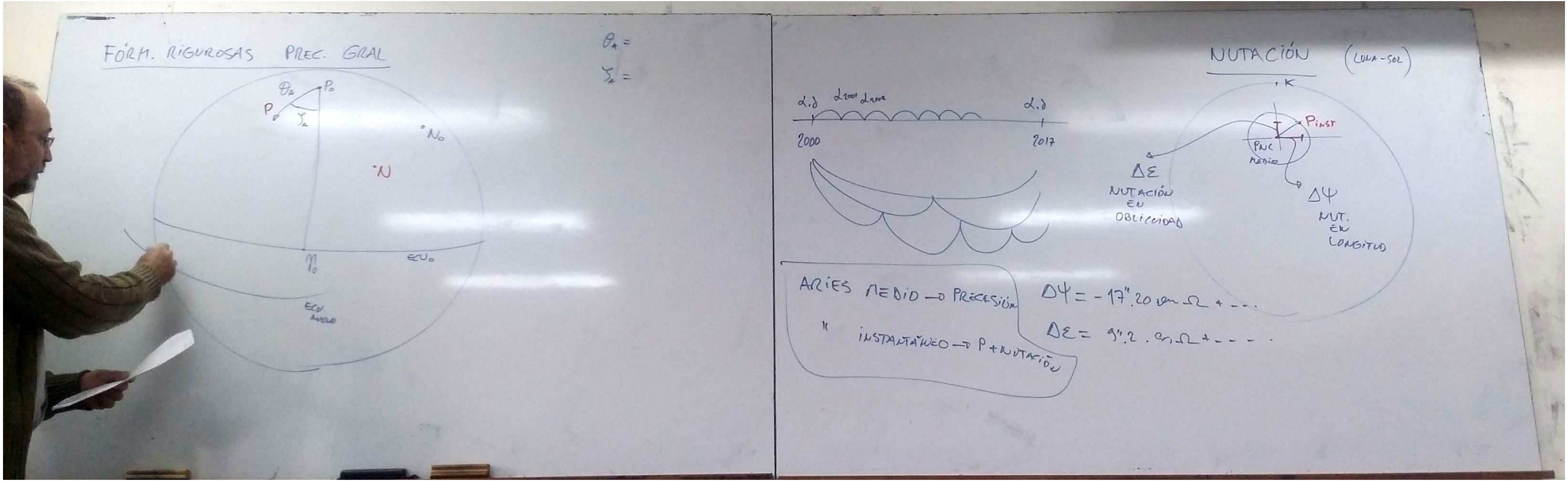
Astronomia Fundamental 2017

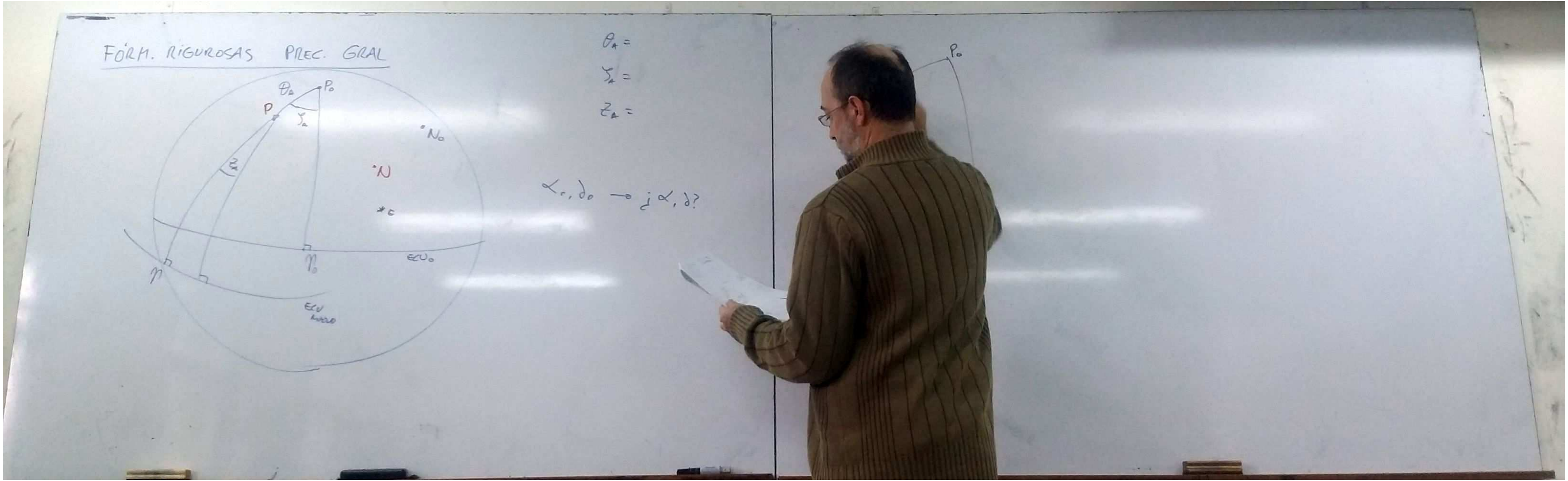


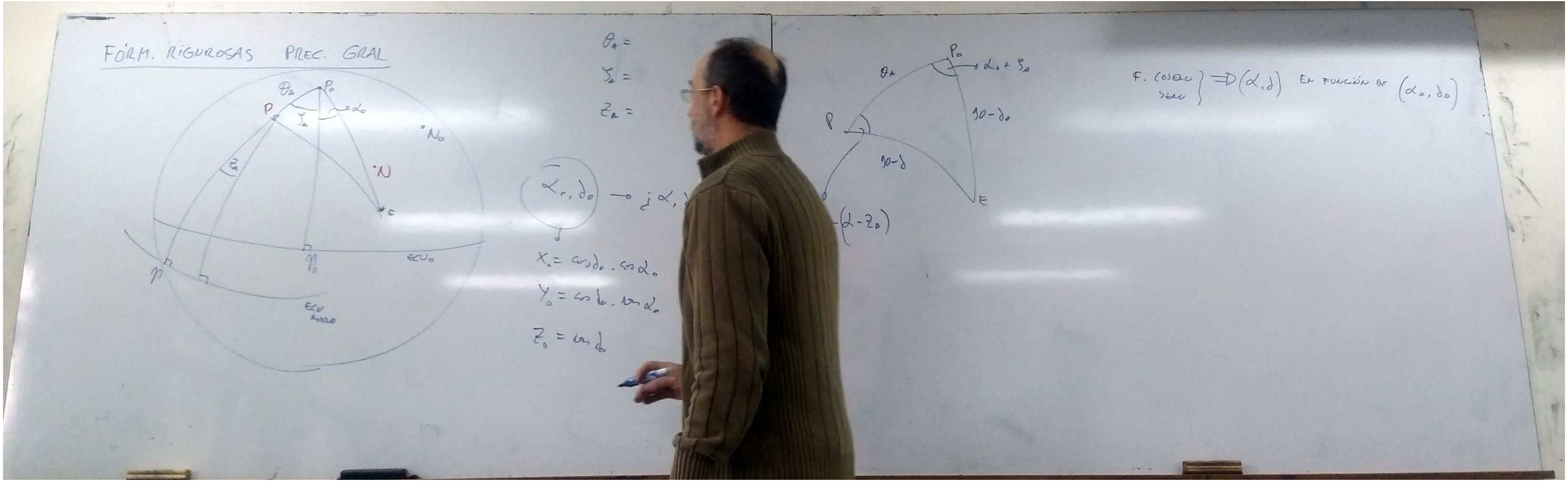

PRECESIÓN
LUNISOLAR
(dβ=0)
dα = Ψ.τ (cos ε + sen ε sen α tg δ)
dδ = Ψ.τ sen ε cos α
PLANETARIA
(dδ=0)
dα = −λ'.τ
dδ = 0
GENERAL : LUNIS + PLANETARIA
dα = m τ + n τ. sen α tg δ
dδ = n.τ. cos α
"CTES" PRECESIONALES
m = Ψ. cos ε − λ'
n = Ψ. sen ε
α, δ
α, δ
2000
2017
NUTACIÓN
(LUNA-SOL)
K
PINST
PNC MEDIO
Δε
NUTACIÓN EN OBLICUIDAD
ΔΨ
NUT. EN LONGITUD
ARIES MEDIO → PRECESIÓN
" INSTANTÁNEO → P + NUTACIÓN
ΔΨ = −17".20 sen Ω + ...
Δε = 9".2 . cos Ω + ...

Astronomia Fundamental 2017

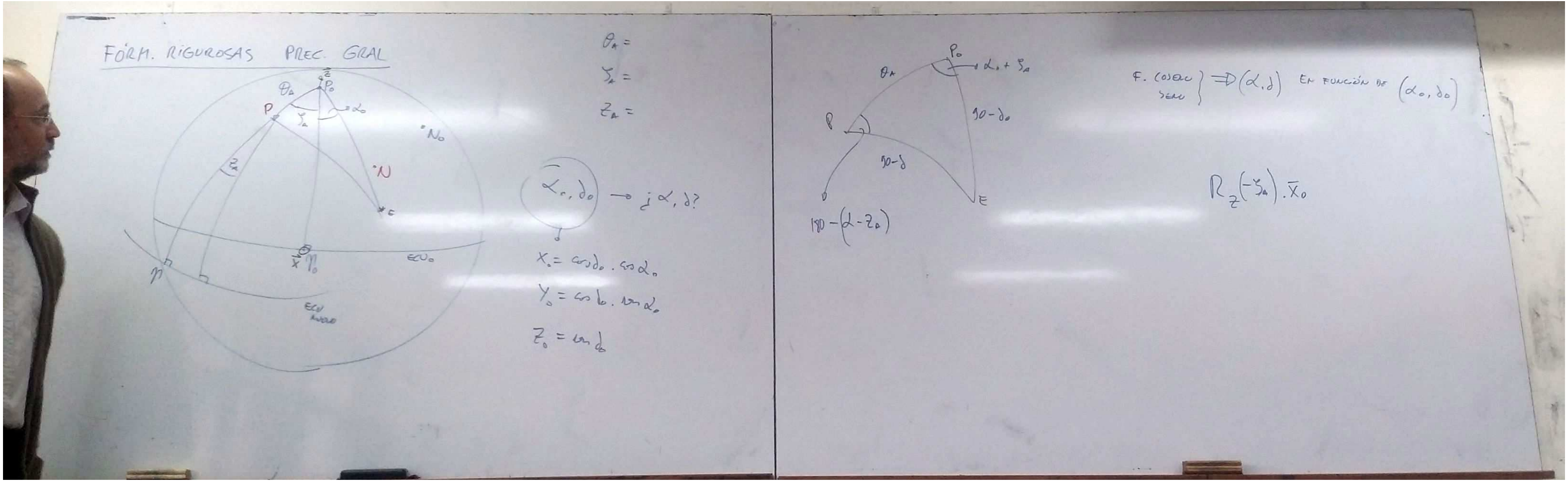



FÓRM. RIGUROSAS PREC. GRAL
NUTACIÓN (LUNA-SOL)
2000
2017
ARIES MEDIO → PRECESIÓN
" INSTANTÁNEO → P + NUTACIÓN
ΔΨ = -17".20 sen Ω + ...
Δε = 9".2 . cos Ω + ...
ΔΕ
NUTACIÓN EN OBLICUIDAD
ΔΨ
NUT. EN LONGITUD
ECU₀
ECU MEDIO

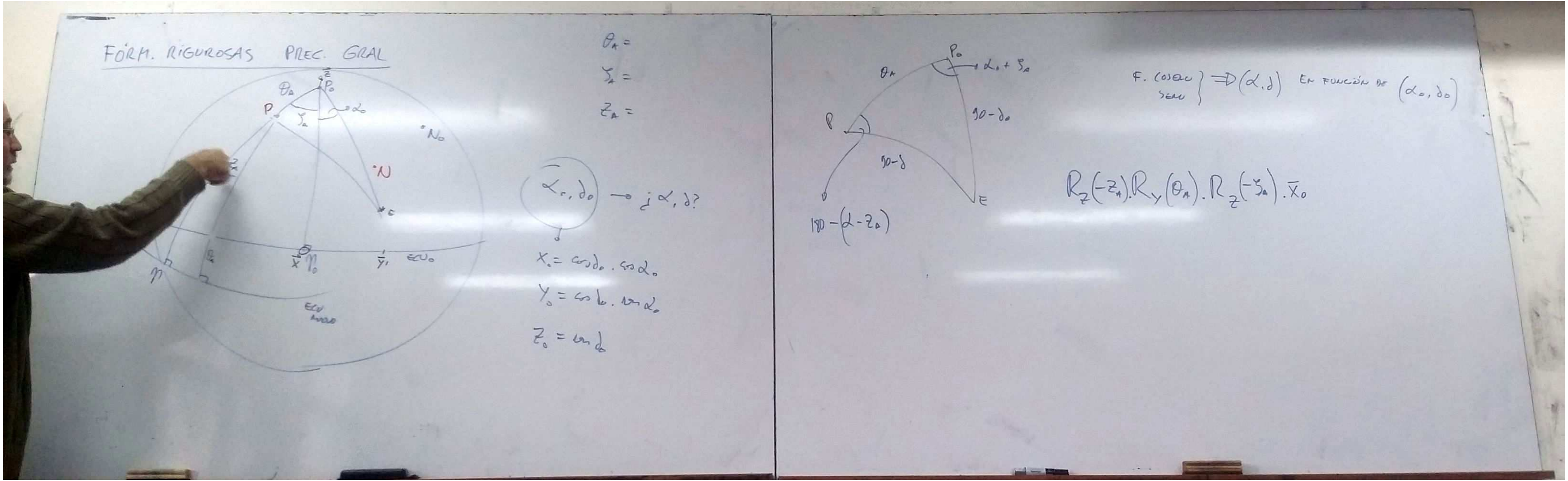

FÓRM. RIGUROSAS PREC. GRAL
θ_A =
ζ_A =
z_A =
$\alpha_0, \delta_0 \rightarrow ¿\alpha, \delta?$
ECU₀
ECU


FÓRM. RIGUROSAS PREC. GRAL
P
P_0
N
ECU
$X_0 = \cos\delta_0 . \cos\alpha_0$
$Y_0 = \cos\delta_0 . \sin\alpha_0$
$Z_0 = \sin\delta_0$
E
F. COSENO SENO } ⟹ (α, δ) EN FUNCIÓN DE (α_0, δ_0)

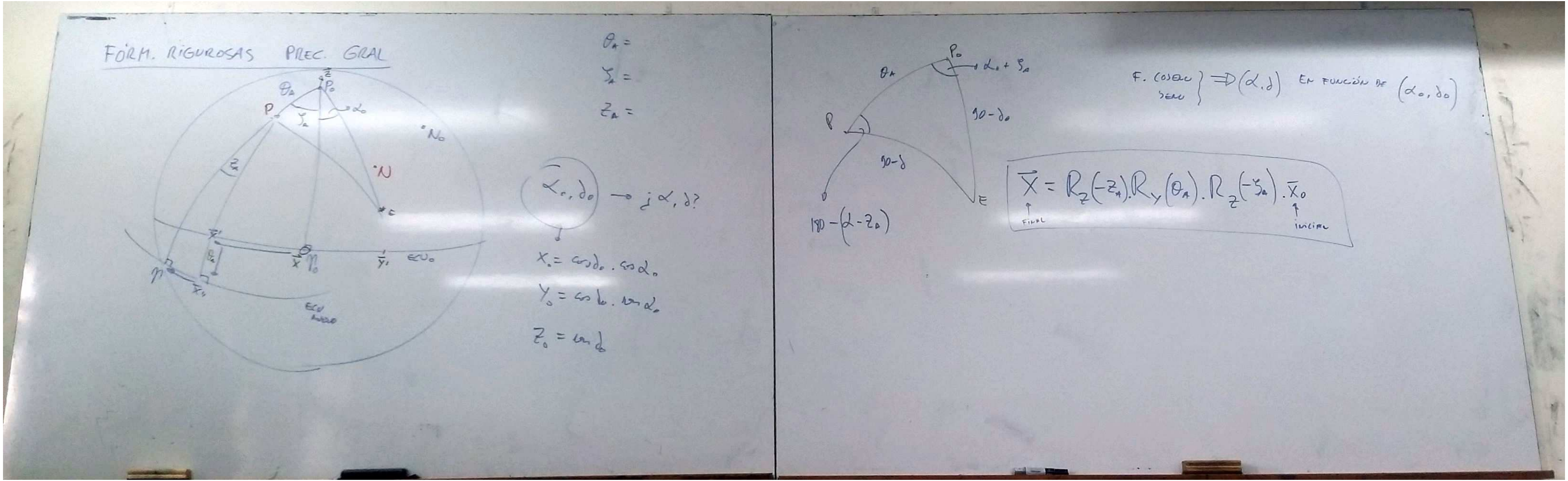
Astronomia Fundamental 2017



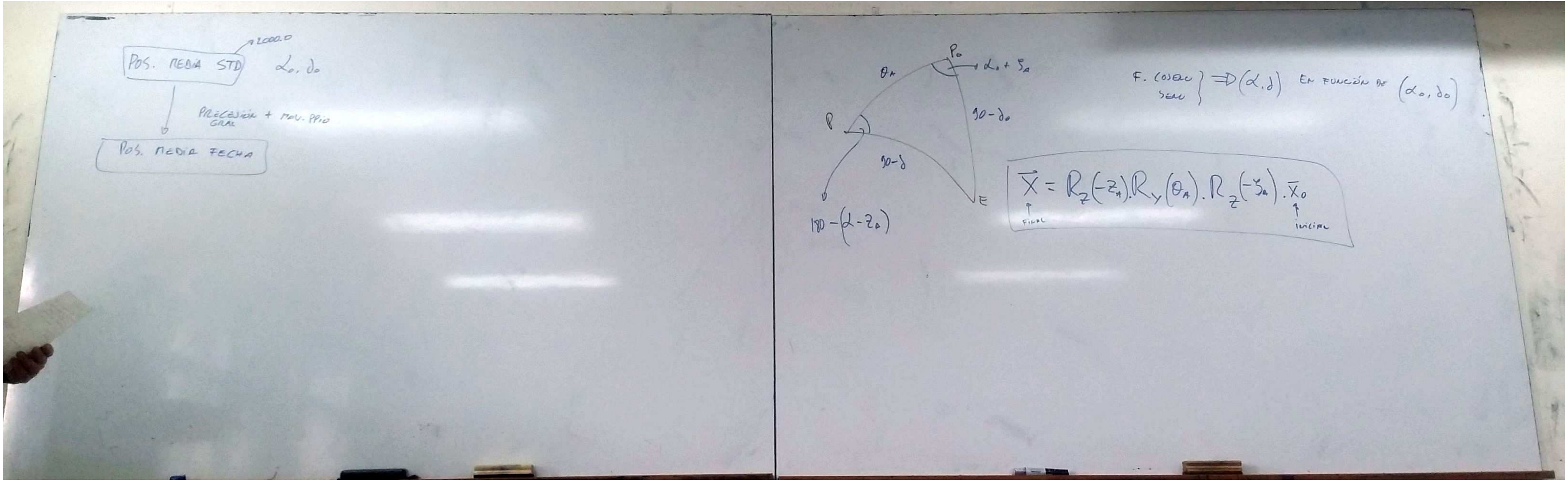
Astronomia Fundamental 2017



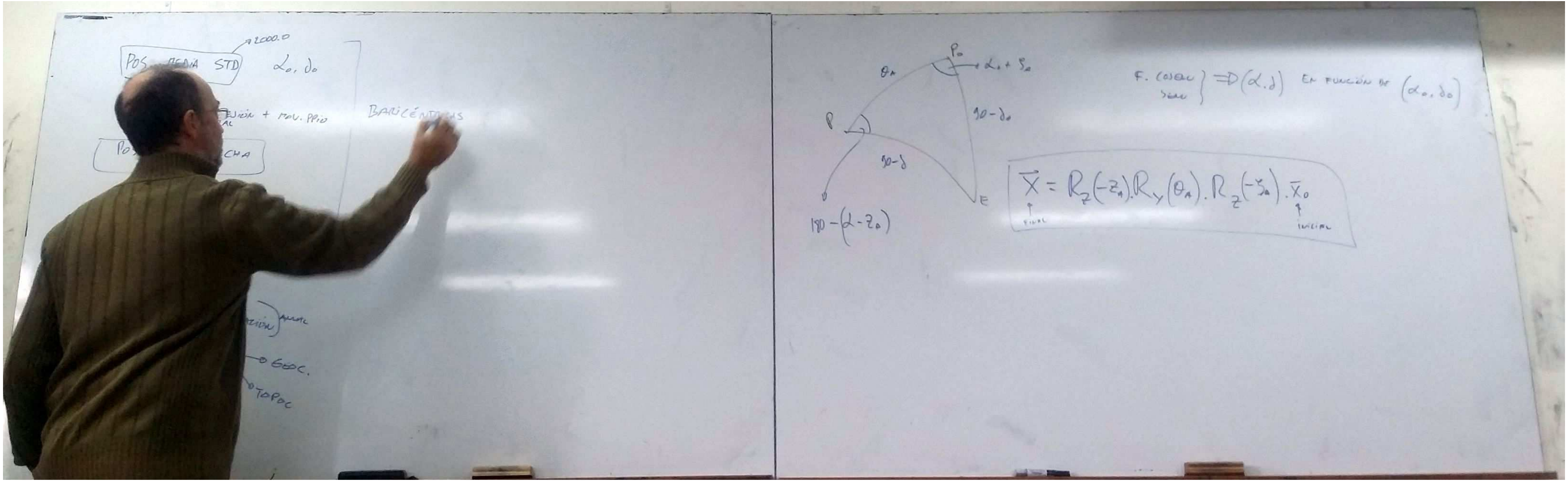
Astronomia Fundamental 2017

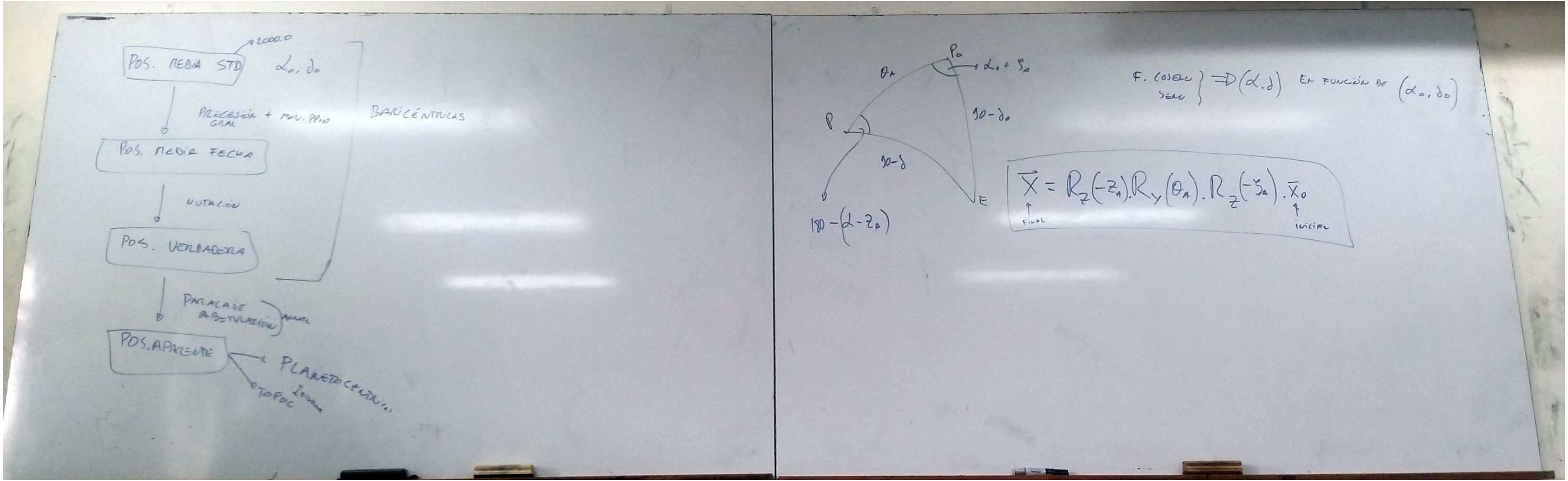


Astronomia Fundamental 2017

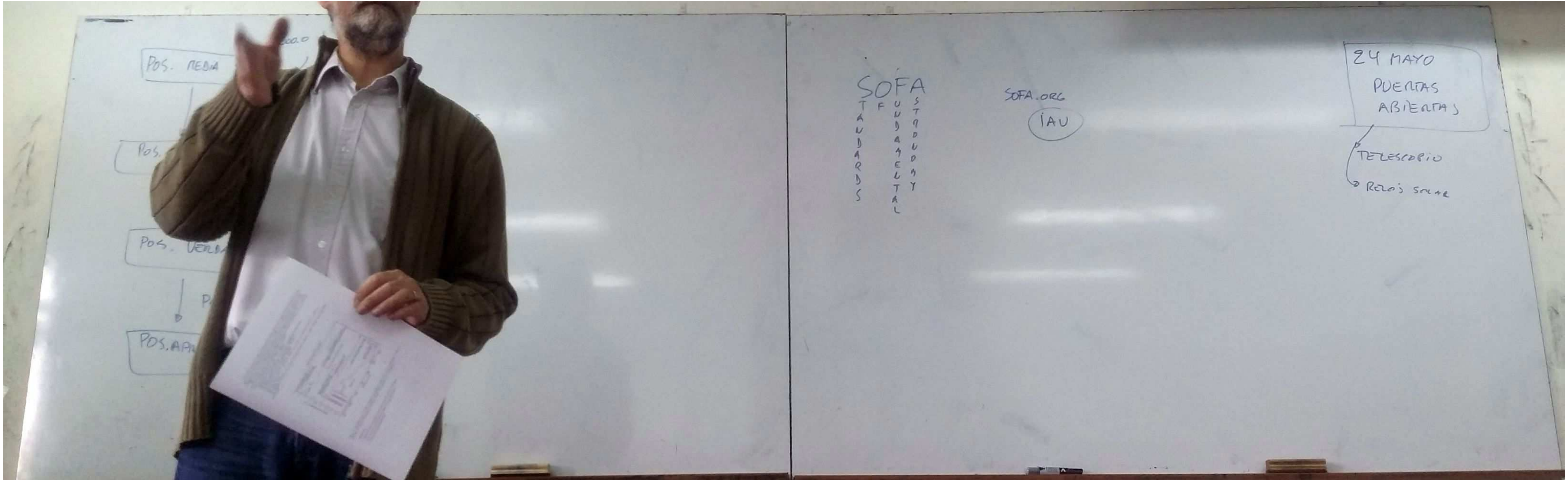


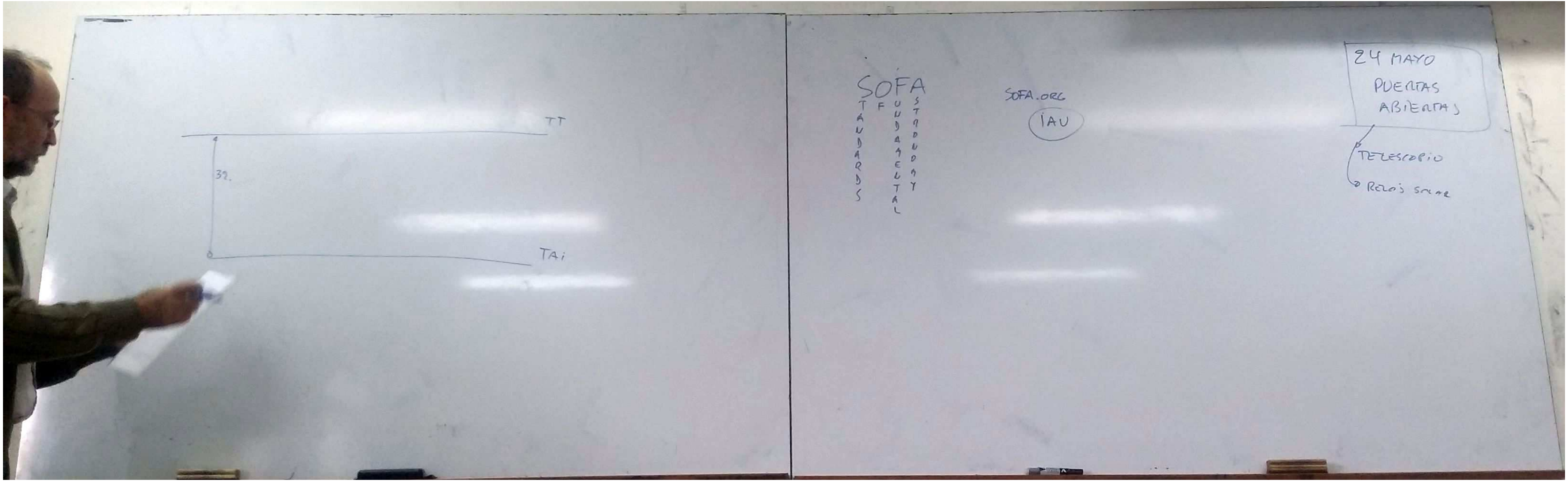
Astronomia Fundamental 2017



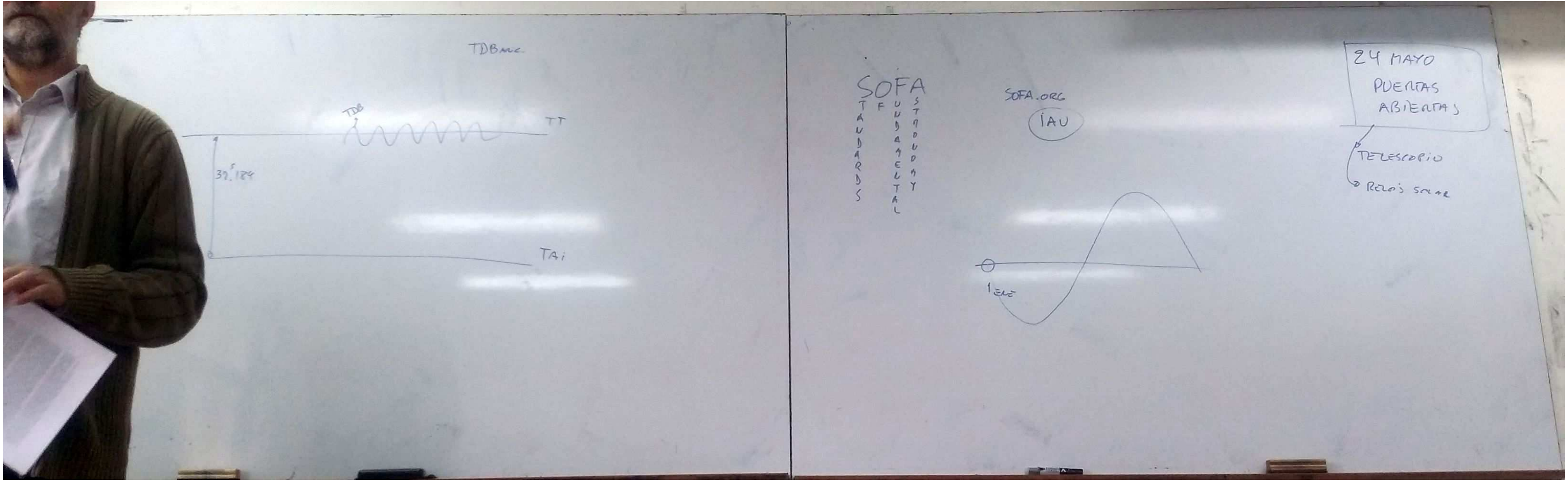

POS. MEDIA STD
POS. MEDIA FECHA
NUTACIÓN
POS. VERDADERA
POS. APARENTE
EN FUNCIÓN DE

Astronomia Fundamental 2017

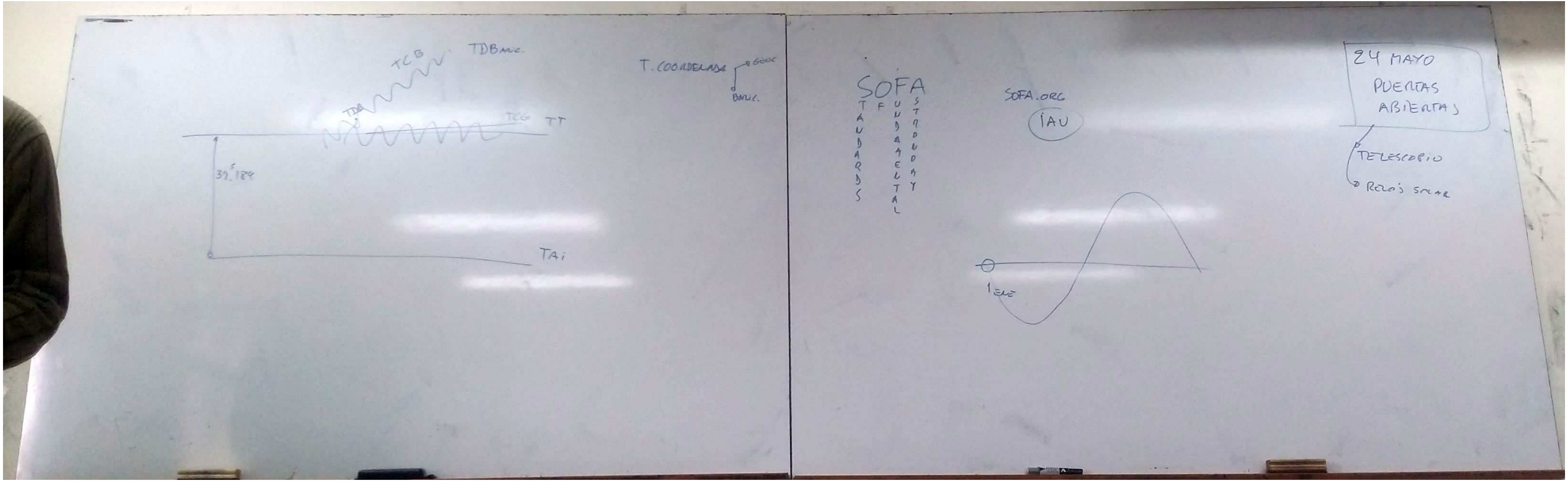



TT
32.
TAi
SOFA
SOFA.ORG
IAU
24 MAYO
PUERTAS
ABIERTAS
TELESCOPIO

Astronomia Fundamental 2017



Astronomia Fundamental 2017



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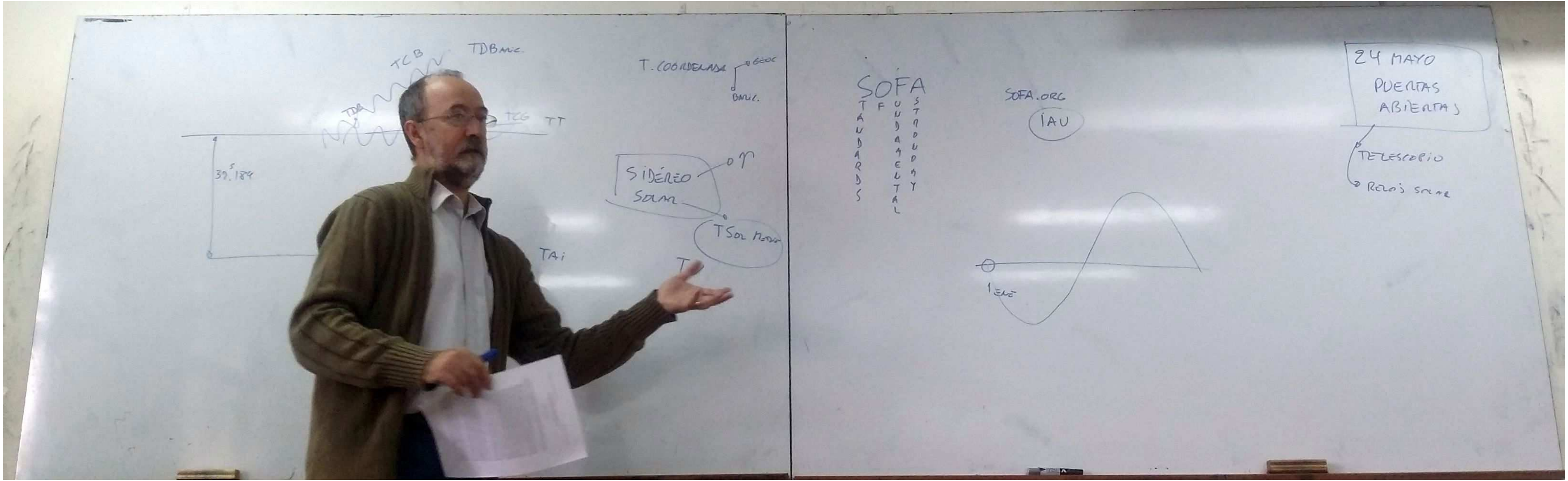
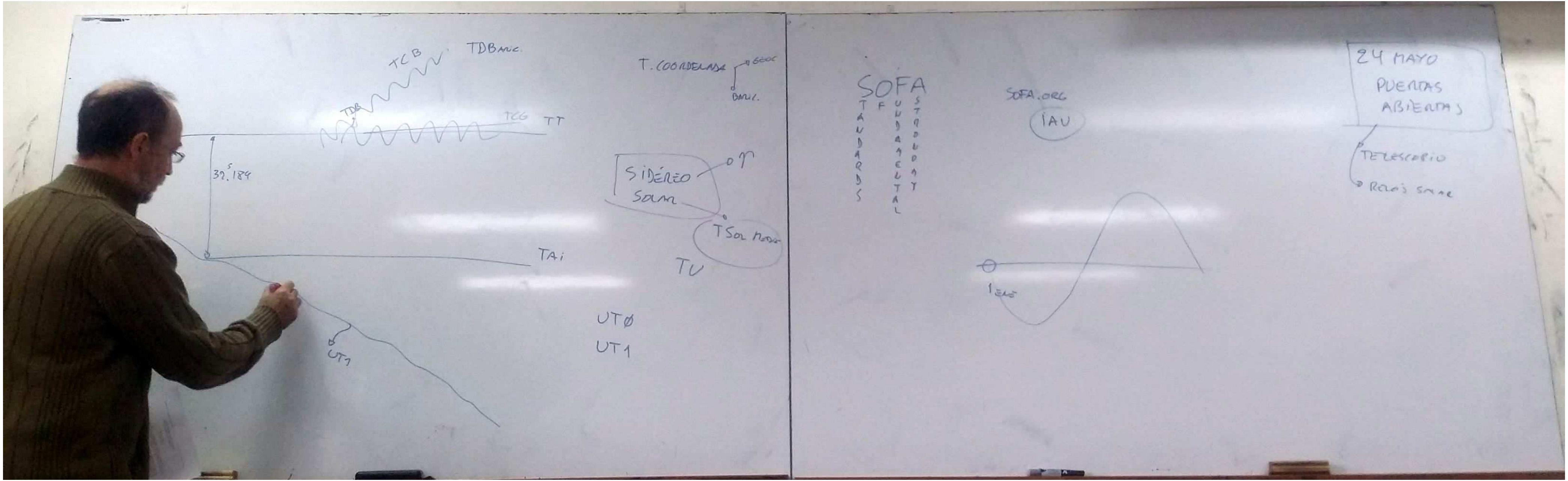
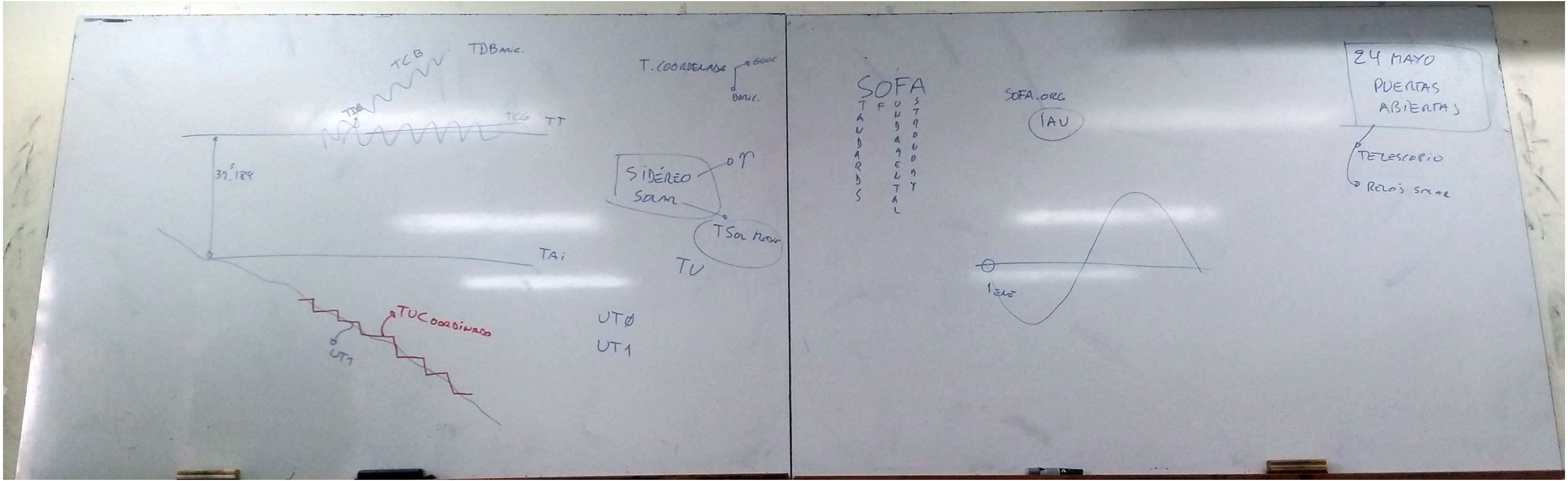


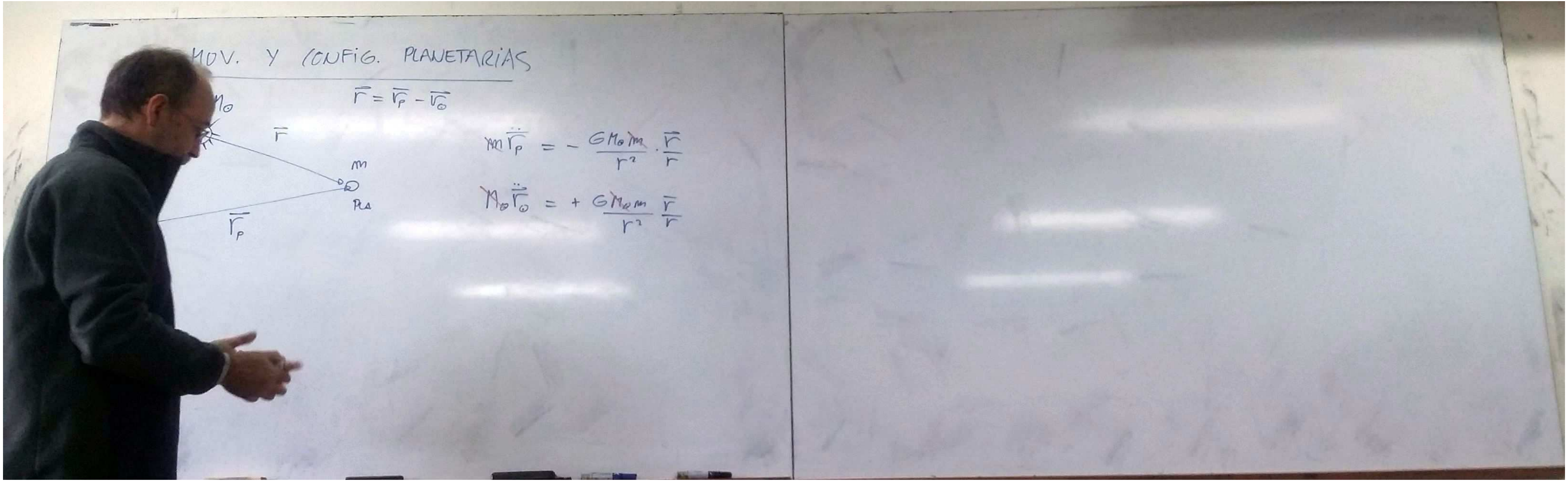

TCB
TDB
TDB BARIC.
TCG
TT
TAi
UT1
T. COORDENADA
GEOC
BARIC.
SIDÉREO
SOLAR
TSOL MEDIO
TU
UTØ
UT1
SOFA
SOFA.ORG
IAU
24 MAYO
PUERTAS
ABIERTAS
TELESCOPIO
RELOJ SOLAR

Astronomia Fundamental 2017




MOV. Y CONFIG. PLANETARIAS
Fijo
m
Pls

Astronomia Fundamental 2017



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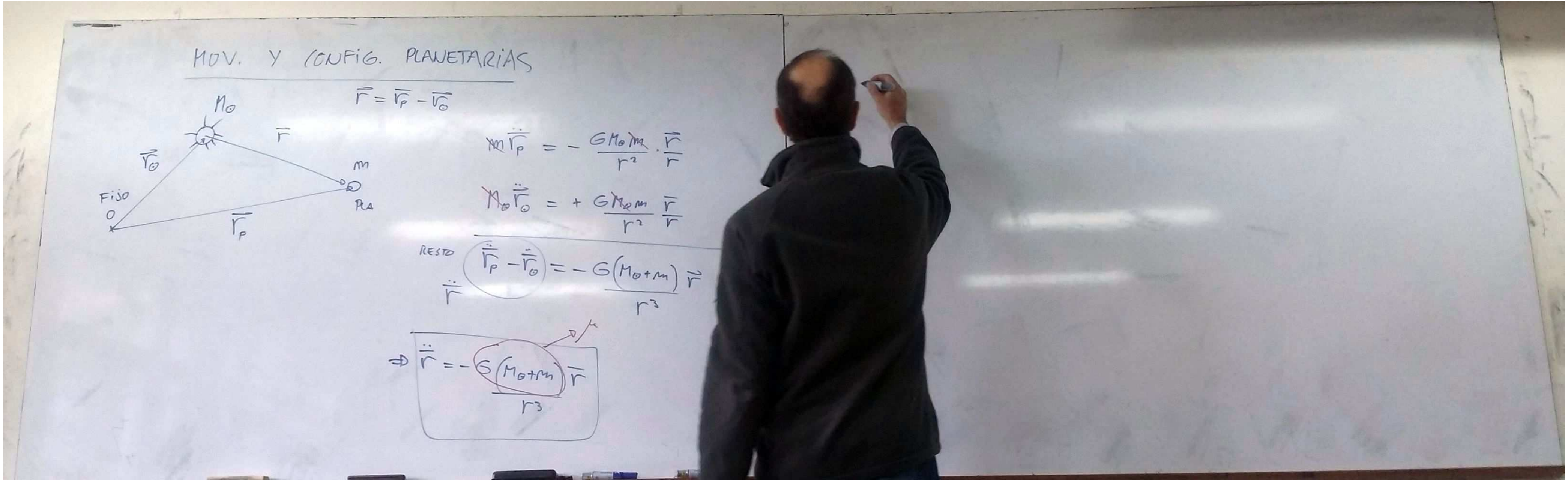

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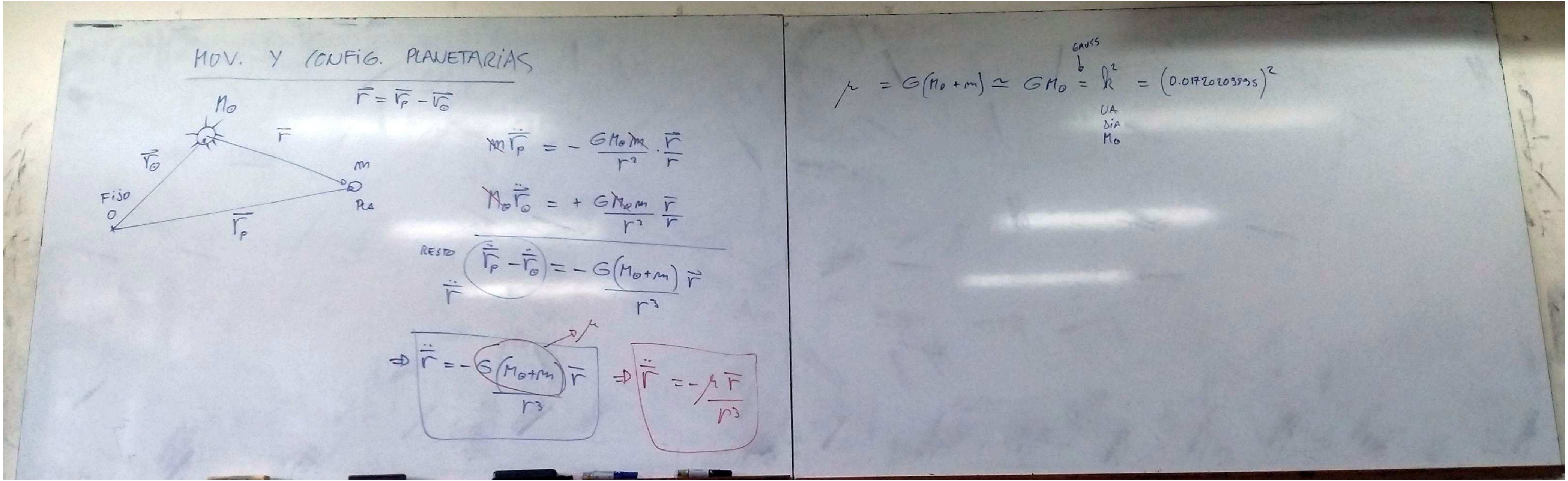

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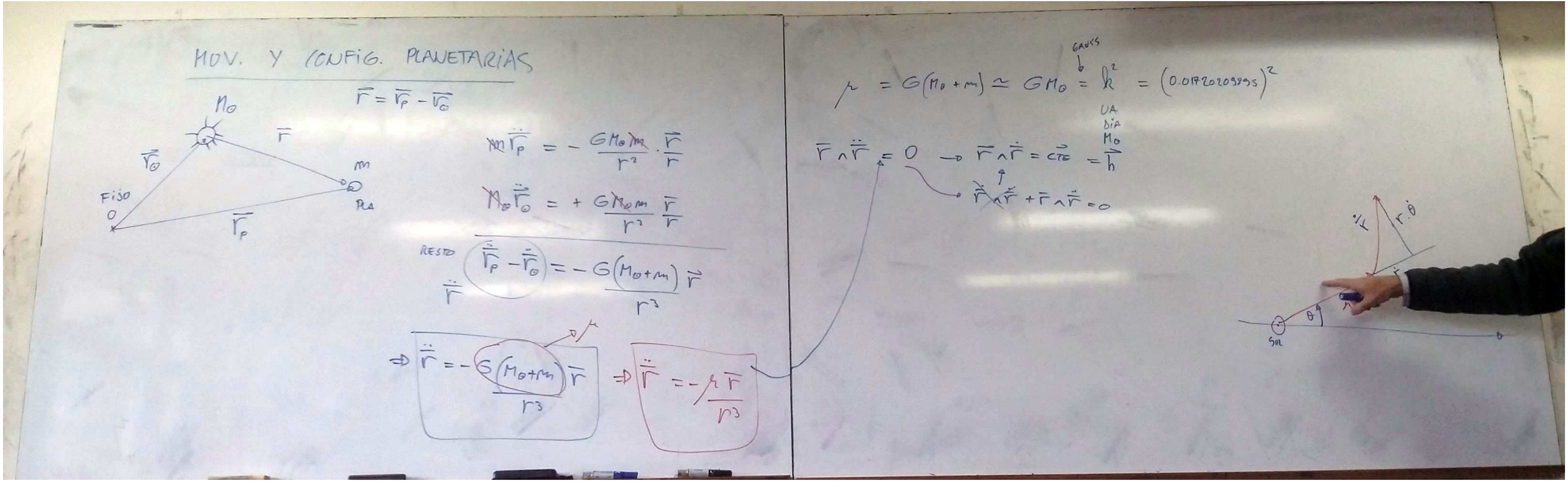
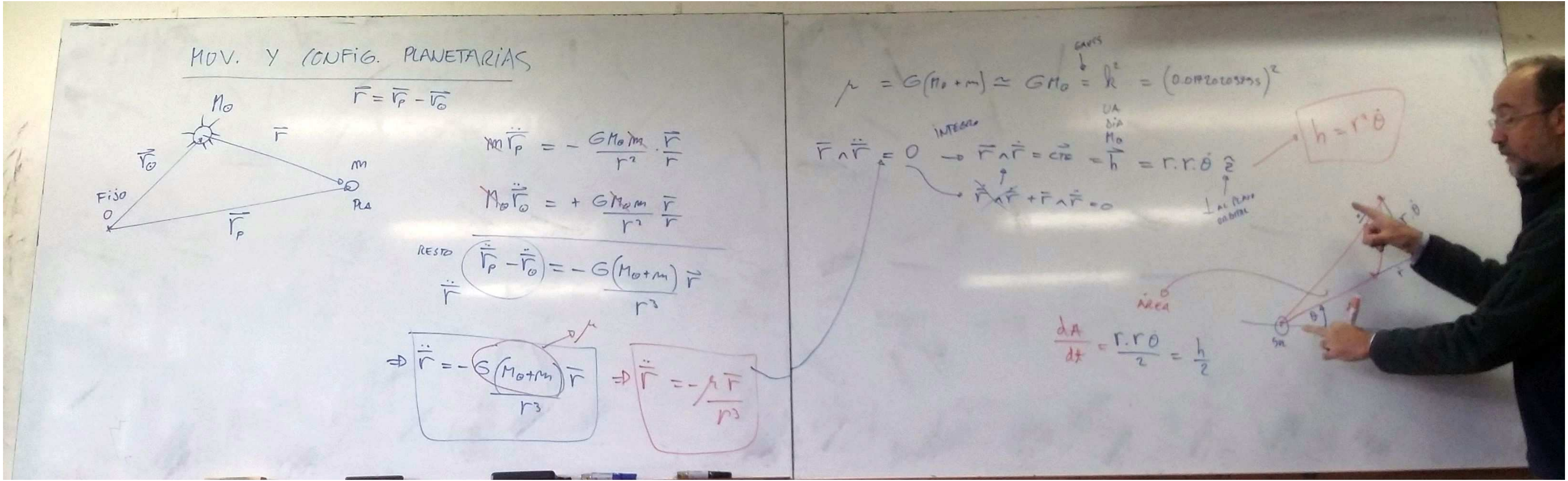


Astronomia Fundamental 2017



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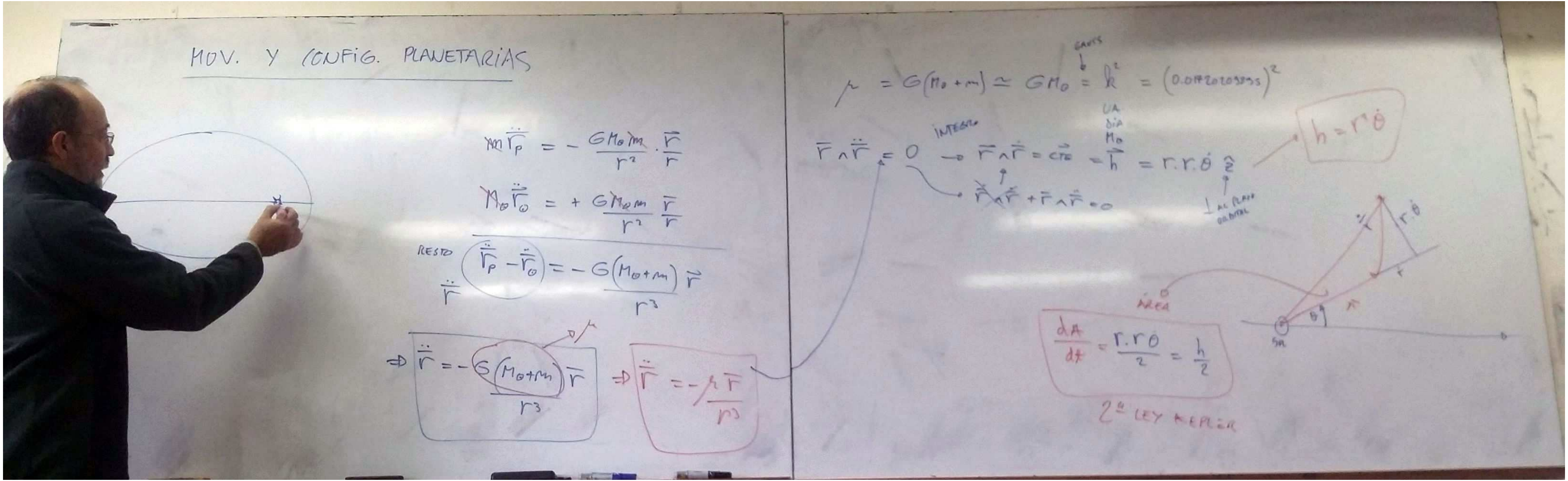

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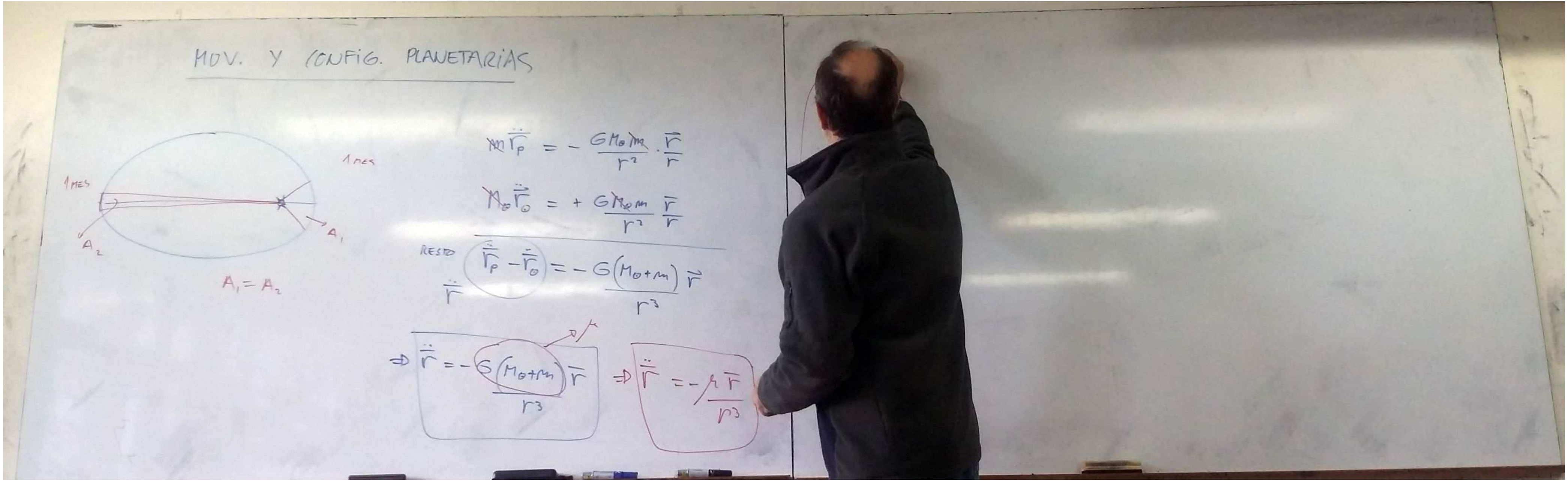
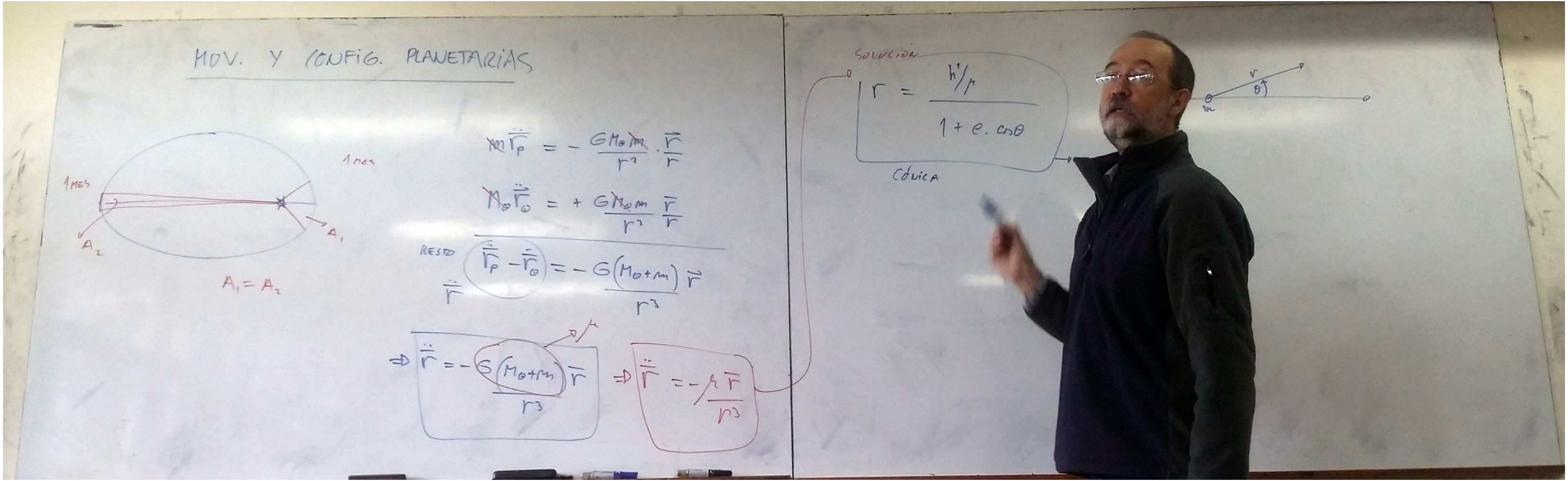
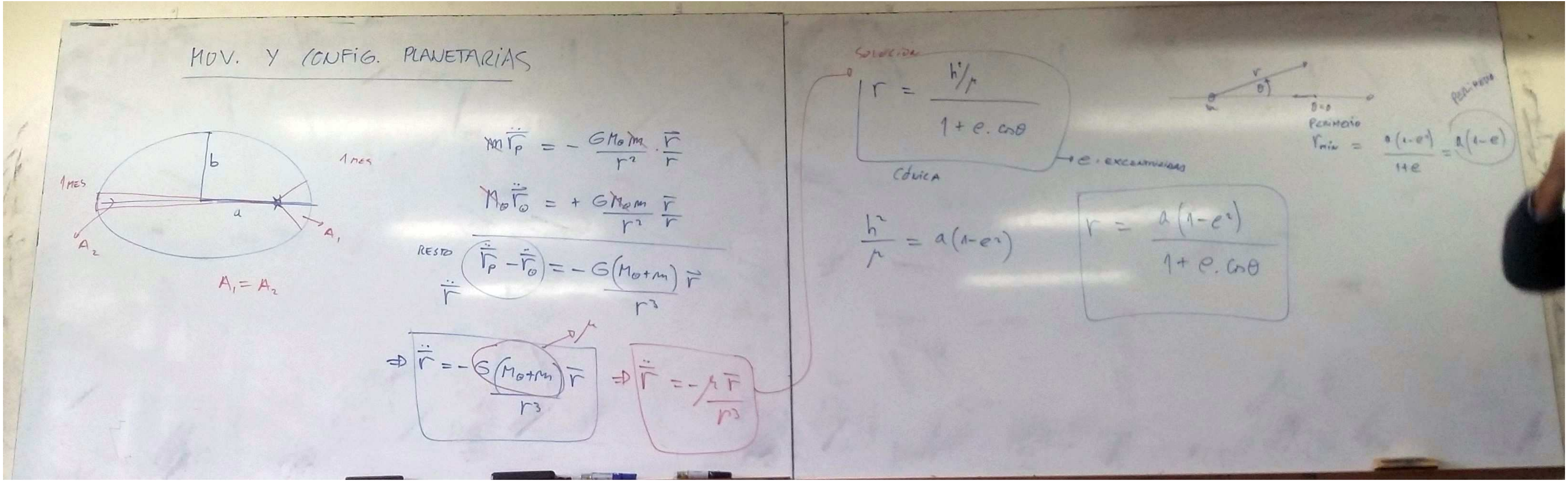
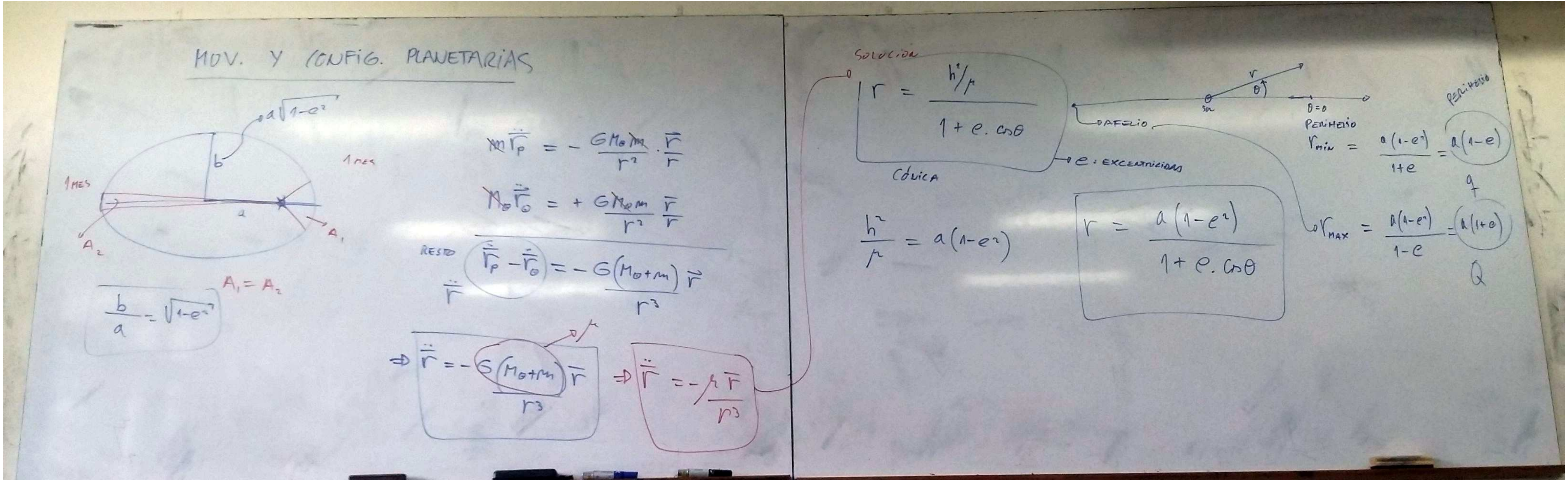
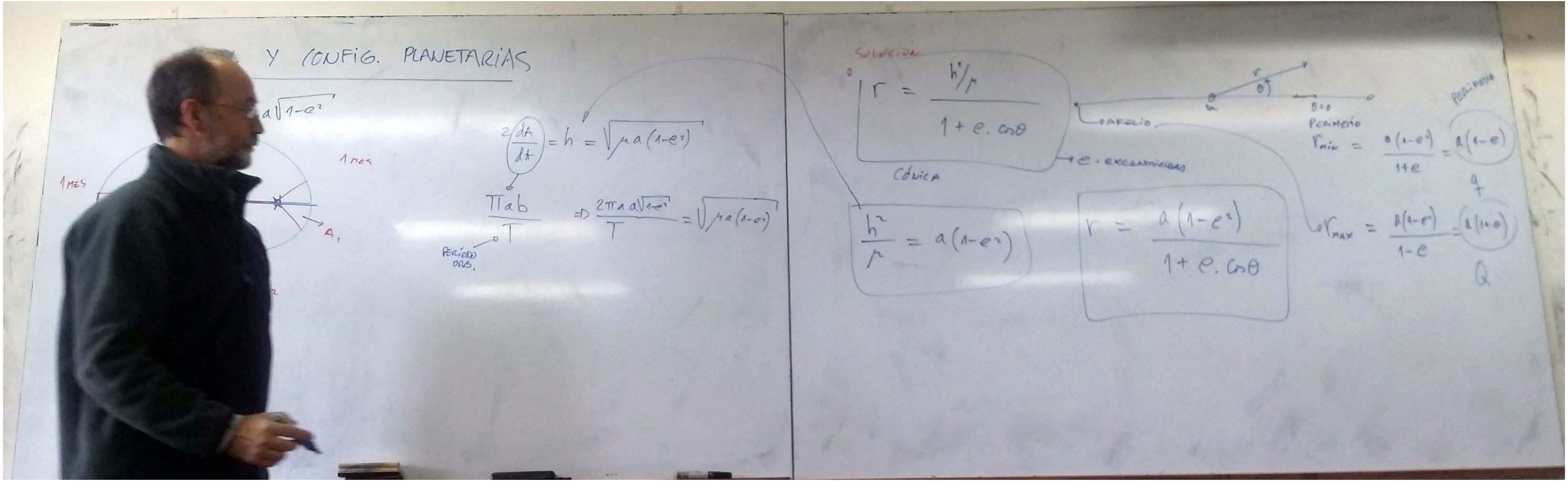



MOV. Y CONFIG. PLANETARIAS
1 MES
1 mes
A1
A2
A1 = A2
RESTO
SOLUCIÓN
CÓNICA

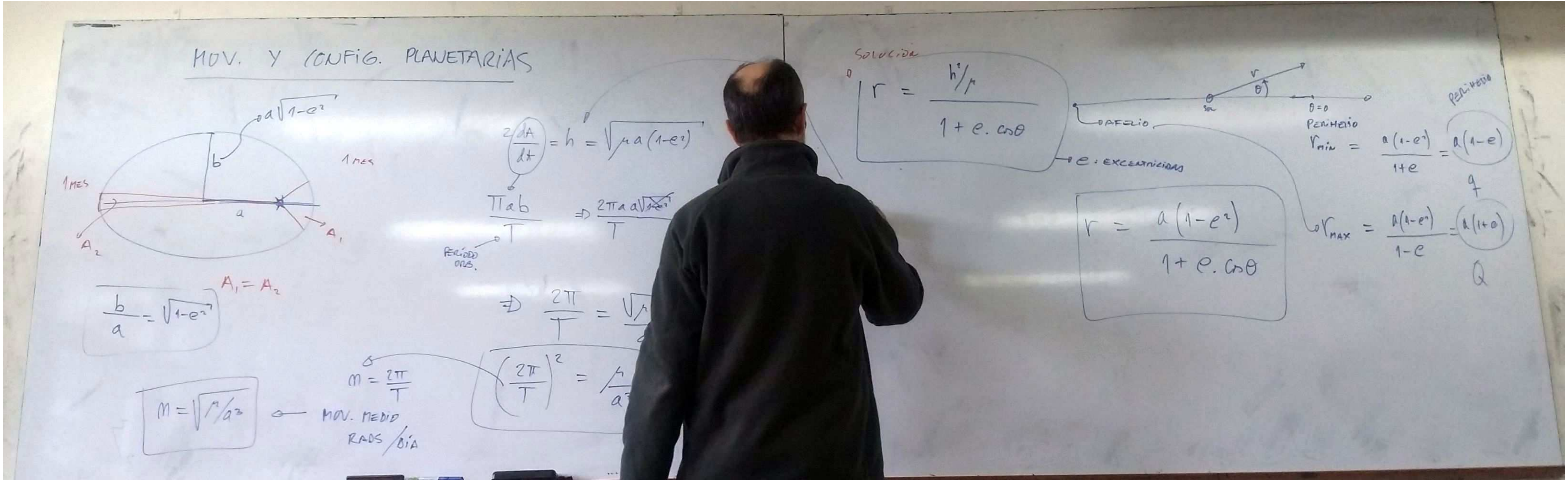

MOV. Y CONFIG. PLANETARIAS
1 MES
1 MES
b
a
A1
A2
A1 = A2
RESTO
SOLUCION
CONICA
e: EXCENTRICIDAD
PERIHELIO
r min = a(1-e²)/(1+e) = a(1-e)
r = (h²/μ) / (1 + e.cosθ)
h²/μ = a(1-e²)
r = a(1-e²) / (1 + e.cosθ)


MOV. Y CONFIG. PLANETARIAS
a√(1-e²)
b
a
1 MES
1 MES
A₁
A₂
b/a = √(1-e²)
A₁ = A₂
RESTO
SOLUCIÓN
r = (h²/μ) / (1 + e. cosθ)
CÓNICA
e: EXCENTRICIDAD
h²/μ = a(1-e²)
r = a(1-e²) / (1+ e. cosθ)
AFELIO
SOL
θ=0
PERIHELIO
r_min = a(1-e²)/(1+e) = a(1-e)
q
r_MAX = a(1-e²)/(1-e) = a(1+e)
Q

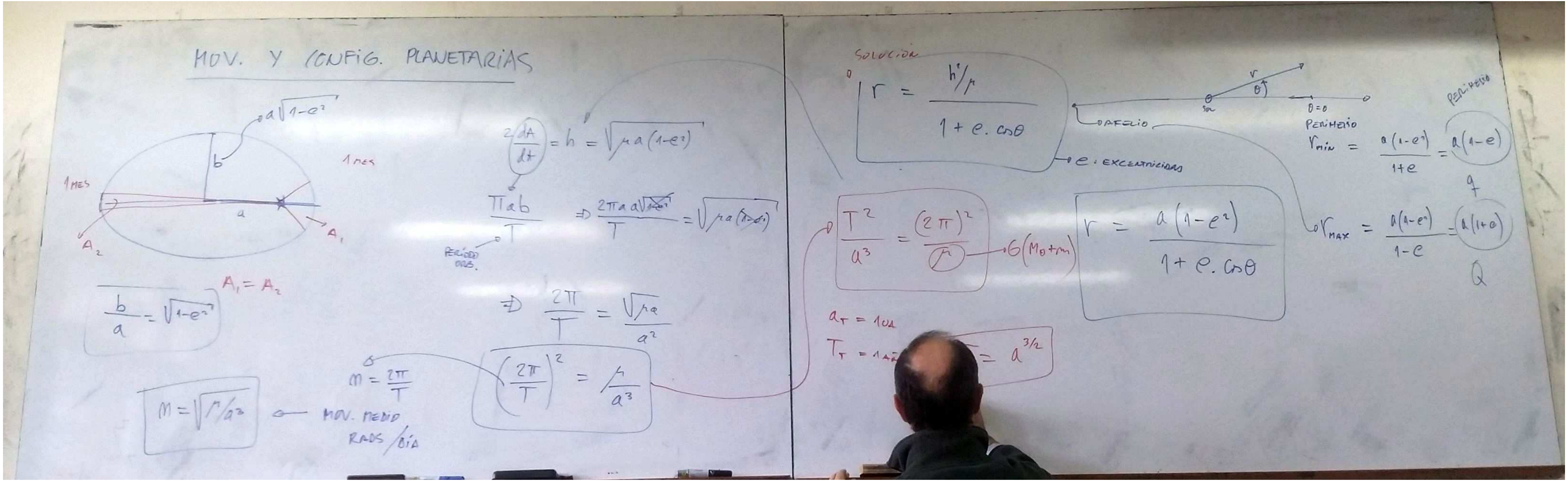
Astronomia Fundamental 2017



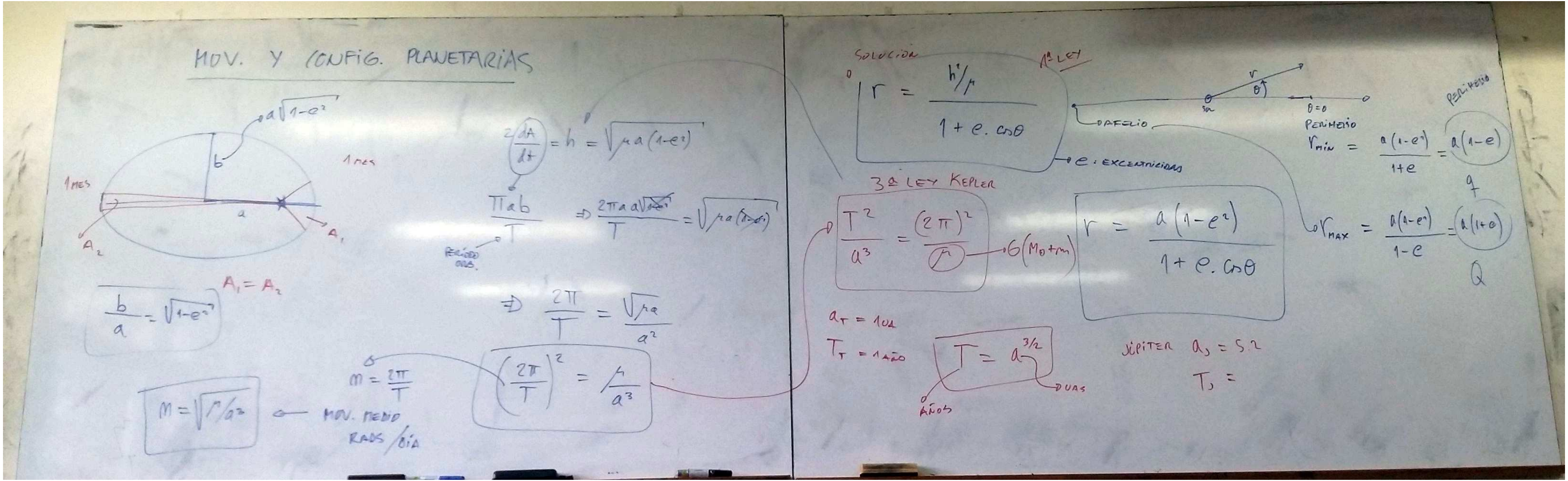
Astronomia Fundamental 2017



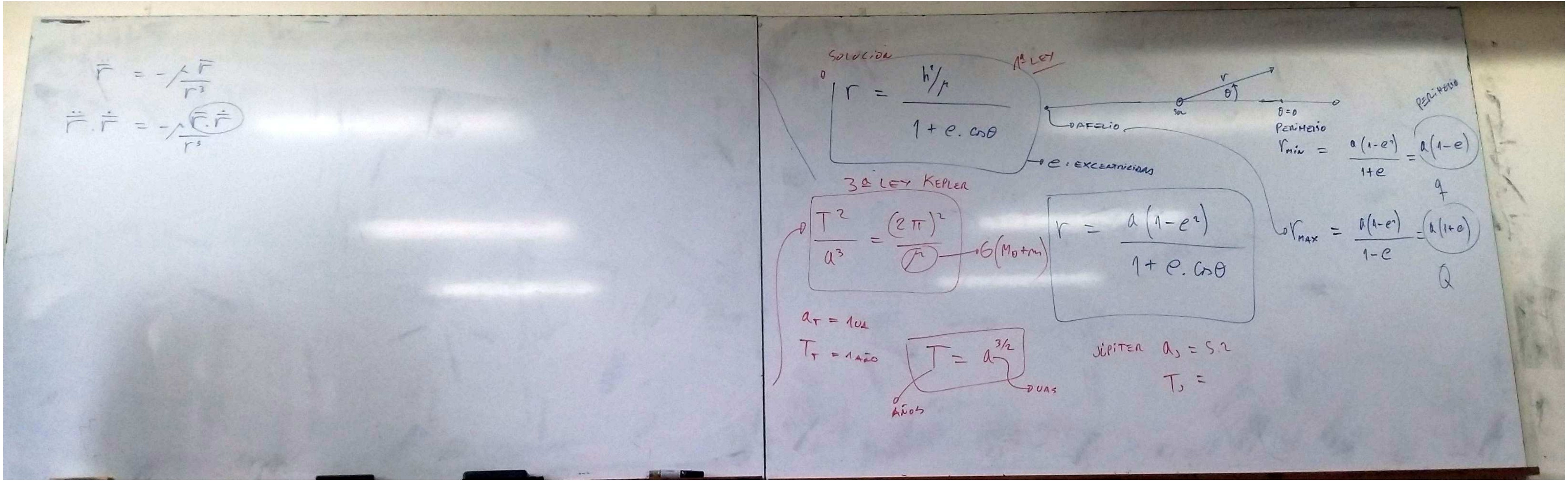
Astronomia Fundamental 2017



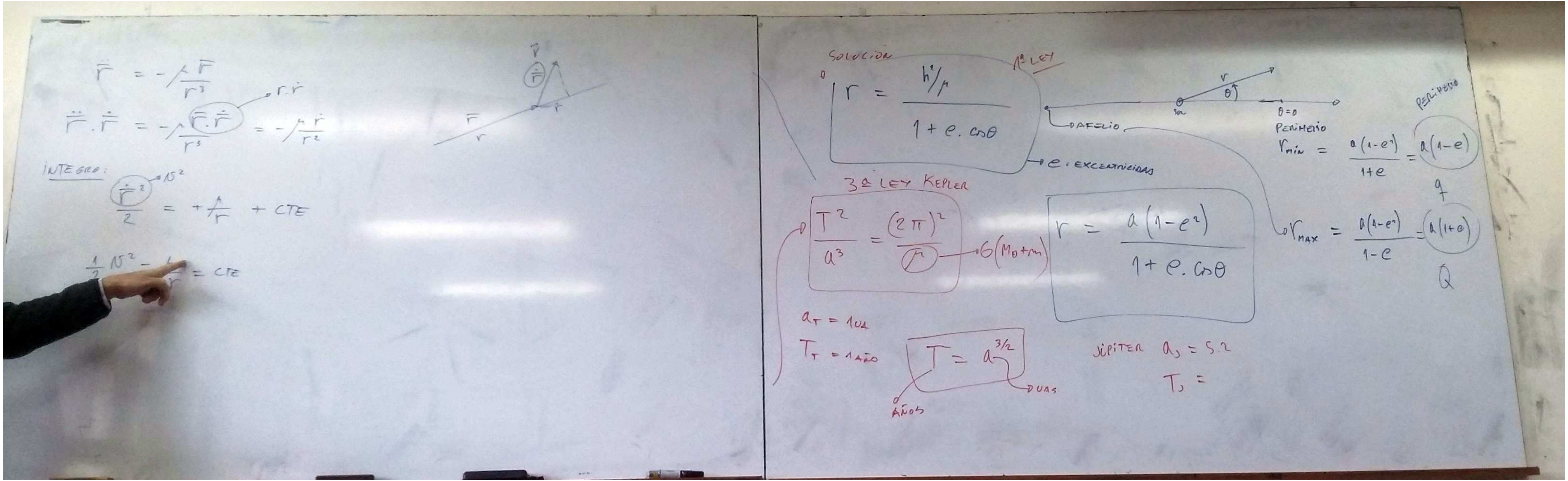
Astronomia Fundamental 2017



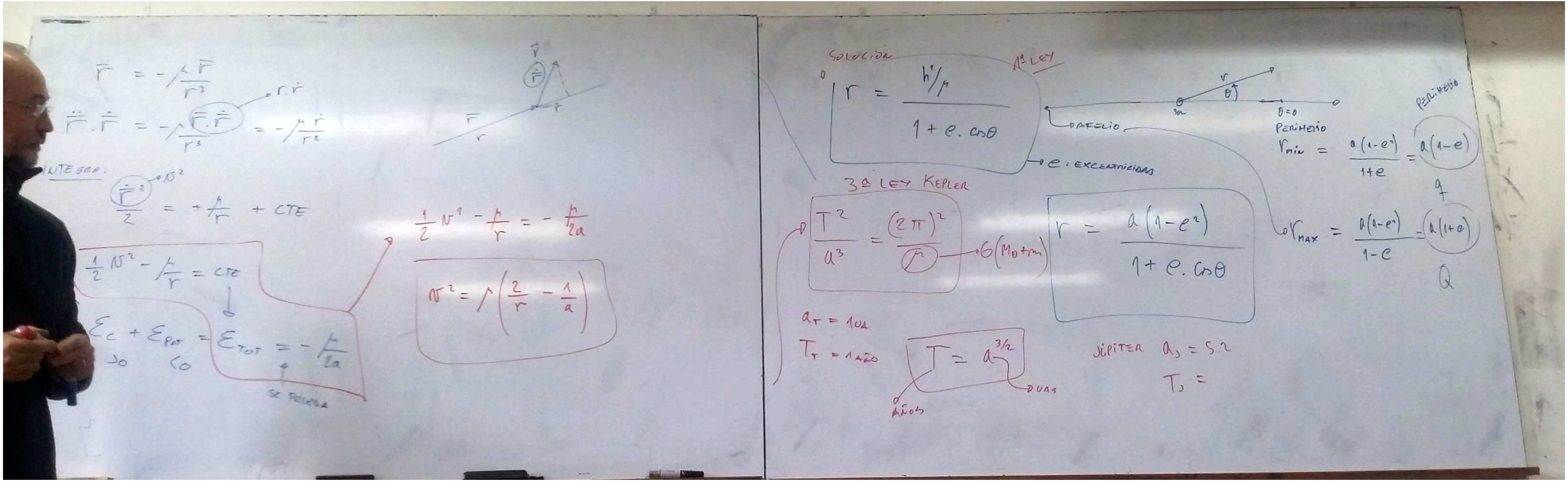
Astronomia Fundamental 2017



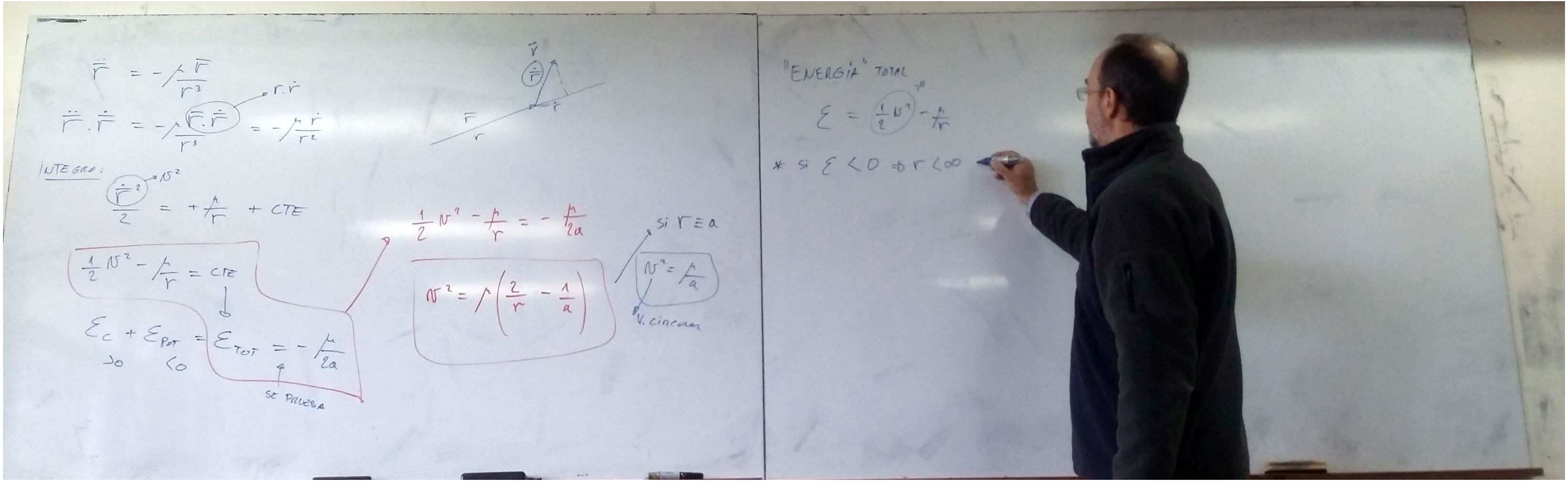
Astronomia Fundamental 2017



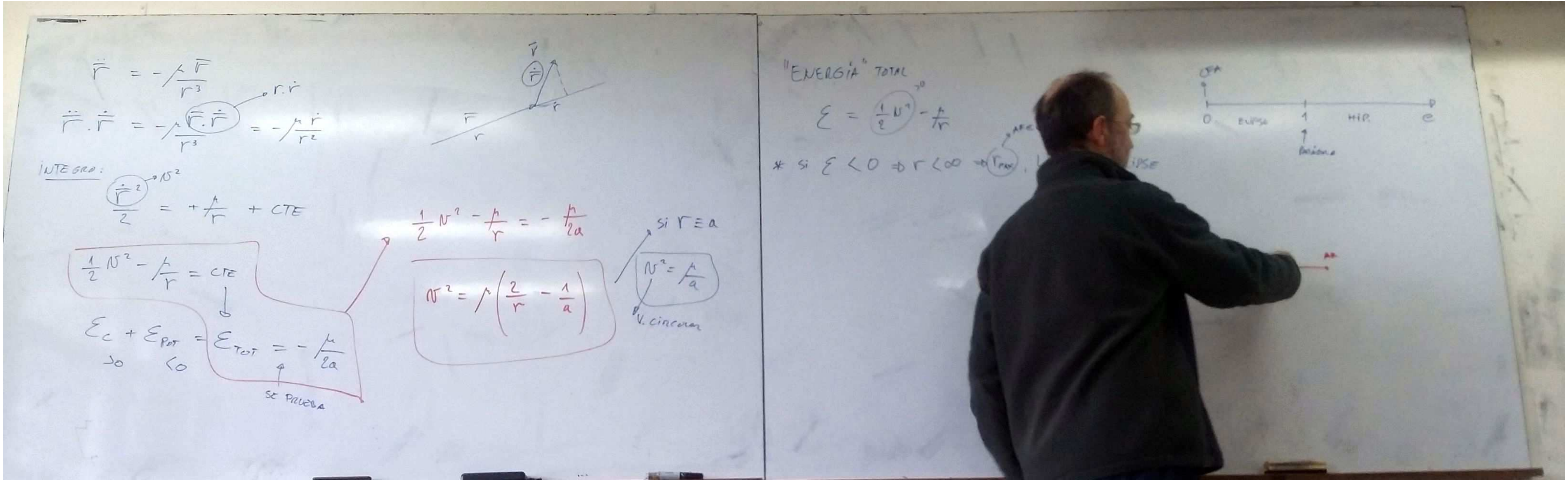
Astronomia Fundamental 2017



Astronomia Fundamental 2017



Astronomia Fundamental 2017



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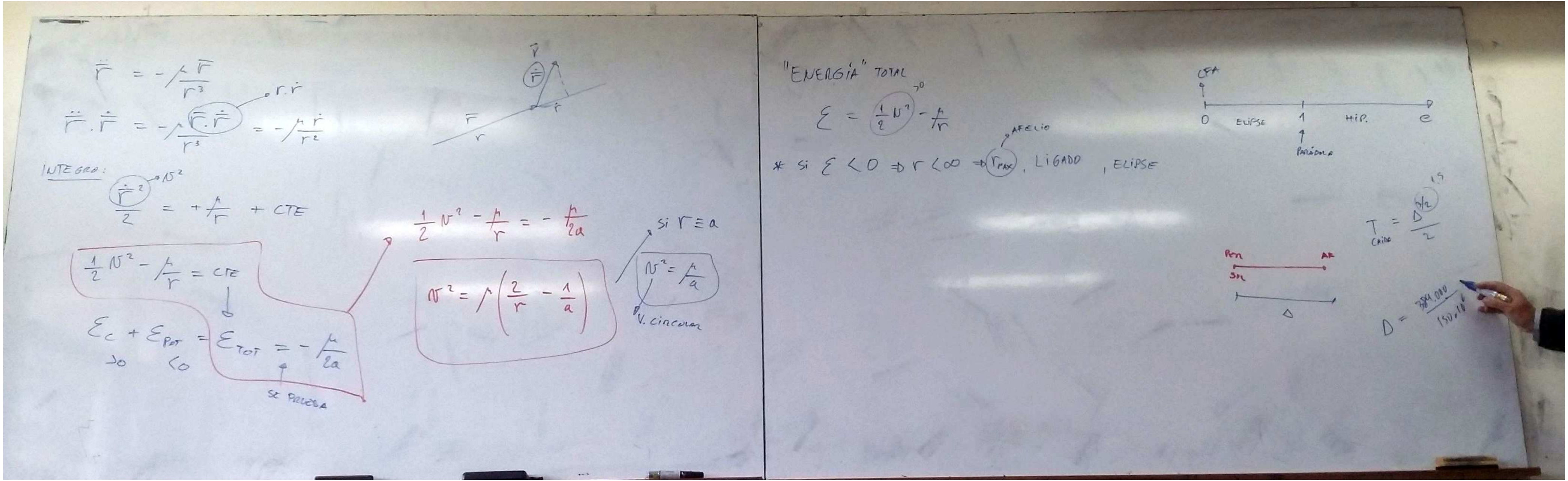

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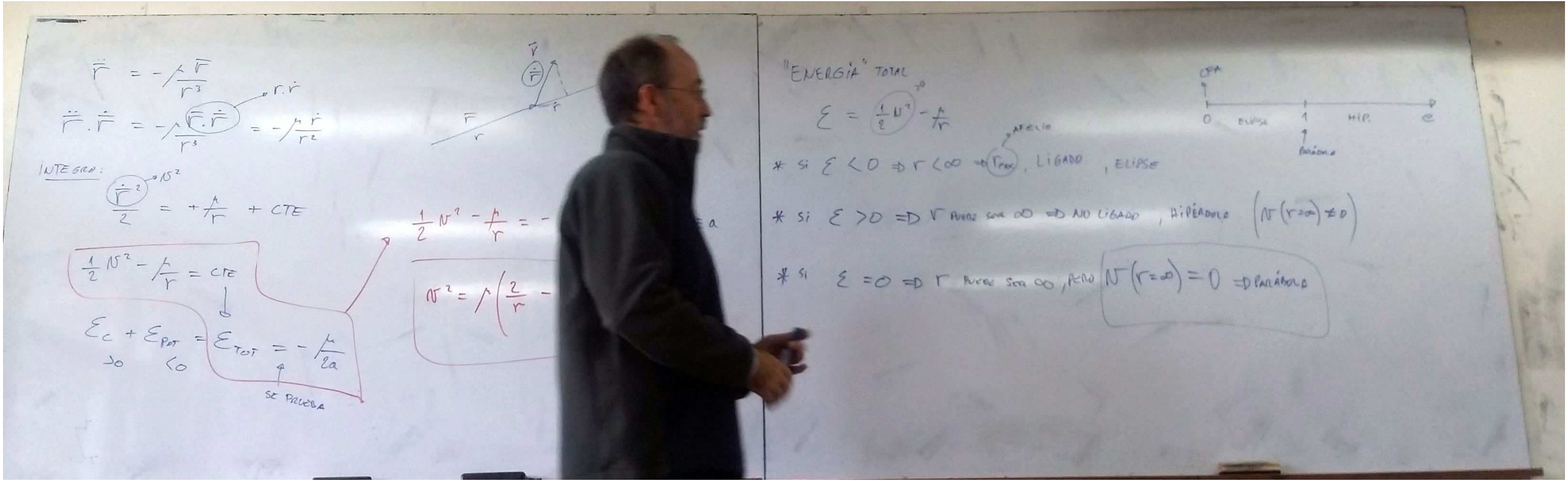
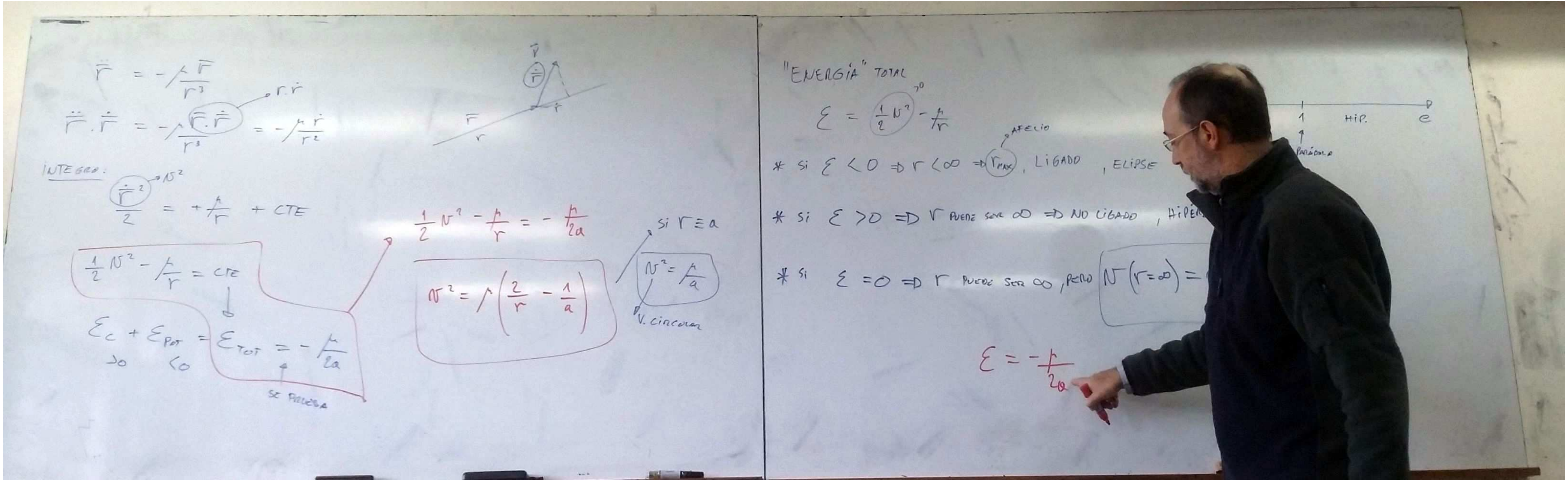


Astronomia Fundamental 2017



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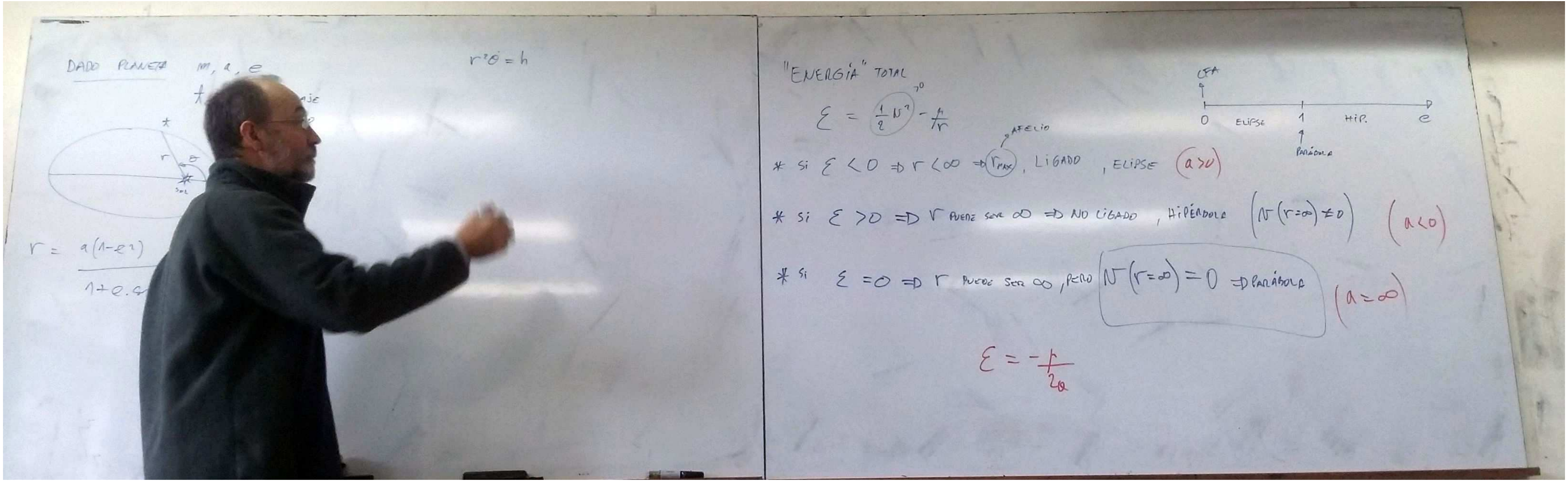

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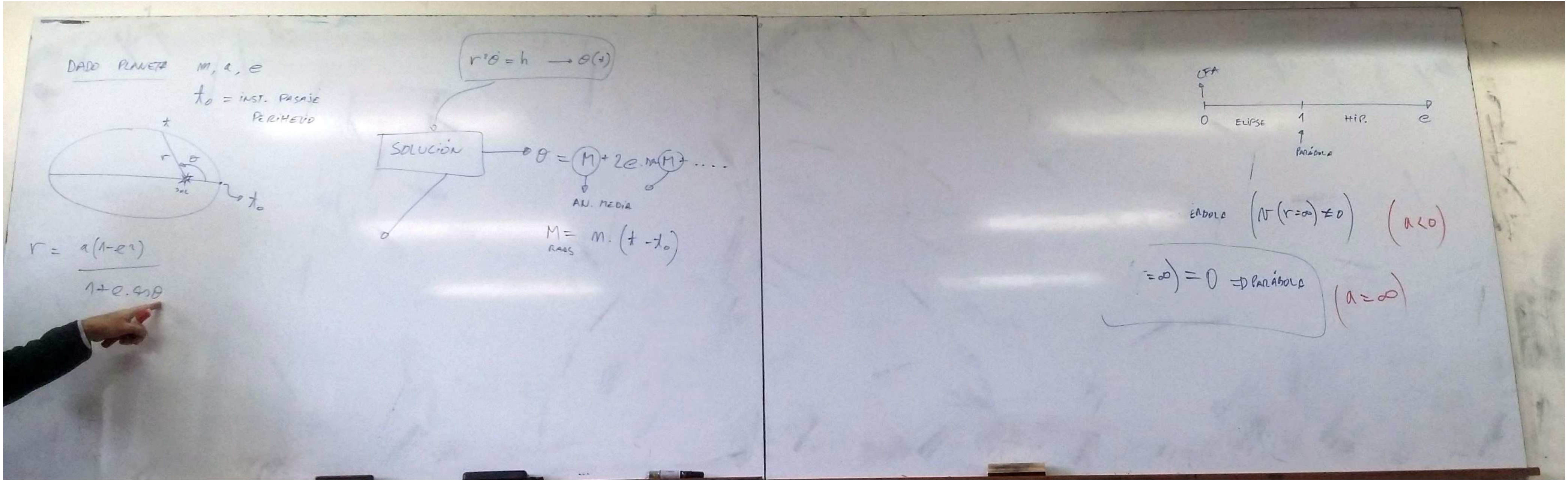
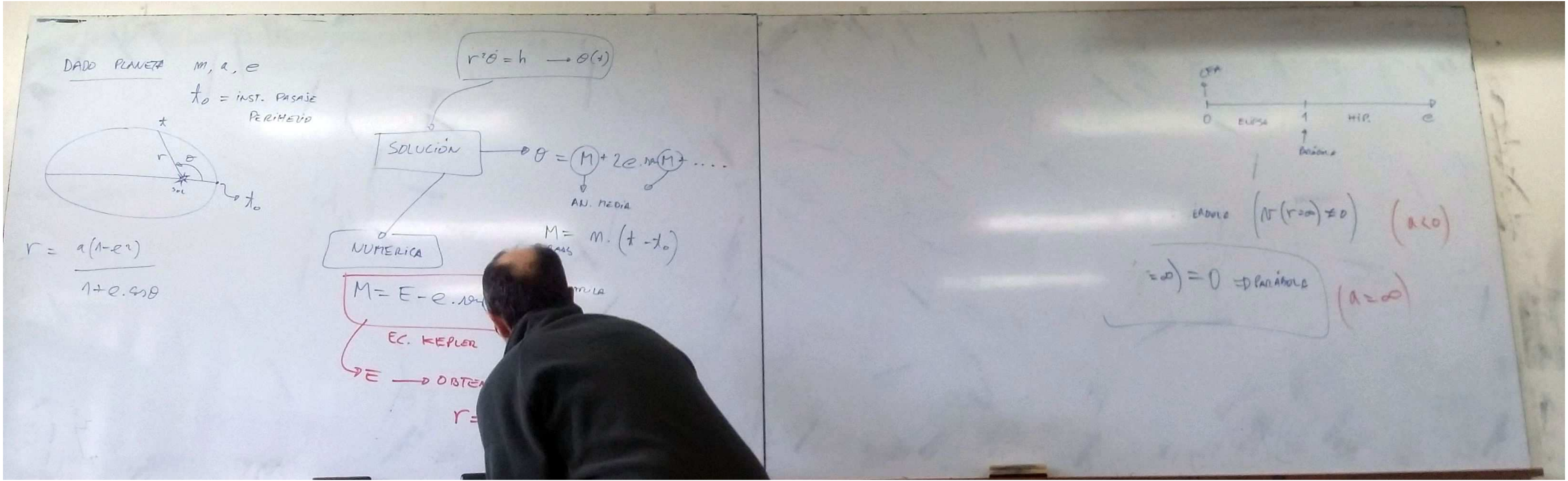


Astronomia Fundamental 2017



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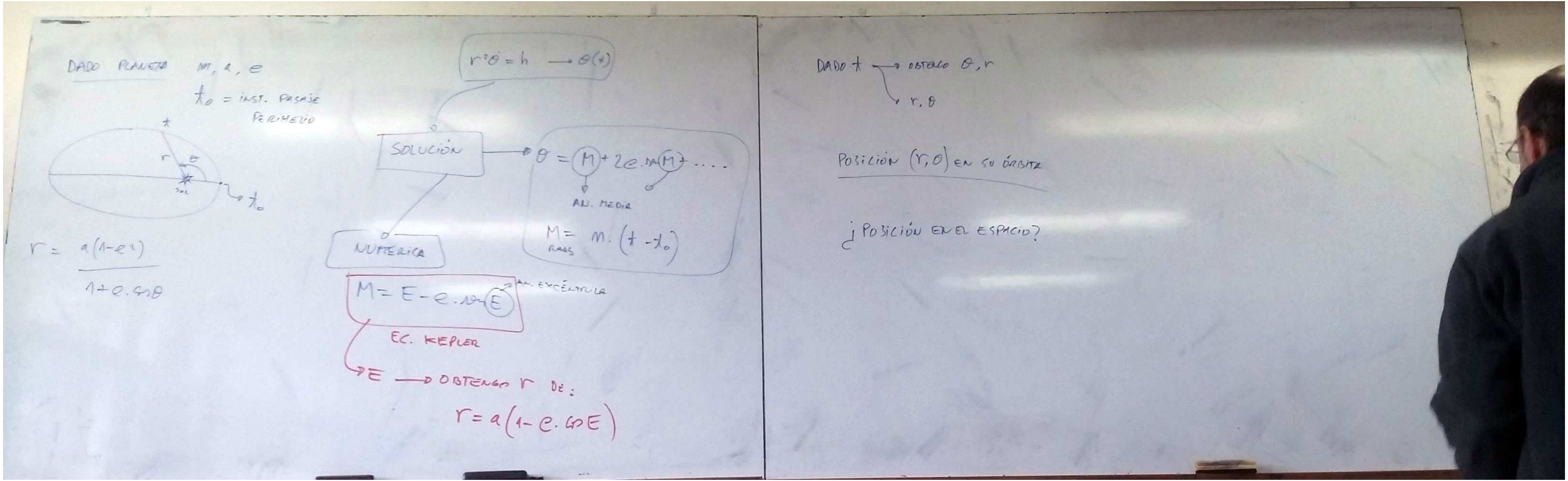
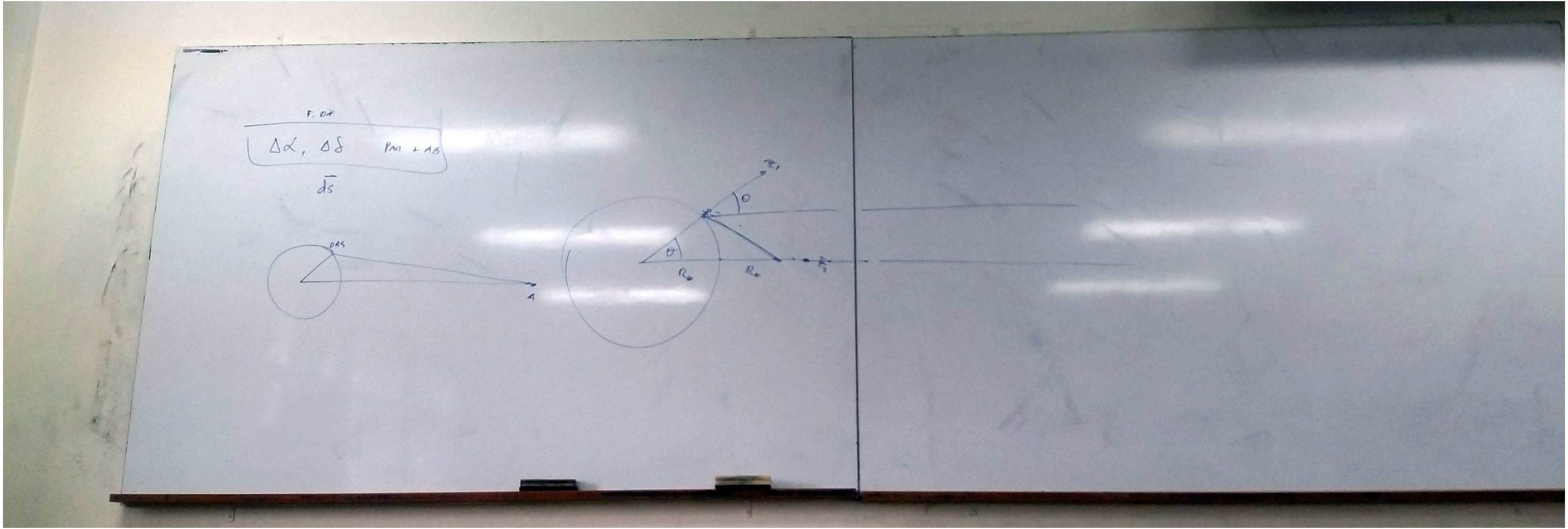
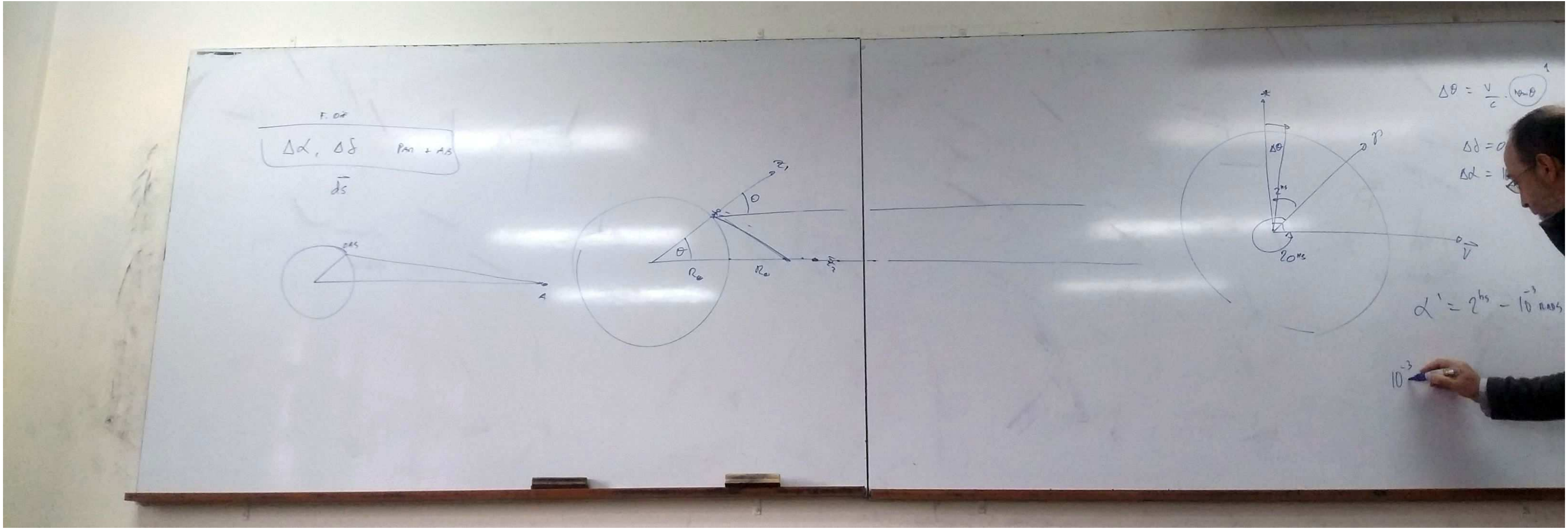
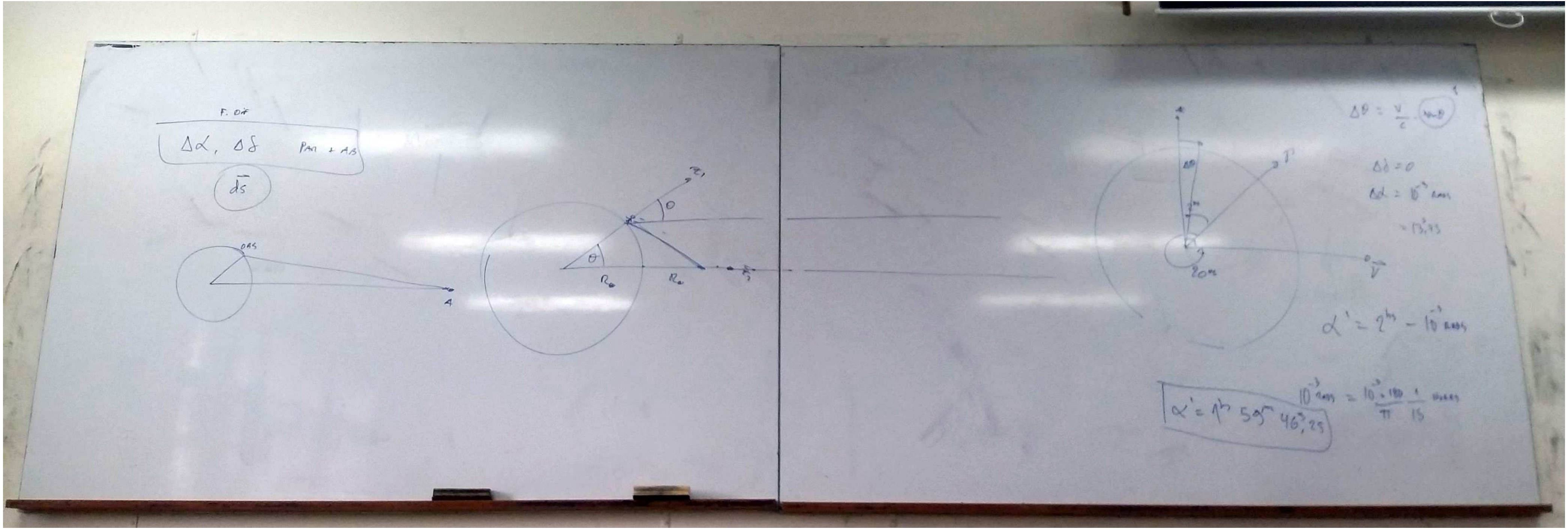



$\Delta\alpha$, $\Delta\delta$
PAn + AB
OBS
A
θ
$R_\oplus$

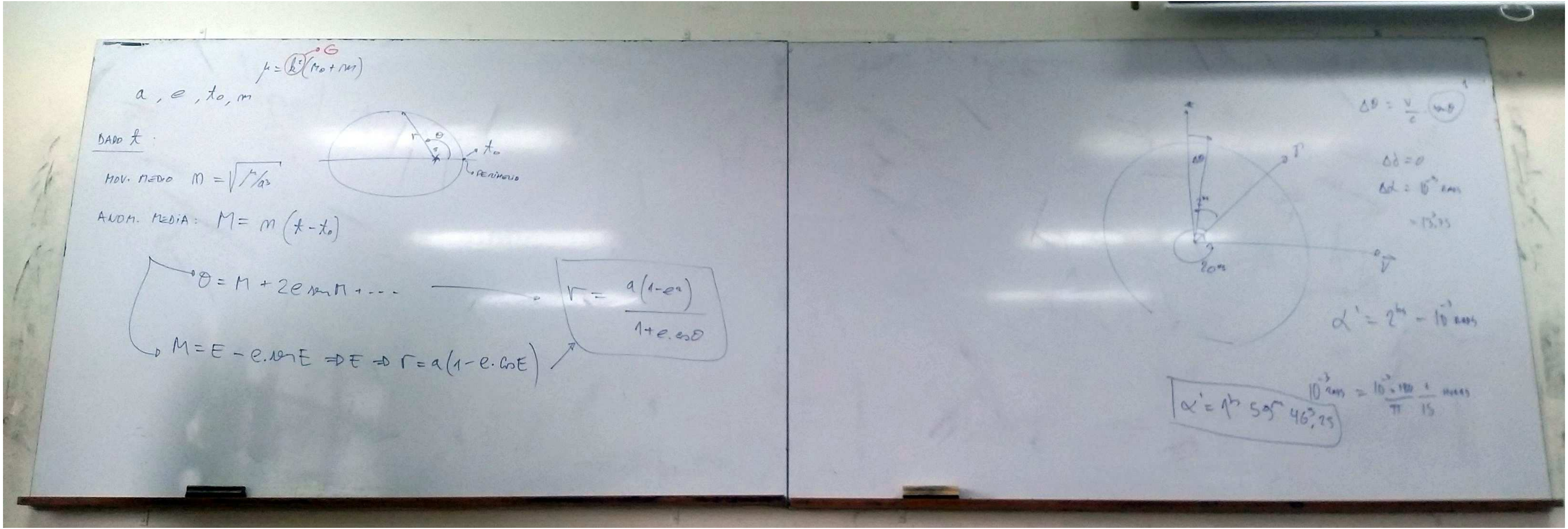

Δα, Δδ
ds
θ
Δθ
V
α' = 2 hs − 10^-3
10^-3

Astronomia Fundamental 2017

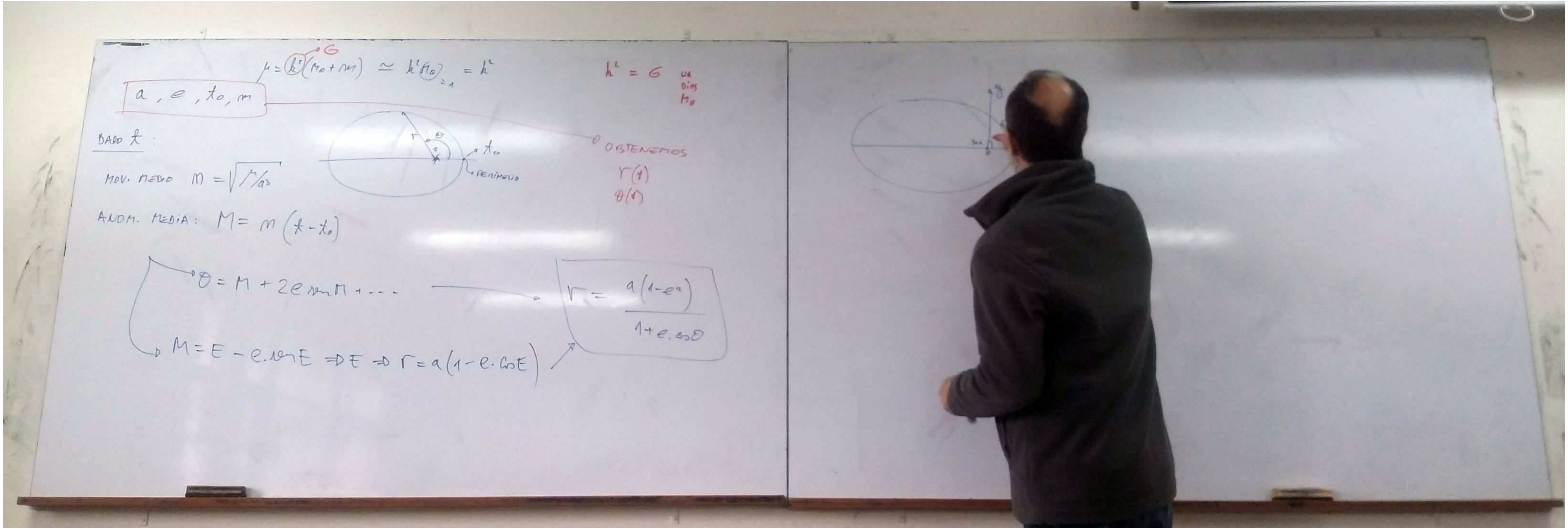


Astronomia Fundamental 2017

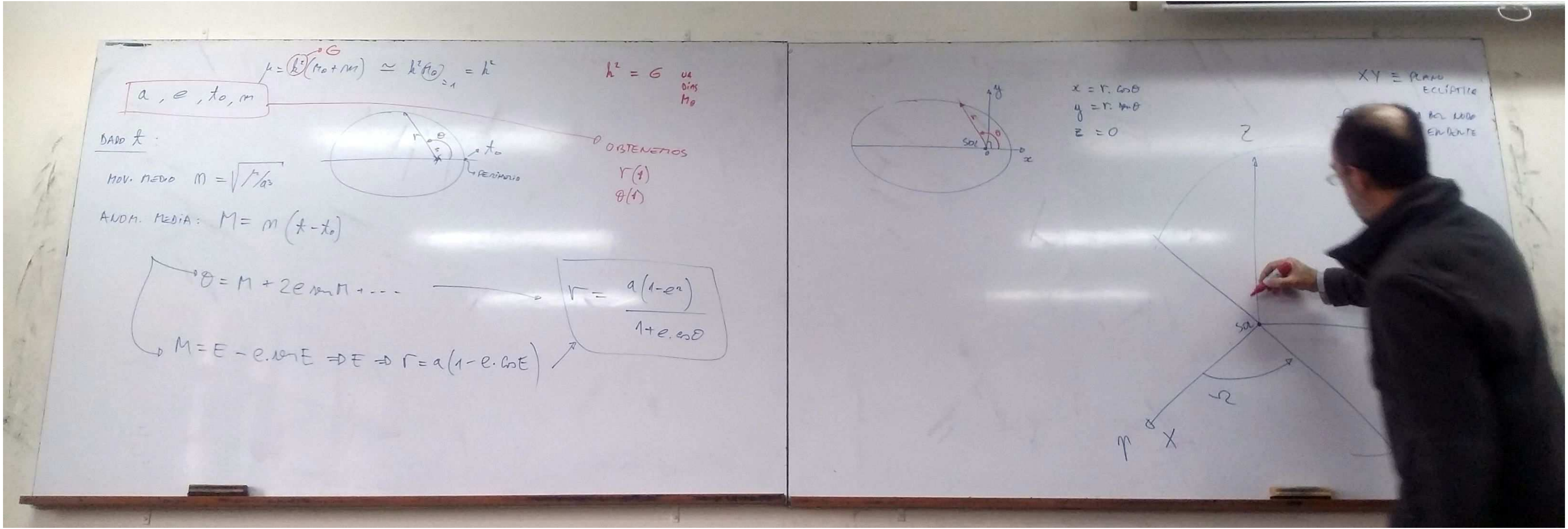
Astronomia Fundamental 2017


a , e , t0 , m
DADO t :
MOV. MEDIO
ANOM. MEDIA :
PERIHELIO

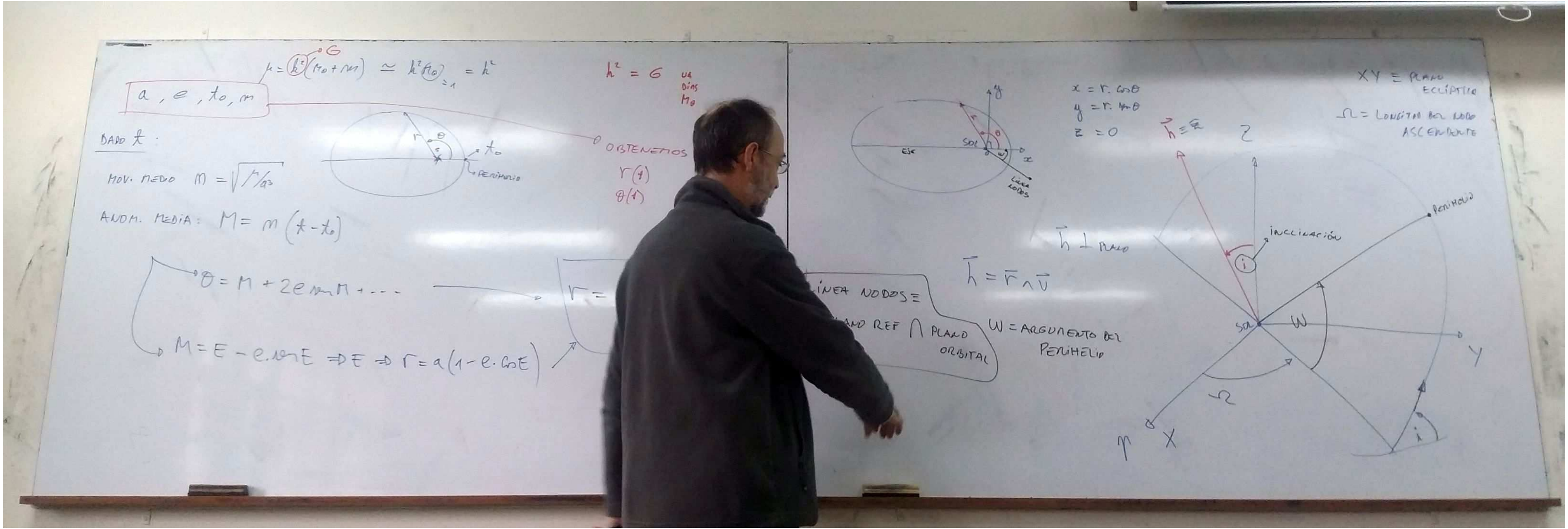
Astronomia Fundamental 2017



Astronomia Fundamental 2017



Astronomia Fundamental 2017



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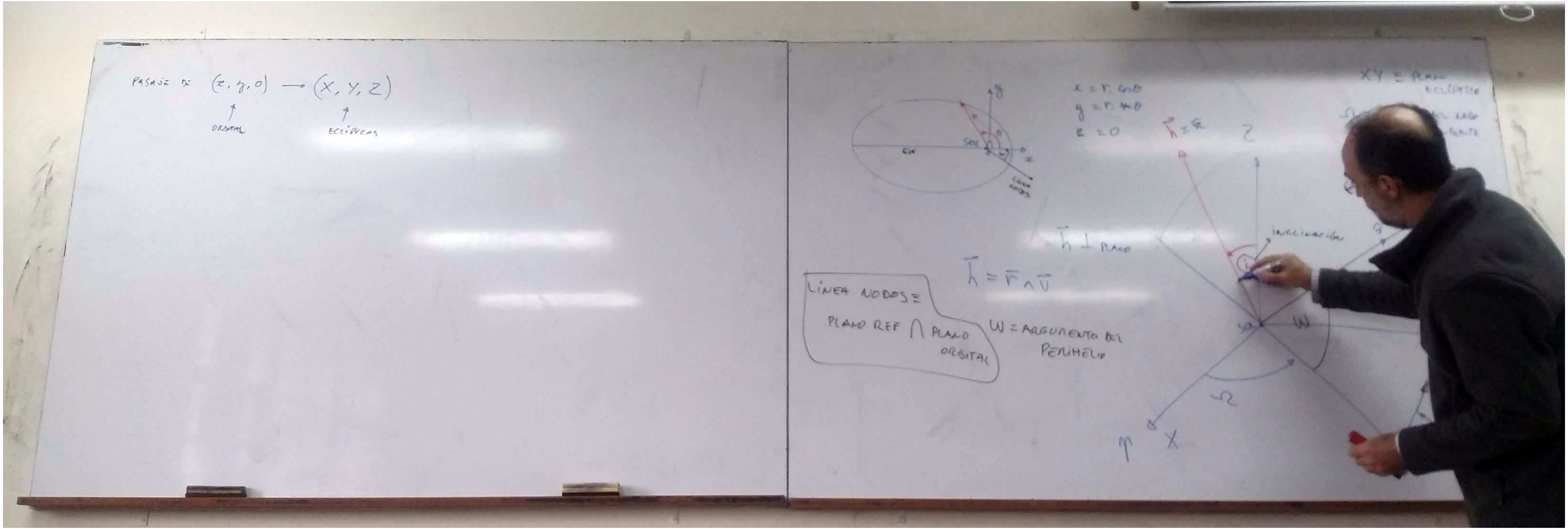

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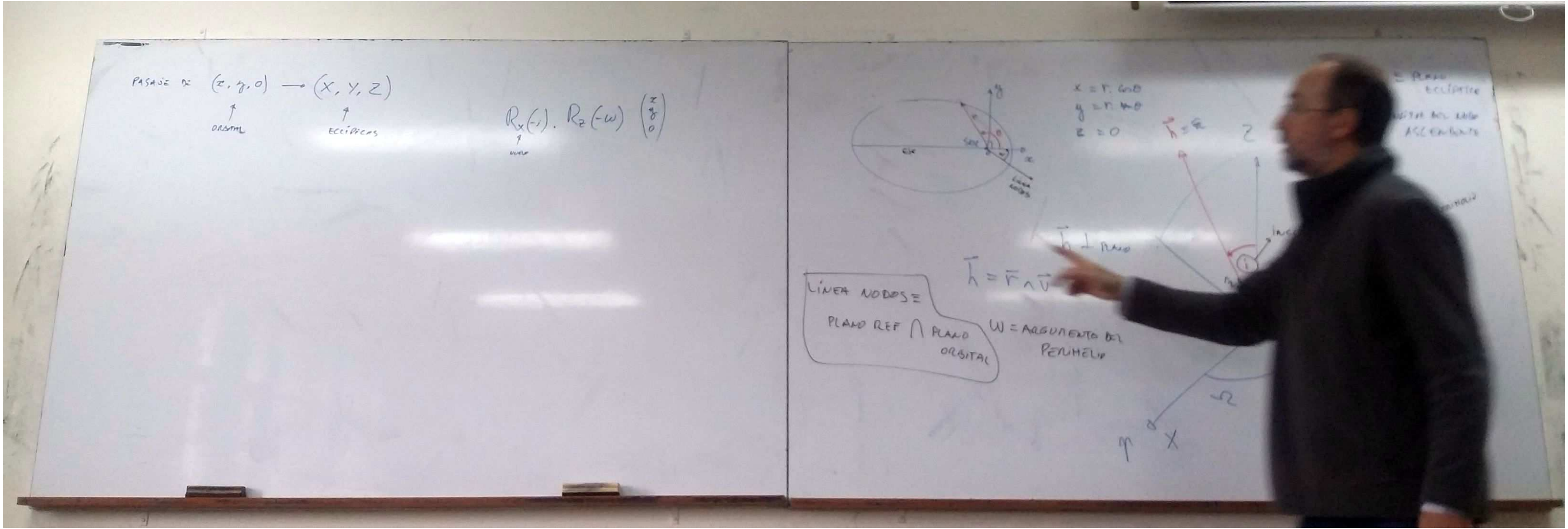

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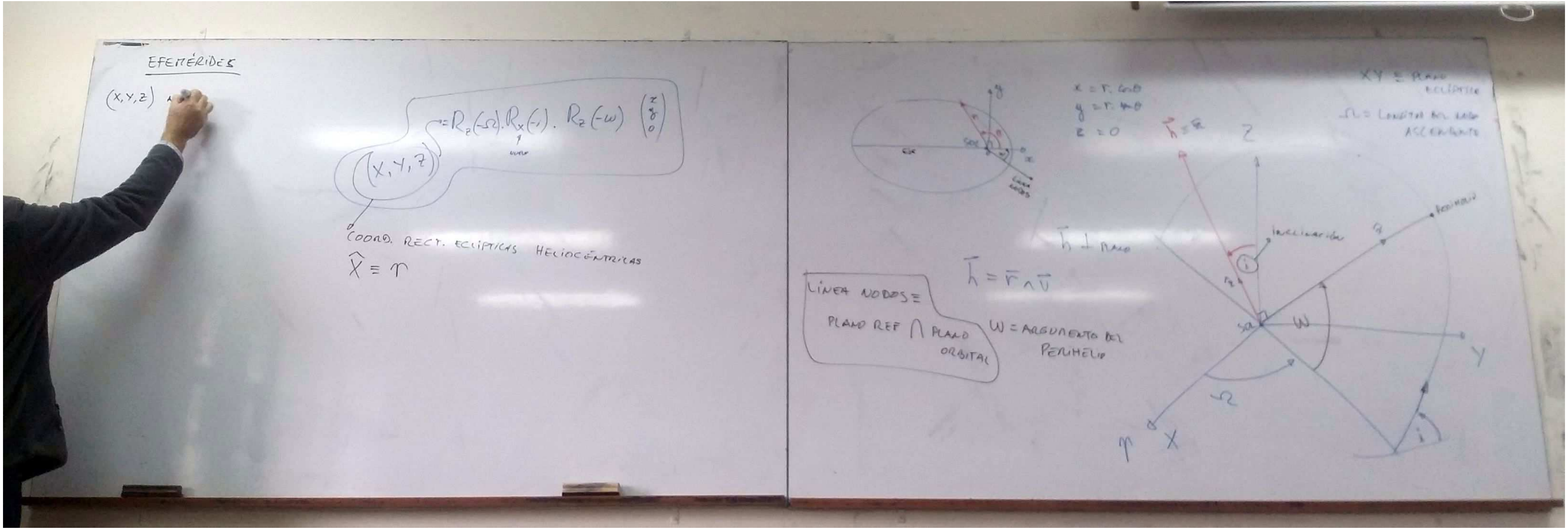
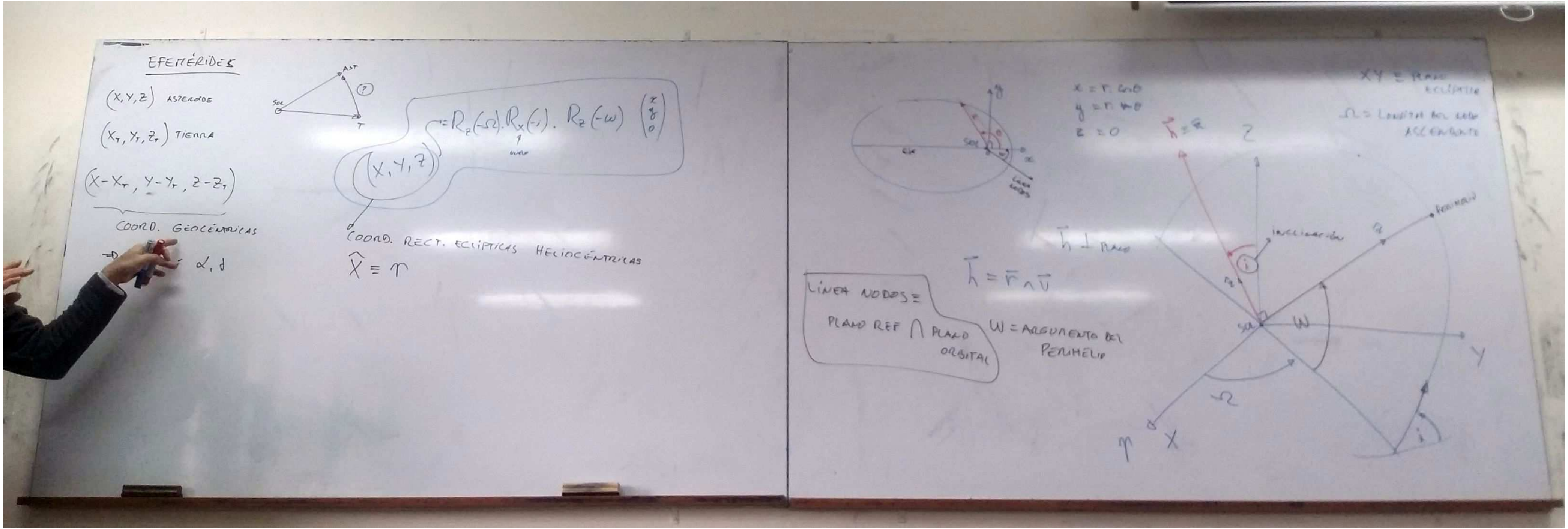
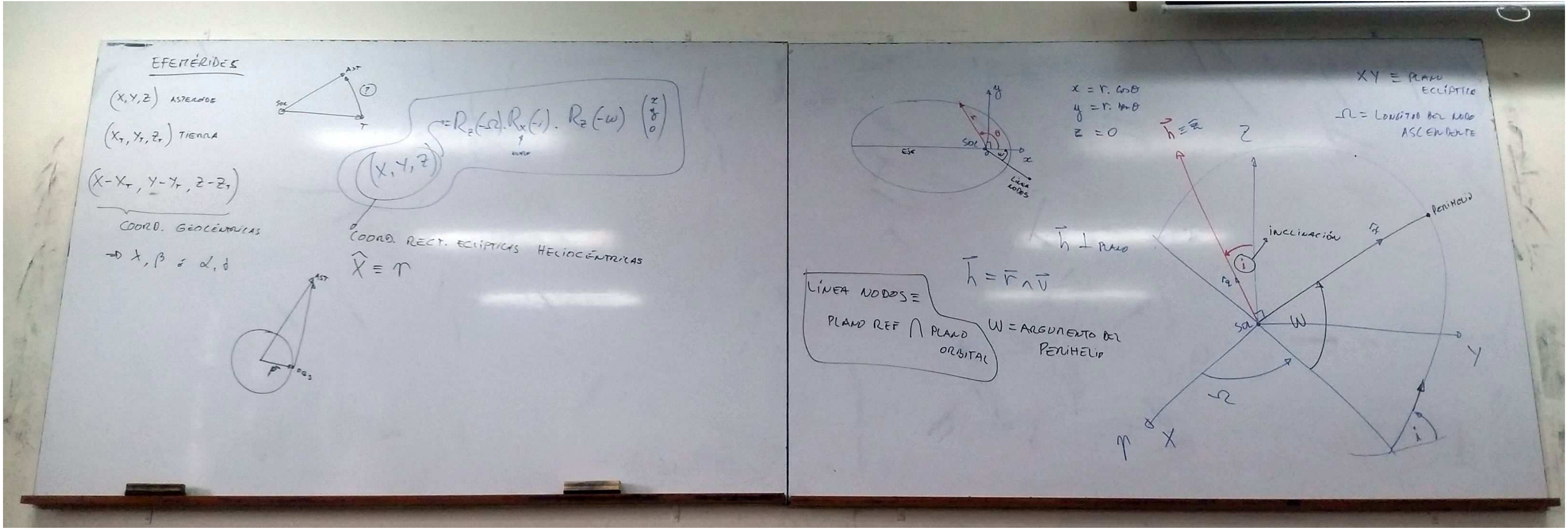
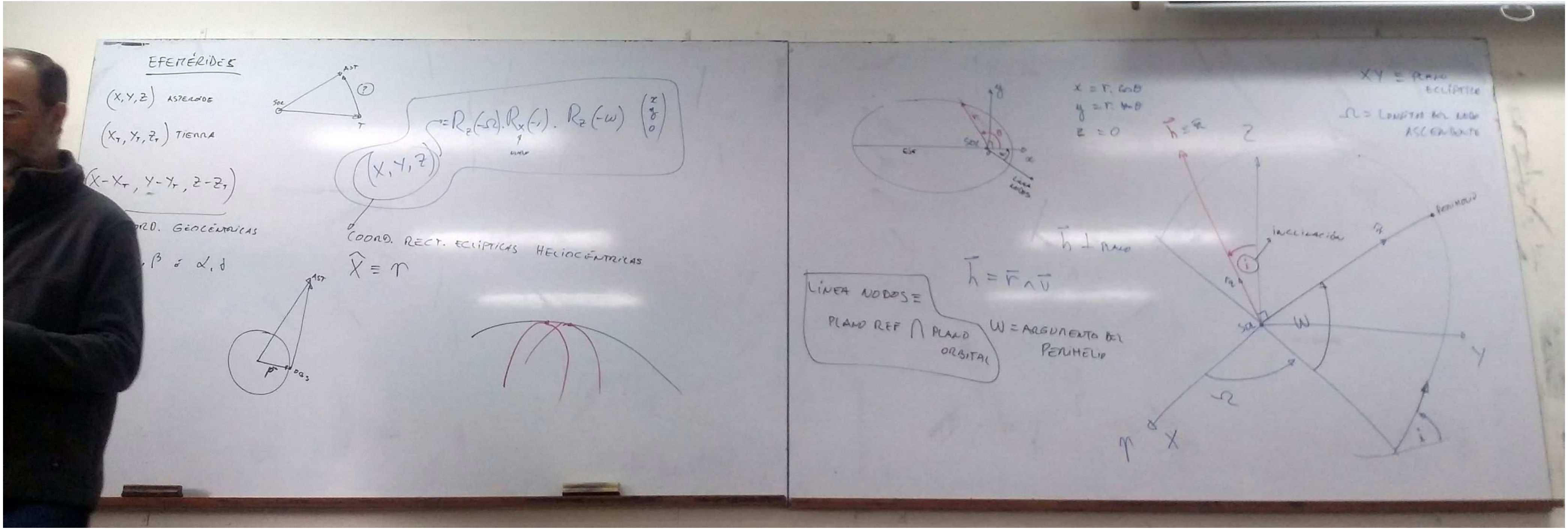



EFEMÉRIDES
(X, Y, Z) ASTEROIDE
(XT, YT, ZT) TIERRA
(X - XT, Y - YT, Z - ZT)
COORD. GEOCÉNTRICAS
α, δ
AST
SOL
T
(x, y, z)
= Rz(-Ω) . Rx(-i) . Rz(-ω)
COORD. RECT. ECLÍPTICAS HELIOCÉNTRICAS
X̂ ≡ ♈
x = r cos θ
y = r sen θ
z = 0
SOL
h ⊥ PLANO
h = r ∧ v
LÍNEA NODOS ≡ PLANO REF ⋂ PLANO ORBITAL
W = ARGUMENTO DEL PERIHELIO
XY ≡ PLANO ECLÍPTICA
Ω = LONGITUD DEL NODO ASCENDENTE
INCLINACIÓN
PERIHELIO
Z
Y
X
♈
SOL
W
Ω
i

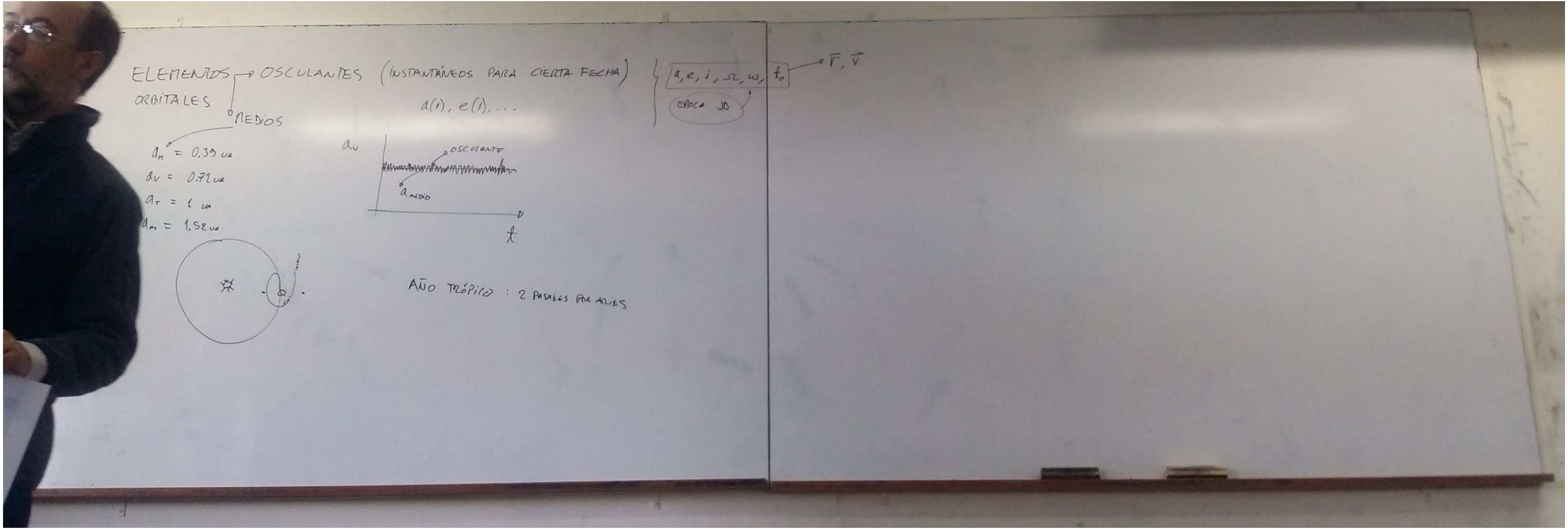
Astronomia Fundamental 2017

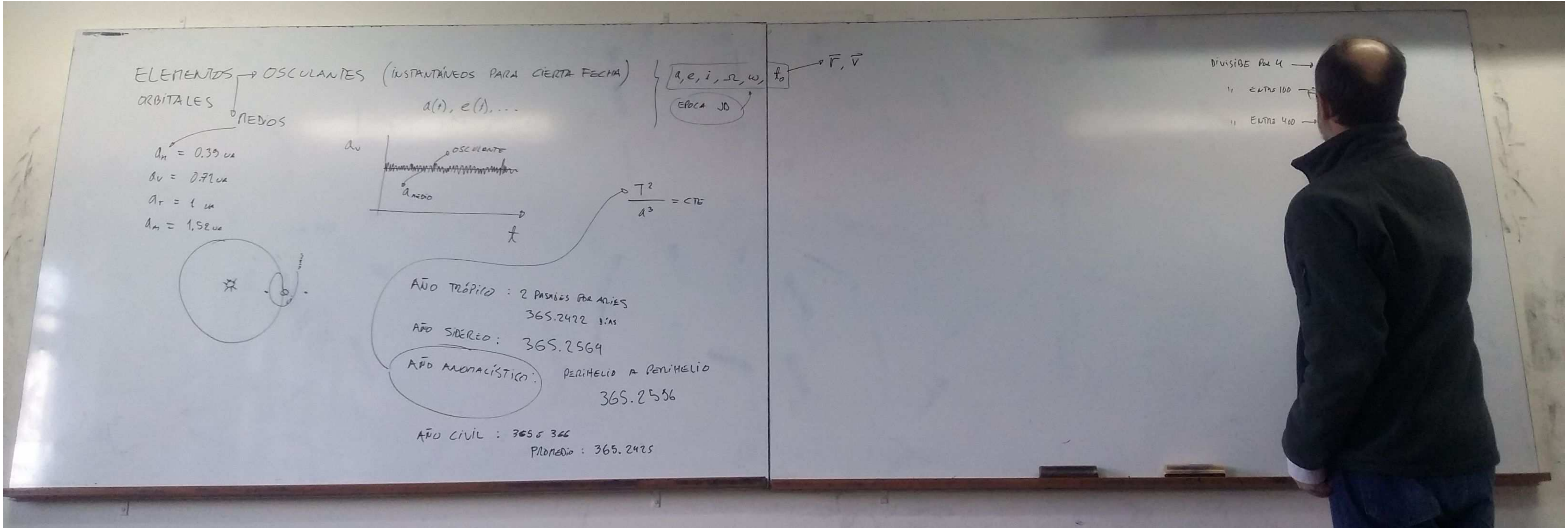


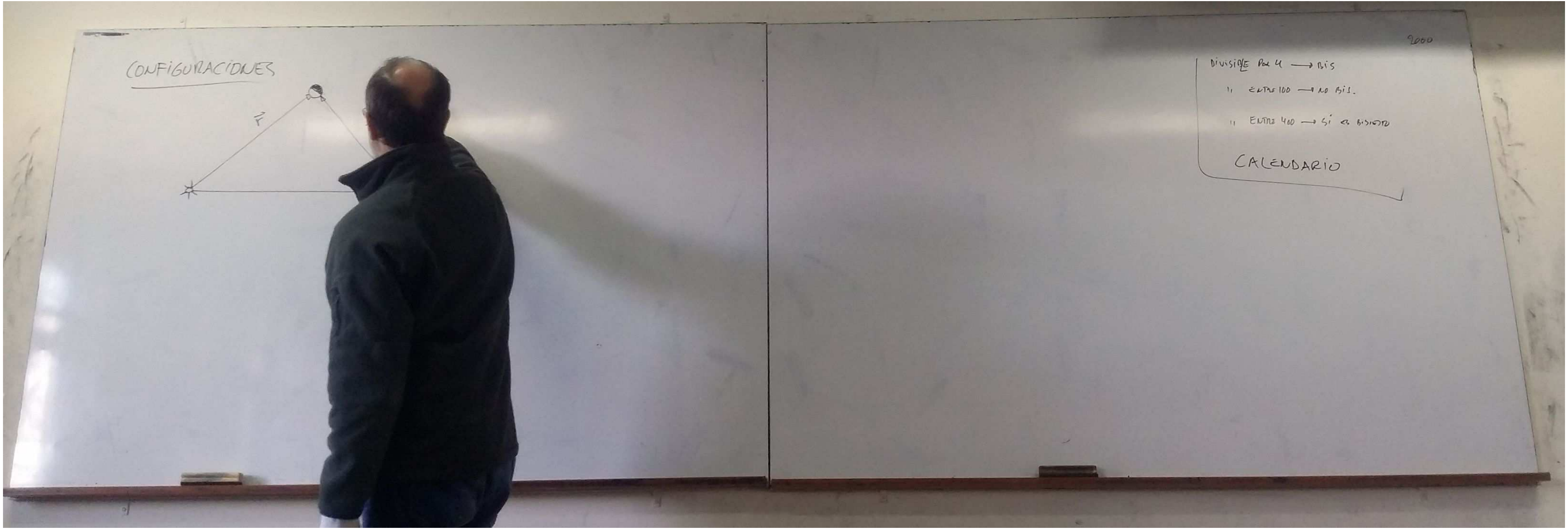
Astronomia Fundamental 2017

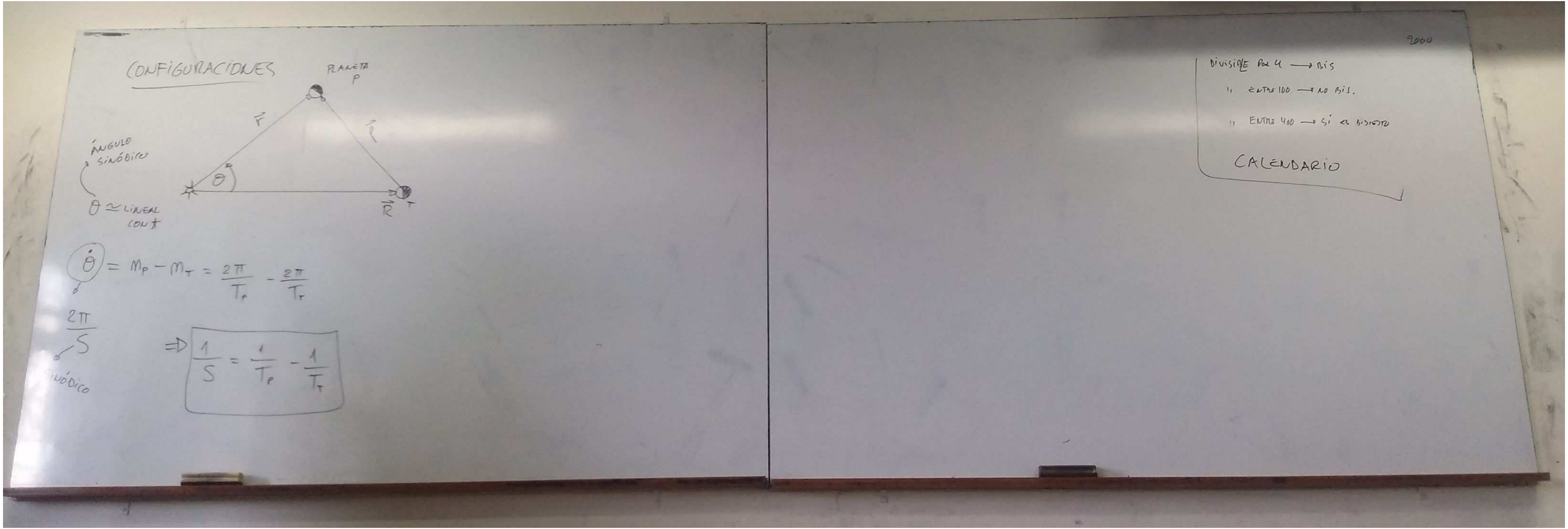



ELEMENTOS ORBITALES
OSCULANTES (INSTANTÁNEOS PARA CIERTA FECHA)
MEDIOS
a(t), e(t), ...
a, e, i, Ω, ω, t₀
EPOCA JD
r, v
OSCULANTE
a MEDIO
t

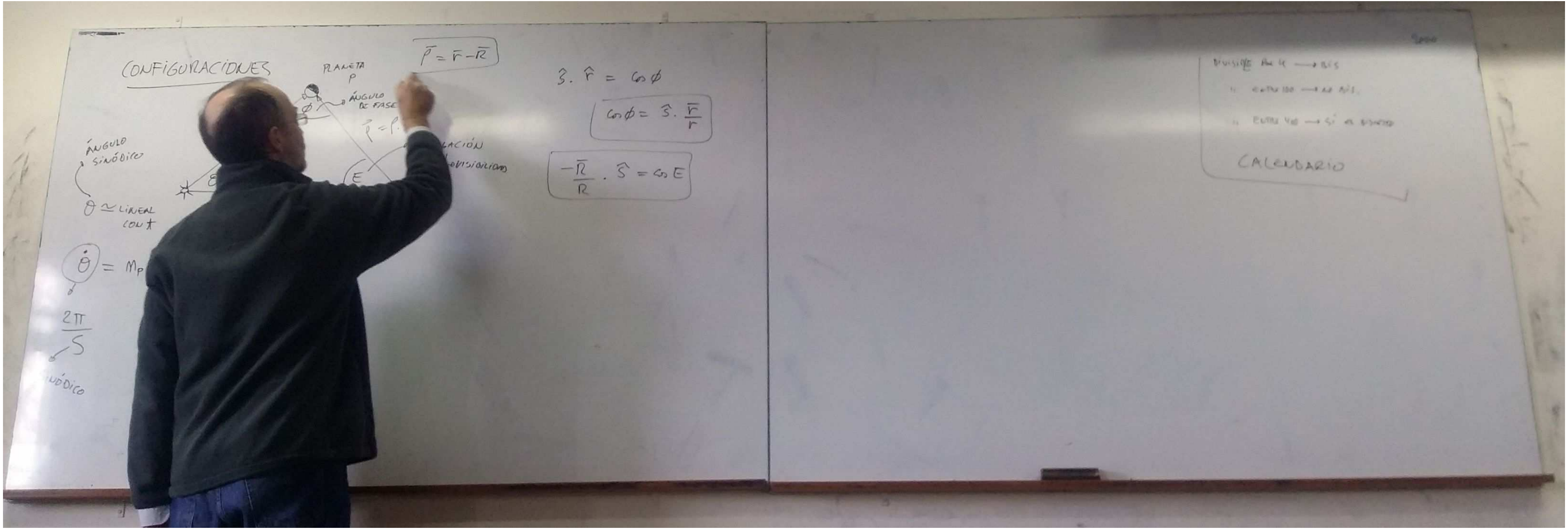

ELEMENTOS ORBITALES
OSCULANTES (INSTANTÁNEOS PARA CIERTA FECHA)
a(t), e(t), ...
MEDIOS
a,e, i, Ω, ω, t₀
→ r, v
EPOCA JD
OSCULANTE
a MEDIO
AÑO TRÓPICO : 2 PASAJES POR ARIES

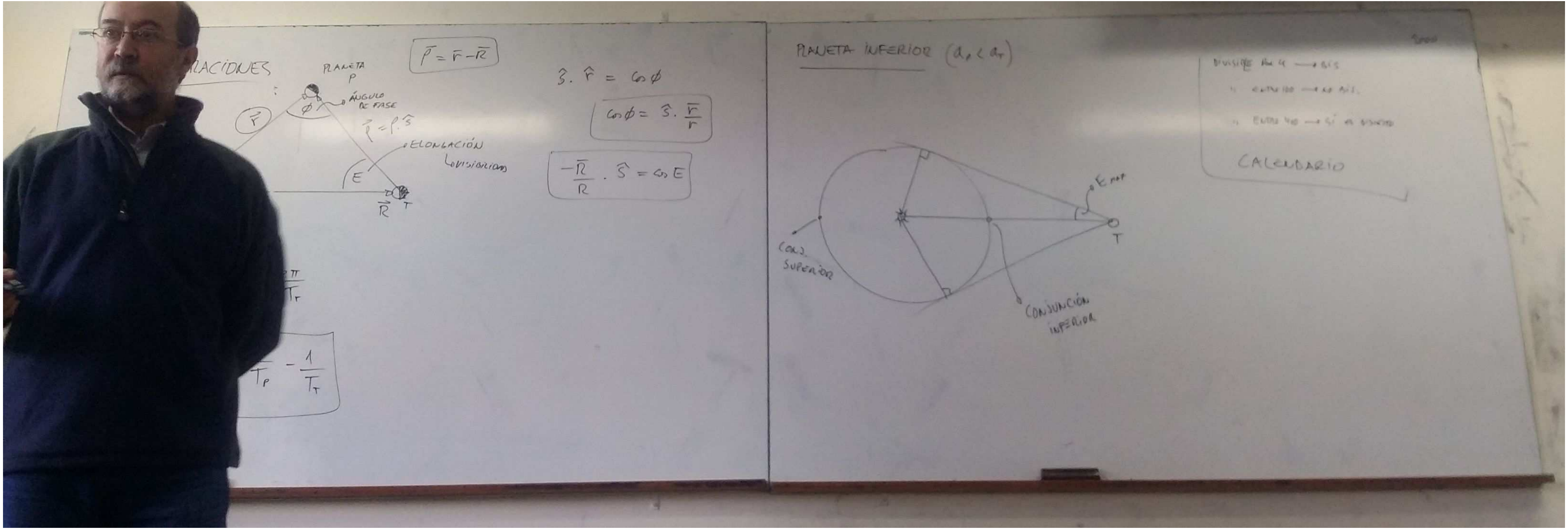

ELEMENTOS ORBITALES
OSCULANTES (INSTANTÁNEOS PARA CIERTA FECHA)
MEDIOS
a(t), e(t), ...
a, e, i, Ω, ω, t₀
ÉPOCA JD
r, v
a_M = 0.39 UA
a_V = 0.72 UA
a_T = 1 UA
a_M = 1.52 UA
OSCULANTE
a MEDIO
t
T²/a³ = CTE
AÑO TRÓPICO : 2 PASAJES POR ARIES
365.2422 DÍAS
AÑO SIDÉREO : 365.2564
AÑO ANOMALÍSTICO : PERIHELIO A PERIHELIO
365.2596
AÑO CIVIL : 365 ó 366
PROMEDIO : 365.2425
DIVISIBLE POR 4
ENTRE 100
ENTRE 400

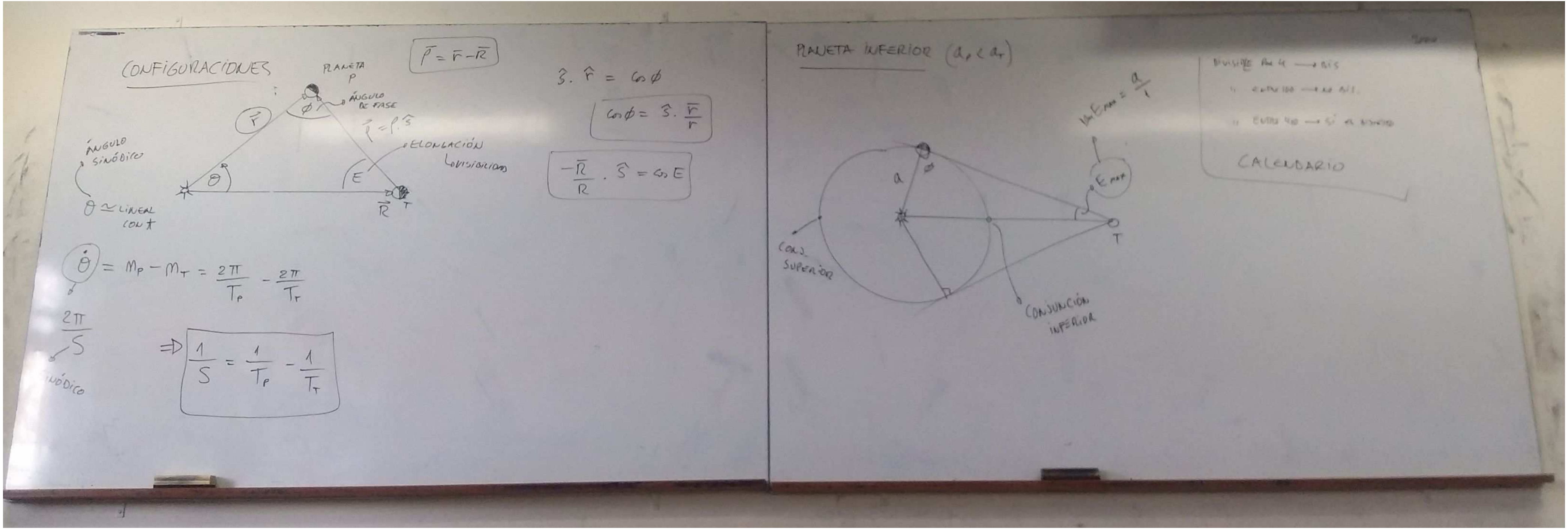

CONFIGURACIONES
2000
DIVISIBLE POR 4 → BIS
" ENTRE 100 → NO BIS.
CALENDARIO

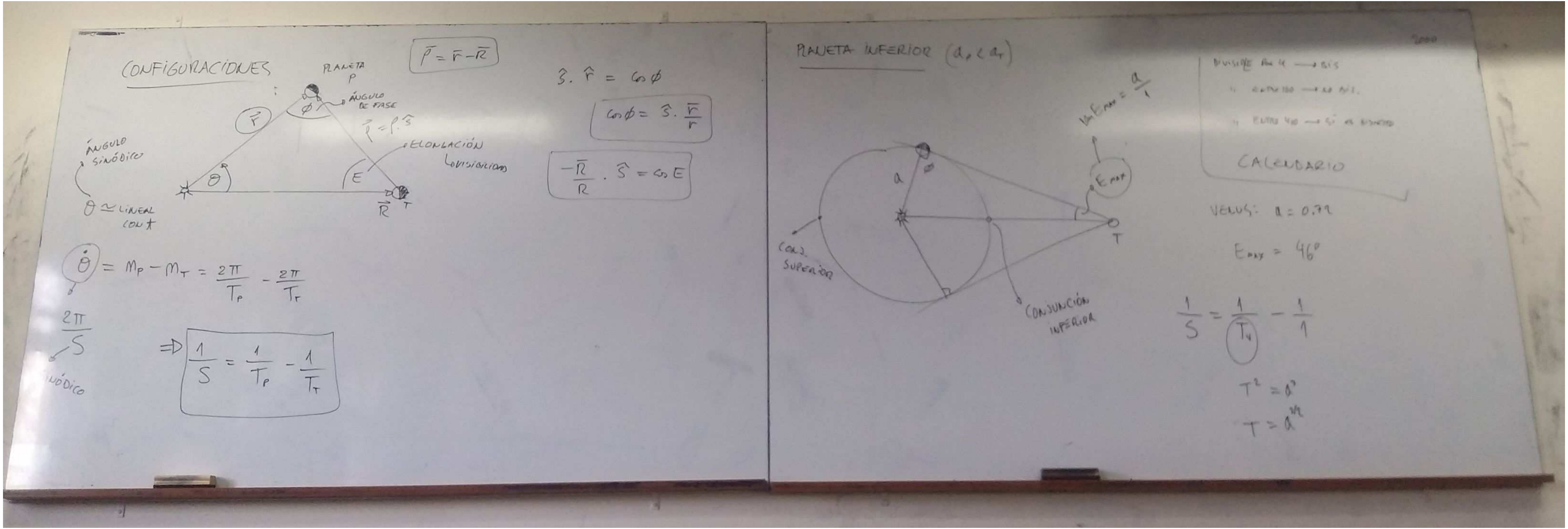

CONFIGURACIONES
PLANETA P
ÁNGULO SINÓDICO
θ ≃ LINEAL con t
T
θ̇ = n_P − n_T = 2π/T_P − 2π/T_T
2π/S
SINÓDICO
1/S = 1/T_P − 1/T_T
2000
CALENDARIO

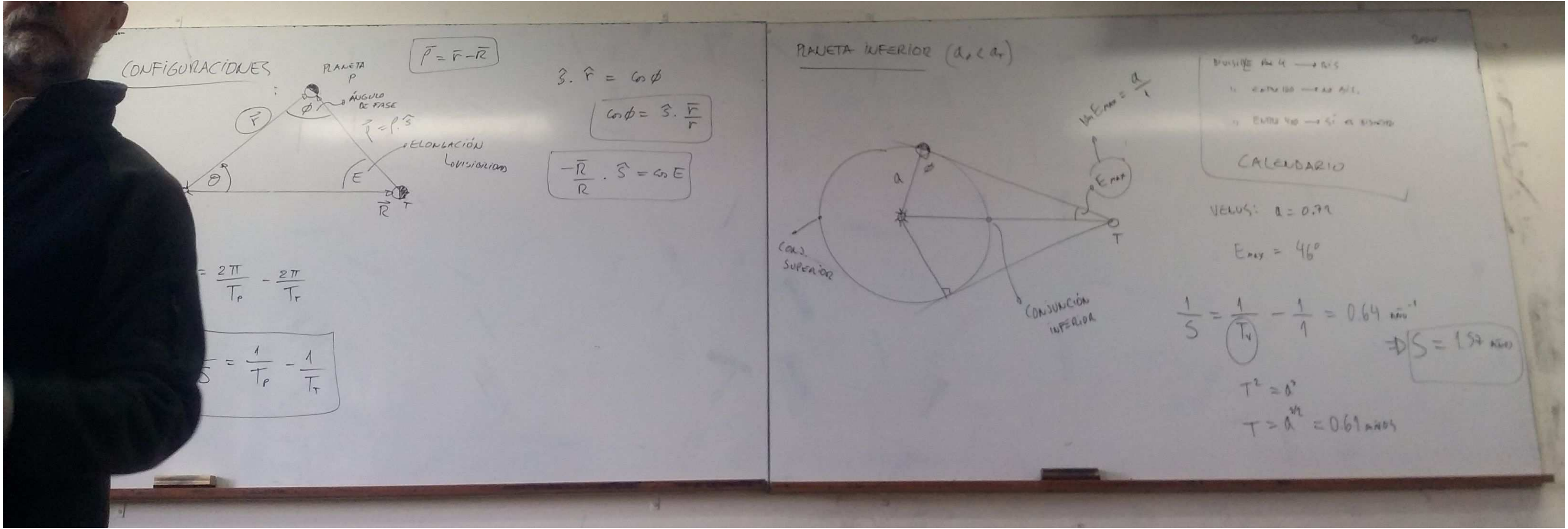
Astronomia Fundamental 2017

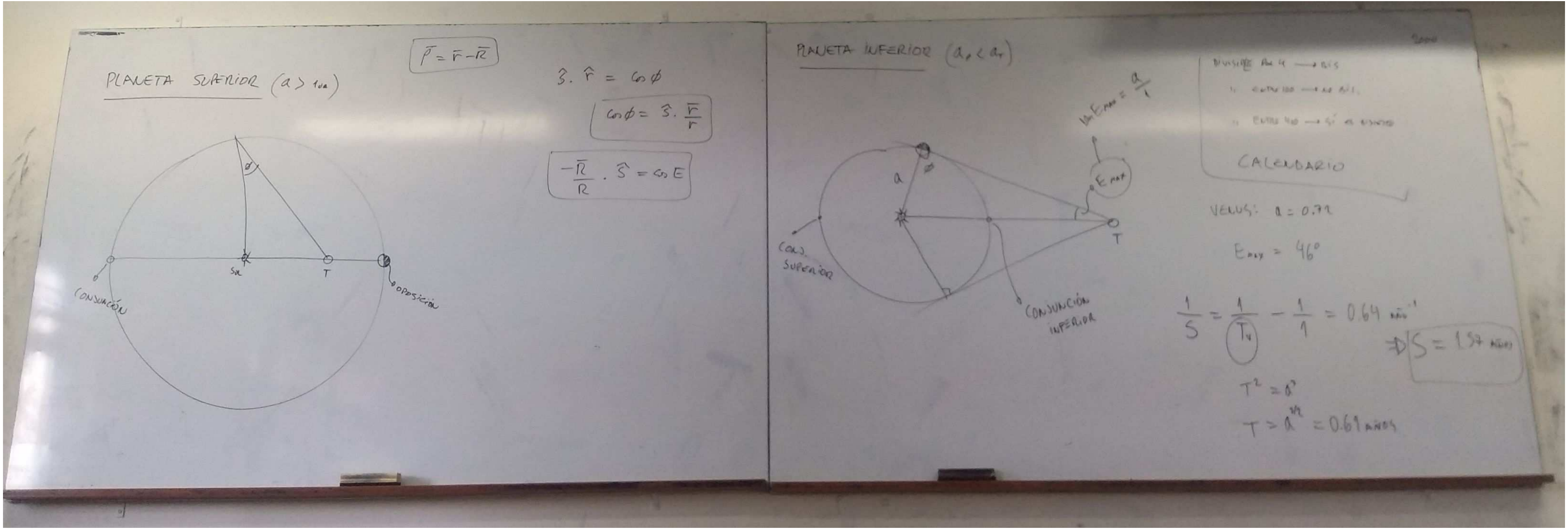

CONFIGURACIONES
PLANETA
P
ÁNGULO
DE FASE
ÁNGULO
SINÓDICO
CALENDARIO


PLANETA P
ÁNGULO DE FASE
ELONGACIÓN
$\bar{\rho} = \bar{r} - \bar{R}$
$\hat{s} \cdot \hat{r} = \cos\phi$
$\cos\phi = \hat{s} \cdot \frac{\bar{r}}{r}$
$-\frac{\bar{R}}{R} \cdot \hat{s} = \cos E$
PLANETA INFERIOR
CALENDARIO
CONJUNCIÓN INFERIOR
T

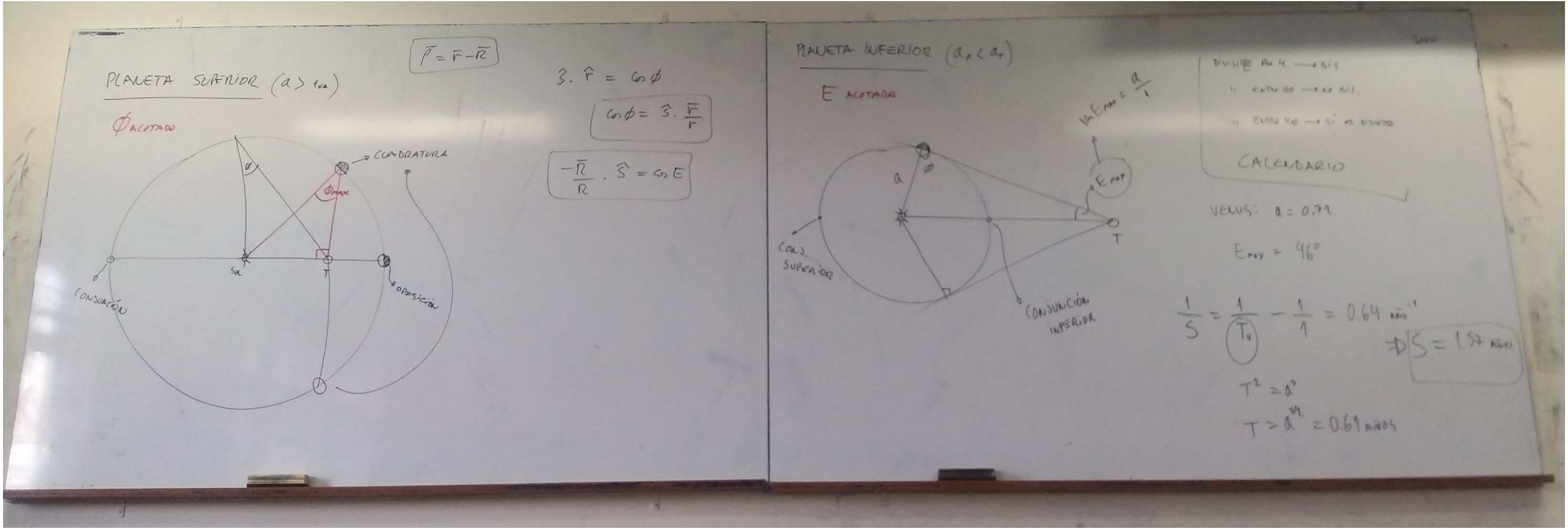

CONFIGURACIONES
PLANETA P
ÁNGULO DE FASE
ELONGACIÓN
ÁNGULO SINÓDICO
PLANETA INFERIOR
CONJUNCIÓN INFERIOR
CALENDARIO

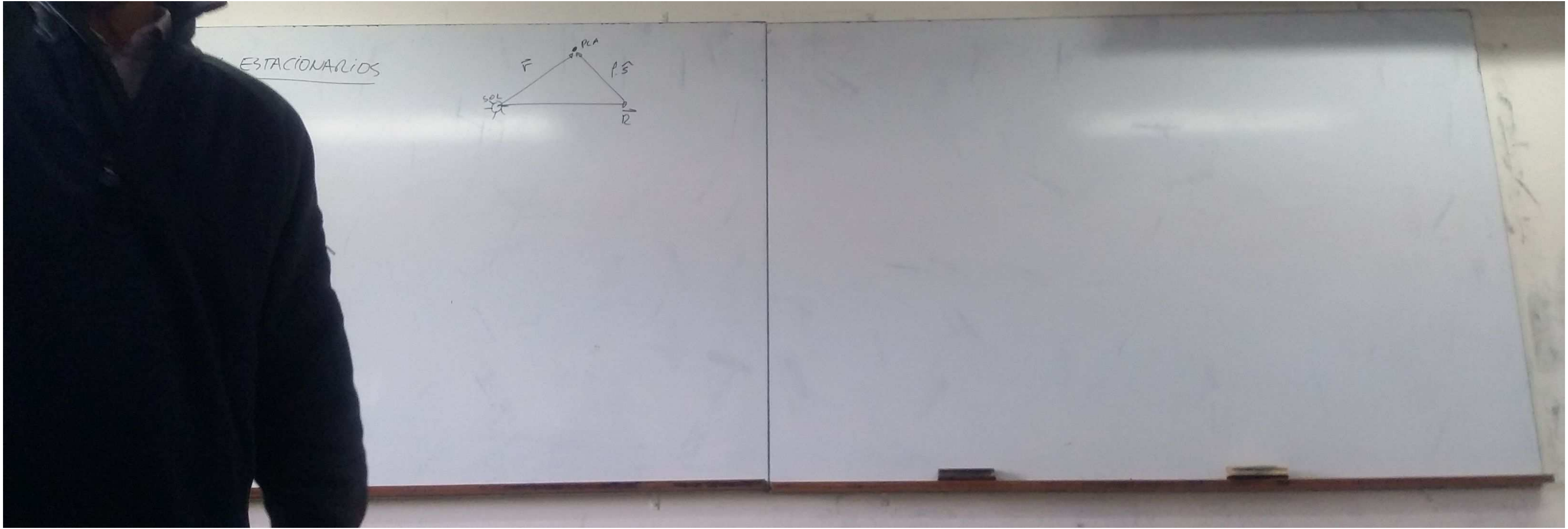

CONFIGURACIONES
PLANETA P
ÁNGULO DE FASE
ELONGACIÓN
ÁNGULO SINÓDICO
θ ≃ LINEAL CON t
T
PLANETA INFERIOR
a
Emax
CONJUNCIÓN INFERIOR
CONJ. SUPERIOR
CALENDARIO
VENUS: a = 0.72
Emax = 46°
T² = a³
T = a^{3/2}

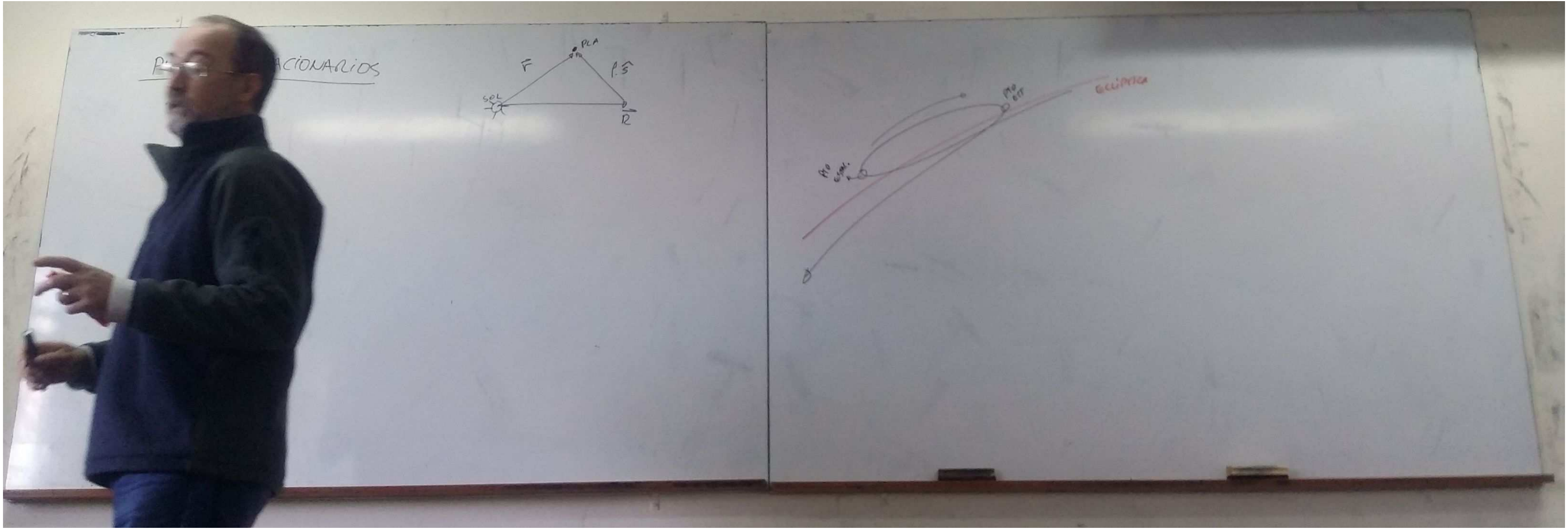

CONFIGURACIONES
PLANETA
P
ÁNGULO DE FASE
ELONGACIÓN
T
PLANETA INFERIOR
CALENDARIO
COND. SUPERIOR
CONJUNCIÓN INFERIOR
VENUS: a = 0.72
E max = 46°
T² = a³

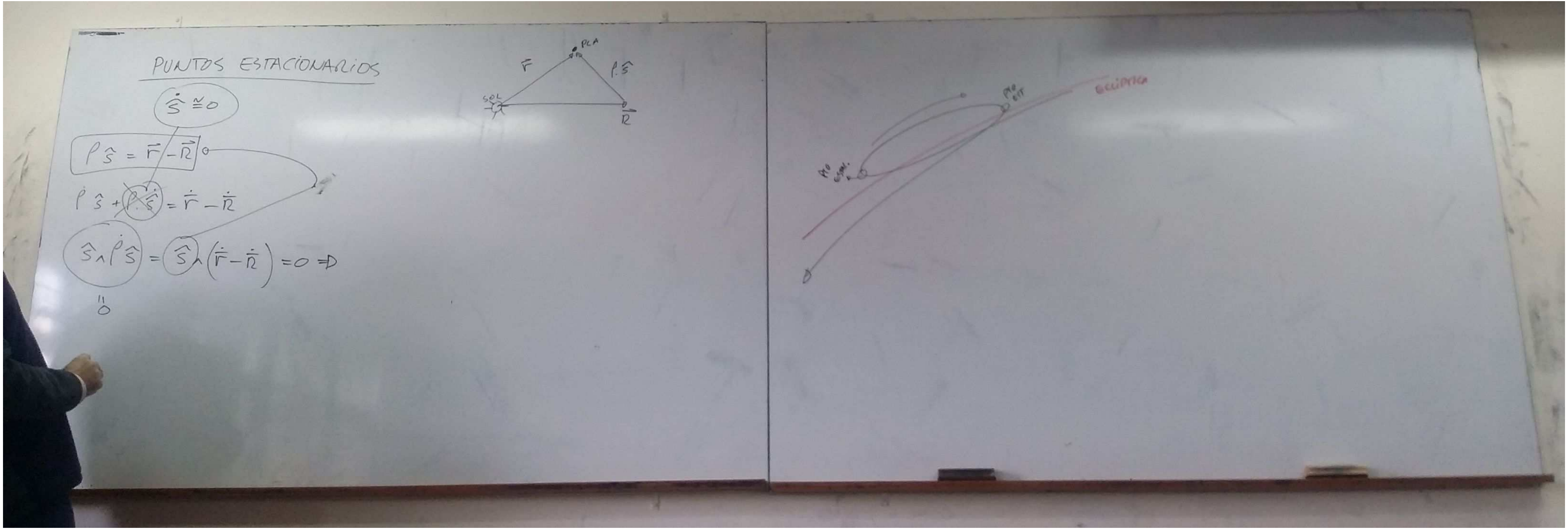

PLANETA SUPERIOR (a > 1ua)
ρ̄ = r̄ − R̄
ŝ . r̂ = cos φ
cos φ = ŝ . r̄/r
−R̄/R . ŝ = cos E
φ
CONJUNCIÓN
SOL
T
OPOSICIÓN
PLANETA INFERIOR (a_p < a_T)
a
φ
CONJ. SUPERIOR
CONJUNCIÓN INFERIOR
T
E max
CALENDARIO
VENUS: a = 0.72
E max = 46°
1/S = 1/T_V − 1/1 = 0.64 años^-1
⇒ S = 1.57 años
T² = a³
T = a^3/2 = 0.61 años

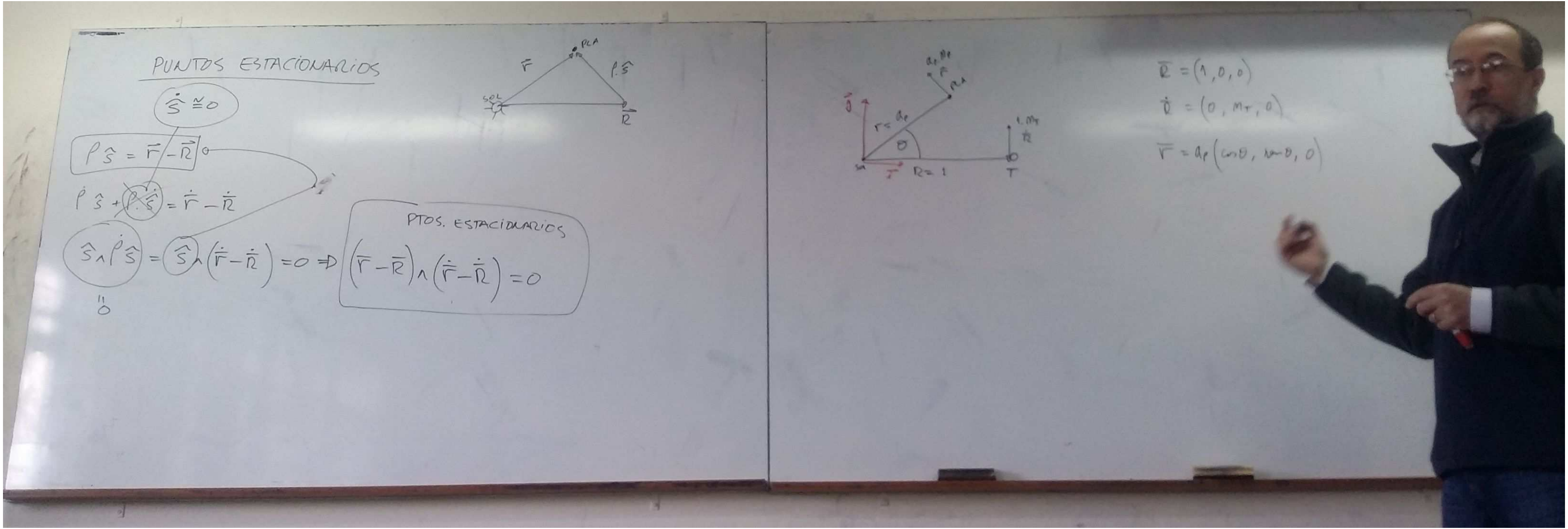
Astronomia Fundamental 2017

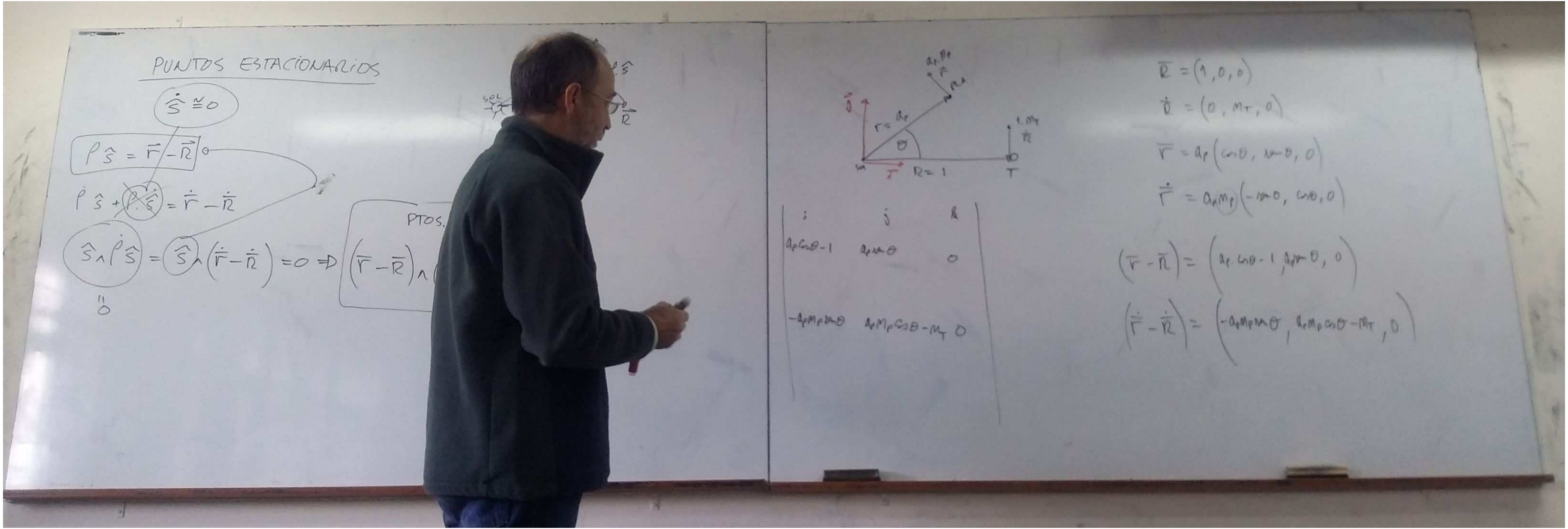


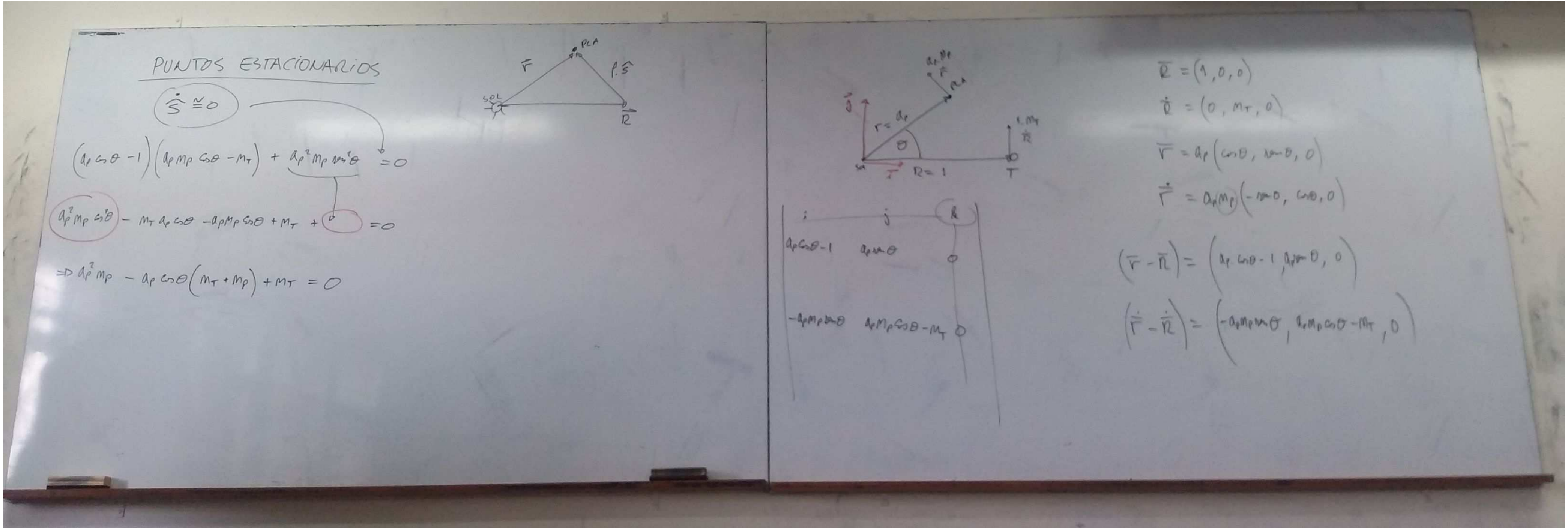

ESTACIONARIOS
PLA
SOL

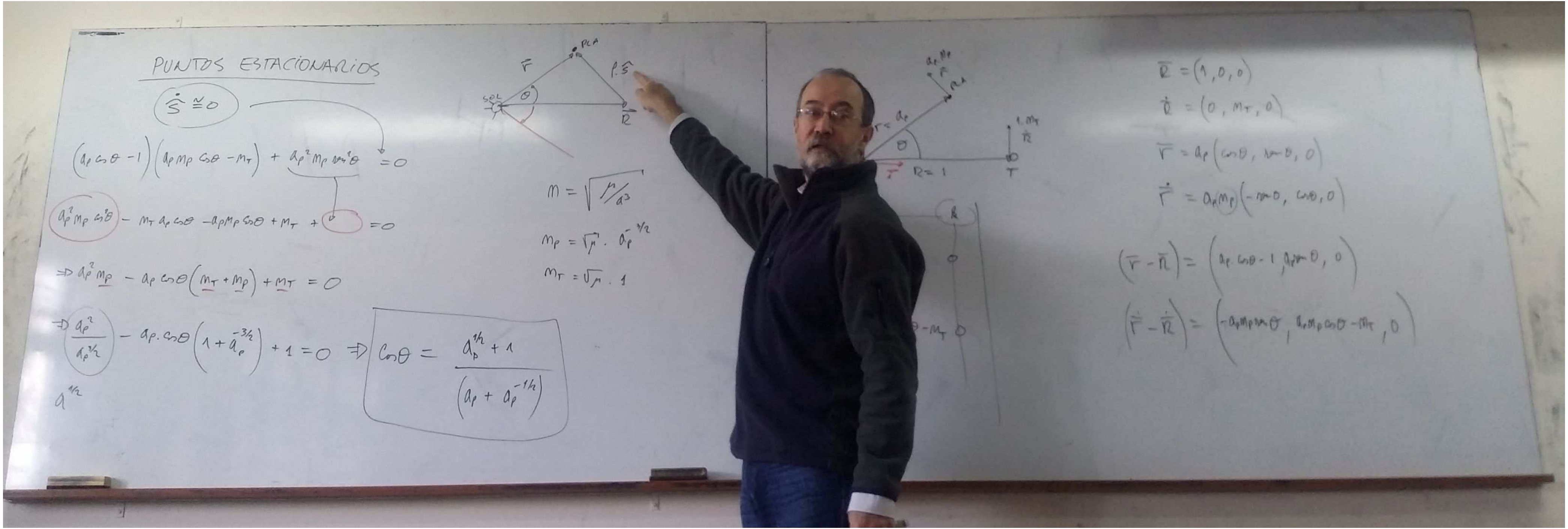

PLA
SOL

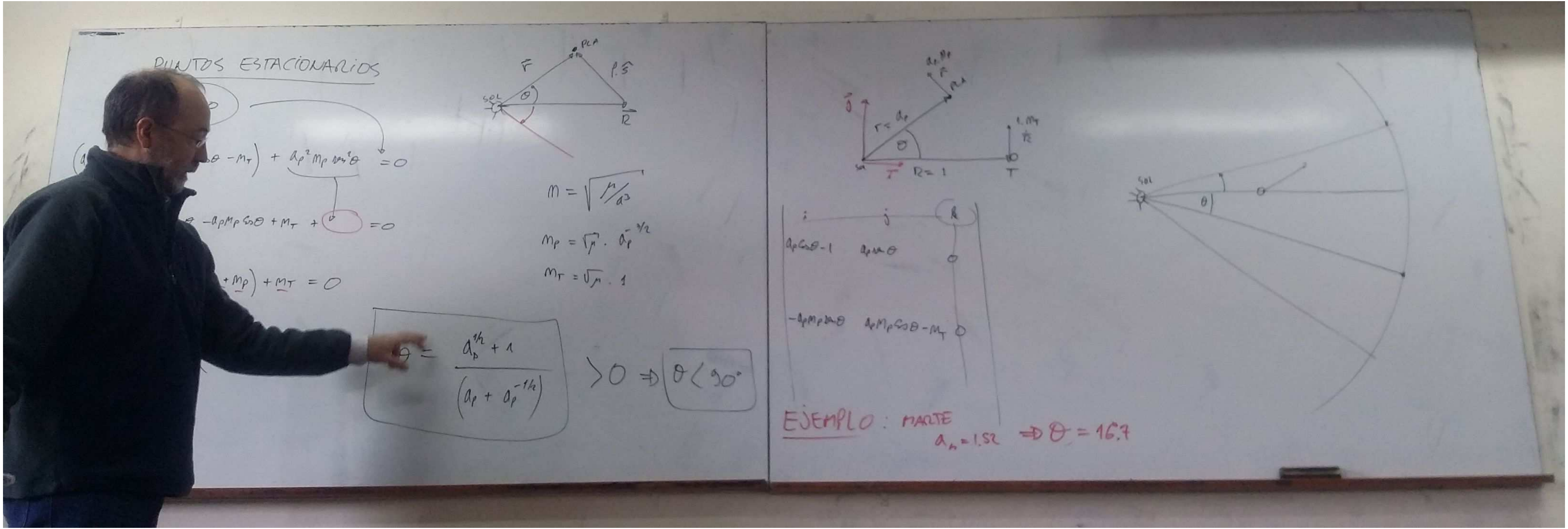

PUNTOS ESTACIONARIOS
SOL
PLA
ECLIPTICA


PUNTOS ESTACIONARIOS
SOL
PLA
PTOS. ESTACIONARIOS
T

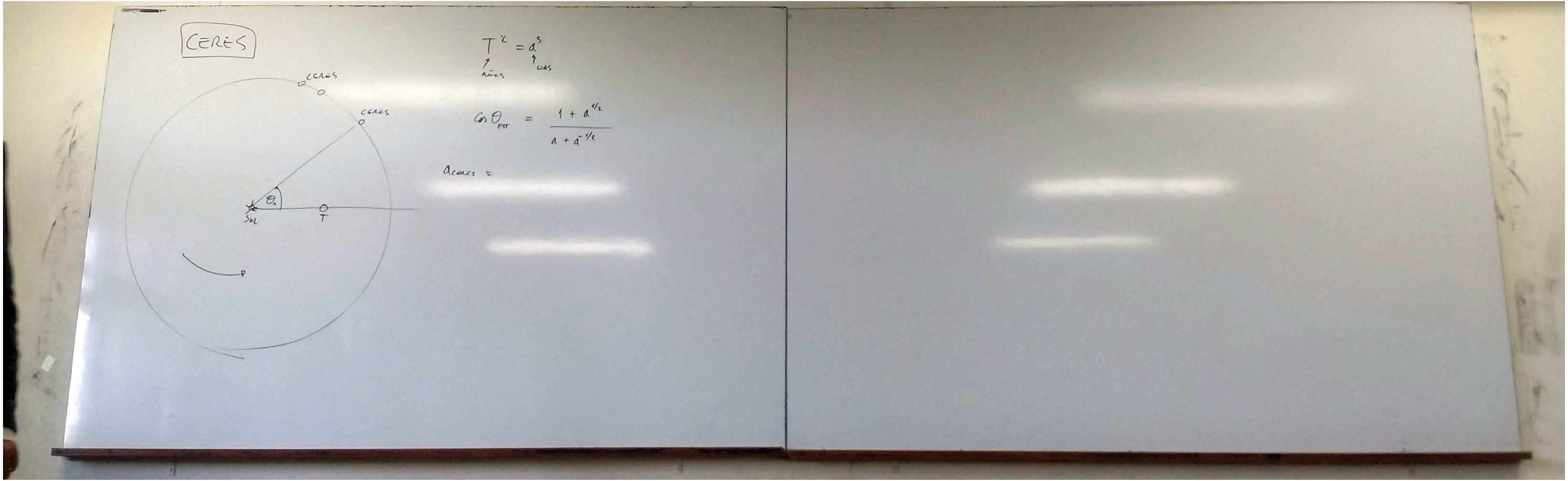



PUNTOS ESTACIONARIOS
PLA
SOL
R
T
θ
R = 1
$\bar{R} = (1, 0, 0)$
$\dot{\bar{R}} = (0, m_T, 0)$
$\bar{r} = a_p(\cos\theta, \sin\theta, 0)$
$\dot{\bar{r}} = a_p m_p(-\sin\theta, \cos\theta, 0)$
$(\bar{r} - \bar{R}) = (a_p\cos\theta - 1, a_p\sin\theta, 0)$
$(\dot{\bar{r}} - \dot{\bar{R}}) = (-a_p m_p\sin\theta, a_p m_p\cos\theta - m_T, 0)$
$(a_p\cos\theta - 1)(a_p m_p\cos\theta - m_T) + a_p^2 m_p\sin^2\theta = 0$
$a_p^2 m_p\cos^2\theta - m_T a_p\cos\theta - a_p m_p\cos\theta + m_T + \quad = 0$
$\Rightarrow a_p^2 m_p - a_p\cos\theta(m_T + m_p) + m_T = 0$

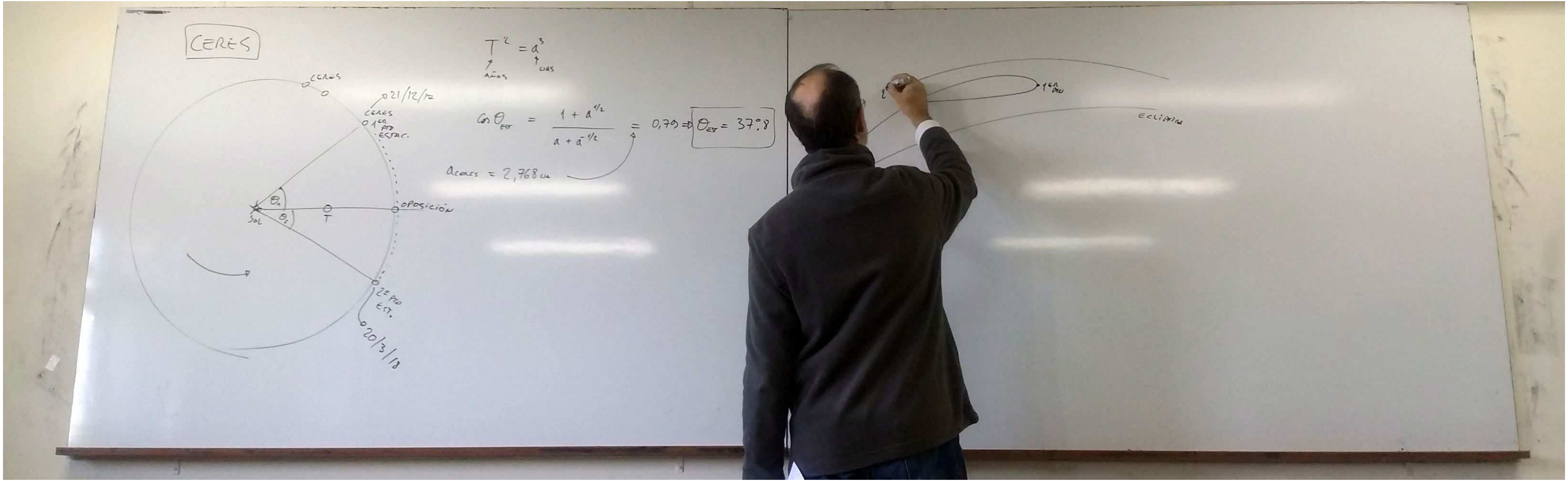

PUNTOS ESTACIONARIOS
SOL
PLA
R = 1
T

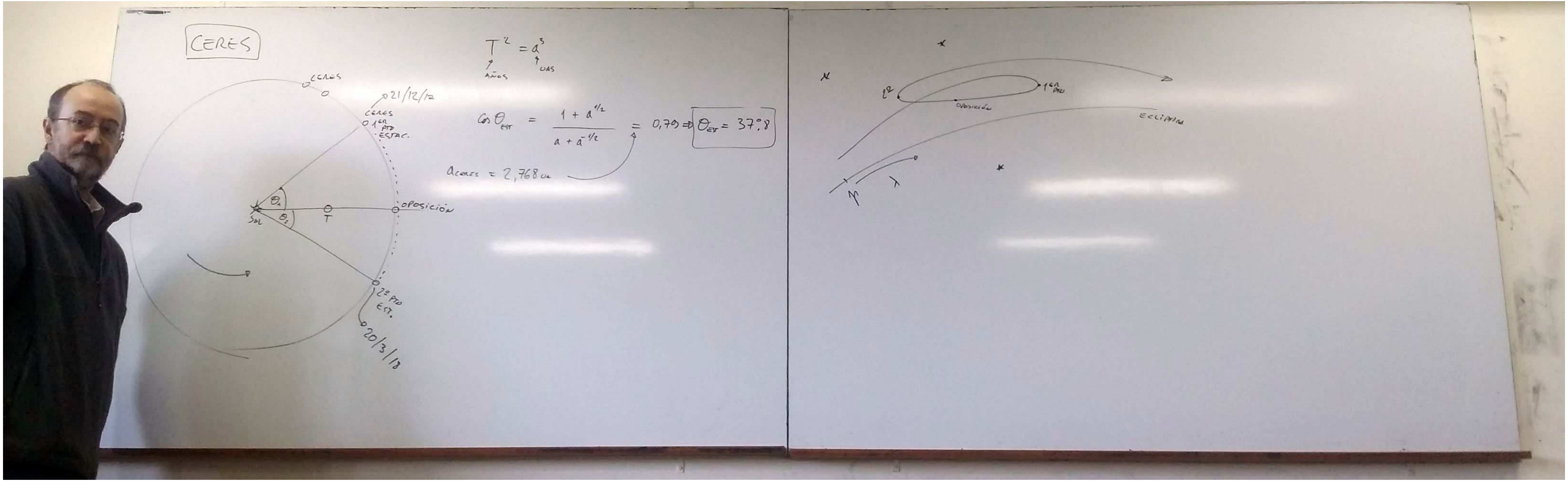

PUNTOS ESTACIONARIOS
SOL
PLA
R
EJEMPLO: MARTE
$a_M = 1.52 \Rightarrow \theta = 16.7$

Astronomia Fundamental 2017

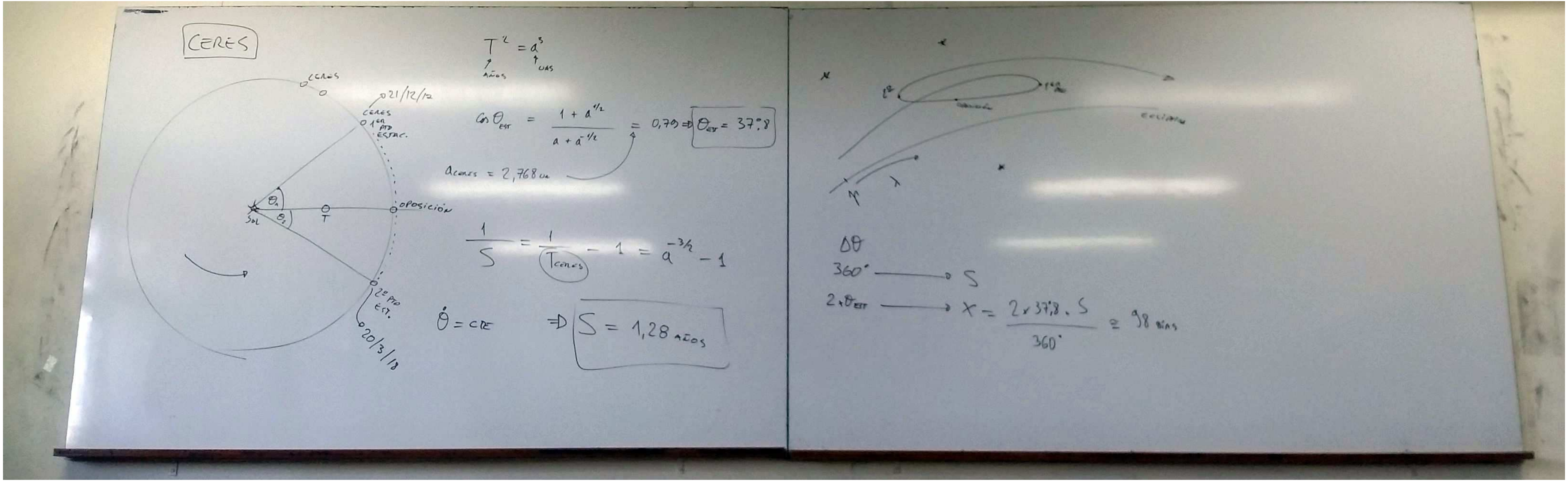


Astronomia Fundamental 2017

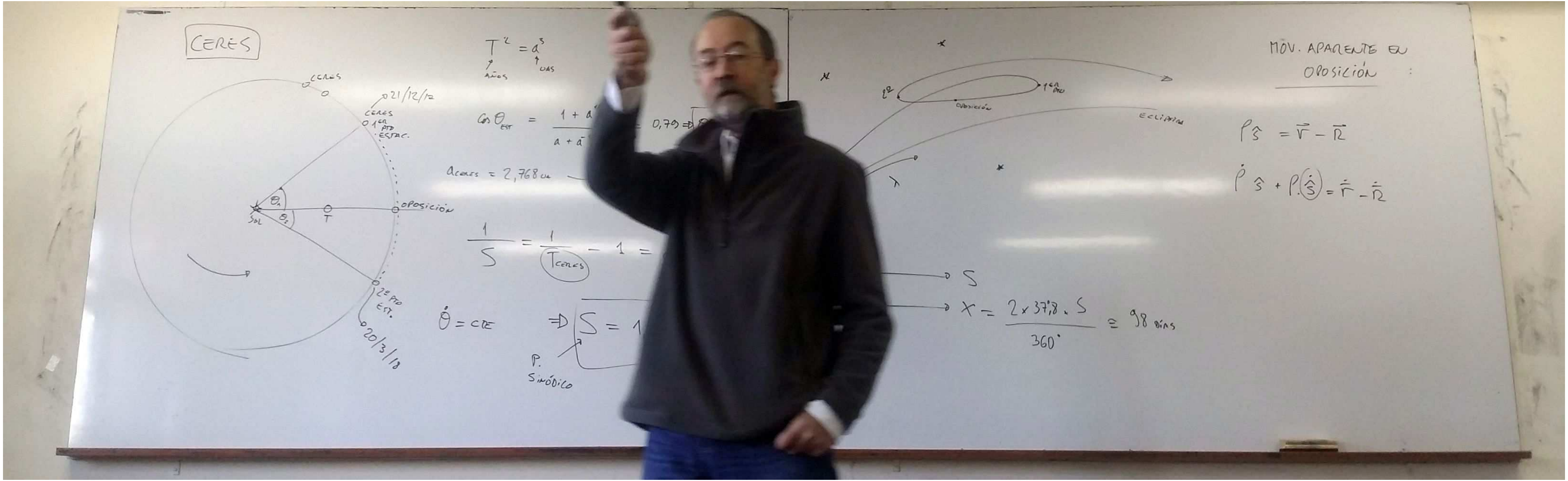



CERES
$T^2 = a^3$
AÑOS
UAS
CERES
21/12/17
CERES
1er PTO ESTAC.
$\cos\theta_{EST} = \frac{1 + a^{1/2}}{a + a^{-1/2}} = 0{,}79 \Rightarrow \theta_{EST} = 37{,}8°$
$a_{CERES} = 2{,}768$ UA
SOL
T
OPOSICIÓN
2º PTO EST.
20/3/18
1er PTO
2º
OPOSICIÓN
ECLÍPTICA

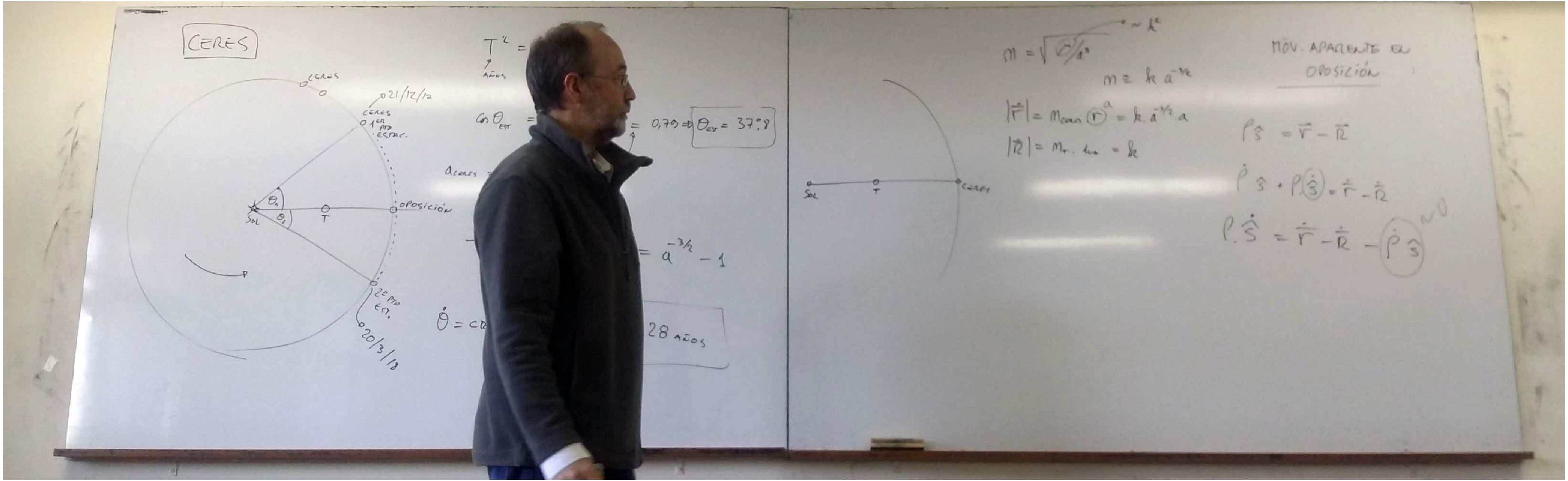
Astronomia Fundamental 2017



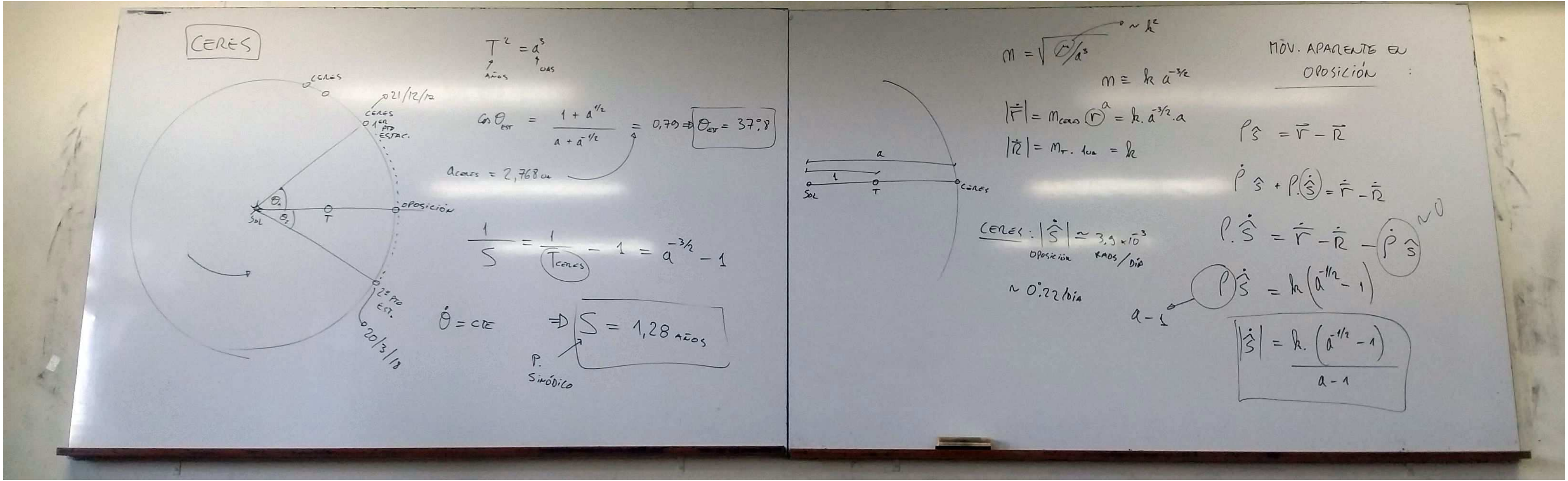
Astronomia Fundamental 2017

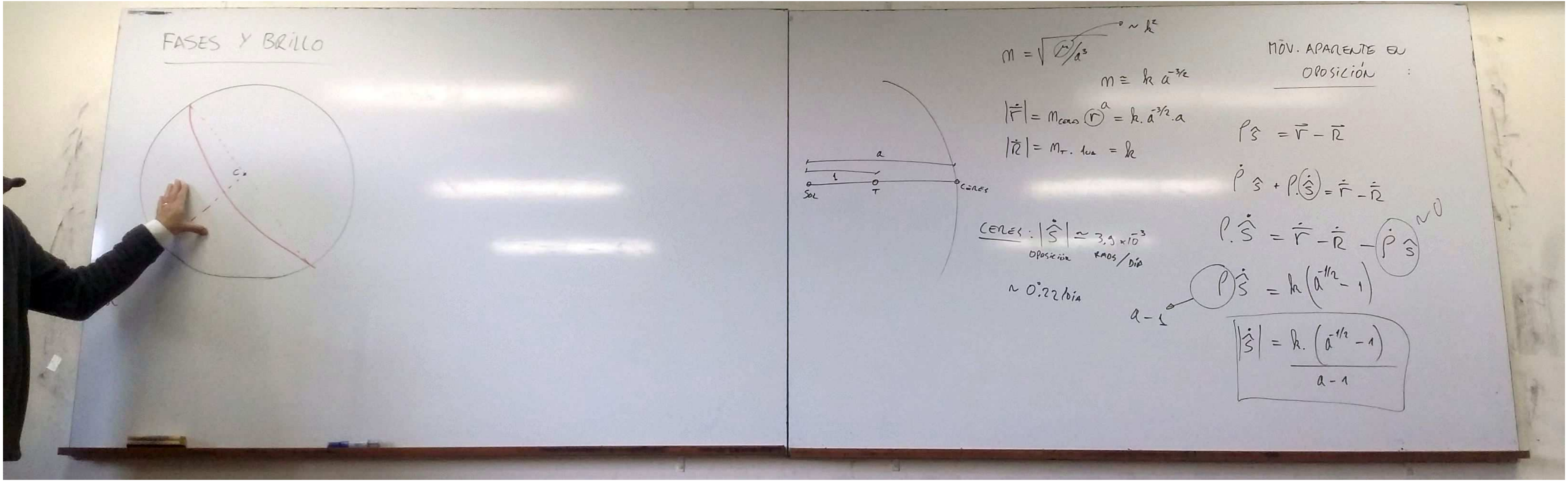


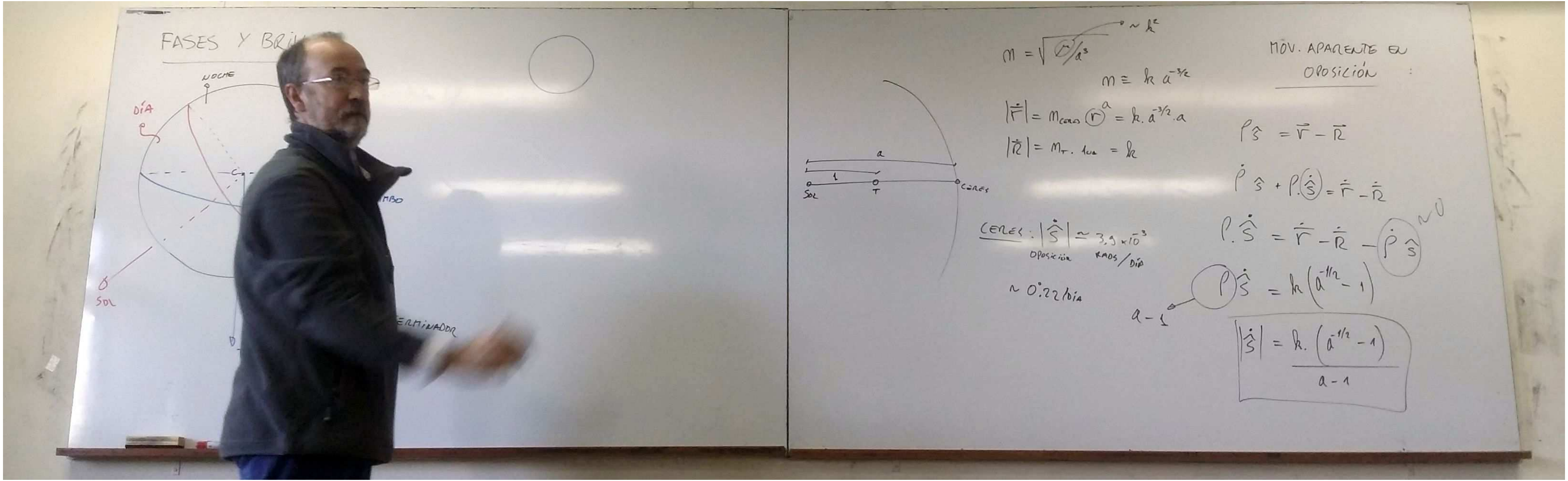
Astronomia Fundamental 2017

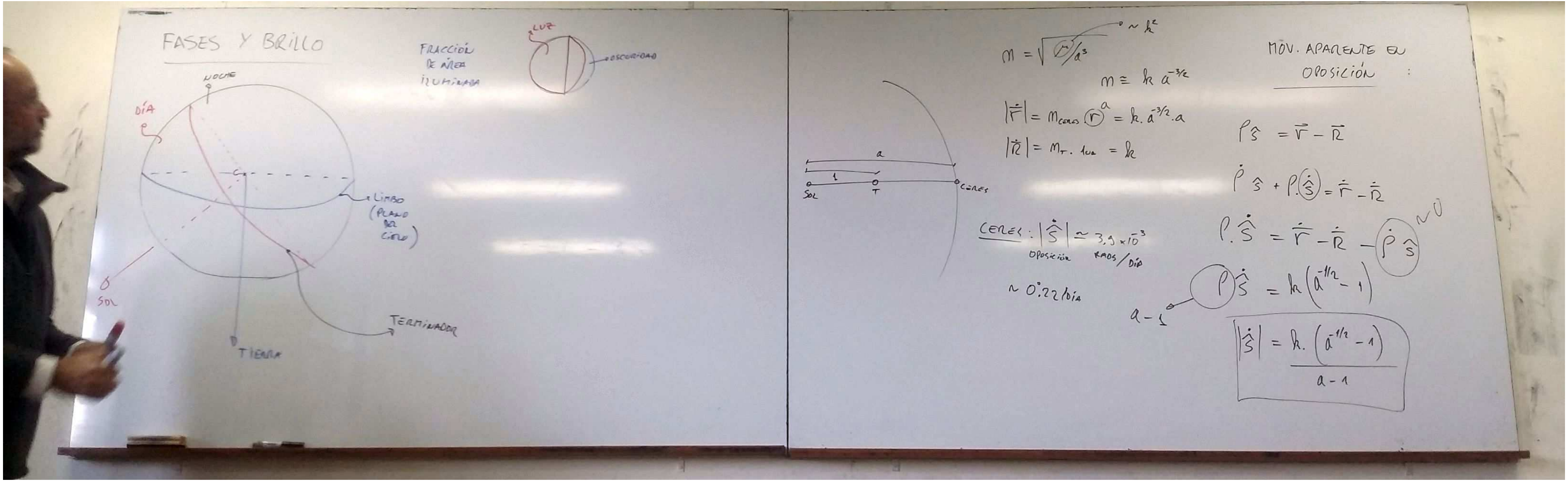


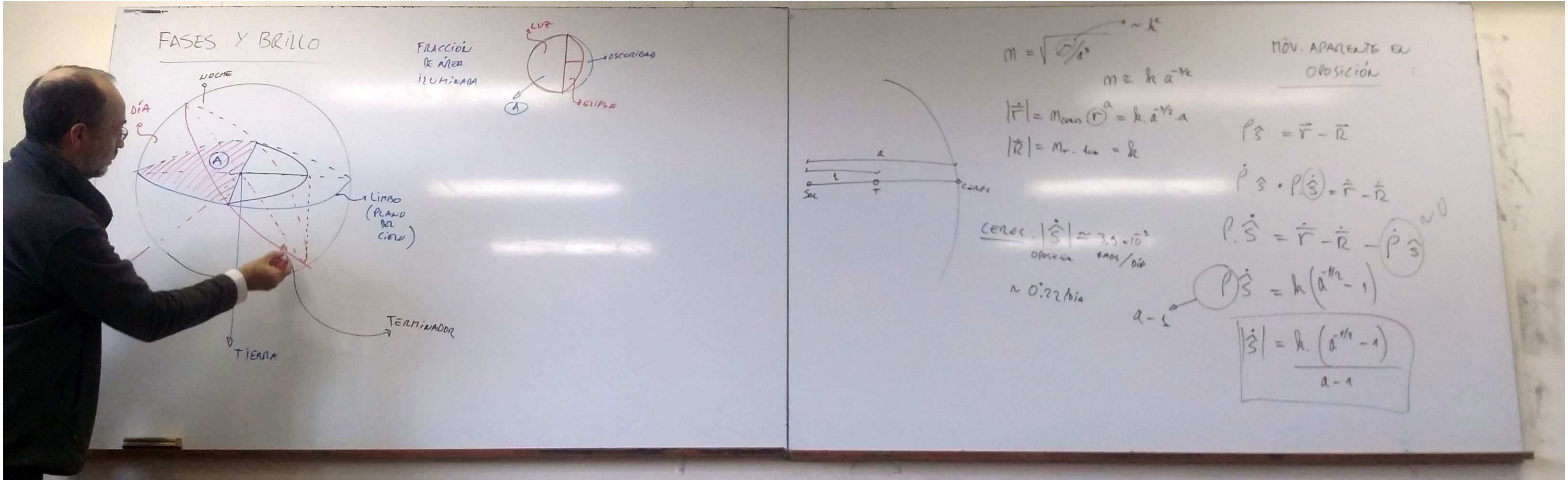
Astronomia Fundamental 2017



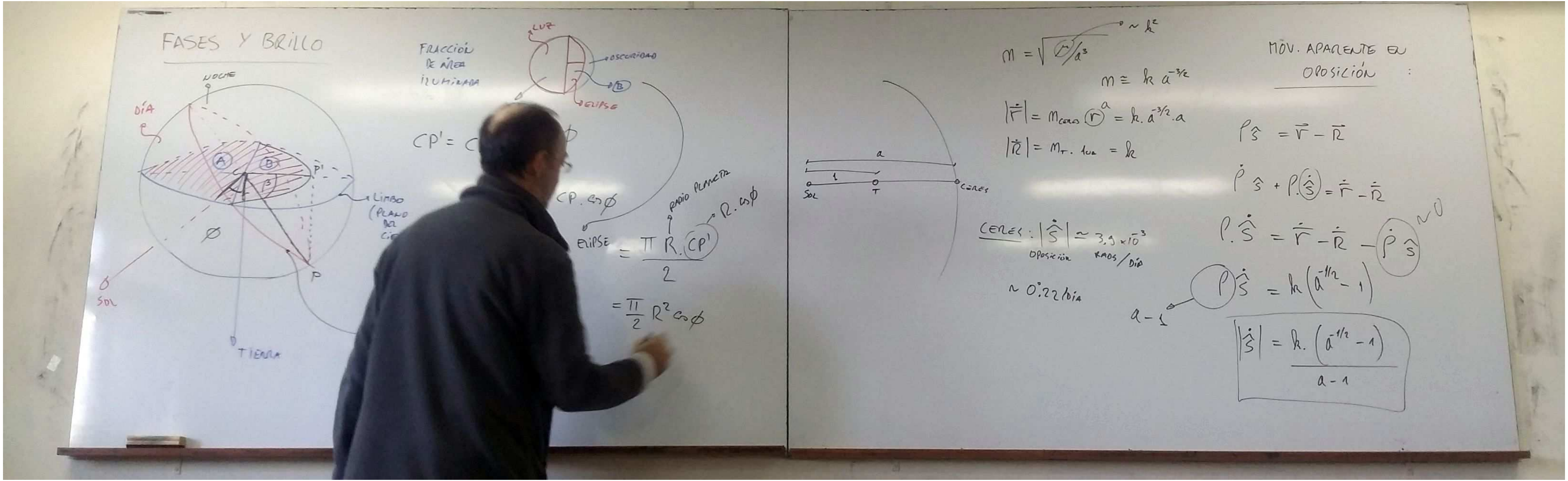

FASES Y BRILLO
MOV. APARENTE EN OPOSICIÓN
SOL
T
CERES
CERES : |ŝ| ~ 3,9 × 10⁻³ RADS / DÍA
OPOSICIÓN
~ 0°,22 / DÍA

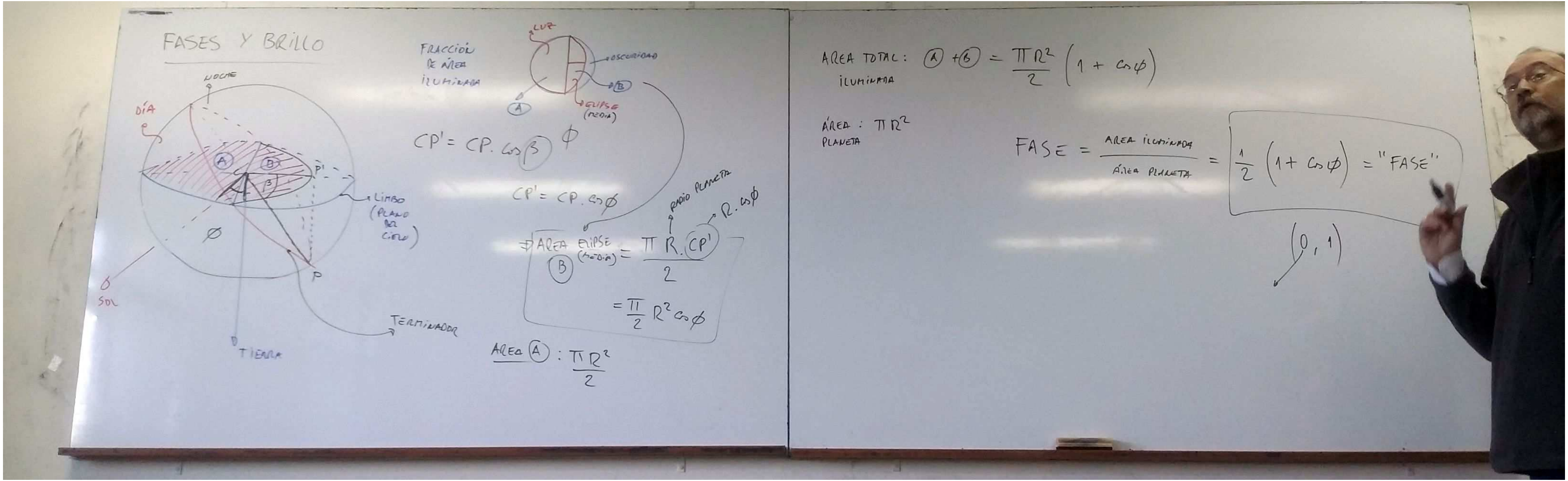

FASES Y BRI
NOCHE
DÍA
SOL
TERMINADOR
MOV. APARENTE EN OPOSICIÓN
a
1
SOL
T
CERES
CERES: |ṡ| ≃ 3,9 × 10⁻³
OPOSICIÓN
RADS / DÍA
~ 0°22 / DÍA
a − 1

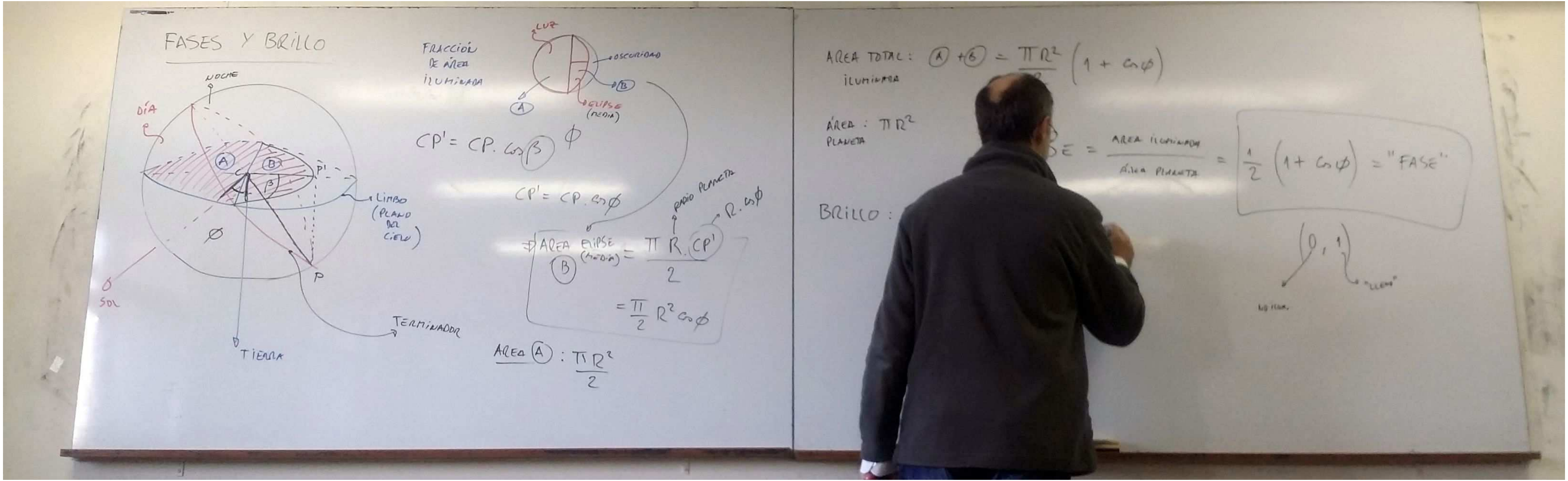

FASES Y BRILLO
FRACCIÓN DE ÁREA ILUMINADA
LUZ
OSCURIDAD
NOCHE
DÍA
LIMBO (PLANO DEL CIELO)
SOL
TIERRA
TERMINADOR
MÓV. APARENTE EN OPOSICIÓN
CERES : |ṡ| ≃ 3,9 × 10⁻³ RADS / DÍA
OPOSICIÓN
~ 0°.22 /DÍA
SOL
T
CERES
a
1
a − 1

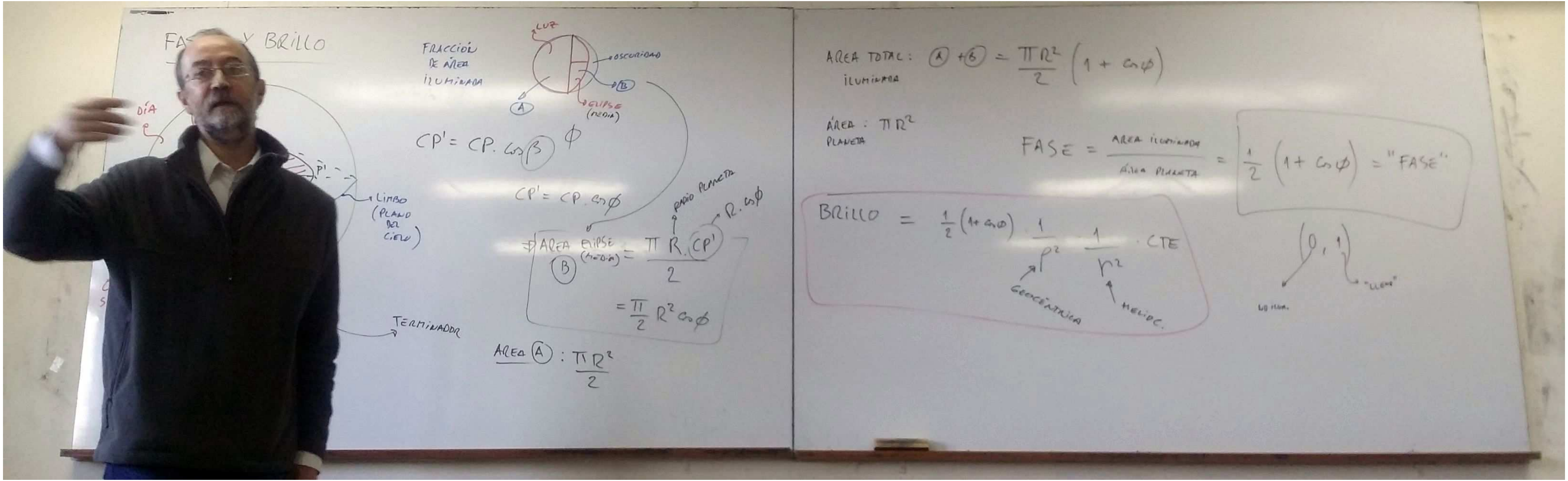

FASES Y BRILLO
FRACCIÓN DE ÁREA ILUMINADA
LUZ
OSCURIDAD
ECLIPSE
NOCHE
DÍA
LIMBO (PLANO DEL CIELO)
TERMINADOR
TIERRA
MOV. APARENTE EN OPOSICIÓN
Sol
T
Ceres

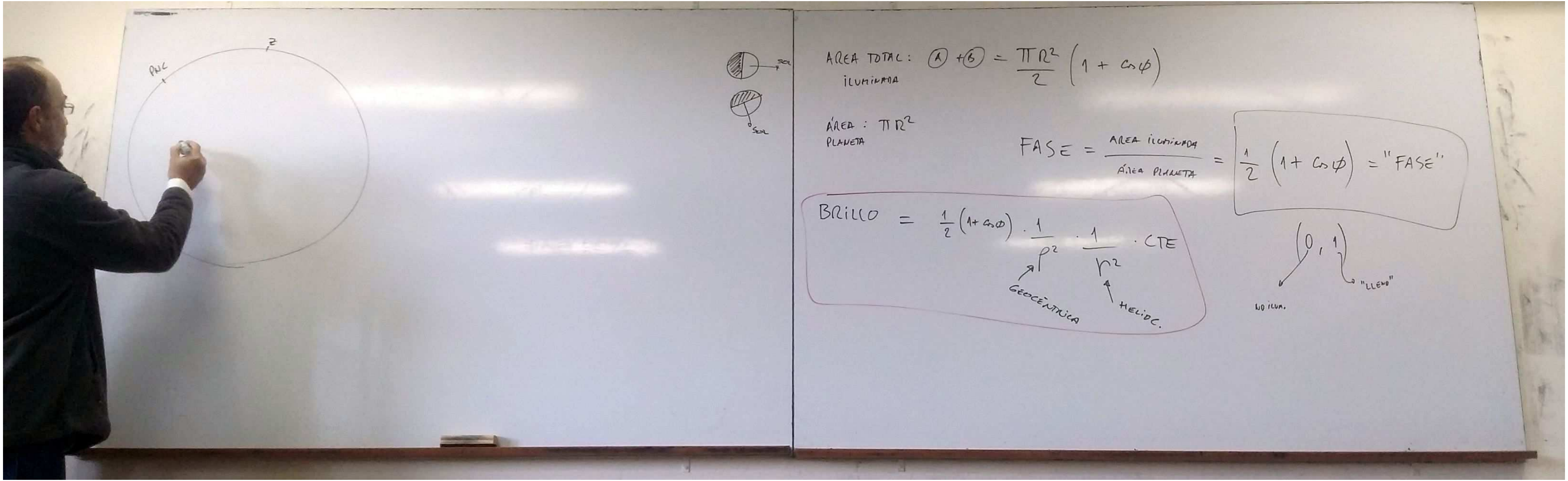
Astronomia Fundamental 2017

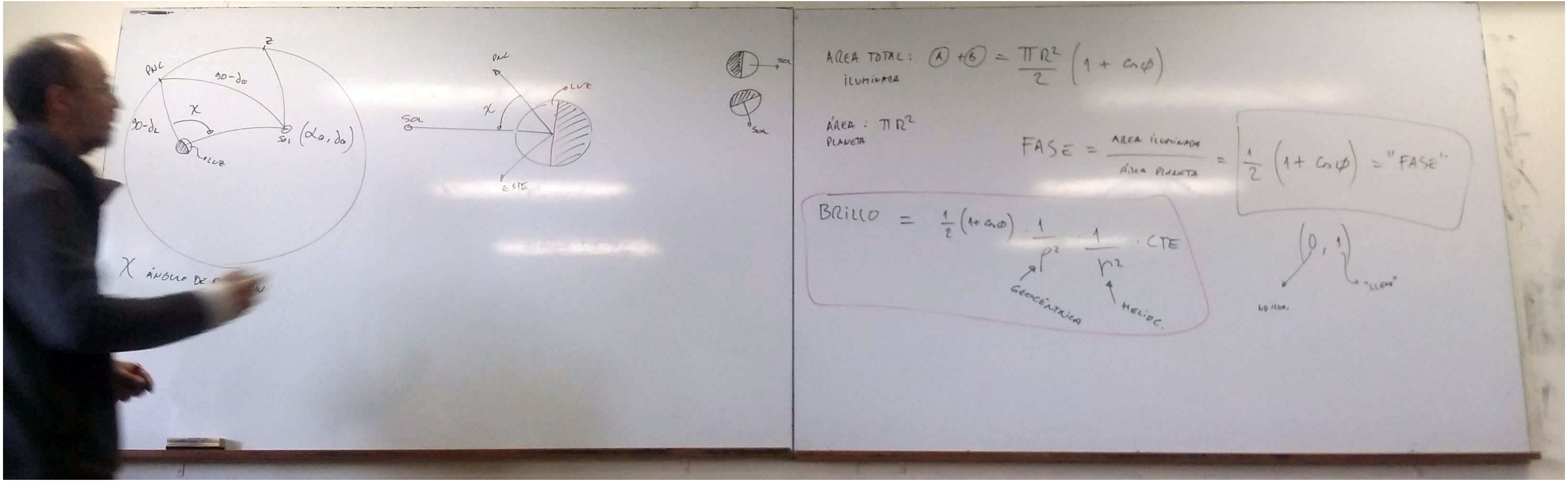



FASES Y BRILLO
NOCHE
DÍA
LIMBO (PLANO DEL CIELO)
SOL
TIERRA
TERMINADOR
FRACCIÓN DE ÁREA ILUMINADA
LUZ
OSCURIDAD
ELIPSE (MEDIA)
CP' = CP. cos β
CP' = CP. cos φ
RADIO PLANETA
R. cos φ
ÁREA ELIPSE (MEDIA) = π R. CP' / 2
= π/2 R² cos φ
ÁREA (A) : π R² / 2
ÁREA TOTAL ILUMINADA : (A) + (B) = π R² / 2 (1 + cos φ)
ÁREA PLANETA : π R²
FASE = ÁREA ILUMINADA / ÁREA PLANETA = 1/2 (1 + cos φ) = "FASE"
(0, 1)


FASES Y BRILLO
NOCHE
DÍA
SOL
TIERRA
LIMBO (PLANO DEL CIELO)
TERMINADOR
P
P'
FRACCIÓN DE ÁREA ILUMINADA
LUZ
OSCURIDAD
ELIPSE (MEDIA)
CP' = CP. Cos β
CP' = CP. Cos φ
ÁREA ELIPSE (MEDIA) = π R. CP' / 2
RADIO PLANETA
R. cos φ
= π/2 R² cos φ
ÁREA A : π R² / 2
ÁREA TOTAL ILUMINADA : A + B = π R² / 2 (1 + cos φ)
ÁREA PLANETA : π R²
ÁREA ILUMINADA / ÁREA PLANETA = 1/2 (1 + cos φ) = "FASE"
BRILLO :
(0 , 1)
"LLENO"

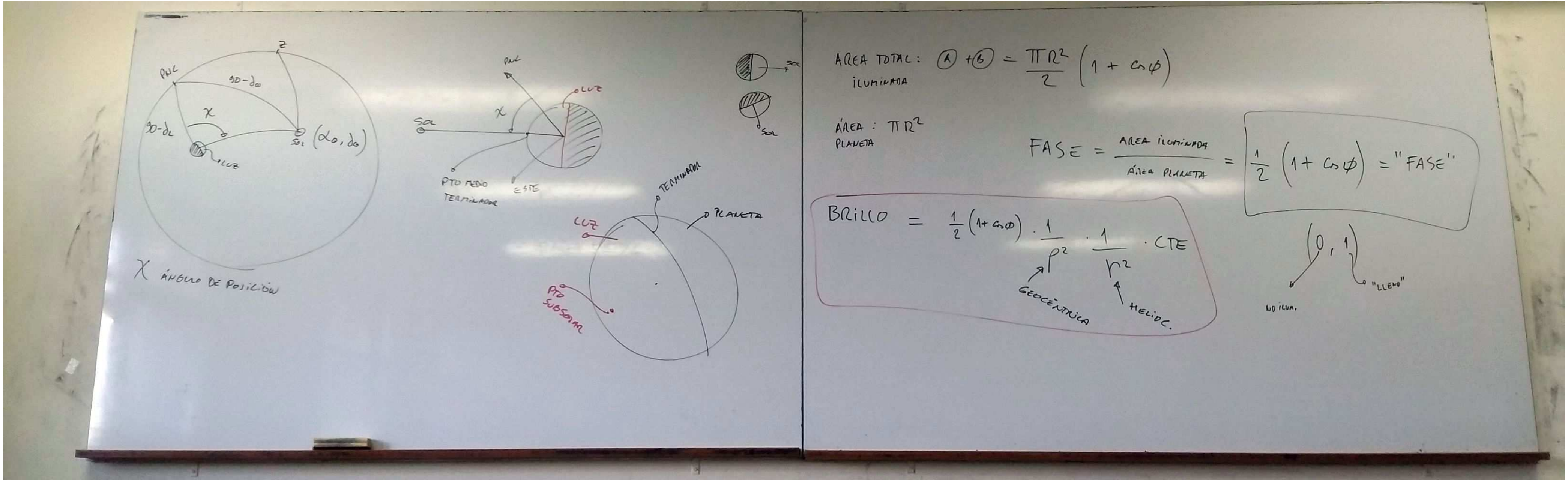

Y BRILLO
DÍA
LIMBO (PLANO DEL CIELO)
TERMINADOR
FRACCIÓN DE ÁREA ILUMINADA
LUZ
OSCURIDAD
ELIPSE (MEDIA)
CP' = CP. cos β
CP' = CP . cos φ
RADIO PLANETA
R. cos φ
ÁREA ELIPSE (MEDIA) = π R. CP' / 2
= π/2 R² cos φ
ÁREA (A) : π R² / 2
ÁREA TOTAL ILUMINADA : (A) + (B) = π R² / 2 (1 + cos φ)
ÁREA PLANETA : π R²
FASE = ÁREA ILUMINADA / ÁREA PLANETA = 1/2 (1 + cos φ) = "FASE"
BRILLO = 1/2 (1 + cos φ) 1/ρ² 1/r² · CTE
GEOCÉNTRICA
HELIOC.
(0, 1)
"LLENO"

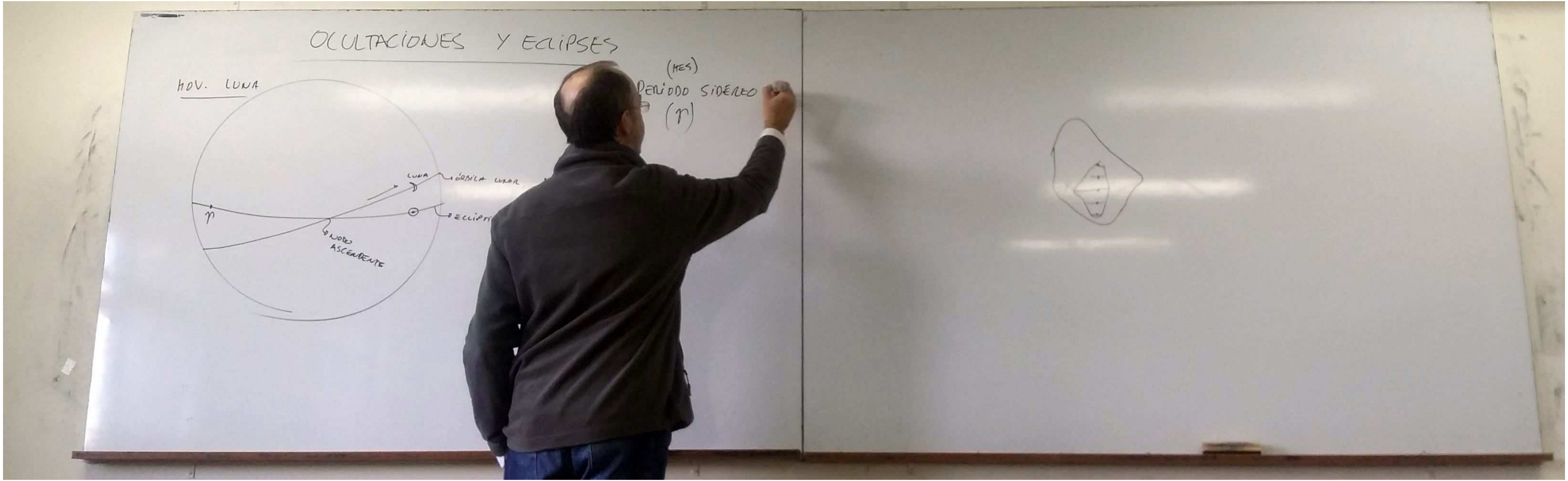

PNC
Z
SOL
SOL
AREA TOTAL : (A) + (B) = πR² / 2 (1 + cos φ)
ILUMINADA
ÁREA : πR²
PLANETA
FASE = AREA ILUMINADA / ÁREA PLANETA = 1/2 (1 + cos φ) = "FASE"
BRILLO = 1/2 (1+ cos φ) · 1/ρ² · 1/r² · CTE
GEOCÉNTRICA
HELIOC.
(0 , 1)
NO ILUM.
"LLENO"

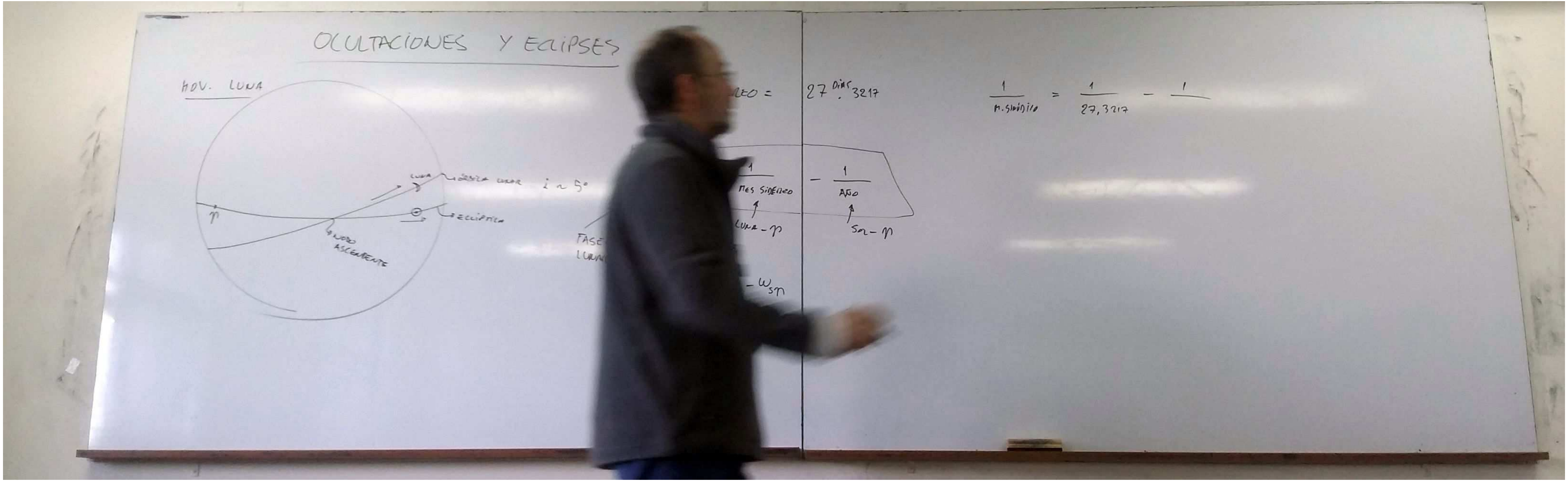


Z
PNC
90 − δ⊙
χ
90 − δL
SOL
(α⊙, δ⊙)
LUZ
χ ÁNGULO DE
PNC
LUZ
SOL
χ
ESTE
SOL
SOL
ÁREA TOTAL: ILUMINADA (A) + (B) = πR²/2 (1 + cos φ)
ÁREA PLANETA : πR²
FASE = ÁREA ILUMINADA / ÁREA PLANETA = 1/2 (1 + cos φ) = "FASE"
(0, 1)
"LLENO"
BRILLO = 1/2 (1 + cos φ) · 1/ρ² · 1/r² · CTE
GEOCÉNTRICA
HELIOC.

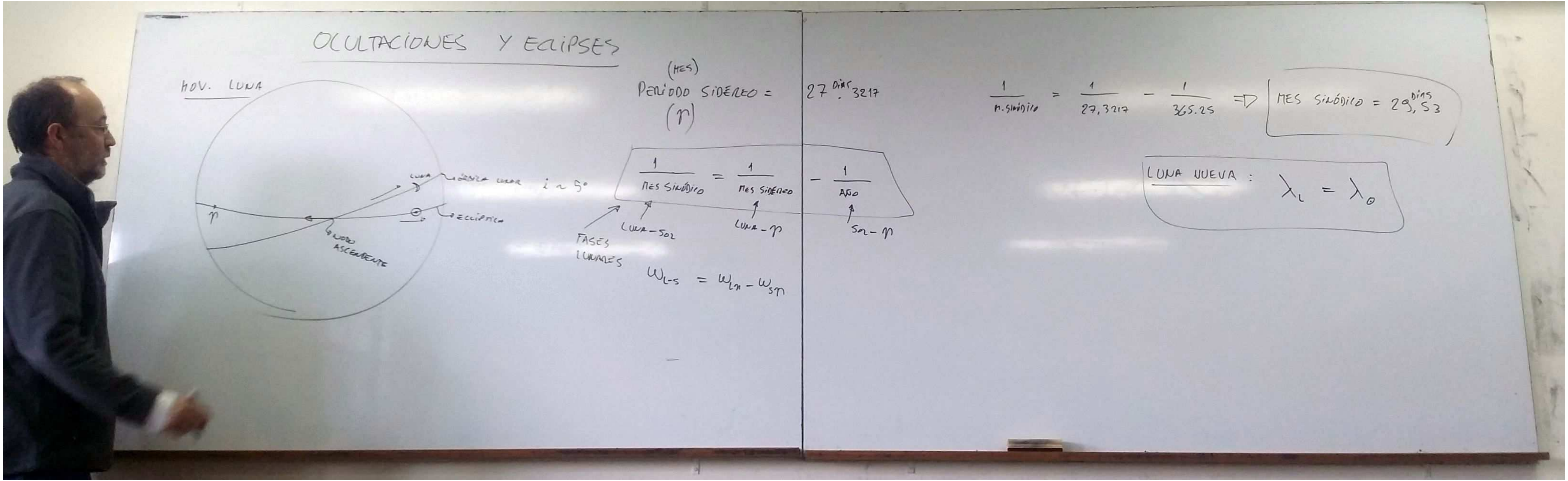
Astronomia Fundamental 2017



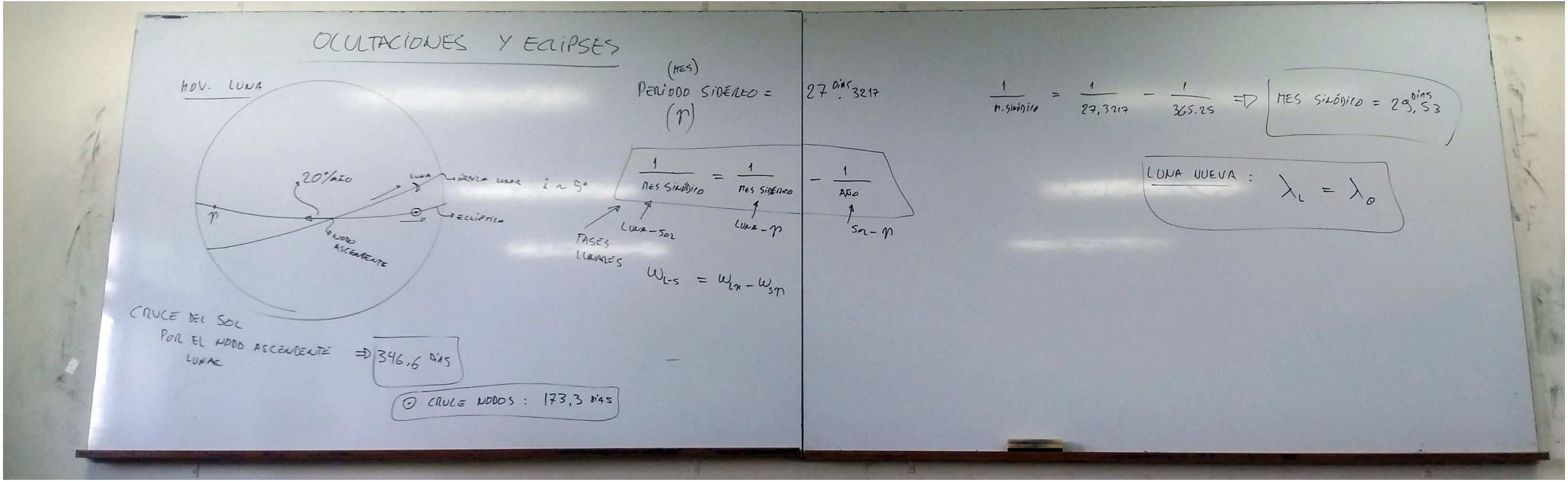

OCULTACIONES Y ECLIPSES
MOV. LUNA
(MES)
PERIODO SIDEREO
LUNA
ÓRBITA LUNAR
NODO ASCENDENTE


OCULTACIONES Y ECLIPSES
MOV. LUNA
NODO ASCENDENTE
ECLÍPTICA
FASE
MES SIDÉREO
AÑO
27 DÍAS ,3217
M. SINÓDICO
27,3217

Astronomia Fundamental 2017

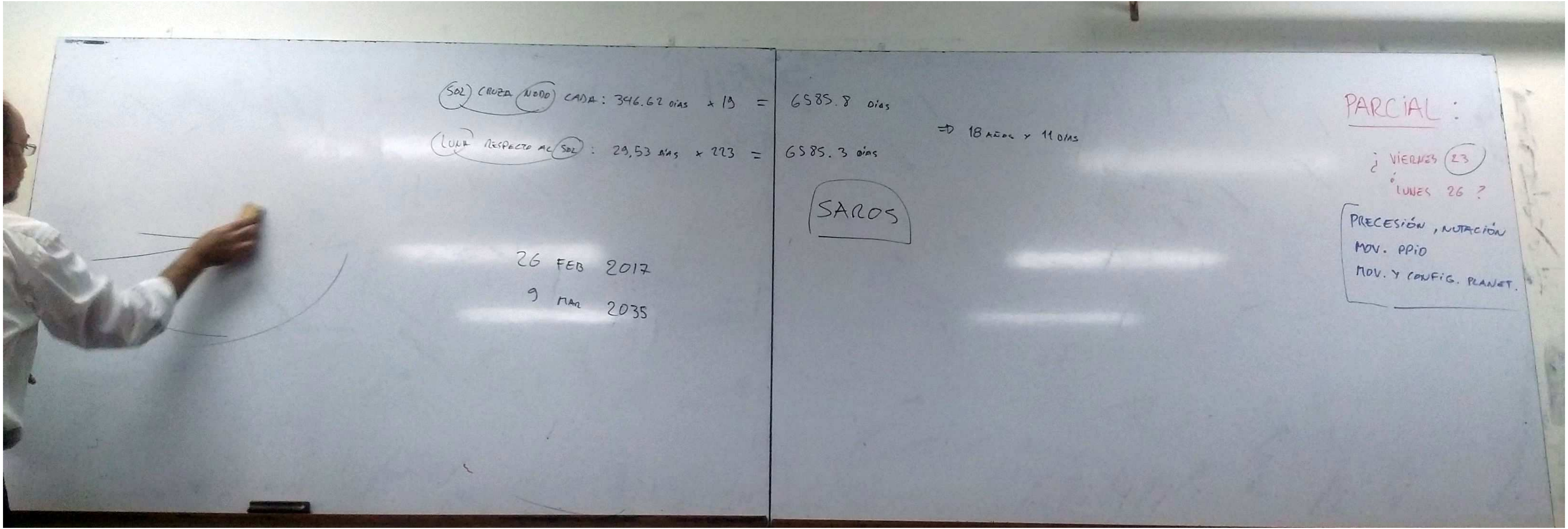


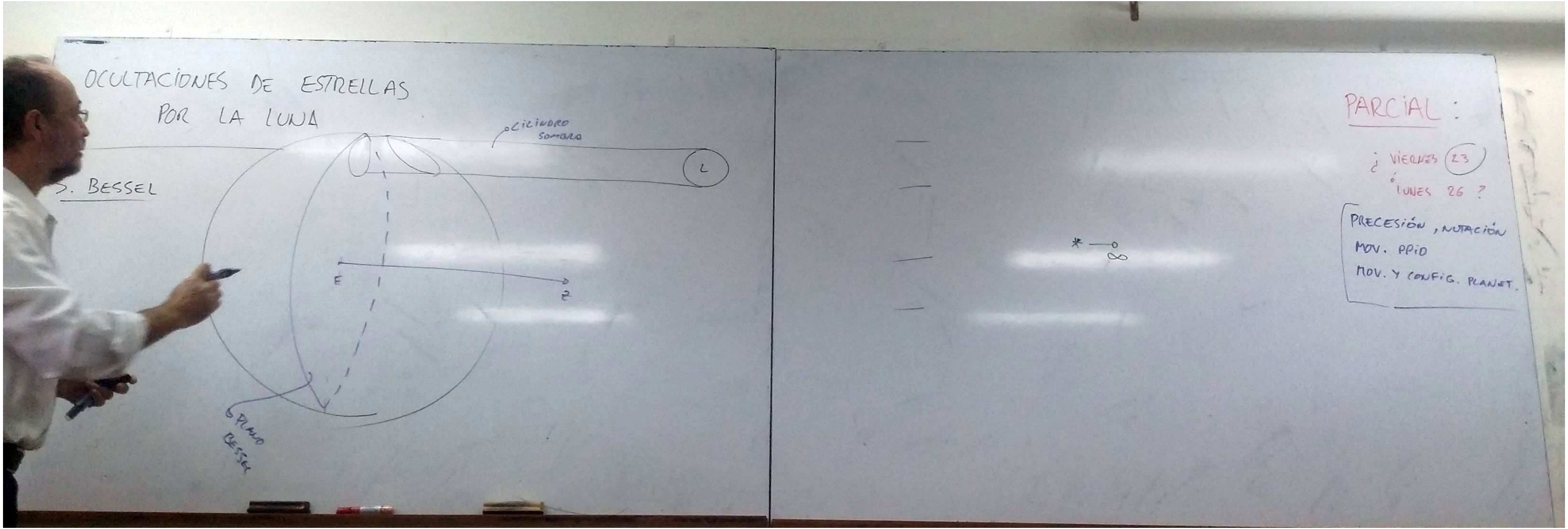
Astronomia Fundamental 2017



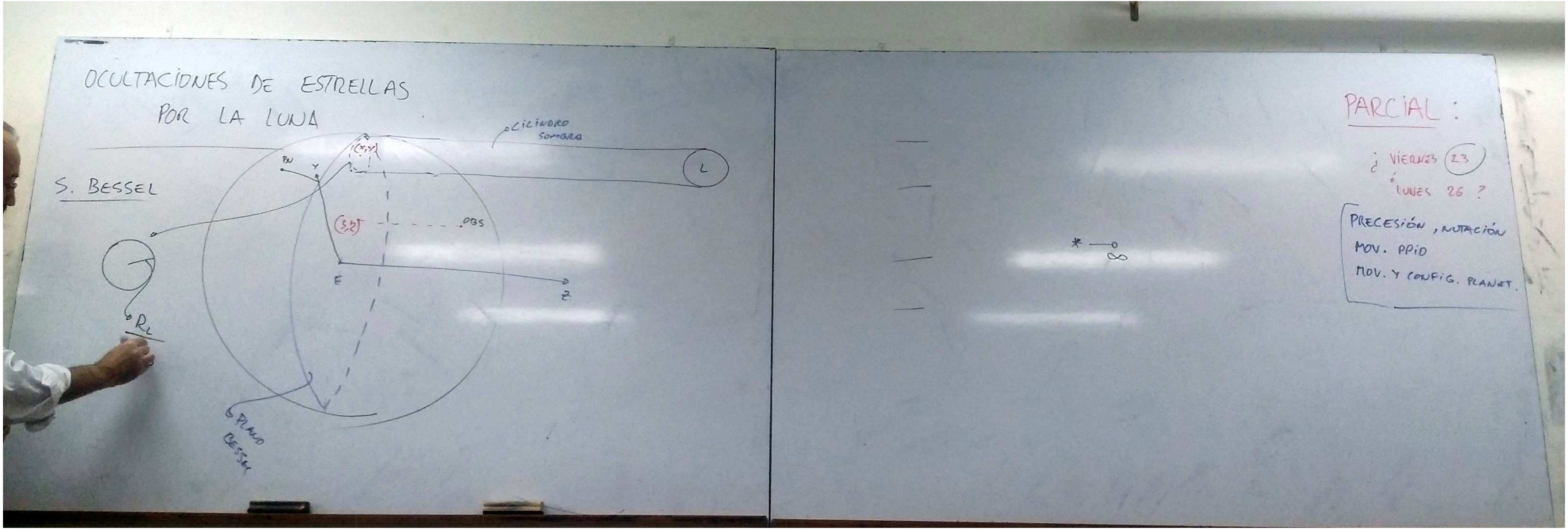
Astronomia Fundamental 2017

Astronomia Fundamental 2017

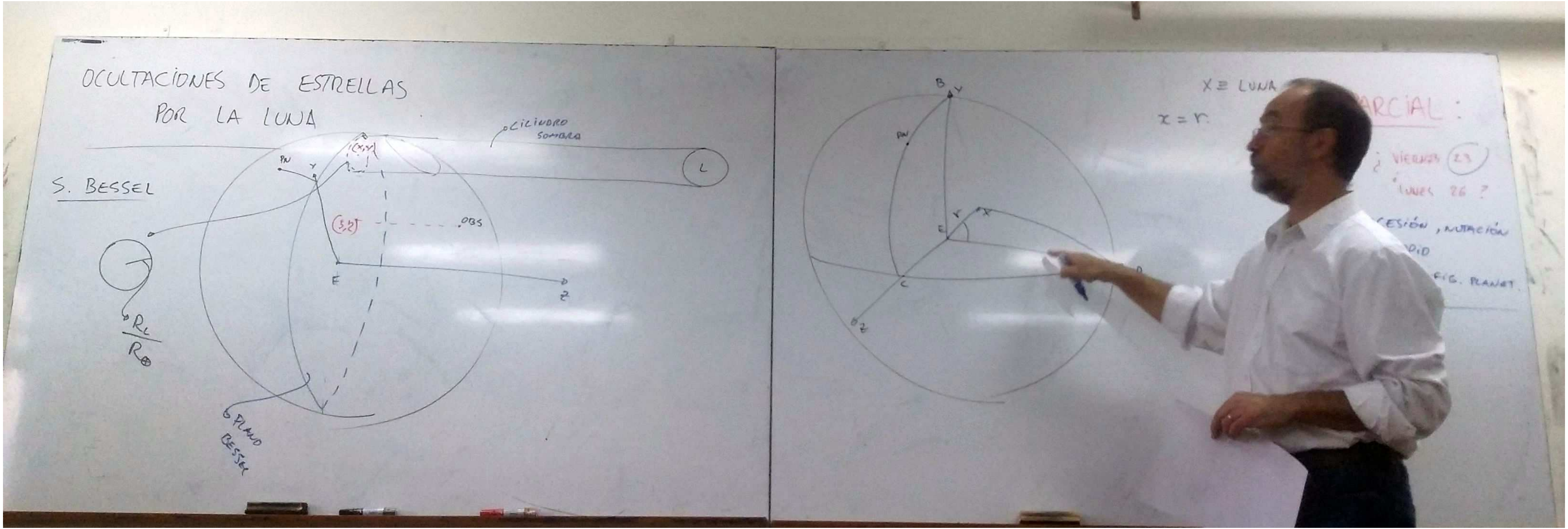


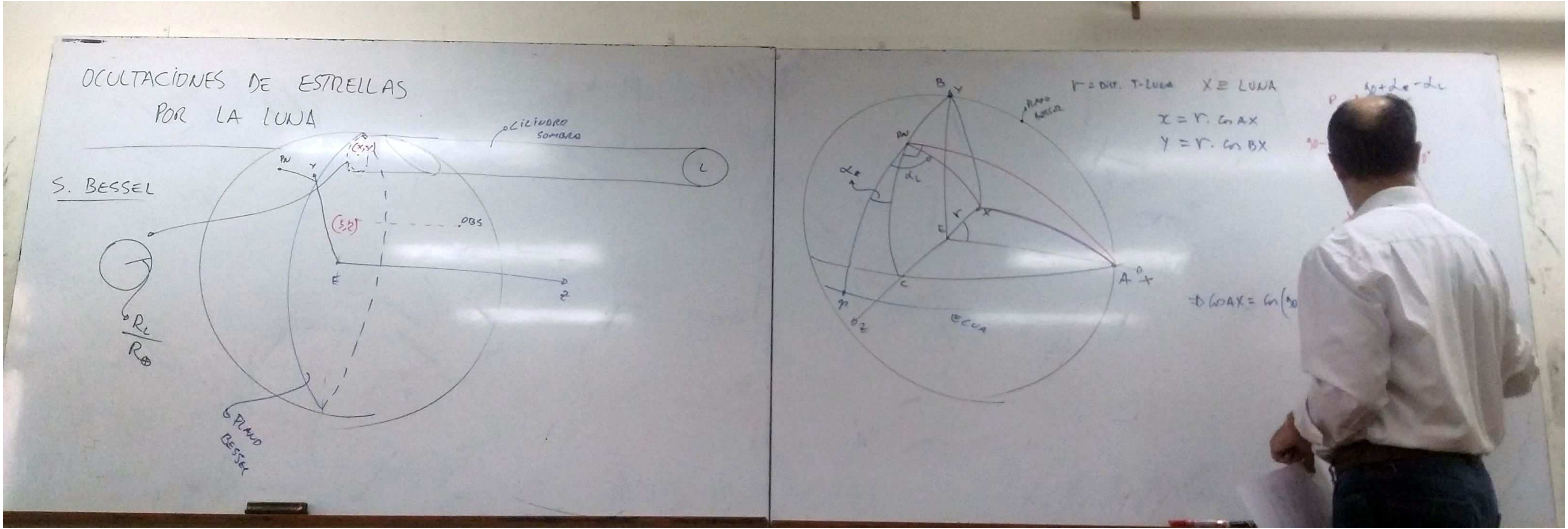

OCULTACIONES DE ESTRELLAS
POR LA LUNA
S. BESSEL
CILINDRO SOMBRA
L
E
Z
PLANO BESSEL
PARCIAL:
¿ VIERNES 23
¿ LUNES 26 ?
PRECESIÓN, NUTACIÓN
MOV. PPIO
MOV. Y CONFIG. PLANET.

Astronomia Fundamental 2017

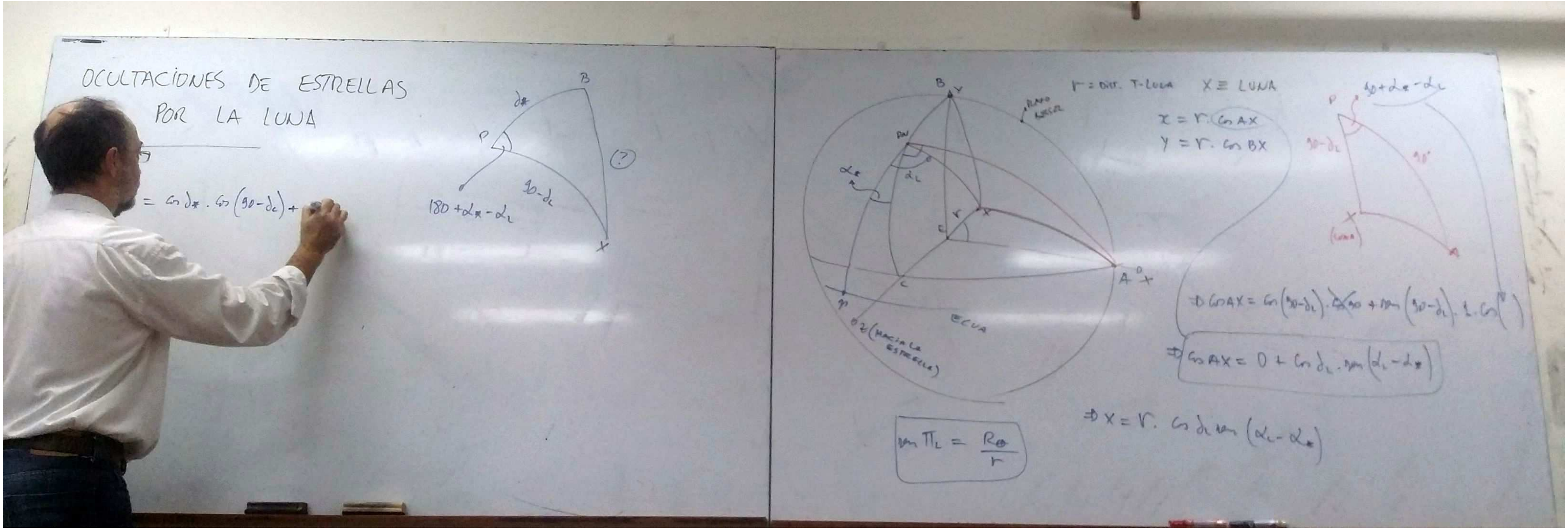


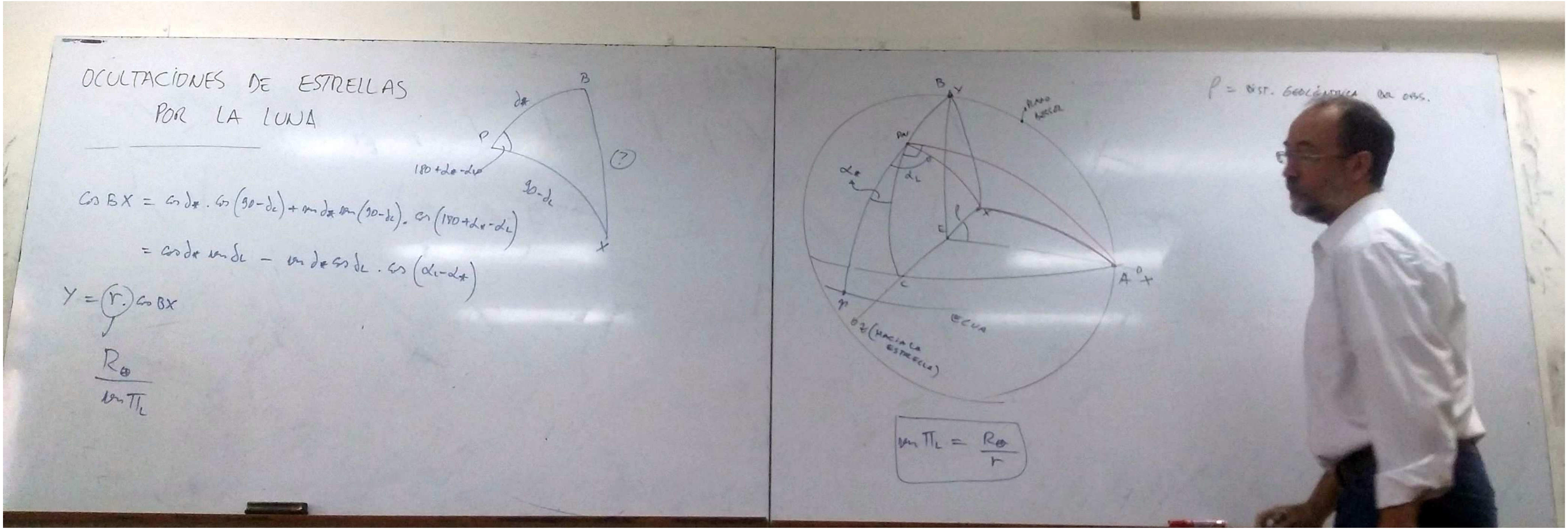
Astronomia Fundamental 2017

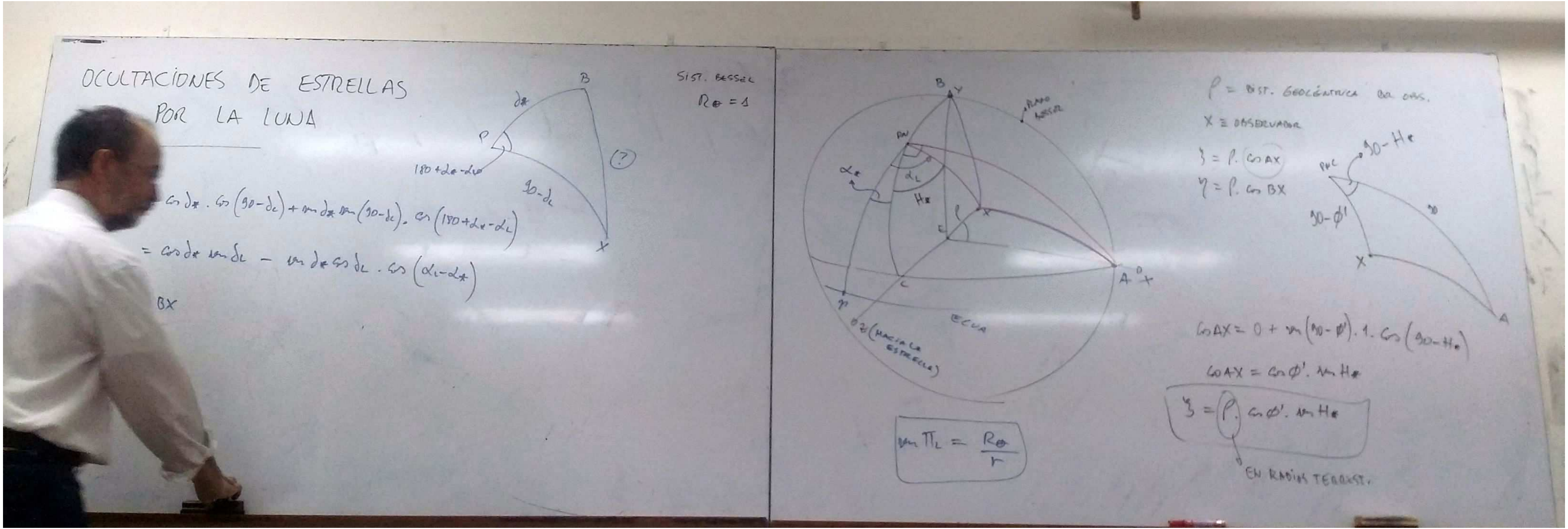


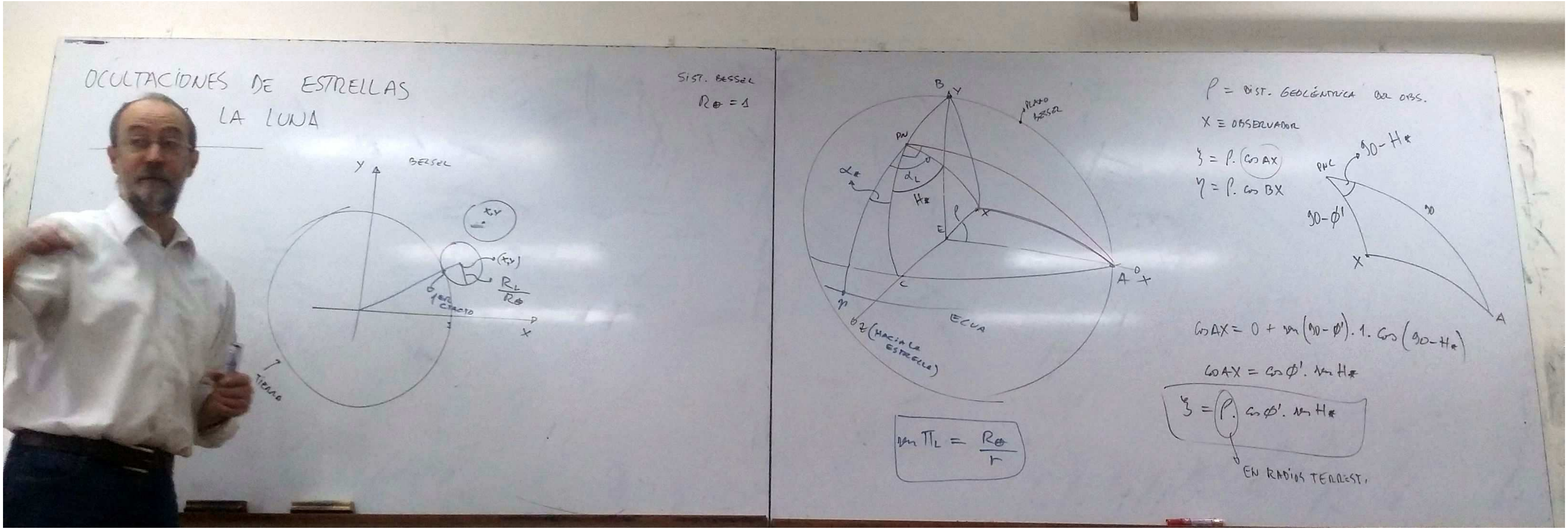


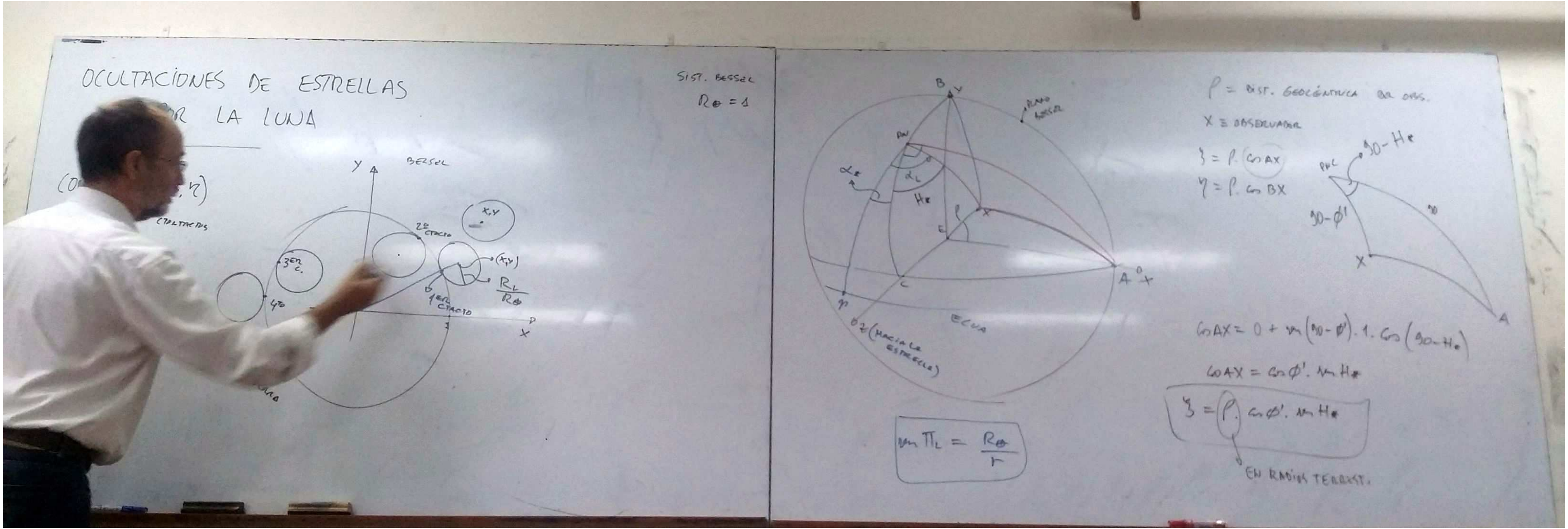
OCULTACIONES DE ESTRELLAS POR LA LUNA
S. BESSEL
CILINDRO SOMBRA
PLANO BESSEL
OBS
x = r. cos AX
y = r. cos BX
X ≡ LUNA
ECUA

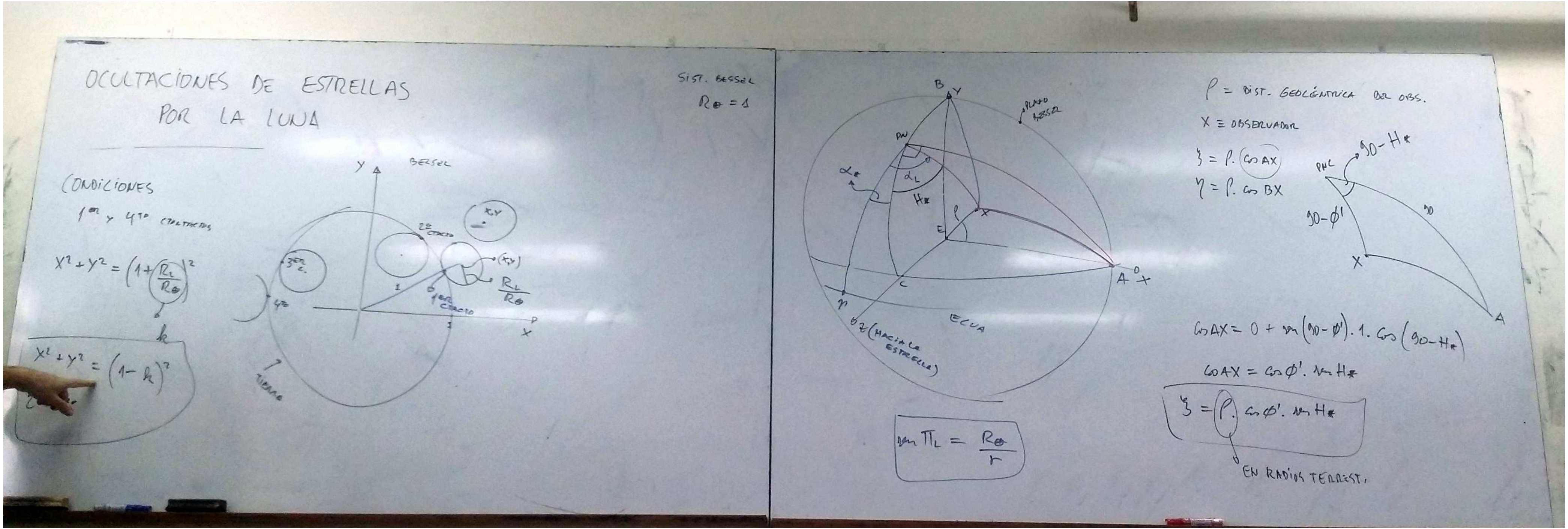

OCULTACIONES DE ESTRELLAS POR LA LUNA
= cos δ* . cos (90 − δL) +
180 + α* − αL
90 − δL
r = DIST. T-LUNA
X ≡ LUNA
x = r . cos AX
y = r . cos BX
ECUA
⇒ cos AX = cos δL . sen (αL − α*)
⇒ x = r . cos δL sen (αL − α*)
sen ΠL = R⊕ / r

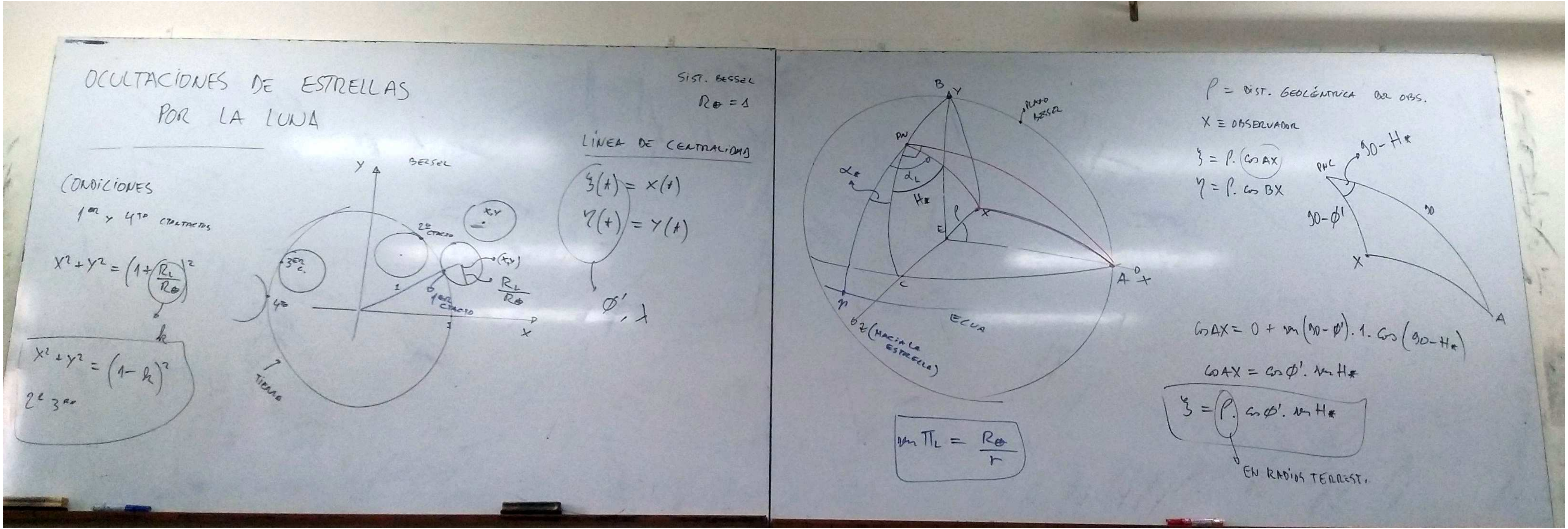

OCULTACIONES DE ESTRELLAS
POR LA LUNA
B
P
X
180 + α* − αL
90 − δL
δ*
cos BX = cos δ* . cos (90 − δL) + sen δ* sen (90 − δL) . cos (180 + α* − αL)
= cos δ* sen δL − sen δ* cos δL . cos (αL − α*)
Y = (r.) cos BX
R⊕
sen πL
ρ = DIST. GEOCÉNTRICA DEL OBS.
PLANO BESSEL
ECUA
sen πL = R⊕ / r

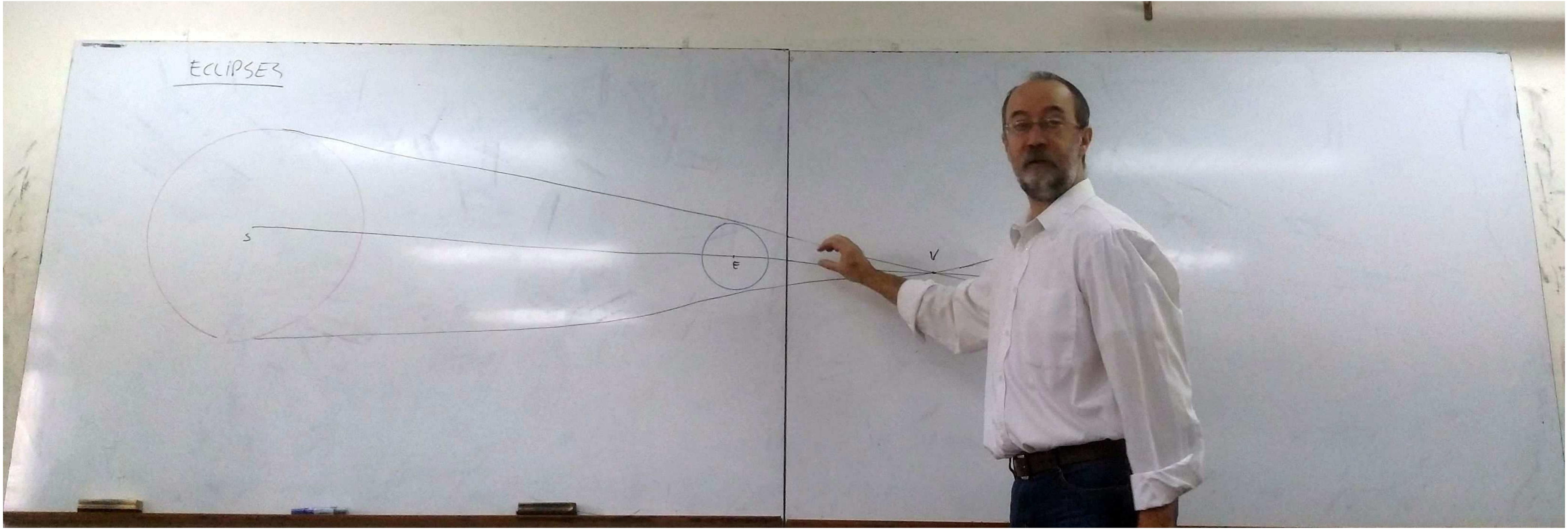

OCULTACIONES DE ESTRELLAS
POR LA LUNA
SIST. BESSEL
BX
ECUA
EN RADIOS TERREST.

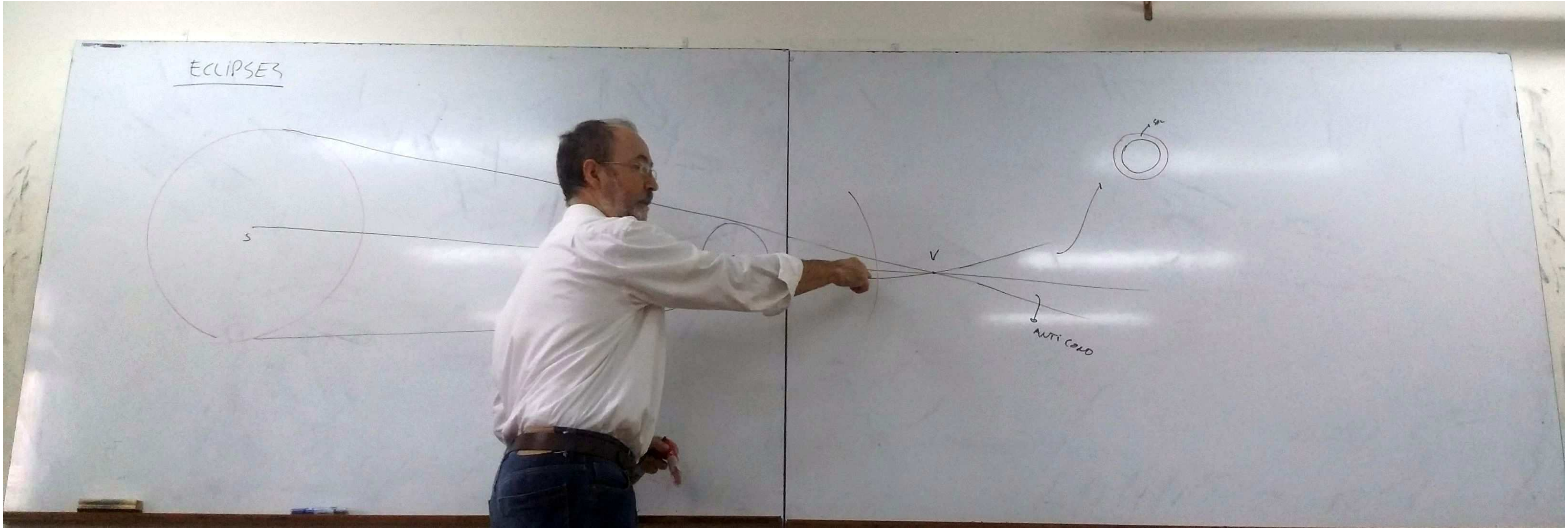

OCULTACIONES DE ESTRELLAS
LA LUNA
SIST. BESSEL
$R_\oplus = 1$
BESSEL
Y
X
$R_L / R_\oplus$
1er CONTACTO
TIERRA
B Y
PLANO BESSEL
PN
α_*
α_L
H_*
ρ
E
X
A X
C
ECUA
η
Z (HACIA LA ESTRELLA)
$\text{sen}\, \Pi_L = \frac{R_\oplus}{r}$
ρ = DIST. GEOCÉNTRICA DEL OBS.
X ≡ OBSERVADOR
$\xi = \rho . \cos AX$
$\eta = \rho . \cos BX$
PNC
$90 - H_*$
$90 - \phi'$
90
A
$\cos AX = 0 + \text{sen}(90-\phi') . 1 . \cos(90 - H_*)$
$\cos AX = \cos\phi' . \text{sen} H_*$
$\xi = \rho . \cos\phi' . \text{sen} H_*$
EN RADIOS TERREST.


OCULTACIONES DE ESTRELLAS
OR LA LUNA
SIST. BESSEL
R⊕ = 1
BESSEL
Y
X
2do CTACTO
1er CTACTO
3er C.
4to
(x,y)
x,y
RL / R⊕
B
Y
A
X
PLANO BESSEL
C
ρ
HL
αL
ECUA
Z (HACIA LA ESTRELLA)
ρ = DIST. GEOCÉNTRICA DEL OBS.
X ≡ OBSERVADOR
ξ = ρ. cos AX
η = ρ. cos BX
90 - H
90 - φ'
90
cos AX = 0 + sen (90 - φ'). 1. cos (90 - H)
cos AX = cos φ'. sen H
ξ = ρ. cos φ'. sen H
EN RADIOS TERREST.
sen ΠL = R⊕ / r

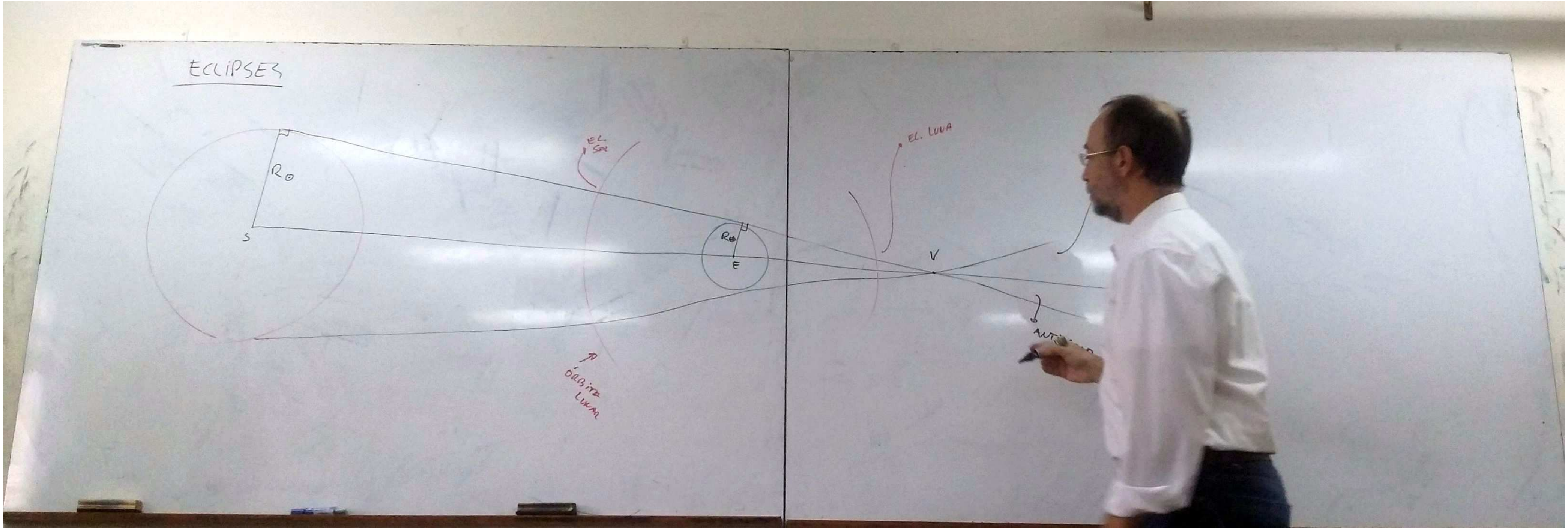

OCULTACIONES DE ESTRELLAS
POR LA LUNA
SIST. BESSEL
CONDICIONES
1er y 4to CONTACTOS
EN RADIOS TERREST.
ECUA
PLANO BESSEL
ρ = DIST. GEOCÉNTRICA DEL OBS.
X ≡ OBSERVADOR

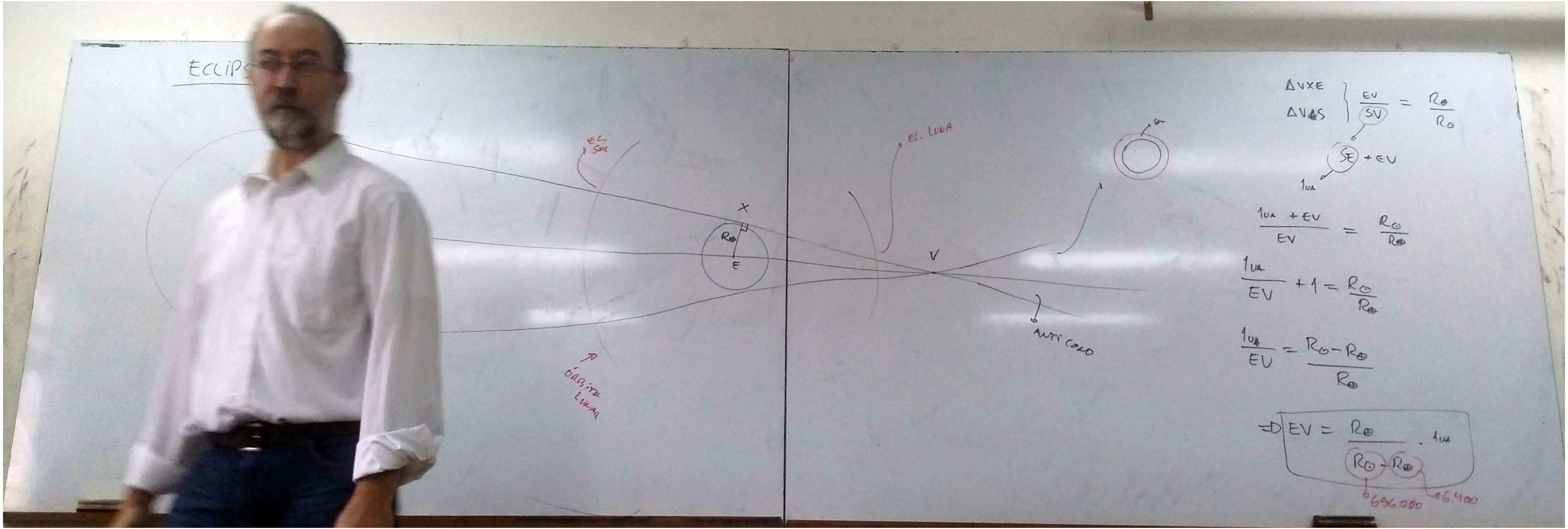

OCULTACIONES DE ESTRELLAS POR LA LUNA
SIST. BESSEL
CONDICIONES
1er y 4to CONTACTOS
LINEA DE CENTRALIDAD
BESSEL
2do CONTACTO
1er CONTACTO
3er c.
4to
TIERRA
EN RADIOS TERREST.
X ≡ OBSERVADOR
ECUA
A
B
C
E
PN
PNC
PLANO BESSEL
Z (HACIA LA ESTRELLA)

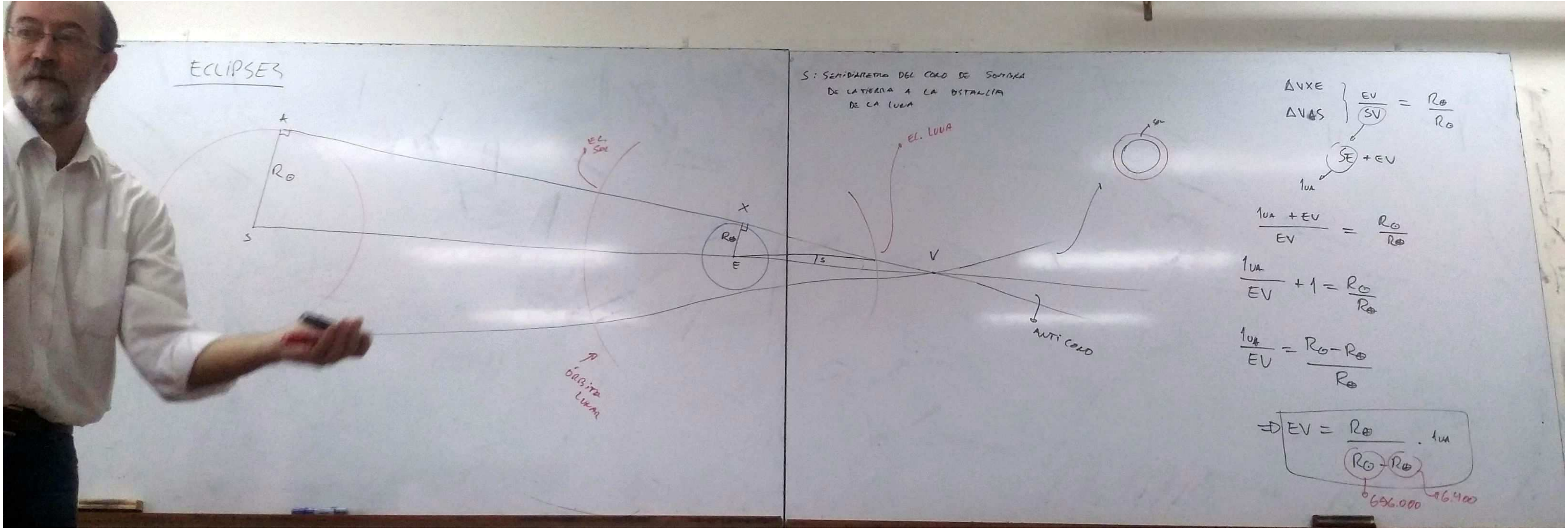

ECLIPSES
S
E
V


ECLIPSES
S
V
ANTI CONO

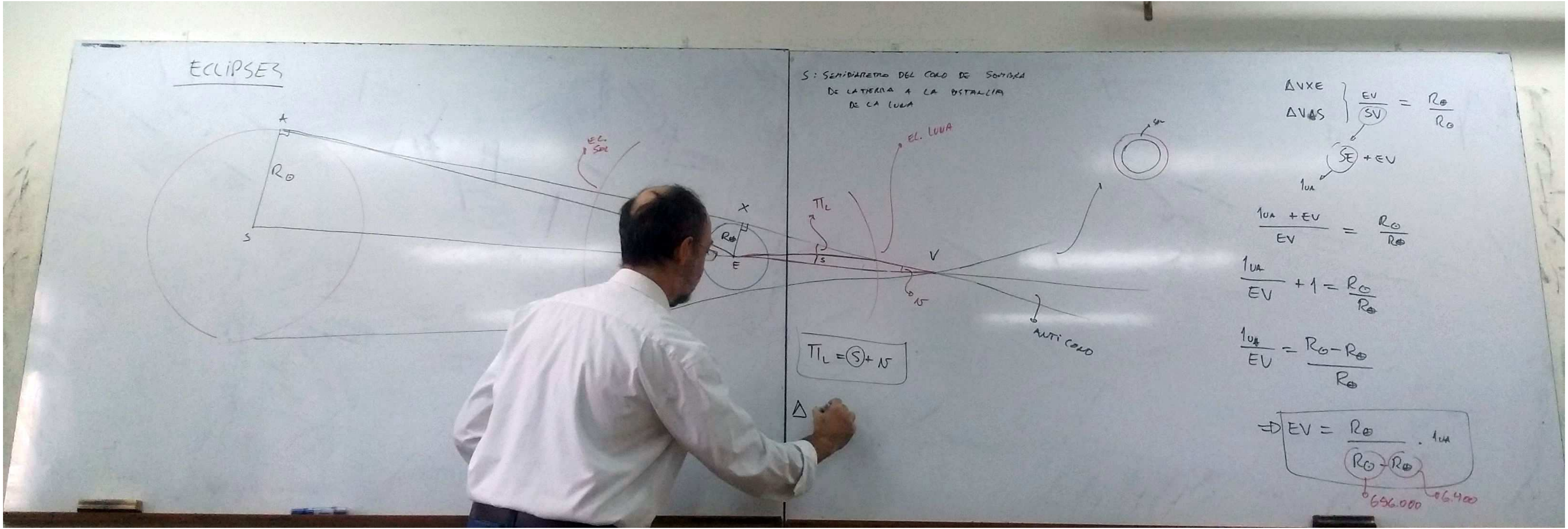
Astronomia Fundamental 2017

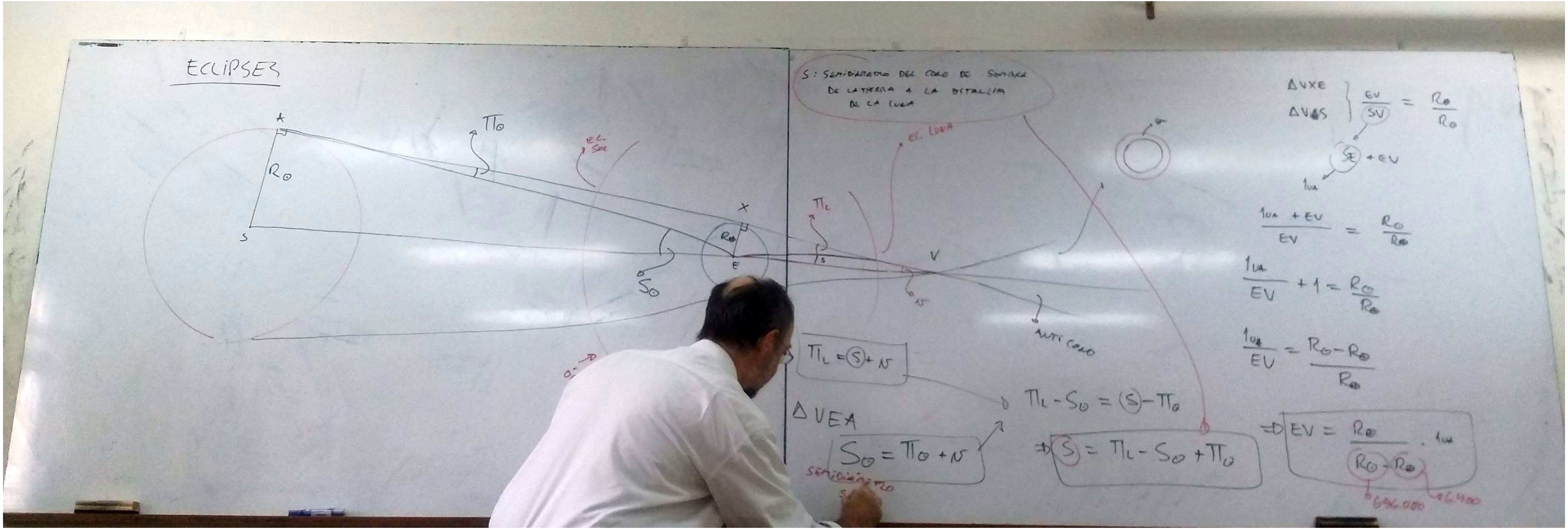


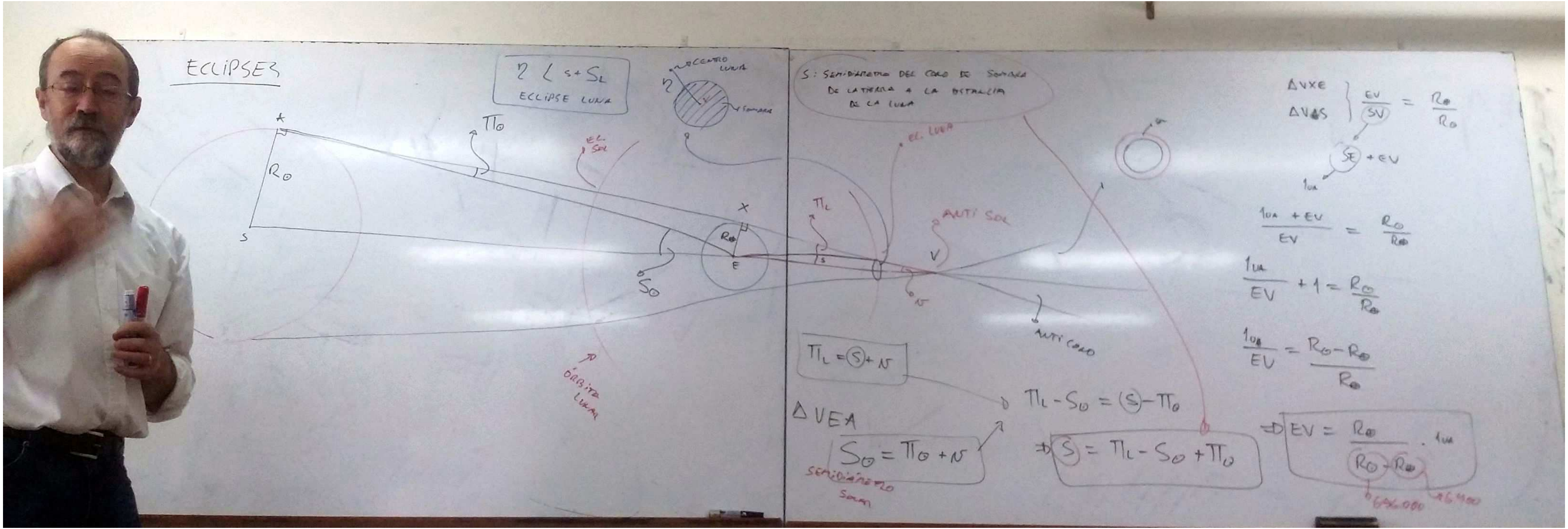

EL. SOL
ÓRBITA LUNAR
EL. LUNA
X
V
E
ANTI CONO
ΔVXE
1UA
EV
696.000
6.400


ECLIPSES
S: SEMIDIAMETRO DEL CONO DE SOMBRA
DE LA TIERRA A LA DISTANCIA
DE LA LUNA
EL. LUNA
ÓRBITA LUNAR
ANTI CONO
ΔVXE
ΔVAS
EV/SV = R⊕/R☉
SE + EV
1UA
(1UA + EV)/EV = R☉/R⊕
1UA/EV + 1 = R☉/R⊕
1UA/EV = (R☉ − R⊕)/R⊕
⇒ EV = R⊕/(R☉ − R⊕) · 1UA
696.000
6.400

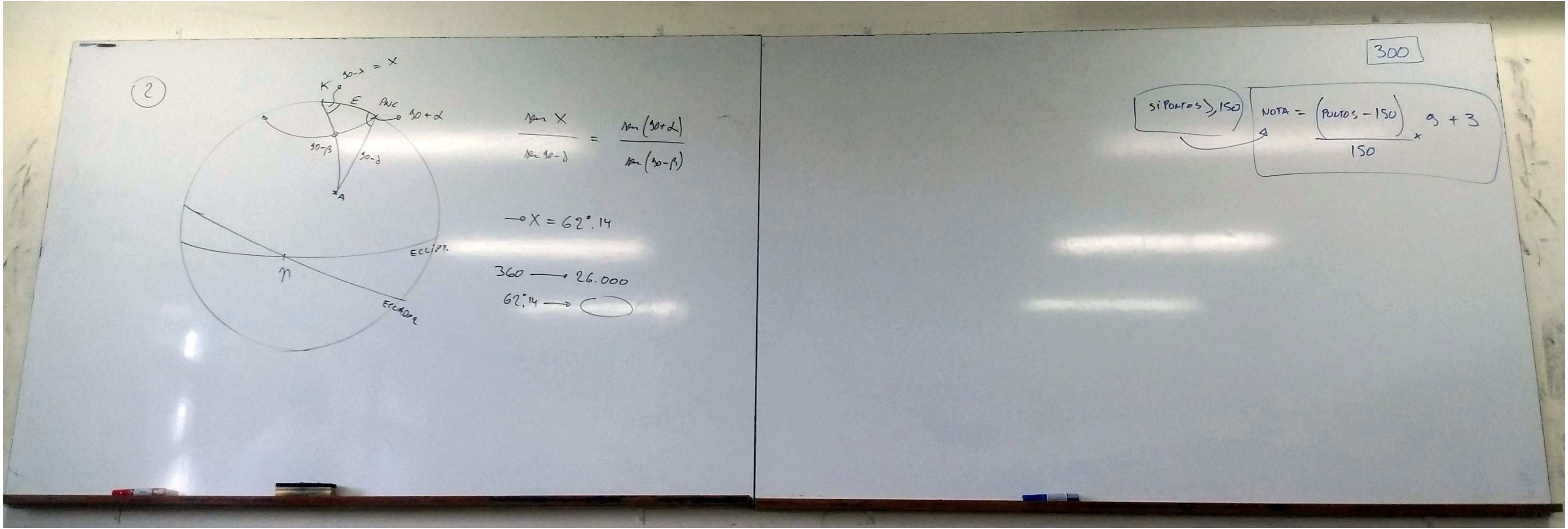
Astronomia Fundamental 2017

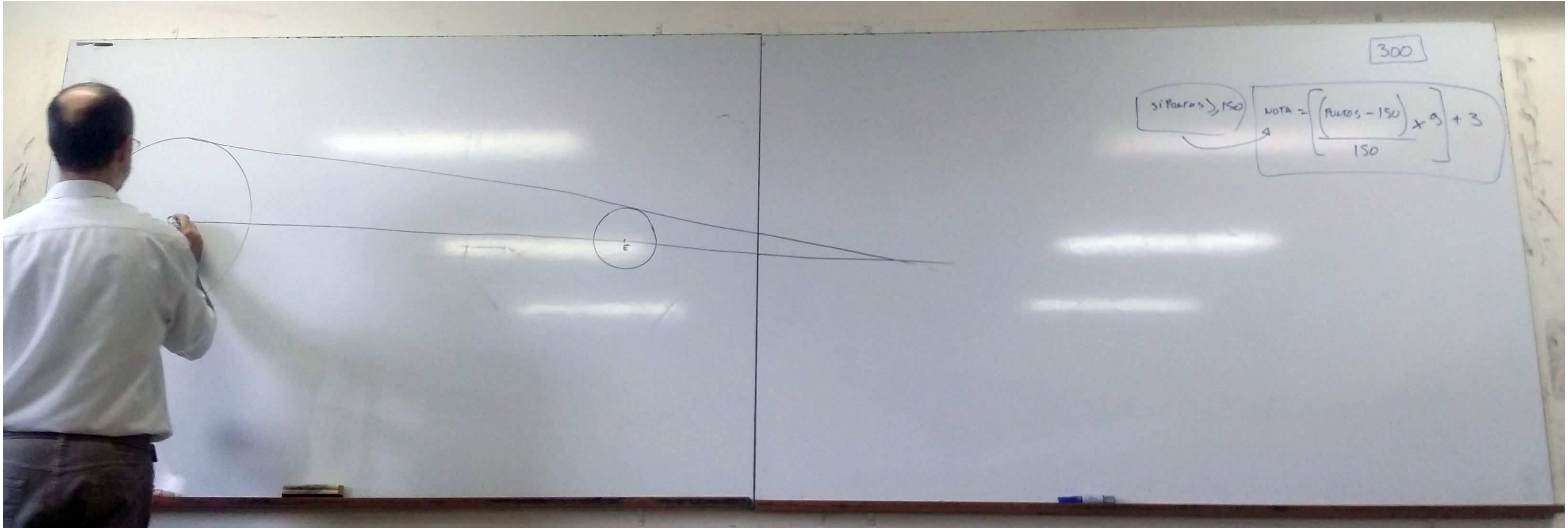



ECLIPSES
S: SEMIDIAMETRO DEL CONO DE SOMBRA DE LA TIERRA A LA DISTANCIA DE LA LUNA
ΔVXE
ΔVAS
EV / SV = R⊕ / R☉
1ua
1ua + EV / EV = R☉ / R⊕
1ua / EV + 1 = R☉ / R⊕
1ua / EV = R☉ − R⊕ / R⊕
⇒ EV = R⊕ / (R☉ − R⊕) . 1ua
696.000
6.400
ANTI CONO
Π_L = S + N
Π_L − S☉ = S − Π☉
ΔVEA
S☉ = Π☉ + N
⇒ S = Π_L − S☉ + Π☉
SEMIDIAMETRO

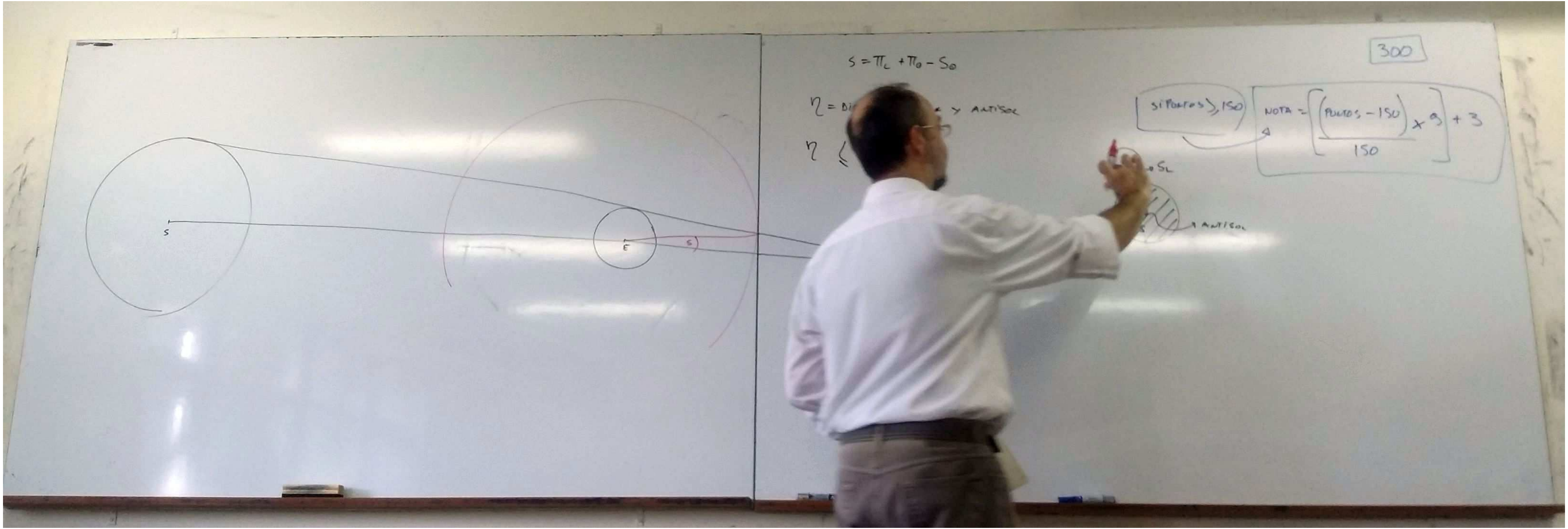

ECLIPSES
ECLIPSE LUNA
CENTRO LUNA
SOMBRA
S: SEMIDIÁMETRO DEL CONO DE SOMBRA DE LA TIERRA A LA DISTANCIA DE LA LUNA
ANTI SOL
ANTI CONO
ÓRBITA LUNA
ΔVEA
SEMIDIÁMETRO SOLAR
ΔVXE
ΔVAS
696.000

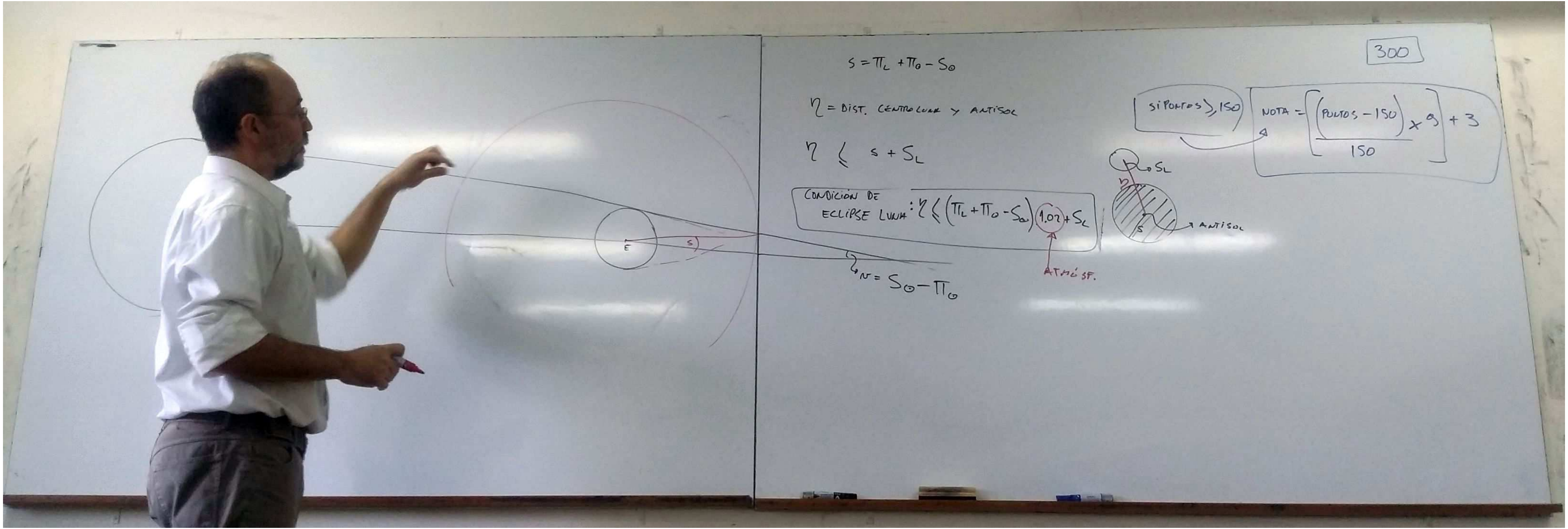
Astronomia Fundamental 2017



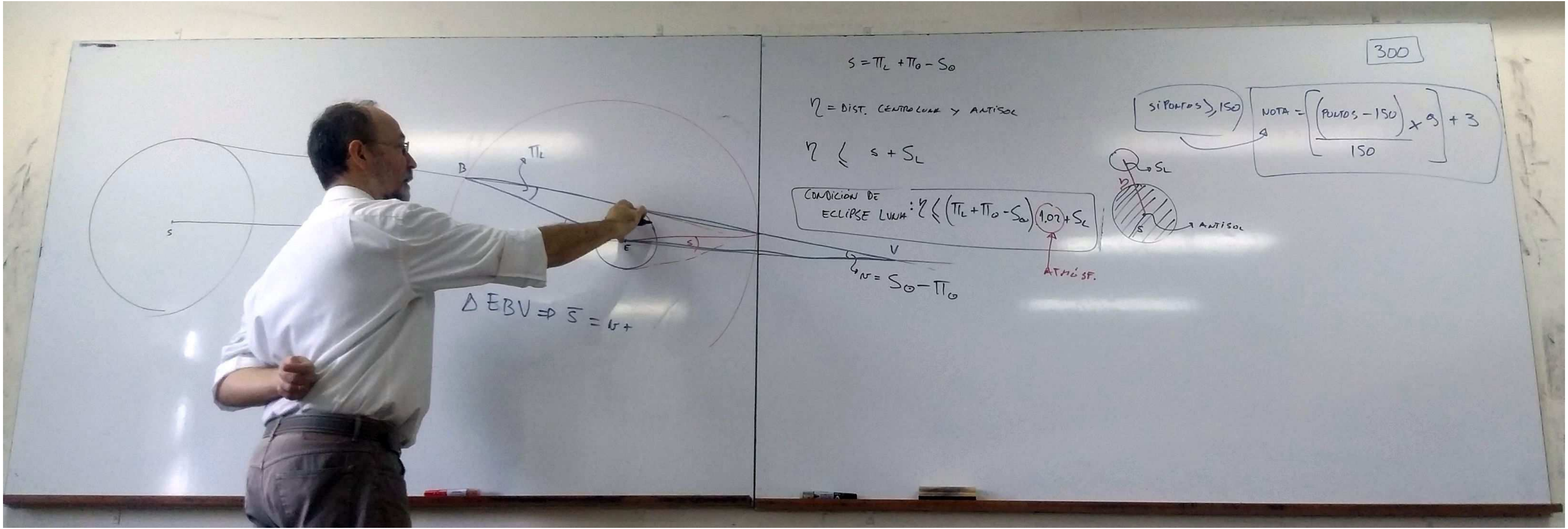

300
NOTA =
150
+ 3

Astronomia Fundamental 2017

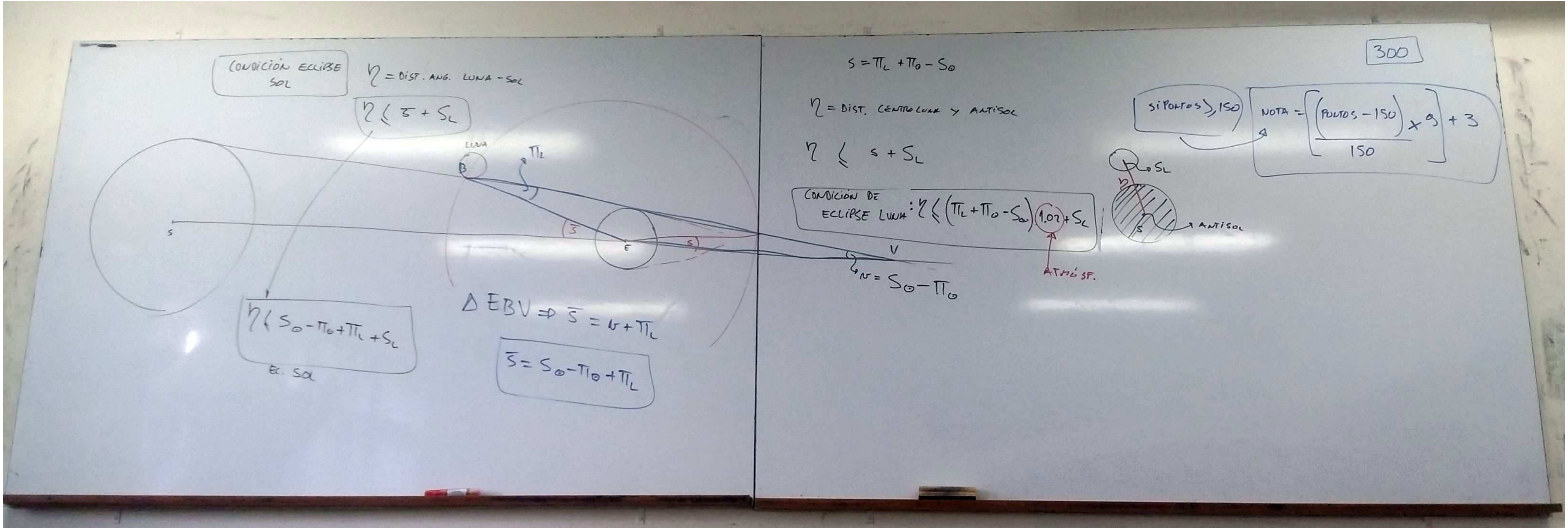



300
s = Π_L + Π_⊙ − S_⊙
η = DIST. CENTRO LUNA Y ANTISOL
η ≤ s + S_L
CONDICIÓN DE ECLIPSE LUNA: η ≤ (Π_L + Π_⊙ − S_⊙) 1.02 + S_L
ATMÓSF.
ν = S_⊙ − Π_⊙
SI PUNTOS ≥ 150
NOTA = [(PUNTOS − 150) / 150 × 9] + 3
S_L
ANTISOL

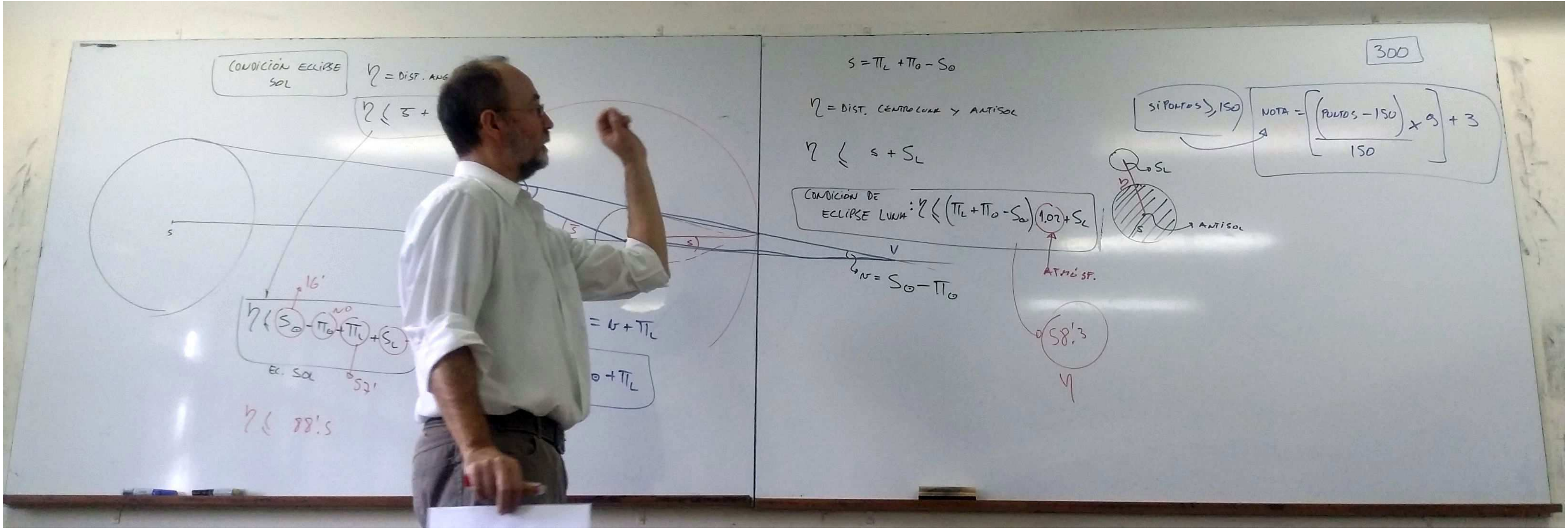
Astronomia Fundamental 2017



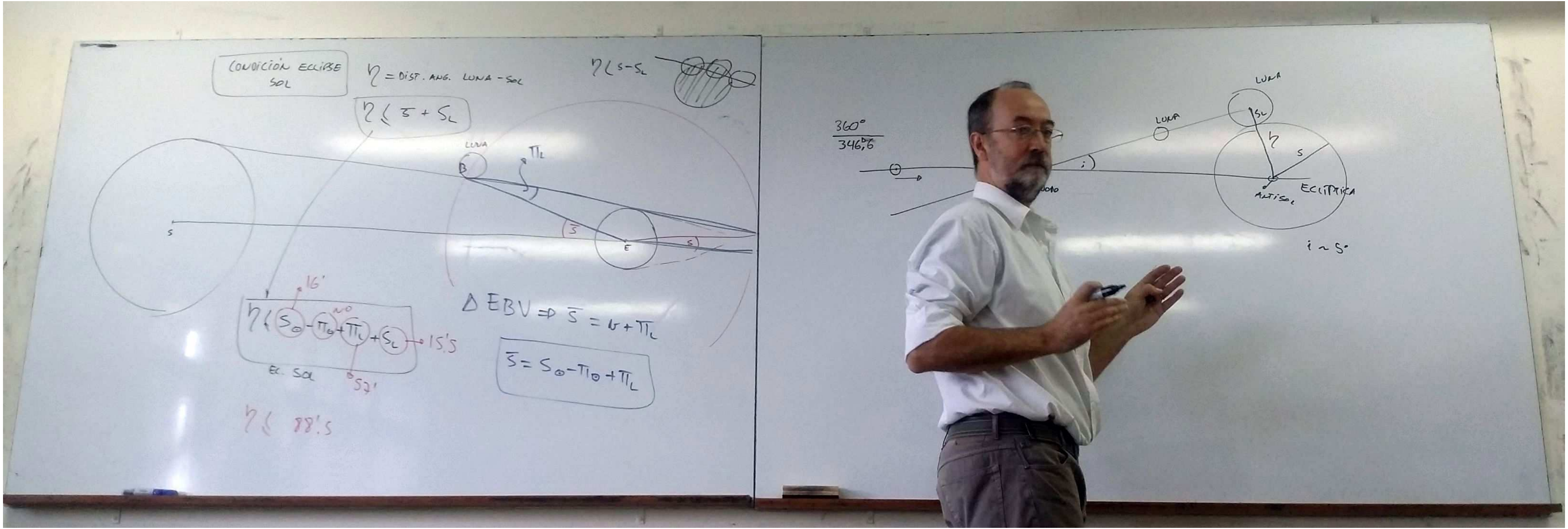
Astronomia Fundamental 2017



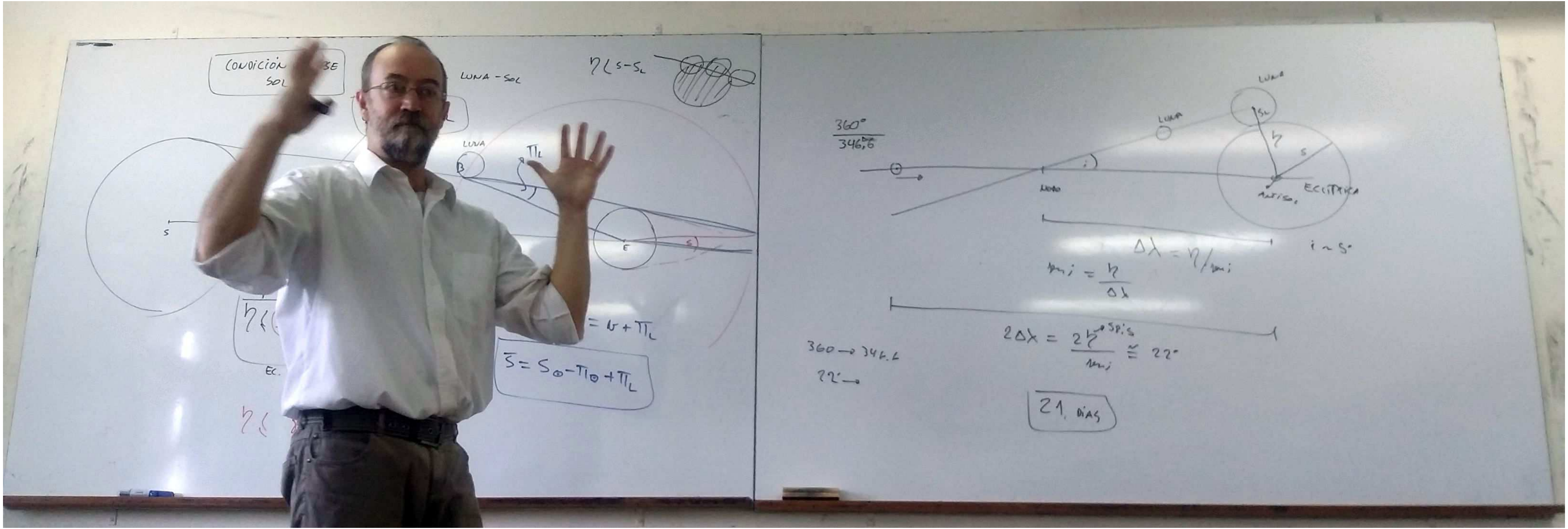
Astronomia Fundamental 2017



Astronomia Fundamental 2017



Astronomia Fundamental 2017



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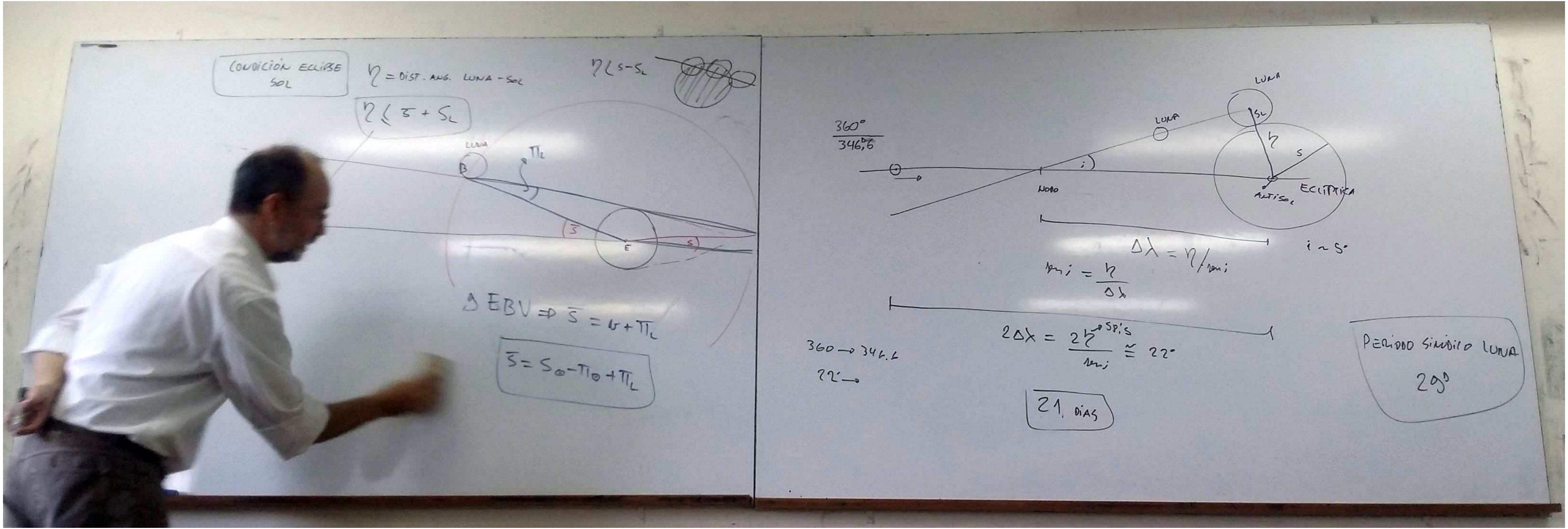
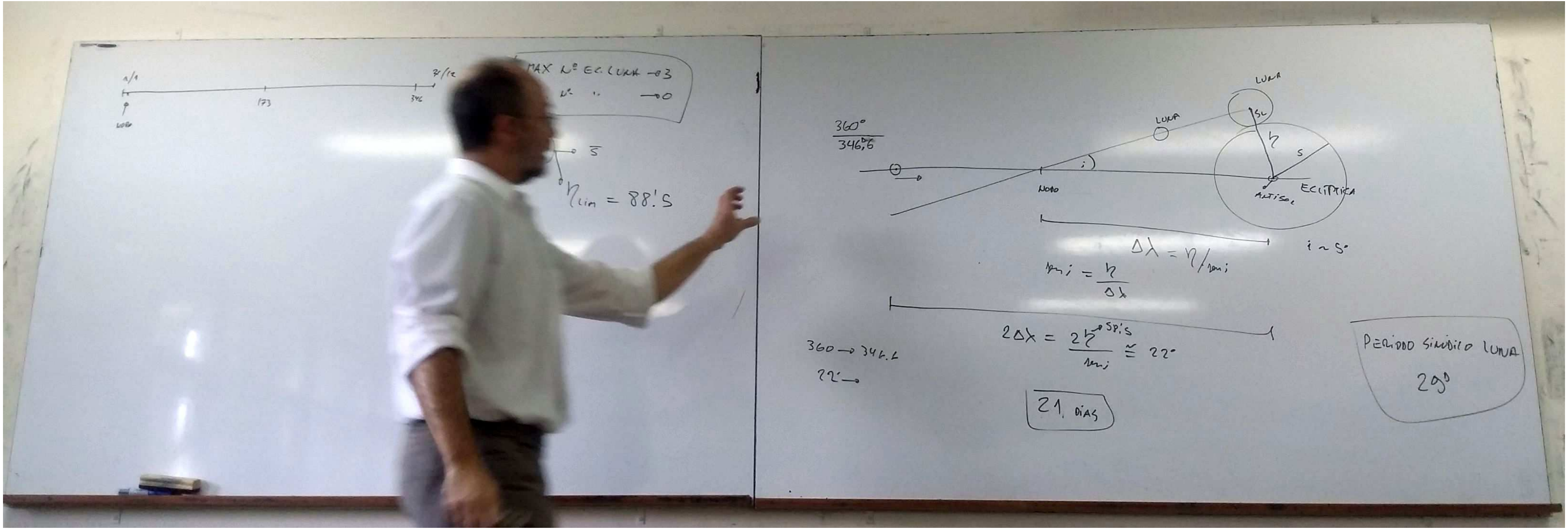


Astronomia Fundamental 2017



Astronomia Fundamental 2017