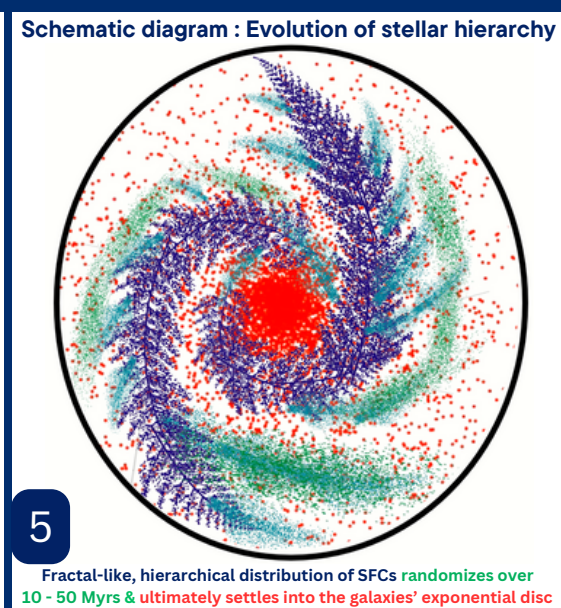
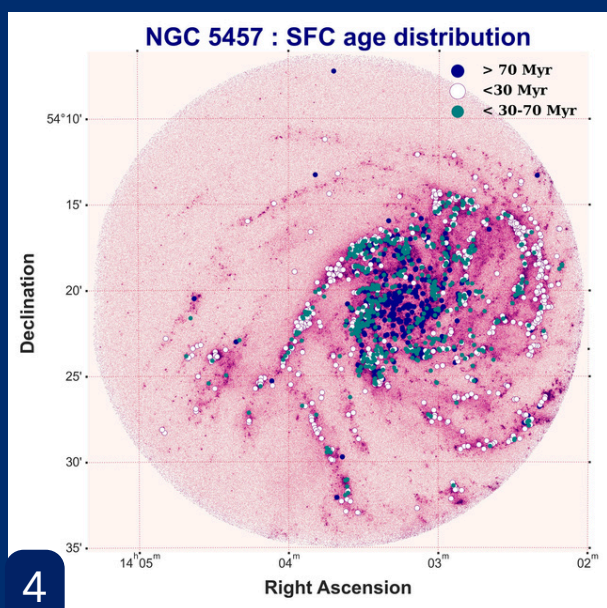
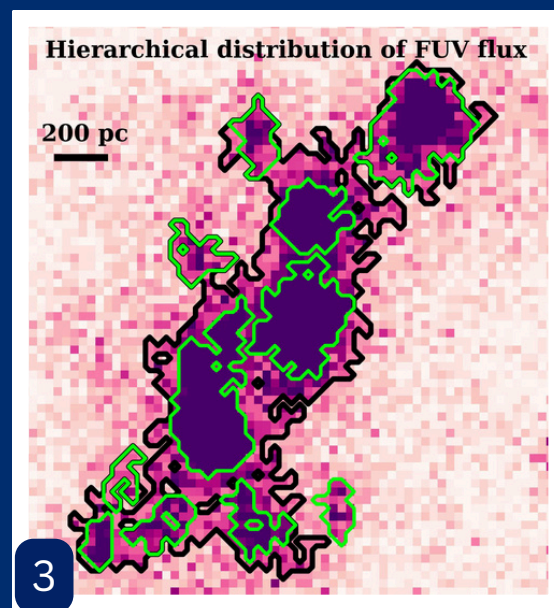
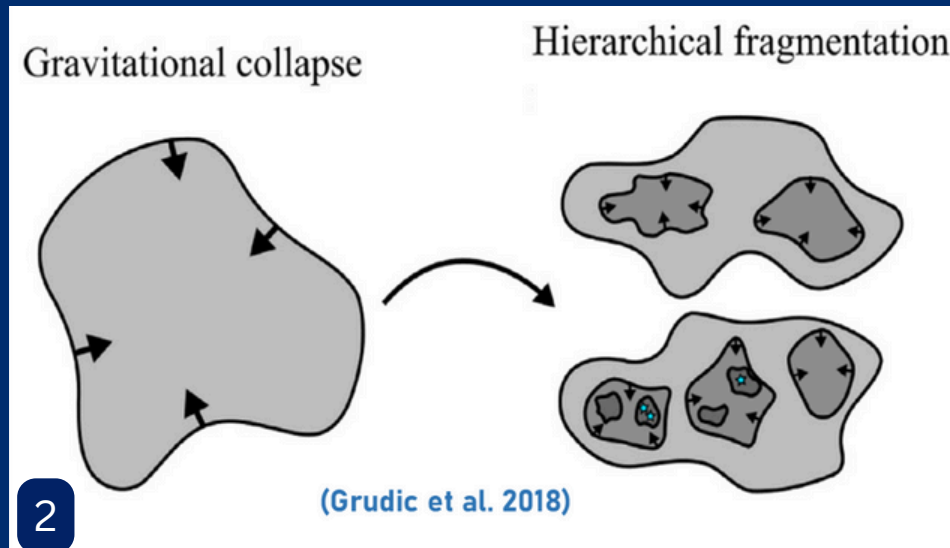
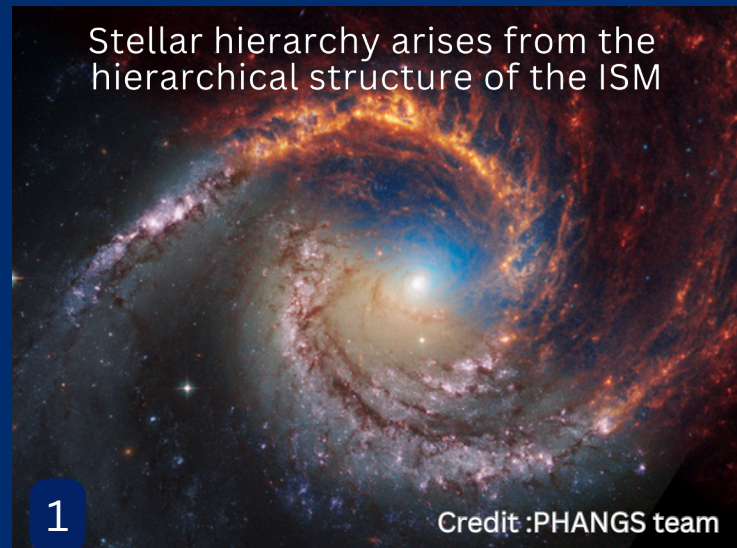


Insights into hierarchical star formation and the resulting feedback in spiral galaxies : As probed with UV bright star forming clumps and HII regions of ionized gas

Shashank Gairola (IIA), Smitha Subramanian (IIA), Shyam H. Menon (Rutgers University; CCA, USA),
Chayan Mondal (ASIAA, Taiwan), Mousumi Das (IIA), Annapurni Subramaniam (IIA)
[DOI : [Shashank et al. 2025, A&A, 693, A188](#)] ; [Mail : shashank.gairola@iia.res.in]

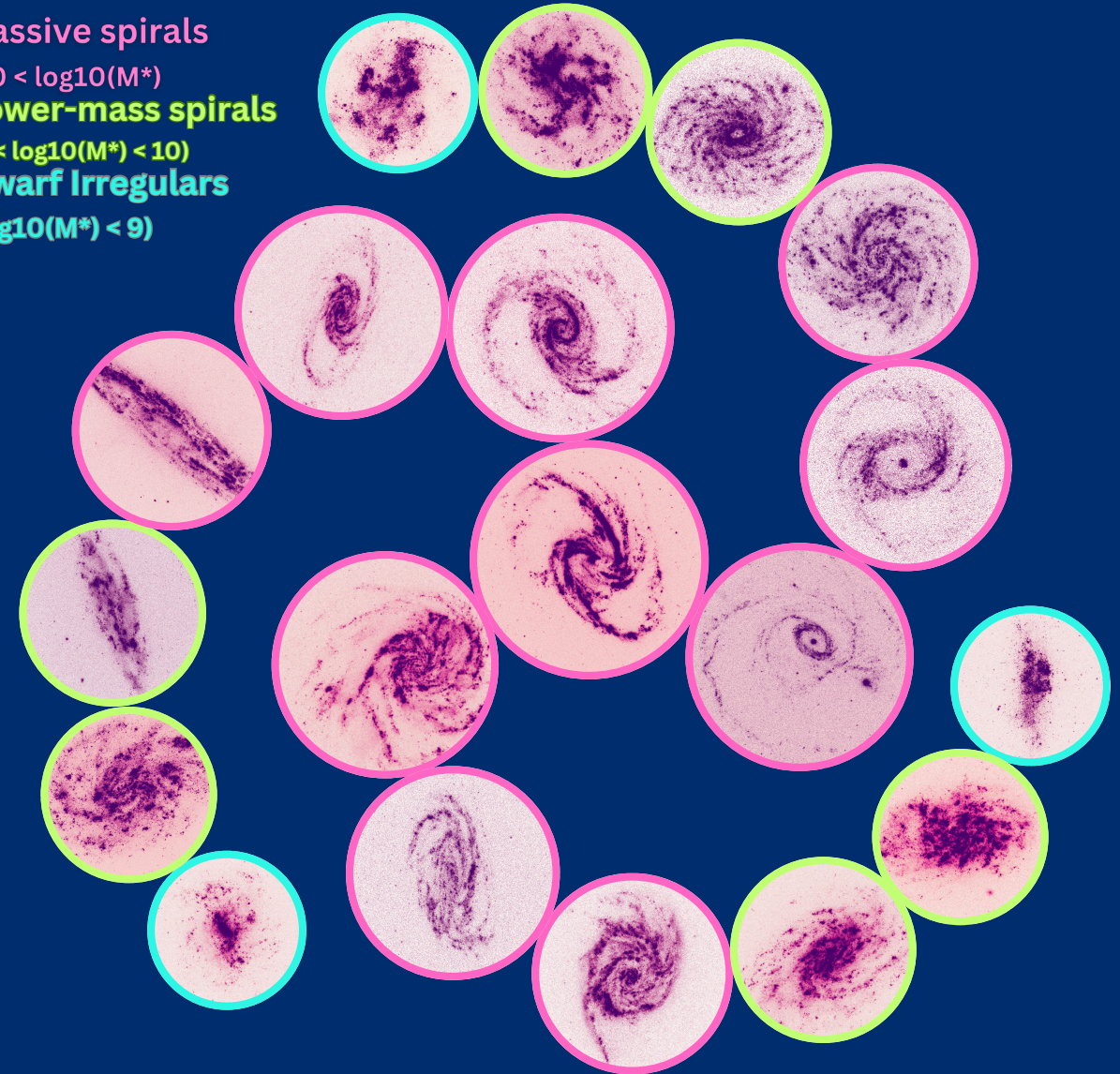


CONTEXT : Investigating hierarchical star formation in a diverse, nearby galaxy sample spanning a wide morphology, environment & mass range.
OBJECTIVE : Derive representative parameters for the galaxies' star formation hierarchy; test their dependence on large-scale galaxy properties.
PRIMARY DATA : Archival Far-UV (FUV) + near-UV (NUV) observations from the [Ultra-Violet Imaging Telescope \(UVIT\) onboard AstroSat - an Indian space observatory](#).
METHOD : Identify UV bright star-forming clumps (SFCs) → Estimate ages of the SFCs using FUV-NUV color-magnitude diagrams (corrected for variable dust attenuation) → Spatial two-point correlation function (TPCF) analysis.
Salient feature : 1.5" FUV observations; full coverage of star-forming discs of sample galaxies - advantageous over small FoV telescopes; largest such sample till date exploring stellar hierarchy.
HII regions : Exploring the connection shared by star formation hierarchy, stellar feedback, and the ionized gas distribution.

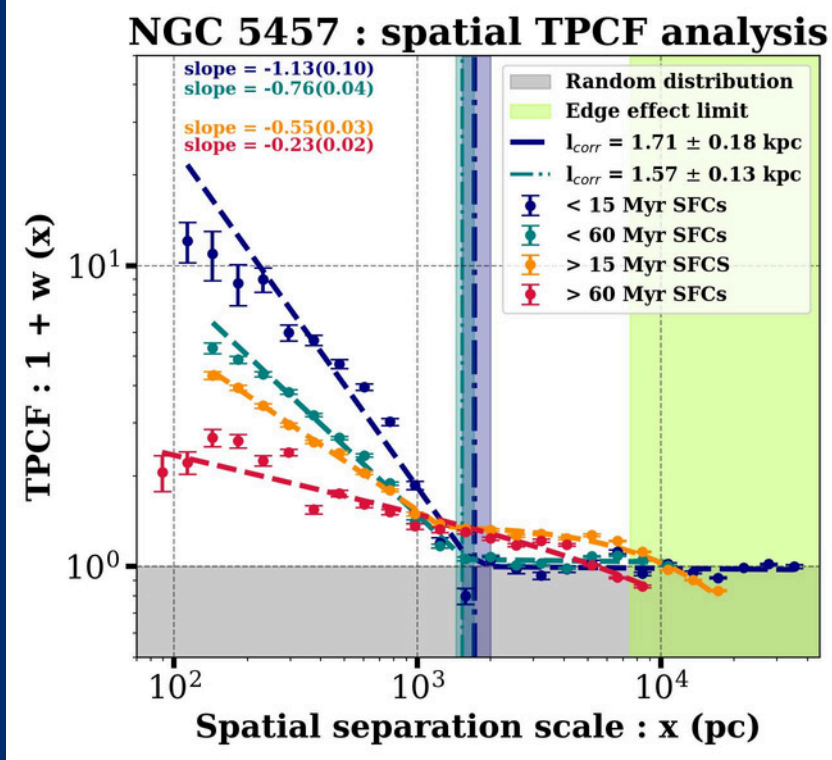


UVIT images of the 19 sample galaxies

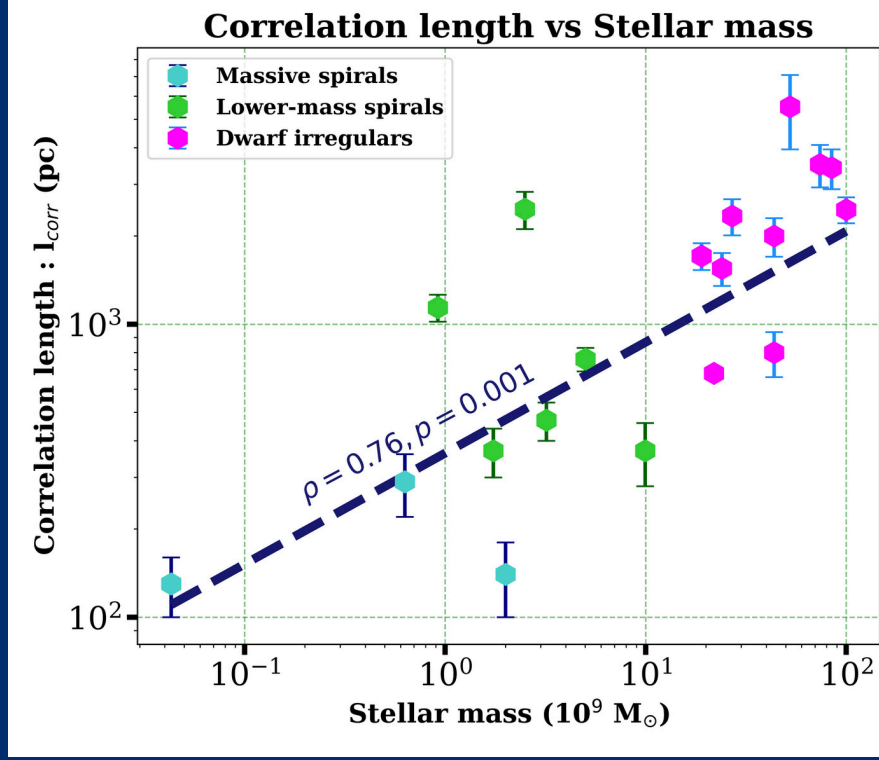
Massive spirals
($10 < \log_{10}(M^*)$)
Lower-mass spirals
($9 < \log_{10}(M^*) < 10$)
Dwarf Irregulars
($\log_{10}(M^*) < 9$)



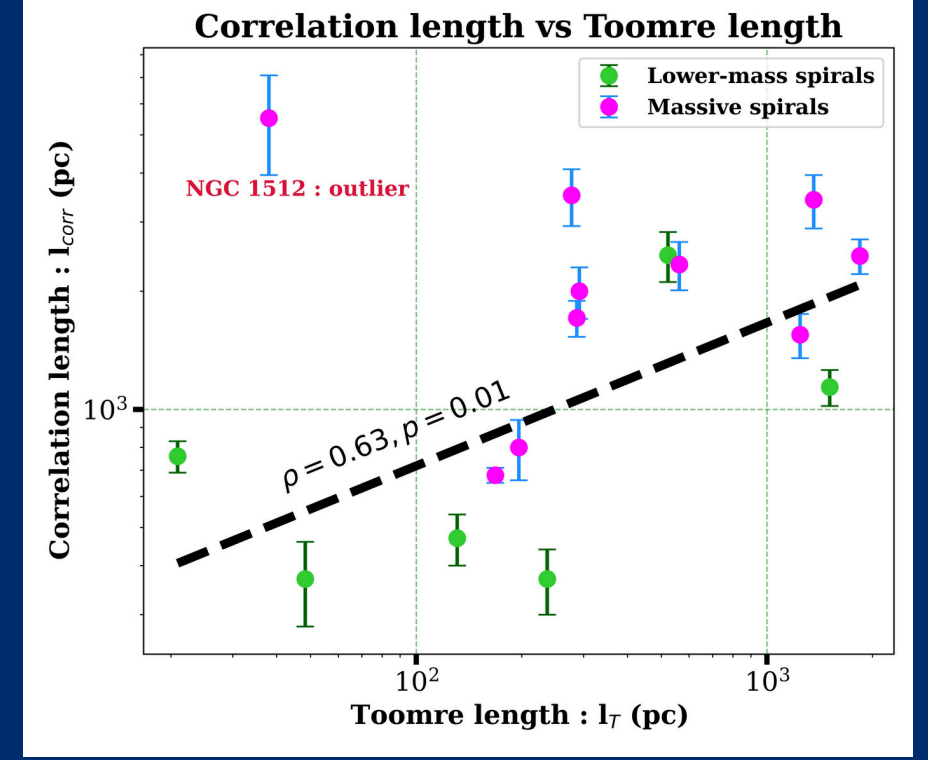
UV-bright SFCs from UVIT



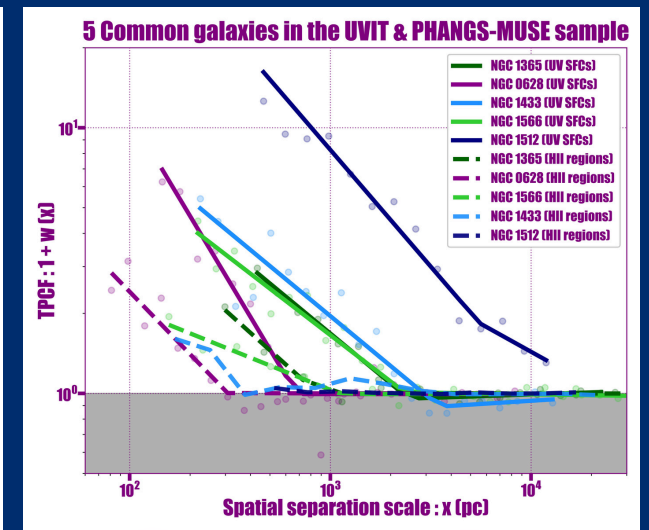
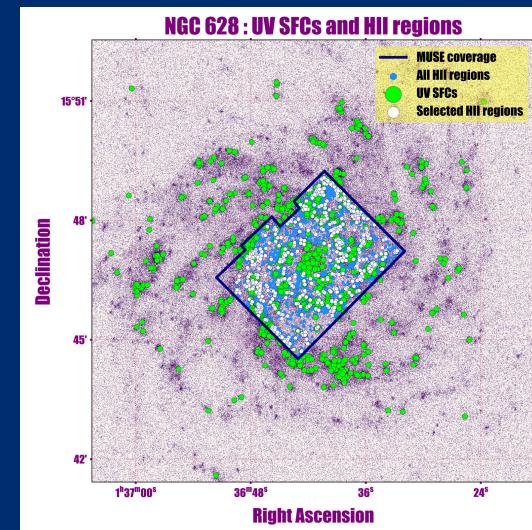
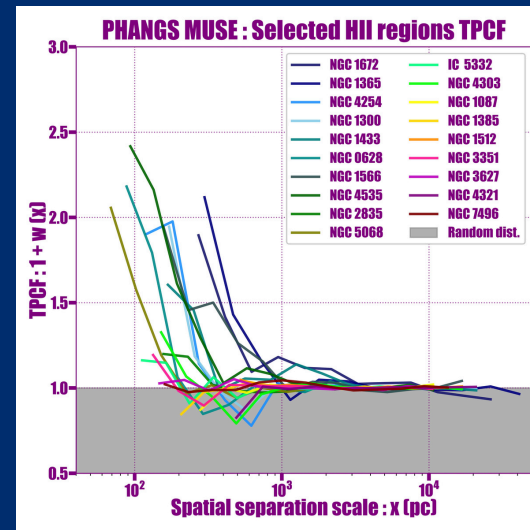
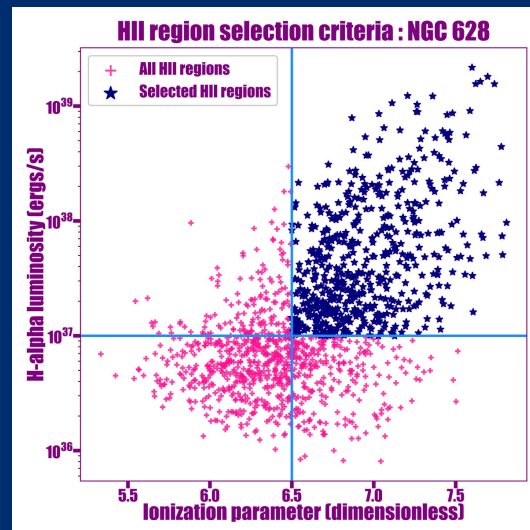
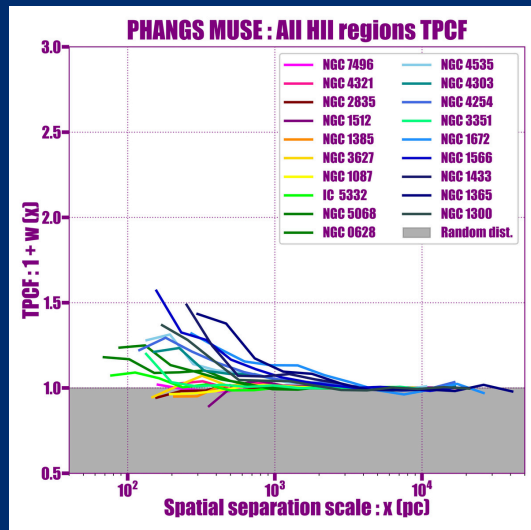
Results from the TPCF analysis of NGC 5457



The largest scale of star formation hierarchy (i.e. correlation length (l_{corr})) has a positive correlation with Galaxy's stellar mass & Toomre length



HII regions from PHANGS-MUSE



Physically motivated cuts to uncover the HII region hierarchy ; HII region distribution has quite different properties than the SFC distribution

Comments are welcome

RESULTS

- Existence of a ubiquitous, galaxy-specific largest scale of star formation hierarchy (correlation length) and hierarchy dissipation timescale; Star formation hierarchy is sustained till the correlation length scale by the ISM turbulence.
- Dependence of correlation length on galaxy's stellar mass (global gravitational potential), Toomre length (Galactic shear) and nature of spiral arms.
- Dwarf irregulars, lower-mass spirals and massive spirals lie on the same, continuous correlation length spectrum, unless (outliers)!
- Value-added products : Catalog of ~30,000 UV-bright SFCs in 19 nearby galaxies with derived ages.
- Most HII regions seem to not comply with any hierarchy - dispersing impact of stellar feedback on the distribution of star-forming gas?!



References :

Boquien et al. 2016. , Calzetti et al. 2015, Elmegreen et al. 1996, Elmegreen et al. 2006, Elmegreen et al. 2014, Federrath et al. 2009, 2013, Grasha et al. 2017a, 2017b, 2018, 2019, Groves et al. 2023, Hao et al. 2011, Lada and Lada 2003, Larsen et al. 1981, Leitherer et al. 1989, Menon et al. 2021, Mondal et al. 2021, Postma & Leahy 2021, Sanchez et al. 2010, Santoro et al. 2022, Shadmehri & Elmegreen 2011, Tandon et al. 2017, 2020