Interstellar Dust in Our Galaxy

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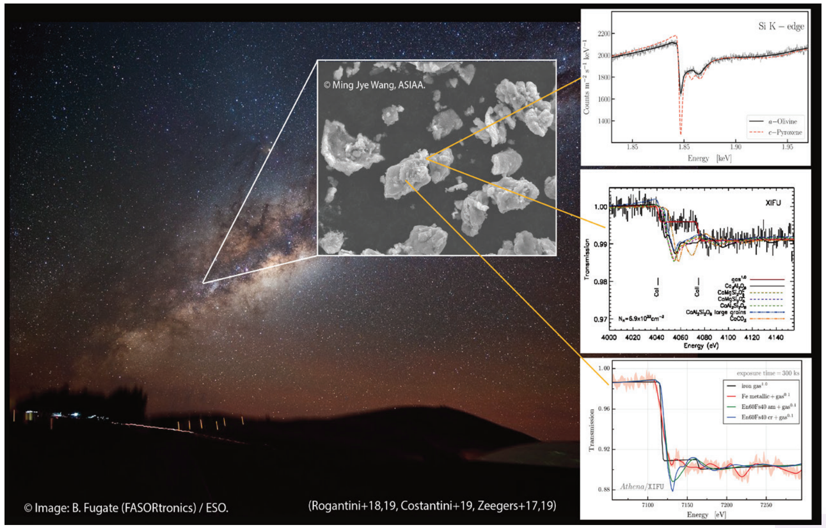

Athena will be able to decipher the chemistry of the dust along our line of sight through spectroscopy of the features the dust imprints on the spectrum of a background X-ray source. In this example Si and Fe are main constituents of silicates, while Ca is believed to reside in the core of the grain.

Dust is everywhere in the Universe, from stellar disks that eventually form planets and life to far-away galaxies formed at the dawn of structures formation. In our Galaxy dust particles constitute about 1% of the total interstellar medium, a tenuous mixture of dust and gas between the stars. The vast majority of dust is made of carbon, silicon, magnesium, iron and oxygen, which are among the main constituents of our own planet.

Interstellar dust was discovered and described in the eighteenth century, but only in the last 50 years, have the physical and chemical properties of dust been identified. This was enabled by multi-wavelength observations, from the radio band to the far-ultraviolet wavelengths. The X-ray band came only recently to substantially contribute to this study, thanks to high energy resolution instruments onboard XMM-*Newton* and *Chandra*. It has been soon realized that X-rays, thanks to their large penetrating power, could investigate environments with different densities, allowing the mapping of many regions of our Galaxy. If an X-ray source lies behind a layer of dust, its primary radiation will be absorbed at specific energies, revealing the composition of dust and in particular of silicates. These are compounds with oxygen, iron, silicon and magnesium, combined with different ratios.

Present and future astronomical observations strongly rely on accurate modeling. For this purpose in recent years a strong boost to laboratory characterization of interstellar dust analogues has been initiated. This allowed researchers to make sound interpretations on both the chemistry of dust, the size of the dust grains as well as their internal structure: does a grain preserve its pristine crystallinity or does it become glassy as soon as it is exposed to cosmic rays and star radiation?

Athena will enable us to explore interstellar dust features with a detail never achieved before and know a lot more about the chemical and physical properties. In particular, *Athena*/X-IFU will access for the first time the iron K edge at 7.1 keV, a signature of extremely dense environments, like the ones near the galactic center, rich in molecular clouds. This will allow us to understand the nature and origin of iron in extreme environments. It will be also possible to observe lower abundance elements (e.g. Ca, Al, S), some of which are likely the original kernel of silicates.