KINEMATIC MODELS OF NON-CIRCULAR FEATURES IN SATURN'S RINGS. J. N. Spitale, C. C. Porco, *CICLOPS/SSI, Boulder, CO 80301, USA, (spitale@lpl.arizona.edu).*

1 Introduction

Using high-resolution movie frames and azimuthal imaging scans with radial scales as fine as a few km and longitudinal resolutions as fine as a fraction of a degree, we examine the shapes and kinematics of the B-ring outer edge and the Huygens ringlet. The former is known to be strongly influenced by its proximity to the 2:1 inner Lindblad resonance with Mimas [1,2]; the latter has been suspected of being so [1]. According to basic Lindblad theory, ring particles perturbed by such a resonance should follow streamlines that take the shape of a body-centered ellipse rotating at the mean motion of the perturbing satellite. Conjunctions between the satellite and the particles should occur at periapse for particles interior to the resonance and apoapse for particles exterior to the resonance.

2 B-ring outer edge

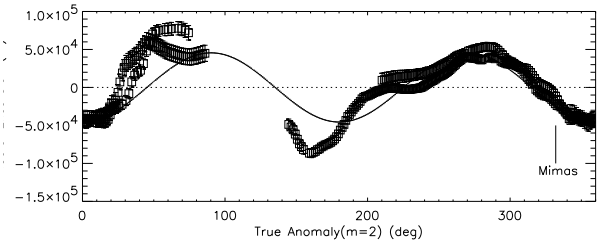

Figure 1: B-ring outer edge. The curve shows the best-fit m=2 model.

The B-ring outer edge lies close to the Mimas 2:1 inner Lindblad resonance. In qualitative agreement with [2], we find that the edge has the expected two-lobed shape rotating with the mean motion of Mimas, but with high residuals, indicating that the shape is more complicated than a simple body-centered ellipse (see Fig. 1). For this m=2 model, we find a radial amplitude of about 45 km, considerably smaller than the 74 km reported by [2], though our longitudinal coverage is far more complete. As seen in Fig. 1, the maximum radial excursion is significantly larger than the amplitude of the model, consistent with the high residuals in the model fit. Mimas is not precisely aligned with periapse, but rather lags it by about 28°, a result expected for a self-gravitating ring in which orbital energy is being dissipated through collisions, or alternatively due to libration with respect to Mimas caused by a free eccentricity.

3 Huygens ringlet

The Huygens ringlet lies 275 km outside the Mimas 2:1 inner Lindblad resonance. In previous work [1,3], two kinematic components were observed in the ringlet: an m=1 freely precessing component, and an m=2 component that precessed with the mean motion of Mimas. In this work, we observe those same modes (Figs. 2 and 3), though we find the amplitude of the m=2 mode to be only about 2 km, small enough to be accounted for by forcing from Mimas alone. The phase of the Huygens m=2 mode is almost precisely opposite to that of the B-ring, a configuration expected for streamlines exterior to the resonance, so Mimas trails its apoapse by about 28°. It has been suggested [1] that part of the Huygens m=2 distortion could be attributable to forcing by the eccentric outer B ring, and the precise anti-alignment between the two may be evidence of that. In addition to these two previously observed modes, we see a periodic signature that appears to be an m=6 mode (Fig. 4) with an amplitude of 1 km moving at 631 $^\circ/day$, the rate expected for an inner Lindblad resonance of that wavenumber. We have not identified a specific resonance that might force such a pattern. Another possible cause of such a disturbance is a viscous overstability (also known as a pulsation instability) [4]. Note that this observation occurs at the limit of our resolution and the fit to the m=6 pattern is rough.

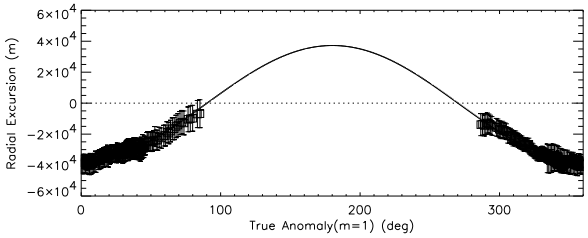

Figure 2: The Huygens ringlet. The curve shows the best-fit m=1 component.

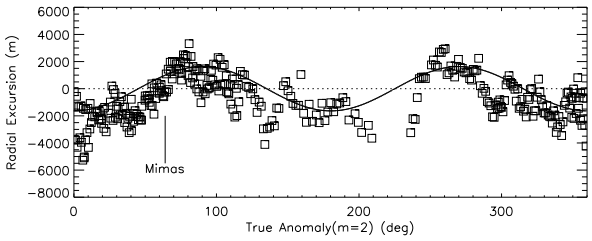

Figure 3: The Huygens ringlet with the m=1 component subtracted. The curve shows the best-fit m=2 component. Error bars have been omitted for clarity.

We will also present our results on the outer edge of the A ring, and other eccentric ringlets throughout the rings.

4 References

[1] Proco, C. (1983) PhD Dissertation [2] Porco, C., Danielson, G. E., Goldreich, P., Holberg, J. B., and Lane, A. L. (1984) *Icarus* 60, 17–28. [3] Turtle, E., Porco, C., Haemmerle, V., Hubbard, W., and Clark, R. (1991) *BAAS* 23. [4] Borderies, N., Goldreich, P., and Tremaine, S. (1985) *Icarus* 63, 406–420.

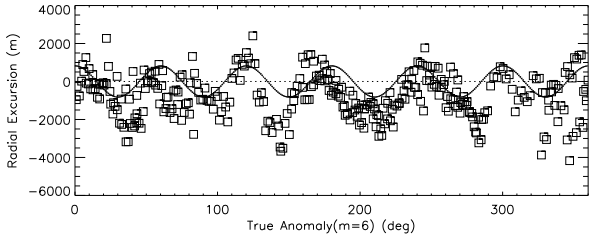

Figure 4: The Huygens ringlet with the m=1 and 2 components subtracted. The curve shows the best-fit m=6 component. Error bars have been omitted for clarity.