SMASHing the LMC

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Collaborator
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The Magellanic System on the Sky

Large Magellanic Cloud

~50 kpc away

Small Magellanic Cloud

~60 kpc away
The Magellanic System on the Sky

HI observation
(Nidever et al. 2010)
I. The LMC Reddening Map and 3D Structure
(Choi et al. 2018a)
Red Clump Stars as Extinction Probes & Standard Candles

- RC stars are confined in a narrow region on CMD

Girardi (2016)
Observed Color and Magnitude Maps of the RC stars

Choi et al. (2018a)
Intrinsic Color Radial Profile of the RC

- Compare with the previously measured metallicity radial gradient and age-metallicity relation in the LMC

Choi et al. (2018a)

Piatti & Geisler (2013)
Inferred Reddening Map

Choi et al. (2018a)
Warps and A Tilted Bar

Choi et al. (2018a)

A simulation of the MCs with a recent direct collision predicts a similar warp in the LMC disk (Besla et al. 2012)
II. A Ring-like Stellar Overdensity in the LMC
(Choi et al. 2018b)
Properties of Magellanic Irregulars:
gas-rich, one-armed spirals, and off-center bars
(de Vaucouleurs & Freeman 1972)

Significant fraction of Magellanic Irregulars do not have obvious companions. But, no companion does not mean no interaction in the past - a snapshot in the late merge stage (Besla et al. 2016)
A Long History of Detection, but Barely Studied

- First detection by de Vaucouleurs (1954a)

- Briefly mentioned or sign of the structure seen in Westerlund (1964), de Vaucouleurs & Freeman (1972), Irwin (1991), van der Marel (2001), Cioni & Habing (2003), Bica et al. (2008), Gaia data
Modeling the LMC: I. Star Count Map using Red Clump

Red Clump Stars selected mostly from the SMASH data and partially from the DES data.

Choi et al. (2018a)

Choi et al. (2018b)
A Ring-like Overdensity at $\sim 6^\circ$

- Continuous over $\sim 270^\circ$ in position angle
- Amplitude as large as 2.5 times higher than the smooth disk

Choi et al. (2018b)
Stellar Age in the Overdensity: at least > 1 Gyr

- No stars older than ~1 Gyr in the overdensity
  (Choi et al. 2018b)
Spatial Correlation with the Intermediate-age Star Clusters

- Red: Bica clusters
- Blue: < 250 Myr (Nayak et al. 2016)

Choi et al. (2018b)
A Looping Spiral is Common in Magellanic Irregulars!
Completely Wrapped up Spiral Arm?

Repeated interactions with the SMC might do that!

Besla et al. (2016)
Response to the Recent Direct Collision with the SMC?

- Stellar overdensity seen in MW-Sgr interaction simulations!

Gomez et al. (2013)
III. The Very Extended Stellar Populations of the LMC
(Nidever et al. 2018b)
Trace the LMC Periphery Using Old Main Sequence Stars

Nidever et al. (2018b)
Detection of the old, metal-poor LMC stars out to $\sim 21^\circ$ ($\sim 18.4$ kpc)

Nidever et al. (2018b)
LMC Stars Out to ~21°
Summary

- Derive the 2D reddening map and map the 3D structure of the LMC -> detect a tidally induced new warp

- Characterize the azimuthally-varying amplitude (up to $2.5 \times$ times higher than the smooth disk) and associated stellar ages ($> 1$ Gyr) of the ring-like overdensity in the LMC for the first time -> its origin might be related with interactions with the SMC

- Very extended LMC periphery out to $\sim 21^\circ$ -> accreted halo or tidally stripped outer disk material

- Comparing observed properties of the LMC disk with simulations allows us to understand the evolution of internal structures in the interacting dwarf galaxies and constrain the MCs mass and MW halo potential!