Abstract Submitted
for the APR15 Meeting of
The American Physical Society

Weighing ULX Black Holes Using X-ray Reverberation Mapping TOD STROHMAYER, NASA/GSFC, DHEERAJ PASHAM, CRESST, NASA/GSFC — Ultra-luminous X-ray sources (ULXs) are bright, variable, non-AGN point sources in nearby galaxies. Their high luminosities and X-ray timing properties suggest some of the brightest ULXs may be accreting intermediate-mass black holes (mass range of a few$\times$(100-1000) solar masses), but definitive, dynamical mass measurements have not yet been achieved. Here we present initial results of the first simultaneous X-ray - optical reverberation mapping study of a ULX in order to weigh its black hole. If the optical flux is driven by X-ray irradiation, then the time lag between the two bands gives the size of the accretion disk. This time lag can then be combined with measured line widths from the disk to obtain a mass estimate in a manner analogous to AGN reverberation mapping. As a pilot study, we observed ULX NGC 5408 X-1 simultaneously in the optical (using FORS2 and the 8m Very Large Telescope) and the X-ray (XMM-Newton). We detect the optical counterpart and obtain a photometric light curve with time resolution of a few minutes. We also detect X-ray variability and present a cross-correlation analysis for this object. We describe the implications of these results for NGC 5408 X-1's mass and discuss future prospects for extending this method to weigh ULX black holes in general

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Date submitted: 09 Jan 2015 Electronic form version 1.4