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Bayesian tools to unveil the properties of galaxies

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The emission lines arising from galaxies are commonly used as proxies to probe the physical and chemical state of galaxies. Spectra observed in the optical domain using ground base telescopes (ALMA, VLT) and in the infrared domain (Herschel, Spitzer, and the coming missions JWST, SPICA) provide unique "finger-prints"of the interstellar medium, in which are embedded a large set of information concerning the stellar, gas and dust content of the observed galaxy. Such emission can be mapped at local scales (kpc) in the closest galaxies in our neighborhood (z~0) but observations at higher red-shifts are most of the time integrated fluxes emerging from the whole galaxy. The interpretation of such spectra is far from being straight forward, especially because multiple components within the galaxy contribute to the observed emission. If most of the light we see originates from the stars and the ionized gas that surrounds them, there is also a non-negligible emission from dust, neutral or partly ionized gas and molecular clouds. To understand what those spectra reveal, there is a critical need to provide reliable multi-phase modeling of the interstellar medium of galaxies and develop statistical tools to analyze them. In this talk I will present Cloudy, the photo-ionization and photo-dissociation code I used to model galaxies, and how its use can be refined by combining models to realistically mimic the patchy, non-homogeneous nature of the interstellar medium. Using a simple grid of models, I will present a strategy to extract galactic properties from the emission lines available using Bayesian methods. Such a tool could be of great interest to analyze spectra but also to serve as a prediction tool in the framework of spatial missions such as SPICA (ESA pre-selected mission).

Field

InterStellar Medium

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