

# Probing the Dynamics of Saturn's Rings

A.S. Bosh (Lowell Obs.),

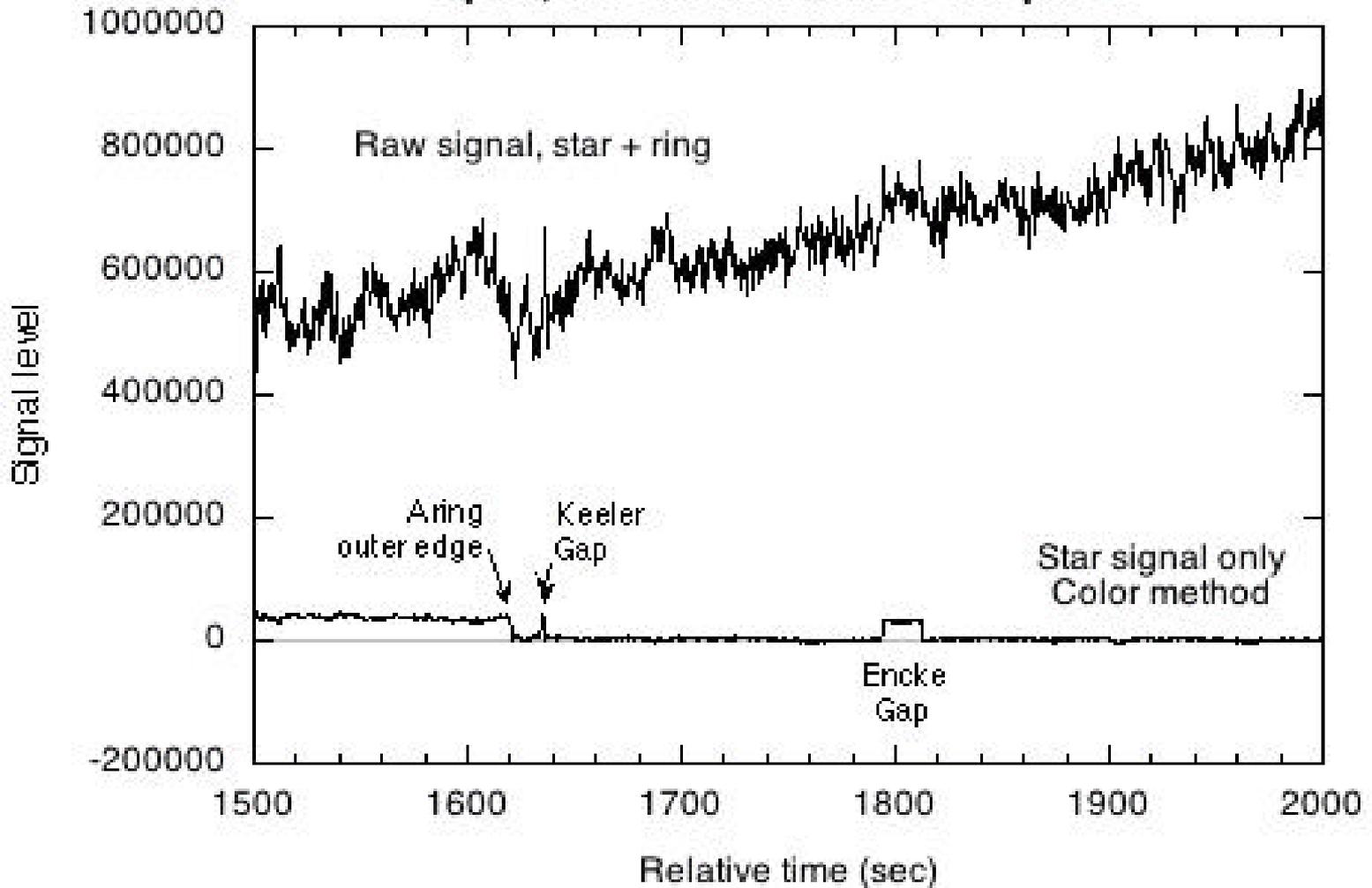
J.L. Elliot, C.B. Olkin, R.G. French, J. Rayner

Stellar occultations provide a powerful technique for the study of solar system objects. The limiting resolution of a stellar occultation is set the beam profile of the Fresnel diffraction (the full width half maximum is 1.7 km for Saturn at 2.2 microns independent of telescope size). In contrast, the limiting angular resolution for direct imaging is 0.1 arcsec (600 km) for HST. Stellar occultations also provide the vertical temperature structure and chemical composition of a planetary atmosphere at pressure levels of 1-100 microbar.

The goal of this program is to improve the kinematic models of Saturn's rings by doubling the number of observed occultations of Saturn's rings. The improved model precision will also reduce the uncertainty of Saturn's pole precession. The latter is provides a significant constraint on Saturn's interior structure.

Attached is a plot of preliminary data reduction from the 24 December 2002 Saturn occultation. This shows the efficiency of the color method for removing background signal from occultation data. The top curve is the sky-subtracted lightcurve for a portion of the event. Because Saturn's rings are so bright at these wavelengths (roughly K), the star signal is not immediately apparent. However, because the star and the rings have different spectral curves, we can use this fact to separate out the ring contribution. The remaining star signal alone is shown in the bottom curve, with its recognizable ring feature signatures (labeled). This method was conceived in 1975 by Elliot et al. and applied to broadband photometric observations of a Jupiter observation. By using spectral data rather than broadband, we can fine-tune the spectral extraction regions to improve the S/N of the resulting lightcurve.

**Saturn occultation data, 24 December 2002  
SpeX, 0.8-2.5 micron low-res prism**



Raw signal (upper curve) compared to the derived stellar signal obtained by removing that of the ring. The removal of the stellar signal requires the occultation to be observed with a spectrograph like SpeX.

Cassini will give us information about Saturn's rings for only a limited time period. Because the rings are dynamic, observations over a long time period are crucial to unraveling the mysteries of ring dynamics.

Observations prior to and during Cassini will complement data taken during the Cassini mission, and will be useful for understanding the data collected by that spacecraft. For example, there are several phenomena that are variable on time scales of decades, such as the F ring's relationship to its shepherd satellites (Prometheus approaches very closely every ~19 years), and the A ring's relationship to the co-orbital satellites Janus and Epimetheus. The IRTF data will be separated by a few years from the Cassini data and will permit the study of changes in response to the satellite configurations.