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DETECTING STELLAR STREAMS IN THE GALACTIC HALO WITH A MODIFIED GC3 METHOD

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In the following contribution we present results on the applicability of a modified Great Circle Cell Counts (GC3) method to detect stellar streams from satellites with different orbits, dynamical ages, total luminosities and star formation histories.

The detection and study of satellite streams in the Galactic Halo plays a key role in unraveling the formation history of the Milky Way (MW) and tracing the gravitational potential of the dark matter halo. The observational data expected from the Gaia astrometric mission will provide an unprecedented opportunity to search for tidal streams using all-sky full-phase-space information for nearly a billion stars in our Galaxy. In this contribution we present results to illustrate the applicability of an extended version of the Great Circle Cell Counts (GC3) method by Johnston et al. (1996), which includes the use of kinematic information for the detection of stellar streams.

The extended GC3 method proposed consists in dividing the sky in a grid of all possible great circle cells, each cell being uniquely defined by its normal vector or pole. A pole count map is produced by counting the number of stars which have positions and velocities contained in the plane defined by each pole, that is which fulfill the conditions:

$$|\hat{L} \cdot \hat{r}| \leq \cos\psi \qquad \text{and} \qquad |\hat{L} \cdot \hat{v}| \leq \cos\psi \,. \qquad (1)$$

The addition of a velocity criterium, with respect to the original GC3 method by Johnston et al. (1996) which uses only the position criterium, decreases the number of MW stars contaminating each cell, hence increasing the "signal-to-noise" ratio of the method.

We used the mock Gaia catalogue from Brown et al. (2005), which constitutes a random realization of kinematic and photometric properties of Milky Way stars in the Galactic disk, bulge and halo, taking into account the appropriate density, velocity, age and color distributions, as well as the normalization in total luminosity for each Galactic component. This resulted in a mock catalogue containing 3.4×10^8 observable Milky Way stars with full phase-space information and observational errors as are expected from Gaia.

We explored the detectability of stellar streams using the extended GC3 method by adding to the mock Gaia catalogue, the satellite streams from N-body simulations described in Brown et al. (2005), with the corresponding observational errors and completeness limits.

We investigated the method's success rate as a function of initial satellite luminosity, SFH and orbit. Each satellite's signature in a pole count map was recovered after subtracting a smoothed image, in which the value of each pixel corresponds to the median value in its neighbourghood.

Finally, we find that the inclusion of the kinematical restriction vastly enhances the contrast between a streamer and the background. The global nature of the method diminishes the erasing effect of phase mixing and permits the recovery of merger events of reasonable dynamical age. Satellites with a star formation history different to that of the galactic background are also better isolated. We find that satellites in the range $10^8 - 10^9$ $L_\odot$ can be recovered even for events as old as $\sim$10 Gyr. Even satellites with $4 - 5 \times 10^7$ $L_\odot$ can be recovered for certain combinations of dynamical ages and orbits.

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