


ARGOS-TITAN-TOSCA workshop - 06/06/2024

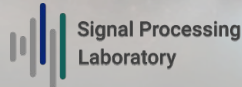
 Heraklion, GR

“Foreground removal and line isolation in LIM sub-mm data”

Athanasia GKOGKOU

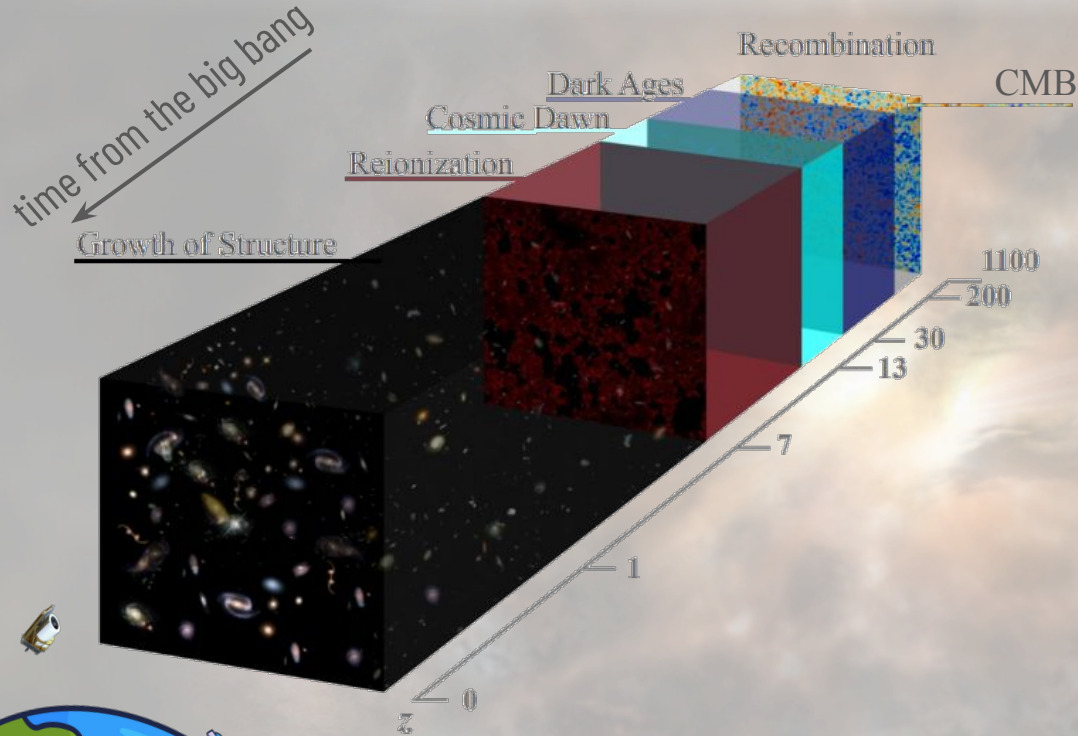
Postdoctoral researcher at IA/ICS-FORTH

Collaborators: V. Bonjean, J-L. Starck, G. Tsagkatakis, P. Tsakalides



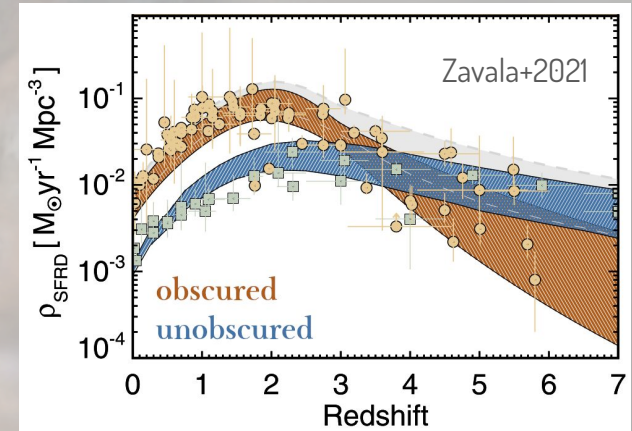
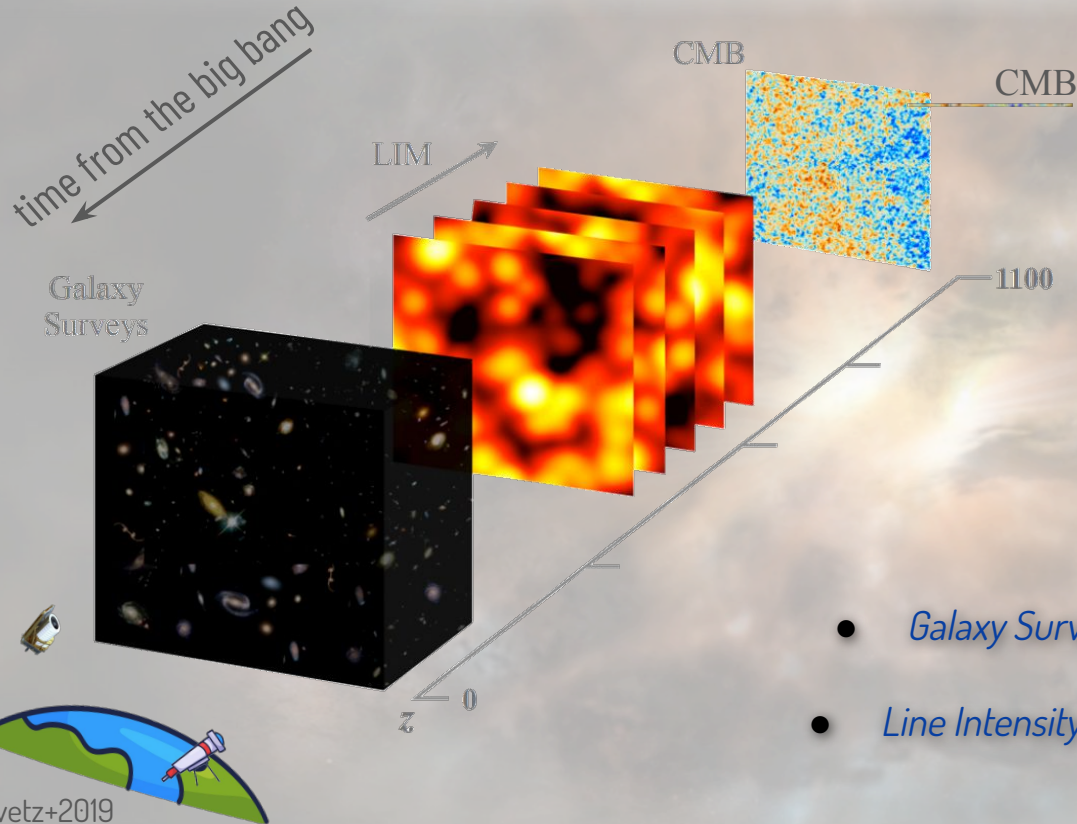
Funded by
the European Union

Galaxy evolution



Kovetz+2019

Galaxy evolution



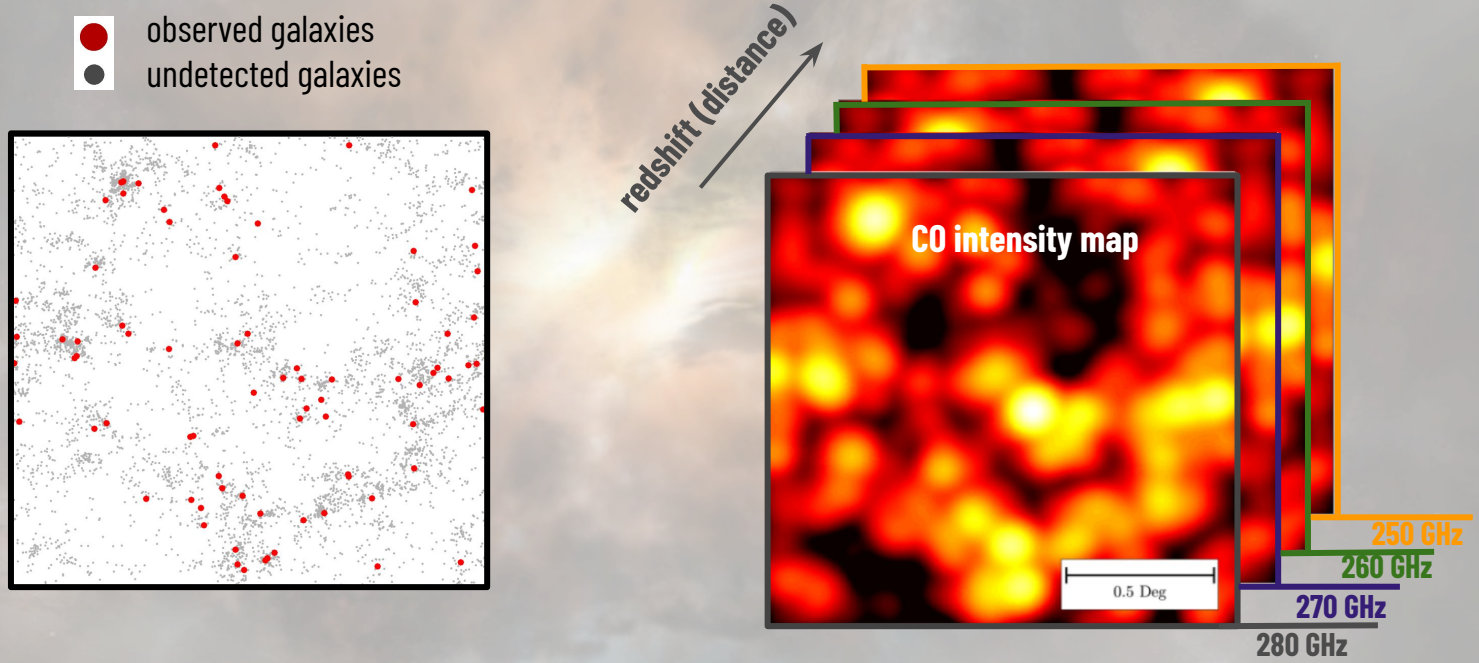
Probes

- *Galaxy Surveys*: understand galaxy formation and evolution
limitations at high- z
- *Line Intensity Mapping (LIM)*: study the large-scale structure of
the Universe up to high- z

Kovetz+2019

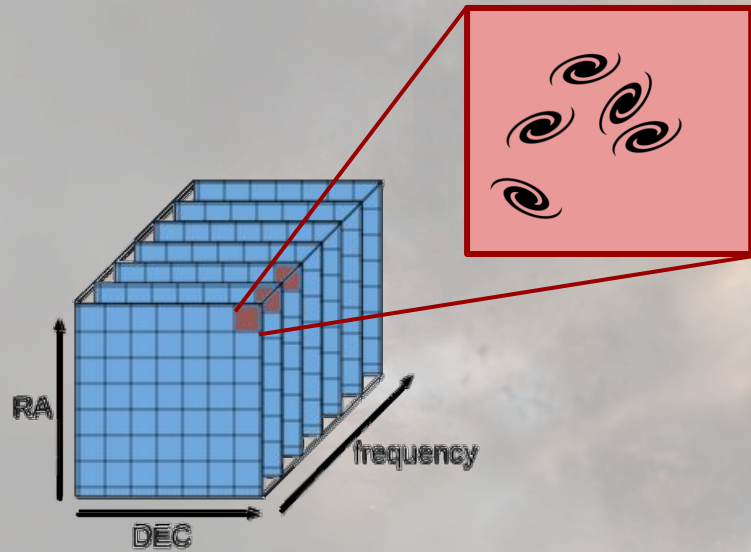
Line Intensity Mapping (LIM) data

LIM: aggregated emission of a spectral line from many unresolved galaxies



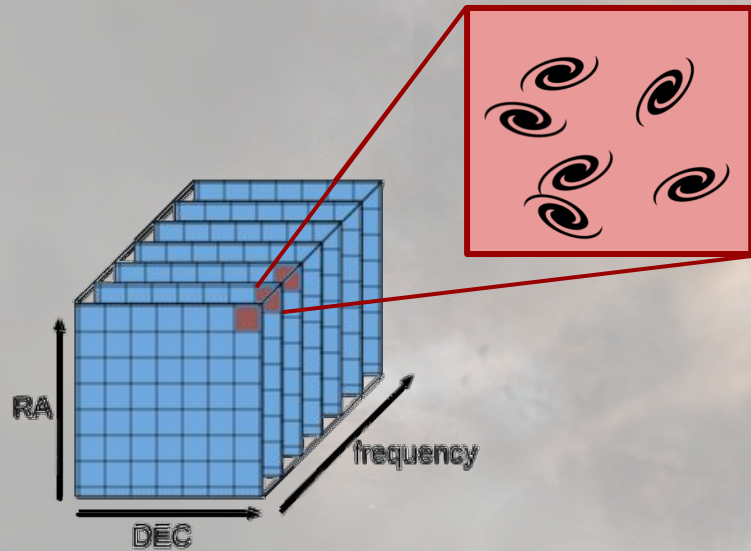
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LIM: aggregated emission of a spectral line from **many unresolved galaxies**



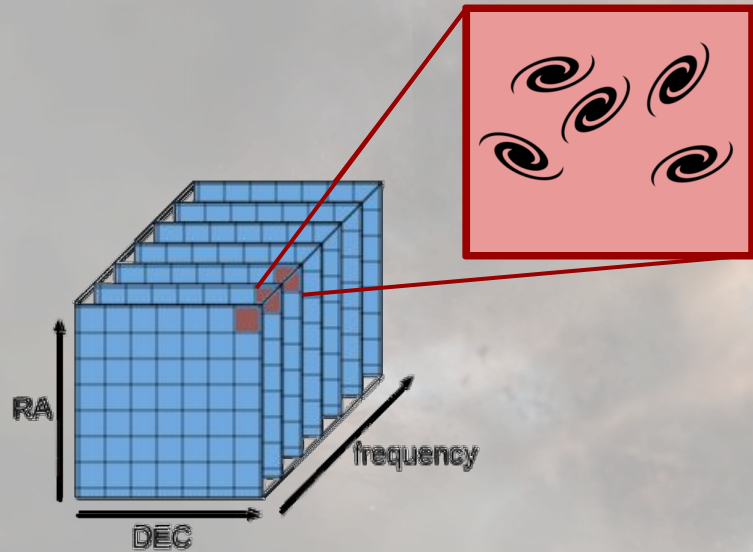
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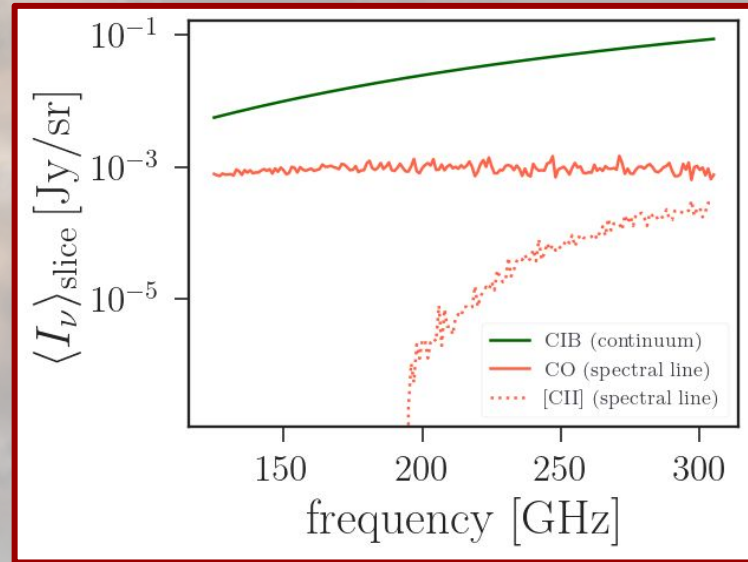
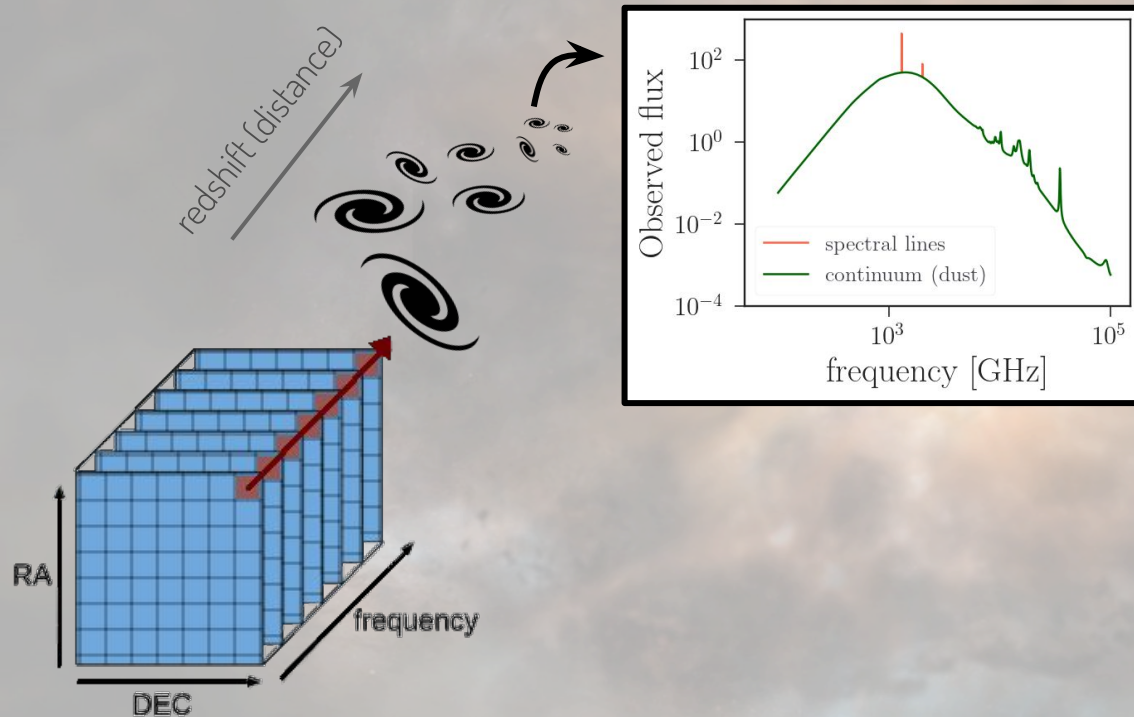
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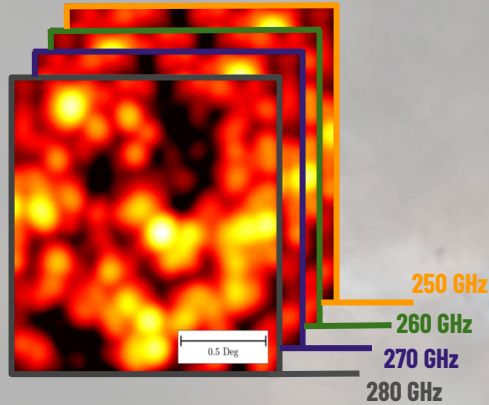
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Interpreting LIM data

LIM data (cubes)

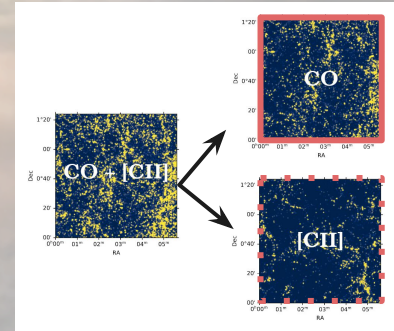
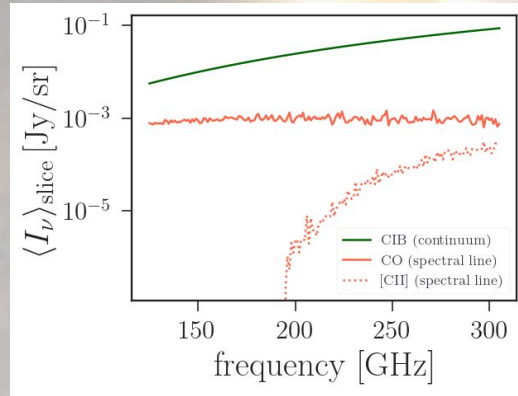


Clean the observed maps/cubes

Denoising

Remove foregrounds (continuum)

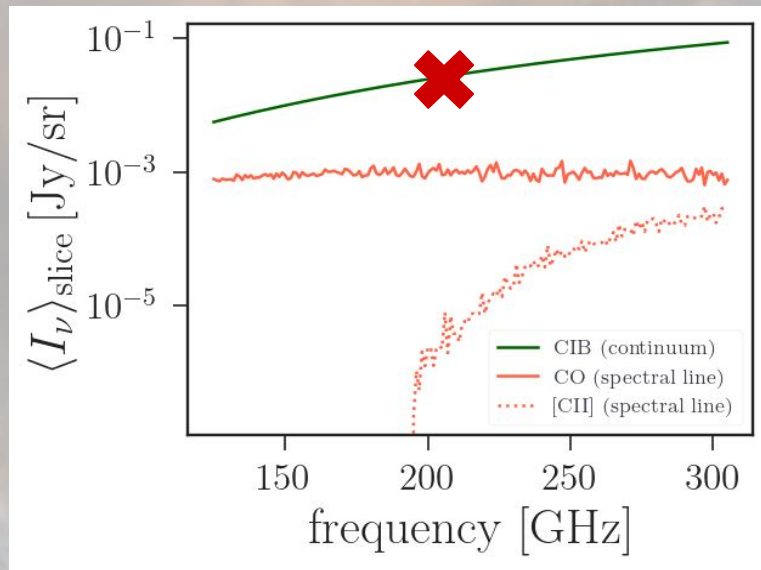
Disentangle the spectral lines



Obtain astro/cosmo parameters

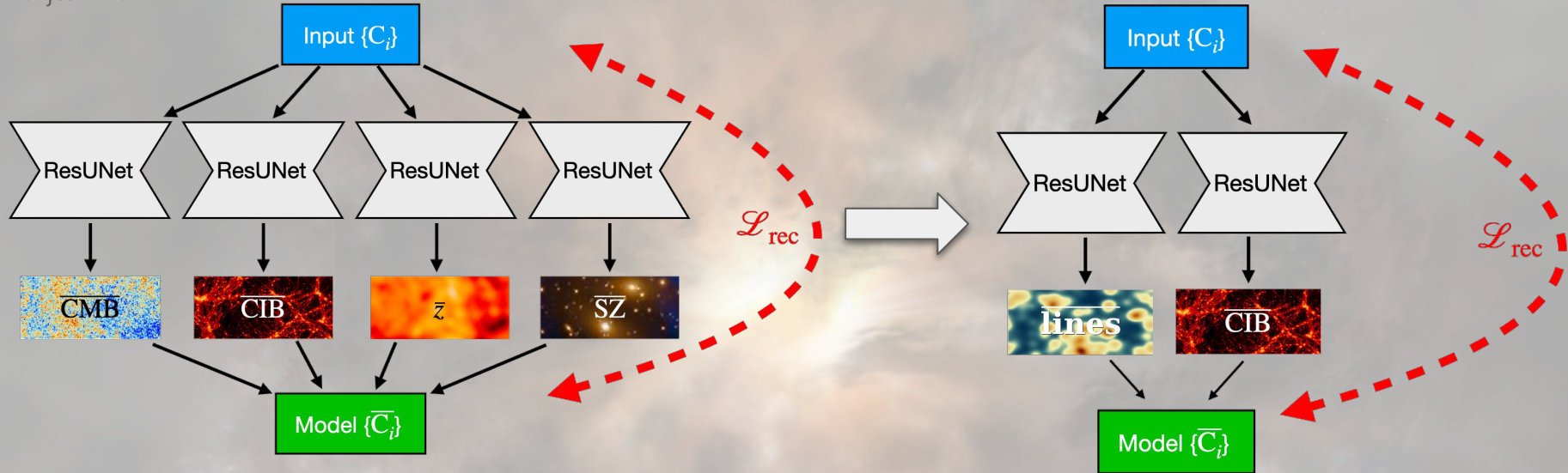
- SFR
- Luminosity function
- Galaxy number density
- $\{\Omega_m, \Omega_b, \Omega_\Lambda, \dots\}$

Foreground removal: Cosmic Infrared Background (CIB)



Foreground removal: Cosmic Infrared Background (CIB)

Bonjean+2024



$$\overline{C}_i = 1 \times \overline{\text{CMB}} + f_i \times \overline{\text{SZ}} + \psi_i(\overline{z}) \overline{\text{CIB}}$$

$$\psi_i(\overline{z}) = \left(\frac{i}{545}\right)^{\beta+3} \times \frac{\exp\left(\frac{h \times 545 \times 10^9 (1+\overline{z})}{k_B T_0 (1+\overline{z})^\alpha}\right) - 1}{\exp\left(\frac{h \times i \times 10^9 (1+\overline{z})}{k_B T_0 (1+\overline{z})^\alpha}\right) - 1}$$

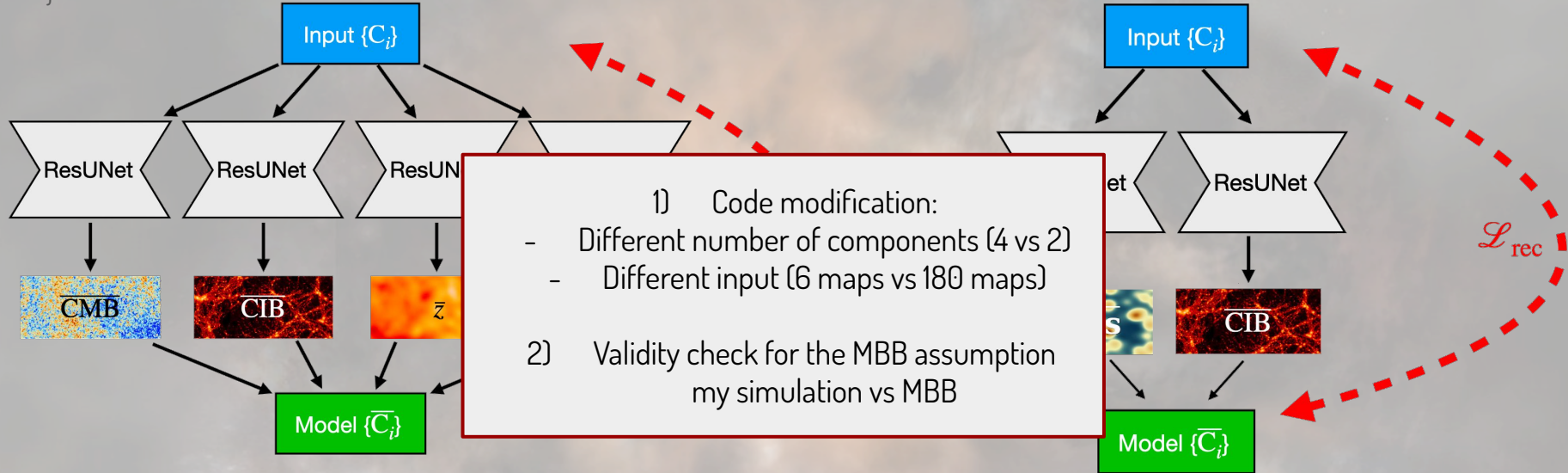
$$C_{i,j} = \text{lines}_{i,j} + \text{CIB}_{i,j}$$

$$C_{i,j} = \text{lines}_{i,j} + g(C_{i,j}) \times \text{CIB}_{\nu_0}$$

i: frequency - j: pixel position

Foreground removal: Cosmic Infrared Background (CIB)

Bonjean+2024



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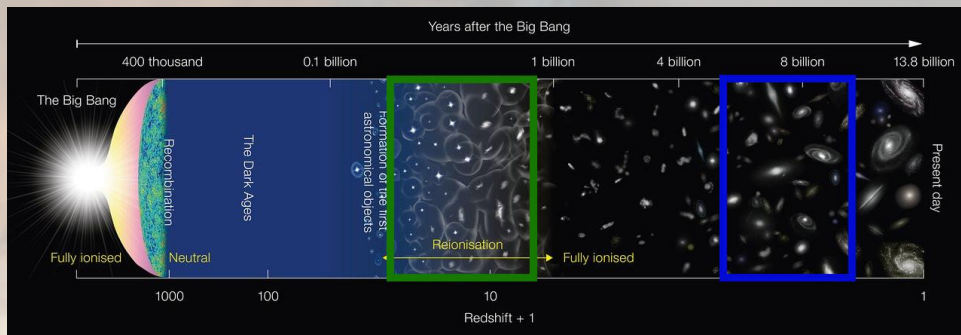
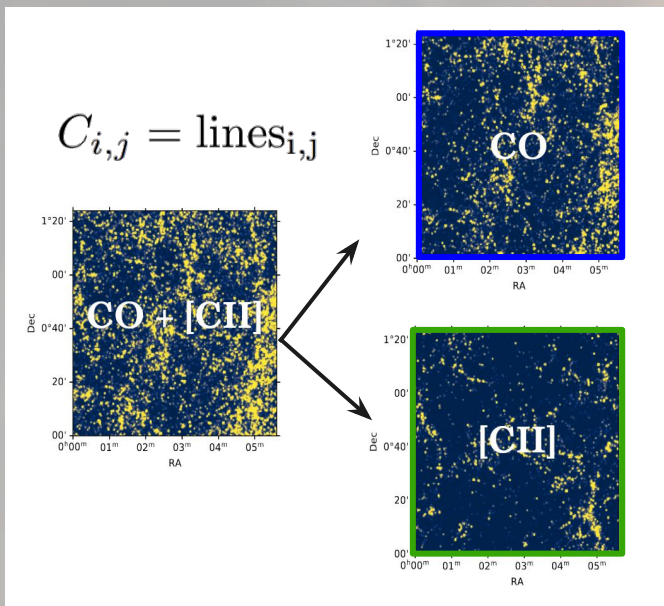
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Component separation: CO vs [CII]



Every cube slice (frequency channel) has different a spatial structure!

“Blind source separation of single-channel mixtures via multi-encoder autoencoders”

Webster & Lee 2024