## [CII] as seen by ALMA and consequences for intensity mapping

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## Abstract

The performance of the future [CII] intensity mapping experiments (CONCERTO, TIME, CCAT-p) will depends on the amplitude of [CII] anisotropies. They are directly related to the clustering of galaxies at the end of reionization, the star formation rate (SFR) history, and the SFR-[CII] relation. While the first item will remain hard to constrain before the first intensity mapping measurements, ALMA is providing us interesting insight on the last two. I will summarize the latest results of ALMA on [CII] at high redshift with an emphasis on the ALPINE survey, an ALMA large program focused on [CII] and dust continuum at z > 4.

The SFR history is generally measured using the UV emission from young, short-lived, massive stars. However, even at high redshift, a significant fraction of the UV light from young stars is absorbed by dust and re-emitted at long wavelength. While at  $z_-2$ , 90% of this light is reprocessed, we expect that this fraction is lower at higher redshift, since less metals were formed. The current UV-based estimates of the SFRD relies on the accuracy of the corrections of this dust extinction and a small contribution from very dust objects missed by short-wavelength surveys. Through its detection of the dust continuum, ALMA allows us to test the methods used to correct for dust extinction, but also to derive secure total SFR by the summing the UV and dusty SFR for short-wavelength samples. In contrast, ALMA confirmed the existence of extremely dusty objects as early as z=7 missed by optical/near-IR surveys. Intensity mapping will not be biased by selection effects and will provide important

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constraints on the total SFR density.

Another key relation to forecast the signal in [CII] intensity mapping experiments is the SFR-[CII] relation. At high redshift, the warmer CMB and the stronger intensity of the interstellar radiation field (lower metallicity, higher star formation efficiency) could imply a lower normalization. Measuring this relation at high redshift is difficult because it requests to build comprehensive samples of [CII] emitters, but also to estimate accurately their SFR. I will present the new ALPINE constraints showing that there is no significant average [CII]-deficit compared to the local relation up to  $z_-6$ , which is an excellent news for first-generation [CII] intensity mapping experiments.