Abstracts for the science team meeting

Week of WEAVE (WoW) 2017

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Thin Disc (dynamics, chemistry, formation), Anticenter

The outer (thin & thick) disc of the Galaxy

Georges Kordopatis

The disc's outskirts enclose valuable information regarding the past accretion history of the Milky Way, as well as the internal mechanisms that regulate disc formation, such as radial migration and inside-out growth. WEAVE's observations towards the anti-centre will allow to obtain a dataset that will quantify these mechanisms by investigating the spatial and kinematic distribution of (mono-age) stellar populations of different metallicities. In this talk I will summarise the analyses that are needed in order to provide the required constraints.

Understanding the Galactic Disc with modern surveys
Ralph Schoenrich
I will discuss new advances and challenges to our understanding of the Galactic disc from modern surveys, like Gaia and WEAVE. I will discuss the impact of uncertainties in the data to our understanding, and how detailed abundances and full 3D velocity information improve the stability of data analysis. This is of particular importance when we study substructure in the disc. If time allows, I will discuss in particular perspectives for an outer disc survey close to the Galactic plane.

Cluster formation/destruction, Stellar Physics

Open clusters through the eyes of WEAVE

Ricardo Carrera
Within the Galactic Archaeology survey several open clusters are going to be sampled. In this talk I will compile several scientific cases that will be addressed with WEAVE data from the existence of chemical diffusion in stars of a given cluster to the investigation of gradients in the Galactic disc among others.

Thick disc (dynamics, chemistry, structure, formation)

Understanding the high-Z structure of the Milky Way disk

J. Ted Mackereth, Liverpool John Moores University (Ted Mackereth)

Elucidating the early formation of the Galactic disk from distributions of stellar observables in multi-parameter (phase and chemical) space is one of the chief goals of galactic archaeology. One of the oldest constituents of the disk is the vertically extended and high [/Fe] component, which until recently, has commonly been conflated with a 'classical' thick disk. Various studies (e.g. Bensby et al. 2011, Cheng et al. 2012, Hayden+ 2015, Bovy+ 2016, Mackereth+ 2017, Hayden in prep.) now seem to show that the old, high-[/Fe] disk is structurally different than the thin disk, as it is centrally concentrated, with a scale length in the range of ~2kpc (whereas the thin disk has a scale length closer to 4 kpc) with both populations spanning a range of scale heights. In this talk, I will present results from the EAGLE suite of simulations that provide a connection between chemistry of disc stellar populations in Milky Way-like galaxies and their assembly histories. These results suggest that a centrally concentrated high [/Fe] disk can be formed during an intense early episode of gas accretion. Low [a/Fe] stars, on the other hand, are chemically detached from their high [a/Fe] counterparts, forming as the result of a more gentle phase of accretion. The simulations make qualitative predictions for the kinematics of such populations, which will be testable with a dataset such as that which will be provided by the WEAVE survey in combination with Gaia distances and proper motions. Using mock survey data from idealised, distribution-function based models, we intend to make quantitative predictions for the kinematic properties of stellar populations as they will be observed by WEAVE and Gaia, and the selection effects and biases that may be present in such data. Contrasting such predictions with the actual data will be the best way to establish the structure of the thick disk and to pin down the mechanism(s) responsible for its formation.

The thick disk population with WEAVE
Misha Haywood
I will present an overview of some of the different problems about the formation and evolution of the thick disk where I think that WEAVE can provide real breakthrough. That includes the chemical evolution of the thick disk and implications about the star formation history of the Milky Way, its formation scenario (inside-out or not) and the interface of the thick disk with the halo and the thin disk.

Galactic Halo (& Globular clusters)

The contribution of Globular Clusters to the Stellar Mass Budget of the Milky Way Halo

Ricardo Schiavon

It has been known for a while now that the Galactic halo field contains a population of stars with abundance patterns typical of globular cluster (GC) populations (e.g., Martell & Grebel 2010, Carretta et al. 2010), which have been interpreted as "GC escapees". More recently, the APOGEE survey identified a large population of such stars in the inner halo (Schiavon et al. 2017), suggesting that the total stellar mass originated from GC destruction may amount to 25% of the total mass budget within 2kpc of the Galactic centre—a finding that may have implications for the stellar content of spheroidal systems in general. In this talk I will describe this finding and elaborate on how WEAVE can be used to constrain the contribution of existing and destroyed GCs to the stellar mass budget of the Galactic halo and thick disk, with an eye towards placing constraints on models for the formation of galaxies and globular clusters.

Globular cluster escapee stars in the Galactic halo
S. Larsen (Nijmegen), A. Helmi (Groningen), A. Brown (Leiden) Globular clusters (GCs) contain large fractions of “2nd-population” (2P) stars with enhanced abundances of certain light elements (He, N, Na, Al) and depleted abundances of others (C, O, Mg). Such stars are rare, but not altogether absent in the general halo field: about 2-3% of halo stars display similar abundance patterns. An interesting question is whether the 2P stars in the halo field have escaped from GCs, and whether it might even be possible to trace them back to specific clusters. We will use the WEAVE LR-highlat survey in combination with Gaia data to apply chemo-dynamical tagging and search systematically for halo stars with GC-like composition and compare the properties (metallicities, spatial distributions, kinematics, detailed abundance patterns) of 2P halo stars with stars in GCs, in the halo as a whole, and possibly even within GC debris streams (identified by Gaia).

Flavours in the box of chocolates: chemical abundances of nearby stellar halo phase-space substructures

Jovan Veljanoski

Stellar halos have been shown to be important tracers of the assembly history of massive galaxies like our own. Intriguingly, the Milky Way halo seems to have two components, an outer and an inner halo. The inner halo appears smooth and spatially well mixed. Using Gaia DR1 data, our group recently discovered several distinct substructures that are well defined in integrals of motion space. In an attempt to learn more about their nature, here I present a follow-up abundance analysis using the data available through the RAVE survey. I will show that the distribution of elemental abundances of these substructures are distinct from the overall smooth stellar halo. In addition, some substructures could potentially be disrupted globular clusters, judging from their small spread in iron. I will also present our groups efforts to identify samples of halo stars without having full phase-space information. Finally, I will discuss how WEAVE can greatly help in both the search and analysis of phase-space substructures in the Galactic stellar halo.

Spectroscopic follow-up of tidal streams in the Galactic halo

Edouard Bernard

With the advent of large photometric surveys -- SDSS, Pan-STARRS1, DES -- the number of known tidal streams in the Milky Way has increased dramatically. However, determining the nature of their progenitor and their orbit, which in turn provides valuable probes of the shape of the halo potential, requires the measurement of their dynamical and chemical properties. I will discuss how we can exploit the WEAVE GA survey for this purpose.

Mining and mapping the first generations of stars with the Pristine CaH&K survey and WEAVE
Nicolas Martin
I will present the first results of the Pristine survey, a Franco-Canadian photometric survey of the Milky Way halo performed with the new CaHK filter on CFHT's MegaCam. Whenever it overlaps with the WEAVE footprint, Pristine is to be used to select high-probability extremely metal-poor star candidates. Currently covering >2,000 deg^2, this survey leads to an efficient metallicity decomposition of the Milky Way halo. In particular, I will show how efficient Pristine is in selecting the metal-poor end of the metallicity distribution ([Fe/H]<-2.5) to hunt for the very rare extremely metal-poor stars (bearer of the chemical imprint of the first stars).

Tools: Ages, Simulations, ...

Simulations for Milky Way chemo-dynamical studies

E. Athanassoula, LAM
GAIA, coupled to the accompanying ground-based spectroscopic surveys, delivers data on stars in our Galaxy of unprecedented quality and quantity. Soon, data provided by WEAVE will be added to these. It is now important for theoreticians to provide models which can interpret these data, so as to obtain a coherent picture of the formation and evolution of a large spiral galaxy, our Milky Way. During the past few years I have worked on simulations specifically targeted to such a goal. These have a number of advantages: they are chemo-dynamic, i.e. they provide not only the usual 3D positions and velocities, but also the stellar ages and chemical abundances for more than a dozen chemical elements and for both stars and gas. They cover the whole galaxy, while being of sufficiently high resolution to allow modelling of specific parts, such as the bar/bulge region. They thus provide a formation and evolutionary scenario in which specific questions can be tackled. Such simulations can constitute a framework for modelling and interpreting GAIA/WEAVE data and I therefore would like to make them available to teams working on such data and subjects.

Chronologically dissecting the Galaxy

Jason Sanders

The combination of Gaia and large spectroscopic surveys such as WEAVE will allow for accurate stellar age estimates across the Galaxy. Using Gaia DR1 combined with RAVE as an illustrative example, I will discuss three methods for age estimation: 1. using stellar models with parallaxes and spectroscopic parameters, 2. using C & N abundances for giant stars and 3. using dynamics. With ages we can chronologically dissect the Galaxy revealing the heating history, radial migration history and chemical enrichment history of the Galactic disc.