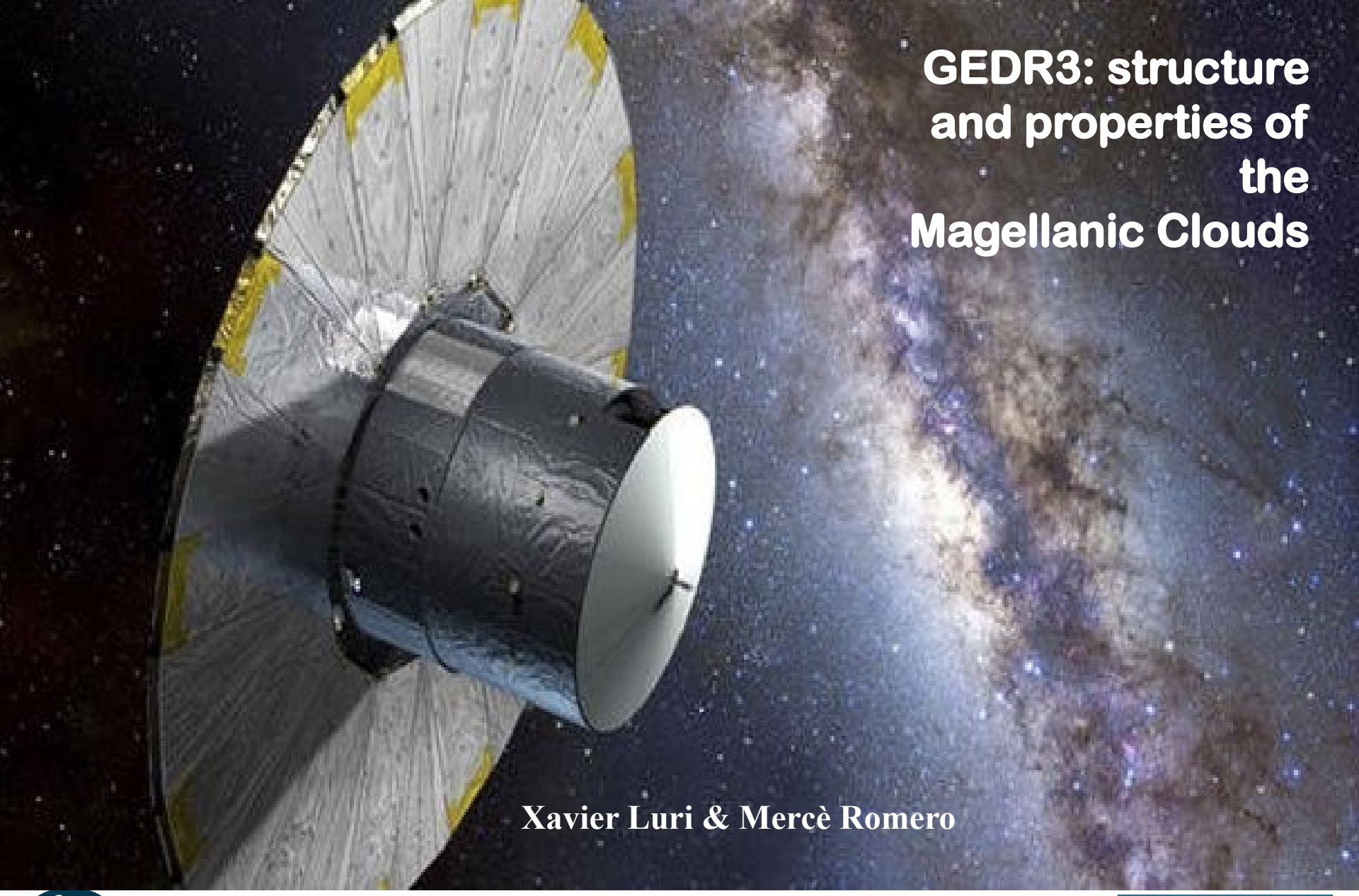


GEDR3: structure and properties of the Magellanic Clouds

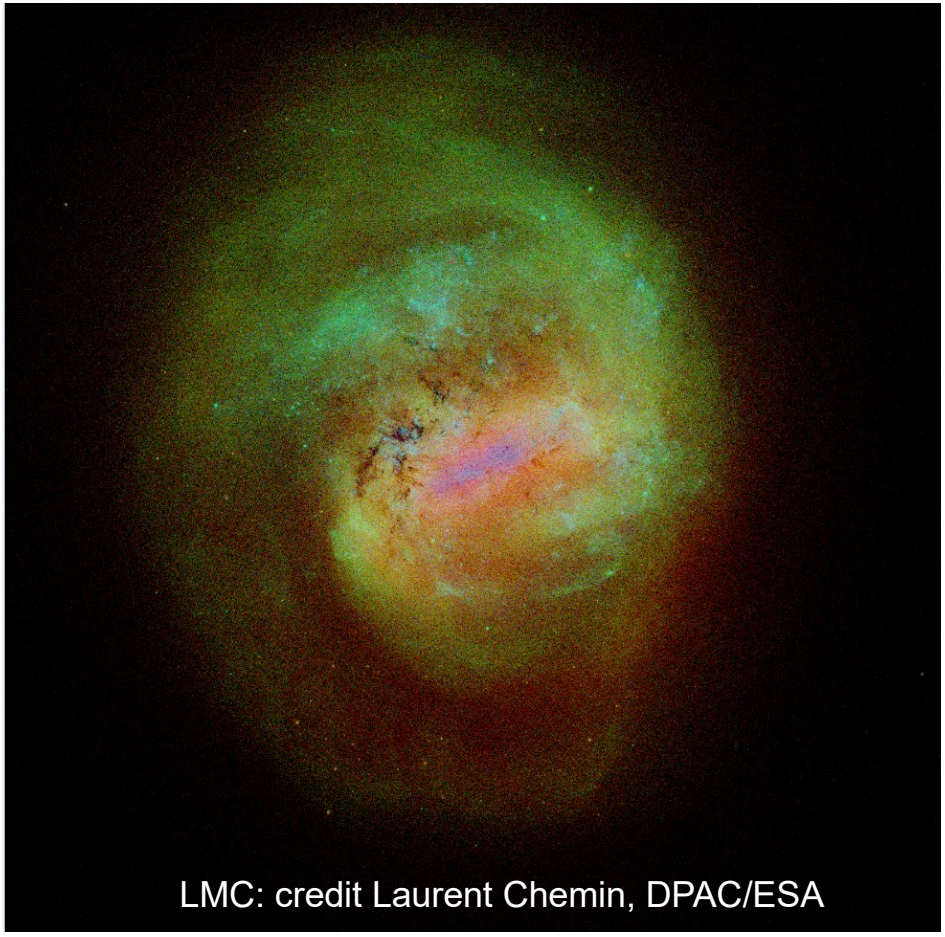
Xavier Luri & Mercè Romero

Gaia EDR3 en tus manos
3 diciembre 2020

REG Red Española de explotación científica de Gaia

GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACIÓN

Structure and properties of the Magellanic Clouds



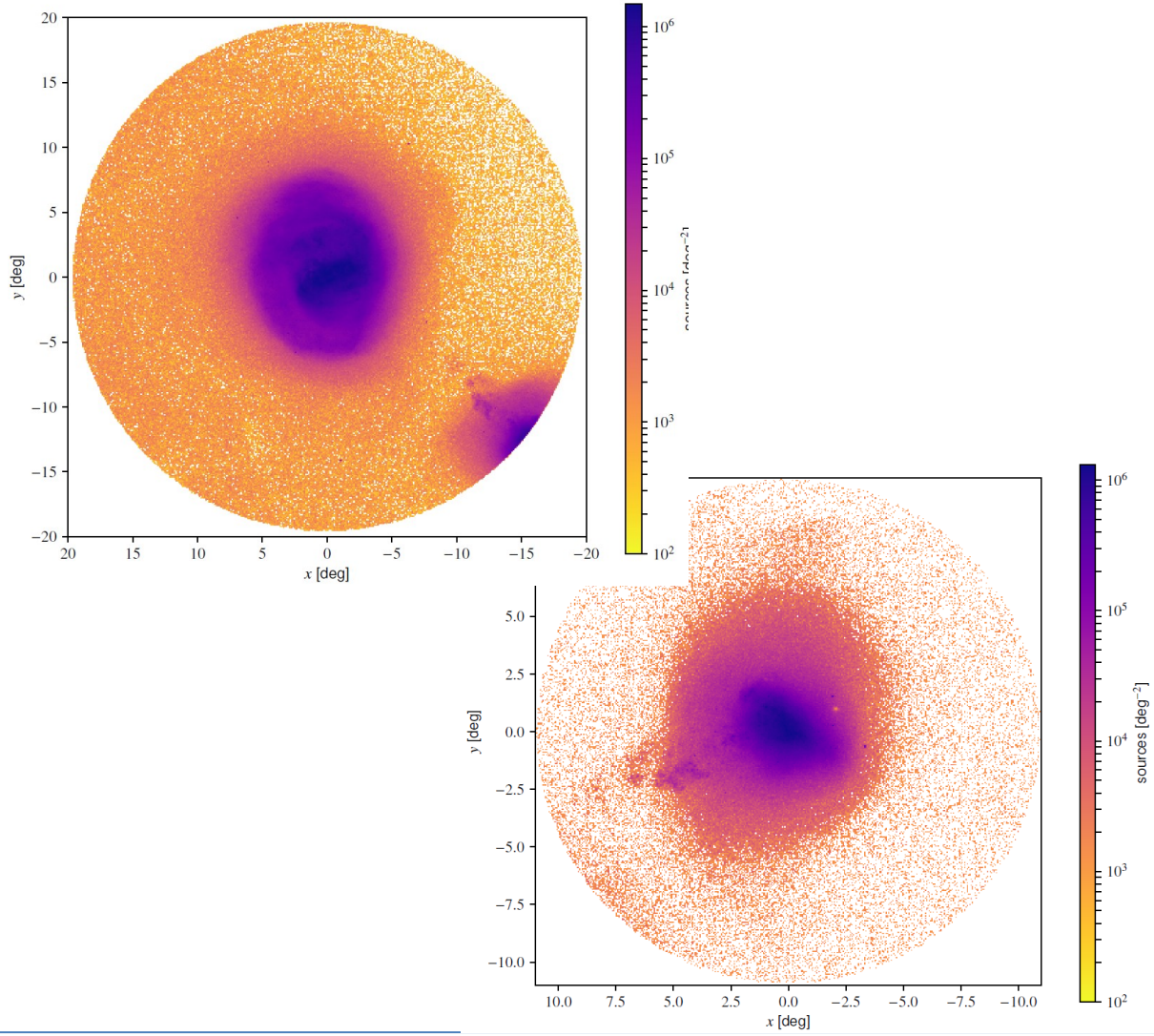
LMC: credit Laurent Chemin, DPAC/ESA

We have used the Gaia EDR3 data to study the structure and kinematics of the Magellanic Clouds.

The large distance to the Clouds is a challenge for the Gaia astrometry, at the very limits of its usability, and therefore an excellent case study to evaluate its quality and properties.

The samples

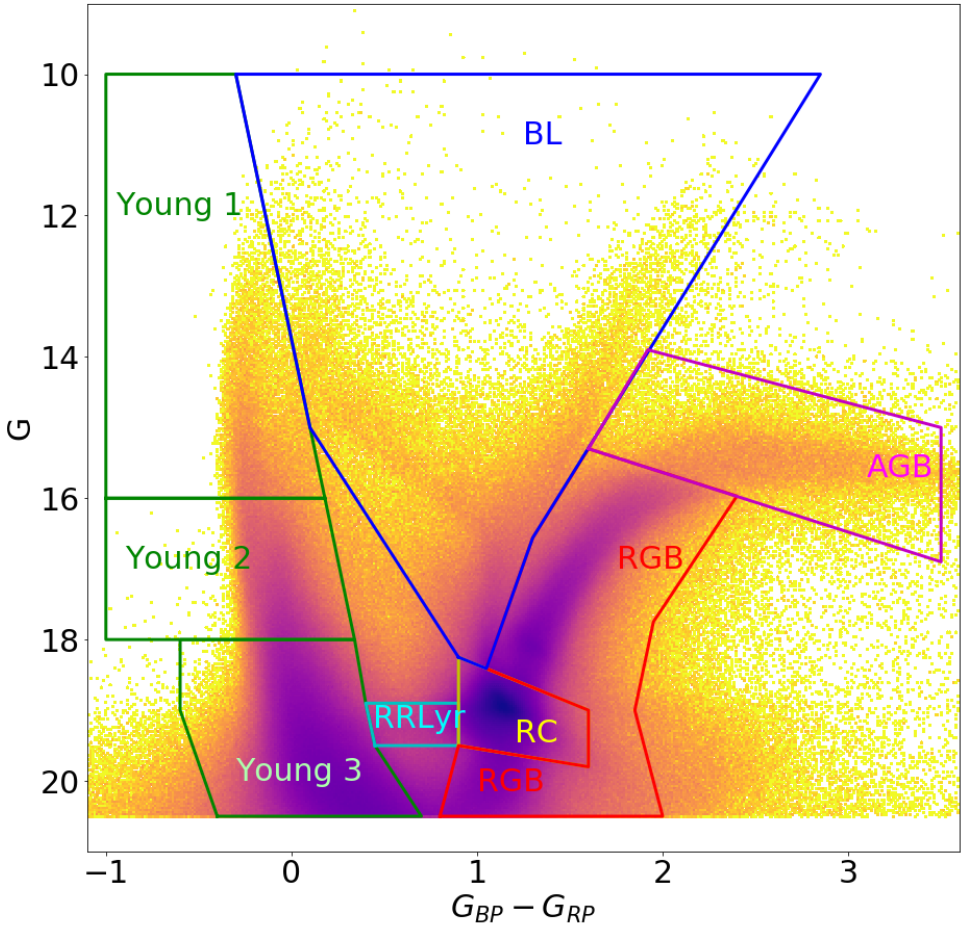
The base samples



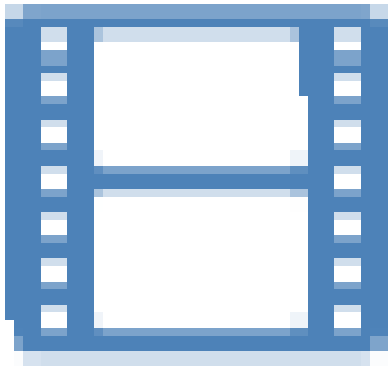
Base samples
LMC & SMC

- Spatial selection around the Cloud centers
- Additional selection based on the mean proper motion to exclude foreground and background objects

Evolutionary phase subsamples



The availability of homogeneous photometry has allowed to select our “evolutionary phase” based on the CMD diagram. These samples represent different populations of the clouds



DR2 vs DR3

Reduced systematics: LMC astrometry

The imprint of the astromètric systematic errors is significantly reduced from DR2 to EDR3

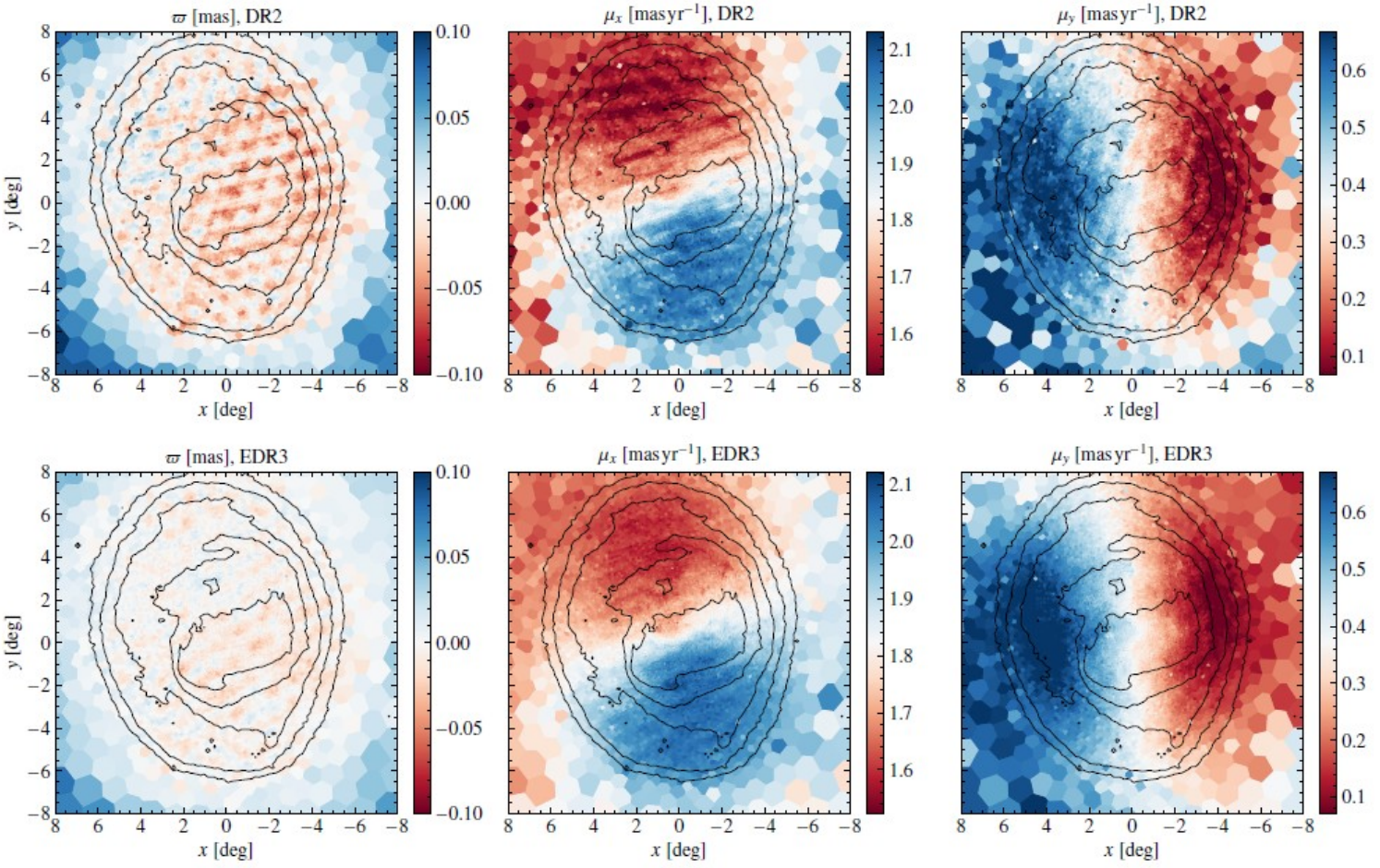
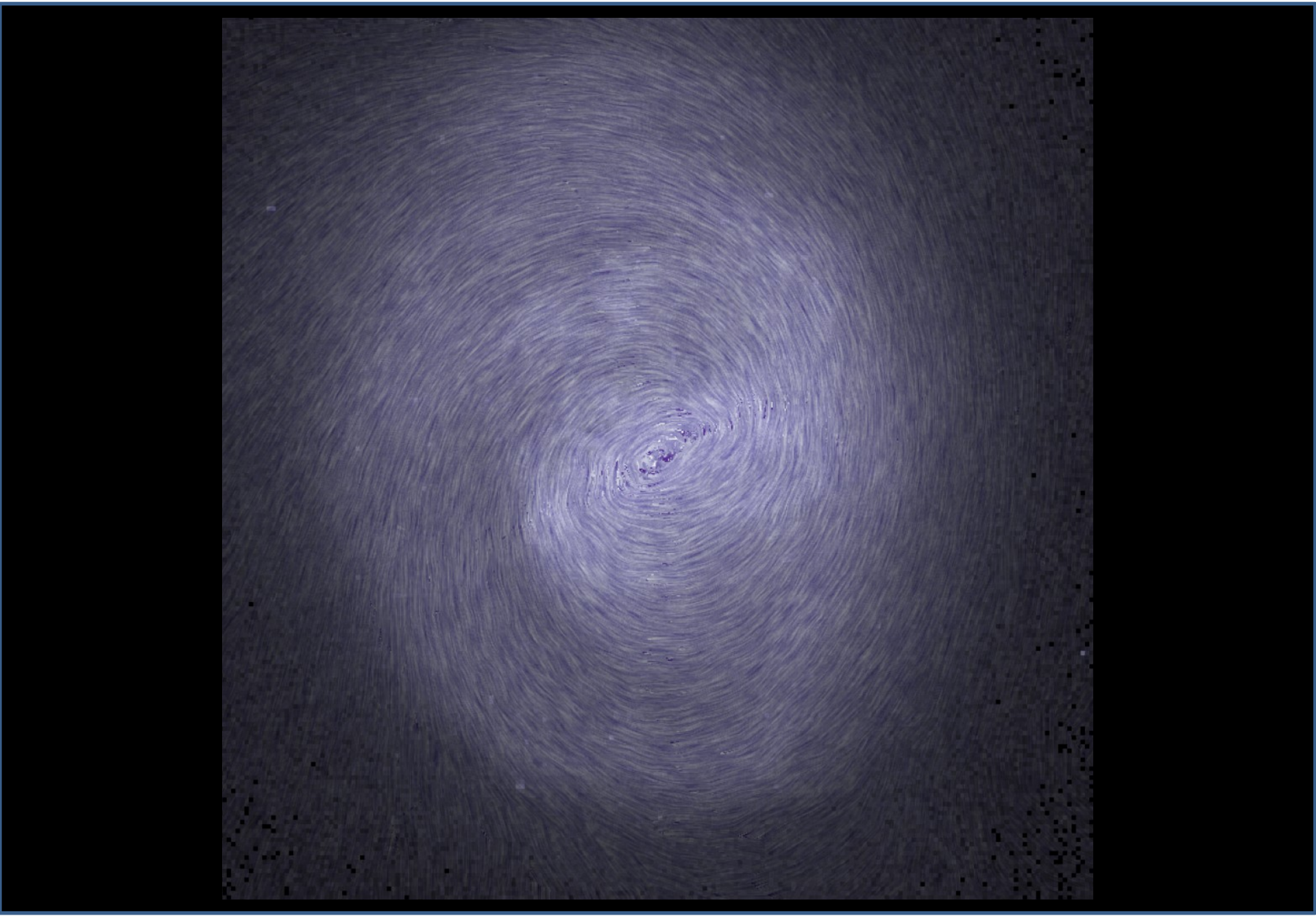
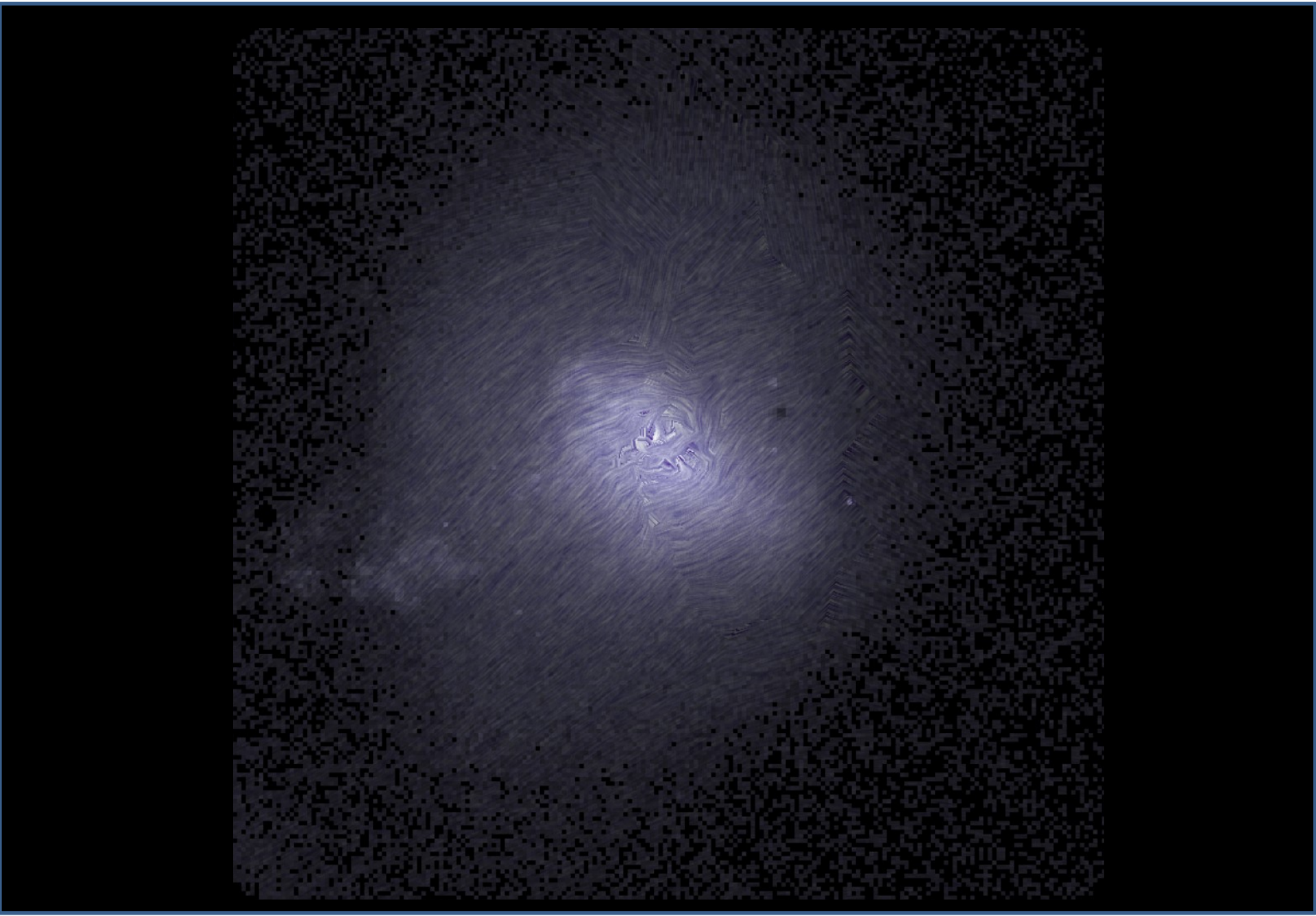


Fig. 4: Comparison of the parallaxes (left) and proper motions in the x and y directions (middle and right, respectively) of LMC sources between *Gaia* DR2 (upper panels) and *Gaia* EDR3 (lower panels).

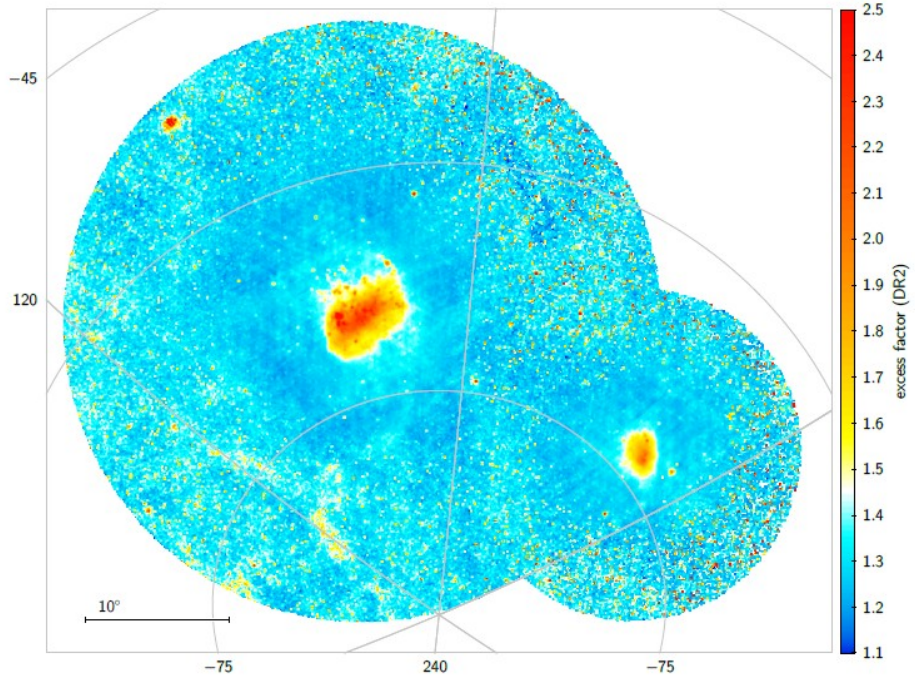
Proper motion field: we trace the LMC rotation

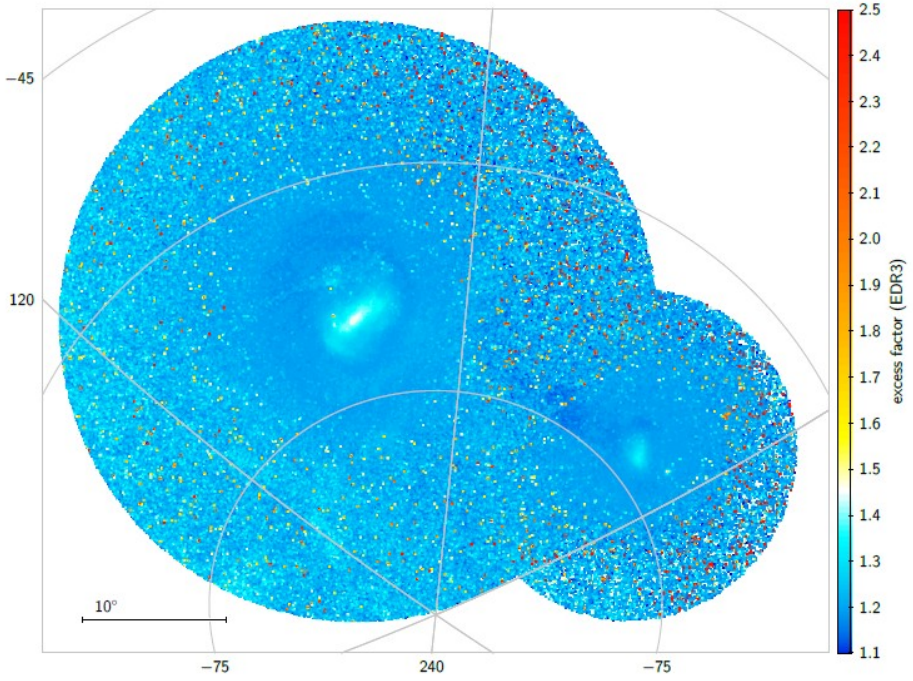


Proper motion field: SMC irregular motion



Reduced systematics: photometry





The photometric excess factor has been much reduced in the crowded areas, reflecting an improvement of the photometry in these regions

3D structure

- We aimed to infer the 3D spatial distribution of sources in the LMC using a simplified model without separating the various populations (Bayesian approach).

- The problem has proven to be very hard to crack. Parallaxes are very small, close to the noise, and in order to infer the parameters of the spatial distribution we have to model the observed parallaxes as affected by a zero-point offset that depends on the celestial coordinates.

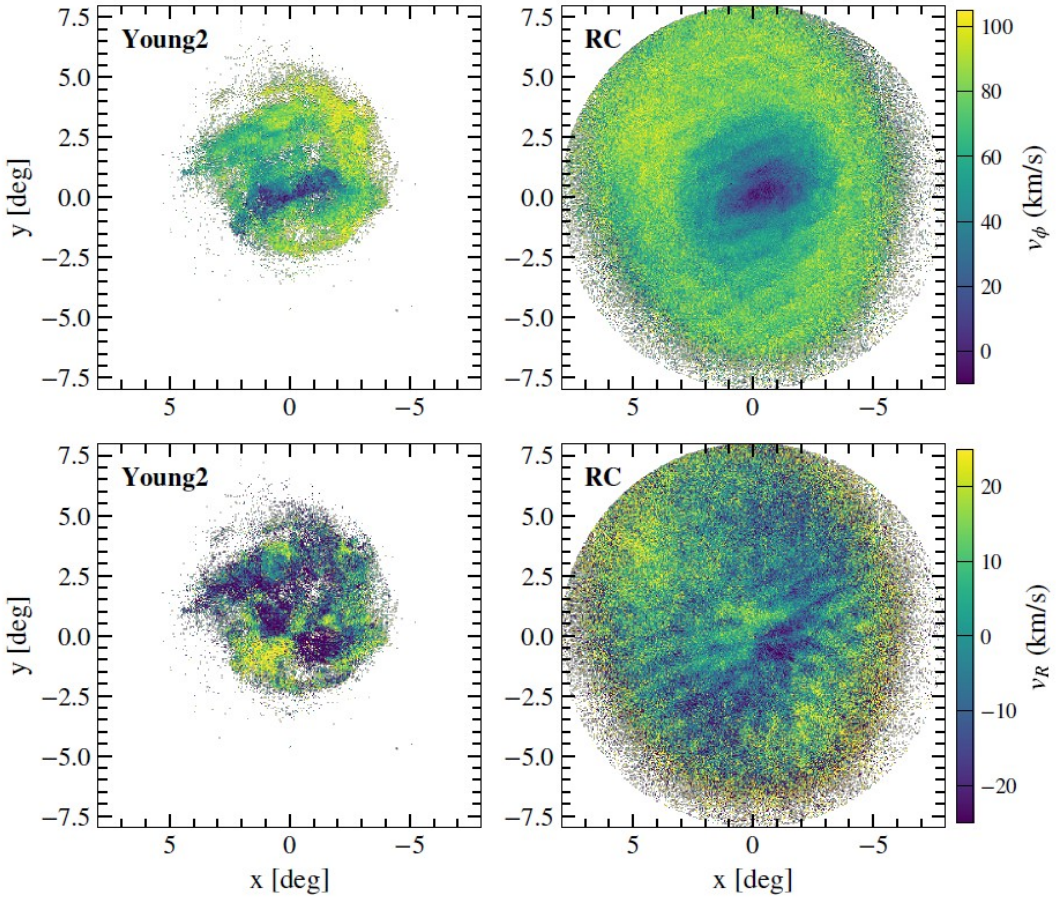
- The work will continue, considering alternative approaches (fitting method, simplified model).

Kinematics

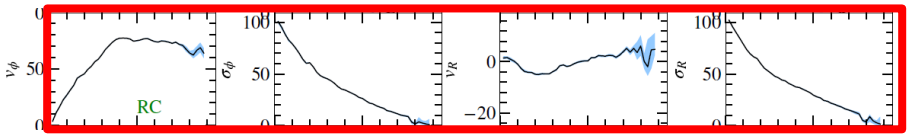
Velocity maps of the LMC populations

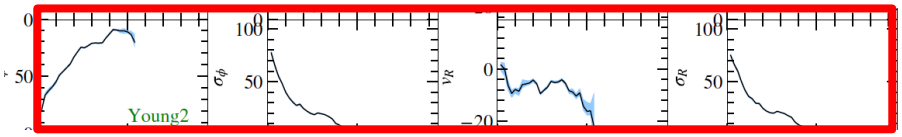
We trace the differences in kinematics of the different populations

This is **the first time** that the two planar components of both the ordered and random motions are derived for multiple stellar evolutionary phases in a galactic disc outside the Milky Way.



Rotation curves of the LMC populations

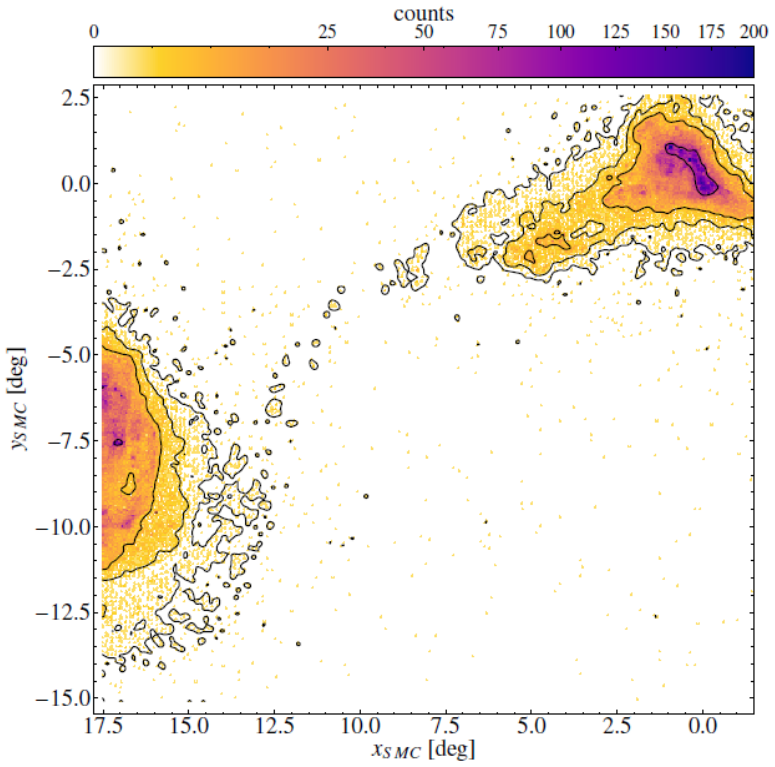


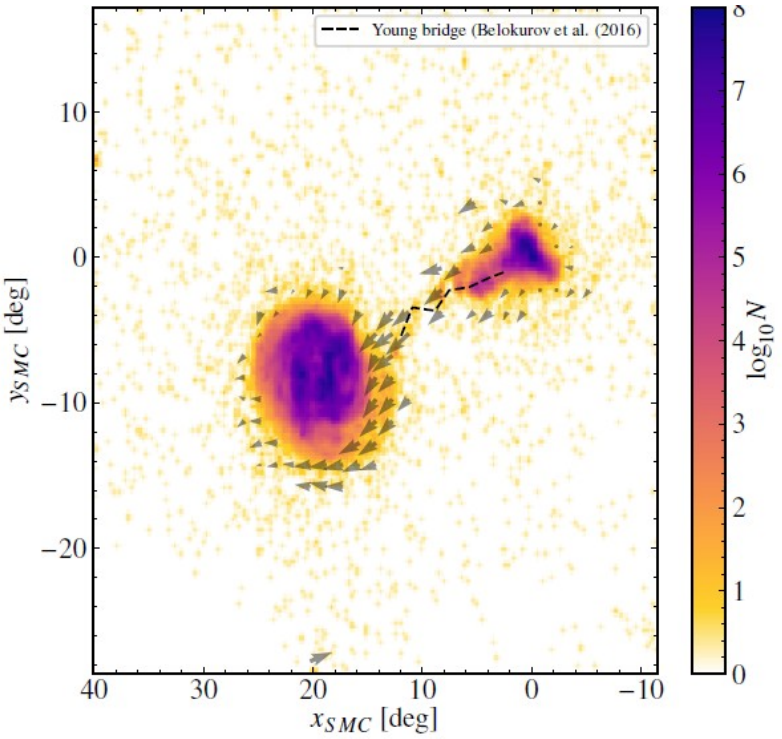


The global profiles are derived and allow us to find that younger stars rotate faster than older stars, a phenomenon called the "asymmetric drift", and exhibit smaller random motions than older stars, on average.

The Magellanic bridge

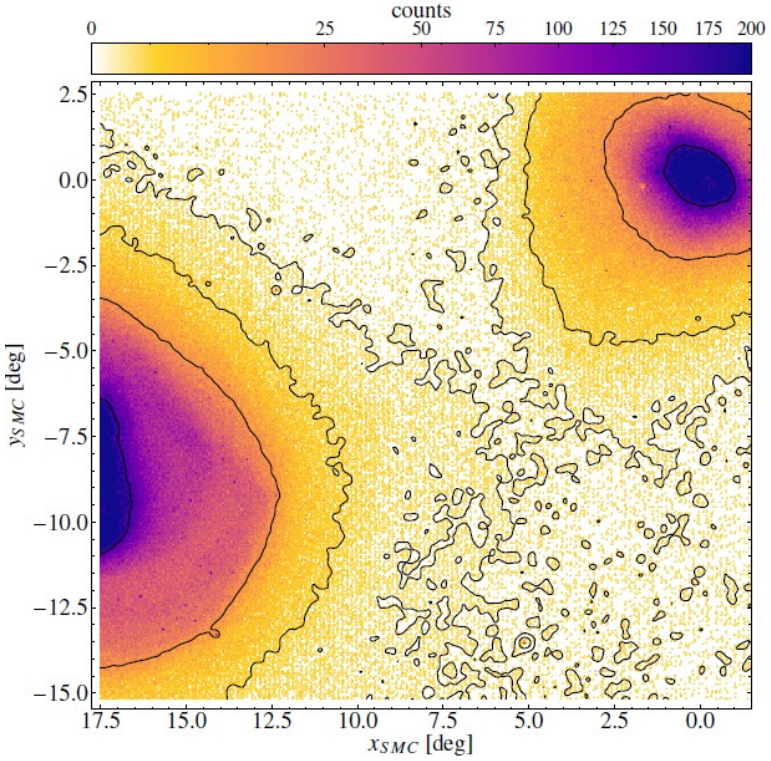
The Young bridge

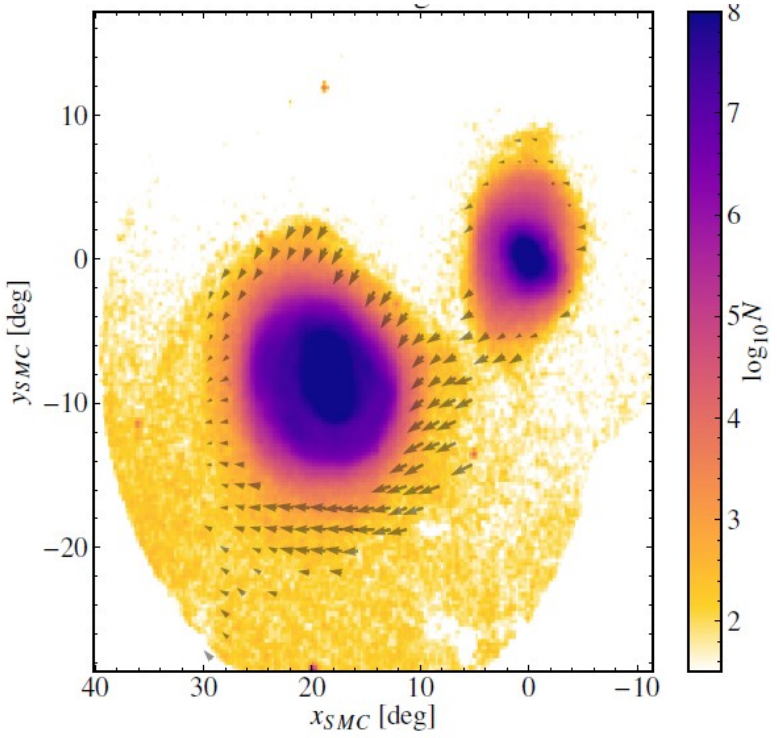




The connection between the SMC and the LMC is clear from the Young 1 and 2 evolutionary phases ,and the velocity vector in the region between clouds confirms it.

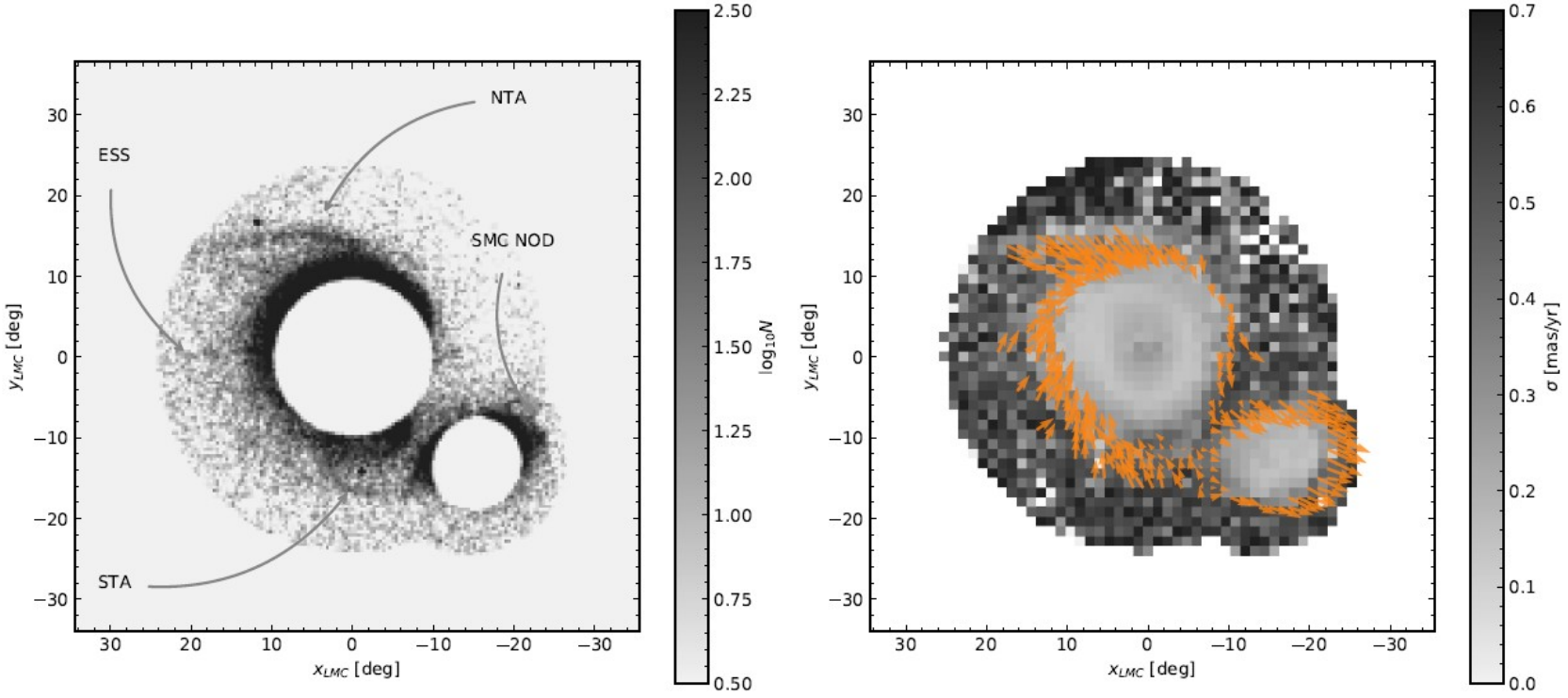
The RC bridge





The precise proper motions in GEDR3 play a key role in tracing the Magellanic Bridge using a more evolved population such as the Red Clump.

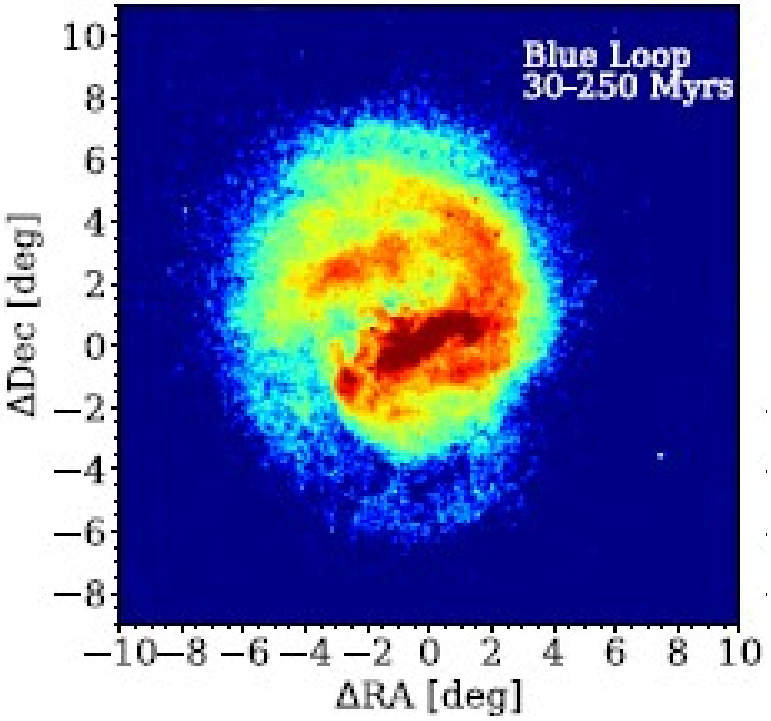
Structures in the outskirts



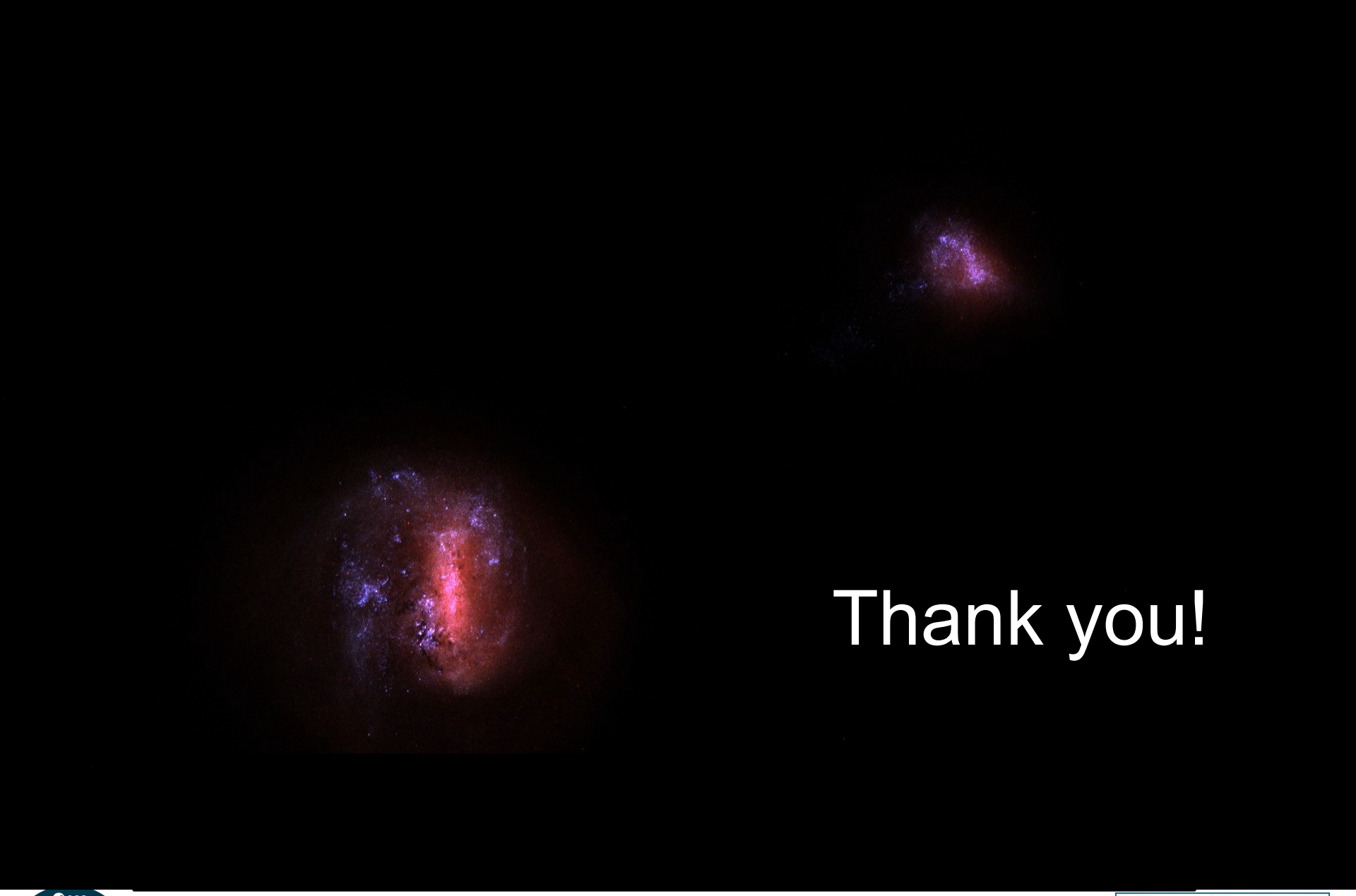
By masking the stars from the clouds and the Milky Way, we manage to highlight faint substructures (stellar streams) found in the halo of the clouds. Together with the bridge, they are witnesses of the formation and evolution of the clouds.

The LMC spiral structure

LMC density maps



The outer grand-design lopsided spiral arm of the LMC is clearly outlined and we are able to study the streaming motions in the arm.


Thank you!