An ALMA view of the interstellar medium of the $z = 4.77$ lensed starburst SPT2132-58

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- Sample of lensed $z \sim 4$ dusty star-forming galaxies from SPT
- Magnification $\mu \sim 5-30$ => line detections 25-900 times faster than unlensed
- A new detection of [NII] and CO(12-11) in only 9 min on source with ALMA

Massive elliptical galaxy ($z \sim 1$)
Bright in optical Faint in mm

Dusty SF galaxy ($z \sim 3-6$)
Faint in optical Bright in mm

Normal telescope (ALMA)  Natural telescope (gravitational lensing)

ALMA (ESO/NROA/NAOJ), Calçada, Hezaveh
ALMA unveils SPT 2132-58: an extreme starbursts with an evolved ISM at \( z = 4.77 \)

- Various lines trace various components of the ISM
- Gas content \( \sim 4 \times 10^{10} \) Msun
  ([CI], CO, dust continuum)
  \( \Rightarrow \alpha_{\text{CO}} \sim 1 \) Msun \( (\text{K km/s pc}^2)^{-1} \)
  (compatible with usual 0.8)
  \( \Rightarrow \) very short gas depletion timescale: 34 Myr
  (local spiral: 1Gyr)
- High [CII]/[NII] ratio
  \( \Rightarrow \) PDR dominated
  \( \Rightarrow \) metal enriched \( (0.5 < Z < 1.5) \)
- Bright CO(12-11) line
  \( \Rightarrow \) presence of highly-excited regions (AGN?)