



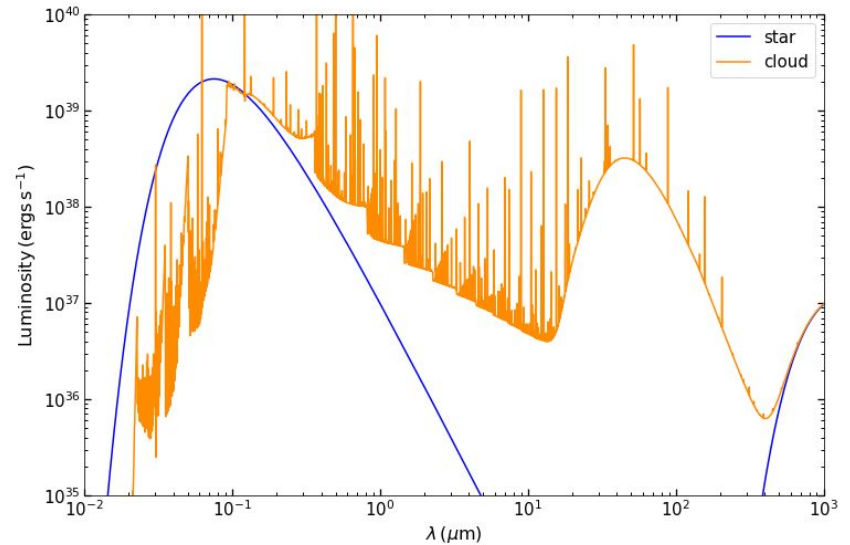
# Cosmic ray ecology using PDRs and **CLOUDY**

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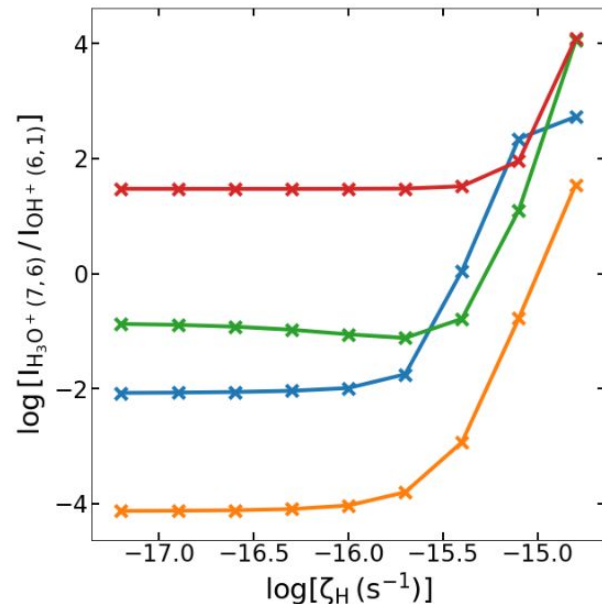
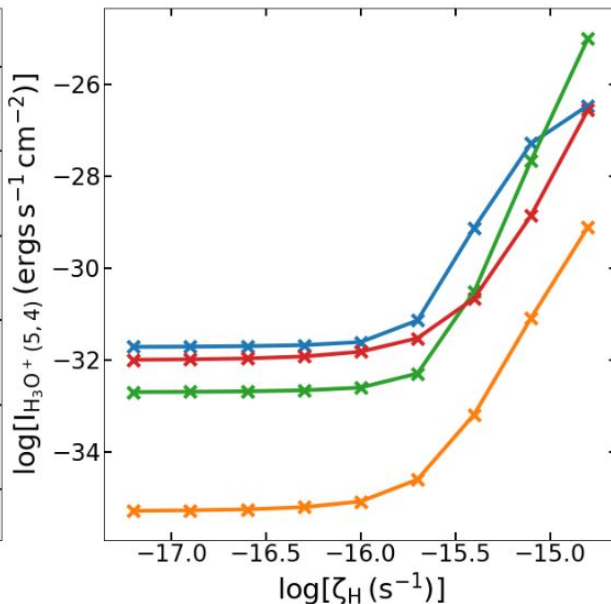
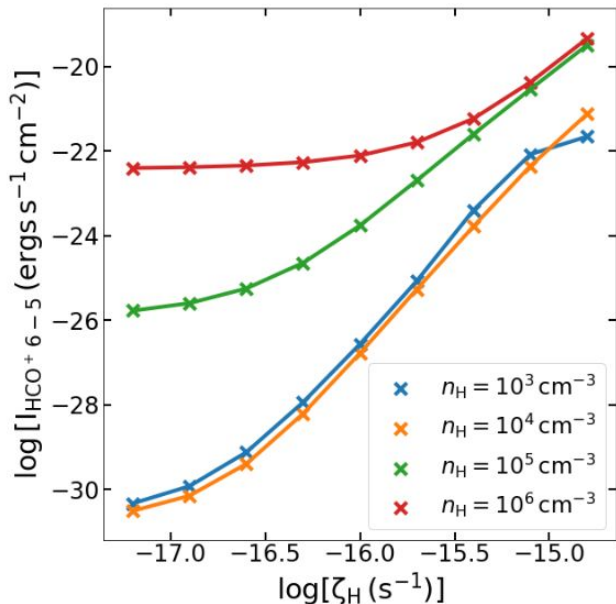
# CLOUDY

- Written in C++, CLOUDY is a spectral synthesis code that simulates the ISM for a broad range of physical conditions (e.g. radiation field, metallicity etc.)
- Simultaneously solves for the ionization, thermal, and chemical state of a cloud
- Predicts the spectrum based on the derived state



predicted spectrum from M16

# Cosmic ray tracers

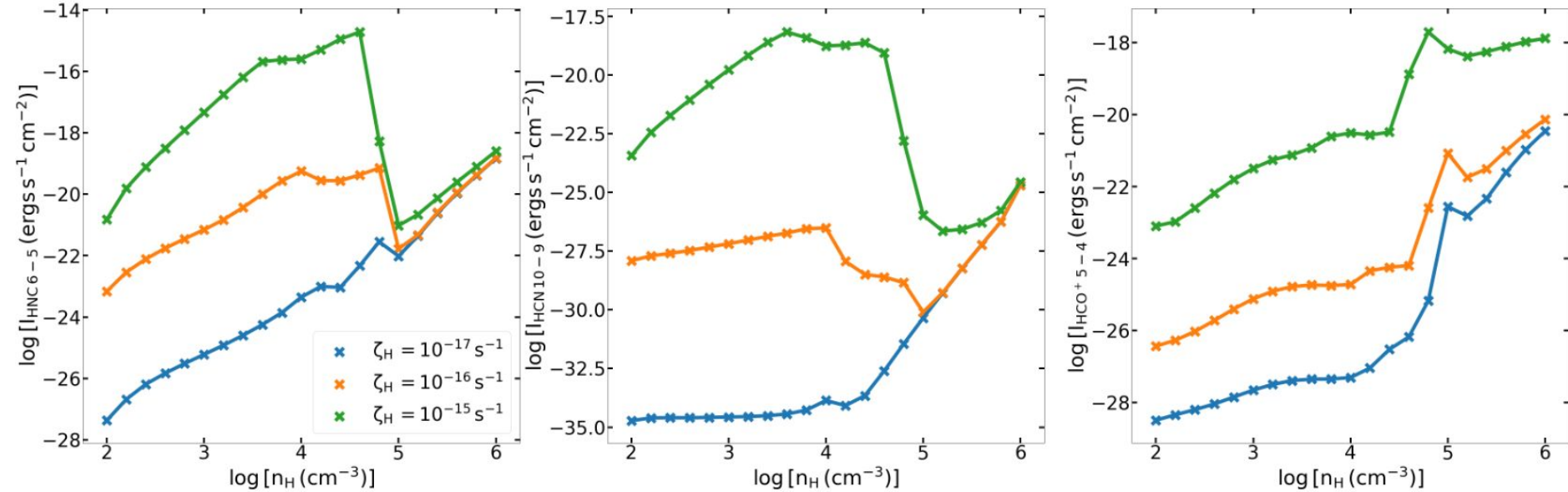


- Cosmic rays heat FUV-shielded regions and affect chemistry
- $\text{HCO}^+$  line intensity gives the best estimate of the cosmic ray background
- $\text{H}_3\text{O}^+/\text{OH}^+$  also traces high cosmic ray backgrounds well

$$G = 10^3 G_0$$

$$\zeta_{\text{MW}} = 2 \times 10^{-16} \text{ s}^{-1}$$

# Dense gas tracers at high $\zeta_H$



$G = 10^3 G_0$

- HNC, HCN, HCO<sup>+</sup> are tracers of gas density (at low  $\zeta_H$ , line intensity follows the density linearly)
- The trend becomes non-linear at higher  $\zeta_H$