Properties of Aromatic Feature Carriers in Nearby Galaxies

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Abstract

The knowledge of interstellar dust grain properties is crucial to understand numerous physical processes at play in galaxies. In addition, their variation as a function of environmental conditions is a powerful constraint on their evolution. The mid-IR domain contains most of the solid-state resonance features of interstellar grains, including the aromatic infrared bands (AIB). They are considered to arise from a statistical mixing of polycyclic aromatic hydrocarbons (PAH) of different sizes and structures. In order to cover the full spectral range of the most prominent AIBs from 3.3 microns up to 17 microns, we have combined the spectral maps observed with *AKARI*/IRC slit-spectroscopy (2.5 – 5 microns) and *Spitzer*/IRS (5 – 30 micorns), and assessed their inter-calibration. We then performed spectral fitting to extract emission bands. We are currently developing a statistically robust new decomposition method, extending to mid-IR spectroscopy the code HerBIE (HiERarchical Bayesian Inference for dust Emission; Galliano 2018). We will present the variations of the grain properties with physical conditions and discuss the band ratios as a diagnostic of galaxy properties.

*Speaker

This work is meant as a preparation to the *JWST*, which will observe a large number of spatially resolved galaxies with unprecendented angular resolution. In addition, it is also pertinent for the *SPICA* and the *OST* missions, since aromatic features will be widely observed in distant objects (z > 1).

Impact of metal-enrichment on the ISM properties and topology

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Abstract

The emission lines available from ground-based and space telescopes arise from different phases (ionized gas, photo-dissociated region, molecular phase and diffuse ionized gas) which are, most of the time, spatially unresolved.
A complex modeling step, taking into account the available tracers, upper limits, and systematic uncertainties, is much needed to constrain the multi-phase topology of the ISM and how it is impacted by metallicity. Specific questions to be answered include the apparent porosity of the ISM at low-metallicity leading to higher fraction of escaping photons, the influence of disseminated X-ray sources, and the estimation of the molecular gas mass component, including the "CO-dark" gas. The results obtained for nearby metal-poor galaxies may help gain insight on the ISM properties in primitive conditions and metallicity effects that allow for large escape fractions in the context of the reionization.

I will present a grid of Cloudy (Ferland et al. 2017) models to investigate low-metallicity galaxies using a combination of different sectors (Cormier et al. 2015; 2019), some of them being density-bounded (Polles et al. 2019) and including the potential contribution of X-ray sources (Lebouteiller et al. 2017). I chose to implement a Bayesian method using Monte Carlo sampling to produce probability density functions of any physical parameters directly or indirectly available in Cloudy.
I will present a first application on the Dwarf Galaxy Survey (Madden et al. 2013), showing how the inclusion of disseminated X-ray sources may explain the tensions of apparent AGN signatures in metal-poor dwarf galaxies and whether the escape fraction depends on metallicity and what combination of lines may be used as proxy.

*Speaker

The intrinsic reddening of the Small Magellanic Cloud using background galaxies

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Abstract

We present a map of the total intrinsic reddening across _˜34 sq. deg of the Small Magellanic Cloud (SMC) derived using optical (ugriz) and near-infrared (YJKs) spectral energy distributions (SEDs) of background galaxies. The reddening map is created using a subsample of 29,274 galaxies with low levels of intrinsic reddening based on the LePhare chiˆ2 minimisation SED-fitting routine. We find statistically significant enhanced levels of reddening associated with the main body of the SMC compared with regions in the outskirts [delta E(B-V) _˜ 0.3 mag]. A comparison with literature reddening maps of the SMC shows that, after correcting for differences in the volume of the SMC sampled, there is good agreement between our results and maps created using young stars. In contrast, we find significant discrepancies between our results and maps created using old stars or based on longer wavelength far-IR dust emission that could stem from biased samples in the former and uncertainties in the far-IR emissivity and the optical properties of the dust grains in the latter.

*Speaker

Modeling Nebular Line Emission (Understanding the Physics Driving the BPT Offsets at High-Redshift)

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Abstract

The Baldwin, Philips & Terlevich (BPT) diagram has long been used as a physical diagnostic for the ionized gas in galaxies. Recent observations have demonstrated that galaxies at high redshifts may reside offset from local galaxies in the BPT-space. To understand the physics driving this offset we combine cosmological hydrodynamic galaxy formation simulations with photoionization modelling calculations. We have adopted a novel approach where we have developed the first-ever model for calculating the nebular emission line spectrum on a particle-by-particle basis for cosmological galaxy formation simulations. This is a significant step forward from more commonly used lookup-table methods. In this talk, I go over the model and the results from our pilot study.

*Speaker

Measuring intergalactic pollution with X-ray dust scattering halos

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Abstract

Dust particles scatter X-ray light, producing a diffuse halo image around X-ray point sources. In our own Galaxy, spectacular dust scattering echoes from X-ray variable sources can be used to map the 3D spatial distribution of interstellar dust. I will show how dust scattering halos around X-ray bright quasars could be used to probe the abundance and composition of dust inhabiting the intergalactic medium. I will discuss current and future X-ray telescopes' abilities to resolve extragalactic scattering halos, place constraints upon the abundance of diffusely distributed intergalactic dust, dust in galaxy halos, and absorption systems.

*Speaker