Star Formation History of the Magellanic Clouds: a survey program with DECam@4mCTIO

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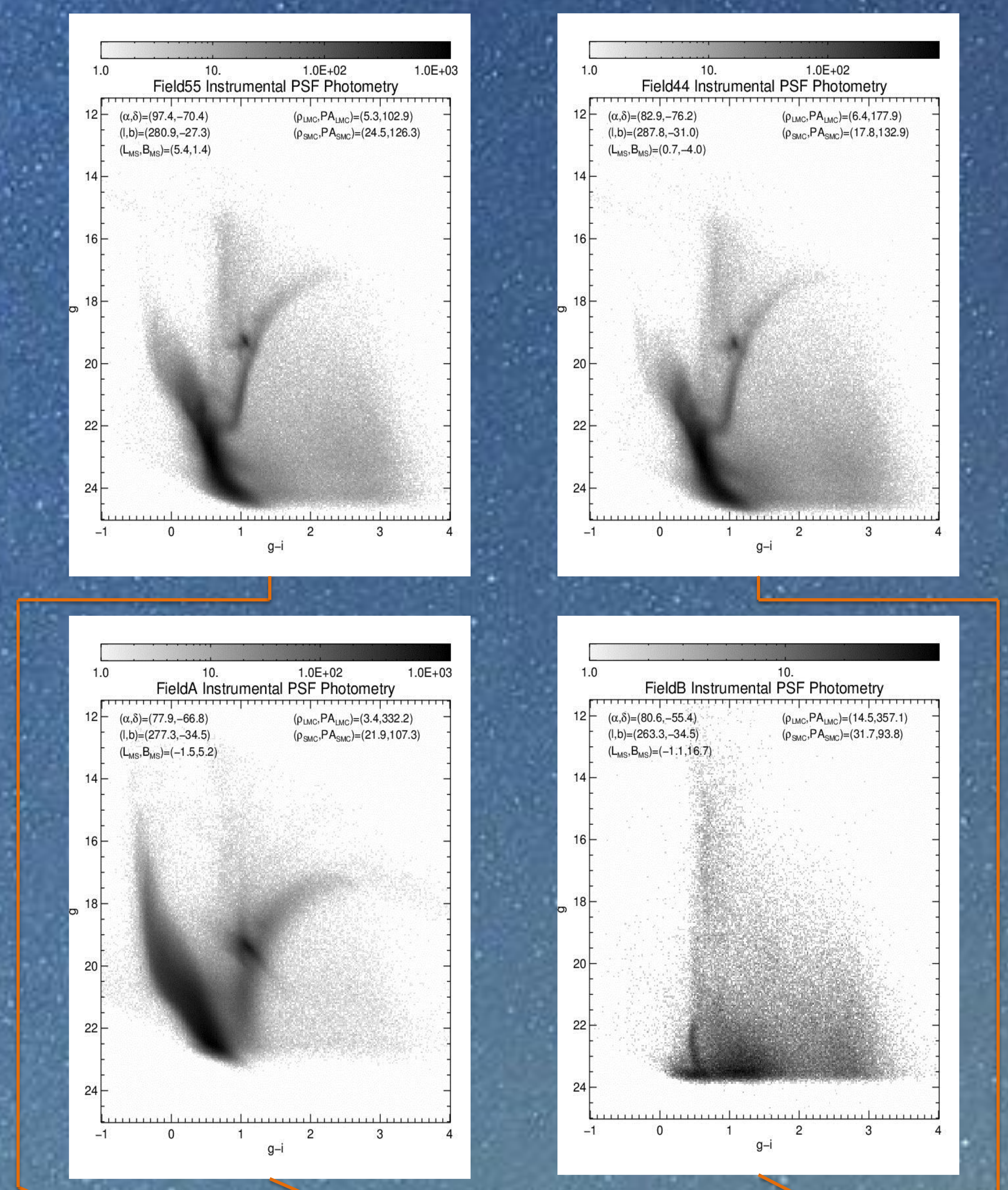
Over the last several years, various discoveries have drastically altered our view of the iconic Magellanic Clouds (MCs), the nearest interacting galaxy system. The best evidence is now that they are on first infall into the Milky Way, that their stellar populations extend much further than previously thought, and that they suffered a close collision that tore out both the well-known Magellanic Stream and a large amount of still undetected stellar debris. **Here we present a community DECam survey of the Clouds mapping 480 deg² (distributed over ~ 2400 deg² at ~ 20% filling factor) to 24th mag griz (and u~23)** that will supplement the 5000 deg² Dark Energy Survey's partial coverage of the Magellanic periphery, allowing us to map the expected stellar debris and extended populations with unprecedented fidelity. We have already conducted a pilot project demonstrating that DECam will allow us to: (1) Map the stellar periphery of the MCs with old main sequence turnoff stars to a surface brightness limit of ~35 mag/arcsec² revealing relics of their formation and past interactions. (2) Identify the stellar component of the Magellanic Stream and Leading Arm for the first time, if they exist, making them the only Galactic halo tracers with both gaseous and stellar components. (3) Derive spatially-resolved star formation histories covering all ages out to large radii of the MCs that will further complement our understanding of their formation.The combination of this survey and DES data will allow us to uncover a multitude of stellar structure that will unveil the complex and dramatic history of these two dwarf galaxies, while enabling a broad spectrum of community-led projects.

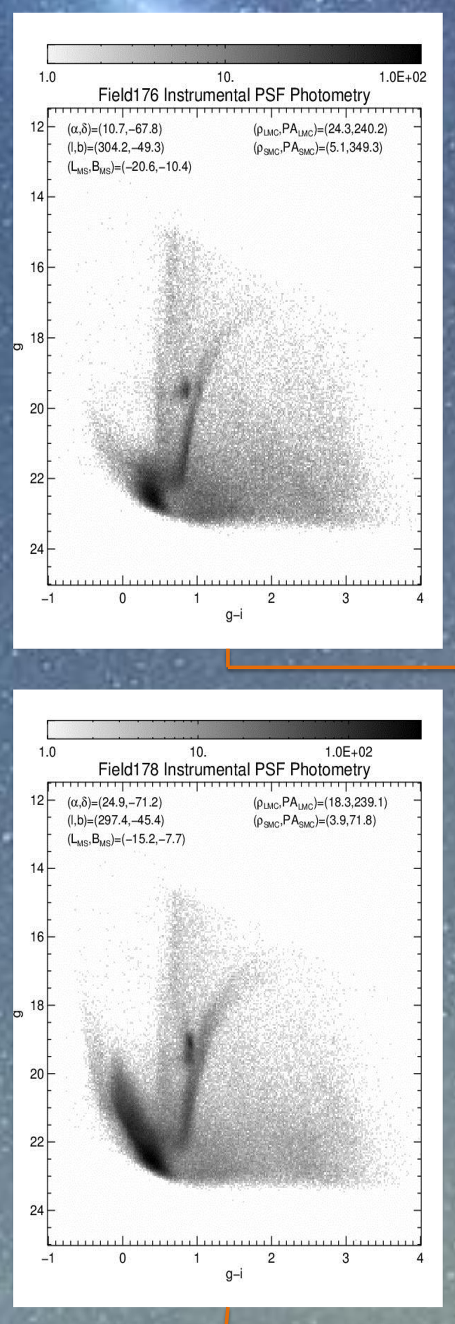
SMASH has obtained initial data through DECam Science Verification (data public now) and through a 30 nights NOAO Survey program. First observing runs were executed in semesters 2013A , 2013B and 2014A (15+8 nights) . Subsequent observations to fulfill the science goals described below will be concluded in the coming two years.

What will SMASH do?

1. Search for the stellar component of the Magellanic Stream and Leading Arm (see Figure 1). The detection of stellar debris in these structures would make them the only tidal streamswith known gaseous and stellar components.This would not only be invaluable for understanding the history and consequences of the Magellanic interaction, but would give us a dynamical tracer of the MW's dark halo and a way to probe the MW's hot halo gas via rampressure effects.
2. Detect and map the smooth components of the Clouds, including their extended disks and potential stellar halos (see Figure 3).The size of the LMC's stellar disk is a direct probe of the tidal radius of the LMC, with which we can explore the dark matter halos of the LMC and MW.
3. Detect and map potential streams and substructure in the Magellanic periphery not associated with HI features.These would probe stages in the formation and interaction of the Clouds at times earlier than the HI dissipation timescale.
4. Derive spatially resolved, precise star formation histories covering all ages of the MCs and to large radii, thus providing detailed information on their complete evolution; see Figure 2.
5. Enable many community-led projects, including studies involving the LMC/SMC main bodies, Galactic structure, discovery of variable objects, and background galaxy populations.



Left: Preliminary CMD of LMC fields 55, 44, A and B. The distance from the LMC center and the position angle are labeled in each panel. In field B, we report the clear detection of turn off and main sequence LMC stars a distance of 14.5 degrees.
Right: Preliminary CMD of SMC fields 176 and 178.



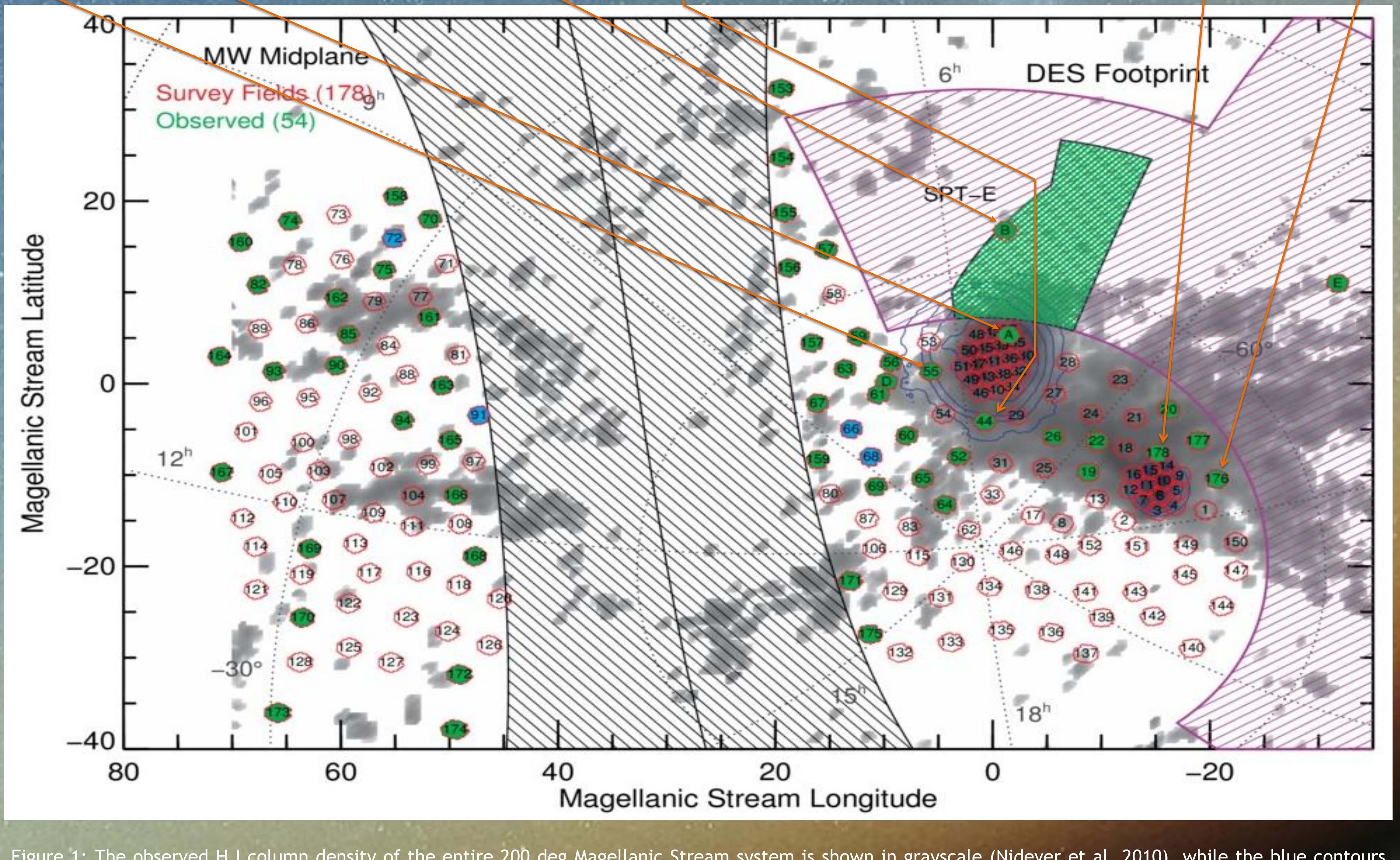


Figure 1: The observed H I column density of the entire 200 deg Magellanic Stream system is shown in grayscale (Nidever et al. 2010), while the blue contours represent the 2MASS RGB star counts. The DES footprint is represented by the purple shaded region which also contains the DES full-depth 175 deg² SV commissioning SPT-E field (green). Our 23 DECam March 2013 fields for the Leading Arm proposal (2013A-0411) are shown as green hexagons. Our target proposed fields are indicated by open red hexagons and large circles (for the main bodies of the MCs). Observations in these fields will definitively address the question of stellar streams/features and whether or not the MC gas is interacting with the hot gas in the Milky Way halo through ram pressure.

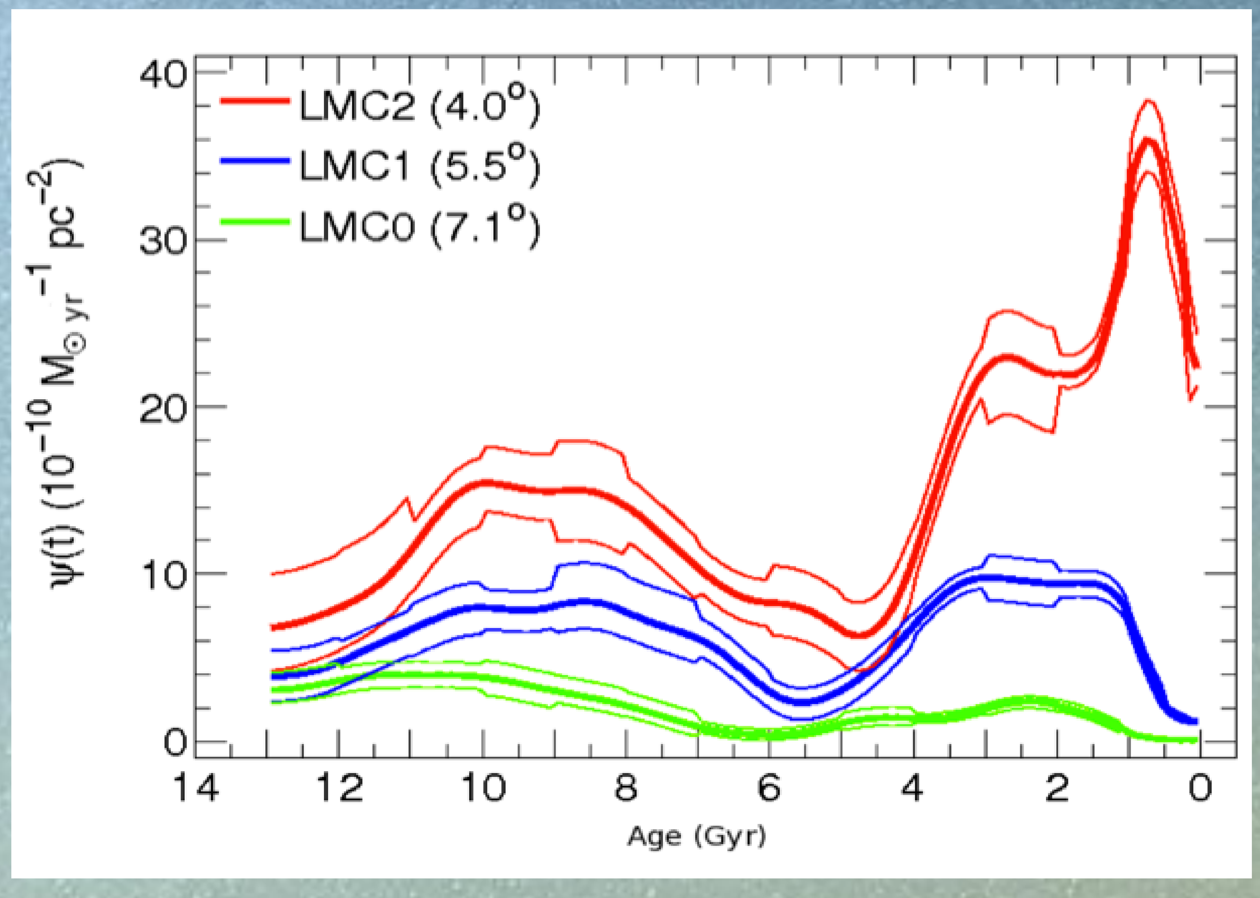


Figure 2: Star formation histories (SFHs) of LMC fields spanning R~4-7 deg (Meschin et al. 2013; see also Gallart et al. 2008). Two main periods of star formation, separated by one with lower activity are present in all fields. The age of the youngest component of the dominant stellar population increased with galactocentric distance contrary to expectations for inside-out formation scenarios. SMASH will further investigate the detailed SFH of the LMC. The IAC team is the main responsible of the determination of the spacially resolved SFHs of both MCs (point 4. above).

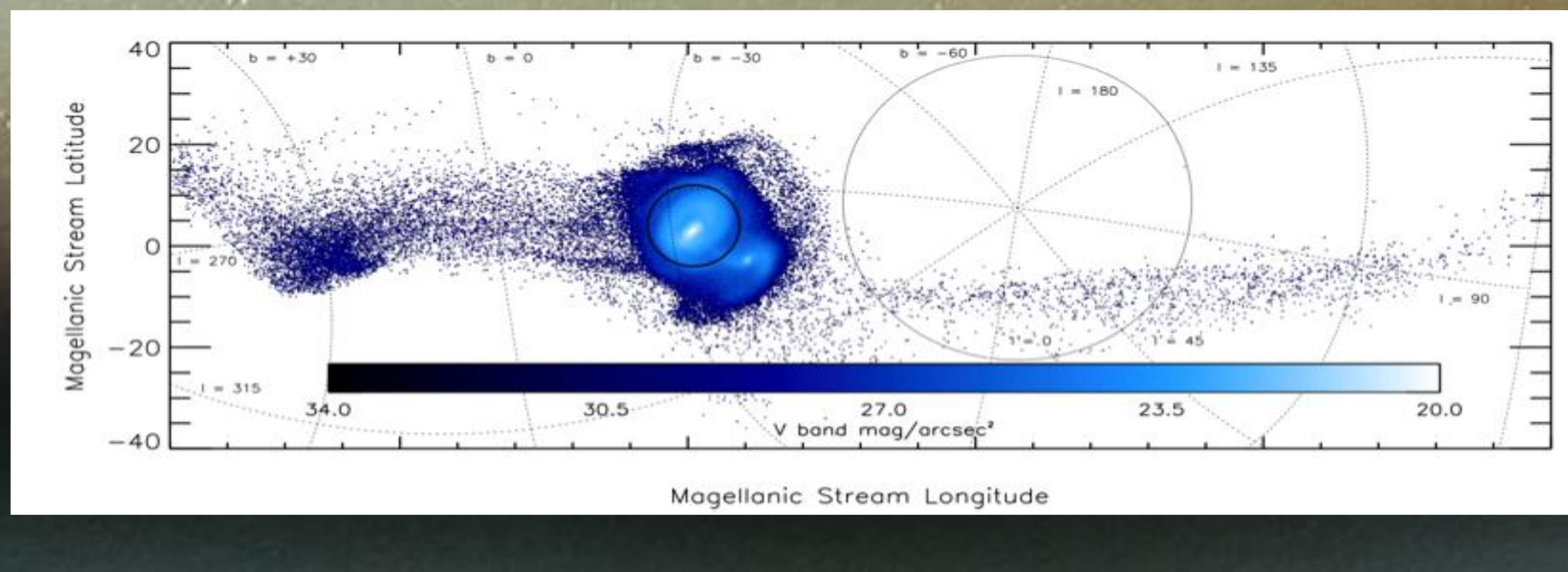


Figure 3: The predicted V-band surface brightness (mag/arcsec²) of the stellar component of the Magellanic system from Besla et al. (2013). The simulation predicts stellar structures out to large radii from the main bodies of the Magellanic Clouds (varying on small scales), and a higher stellar density in the Leading Arm (not covered by the Dark Energy Survey, DES) than in the trailing Stream.

References:
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Gallart et al. 2008, ApJ, 682, L89
Meschin, et al. 2014, MNRAS, 438, 1067
Nidever et al. 2010, ApJ, 723, 1618

Do you have any question?
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