Stellar Halos Across the Cosmos

Heidelberg, July 2-6

Unconference Sessions: topics and proposals

1. Operational definitions of stellar halos.

    1. Can we agree on (a set of) well-defined operational definitions of stellar haloes i.e, halo stars?

    2. Is there any physical boundary between galaxies and their stellar haloes, and if so should we care? And is there any difference between stellar haloes and ICL?

    3. How can we best interface the operational definitions usually adopted for the Galaxy with those that can be applied to outer galaxies?

    4. Different systematics affect the measurements in observations and simulations. Different groups have different practices. Can we agree on a number to be quoted which all groups can adhere to and agree on? Total stellar mass within a specific radius (e.g. M200, M500) or specific aperture? By that, I mean a number which cannot be affected by subjective choices of what is a galaxy and what is its stellar halo. Should we let the data speak for itself?

    5. A universal definition of ICL?

    6. What is the best way to separate galaxies from stellar halos in simulations and observations?

    7. What are the definitions of stellar halos, especially in massive galaxies where there are extended metal-rich stellar envelopes as well as a classical metal-poor halo?

    8. What is the definition of a ``physical'' boundary between different morphological components in a galaxy? Suggestions for quantitative measurements that lead to such assessment

    9. When does the halo start? What is the transition radius between in situ and ex situ dominated populations? Does it depend on galaxy type, mass, environment, etc?

2. Survey strategy, optimisation, challenges and the future

    1. What is the best way to observe stellar haloes 10 Mpc away? Small telescopes, large telescopes? Stellar populations?

2. Community observing projects to investigate the nature, origin, and evolution of galaxy and cluster stellar halos: with HST, JWST, and wide-field, ground-based, 4m+ aperture telescopes.

3. We would discuss some strategies for the observing plans of stellar halos (including substructures and satellites) in external galaxies using existing facilities. It'd be also interesting to talk about the prospects using extremely large telescopes, including TMT and GMT.

4. IFU spectroscopy of large (~1,000) samples of galaxies out to ~4Re. Is this feasible? What telescope? What kind of campaign is needed?

5. Future Observations of Stellar halos

6. Challenges in the upcoming big surveys: HSC-SSP, LSST…

7. Data reduction techniques for LSB imaging

3. Observations vs. simulations, synthetic libraries

   1. Synthetic libraries of stellar halos from simulations. Are they useful? How can they be useful to observers? What formats are desirable?

   2. Maybe we could include a discussion on how to properly mimic surface brightness cuts in Simulations for a better comparison with observed streams and shells.

   3. As one of the builders of the Gaia mock catalogue, Aurigaia, I would like to know what other information people need. How can we improve it, etc?

   4. What are practicable/useful ways to compare 'halo substructure' between simulations and observations, both in the MW halo and external galaxies?

   5. How can one compare predictions from observations and numerical simulations on the outskirts of galaxies?

   6. How can we develop techniques to compare simulations to observations in a way that treats satellites and streams on equal footing?

   7. So, you have perfect data on 100 external galaxies, and you have now Gaia within that galaxy,what are the data-simulation comparison plots that would allow you to draw conclusions?

4. Big and small questions

   1. I'd like to understand what people are hoping to learn from stellar halos. e.g., if you're interested in the accreted stars - why? Are you trying to confirm LCDM? Are you trying to measure what larger accretions do to galaxies empirically? Are you trying to constraint metallicity-mass relation evolution? If you're interested in in situ - why? Is it to constrain SF at low gas densities or large radii? Is to understand disk heating?

   2. What are the big/pressing questions about stellar halo we need to focus on?

   3. Suppose tomorrow we get access to the perfect 6d phase -space measurements for all the stars (100 billion or so) in our Galaxy, along with other physical parameters such as mass, luminosity, temperature, chemical abundances, etc. We all know that such a data would behave in the way that it wants and keeping in mind that "nature is under

no obligation to make sense to us", how likely are we to actually make any sense of this ULTIMATE DATASET? And will such a dataset actually answer all our questions pertaining to Galactic Archaeology ? If not, then what will ?

4. Are we learning more? Can stellar halos at the extra-galactic level help us to understand new aspects of the hierarchical formation of galaxies, cosmology, dark matter, and/or constrain the physics regulating galaxy formation?

5. Do we HONESTLY actually think that the questions that we often ask in our field (premerging history of our Galaxy, dark matter distribution and it's lumpiness ,etc) are actually answerable ?

6. Suppose we describe the merger history of the Galaxy: so what?

7. Are we progressing? How much of the literature on unresolved stellar halos is reliable?

8. Does _every_ massive galaxy _have_ to have a stellar halo? In particular, can big disc galaxies form without stellar halos?

9. Are UDGs teaching us anything new about galaxy formation? Or are we only re-discovering aspects of LSB galaxies? Debate?!

5. Substructure and streams: what to do and to be learnt

   1. Structures in stellar halos: how to measure/define, long-lived versus transient, what do they tell us, should we try to measure individual objects or describe an overall statistical distribution?

   2. Substructures in halos: are shells and streams all that there is out there? How about substructures that come from either plumes or hot stellar systems, i.e. very extended diffuse substructures. How do we identify them?

   3. What can we learn from extragalactic tidal streams?

   4. Agreeing on a shared catalog/database of streams/over densities/satellites in the Local Group

   5. Automated identification of stellar halo features

   6. What can deep learning bring to the field? (automatic classification, etc.)?

6. Using sims and obs to infer "origin": how exactly?

   1. Based on predictions from simulations, how could we observationally discriminate accreted halo stars long after the accretion? I.e., what remaining structural, kinematic, and stellar population signatures are there?

   2. What are the best observables for constraining stellar halo origins? (metallicities? ages? abundance patterns? kinematics?)

   3. What can we learn from comparing intact satellites (dwarfs and globular clusters) with diffuse stellar halos?

   4. Does _every_ massive galaxy _have_ to have a stellar halo? In particular, can big disc galaxies form without stellar halos?

5. So, you have perfect data on 100 external galaxies, and you have now Gaia within that galaxy,what are the data-simulation comparison plots that would allow you to draw conclusions?

7. Are we properly exploiting Gaia?

    1. New substructures with Gaia

    2. ….

8. How to best compare the outputs of simulated globular cluster systems with observations?

    1. What are the most robust predictions of simulations?

    2. What are theorists looking to compare to in the observations?

    3. How can we minimize mismatch in our comparisons? E.g., thinking of the DM fraction aperture question, but say for spatial extent of GC systems in kpc vs stellar Reff.