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Distribution of Matter in and around Galaxies

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The chemical evolution of the Universe embraces aspects that reach deep into modern astrophysics and cosmology. We want to know how present and past matter is affected by various levels and types of nucleo-synthesis and stellar evolution. Three major categories include the study of pre-mordial star and black hole formation, the embedded evolution of the intergalactic medium (IGM), and the status and evolution of stars and the interstellar medium (ISM) in galaxies. A fourth category relates to our understanding of dark matter in relation with these three categories. The X-ray band is particularly sensitive to K- and L-shell absorption and scattering from high abundant elements like C, N, O, Ne, Mg, Si, S, Ar, Ca, Fe, and Ni. Like the Lyman alpha forest in the optical band, absorbers in the IGM produce an X-ray line forest along the line of sight in the X-ray spectrum of a background quasar. Similary bright X-ray sources within galaxies and the Milky Way produce a continuum, which is being absorbed by elements in various phases of the ISM.

Since its emergence, high resolution X-ray spectroscopy has greatly impacted studies of properties of the gas phases of the ISM of the Milky Way. greatly impacted studies of properties of the gas phases in the interstellar medium (ISM) of the Milky Way and warm absorber phases in galaxies. At the forefront we have the high energy transition grating spectrometer (HETGS) with its unprecedented spectral resolution onboard the Chandra X-Ray Observatory. Resolving the O K, Ne K, and to some extent the Fe L edge structures reveal how X-ray spectra are are affected by absorption and exposed the physics of the cold, warm, ionized and hot phases of the ISM. Studies of higher Z edges such as Mg K, Si K, S K and to a large extent Fe L in contrast indicate dominant dust signatures in the edge structure. In this presentation we review and summarize the efforts made by observations with the HETGS so far and include recent findings of multiple edge functions, near edge absorption excesses from silicates in dust form, contributions from X-ray scattering optical depths as well a the presence of variable warm absorbers from silicon and iron. These studies also reveal that many of the details we observe remain unchallenged by current capabilites. In this respect we also show how future observatories such as Athena, XARM, and possibly Arcus and Lynx will lead us to a much broader understanding of the categories defining the state and distribution of matter in and around galaxies.

Topic

Compact and diffuse sources in galaxies and in the Galactic Center

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