Feedback at the Working Surface: A Joint X-ray and Low-Frequency Radio Spectral Study of the Cocoon Shock in Cygnus A

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401.05 – Feedback at the Working Surface: A Joint X-ray and Low-Frequency Radio Spectral Study of the Cocoon Shock in Cygnus A

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We report on preliminary results from a joint spectral analysis of the cocoon shock region in Cygnus A using deep archival Chandra data and new low-frequency radio data from LOFAR. Being both bright in X-rays and the most powerful radio source in the local universe, the FRII radio galaxy Cygnus A represents an ideal opportunity to study the interaction between the jets produced by the central AGN and the surrounding intracluster medium (ICM) in which that AGN is embedded. Using the entire 235 ksec archival Chandra exposure, we have performed a spatially resolved, X-ray spectral analysis of the ICM in Cygnus A. By combining the resulting X-ray images and temperature maps with spectral index maps between 30-80 MHz and 120-180 MHz calculated from a recent, deep

LOFAR observation, we can resolve the X-ray and radio emitting plasmas in any given region on spatial scales of 3-4 kpc over the central 100 kpc. We clearly resolve the cocoon shock surrounding Cygnus A and determine the Mach number of the shock as a function of position angle. Temperature jumps associated with this shock are detected over a large fraction of the total shock circumference. Significant non-thermal emission is also detected in the regions surrounding the SE and NW leading edges of the shock near the hotspots. In this talk, we will present a detailed analysis of the energetics of this interface region between the radio plasma inside the cocoon shock and the X-ray emitting gas outside the shock. Inside the shock, we will present constraints on the emission mechanisms in the jet, counter-jet, and hotspots based on the combined radio and X-ray spectra. Using maps of the spectral age derived from the LOFAR data and independent age estimates based on various cavity features seen in the X-ray image, we will present a picture of the evolution of the shock region in Cygnus A over the past 50 Myr. Finally, we will discuss the implications these observations have for AGN feedback models as well as the energy transfer mechanism itself.