

XMM-NEWTON OBSERVATIONS OF CYGNUS X-1

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Final Report

For Period 1 May 2004 through 31 August 2005

Principal Investigator
Dr. Jon Miller

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The Smithsonian Astrophysical Observatory
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Harvard-Smithsonian Center for Astrophysics

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Report on Grant NNG04GI82G

XMM-Newton Observations of Cygnus X-1

PI: Dr. Jon M. Miller (jmmiller@cfa.harvard.edu)

Note: This report is submitted so that the PI may transfer the award from SAO to The Univ. of Michigan Dept. of Astronomy. The PI will be an assistant professor of astronomy starting on Sept. 1 2005.

Award Start Date: May 1 2004

Proposed SAO End Date: August 31 2005

Proposed Univ. of Michigan Start Date: October 1 2005

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UM contact: Ms. Stephanie Ford (zeeford@umich.edu)

1 Work Completed at SAO

Observations of Cygnus X-1 were first attempted under this program in the spring of 2004, but were complicated by instrumental flaring problems. Successful observations were completed in the fall of 2004, and processed data were delivered to the PI in the winter and spring of 2005. Thus, focused work on this data was only possible starting in 2005.

A preliminary reduction and analysis of data from the EPIC CCD cameras and the Reflection Grating Spectrometer has been made. The EPIC spectra reveal the best example of a broadened, relativistic iron emission line yet found in Cygnus X-1. The Oxygen K-shell region has been shown to be a very complex wavelength range in numerous spectra of accreting sources, but the RGS spectra reveal this region in great detail and will be important in understanding the wind from the O-type donor star that is focused onto the black hole in Cygnus X-1.

2 Future Work Under this Grant

Future work on these observations will include finishing a full analysis of the data, reporting the results in refereed journals, and presentation of the results at conferences.

The remaining analysis involves a particularly complex modeling component, in which model spectra are relativistically "blurred" before comparison to the observed spectra. This step is crucial to understanding the innermost relativistic regime around the black hole in Cygnus X-1, and will require the PI to travel to the UK to collaborate directly with Co-I Fabian at the Univ. of Cambridge.

As the research remaining is both important and extensive, the full remainder of the original award should be transferred to the PI at the University of Michigan to assure that the required work is completed.