DETECTING A PLANET BY ROTATION OF STRUCTURE IN THE EPSILON ERIDANI DEBRIS DISK.

J. S. Greaves[1] , C. J. Poulton[1], W. S. Holland[2], M. C. Wyatt[3] and W. R. F. Dent[2], [1]Physics & Astronomy, University of St Andrews, Fife KY16 9SS, UK, [2]Astronomy Technology Centre, Royal Observatory, Edinburgh EH9 3HJ, UK, [3]Institute of Astronomy, University of Cambridge, Cambridge CB3 0HA, UK.

Introduction: We present submillimetre images of the epsilon Eridani debris disk, made between 1997 and 2002 using the SCUBA camera at 450 and 850 microns [1,2]. The thermal emission of dust particles traces debris generated by collisions amongst a belt of comets, situated between 40 and 90 AU from the star. Bright peaks in the dust belt originally detected at 850 microns in 1997 are confirmed in later images and also seen at 450 microns (Figures 1a, 1b). This structure is characteristic of dust trapped in resonances with a planetary body.

Results: The long-period experiment has allowed a search for translation of the dust ring across the sky following the star's proper motion, and a preliminary test for rotation of the clumps assuming they follow the orbital motion of an unseen planet. The data confirm that the ring is a coherent structure associated with the star. Further, three bright peaks (Figure 1c) are suggested to have anti-clockwise rotation of the order of 1 degree per year, while other features are background objects or blends of ring-dust and background emission.

Simulations: The orbital period of the planet can be estimated by fitting the data from two epochs separated in time and looking for an image match with varying degrees of rotation. The preliminary results are consistent with an orbit at tens of AU [3]. The results are affected by the number of non-moving background dusty galaxies included in the vicinity of the dust ring, and simulations were made to investigate this problems. These simulations show that the rotation periods of interest (hundreds of years) are difficult to extract given that the galaxy population is a signifcant source of non-uniformity, and that the clumps move by less than a beam-width over a few years. We use the simulations to estimate at what point in the future a rotation signature will be robust, and show that a definitive test may be made with the SCUBA-2 camera, due to be available in 2007.

References: [1] Greaves J. S. et al. (1998) *ApJ, 506*, L133 [2] Greaves J. S. et al. (2005) *ApJ, 619*, L187 [3] Poulton C. J. and Greaves J.S., in prep.

Figure 1. SCUBA images of the epsilon Eridani debris disk. (a) 850 microns, (b) 450 microns overlaid with 850 micron contours, (c) 1997/8 image at 850 microns overlaid with contours of 2000-2002 image at the same wavelength. Black arrows show proper motion and suggested rotation of the clumps; black squares show non-moving features.