FULL DISC [C II] MAPPING OF NEARBY STAR-FORMING GALAXIES

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As a major cooling line of interstellar gas, the far-infrared 158μm line from singly ionised carbon [C II] is an important tracer of various components of the interstellar medium, yet there is still not a strong constraint on the origins of [C II] emission. In this work, we derive the resolved [C II] star formation rate relation and aim to unravel the complexity of the origin of [C II] from SOFIA/FIFI-LS observations in three nearby star-forming galaxies at sub-kiloparsec scales.

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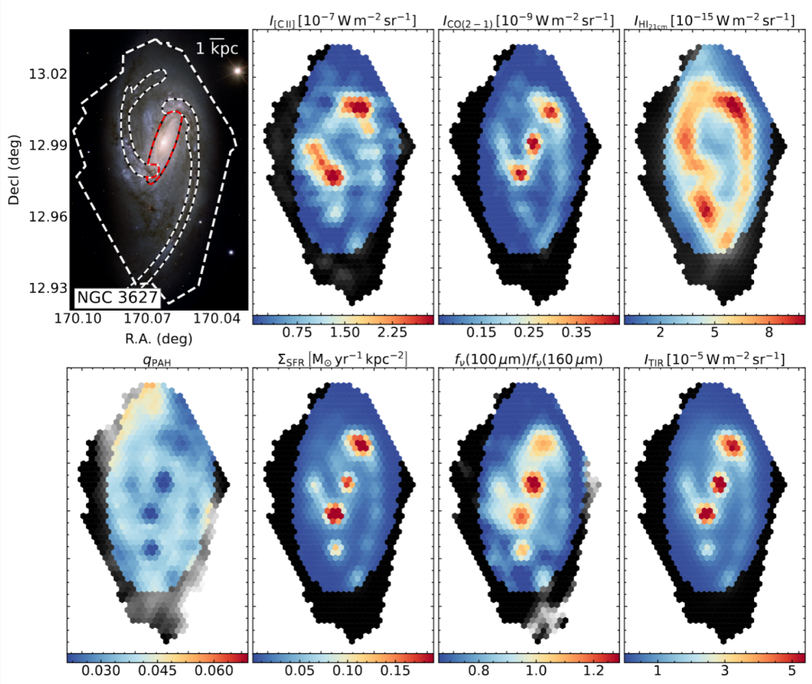
GALAXY SAMPLE

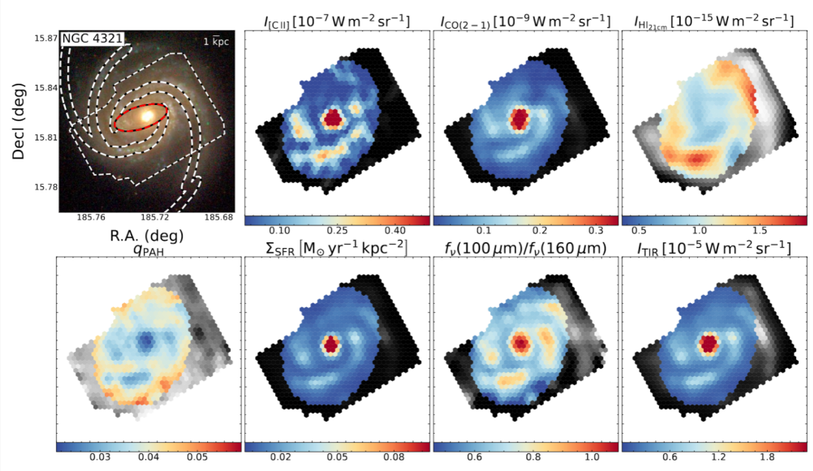
We selected three star-forming galaxies: NGC 3627, NGC 4321, and NGC 6946.

Due to their proximity (7.3 to 15.2 Mpc), the SOFIA observations profit from the high spatial resolution (0.5 – 1.5 kpc) sampling a variety of local environmental conditions.

Additionally, these galaxies are well studied at many other wavelengths, bringing the advantage of available complementary data for the analysis.

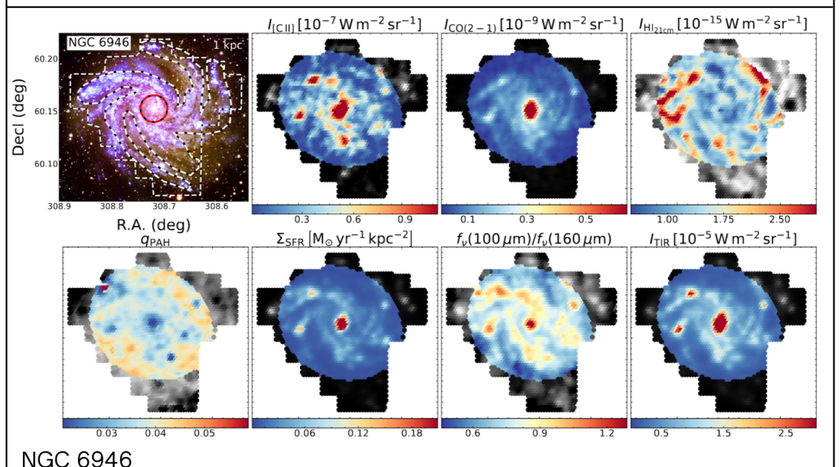


NGC 3627
A barred spiral galaxy with an AGN and an accumulation of gas mass in the spiral arms.



NGC 4321

An intermediate spiral galaxy with an AGN that belongs to the Virgo Cluster and is hydrogen deficient throughout the disc.



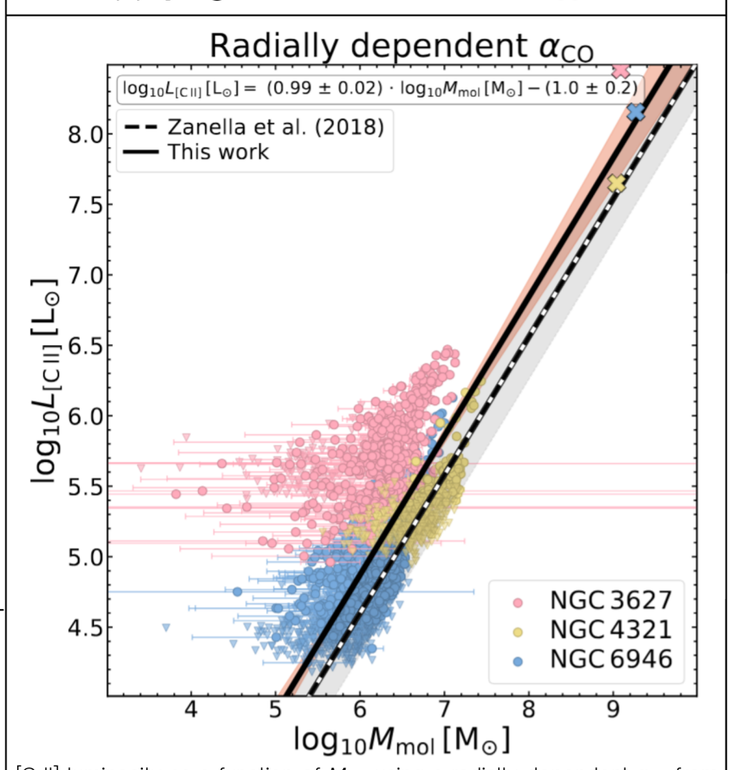
NGC 6946

A double-barred intermediate spiral galaxy with a high SFR and high number of supernovae, belonging to the Local Void.

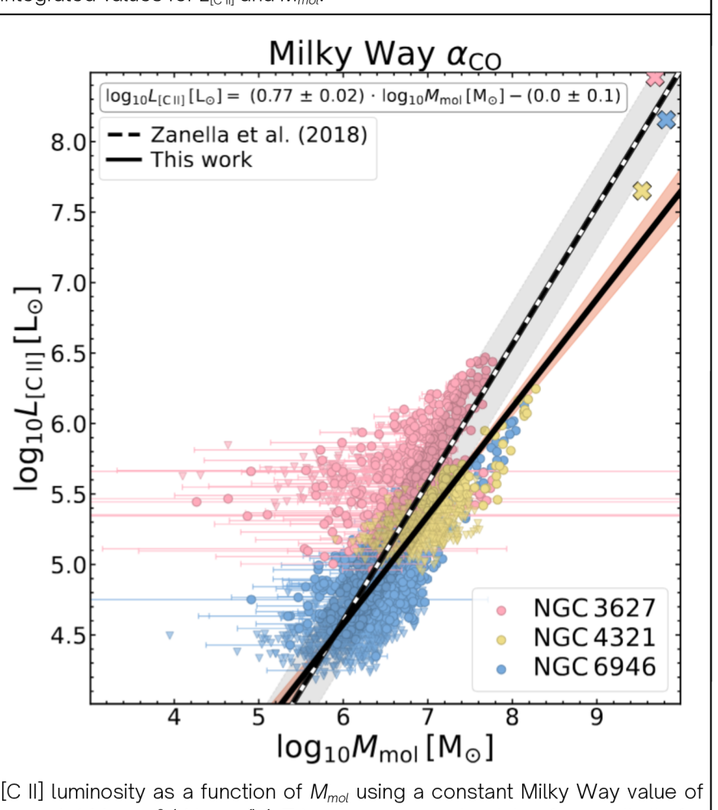
[C II] AS A TRACER OF MOL. GAS

Our analysis reveals a nuanced nature of [C II] as a molecular gas tracer. We derived a relationship between M_{mol} modelled from the HERACLES CO(2-1) observations and [C II] luminosity and compared it with Zanella et al. (2018). We showed that the fit depends on the galaxy, but also the environment within the galaxy.

Additionally, the choice of α_{CO} has a strong effect on this relationship as well, demonstrating the importance of studying full galaxies with high spatial resolution and applying accurate values of α_{CO}.



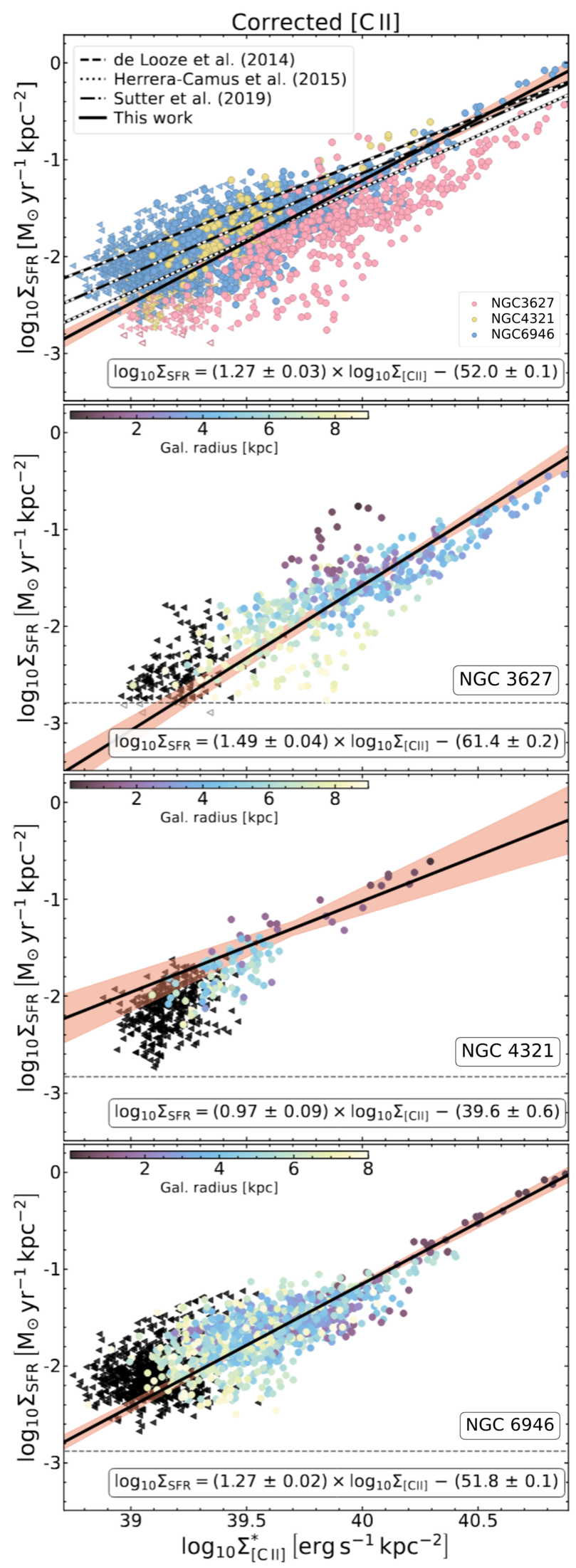
[C II] luminosity as a function of M_{mol} using a radially dependent α_{CO} from Sandstrom et al. (2013). Triangles represent points of upper limits for [C II], with error bars representing ±1σ uncertainty. Large crosses represent integrated values for $L_{[C II]}$ and M_{mol}.



[C II] luminosity as a function of M_{mol} using a constant Milky Way value of α_{CO} = 4.4 M$_\odot$ pc^{-2} (K km s^{-1})$^{-1}$. Triangles represent points of upper limits for [C II], with error bars representing ±1σ uncertainty. Large crosses represent integrated values for $L_{[C II]}$ and M_{mol}.

[C II] AS AN SFR TRACER

Our results show that the use of [C II] as a tracer for star formation is much more tangled than has previously been suggested within the extragalactic literature, which typically focuses on small regions of galaxies and/or uses large-aperture sampling of many different physical environments.



Σ_{SFR} as a function of IR colour-adjusted $\Sigma^*_{[C II]}$ (Herrera-Camus et al. 2015) for the entire dataset, followed by fits for each single galaxy (NGC 3627, NGC 4321, and NGC 6946). Triangles represent points of upper limits for [C II].