Project Ideas

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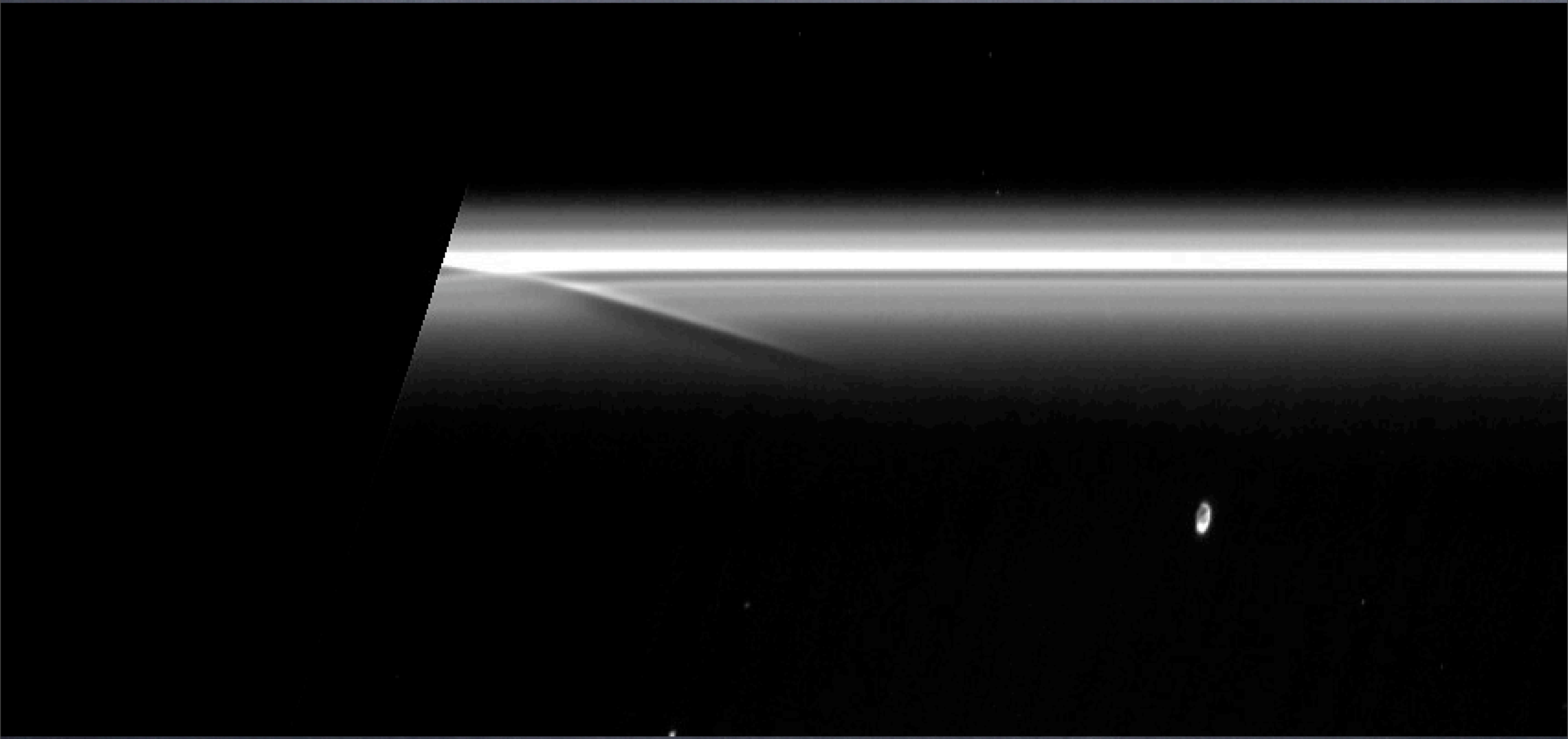
Project Ideas

- Simulate Prometheus and the F Ring.
- Study G Ring confinement by the Mimas 7:6 corotation resonance.
- Determine if the F Ring brightness has changed since Voyager.
- Anything else—just talk to me.

Prometheus and the F Ring



Prometheus and the F Ring

- Integrate using SWIFT.
  - www.boulder.swri.edu/~hal/swift/html
- Define ring region using "N" test particles.
- Put test particles on circular orbits using formulas from my talk.
- Get initial state vector for Prometheus using SPICE.
- Integrate for 1 passage of Prometheus.
  - Make periodic scatter plots of particle positions.
- Vary mass and eccentricity of Prometheus to see how effect changes.

Arc Confinement in the G Ring

Arc Confinement in the G Ring

- Integrate using SWIFT.
  - www.boulder.swri.edu/~hal/swift/html
- Define ring using "N" test particles.
- Put test particles on circular orbits using formulas from my talk.
- Get initial state vector for Mimas using SPICE.
- Integrate for many passages of Mimas.
  - Make period scatter plots of test particles.
- Note where resonant patterns appear.

Changes in F Ring Brightness

- Find images of the F Ring tip that include the A Ring for reference.

Changes in F Ring Brightness

- Determine how to calibrate Cassini images.
  - Approximate calibration is OK.
  - Google "Cassini ISS Calibration Report" at the Rings Node for lots of information.
- Determine the image pixel scale, phase angle and ring opening angle using SPICE (or tools on line at the Rings Node!)

Cassini ISS "Draft" Calibration Report Web Page

http://pds-rings.seti.org/cassini/iss/COISS_0011_DOCUMENT/REPORT/

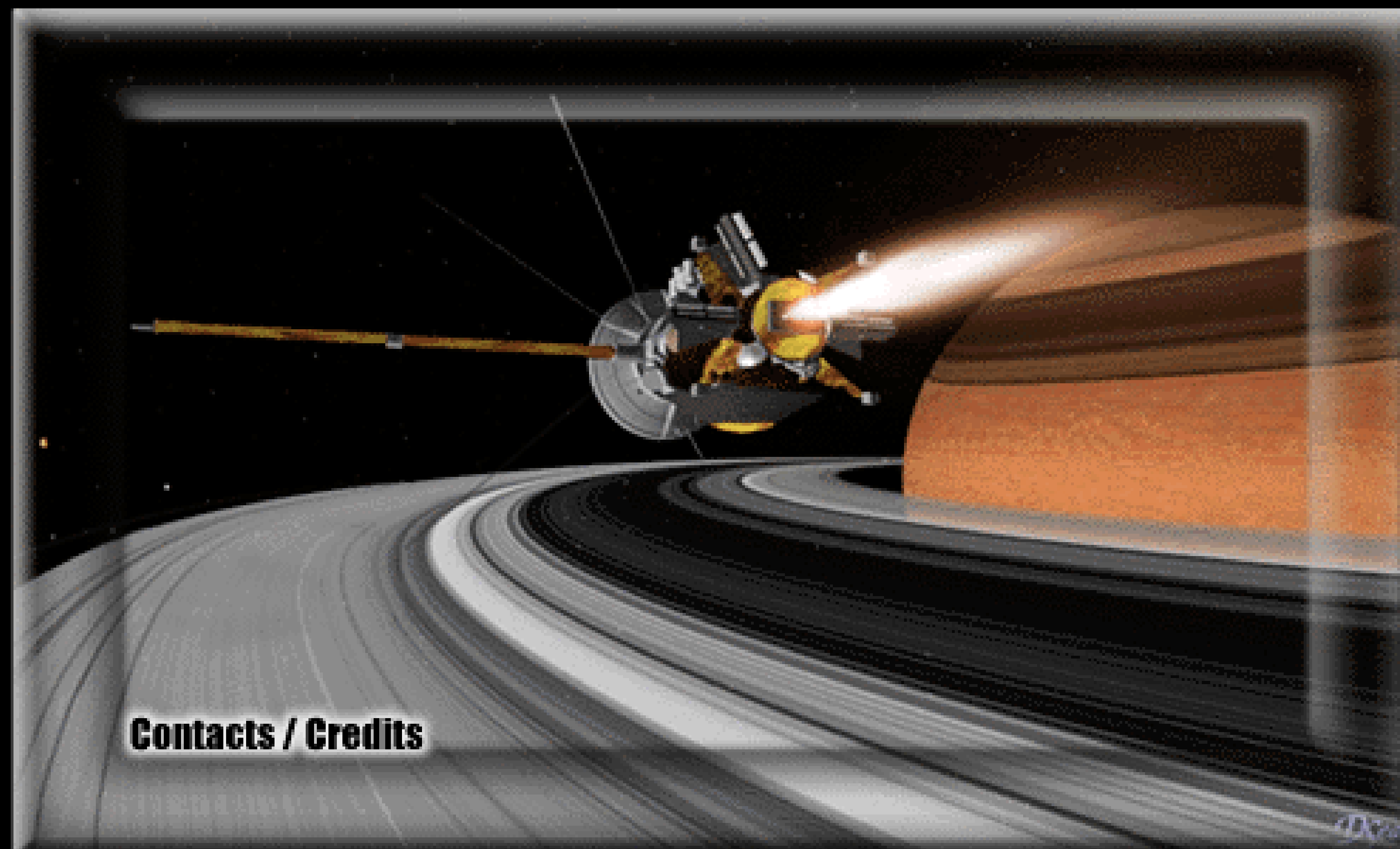
Google

Info ▾ Cassini ▾ PDS ▾ HST ▾ Astronomy ▾ Travel ▾ Shopping ▾ Entertainment ▾ Vacation ▾ Collections ▾ Apple (100) ▾

Cassini ISS "Draft" Calibrati...

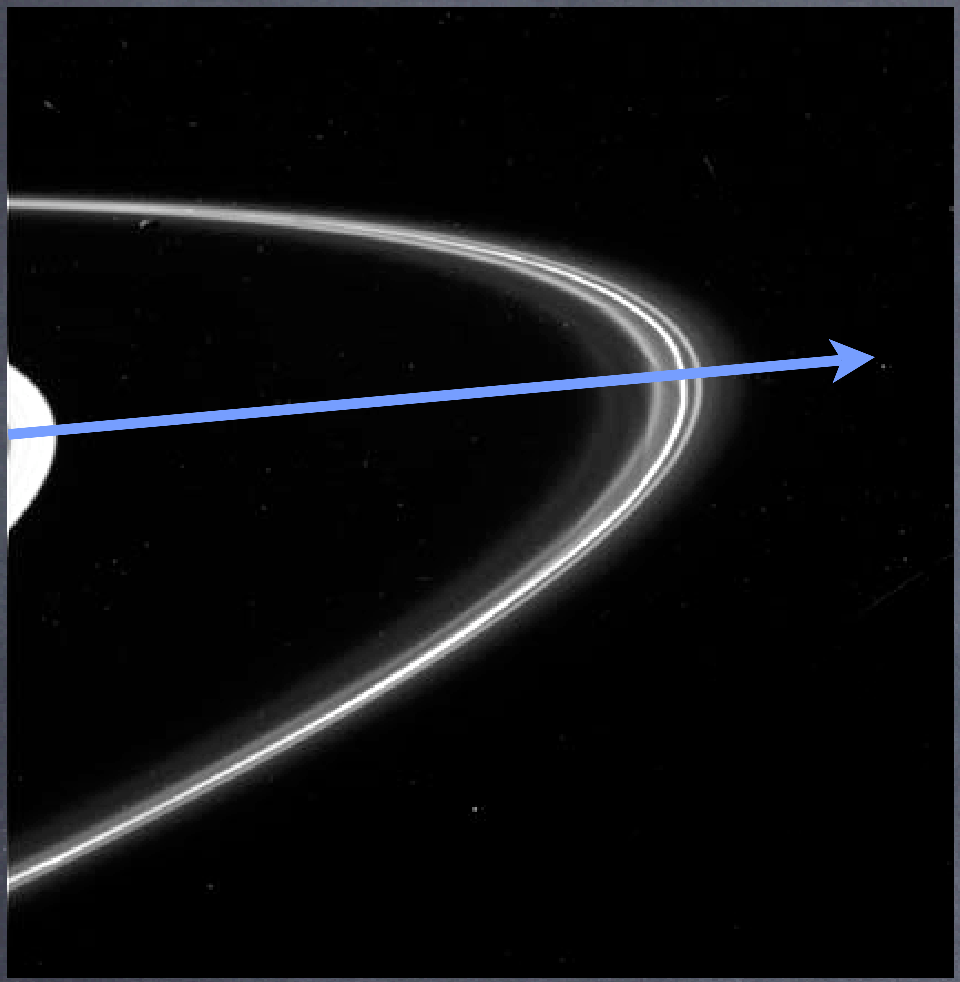
* Additional Cassini Web Sites *

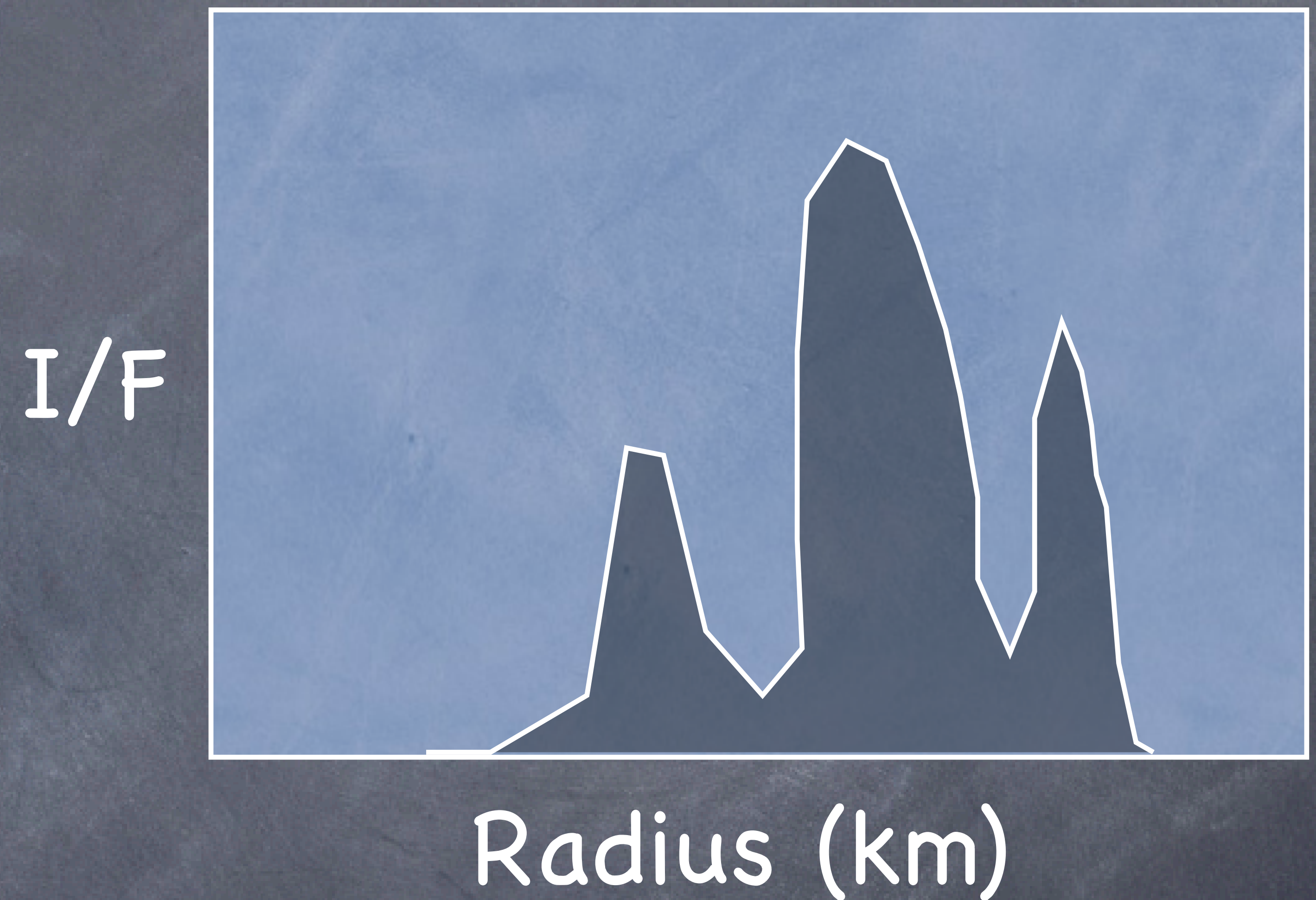
CASSINI



ISS Calibration Report

Changes in F Ring Brightness





- Derive radial profiles from several images.
- Integrate the "area under the curve".
  - This is called the "equivalent width".

Changes in F Ring Brightness

- Compare results to those from Voyager at the same phase angles.
- See Showalter et al. (1992). A photometric study of Saturn's F Ring. Icarus **100**, 394-411.
    - I can provide the reprint.

ICARUS 100, 394–411 (1992)

A Photometric Study of Saturn's F Ring

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Constraints on the particle properties in Saturn's F Ring have been derived from Voyager images and occultation data. We have measured the ring's radially integrated brightness over a wide range of phase angles (7° to 156°) from the Voyager images. Whenever possible, measurements have been repeated in multiple images over a wide range of longitudes in order to average out the ring's intrinsic brightness variations. To model the resultant phase curve we have divided the ring population into two regimes: dust, of size comparable to or smaller than the wavelength of light (0.5 μm), and larger bodies. We model the single scattering properties of the small particles using a semiempirical theory for scattering by randomly oriented, nonspherical particles; scattering by the large bodies is based on the photometric behavior of satellites. We apply a doubling algorithm to solve the multiple scattering problem and to include the contribution of Saturn-shine to the incident radiation field. The free parameters in our models include the power law index q of the dust size distribution and the fractional contribution f of the dust to the total optical depth. Least-squares fits of this model to the imaging phase curve yield $q = 4.6 \pm 0.5$ and $f \geq 98\%$. Comparison of optical depth profiles across the F Ring at wavelengths of 0.264 μm, 3.6 cm, and 13 cm indicates that centimeter-sized particles are the dominant source of opacity in a core ~1 km wide, while the micrometer-sized dust dominates in a much wider "envelope" that extends inward from the core. We suggest that the dust in the envelope arises from micrometeoroid impacts into the larger core particles and then migrates inward under Poynting–Robertson drag.

1. INTRODUCTION

Saturn's F Ring was first detected by the Pioneer 11 imaging experiment in 1979 (Gehrels *et al.* 1980). This narrow ring lies a few thousand kilometers beyond the outer edge of the much broader main ring system of Saturn. A year later the ring appeared with much greater clarity under the scrutiny of the Voyager 1 cameras, in which it revealed a remarkable degree of longitudinal variation, including clumps, kinks, and the so-called "braids" (Smith *et al.* 1981, 1982).

Due to Kepler shear, it should be very difficult for a ring to maintain longitudinal variations for more than a few hundred orbital periods. It seems likely that these persistent features are related to the gravitational perturbations exerted on the ring particles by the "shepherding" moons Pandora and Prometheus, plus perhaps one or more possible embedded moonlets (Dermott 1981, Showalter and Burns 1982, Lissauer and Peale 1986, Kolvoord *et al.* 1990, Kolvoord and Burns 1992). Nevertheless, a detailed explanation for all of the F Ring's diverse structures remains elusive a decade after its discovery.

However, the ensuing decade has revealed that the F Ring's variations are not unique. The Adams Ring of Neptune shows a grouping of three major arcs (Smith *et al.* 1989), first detected by Earth-based stellar occultations (Hubbard *et al.* 1986), that appears to have persisted for at least 5 years (Nicholson *et al.* 1990). A recent reanalysis of the Voyager images from Uranus reveal that Ring λ also has brightness variations and localized clumps (Showalter 1991a). At Saturn, the closest analogs to the F Ring are two or more narrow ringlets embedded in the Encke Gap, which are known to be kinked and clumpy (Smith *et al.* 1982). While explanations have been proposed for the Adams Ring arcs (Lissauer 1985, Goldreich *et al.* 1986, Porco 1991) and for one of the Encke Gap ringlets (Showalter 1991b), it is clear that much work remains to be done to gain an understanding of these phenomena.

Studies of the F Ring are of interest in and of them-

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0019-1035/92 $5.00

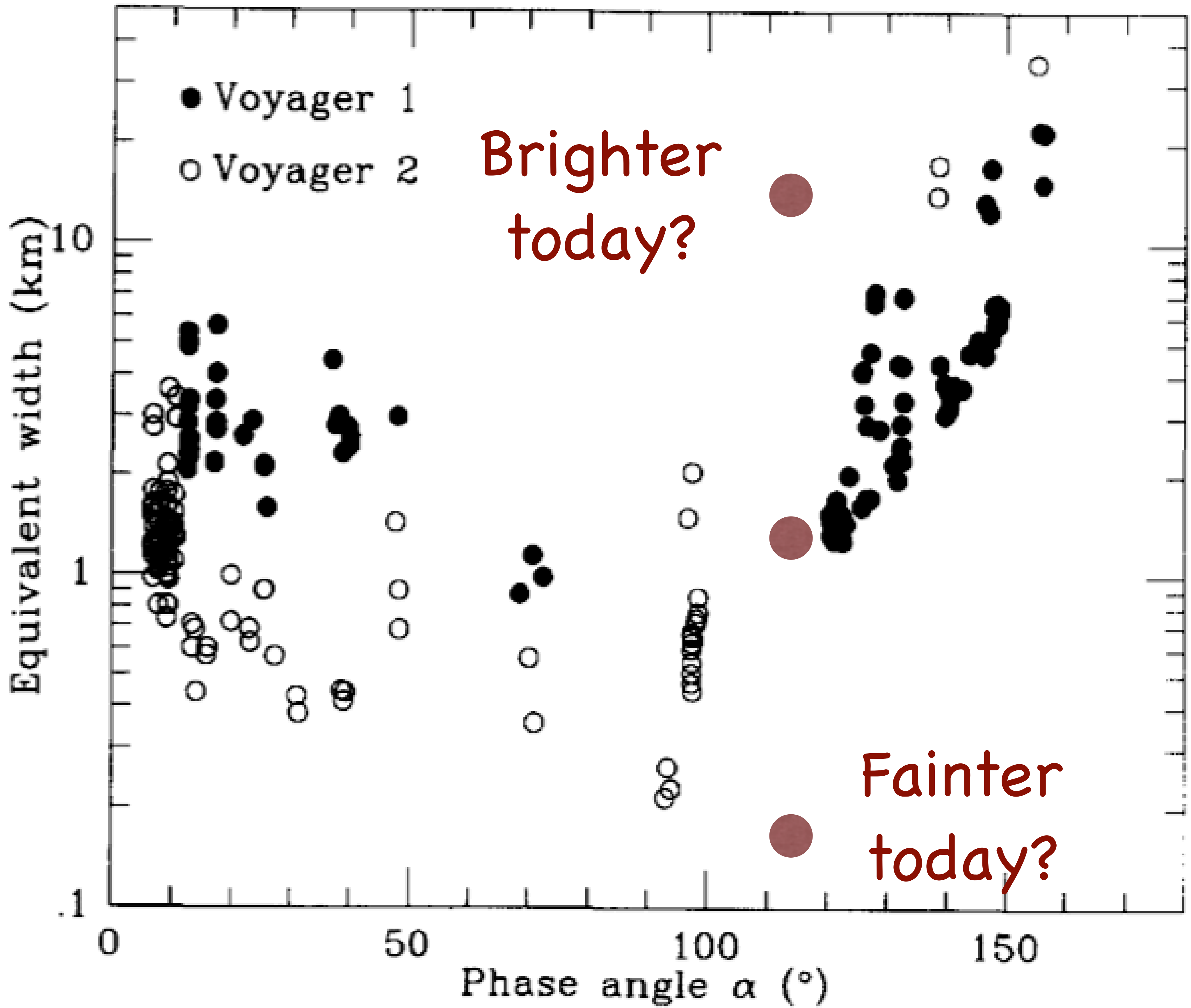

FIG. 3. A summary of every equivalent width measurement of the F Ring as a function of solar phase angle. The closed circles indicate

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