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First Test of an Aerogel Cherenkov Detector for Characterizing the Cygnus X-ray Source

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A dual-module Aerogel Cherenkov Detector for Cygnus (ACD/C) was used to measure the X-ray energy spectrum from Cygnus –an intense flash X-ray source operated at the Nevada National Security Site. The ACD/C employs an array of SiO2 aerogels & solids (i.e., quartz) at different densities (50 –2500 mg/cc) and hence varying Cherenkov energy thresholds (2.8 MeV X-ray energy for aerogel with 50 mg/cc down to 0.4 MeV X-ray energy for quartz with 2500 mg/cc). The energy range of ACD/C is adequate to characterize the Cygnus spectrum, where the maximum energy of the spectrum is normally around 2.25 MeV. The ACD/C also has a fast-time response, on the order of 1 ns, which can provide the temporal resolution needed to characterize the ˜ 50 ns radiation pulse of Cygnus.

For the initial proof-of-concept test, two energy thresholds (0.4 MeV by quartz and 1.1 MeV by aerogel with 260 mg/cc) were tested simultaneously. For a 50 ns full width at half maximum (FWHM) Cygnus pulse, the quartz signal of 0.4 MeV threshold was approximately 32 ns FWHM and the aerogel signal of 1.1 MeV threshold was approximately 18 ns FWHM. These data qualitatively suggest that the Cygnus X-ray spectrum is evolving in time, and the high-energy X-ray peak exists on a shorter timescale than the Cygnus voltage or current pulse. In addition, the ACD/C signal ratio of the 1.1 MeV module to the 0.4 MeV module responded to variations in diode voltage intended to vary the spectral end point energy. This will be further quantified by comparison with magnetic spectrometer data.

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