

PRECESIÓN Y NUTACIÓN

LUNISOLAR (MOV. PNC)

+

PLANETARIA (MOV. K)

LUNISOLAR

(OSCILACIÓN PNC
PEQUEÑA)

PRECESIÓN Y NUTACIÓN

LUNISOLAR (MOV. PNC)

+

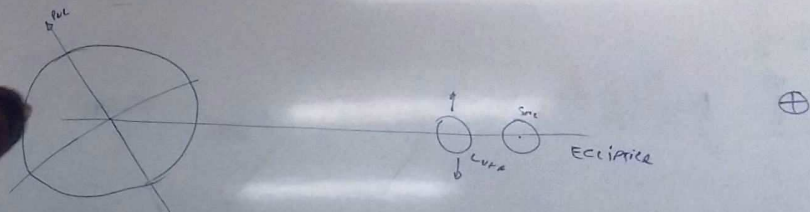
PLANETARIA (MOV. K)

NUTACIÓN

LUNISOLAR

(OSCILACIÓN PNC)
PEQUEÑA

ABULMENTO ECUATORIAL → ROTACION



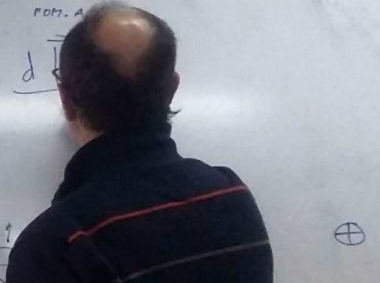
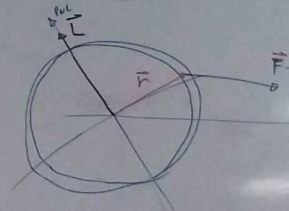
PRECESIÓN Y NUTACIÓN

LUNISOLAR (MOV. PNC)
+
PLANETARIA (MOV. K)

LUNISOLAR
(OSCILACIÓN PNC)
PEQUEÑA

ABOLVIMIENTO ECUATORIAL → ROTACION

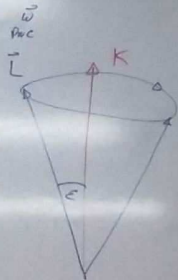
$$\vec{H} = \vec{v} \wedge \vec{F}$$



PRECESIÓN Y NUTACIÓN

LUNISOLAR (MOV. PNC)
+
PLANETARIA (MOV. K)

LUNISOLAR
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PEQUEÑA)

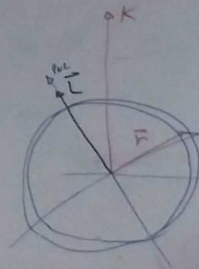


ABOLVIMIENTO ECUATORIAL → ROTACIÓN

FORM. ANGULAR

$$\frac{d\vec{L}}{dt}$$

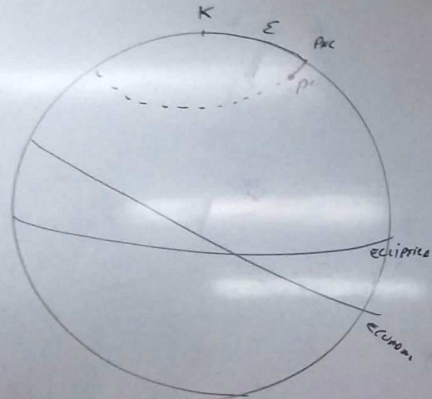
$$\vec{\pi} = \vec{v} \wedge \vec{F}$$



\vec{F}

⊕

QUISOLAR

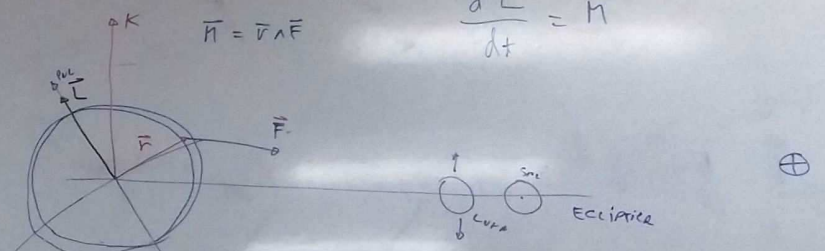


ABOLUNTAMENTO ECATORIAL → ROTACION

MOM. ANGULAR

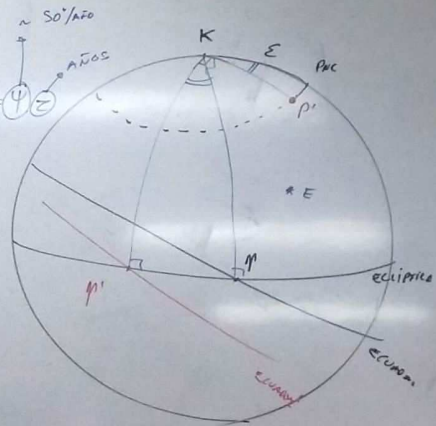
$$\frac{d\vec{L}}{dt} = \vec{\tau}$$

$$\vec{H} = \vec{v} \wedge \vec{F}$$



PREC. LUNISOLAR

$$\widehat{p'q} = \widehat{q'kq} = \widehat{p'kp} = \Delta\lambda = \psi \approx \epsilon$$



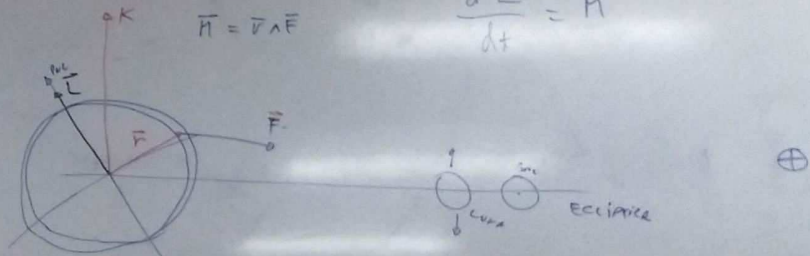
$$\begin{aligned} d\alpha & \\ d\delta & \\ d\lambda &= \psi \cdot z \\ d\beta &= 0 \end{aligned}$$

ABOLIMIENTO ECUATORIAL - ROTACION

FORM. ANGULO

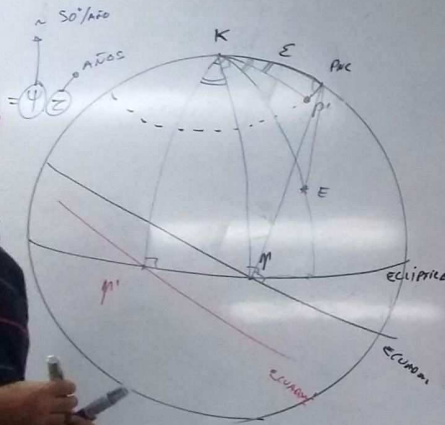
$$\frac{d\vec{L}}{dt} = \vec{H}$$

$$\vec{H} = \vec{v} \wedge \vec{F}$$

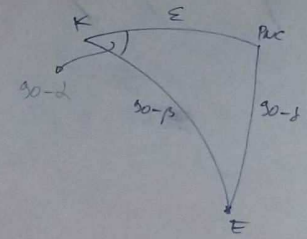


PREC. LUNISOLAR

$$\widehat{p'p} = \widehat{p'k} = \widehat{p'e}$$

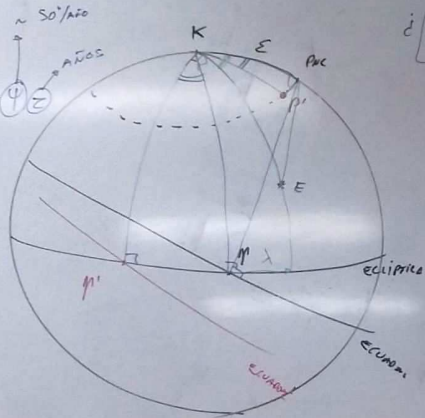


$$\begin{aligned} d\alpha & \\ d\delta & \\ d\lambda &= \psi \cdot z \\ d\beta &= 0 \end{aligned}$$



PREC. LUNISOLAR

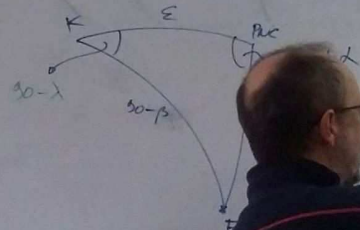
$$\widehat{P'K} = \widehat{P'K} = \widehat{P'K} = \Delta\lambda = \psi \oplus \epsilon$$



$$\frac{d\lambda}{d\delta} ?$$

$$d\lambda = \psi \cdot \epsilon$$

$$d\beta = 0$$



$$\cos(90-\delta) = \cos \epsilon \cdot \cos(90-\beta) + \sin \epsilon \cdot \sin(90-\beta) \cos(90-\lambda)$$

$$\sin \delta = \cos \epsilon \cdot \sin \beta + \sin \epsilon \cdot \cos \beta \cdot \sin \lambda$$

$$\cos \delta \cdot d\delta = \sin \epsilon \cdot \cos \beta \cdot \cos \lambda \cdot d\lambda$$

PREC. LUNISOLAR

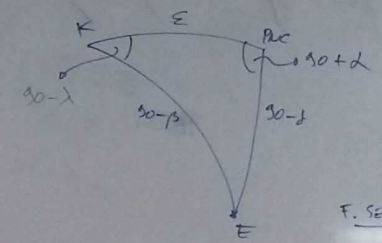
$$\widehat{P'K} = \widehat{P'K} = \widehat{P'K} = \Delta\lambda = \psi \oplus \epsilon$$

$\sim 50^\circ / \text{año}$
 $\sim 10^\circ / \text{año}$

$$\frac{d\lambda}{d\delta} ?$$

$$d\lambda = \psi \cdot z$$

$$d\beta = 0$$



F. COSEC

$$\cos(90-\delta) = \cos \epsilon \cdot \cos(90-\beta) + \sin \epsilon \cdot \sin(90-\beta) \cdot \cos(90-\lambda)$$

$$\sin \delta = \cos \epsilon \cdot \sin \beta + \sin \epsilon \cdot \cos \beta \cdot \sin \lambda$$

$$\cos \delta \cdot d\delta = \sin \epsilon \cdot \cos \beta \cdot \cos \lambda \cdot d\lambda$$

F. SEC

$$\frac{\sin(90+\delta)}{\sin(90-\beta)} = \frac{\sin(90-\lambda)}{\sin(90-\delta)} \Rightarrow \frac{\cos \delta}{\cos \beta} = \frac{\cos \lambda}{\cos \delta}$$

$$\Rightarrow \cos \beta \cdot \cos \lambda = \cos \delta \cdot \cos \delta$$

PREC. LUNISOLAR

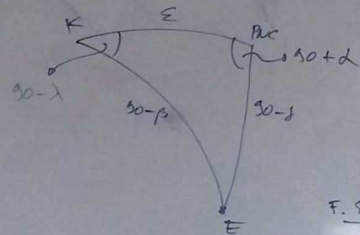
$$\widehat{P'K} = \widehat{P'K} = \widehat{P'K} = \Delta\lambda = \psi \quad \begin{matrix} \sim 50^\circ/\text{año} \\ \sim 15^\circ/\text{año} \end{matrix}$$

$$\frac{d\lambda}{d\delta} ?$$

$$\begin{aligned} d\lambda &= \psi \cdot z \\ d\beta &= 0 \end{aligned}$$

~~$$\cos \delta = \sin \epsilon \cdot \sin \lambda \cdot \cos \delta$$~~

$$\Rightarrow d\delta = \sin \epsilon \cdot \cos \delta \cdot d\lambda \quad \psi \cdot z$$



F. COSEC

$$\cos(90-\delta) = \cos \epsilon \cdot \cos(90-\beta) + \sin \epsilon \cdot \sin(90-\beta) \cdot \cos(90-\lambda)$$

$$\sin \delta = \cos \epsilon \cdot \sin \beta + \sin \epsilon \cdot \cos \beta \cdot \sin \lambda$$

$$\cos \delta \cdot d\delta = \sin \epsilon \cdot \cos \beta \cdot \cos \lambda \cdot d\lambda$$

F. SEFO

$$\frac{\sin(90+\delta)}{\sin(90-\beta)} = \frac{\sin(90-\lambda)}{\sin(90-\delta)} \Rightarrow \frac{\cos \delta}{\cos \beta} = \frac{\cos \lambda}{\cos \delta}$$

$$\Rightarrow \cos \beta \cdot \cos \lambda = \cos \delta \cdot \cos \delta$$

PREC. LUNISOLAR

$\widehat{P'K} = \widehat{P'K} = \widehat{P'K} =$

$d\delta = \sin \delta \cdot d\alpha$

$\Rightarrow d\delta = \sin \delta \cdot \psi \cdot z$

PROBAB

$\Rightarrow d\alpha = \frac{d\delta}{\sin \delta} = \frac{d\delta}{\sin \delta} \cdot \psi \cdot z$

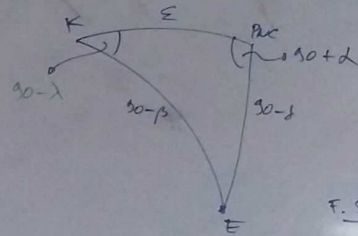
$\frac{d\delta}{d\alpha} ?$

$d\lambda = \psi \cdot z$

$d\beta = 0$

$\psi = 50'' \cdot 3878 + 0'' \cdot 0045 \cdot T$

$T = \frac{(t - 2000)}{100}$



F. CASE

$\cos(90 - \delta) = \cos \epsilon \cdot \cos(90 - \beta) + \sin \epsilon \cdot \sin(90 - \beta) \cdot \cos(90 - \lambda)$

$\sin \delta = \cos \epsilon \cdot \sin \beta + \sin \epsilon \cdot \cos \beta \cdot \sin \lambda$

$\cos \delta \cdot d\delta = \sin \epsilon \cdot \cos \beta \cdot \cos \lambda \cdot d\lambda$

F. SEFD

$\frac{\sin(90 + \delta)}{\sin(90 - \beta)} = \frac{\sin(90 - \lambda)}{\sin(90 - \delta)} \Rightarrow \frac{\cos \delta}{\cos \beta} = \frac{\cos \lambda}{\cos \delta}$

$\Rightarrow \cos \beta \cdot \cos \lambda = \cos \delta \cdot \cos \delta$

PREC. LUNAR

$\widehat{P'K} = \widehat{P'K} = \widehat{P'K} = \Delta\lambda = \psi$

$\frac{d\alpha}{d\delta}$
 $\frac{d\lambda}{d\beta}$

~~$\cos \delta \cdot d\delta = \sin \epsilon \cdot d\lambda \cdot \sin \delta$~~

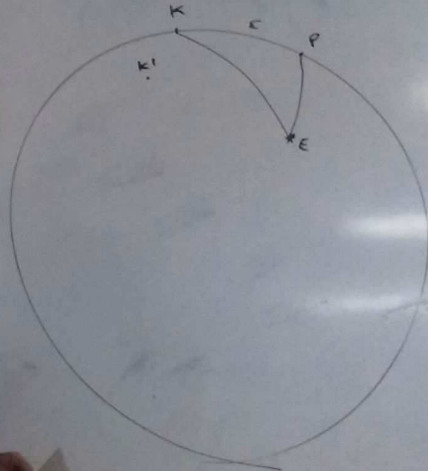
$\Rightarrow d\delta = \sin \epsilon \cdot \cos \delta \cdot d\lambda \cdot \psi$

PROBAN

$\Rightarrow d\alpha = \left(\cos \epsilon + \sin \epsilon \cdot \sin \delta \cdot \frac{d\delta}{d\lambda} \right) \cdot \psi$

$\psi = 50'' \cdot 38778 +$

$T = \left(\frac{1}{f} - \dots \right)$



PREC. LUISOLAR

$\widehat{\eta' \eta} = \widehat{\eta' K \eta} = \widehat{P' K P} = \Delta \lambda = \Psi \cdot \varepsilon$

So' / año
ANOS

$i \frac{d\lambda}{d\delta} ?$

$d\lambda = \Psi \cdot \varepsilon$
 $d\beta = 0$

~~$\cos \delta \cdot d\delta = \sin \varepsilon \cdot d\lambda \cdot \cos \delta$~~

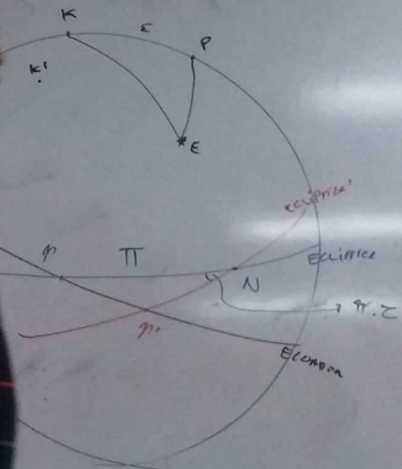
$\Rightarrow d\delta = \sin \varepsilon \cdot \cos \delta \cdot d\lambda \cdot \Psi \cdot \varepsilon$

PROBAR

$\Rightarrow d\alpha = \left(\cos \varepsilon + \sin \varepsilon \cdot \sin \delta \cdot \frac{1}{\cos \delta} \right) \cdot \Psi \cdot \varepsilon$

$\Psi = 50'' \cdot 3878 + 0'' \cdot 0045$

$T = \left(\frac{1}{100} - 2000 \right)$



$\Pi, \pi \Rightarrow$ TEORÍA PLANETARIA

$\Pi = 174'' \cdot 8364 + 0'' \cdot 9137 \cdot T$

$\pi = 0'' \cdot 4200 - 0'' \cdot 0004 \cdot T$

PREC. PLANETARIA

$$d\alpha = -\dot{\lambda} \cdot c$$

$$d\delta = 0$$

$$dt$$

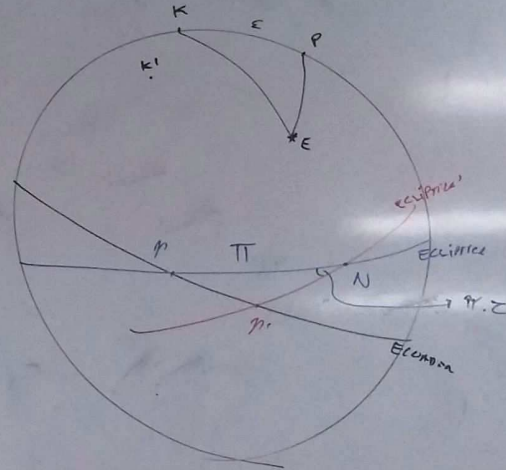
$$\frac{d\alpha}{d\delta} ?$$

$$d\lambda = \psi \cdot c$$

$$d\beta = 0$$

$$\psi = 50'' \cdot 3877 + 0'' \cdot 0045 \cdot T$$

$$T = \frac{\int_{\text{inst. en años}}}{100} - 2000$$



$\pi, \pi \Rightarrow$ TEORÍA PLANETARIO

$$\pi = 174^{\circ} \cdot 8764 + 0^{\circ} \cdot 9137 \cdot T$$

$$\pi = 0^{\circ} \cdot 4700 - 0^{\circ} \cdot 0007 \cdot T$$

PREC. PLANETARIA

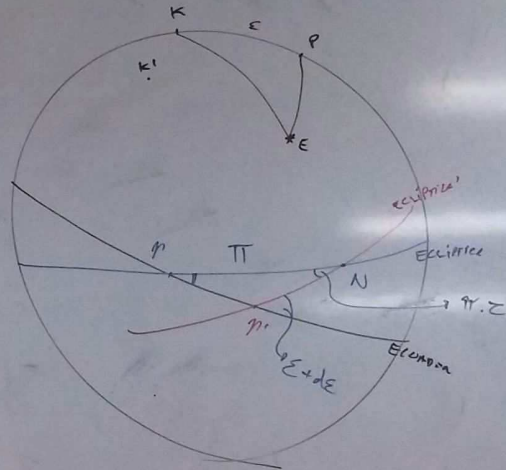
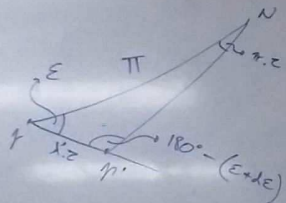
$d\alpha = -\dot{\lambda} \cdot c$ — COEF. DE PRECESIÓN PLANETARIA

$d\delta = 0$

$d\lambda =$

$d\beta =$

$\lambda', \pi, \pi'?$



$\pi, \pi' \Rightarrow$ TEORÍA PLANETARIA

$\pi = 174^{\circ}.8764 + 0^{\circ}.9137 \cdot T$

$\pi' = 0^{\circ}.4700 - 0^{\circ}.0007 \cdot T$

PREC. PLANETARIA

$d\alpha = -\lambda' \epsilon$ DEF. OF PRECESSION PLANETARIA

$d\delta = 0$

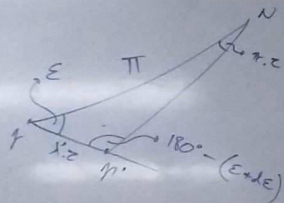
$d\lambda =$

$d\beta =$

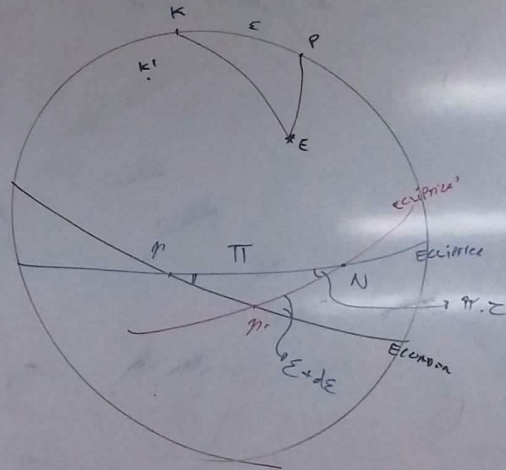
F. SERRA:

$$\frac{\sin(180 - (\epsilon + d\epsilon))}{\sin \pi} = \frac{\sin(\lambda \epsilon)}{\sin \lambda' \epsilon}$$

$\lambda', \pi, \pi'?$



$$\frac{\sin(\epsilon + d\epsilon)}{\sin \pi} = \frac{\pi \frac{1}{\epsilon}}{\lambda' \frac{1}{\epsilon}} \Rightarrow \lambda' = \frac{\pi}{\lambda \epsilon}$$



$\pi, \pi' \Rightarrow$ TEORÍA PLANETARIA

$\pi = 174^{\circ}.8764 + 0^{\circ}.9137 \cdot T$

$\pi' = 0^{\circ}.4700 - 0^{\circ}.0007 \cdot T$

PREC. PLANETARIA

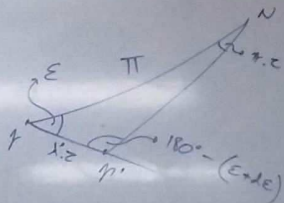
$d\lambda = -\lambda' \cdot \zeta$ (COEF. DE PRECESIÓN PLANETARIA)

$d\delta = 0$

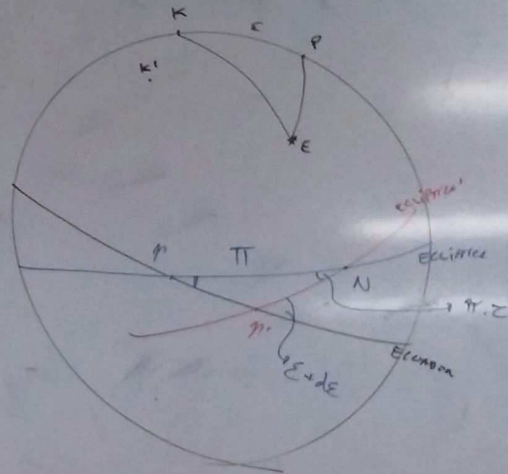
¿ λ' , π , π' ?

F. SENA:

$$\frac{\tan(180 - (\varepsilon + d\varepsilon))}{\tan \pi} = \frac{\tan(\pi \cdot \zeta)}{\tan \lambda \cdot \zeta}$$



$$\frac{\tan(\varepsilon + d\varepsilon)}{\tan \pi} = \frac{\pi \cdot \zeta}{\lambda \cdot \zeta} \Rightarrow \lambda' = \pi \cdot \frac{\tan \pi}{\tan(\varepsilon + d\varepsilon)} \Rightarrow \lambda' = \pi \frac{\tan \pi}{\tan \varepsilon}$$



π , $\pi' \Rightarrow$ TEORÍA PLANETARIA

$\pi = 174^{\circ}.3364 + 0^{\circ}.9139 \cdot T$

$\pi' = 0^{\circ}.4200 - 0^{\circ}.0004 \cdot T$

SE PUEDE PROBAR QUE

$d\varepsilon = \pi \cdot \zeta \cdot \cos \pi$

PREC. PLANETARIA + P. LUNISOLAR = PRECESION GENERAL

$$\Delta \alpha_{\text{total}} = \Delta \alpha_{\text{LS}} + \Delta \alpha_{\text{PLAN}} =$$

PREC. PLANETARIA + P. LUNISOLAR = PRECESION GENERAL

$$\Delta \alpha_{\text{total}} = \Delta \alpha_{\text{LS}} + \Delta \alpha_{\text{PLAN}} = (\cos \varepsilon + m \varepsilon \cdot \sin \delta) \cdot \psi \cdot z - \lambda' \cdot z$$

$$\Delta \delta_{\text{total}} = \Delta \delta_{\text{LS}} + \Delta \delta_{\text{PLAN}} = m \sin \varepsilon \cdot \cos \delta \cdot \psi \cdot z$$

"0"

$$\alpha, \delta, \varepsilon, \psi, \lambda', z \rightarrow \alpha', \delta'$$

LIBRACION : oscilación de P.V.C. $\approx 20''$



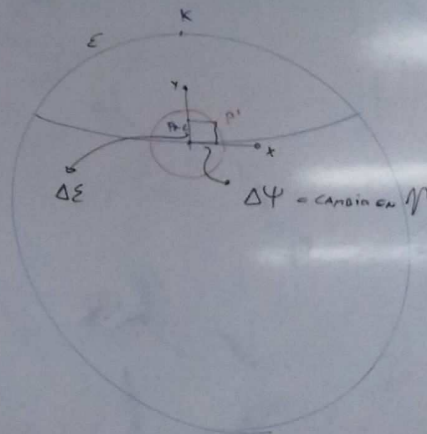
PRECESION GENERAL + P. LUNISOLAR = PRECESION GENERAL

$$\Delta \alpha = \Delta \alpha_{LS} + \Delta \alpha_{PLUN} = (\cos \epsilon + m \cdot \epsilon \cdot \cos \delta) \cdot \psi \cdot z - \lambda' \cdot z$$

$$\Delta \delta = \Delta \delta_{LS} + \Delta \delta_{PLUN} = m \sin \epsilon \cdot \cos \delta \cdot \psi \cdot z$$

$$\alpha, \delta, \epsilon, \psi, \lambda', z \rightarrow \alpha', \delta'$$

NUTACION : oscilación de ϵ $\approx 20''$



P' = POLO INSTANTANEO

P = POLO MEDIO

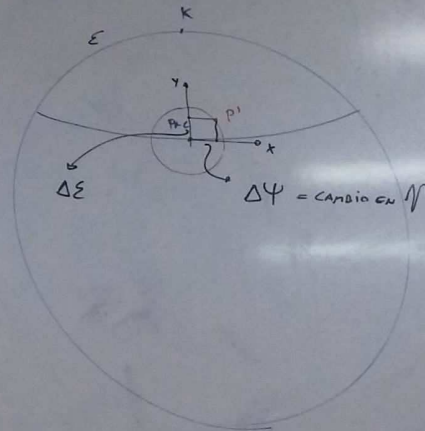
PREC. PLANETARIA + P. LUNISOLAR = PRECESION GENERAL

$$\Delta \alpha_{total} = \Delta \alpha_{ES} + \Delta \alpha_{PLN} = (G \epsilon + m \epsilon \cdot \cos \delta) \cdot \psi \cdot z - \lambda' \cdot z$$

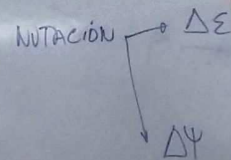
$$\Delta \delta_{total} = \Delta \delta_{ES} + \Delta \delta_{PLN} = m \epsilon \cdot \cos \delta \cdot \psi \cdot z$$

$$\alpha, \delta, \epsilon, \psi, \lambda', z \rightarrow \alpha', \delta'$$

NUTACION : oscilación de PNC $\sim 20''$



P' = POLO INSTANTANEO
P = POLO MEDIO



Ψ INSTANTANEO

Ψ MEDIO DEFINIDO P

