Photophysics and evolution of cosmic PAHs at the JWST era

Sacha Foschino - MICMAC
Ph.D. day May 16th 2018
IRAP
Infrared observation of the interstellar medium

Aromatic Infrared Bands (AIBs) attributed to Polycyclic Aromatic Hydrocarbons (PAH) (Leger & Puget 1984, Tielens, Allamandolla & Barker 1985)

M81 (spitzer)

NGC 7023
(© Aurelien Lepanot)

Spitzer-IRS spectrum
Ubiquitous emission of PAHs
The identification problem in the interstellar medium

But we can find some tendencies!
Spatial variations of mid-IR spectra

NGC 7023, Spitzer-IRS, 8 µm

Wavelength (µm)

Intensity

Spitzer-IRS spectra

Physical conditions

physicochemical properties of PAHs

Observed variations in mid-IR spectra
Blind signal separation for astronomical PAH spectroscopy

My job until now

Revisit it on spectra with:

- **Larger** wavelength range
- **Higher** spectral resolution

Berné et al. 2007
Spitzer-IRS data
R~70
5 to 15 microns

ISO- SWS spectra:
2.8 to 15 microns
R~260
Necessity to pretreat the data

• Not the same spectral resolution and binning in each spectrum
• Gaz lines
• Dust and star continuums
  ‣ Non-negative least square fit to get only the AIBs
Blind signal separation for astronomical PAH spectroscopy

31 spectra

BSS by MASS-NMF method

ISO-SWS spectrum

MASS: Maximum Angle Signal Separation
(Boulais et al. (2015), IRAP-SISU, Thesis defence dec. 2017)

NMF: non-Negative Matrix Factorization
(algorithm used from Lin 2007)
Spectral reconstruction

- Emission map in good agreement with previous works (Pilleri et al. 2012, Berné et al. 2007)
- Fit not perfect
Futur work with JWST data

This study was made in preparation of the JWST launch

<table>
<thead>
<tr>
<th>Mission</th>
<th>Spatial resolution</th>
<th>Spectral coverage</th>
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<th>Diameter (m)</th>
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<tbody>
<tr>
<td>JWST-NIRSpec/MIRI</td>
<td>0.1 '' (at 2 µm)</td>
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<td>3000</td>
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Thank you for your attention!

(Did you find Waldo?)
More slides
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NMF Initialisation with MASS

- **Maximum Angle Source Separation, Boulais et al. 2015**

  - Allow to determine in the data the vectors that are the most distant in term of angle

  - NMF initialisation with MASS solution near to the expected solution.