Stellar archaeology in the solar neighbourhood

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GCS: Basic and derived data

- **Sample:** 14.000 FG dwarfs, all-sky, binaries identified

- **Observations**: photometry, RV, parallaxes, proper motion, volume complete

- **For most stars** (incl. uncertainties)**:**

  distance, M_v, T_{eff}, [M/H], μ, RV, age,

  U, V, W, vsini i, orbits (R_m, e, z_{max}) etc.

Search for past accretion events in MW

Numerical simulations of dwarf galaxy crossing Solar Neighbourhood showed that stars with common progenitor

- Defines a coherent lump in "phase space"

- Should have distinct correlations between A, P and L_z (angular momentum in z).

- Should cluster around constant eccentricity

High resolution spectroscopy (elemental abundances)
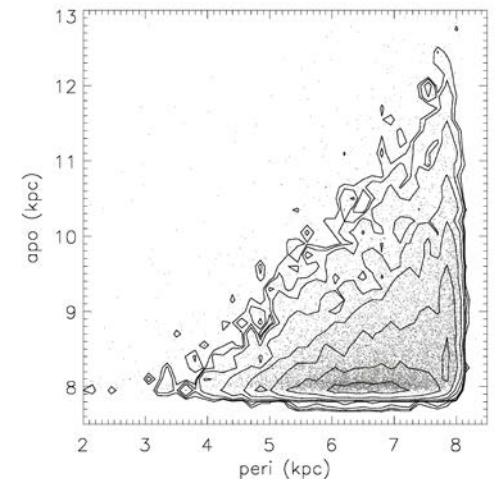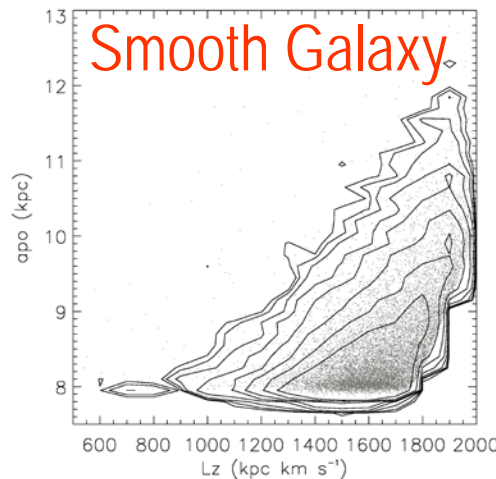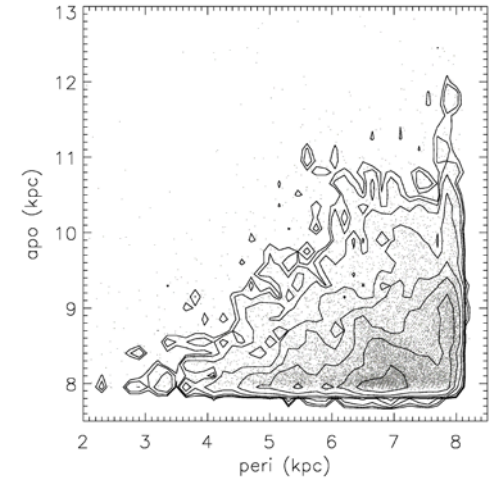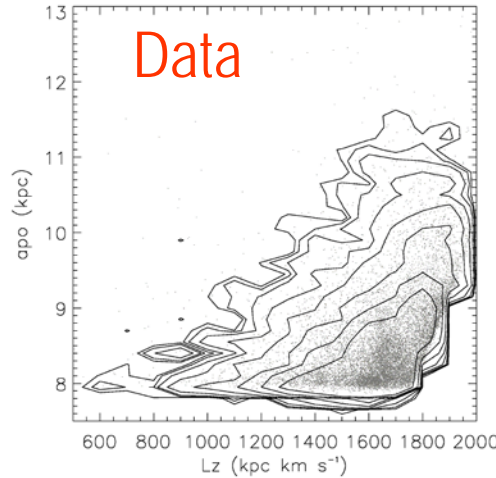
The APL-space for nearby stars

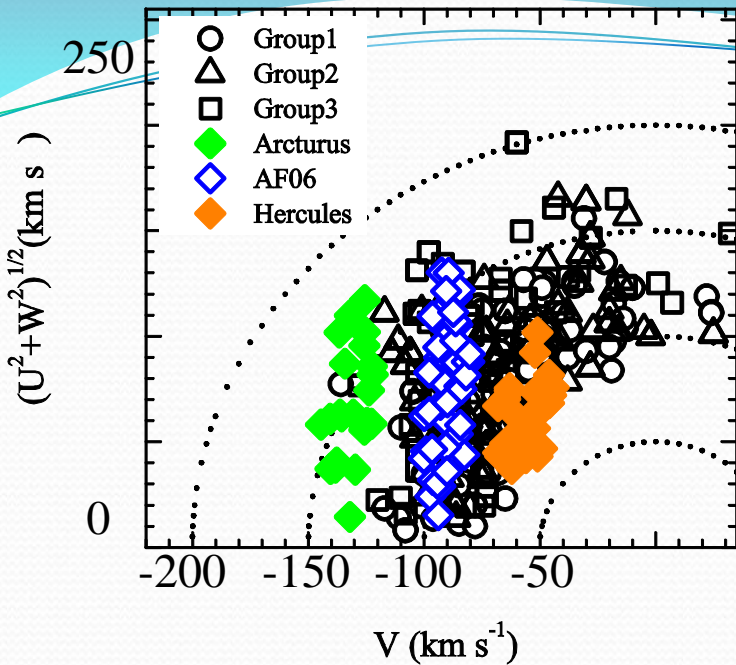Computed orbits in Galactic potential to derive APL_z location

Large amounts of substructure in comparison to smooth Galaxy model

Most prominent featurs due to dynamical streams

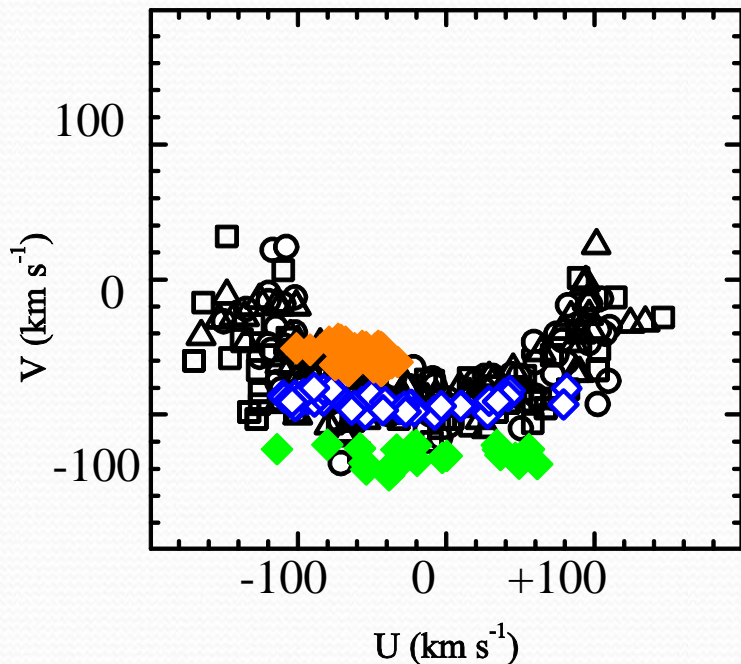Smooth Galaxy model. Same number of stars and spatial location as data;

APL_z= Apo-, Pericentre, z angular momentum

Helmi et al. 2006

Toomre diagram

Kinematic groups 1,2,3(o,Δ,□)
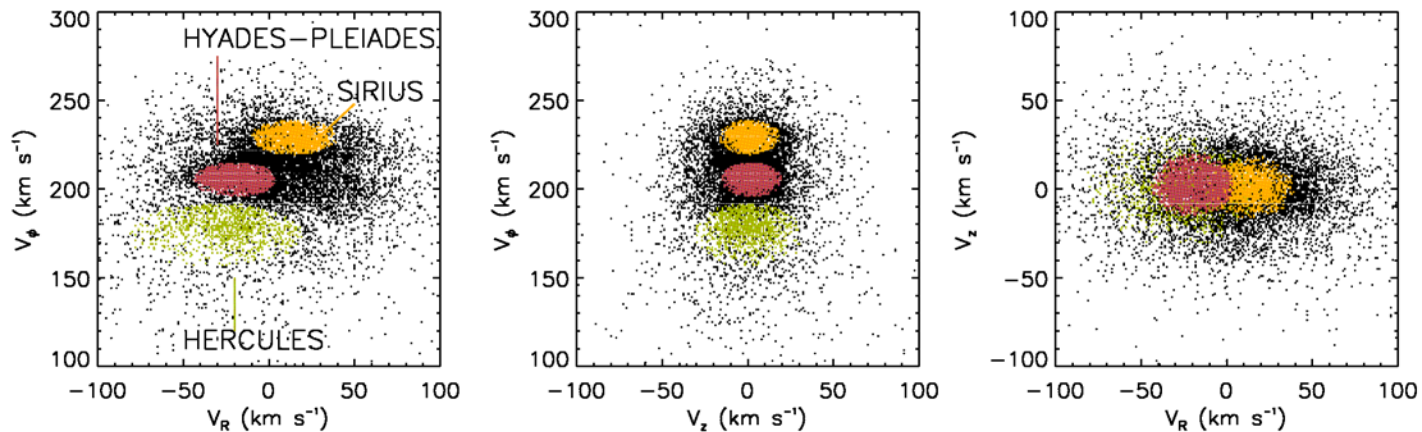Dynamical streams ■,■,■

UV velocities:
Kinematic groups – banana shape

Ženovienè et al. 2015
arXiv 1501.06401v

Known dynamical streams

"Dynamical streams" identified by Famaey et al. (2005), a very large sample of K & M nearby giants
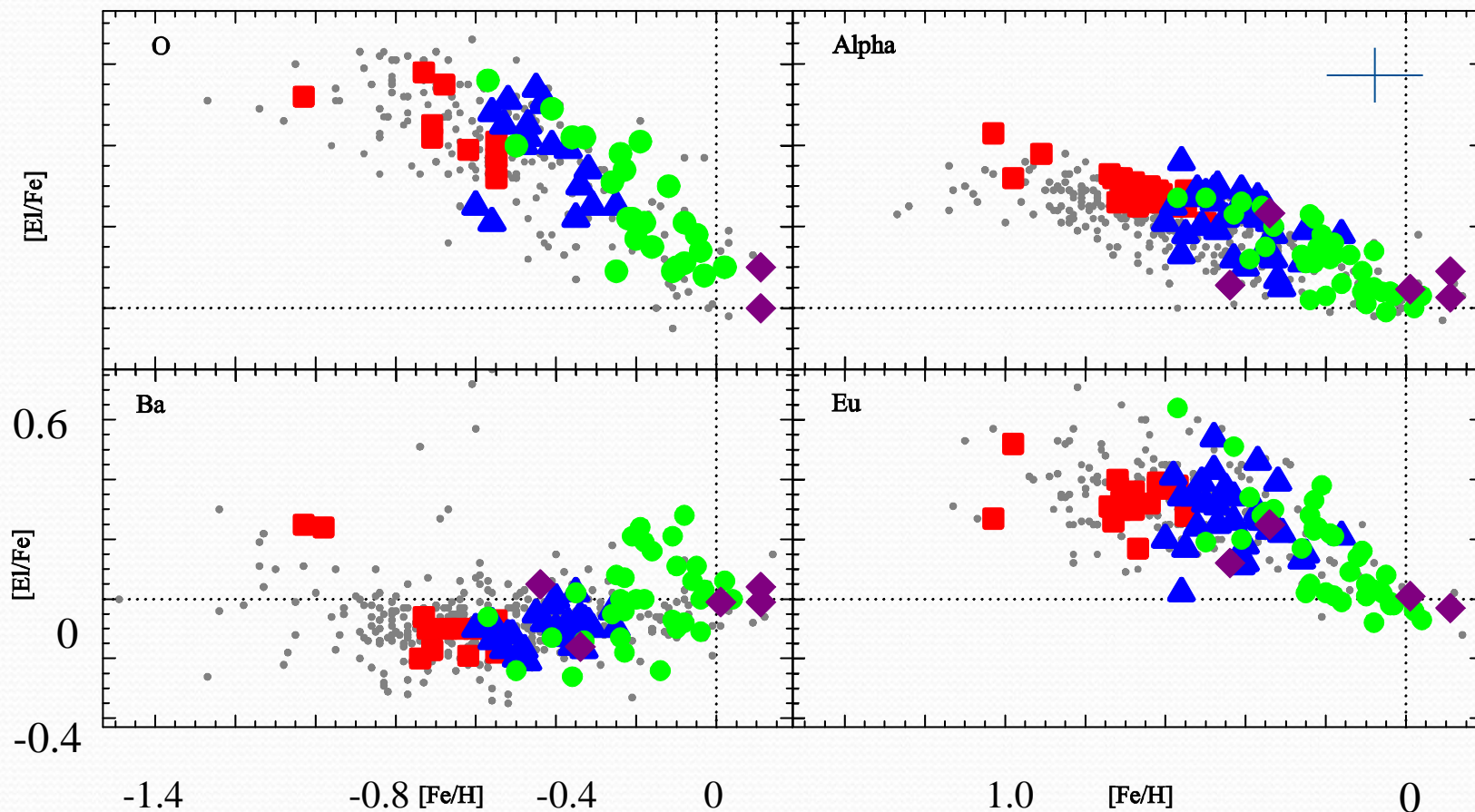

How to distinguish these dynamical features from the substructure due to past mergers?

- Velocity distribution of dynamical streams is different
    - no "banana" shape
    - not-mixed in V_R

- The APL-space distribution is different…

Abundances: O, α, Ba, Eu
spectra from FIES @ NOT. R=68000 S/N >100

Groups **3 red**, 2 **blue**, 1 **green**, purple+grey thick disk
17 more elements, Mg and Na: non-LTE

Žcnovicnè et al. 2015

Conclusions

- **Substructure** identified even in Solar Neighbourhood

- Three groups: 120, 86, 68 stars (Helmi et al. 2006)

- **Kinematic** characteristics (excess of stars of common eccentricity). Like merger debris.

- **Chemical** characteristics:[Fe/H], α etc. (21 elements)

- Characteristic **ages:** 9, 11,13 Gyr; 2 Gyr spread in each group

- Origin of the substructures? Merger event?

- Similar chemical signatures as thick disk.

Discussion points

What observables are needed to trace (find) the MW building blocks? To what accuracy?

What deeper surveys could reveal more kinematic groups?

Can we find the progenitors?