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Keck and VLT AO Observations and Models of the Uranian Rings During the 2007 Ring Plane Crossings

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Abstract

We observed the uranian rings at and near the ring plane crossing (RPX) of 16 August 2007 using the Keck and VLT telescopes, both equipped with near-infrared cameras coupled to adaptive optics systems. The rings are partially obscuring each other when they are close edge-on, therefore we developed a model to analyze the observations. The model was tested by Dunn, de Pater and Stam (2010) against observations of the uranian rings that were taken in July 2004. In this talk we present results based on a comparison of the RPX Keck and VLT observations with models.

1. Introduction

In 2007, the rings of Uranus appeared edge-on as seen from Earth for the first time since their 1977 discovery. Three ring plane crossings (RPXs) occurred from Earth's perspective over a ~9.5 months period: 3 May 2007, 16 August 2007, and 20 February 2008. The Sun crossed the ring plane on 7 December 2007 (equinox). We used the Keck telescope equipped with the NIRC2 camera coupled to the adaptive optics system in July-September and in December 2007. This period includes the RPX on August 16, and observations of the dark (unlit) face of the rings (May-August; December) and the lit side under small ring inclination angles (August-September). Together with observations obtained in previous and later years, the data cover a wide range of illumination and viewing geometries. We used the VLT on 15-17 August 2007, covering the 16 August RPX.

Dunn, de Pater and Stam (2010) developed a model to simulate the uranian rings. We adapted this model to very small ring inclination angles, i.e., at angles where the rings are partially obscuring each other. We use this model to extract information about the uranian rings during RPX. Note that this edge-on geometry provides views of the planet's ring system that differ significantly from what is normally seen: optically thick rings fade when the ring opening angle decreases, and optically thin rings brighten. As discussed by de Pater et al. (2007), the first observations during the 2007 ring plane crossing (RPX) event revealed large changes in the spatial distribution of dust in the uranian rings since they were imaged by the Voyager spacecraft in 1986. Hence a more detailed analysis of the rings under these viewing conditions will provide us with a wealth of new information on the physical properties of the rings.

2. Results

A preliminary comparison between data and models is shown in Figure 1. A quantitative comparison shows, e.g., that the zeta ring must be "puffy", with an effective full ring thickness of ~850 km.

Acknowledgements

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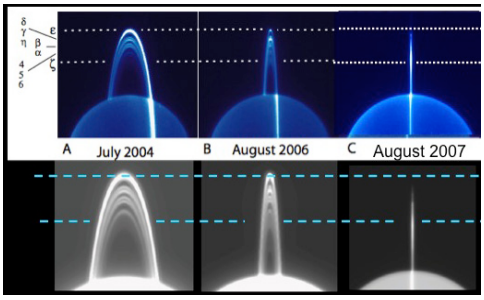

Figure 1: Data obtained with the Keck telescope are shown at the top (from de Pater et al. 2007); models at the same viewing aspects are shown in the bottom row. The dotted lines show the location of the epsilon and zeta rings.

References

[1] Dunn, D. E., I. de Pater, and D. Stam, 2010. Modeling the uranian rings at 2.2 lm: Comparison with Keck AO data from July 2004. Icarus, 208, 927-937.

[2] de Pater, I., Hammel, H.B., Showalter, M.R., van Dam, M.A., 2007. The dark side of the rings of Uranus. Science 317 (5846), 1888–1890.