We present the design and scientific motivation for Arcus, an X-ray grating spectrometer mission to be proposed to NASA as a MIDEX in 2016. This mission will observe structure formation at and beyond the edges of clusters and galaxies, feedback from supermassive black holes, the structure of the interstellar medium and the formation and evolution of stars. Key mission design parameters are R=3000 and ~500 cm$^2$ of effective area at the crucial O VII and O VIII lines, with the full bandpass going from ~10-50 Å. Arcus will address significant aspects of the science goals of the 2010 Decadal Survey at the cost of a MIDEX mission, with observational capability thereafter.

**EXPLORING MATTER AT THE EDGES OF GALAXIES**

Bright background sources illuminate material at and beyond the edges of clusters and galaxies. Combined with spectra of Milky Way sources, Arcus will allow us to create a complete picture of the formation and cycling of metals in and out of galaxies and clusters. Multiple lines of sight exist that will allow us to map the location, motion, and temperature of hot gas around galaxies, groups, and clusters, revealing its origin and destiny.

**FEEDBACK FROM SUPERMASSIVE BLACK HOLES**

Arcus will observe the end products of structure formation in the form of hot gas beyond the virial radius of galaxies and clusters, as well as detecting filaments in the IGM itself via absorption to background AGN. In the case shown at right, a single AGN observation can reveal absorption features from multiple galaxies to map the distribution of hot gas around typical galaxies with ease. Arcus will allow us to identify features in hot gas outflow that match cooler gas detected by HST (see right). Hot gas is thought to carry most of the energy of the outflow, but diagnosing their mass requires using density-sensitive lines that are not resolvable with existing missions or even Astro-H.

**THE BIRTH AND EVOLUTION OF STARS**

Accretion from a protoplanetary disk drives the final stage of star formation, during which planets are also formed. Accreting young stars are spinning too slowly, given that they are still adding mass and contracting. Does the accretion drive a wind that removes angular momentum? Similarly, young stars show high levels of magnetic activity relative to their main sequence counterparts. How do the accretion streams interact with the stellar magnetic fields? High-resolution X-ray spectra are the only way to diagnose these highly-energetic processes.

**Conclusions**

The Arcus science goals were highly regarded both by NASA and by the community, as reflected by their mention in the 2010 New Worlds, New Horizons Decadal Survey. With ESA’s decision to launch Athena in 2028 as their L2 mission, the grazing science community remains an exciting opportunity. The challenge has been to achieve those goals in a timely fashion and an affordable cost.

Arcus will address significant aspects of the scientific recommendations of the 2010 Decadal Survey at the cost of a MIDEX mission, with observational capability thereafter.

**Arcus: Exploring the Formation and Evolution of Clusters, Galaxies and Stars**

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