Unravelling the history of the Magellanic Clouds with SMASH

POL MASSANA

Postdoc
Montana State University

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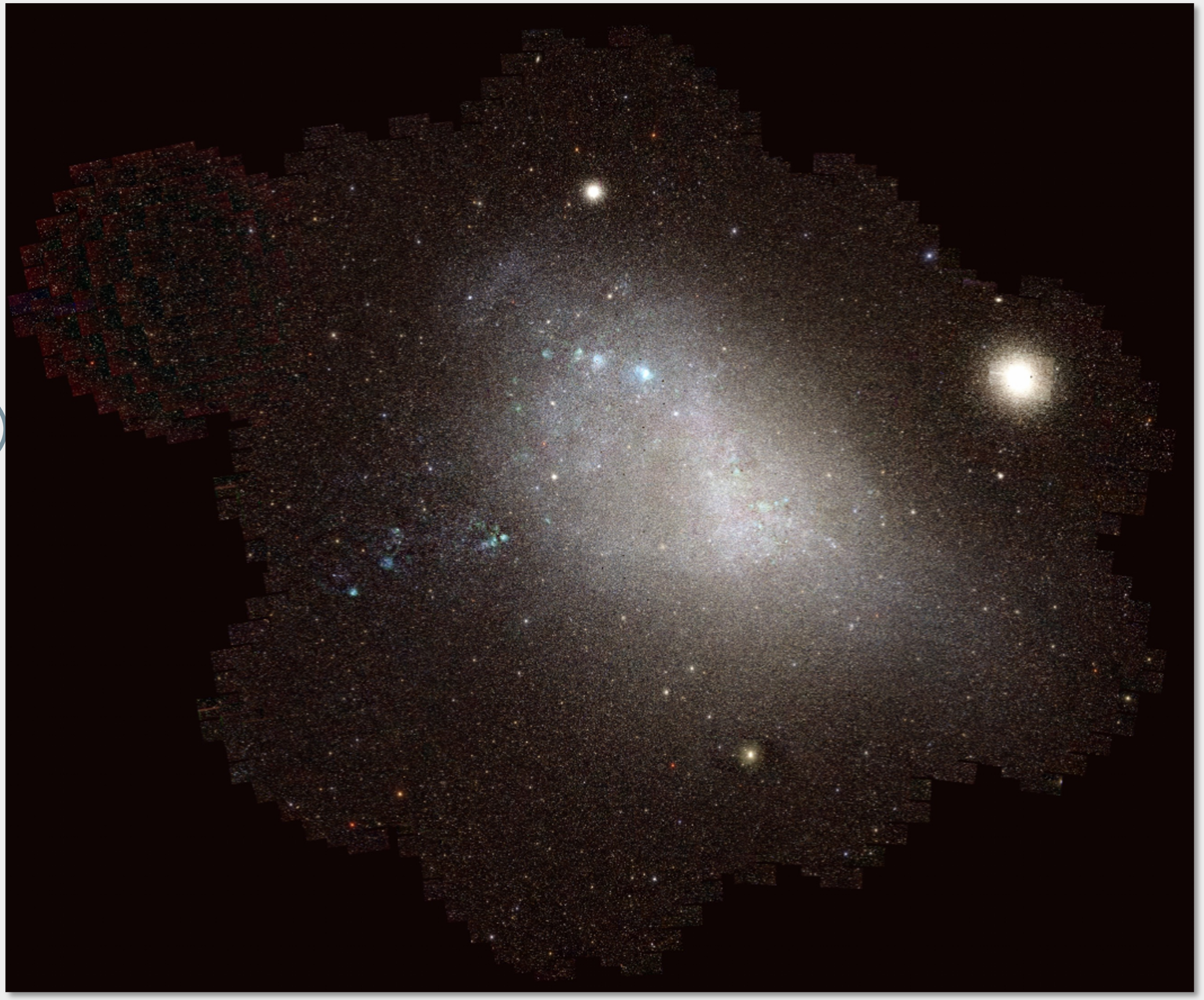
SMASH GOALS

1. To map out the extended stellar peripheries of the Clouds.
2. Derive spatially-resolved star formation histories of the central regions.
3. Detect and map potential streams and substructure in the Magellanic periphery not associated with HI features.



Credit: Tomás Ruiz-Lara, David Nidever and the SMASH team.

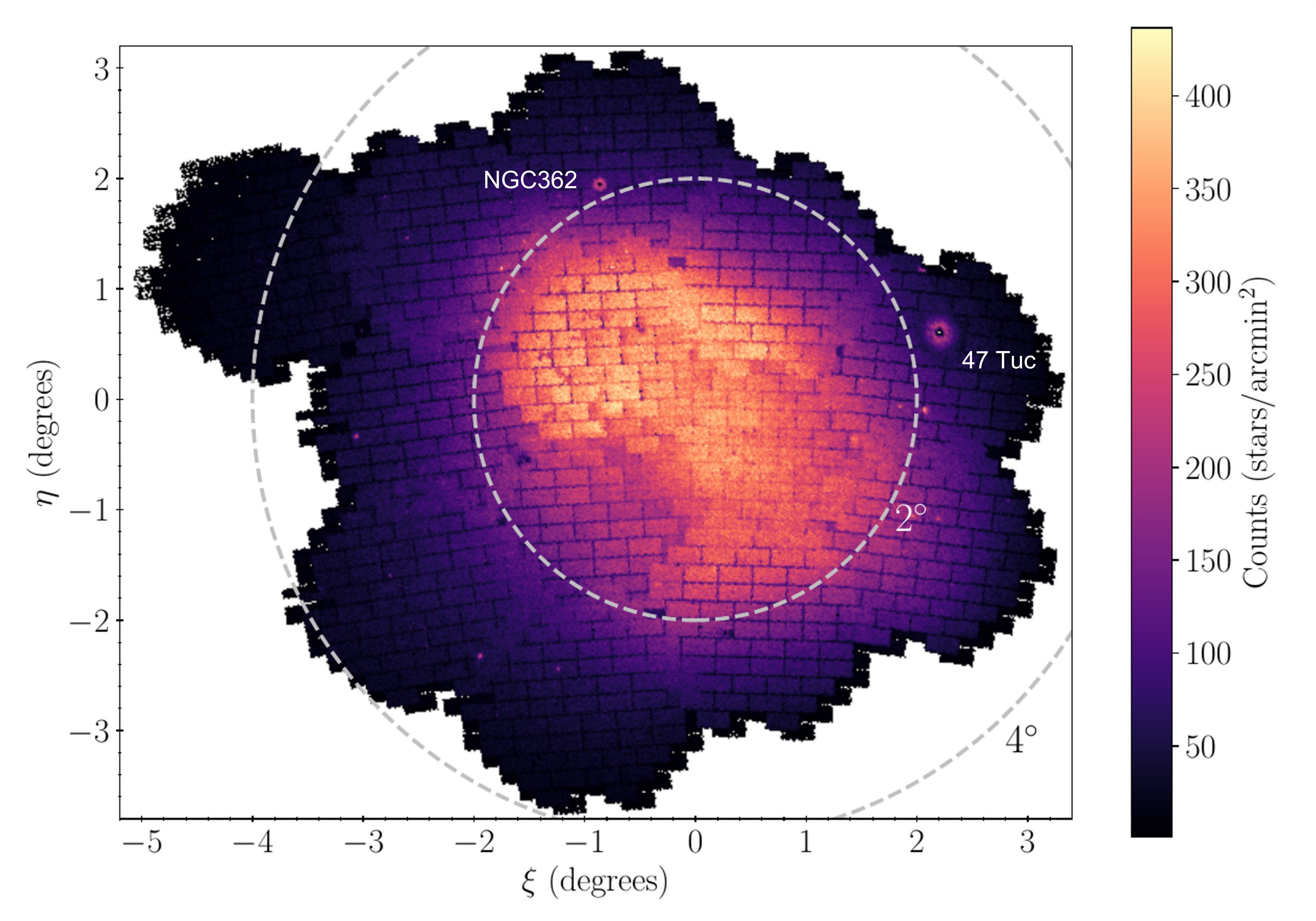
SMC COVERAGE

The Survey of the MAgellanic Stellar History (**SMASH; Nidever et al. 2017**) is a DECam survey that tackles those three main goals.

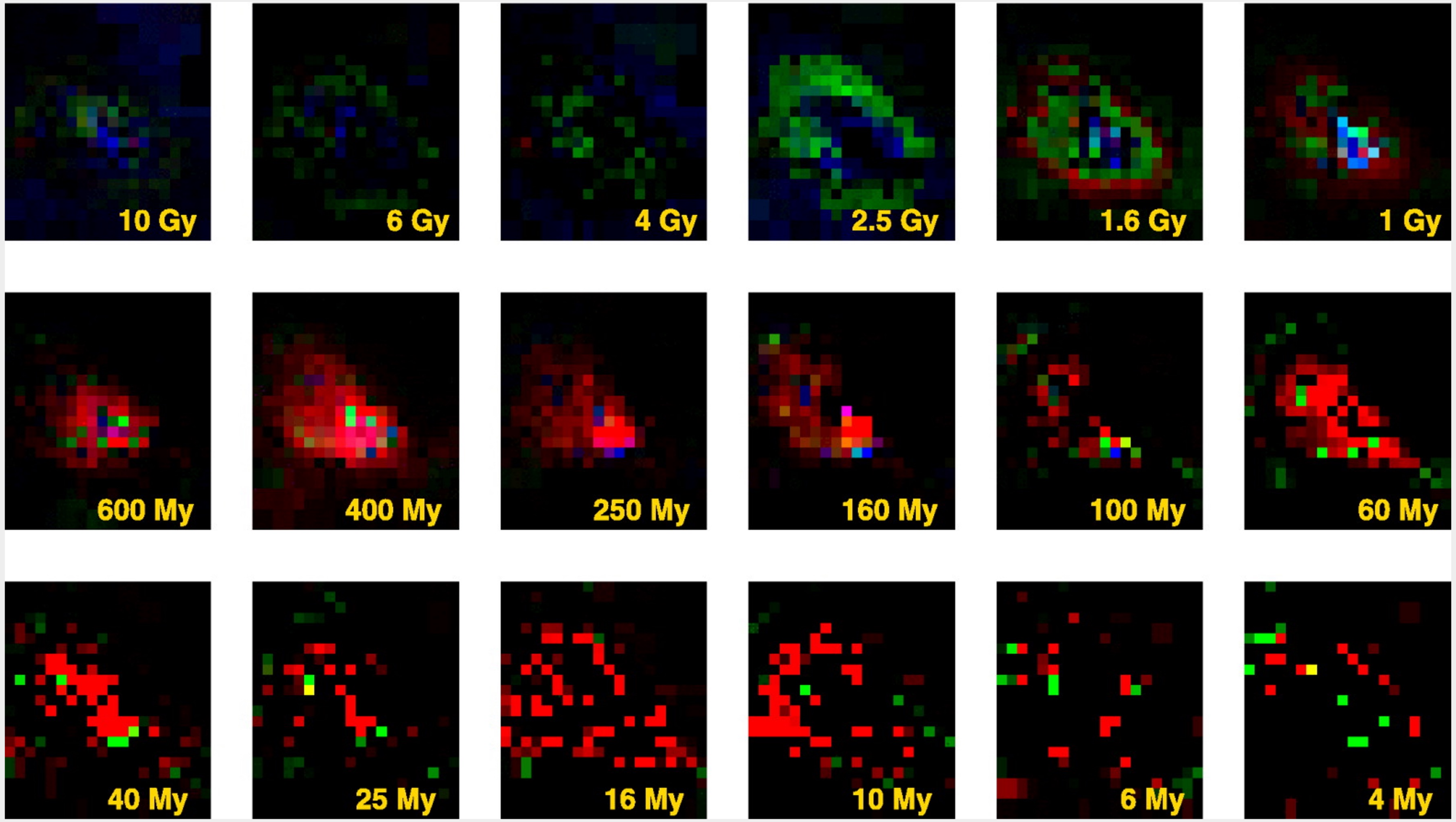
Second (and final) data release occurred in September 2019 (**Nidever et al., 2020b**).

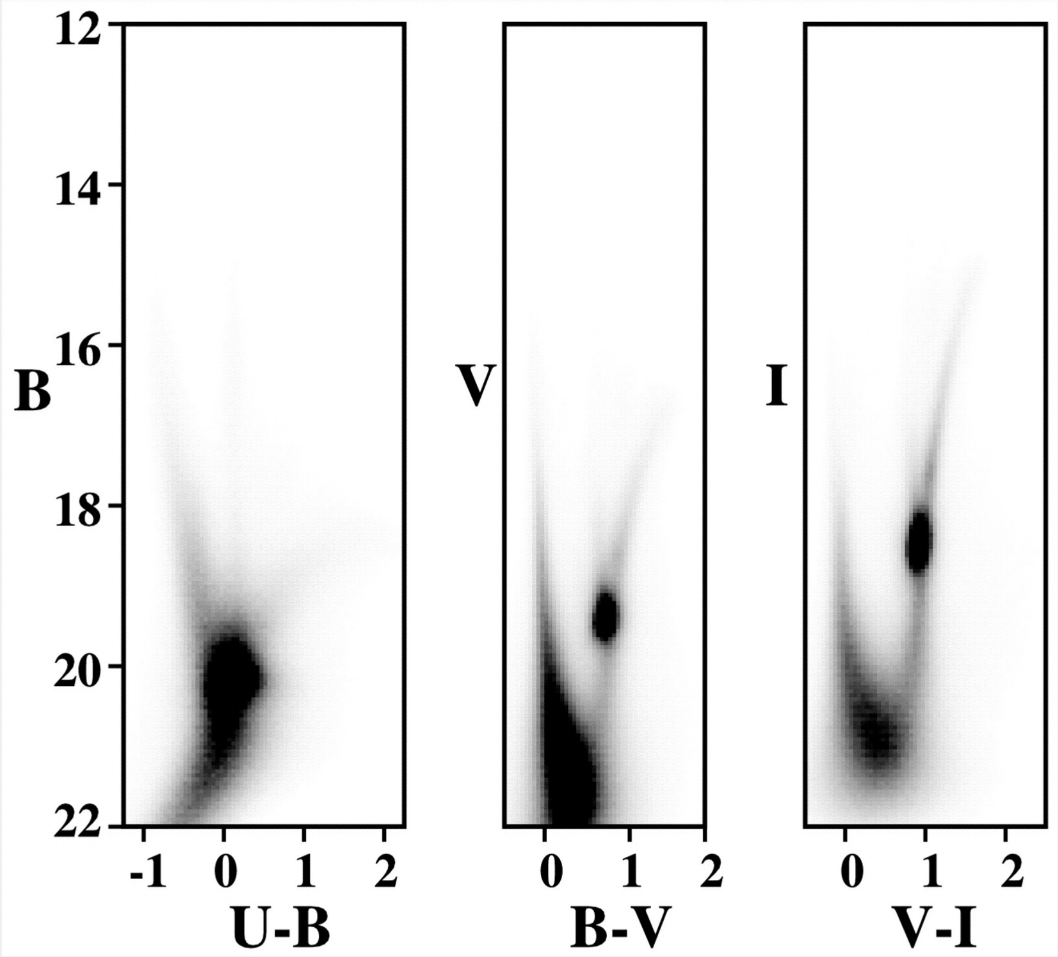
In the SMC area the depth reaches $g \approx 24$ mag, well beyond the main sequence turn-off ($g \approx 22$).

There are 36.2 deg^2 of continuous coverage of the main body of the SMC. Plus 7 more fields within 7 degrees of its centre.



THE MISSING PIECE IN SFH



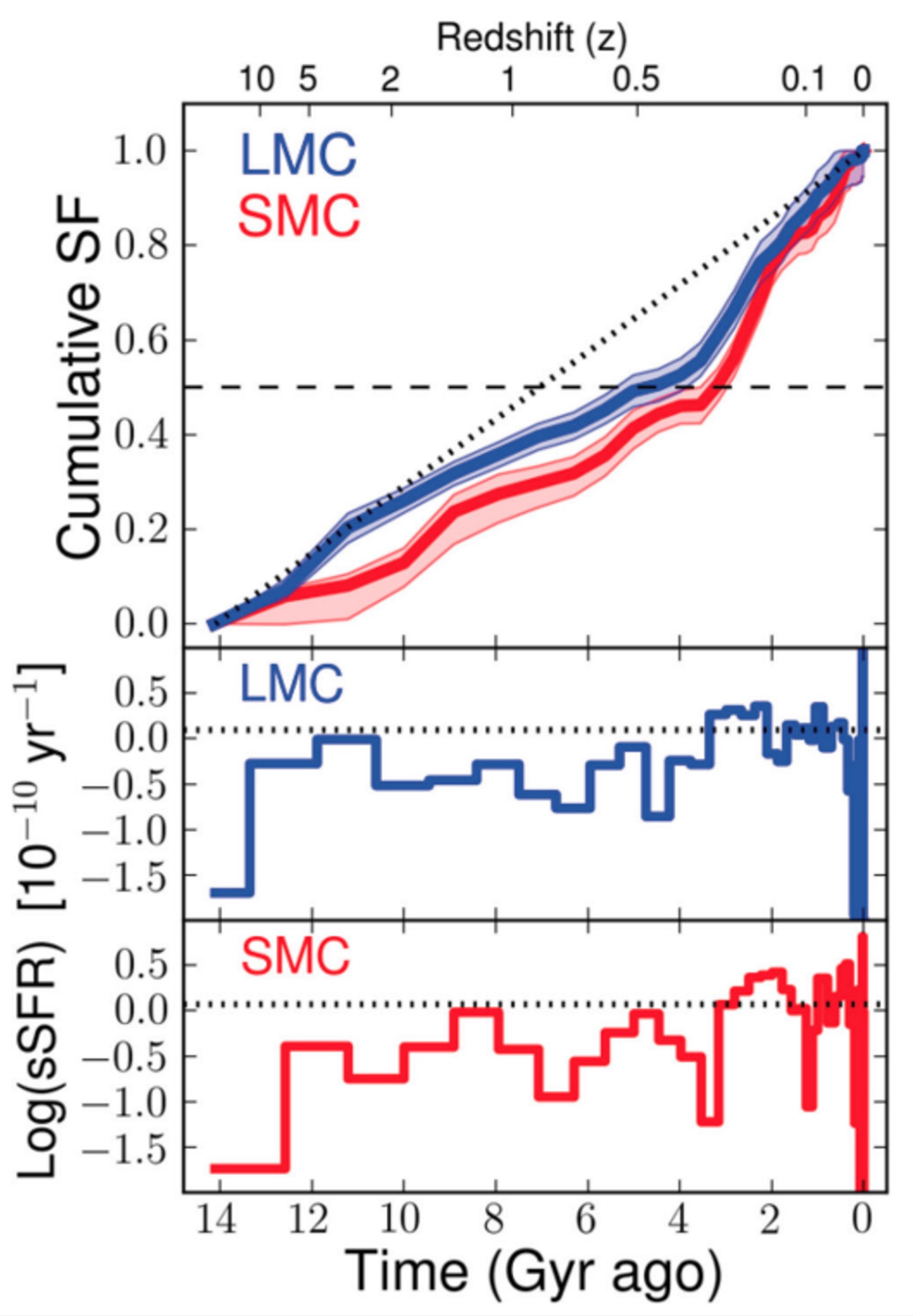


Harris & Zaritsky (2004) used a 4°× 4.5° survey with photometry down to V≤22. Completeness issues around the main sequence turn-off.

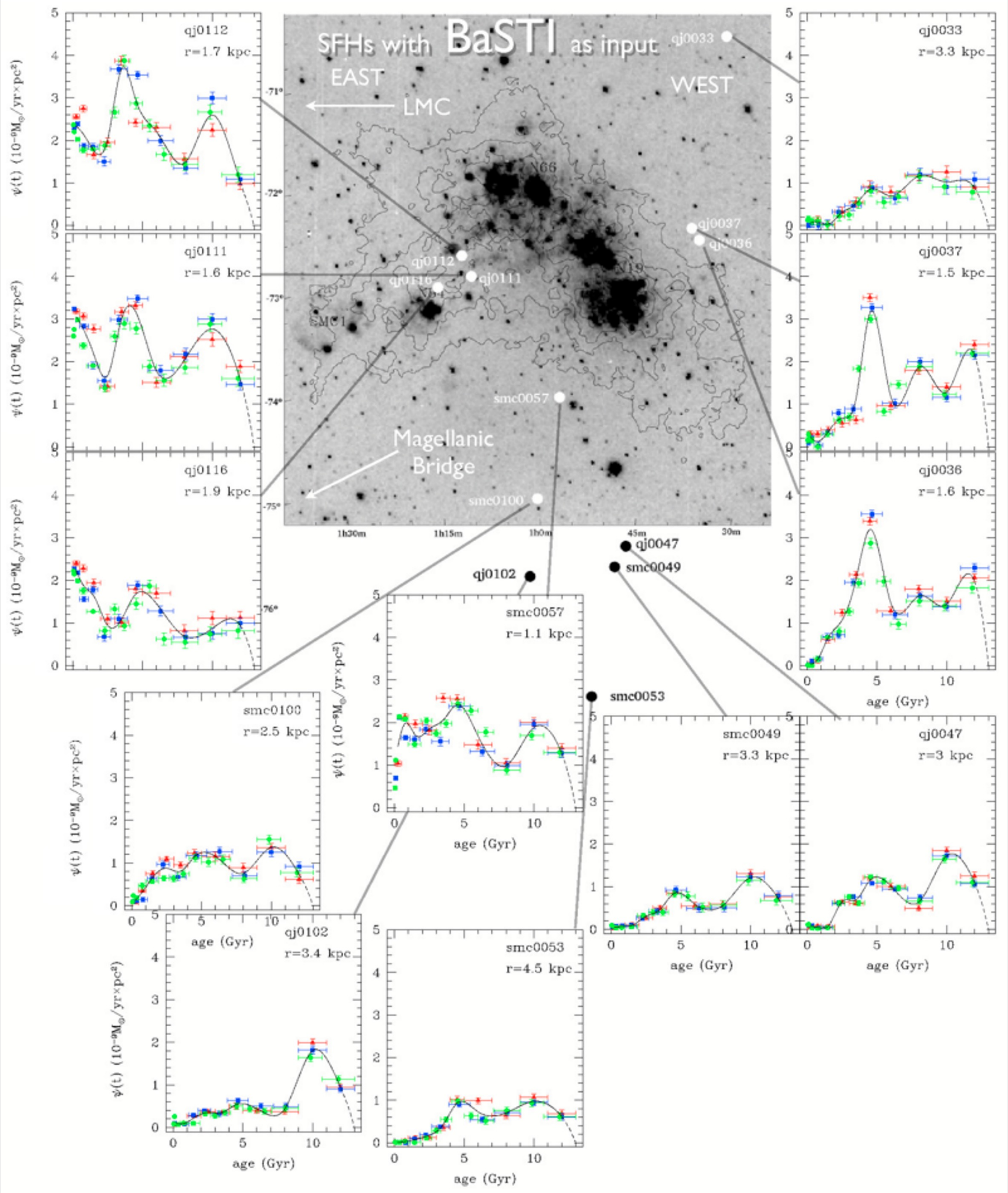
THE MISSING PIECE IN SFH

Noël et al. (2009) used smaller fields, but for the first time reaching deeper in magnitude and below the main sequence turn-off.

A similar strategy was followed by **Cignoni et al. (2012)** and **Weisz et al. (2013)** for the inner parts of the galaxy using HST data.



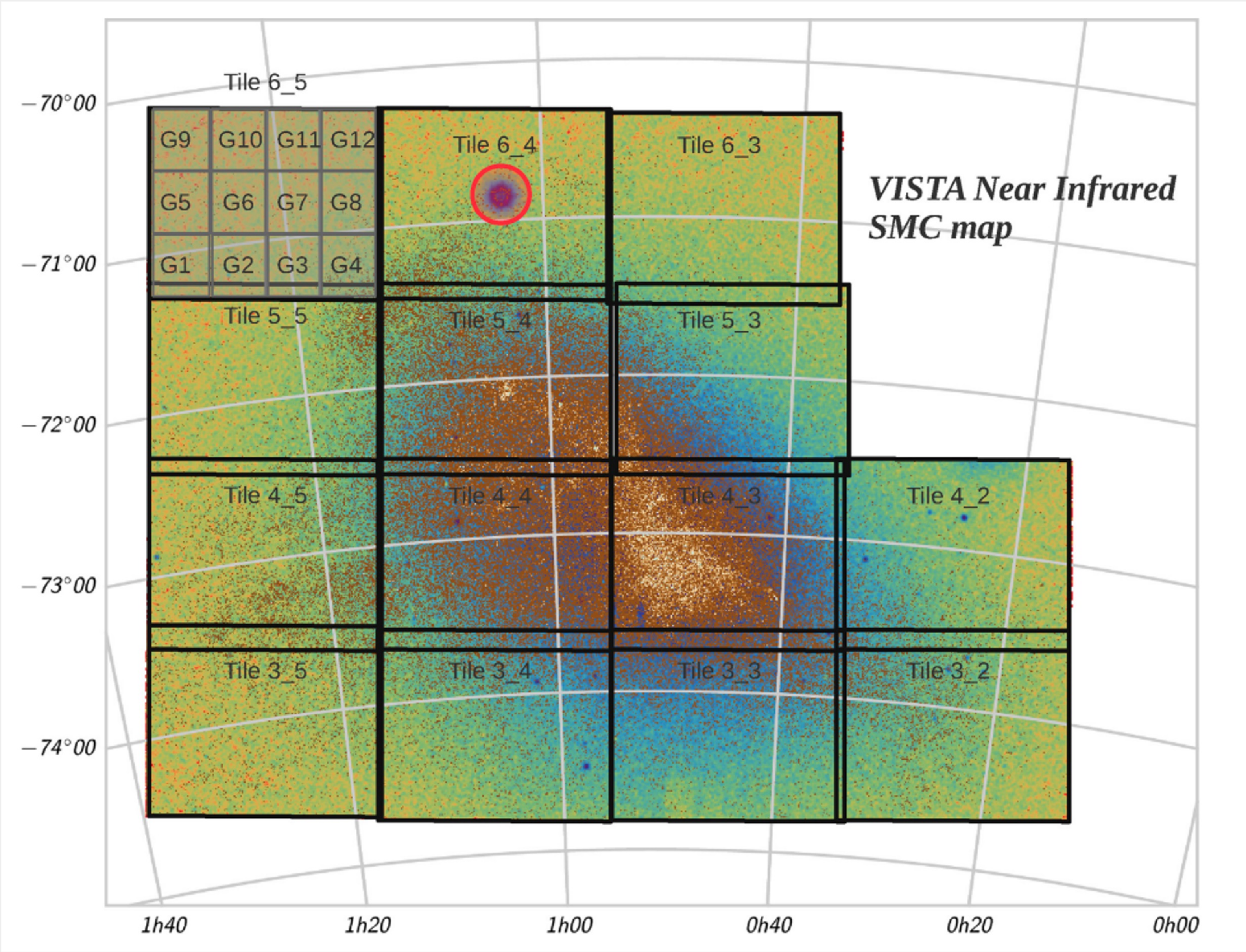
Weisz et al. 2013

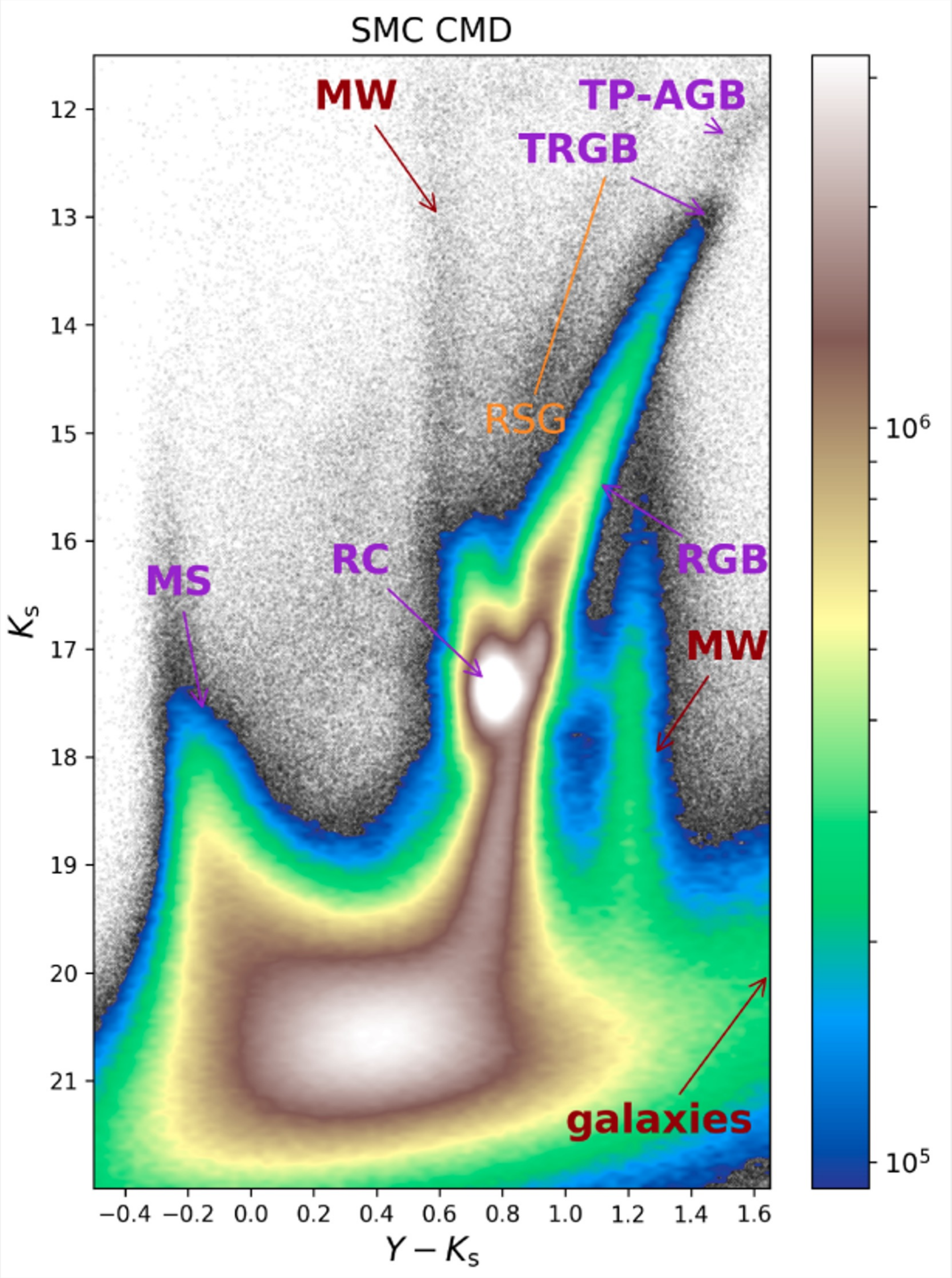


Noël et al. 2009

THE MISSING PIECE IN SFH

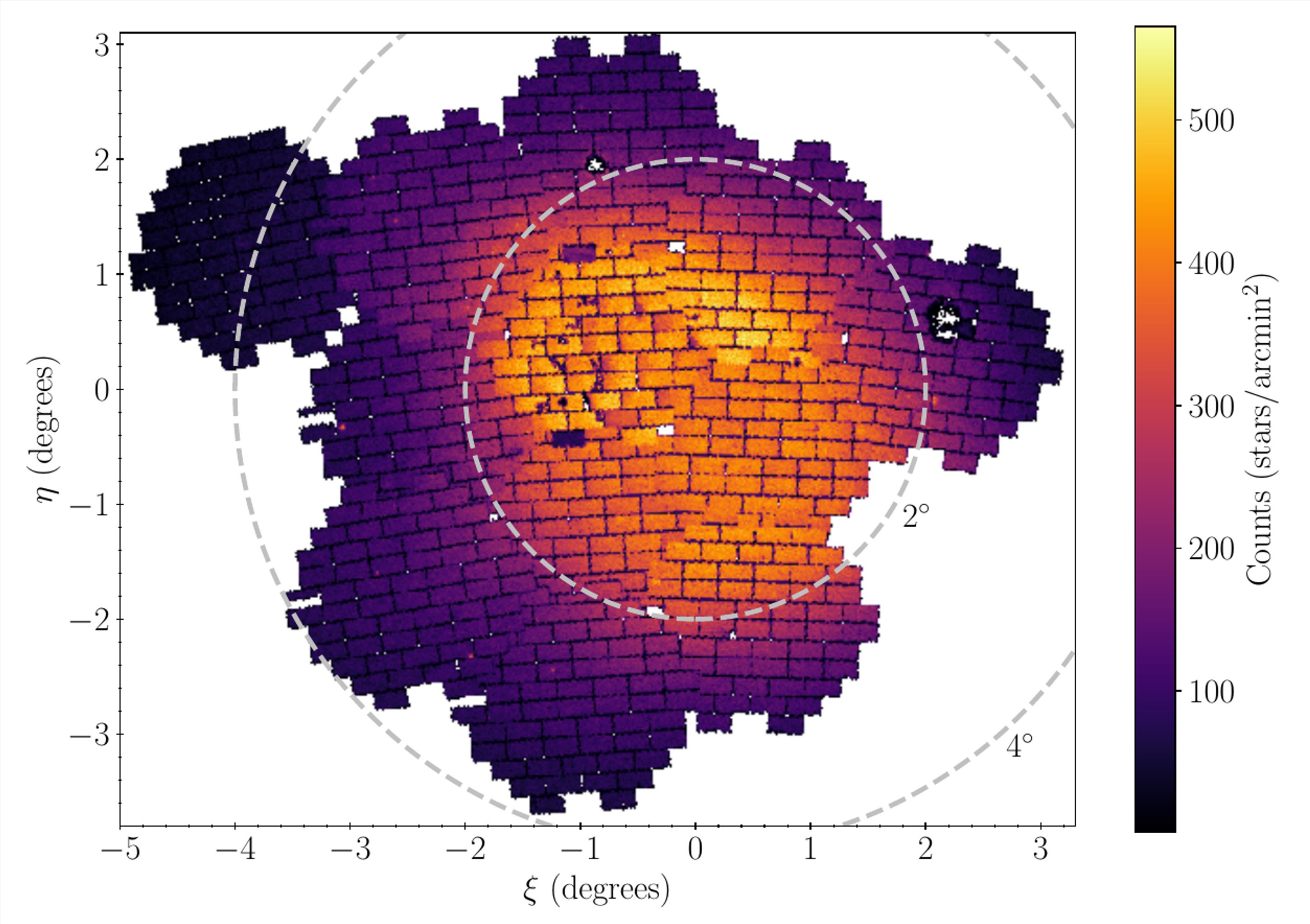
Finally, **Rubele et al. (2018)** used the VMC survey covering a big area of the SMC main body (23.57 deg^2). Completeness issues remain in the MSTO.



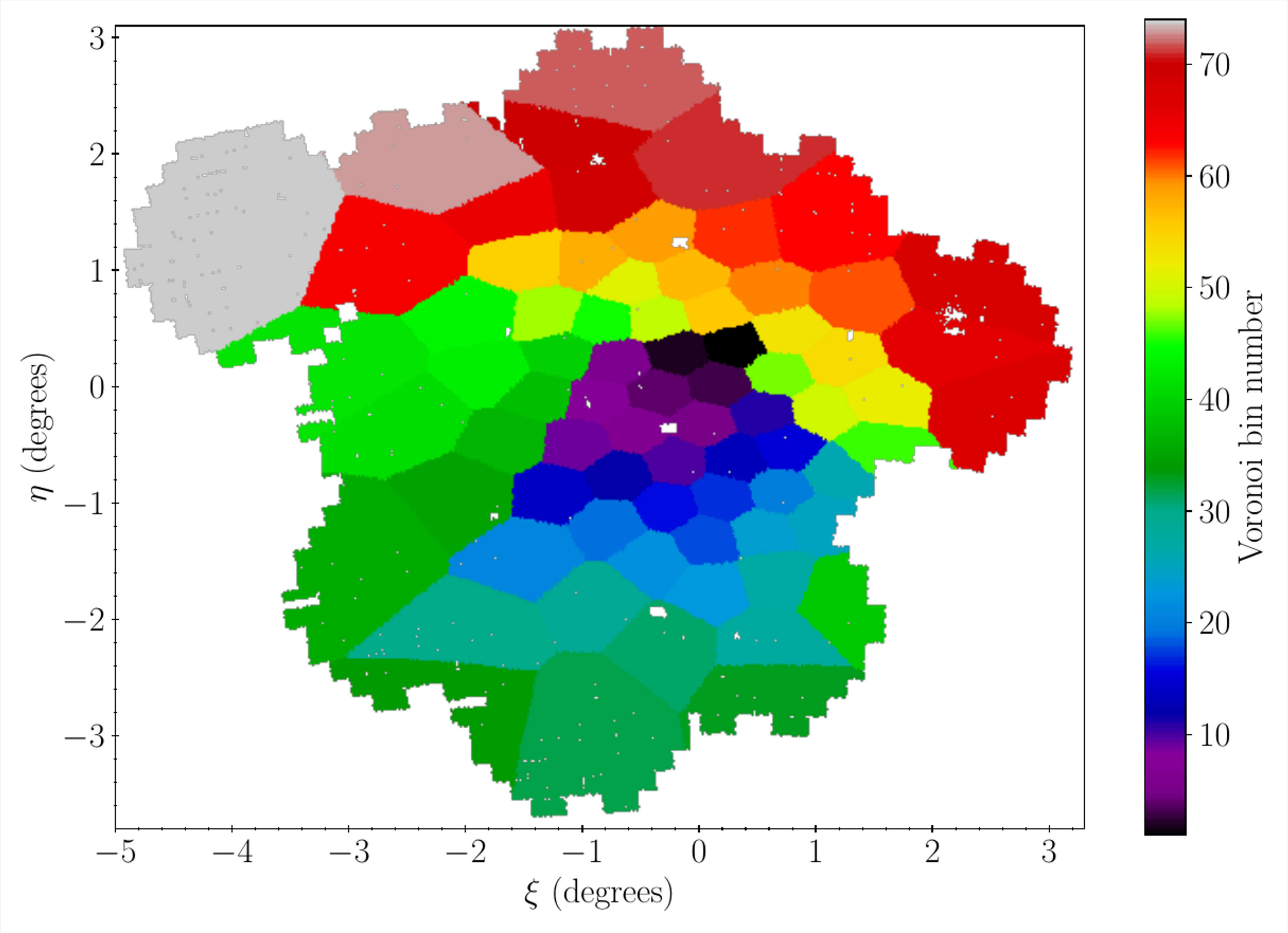


We were missing a combination of both photometric **depth** and wide **coverage**!

METHODOLOGY

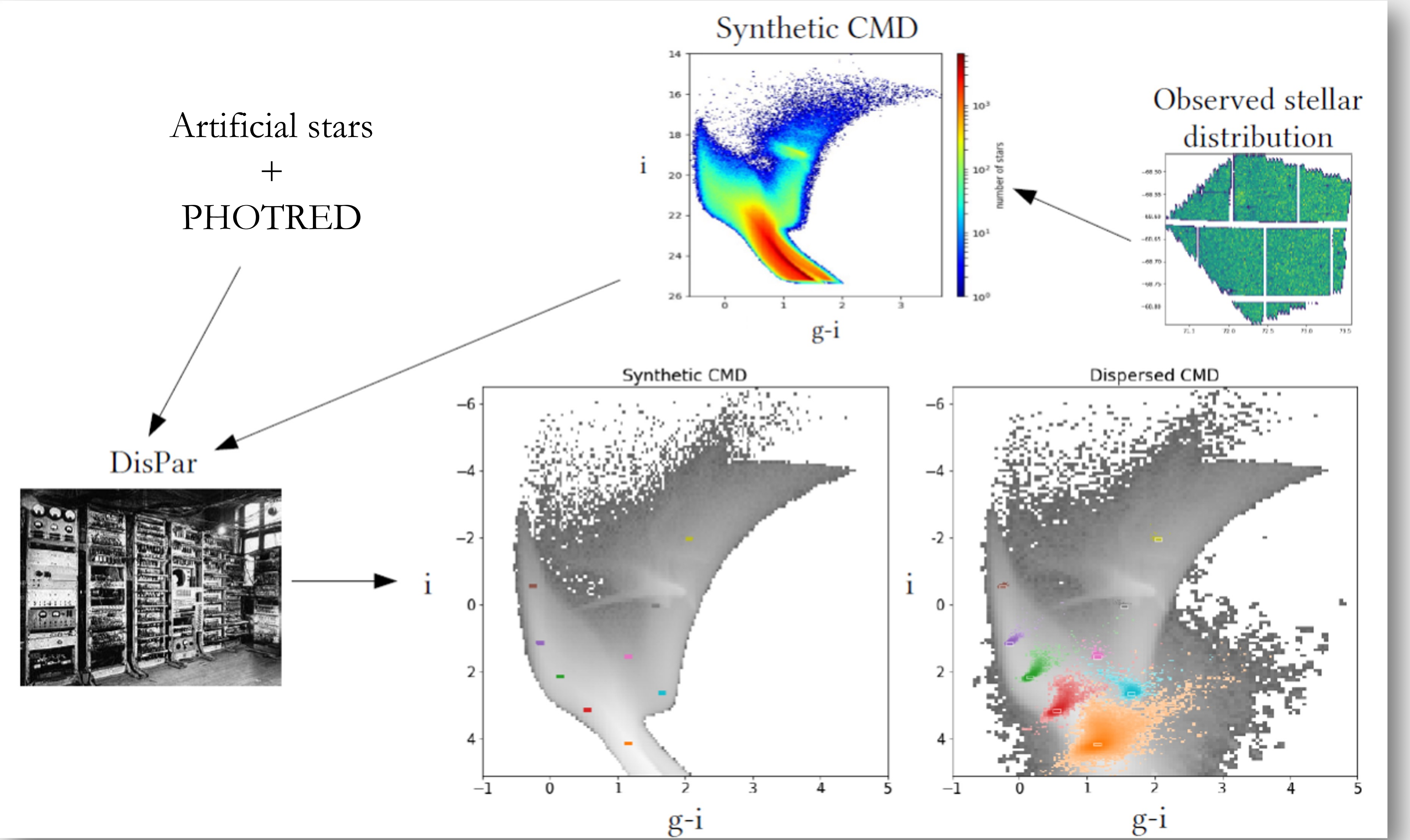


31 deg^2 of covered area



2D on-sky Voronoi tessellation (Cappellari & Copin 2003)
~281,000 stars per bin on average

METHODOLOGY



Credit: Tomás Ruiz-Lara

We use synthetic CMDs created using **BaSTI** stellar evolutionary models (**Pietrinferni et al. 2004**).

- Age range: 0.03 Gyr to 14.0 Gyr
- Metallicity range (Z): 0.0001 to 0.025

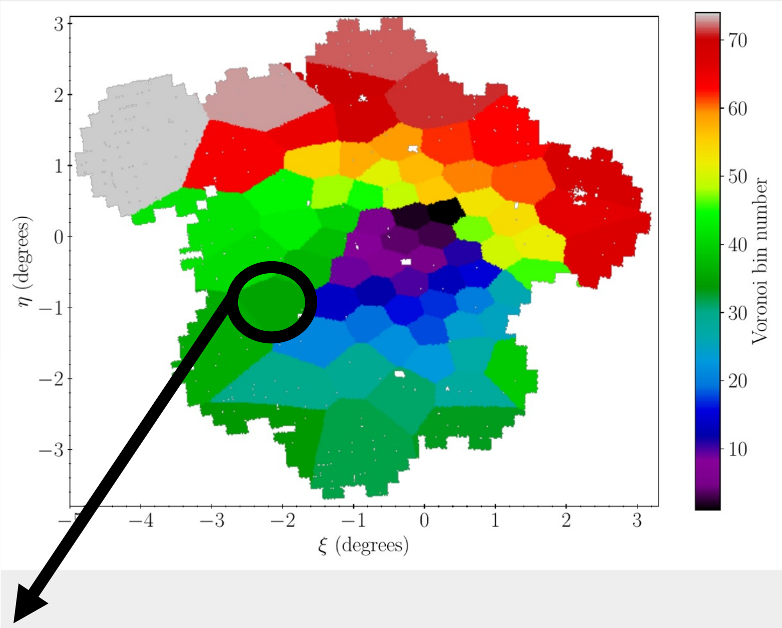
Observational errors are calculated using artificial star tests with the SMASH pipeline (PHOTRED; **Nidever et al. 2017**).

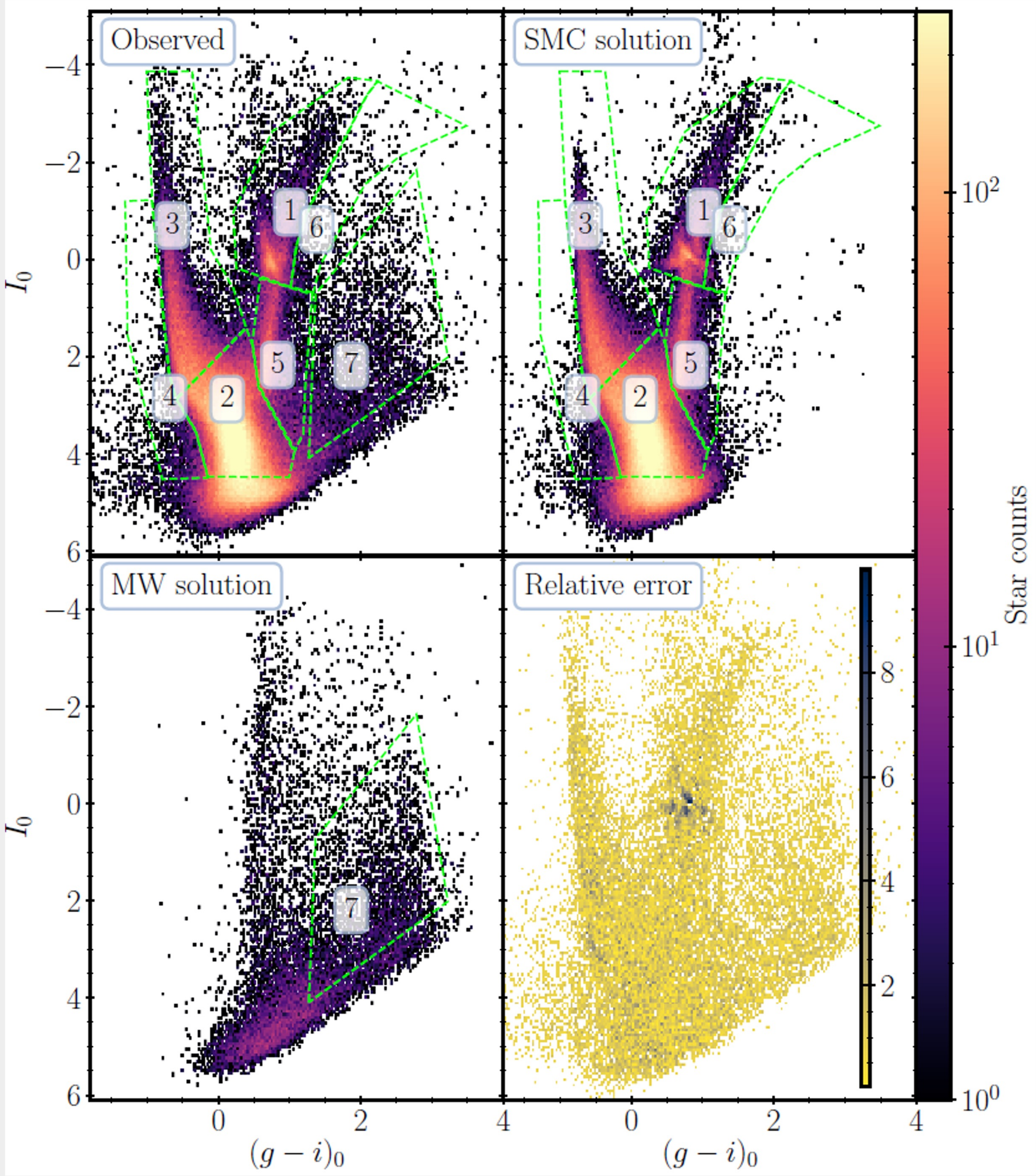
The observed stellar distribution is used to obtain dispersed synthetic CMDs (**Gallart et al. 1999**).

OUR SMC RESULTS

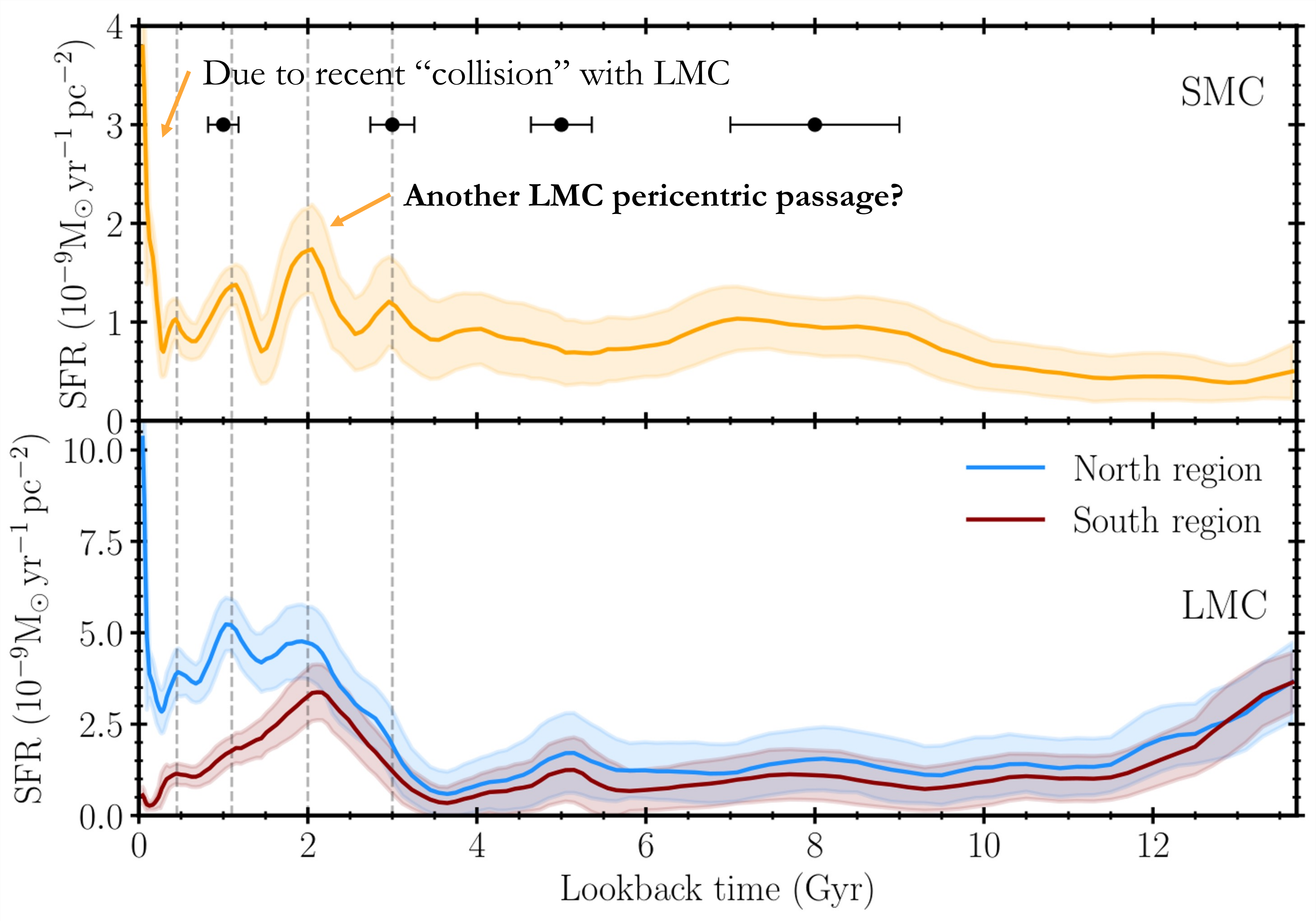
We use ***TheStorm*** code (**Bernard et al. 2015, 2018**) to perform the SFH calculation.

Comparing star counts in each region (defined by green dashed polygons).





GLOBAL SMC/LMC SFH



We see **evidence for a peak 2 Gyr ago**, simultaneous with a peak in the LMC (**Ruiz-Lara et al. 2020**).

Similarly, other peaks at 0.4, and 1.1 Gyr ago are also synchronised. There is potential evidence for **common evolution since 4 Gyr ago**.

Star formation in the SMC "agitated" for the last ~ 4 Gyr.

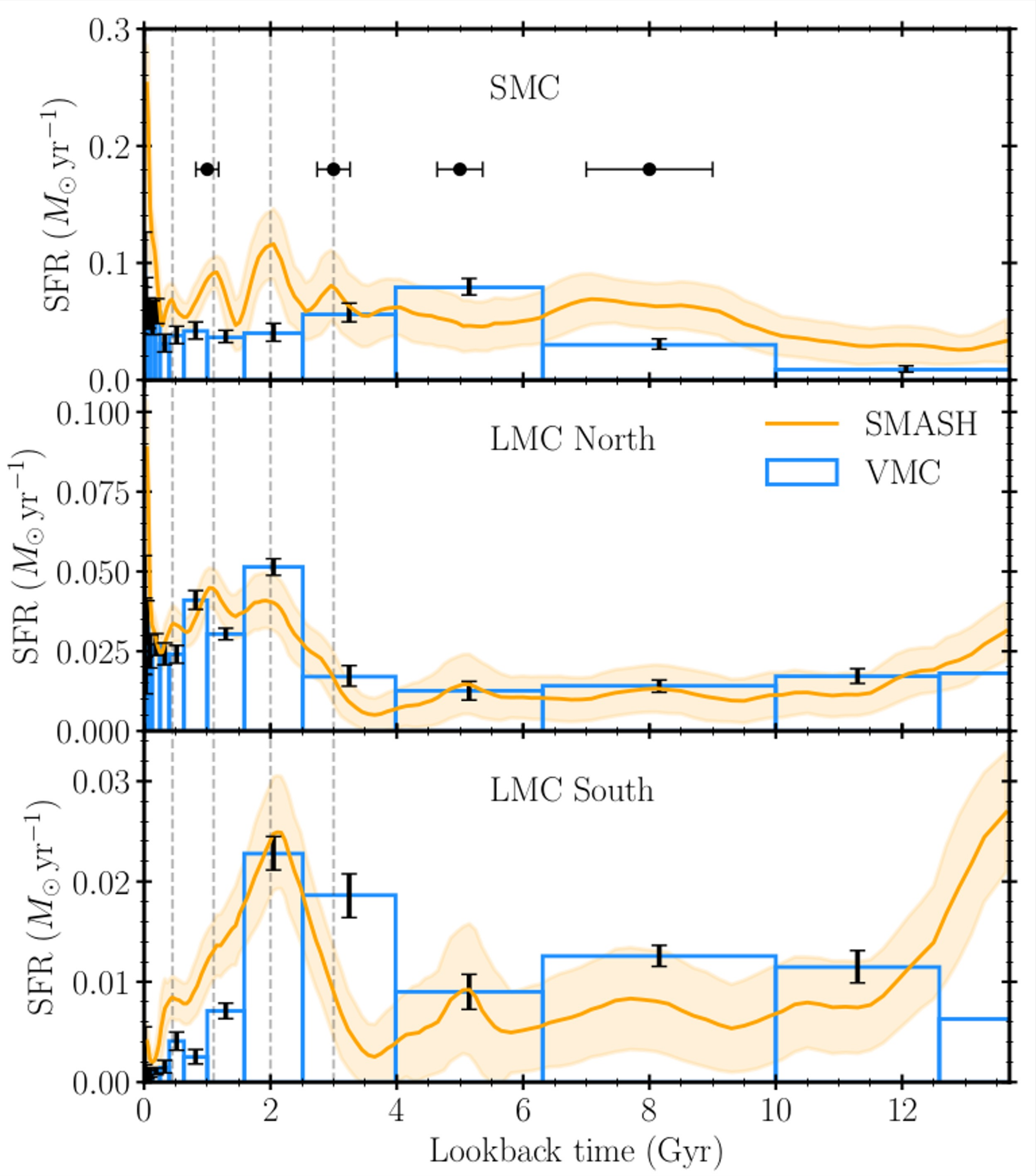
Current star formation enhanced in both galaxies due to recent collision (~200 Myr ago; Zivick et al. 2018).

GLOBAL SMC/LMC SFH

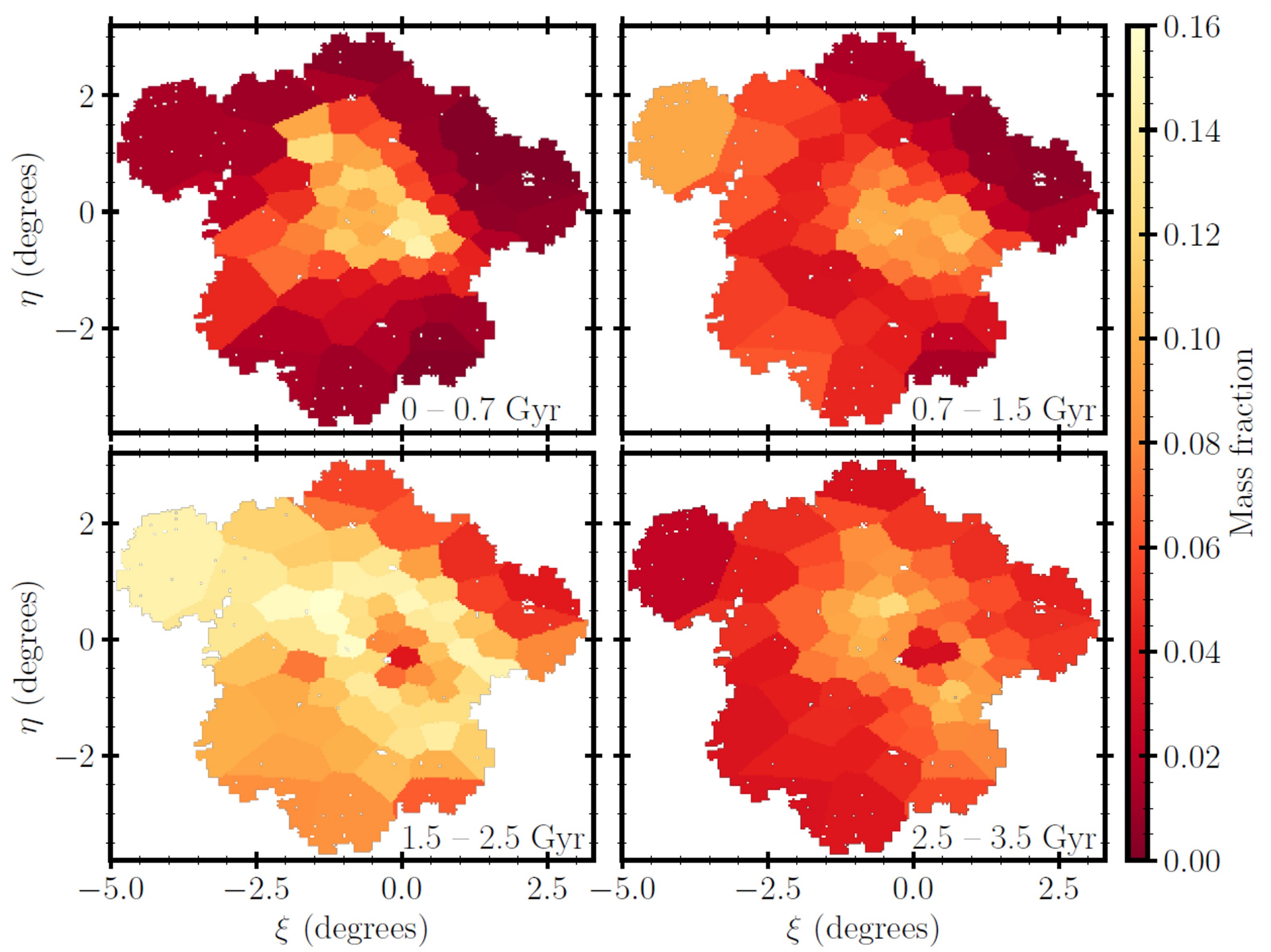
We compare our results to those of the VMC survey. The SMC VMC results come from **Rubele et al. (2018)**, and the LMC results from **Mazzi et al. (2021)**.

Remarkable agreement is found in the LMC results, while there seems to be a disparity with the SMC results.

Conclusion: photometric depth helps the SMC a lot more than the LMC due to its larger distance and line of sight depth.



2D SMC MASS FRACTION DISTRIBUTION



The top left panel shows that the **central bins** and some of the Eastern ones (**Magellanic Bridge**), are the predominant locations for **star formation in the last 0.7 Gyr**, partly as a result of the last LMC-SMC interaction ~0.2 Gyr ago.

The left panel in the bottom row shows that the stars produced in the burst **2 Gyr ago are distributed everywhere in the SMC**, in contrast with the mostly central star formation in the other periods. Although some mixing is expected due to rotation and secular evolution, the **effect shown is much bigger than for the stars born during the 2.5 - 3.5 Gyr period**.

CONCLUSIONS

- **Star formation in the SMC was triggered 3, 2, 1 and 0.5 Gyr ago** coinciding with most of the star formation peaks reported in Ruiz-Lara et al. (2020b) for the LMC. This, together with our ability to discern individual bursts of star formation, allows us to claim that **the SMC and LMC have been interacting and mutually affecting each other for the last 3.5 Gyr**.
- **The most prominent SFR peak in both systems took place around 2 Gyr ago**, having a global influence in the SMC while affecting only locally the LMC owing to their mass difference.
- Our photometric depth allowed a far more accurate SMC SFH determination, enabling an extremely accurate comparison with the LMC SFH.

Thank you!