

The MUSE view of the Sculptor

Enrico Congiu - European Southern Observatory

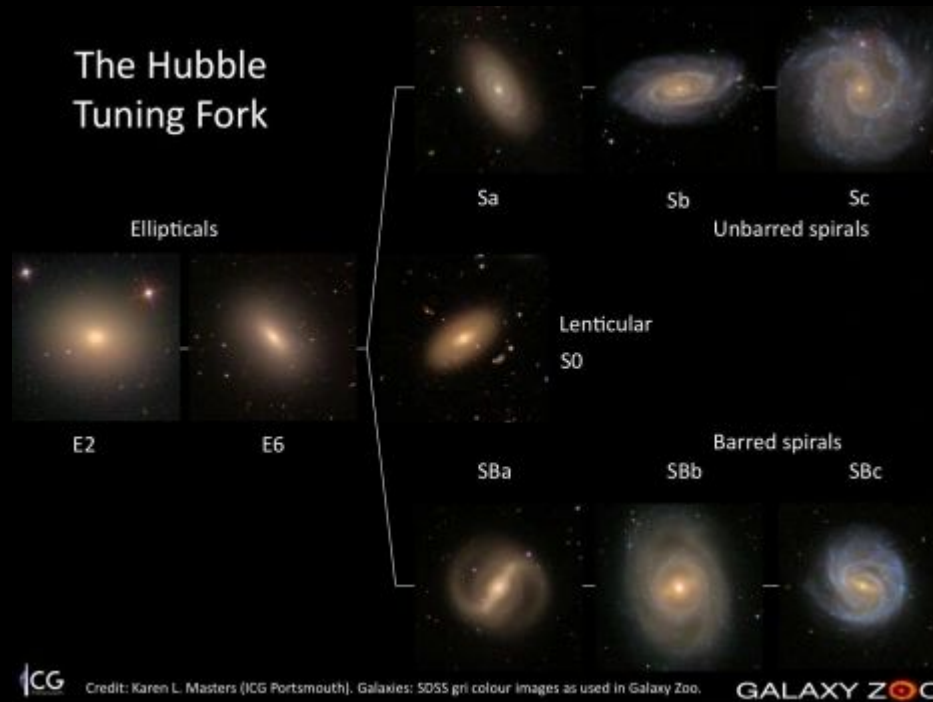
in collaboration with: F. Scheuermann (ARI), K. Kreckel (ARI), A. Leroy (OSU),
E. Emsellem (ESO), F. Belfiore (INAF), O. Egorov (ARI), J. Hartke (FINCA),
Rebecca McClain (OSU), T. Kravtsov (U. Turku) and the PHANGS team.



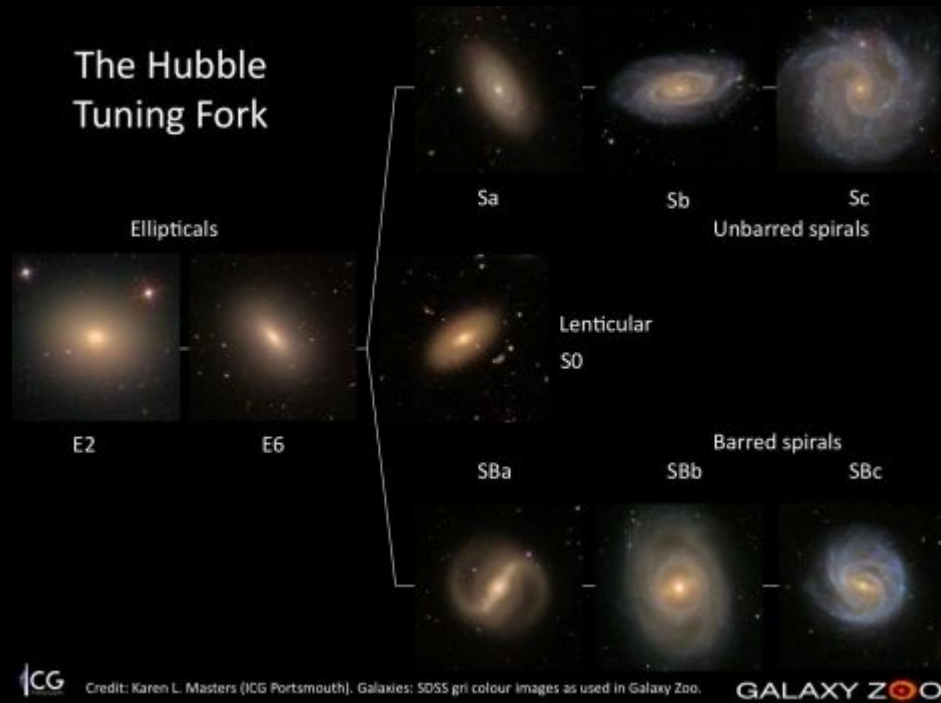
Global effects

Local processes

The Hubble Tuning Fork



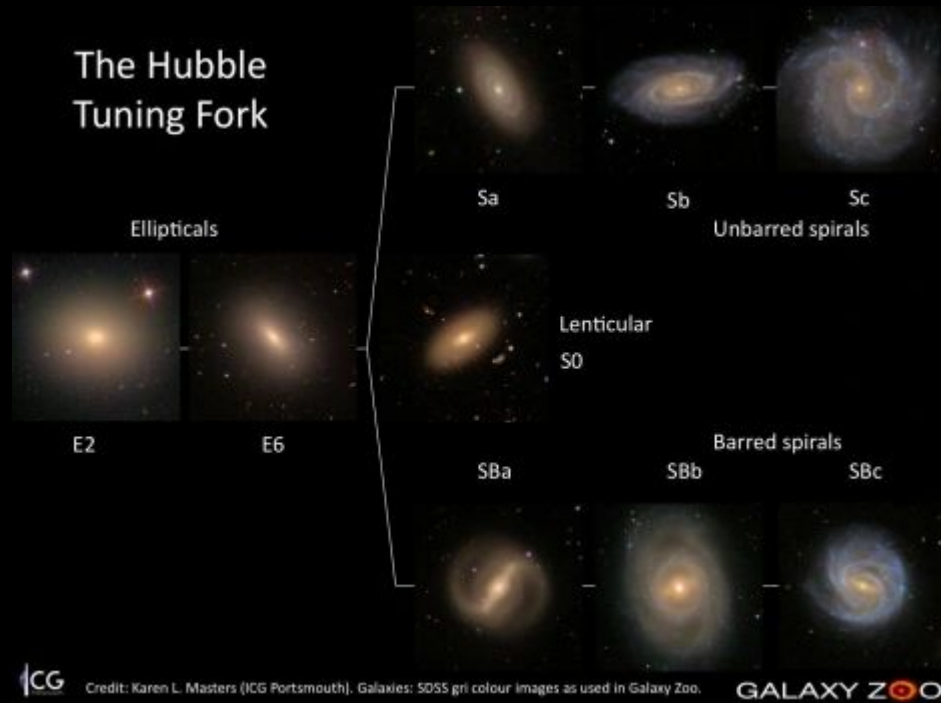
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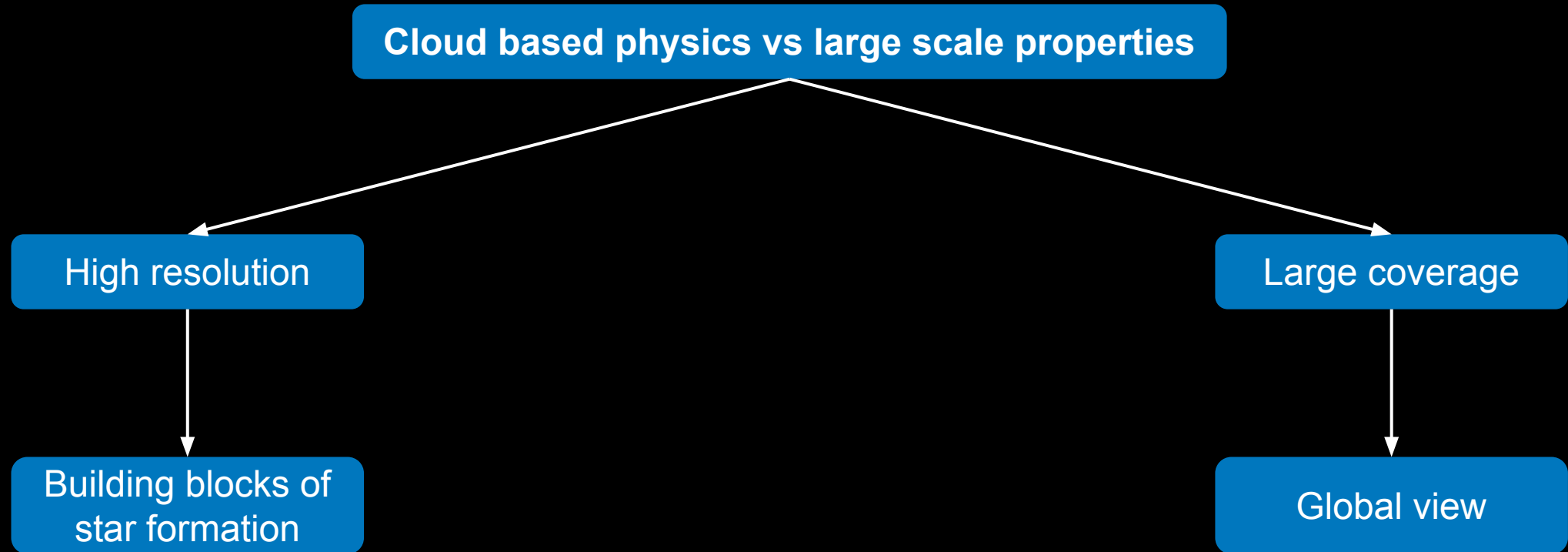


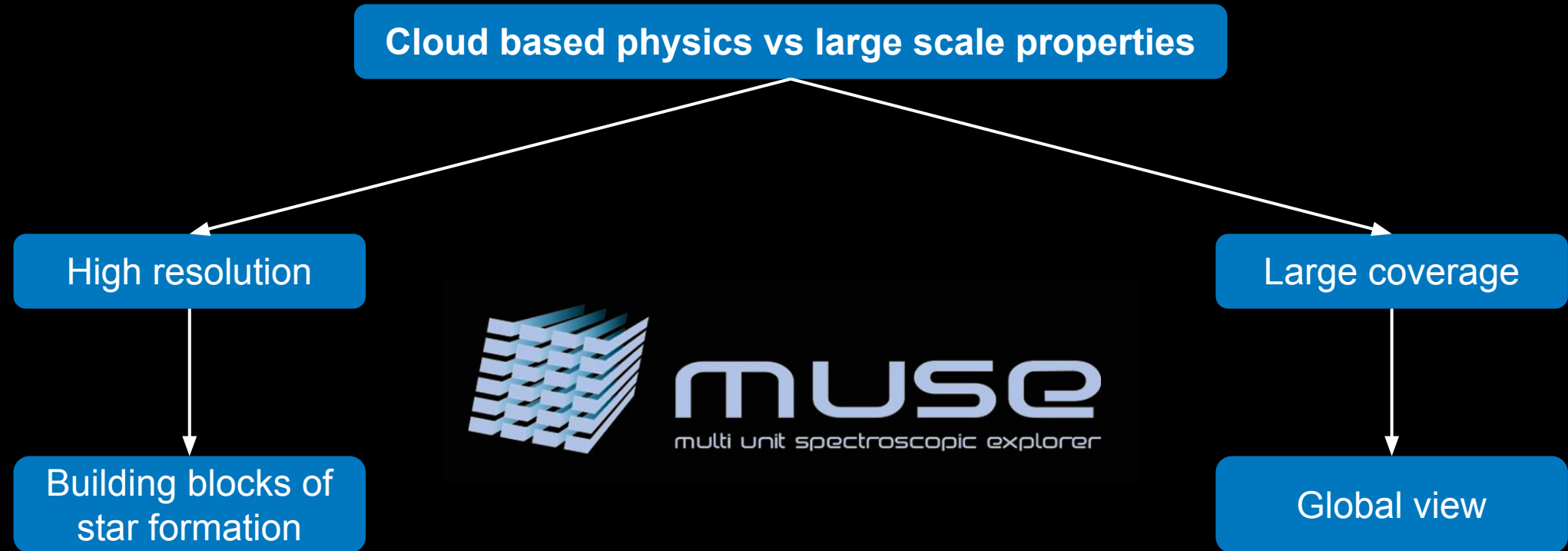
Global effects



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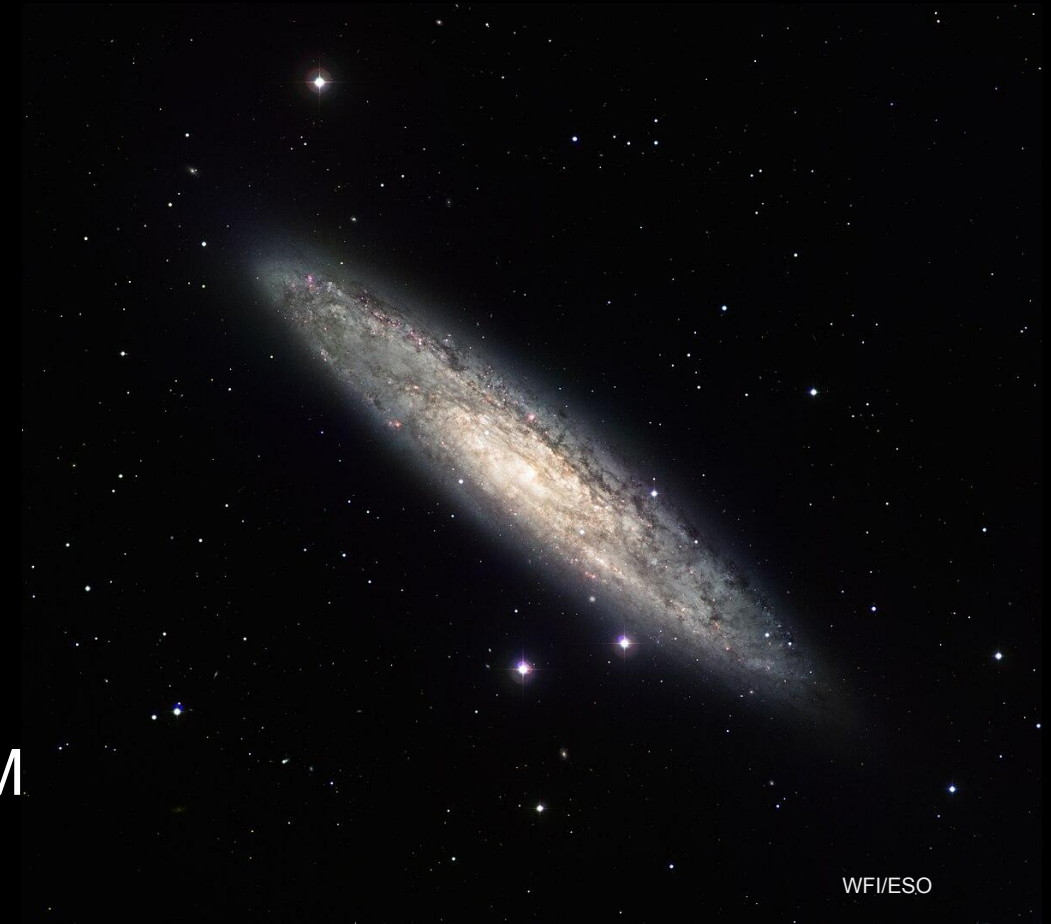


The MUSE view of the Sculptor [galaxy] - NGC 253

- Cloud based view (50-100 pc) is not enough
 - Too large to **resolve** structures
- We need to go to **higher** resolutions while keeping the global view
- How do we do it? → Move to closer targets!

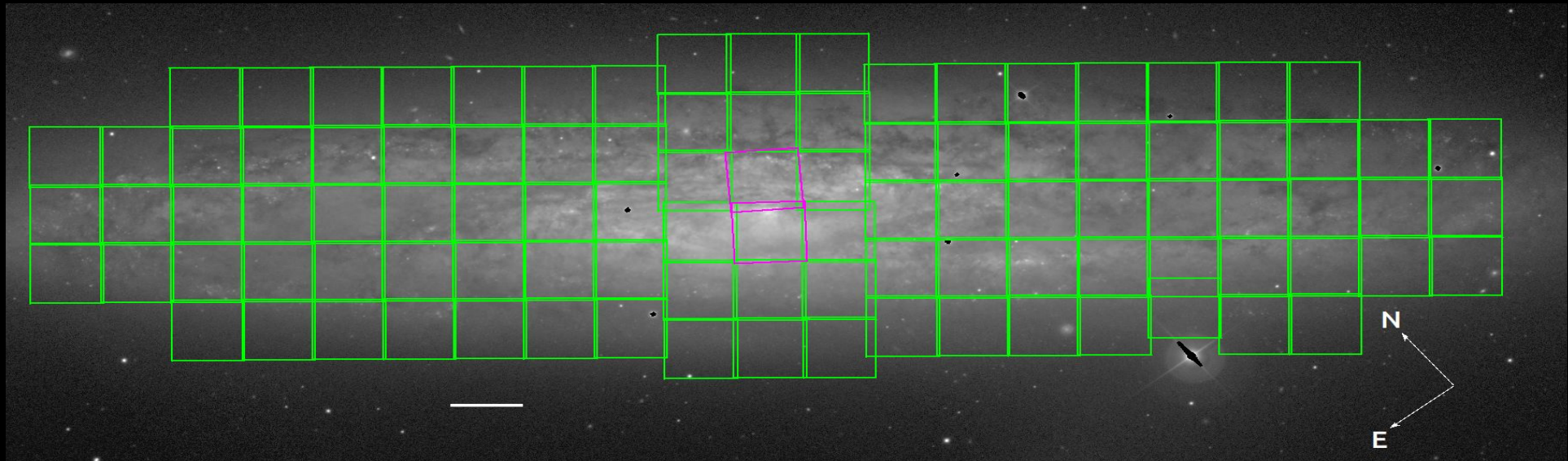
The MUSE view of the Sculptor [galaxy] - NGC 253

- Nearby – $D \sim 3.5 \text{ Mpc} \rightarrow 1'' \sim 17 \text{ pc}$
- Strong star formation – $4.2 \text{ M}_{\odot}/\text{yr}^1$
- Powerful starburst:
 - 50% of the total SFR
 - kpc scale multiphase outflow²
- Moderately inclined
 - High resolution view of the disk
 - Probe the vertical structure of the ISM



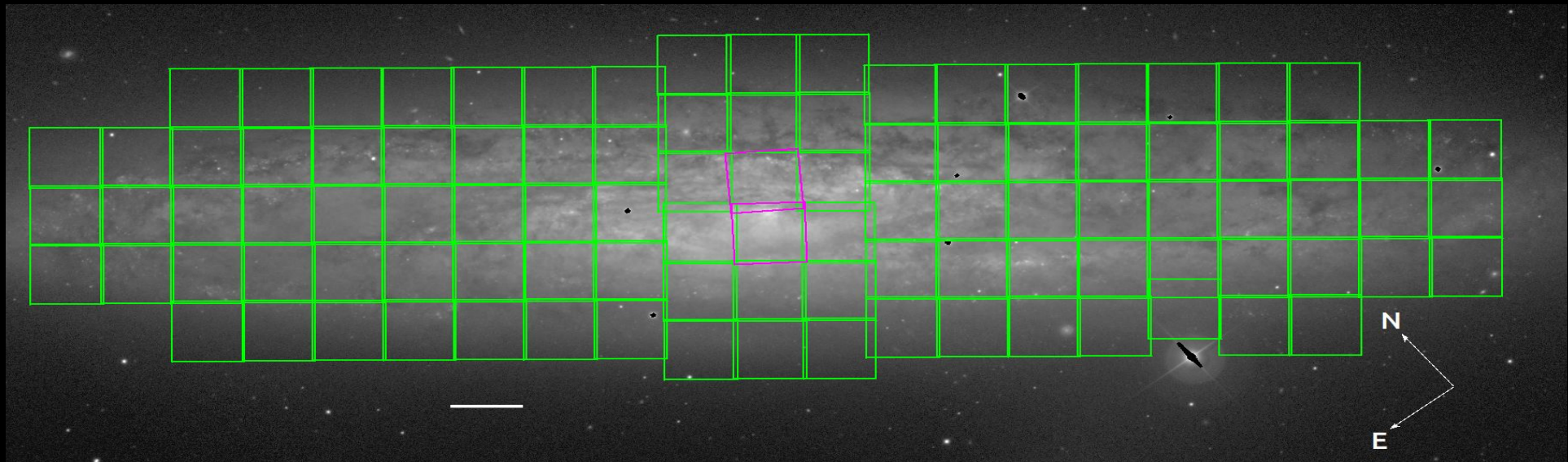
The MUSE view of the Sculptor [galaxy] - NGC 253

- 51 MUSE hours mosaic of NGC 253
 - 98 pointings (P.I. Congiu) + 2 archival (P.I. Zschaechner)
 - 20x5 arcmin² mosaic



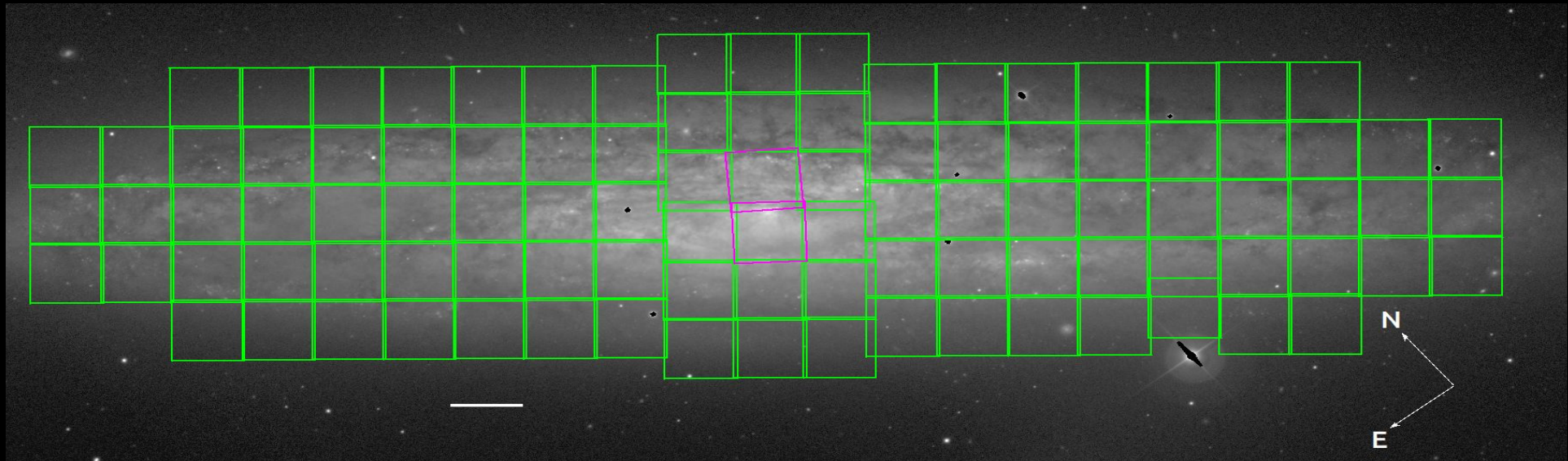
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- 844s exposure on source per pointing, WFM-NOAO-E





Data processing

- Reduction and analysis completed
 - `pymusepipe` (Emsellem+2022)
 - PHANGS-DAP (Emsellem+2022)



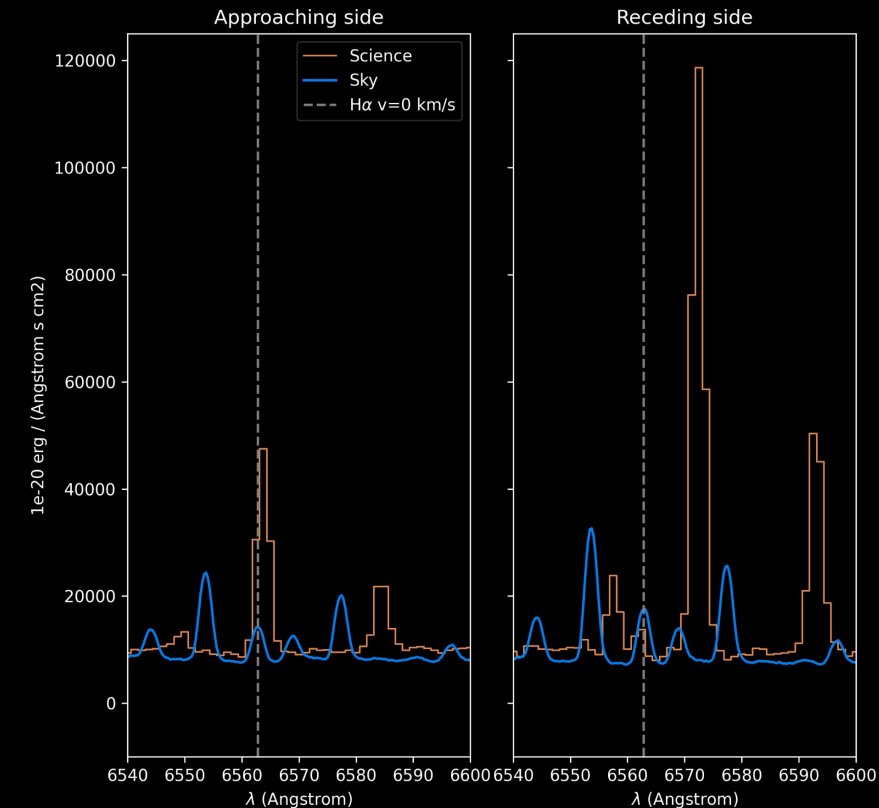
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 - Sky subtraction – Low redshift galaxy
 - Complex kinematics/High extinction – difficult spectral fitting



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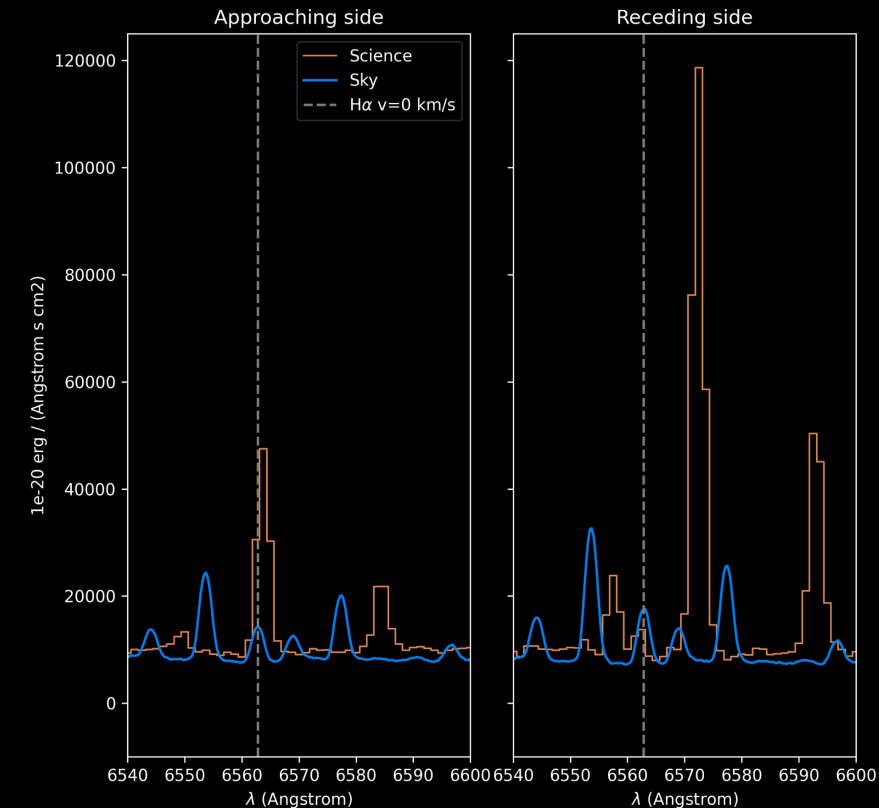
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- Science in early stages
 - Once ready, data and data products will be released to the community



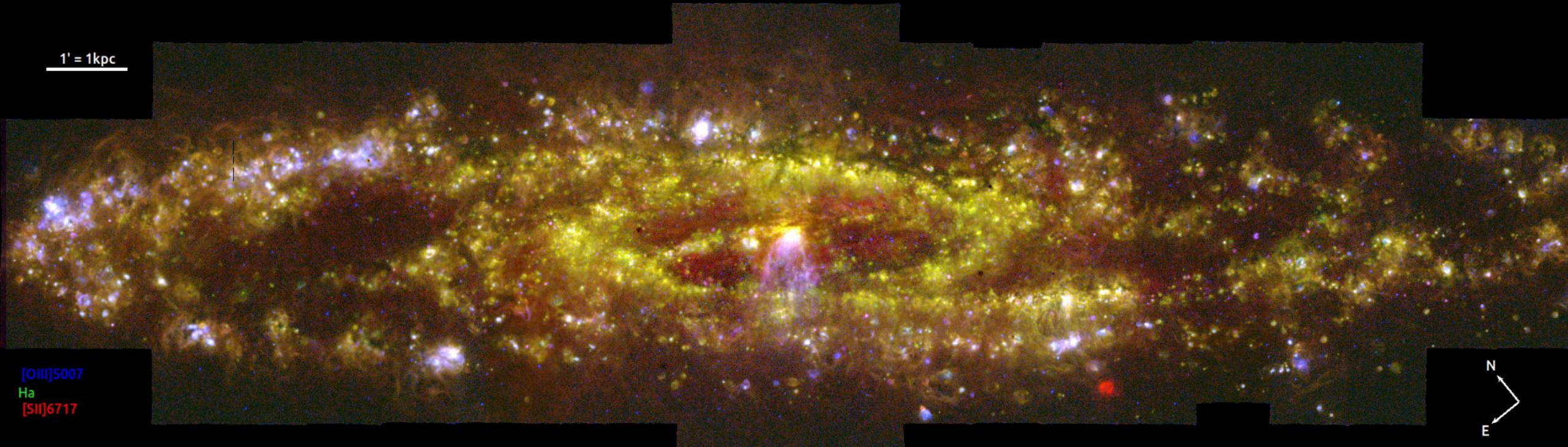
Ha

[O III] 5007

[S II] 6717, 6731



1' = 1kpc



N
E

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Ha
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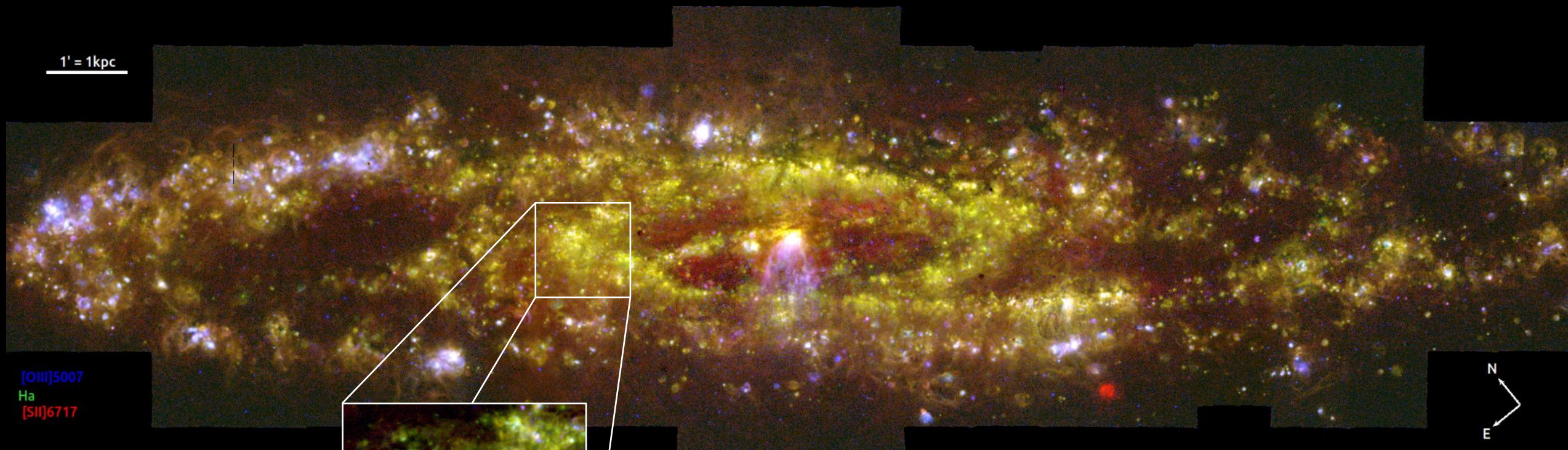
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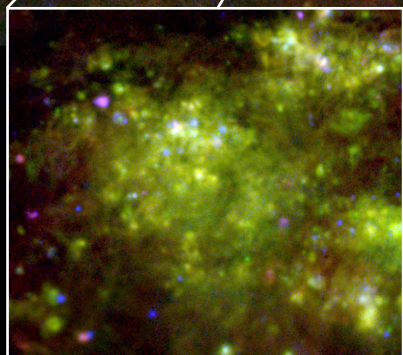
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Plenty of ionized
nebulae of all
sizes and shapes



Ha
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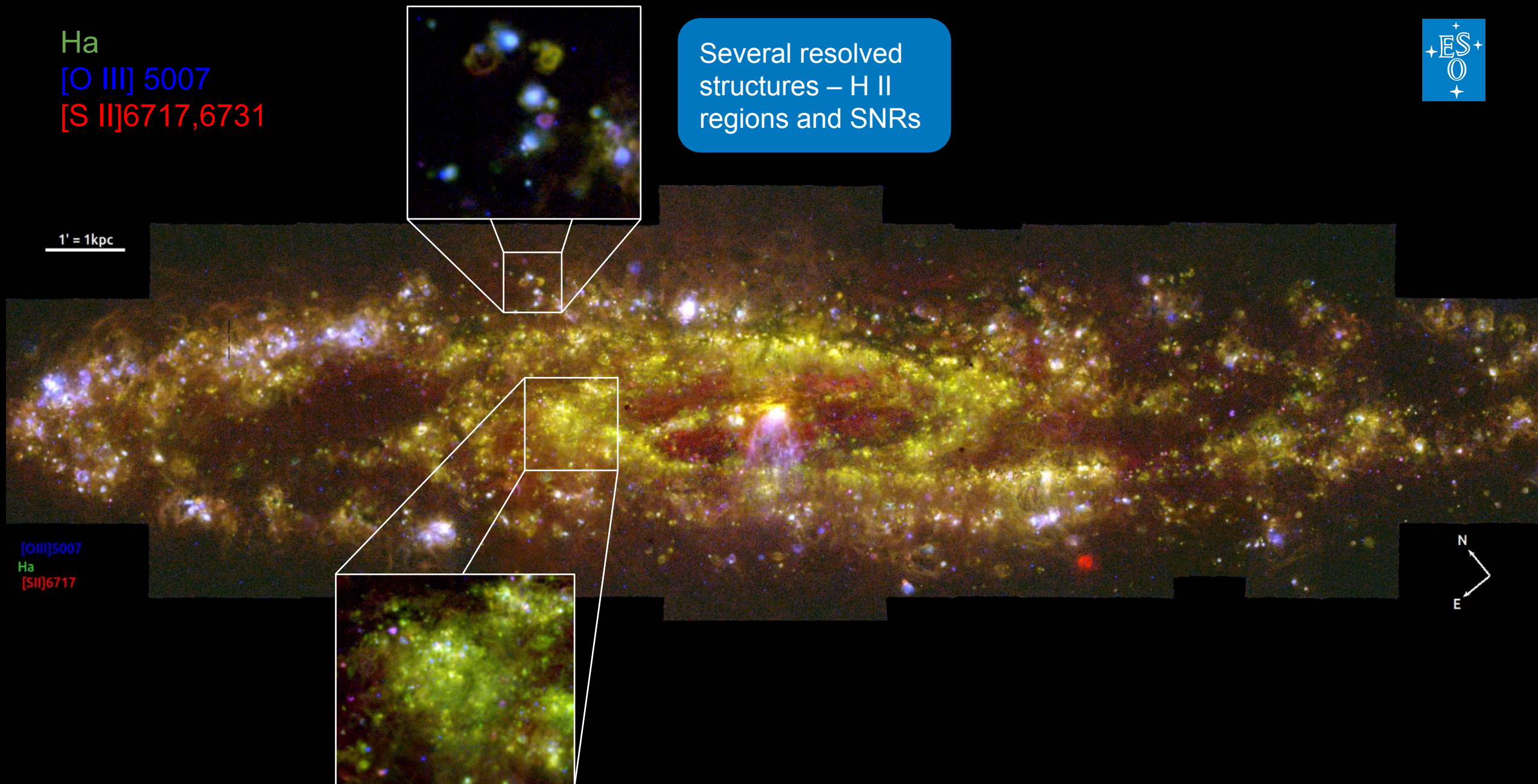
Several resolved
structures – H II
regions and SNRs



1' = 1kpc



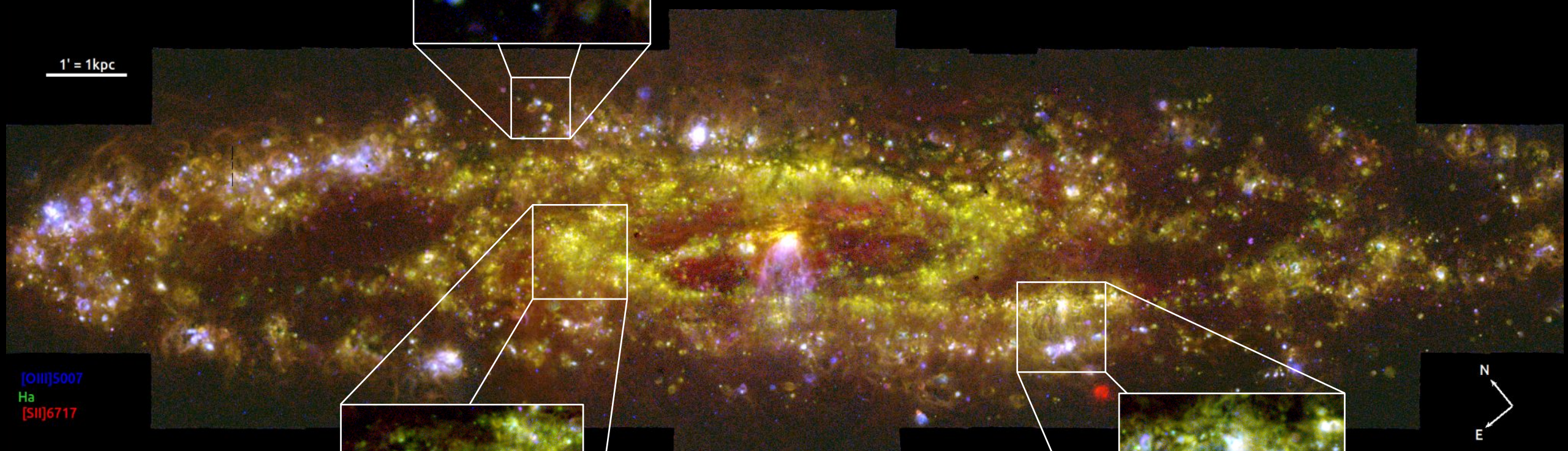
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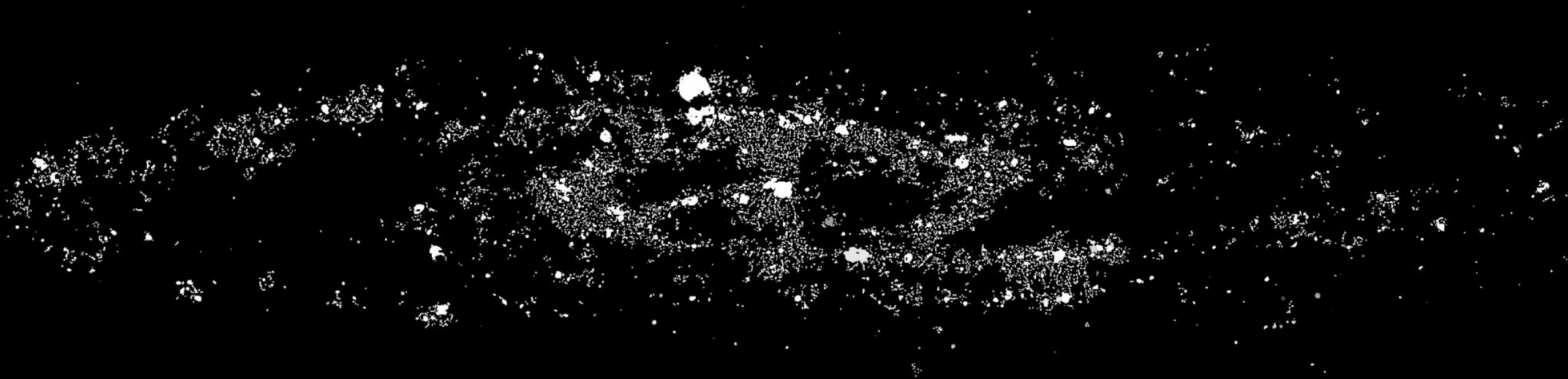
1' = 1kpc



Detailed view of
the DIG structure

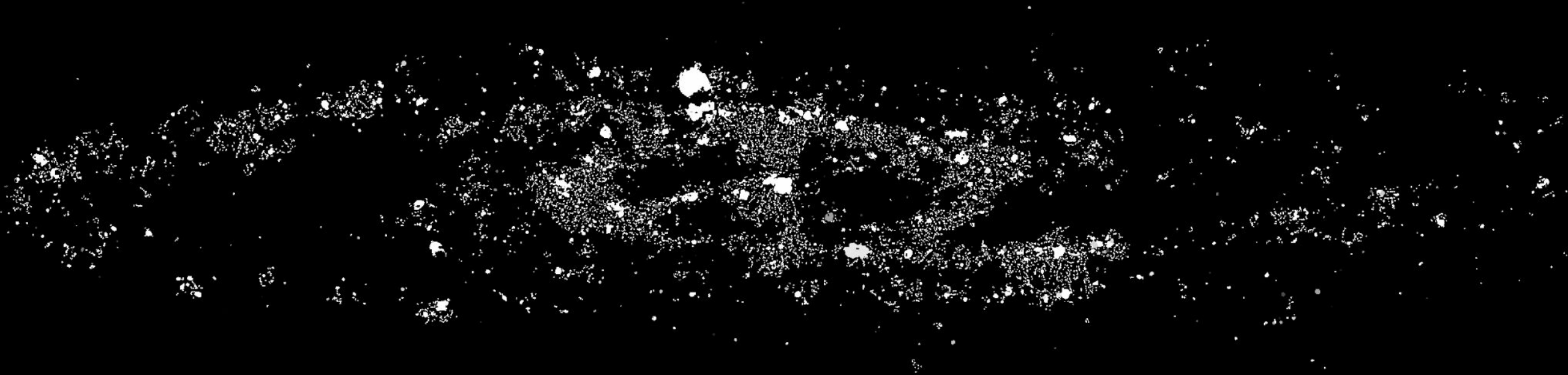
H II regions

- Preliminary tests → 8500 Nebulae
 - HIIphot and Ha map→Problematic segmentation



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WORK IN PROGRESS!



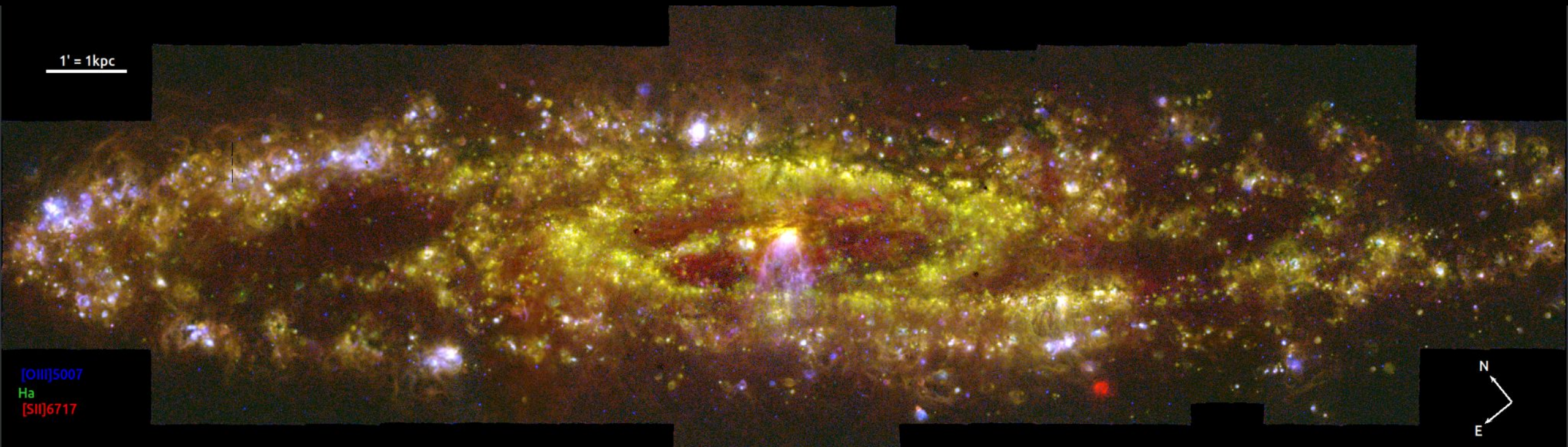
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PNLF – Congiu et al. in prep.



- Planetary nebula luminosity function → secondary distance indicator

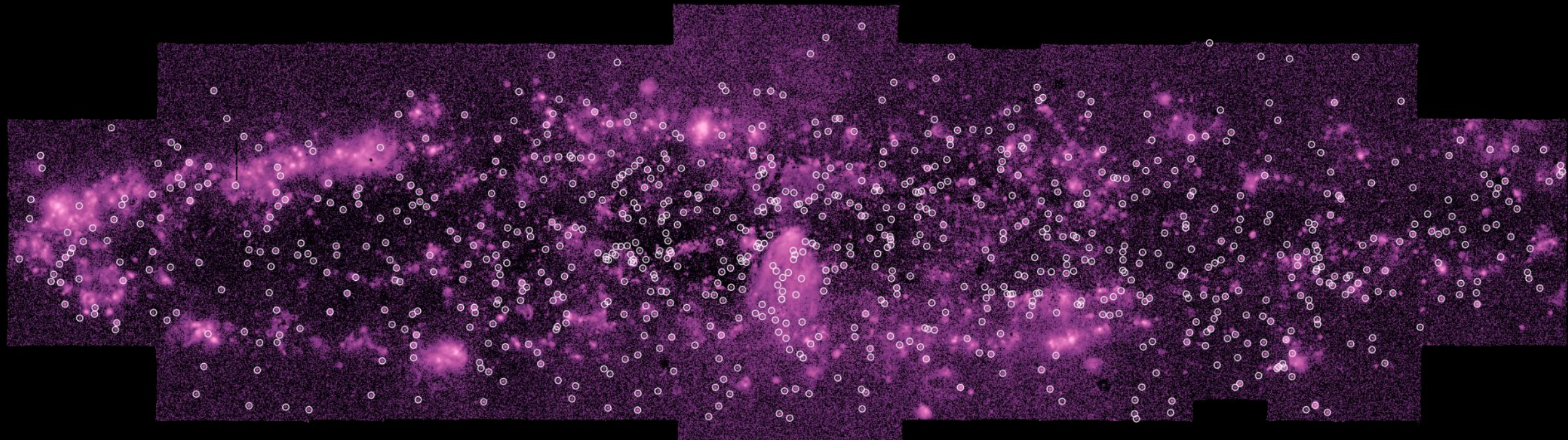


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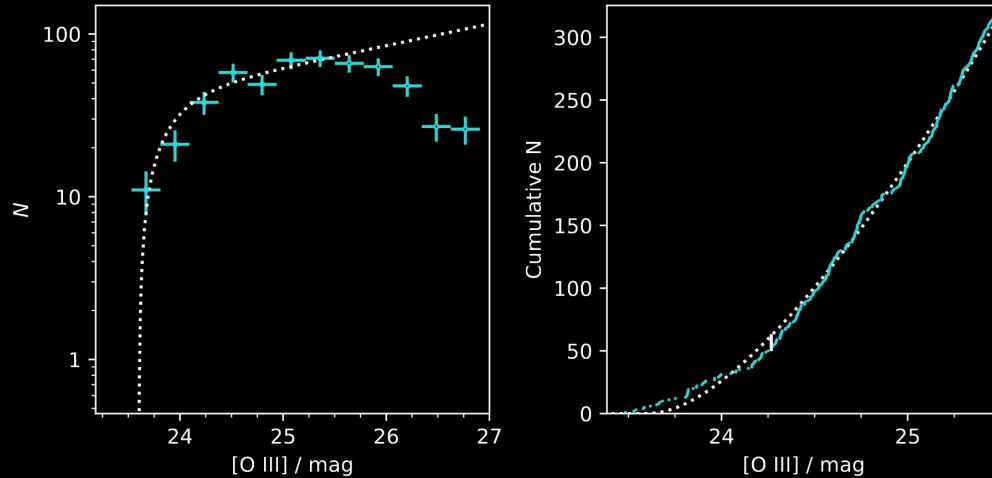
- Planetary nebula luminosity function → secondary distance indicator
- Last attempts: Rekola+2005 and Jacoby+2024
 - Measured distance: ~ 3.34 Mpc vs 5.4 Mpc
 - Only 14 PNe identified in the a narrowband image vs ~ 30 in the archival MUSE pointings

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- MUSE PNe: 571 → 319 can be used to compute the PNLF (< 25.5 mag completeness limit)

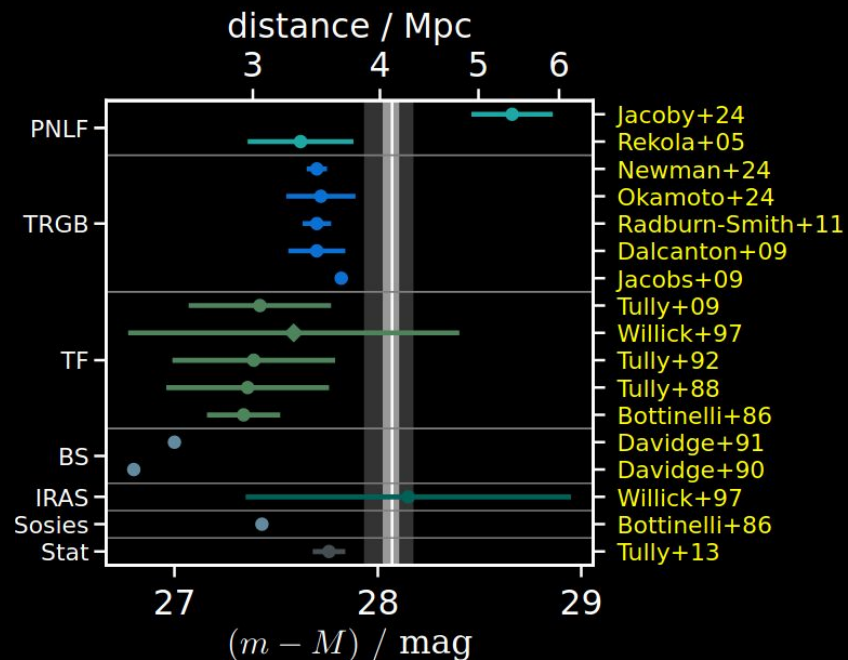


PNLF – Congiu et al. in prep.

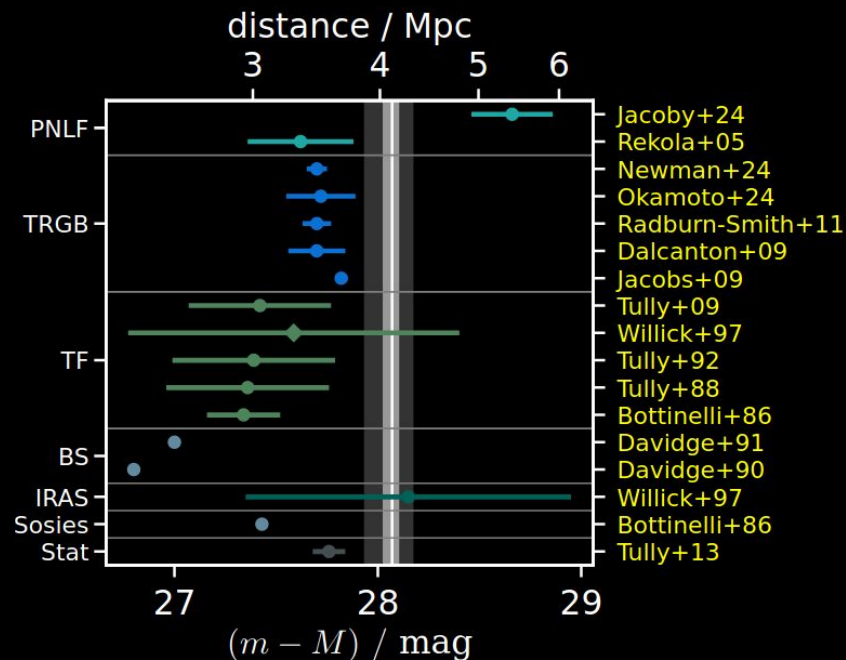
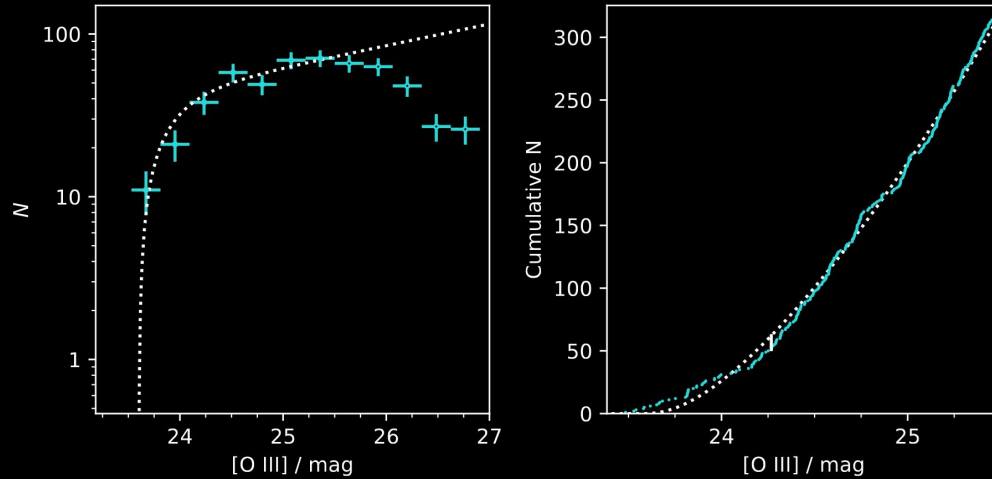


28.07 mag (4.11 Mpc) vs 27.72 mag (3.5 Mpc)¹

¹ Okamoto+2024, ...

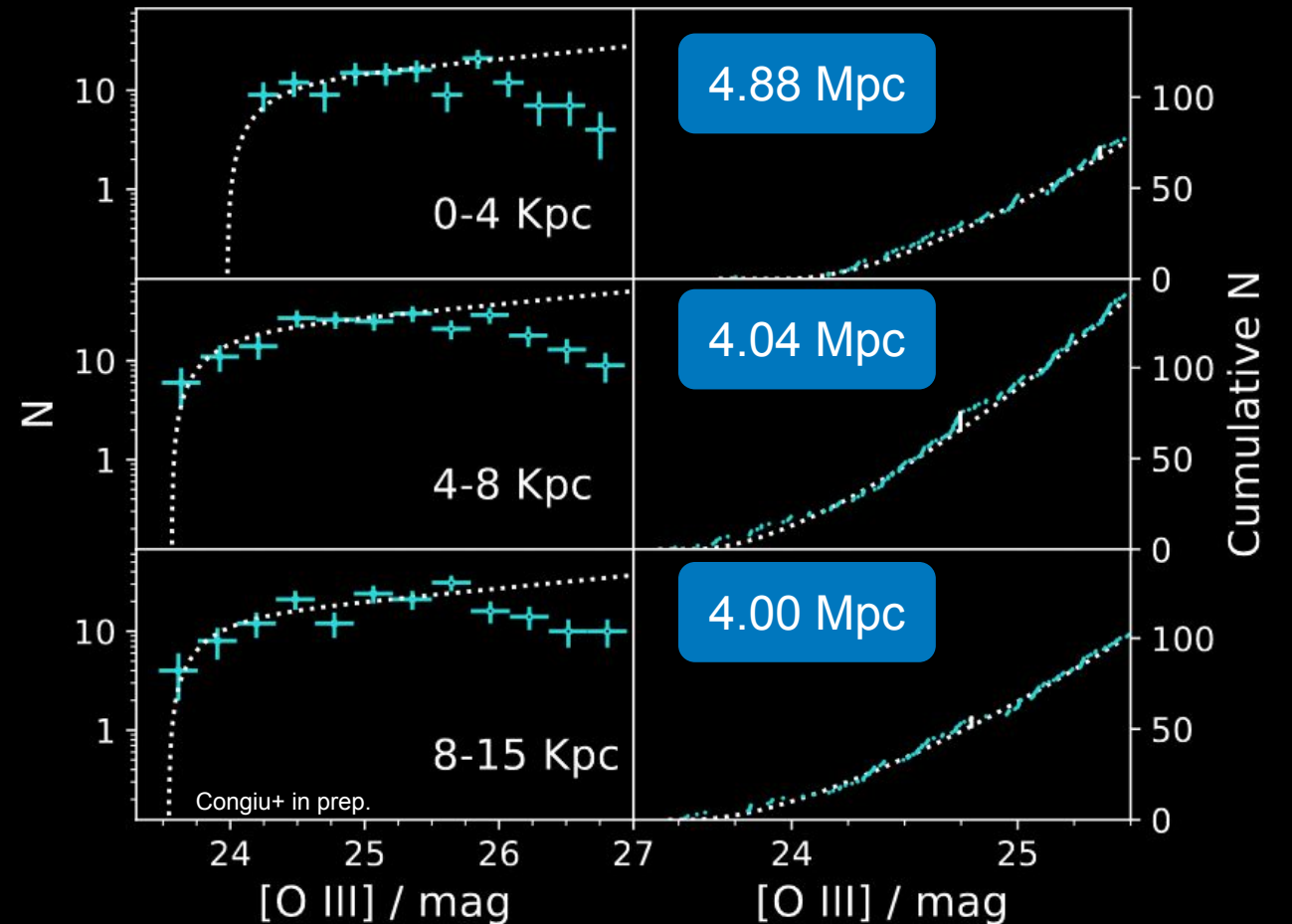


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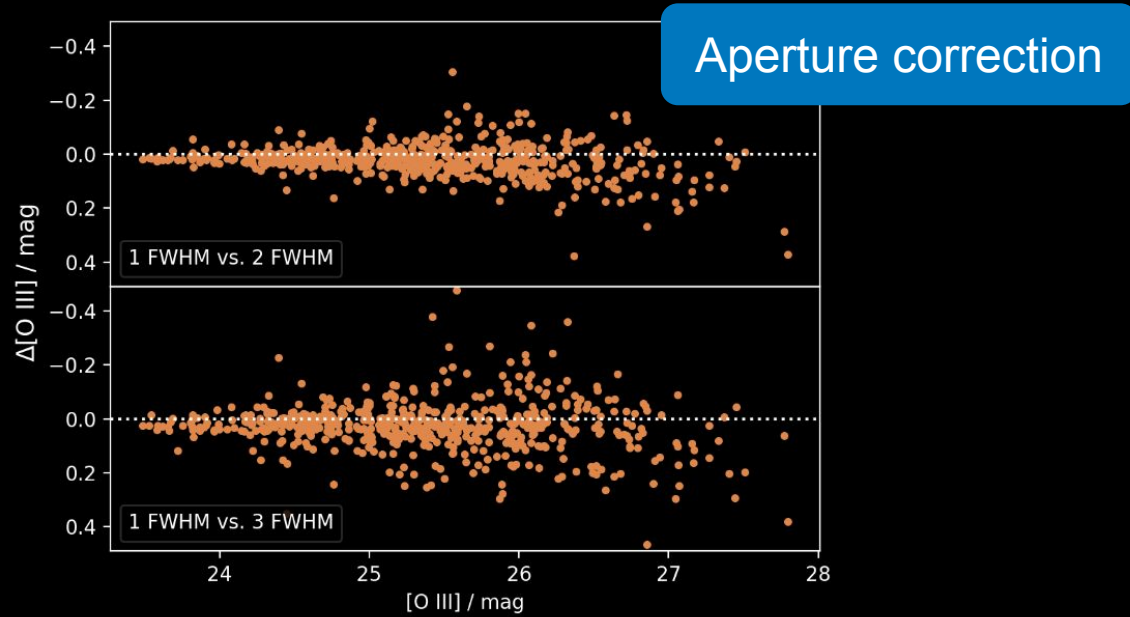


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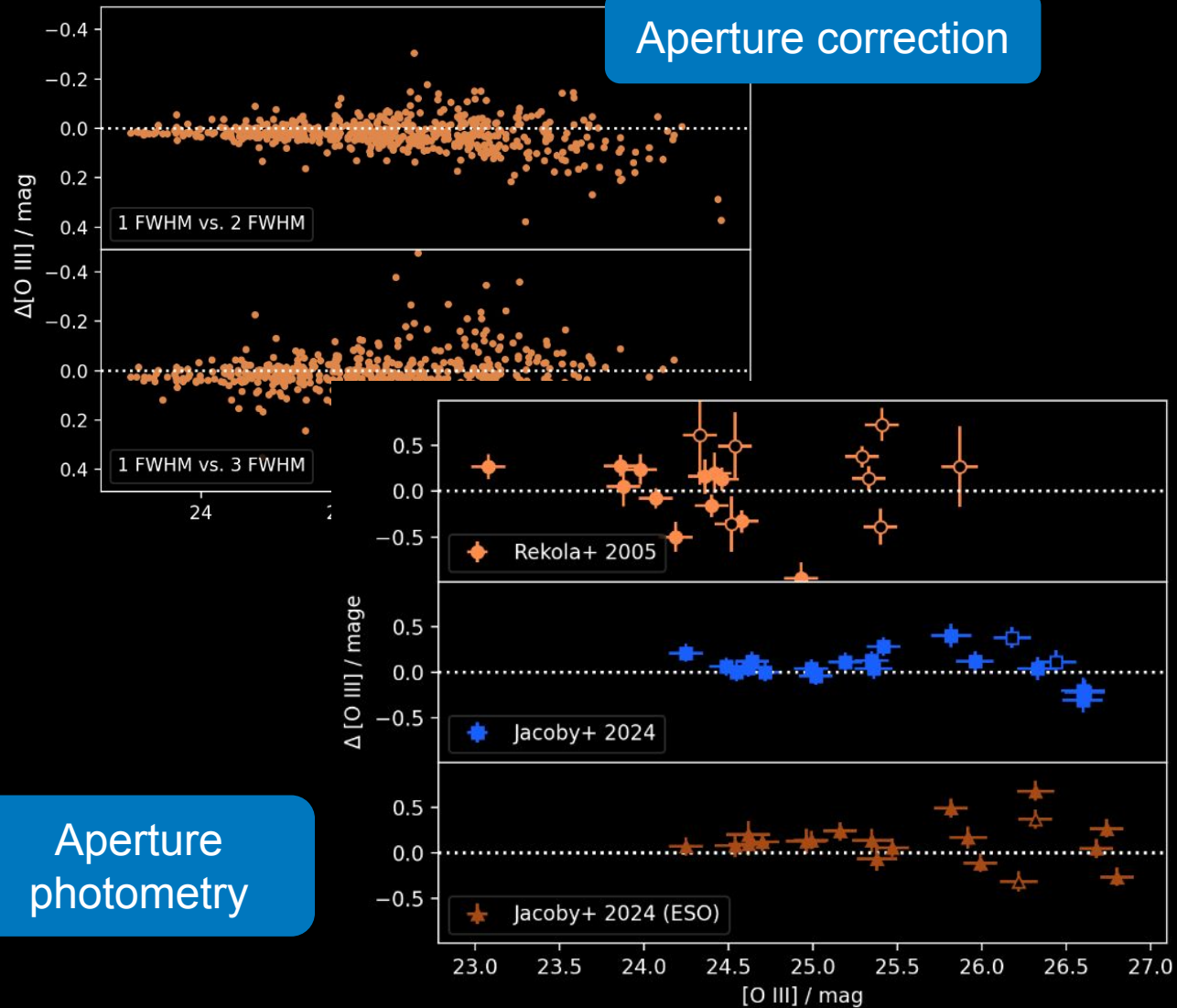


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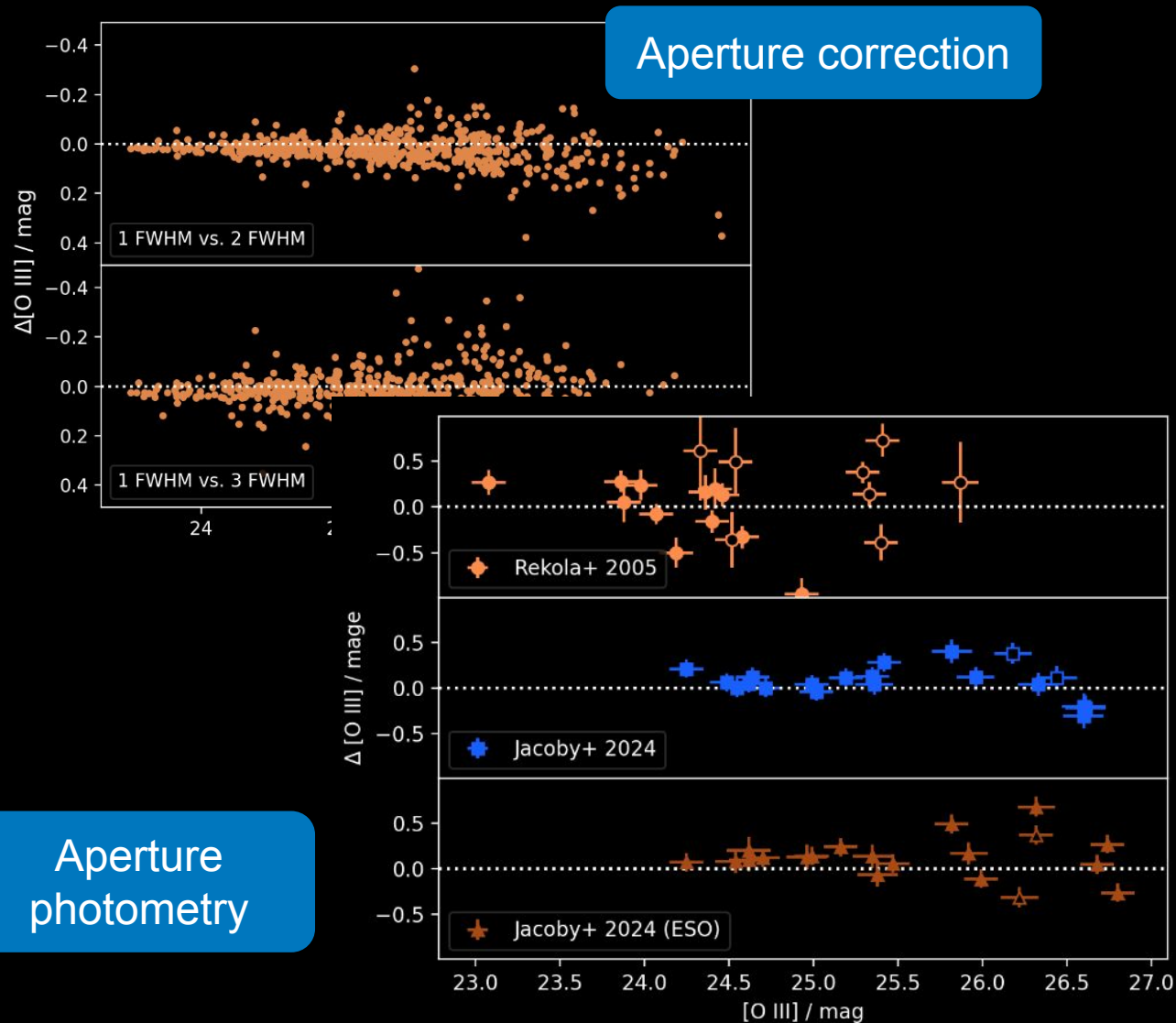
PNLF – Congiu et al. in prep.

Aperture correction

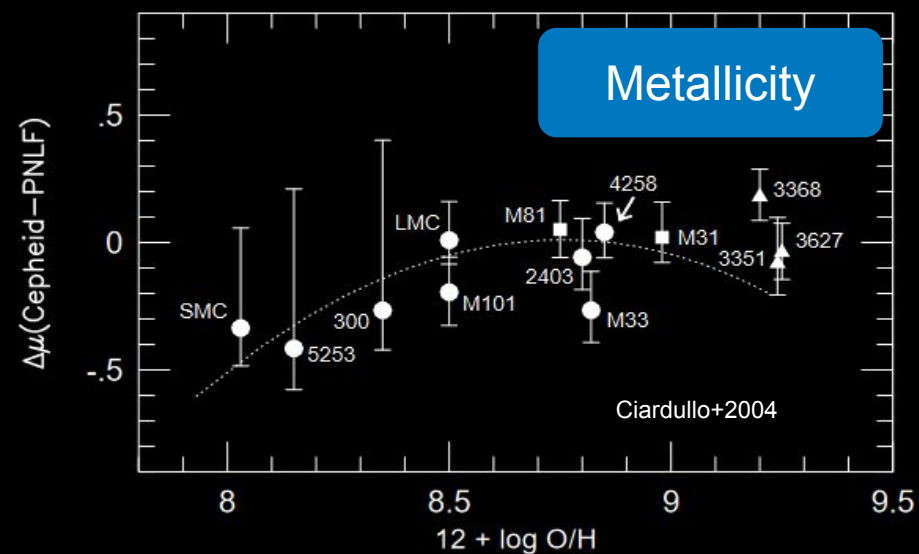


Aperture
photometry

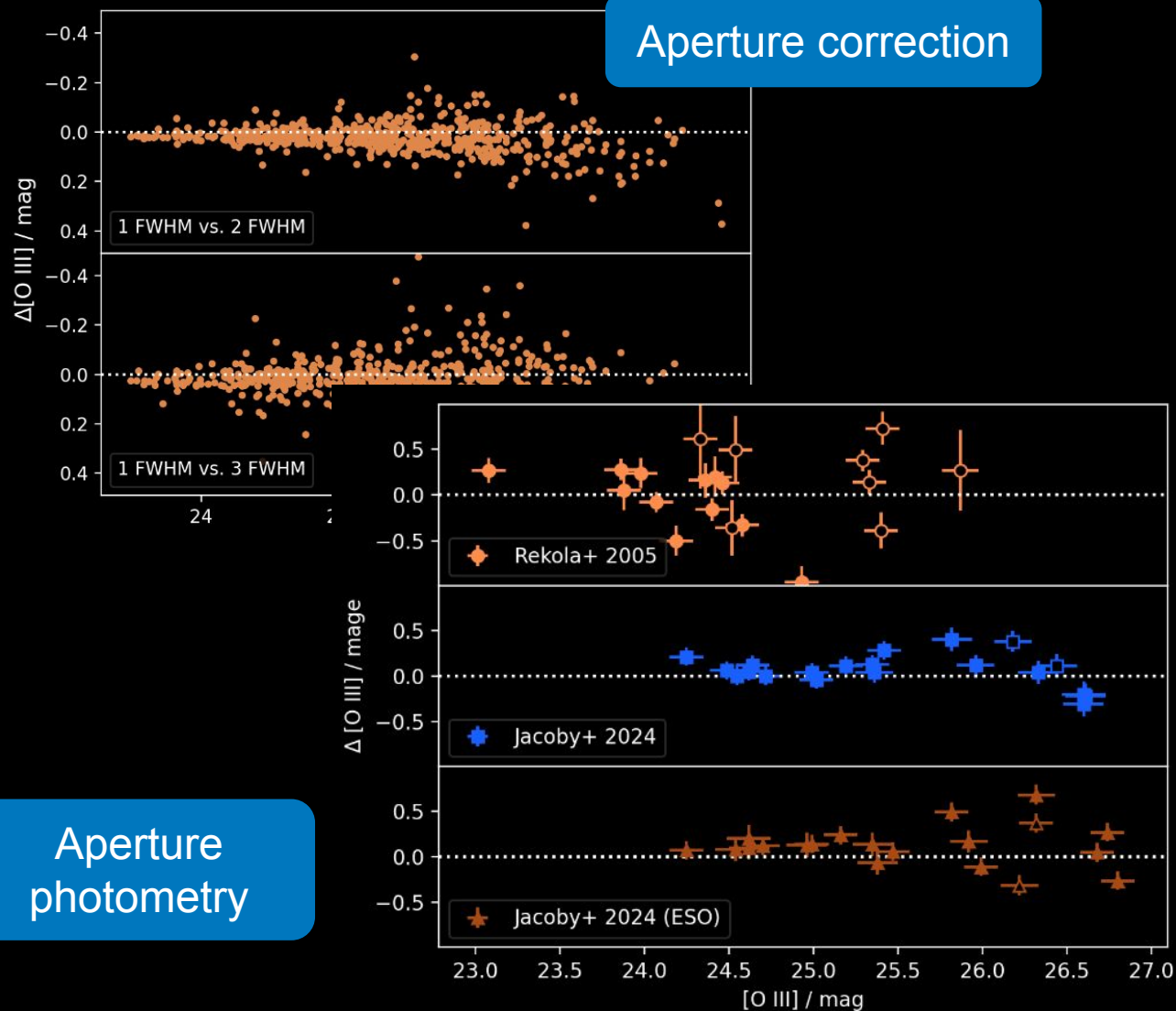
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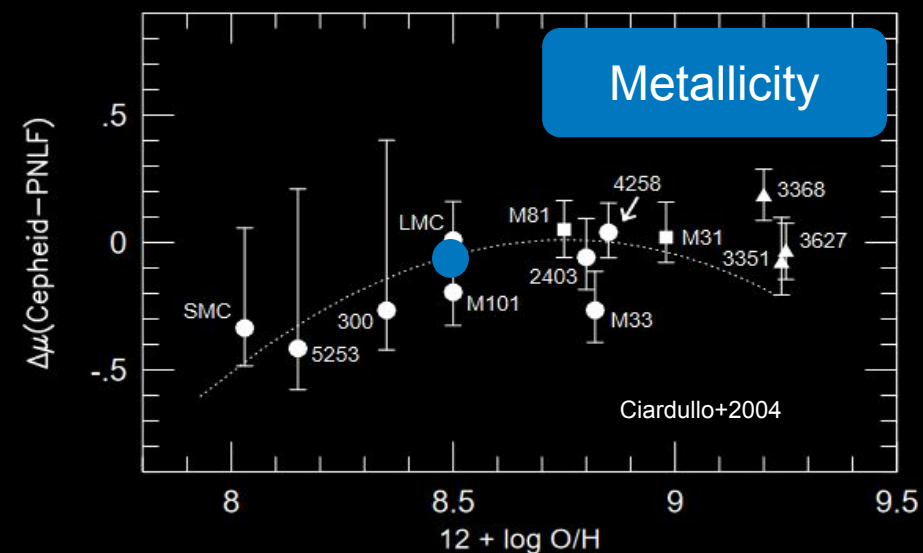
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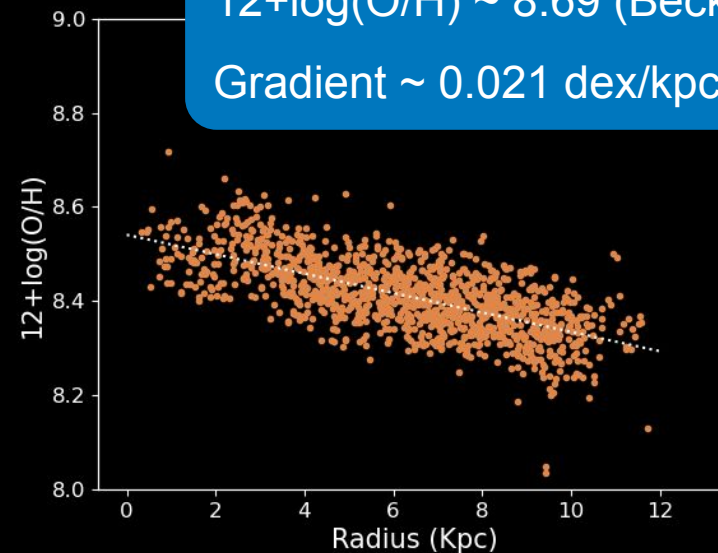
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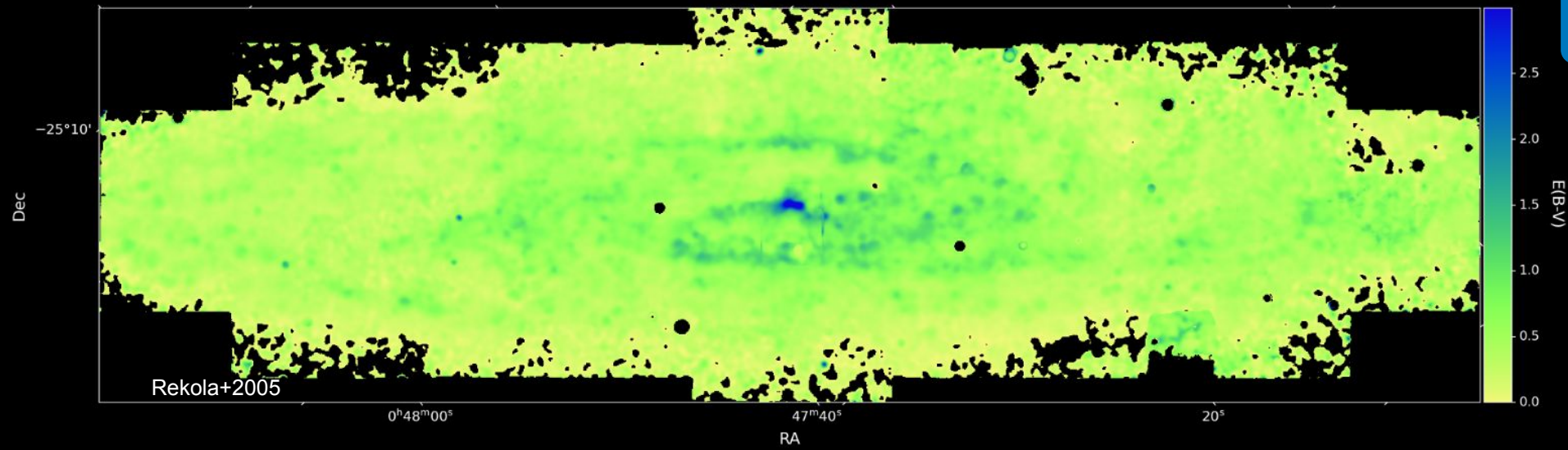
Aperture photometry



12+log(O/H) ~ 8.69 (Beck+22)
Gradient ~ 0.021 dex/kpc

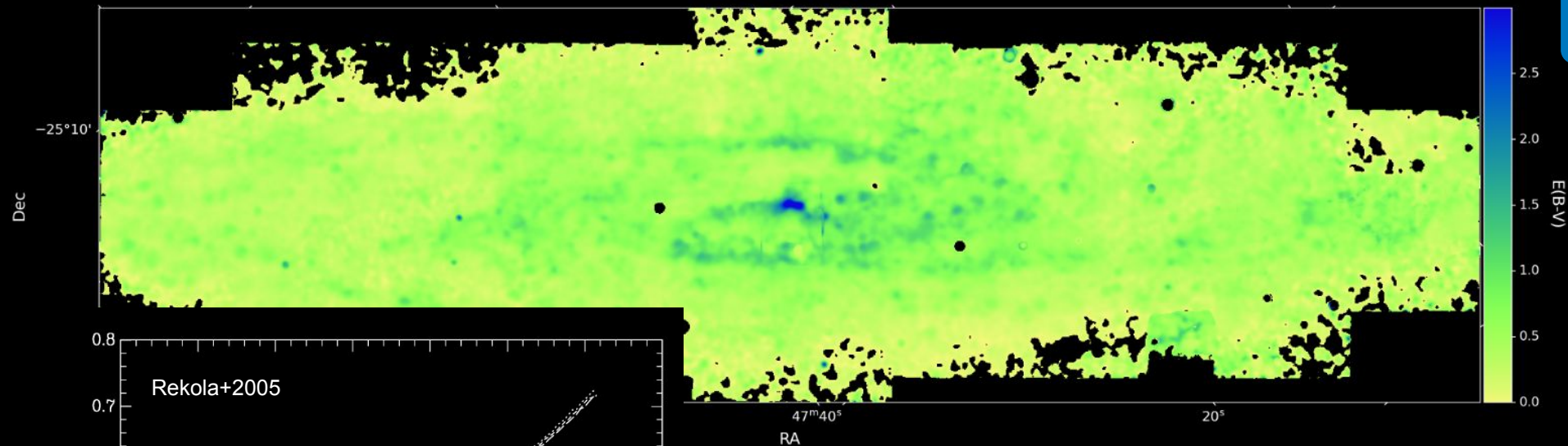


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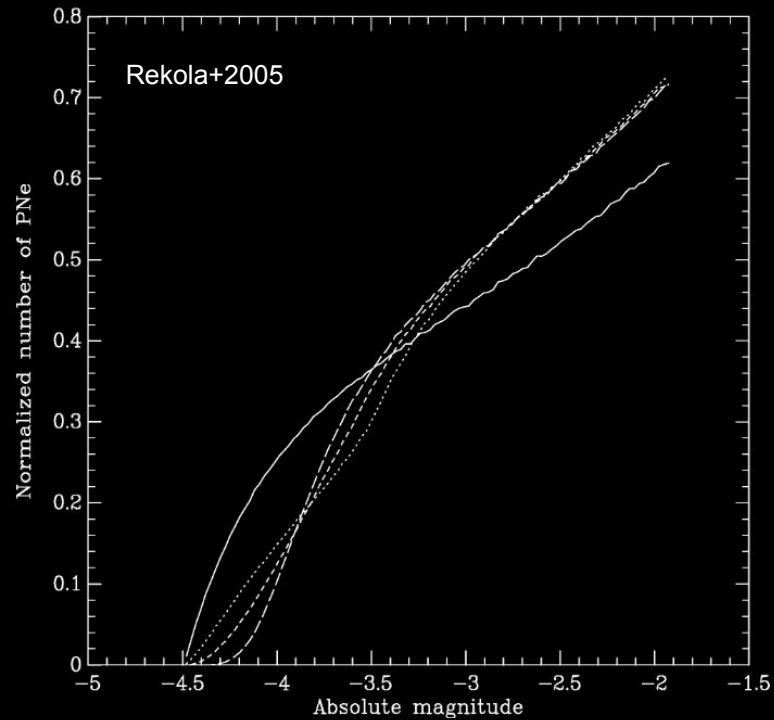


Extinction

PNFLF – Congiu et al. in prep.



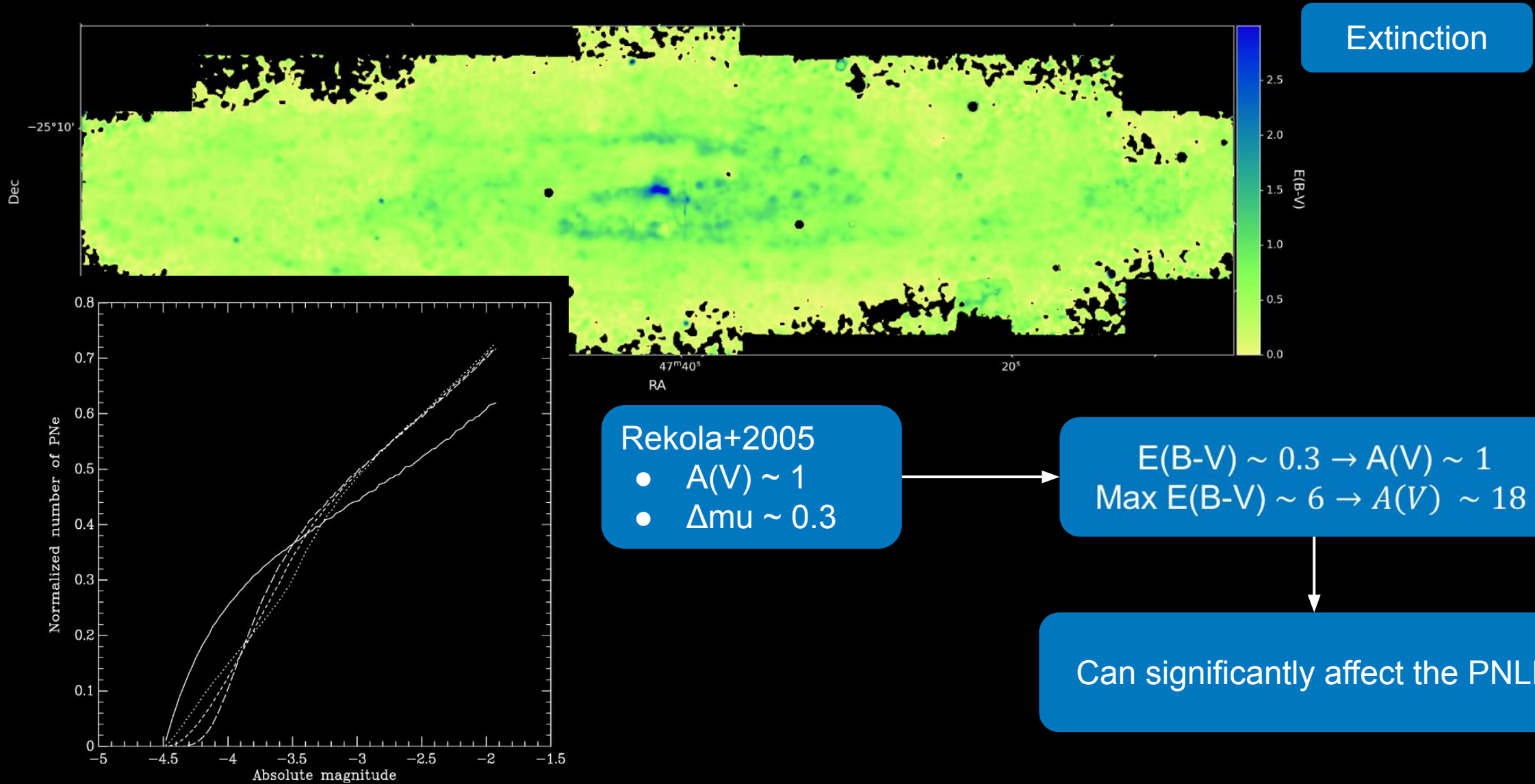
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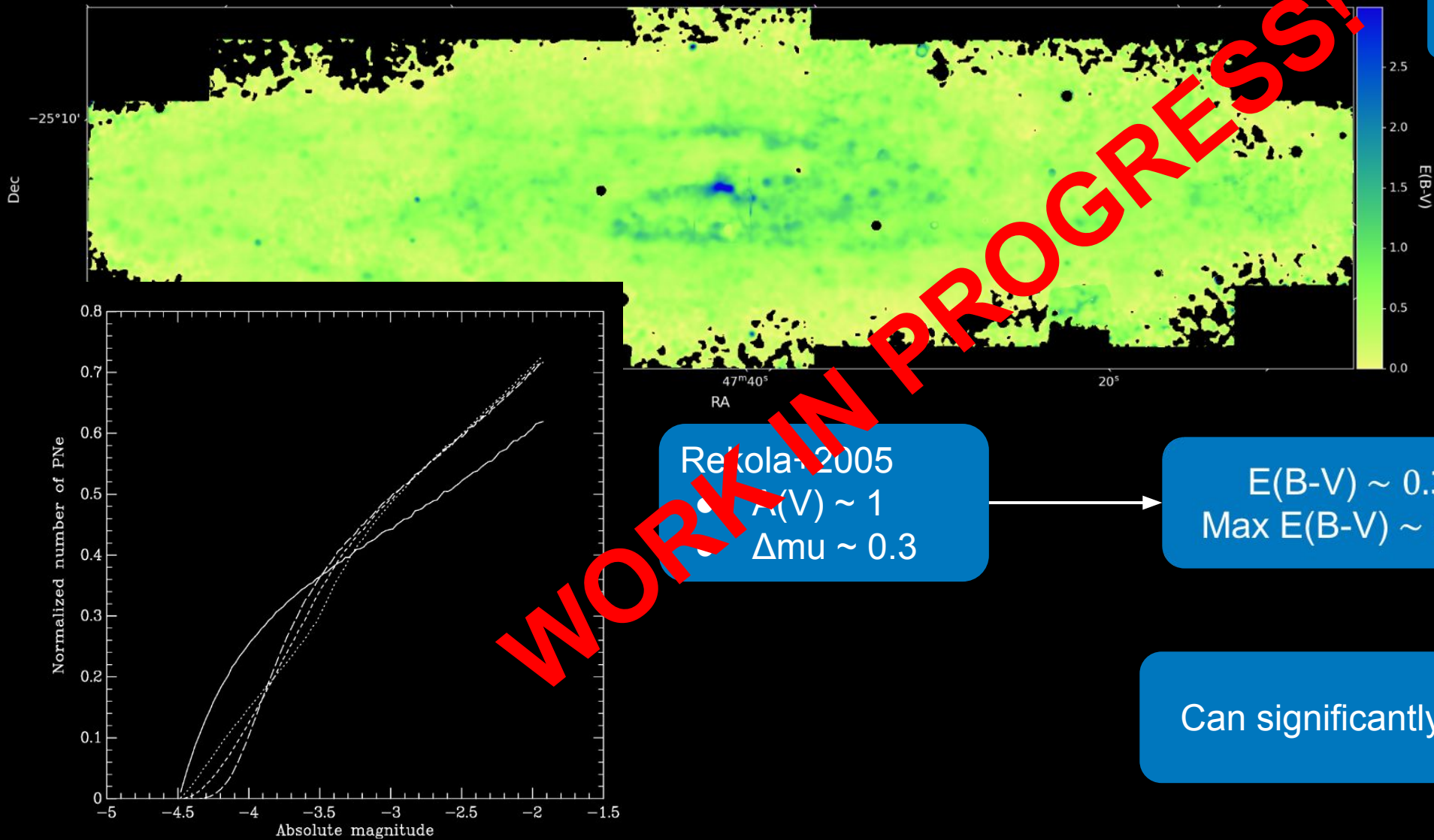
Rekola+2005

- $A(V) \sim 1$
- $\Delta\mu \sim 0.3$

PNLF – Congiu et al. in prep.



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Summary and Conclusions

1. NGC 253 is the perfect target for resolved star formation studies
 - a. Closest massive starburst to the Milky Way
 - b. High resolution but manageable size
2. New MUSE mosaics of the galaxy
 - a. 100 pointings – 20x5 arcmin²
 - b. Ready for science!
3. First scientific results:
 - a. NGC 253 PNLF – Congiu+ in prep.
 - b. H II regions – Rebecca's talk, Congiu+ in prep. b
4. Much more interesting works in preliminary phase

Thank you!

