Tearing the Small Magellanic Cloud apart

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Rationale

Our closest interacting neighbours, the Small and the Large Magellanic Clouds (SMC/LMC) are unique laboratories to study the formation and evolution of galaxies in exquisite detail.

Despite the wealth of observational data we still do not know how the encounters between these two systems shaped the smaller companion, the SMC. With an apparent structure of a few kpc across the sky but a considerably larger extension along the line of sight, a reconstructed signature of an ordered rotation in the HI kinematics and conflicting reports of a coherent rotation in the different stellar populations, the SMC is still a puzzle to be understood.

Our approach

With the goal of shedding light on the internal structure and dynamics of the SMC, we performed kinematics' studies using ~6000 RGB stars in the SMC up to 5 deg from the centre observed with the AAOmega. We cross-matched our extended sample with Gaia DR2. Including confirmed SMC members, our extended data set possesses 5636 stars with radial velocity determinations and proper motions. To get a more complete view of the observed area we generated through MC sampling a smoothed data set reproducing the spatial distribution of our data.

Finally we confronted our results with in-house simulations of the SMC disrupting around the LMC

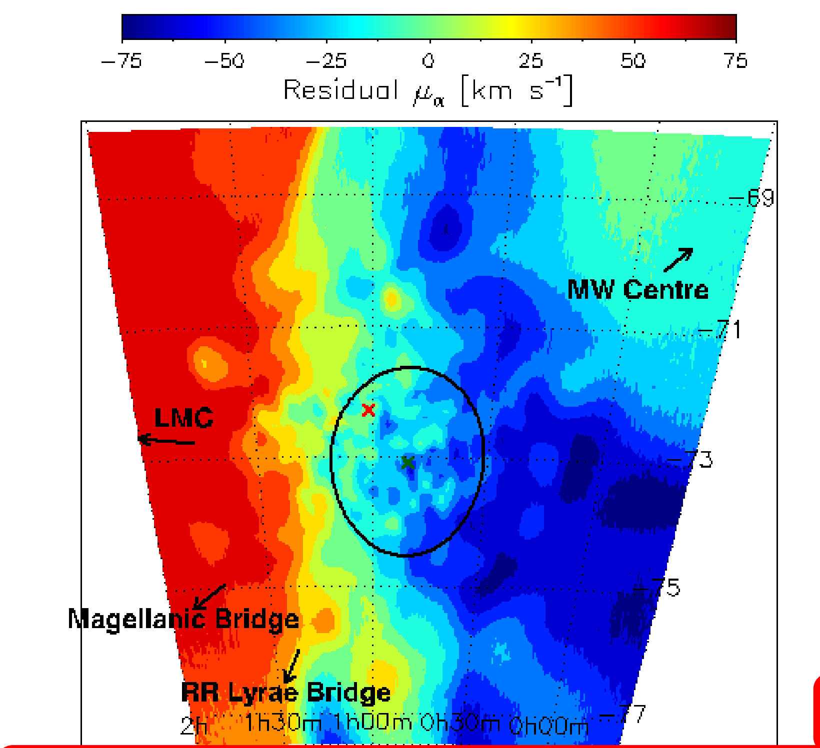

Fig. 1: map in (α,δ) of the residual proper motions in the α direction, the black ellipse is the half-light radius, the green cross is the photometric centre of the SMC while the red cross is the dynamical centre of the HI

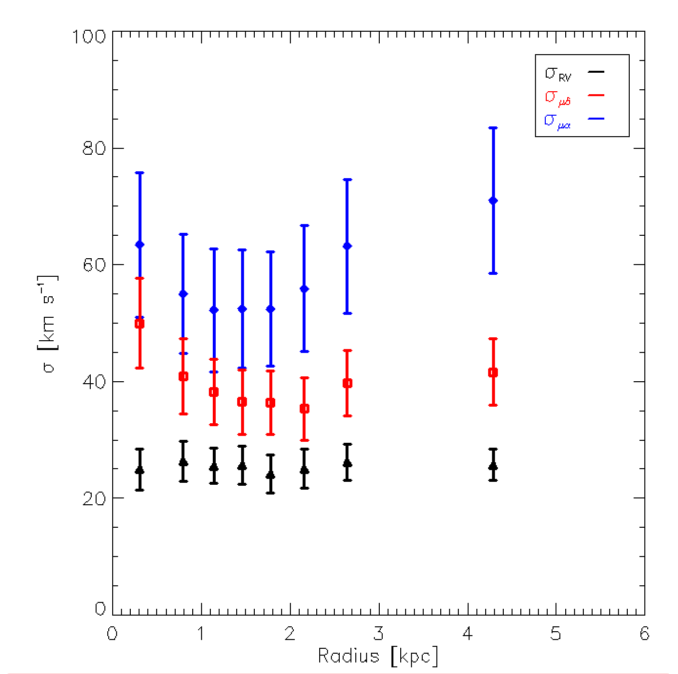

Fig. 2: velocity dispersions (see legend) binned against distance from the photometric centre

Results

Figure 1 depicts the smoothed data sample of the residual proper motions' maps in right ascension. It shows the distinct kinematics of the stars in the core of the SMC and on the eastern and western parts (respectively left and right of the photometric centre, the green cross), reproducing a clear tidal pattern.

Figure 2 shows the velocity dispersions in equal-number-of-stars cylinders around the photometric centre, the pattern shown is the same as that of in-house simulations of the SMC heavily disrupting around the LMC.

Conclusions

We found that the tidal disruption of the SMC is the effect dominating the kinematics of the old stellar population. This disruption is bound to have an impact on the gas content too and this calls for a new paradigm of the gas kinematics. Models having a large bound structure along the line of sight are disfavoured, with most of the stars observed probably being tidal debris. To confirm this last point we need more accurate distance determination of non-variable stars and different mass models.

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