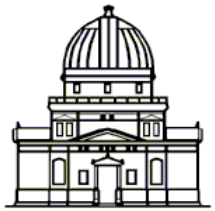


Observatoire astronomique
de Strasbourg

RAVE
status and recent results

A. Siebert for the RAVE collaboration
Observatoire de Strasbourg
CDS

Outline

Observatoire astronomique de Strasbourg

SF2A, Nice, June 6th 2012

- Overview of the project
  - aims and principles
- Status of observations
- Auxiliary data
  - atmospheric parameters, distances, abundances
- Recent scientific results
  - Milky Way structure
  - Substructures & formation history
  - Stellar astrophysics
- Future works

Aims and principle

Observatoire astronomique de Strasbourg

- Measure the radial velocity for up to 600k stars in the Milky Way to ~2 km/s accuracy
  - search for signatures of the hierarchical build-up of the Galaxy
  - moving groups and streams
  - structure and kinematics of the Galactic disc
  - peculiar objects...

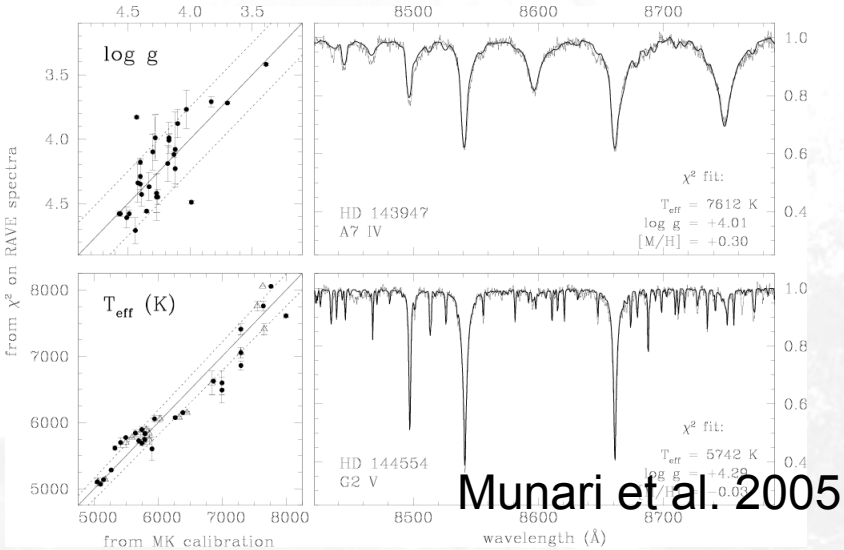
Aims and principle

Observatoire astronomique de Strasbourg

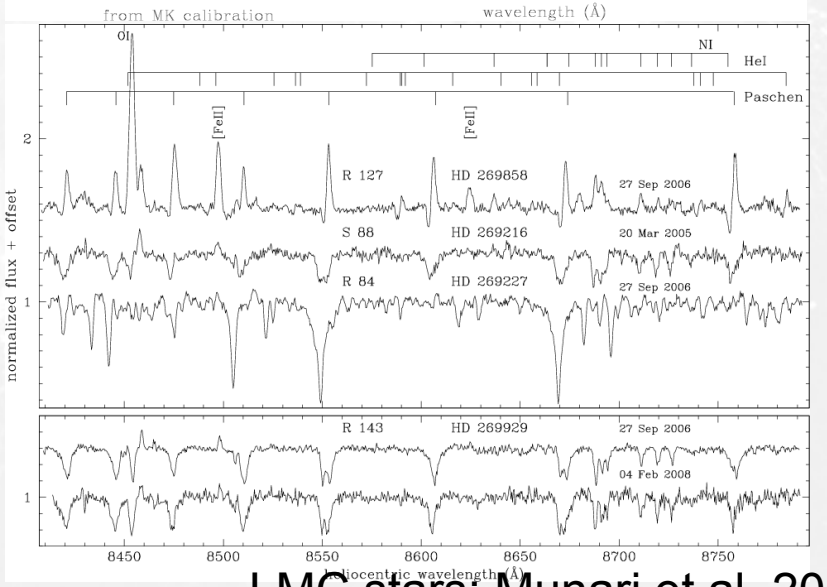
SF2A, Nice, June 6th 2012

- MOS spectroscopy
  - 6dF @ UKST, AAO:
    - 150 fibers
    - 6deg FOV
  - R~7500
  - CaT region

    8410<λ<8795 AA
  - 9<I<12
    - K0V: d=50-250 pc
    - K0III: d=0.7-3 kpc
    - reach LMC for most luminous stars



Munari et al. 2005



LMC stars: Munari et al. 2009

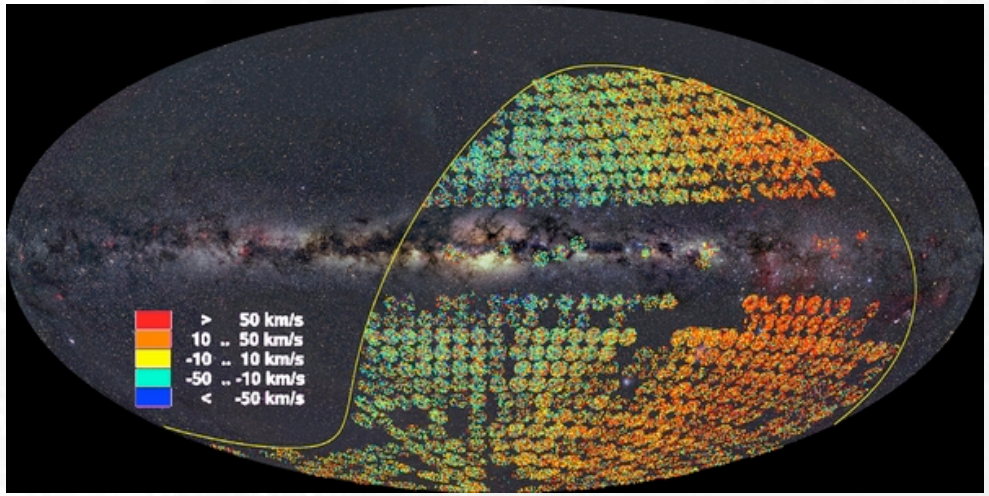
Current status: public

Observatoire astronomique de Strasbourg

SF2A, Nice, June 6th 2012

Latest public release:

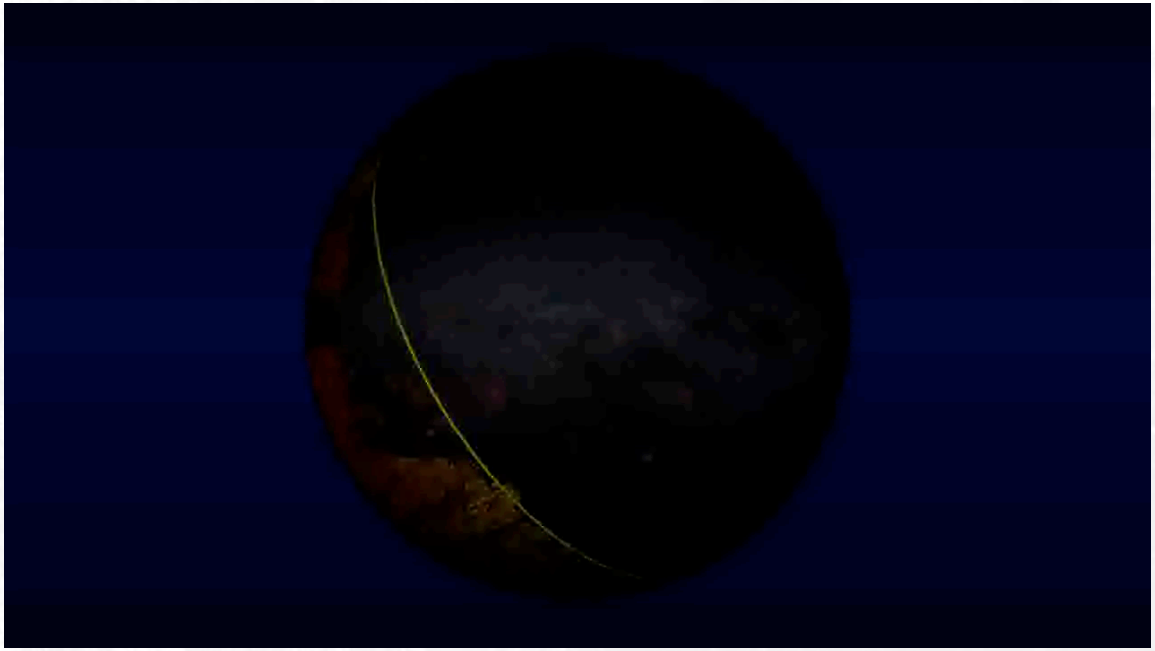
- DR3 (Siebert et al. 2011)
  - Complete pilot survey
  - 11,500 deg2
  - 77,461 stars
  - 83,072 radial velocities
  - 39,833 stars with atmospheric parameters



Current status: survey

Observatoire astronomique de Strasbourg

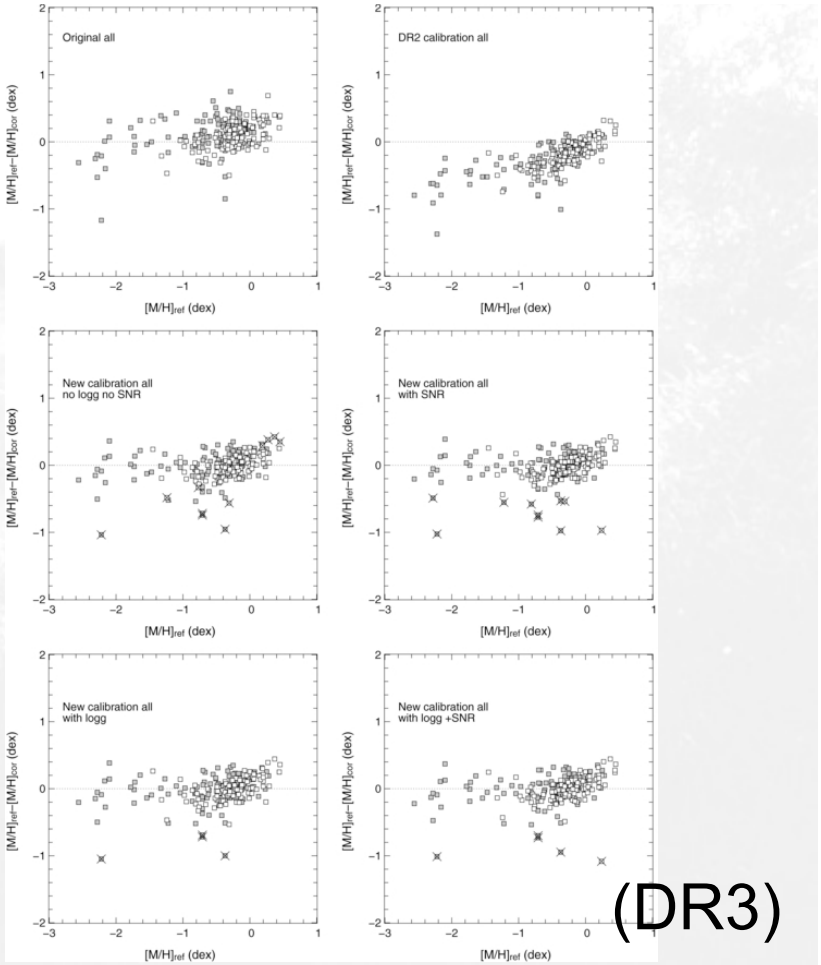
- 510,000+ spectra
- 427,000+ stars



Auxiliary data: parameters

- Atmospheric parameters
  - part of the RAVE data releases
  - provided for SNR>20
  - Teff and logg ok
  - [M/H] needs calibration
  - Vrot and [α/Fe] enter calibration (not to be used alone)
  - use of parameters ok in a relative sense
  - for studies based on absolute values or distribution: use with care

$$[\mathrm{M/H}] = c_0 + c_1 \cdot [\mathrm{m/H}] + c_2 \cdot [\alpha/\mathrm{Fe}] + c_3 \cdot \frac{T_{\mathrm{eff}}}{5040} + c_4 \cdot \log g + c_5 \cdot \mathrm{STN}\,,$$



(DR3)

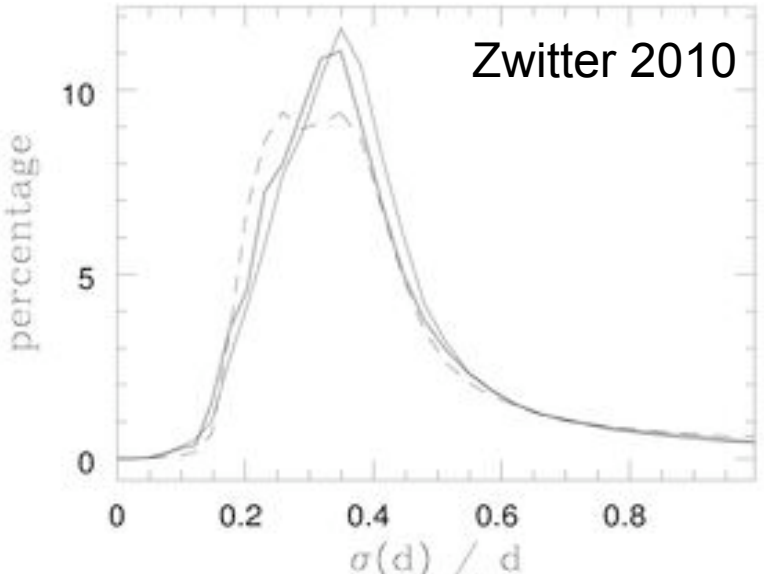
Auxiliary data: distances

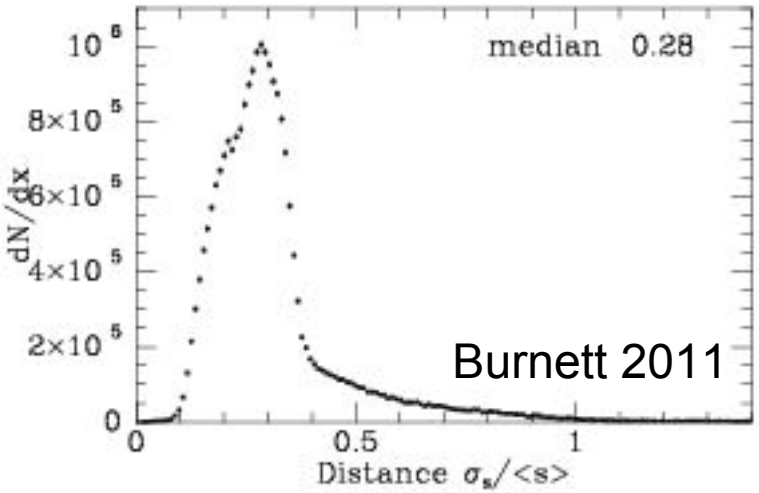
Observatoire astronomique de Strasbourg

SF2A, Nice, June 6th 2012

3 different measures of distances

- Based on atmospheric parameters from the RAVE pipeline
- Breddels et al. 2010
  - isochrone based measure
- Zwitter et al. 2010
  - isochrone + standard evolution (IMF)
  - public catalog
- Burnett et al. 2011
  - isochrone + evolution + Galactic structure model
  - public method but private catalog



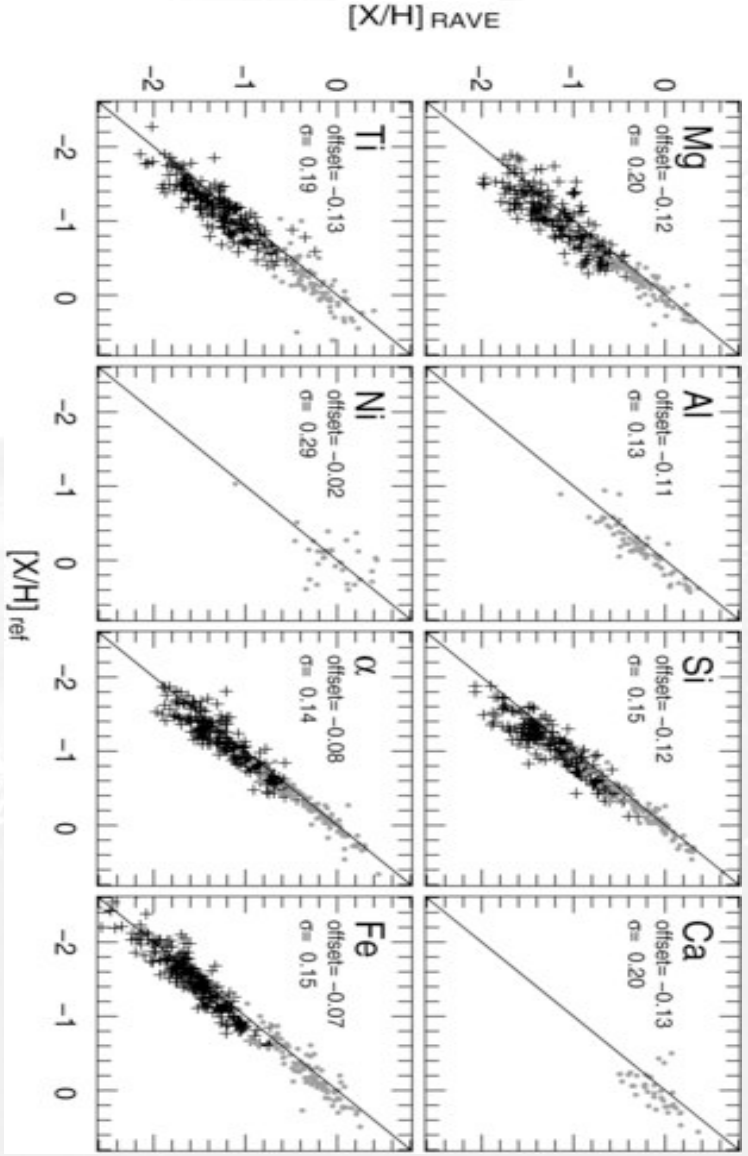


Auxiliary data: abundances

Observatoire astronomique de Strasbourg

Boeche et al. 2011

- up to 7 elements could be measured:
  - Mg,Al,Si,Ca,Ti,Fe,Ni
- mean error ~0.2dex
- abundances ok for S/N>40
- 20<S/N<40 only Fe/H and α/Fe should be used



SF2A, Nice, June 6th 2012

RAVE Science: structure

Observatoire astronomique de Strasbourg

SF2A, Nice, June 6th 2012

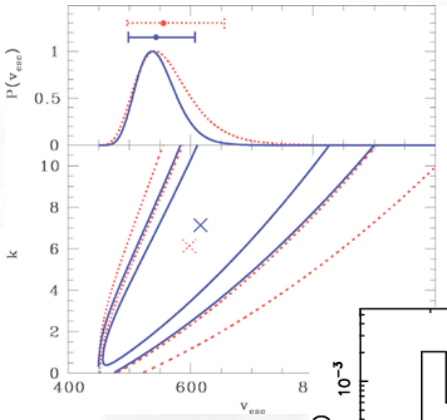
- Earlier results:
  - Smith et al. 2007: escape velocity

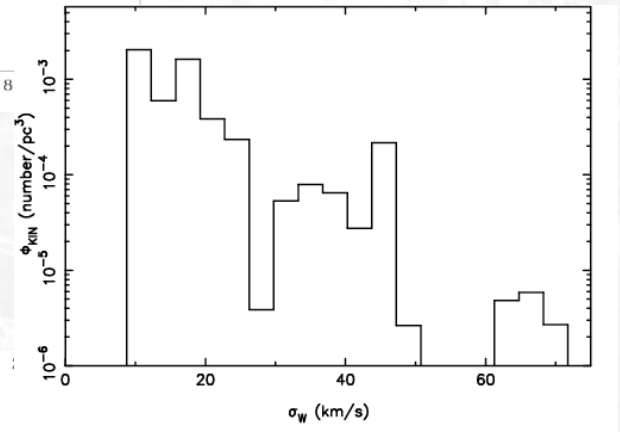
    V_{esc}~544 km/s ⇒

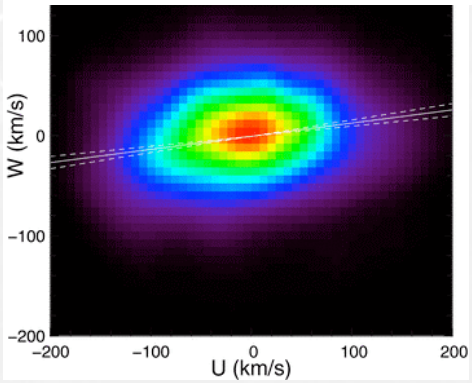
    M_{MW}~1.42 10^{12} M_{sun}
  - Veltz et al. 2008: disc vertical structure

    $h_{z\ thin/thick}$=225/1048 pc
  - Siebert et al. 2008: tilt of the velocity ellipsoid

    α~7deg ⇒ h_R=2.5-2.7kpc for ~spherical halo







RAVE science: structure

Observatoire astronomique de Strasbourg

- Also:
  - Coskunoglu et al. 2011: measurement of the local standard of rest using DR2
  - Coskunoglu et al. 2012: radial metalicity gradient using DR2
  - Bilir et al 2011: structure parameters from dwarfs and giants with DR2
  - Casetti-Dinescu et al. 2011: global properties of the disc with SPM4 + RAVE DR2
  - Karatas & Klement 2012: velocity ellipsoid from DR2 dwarfs

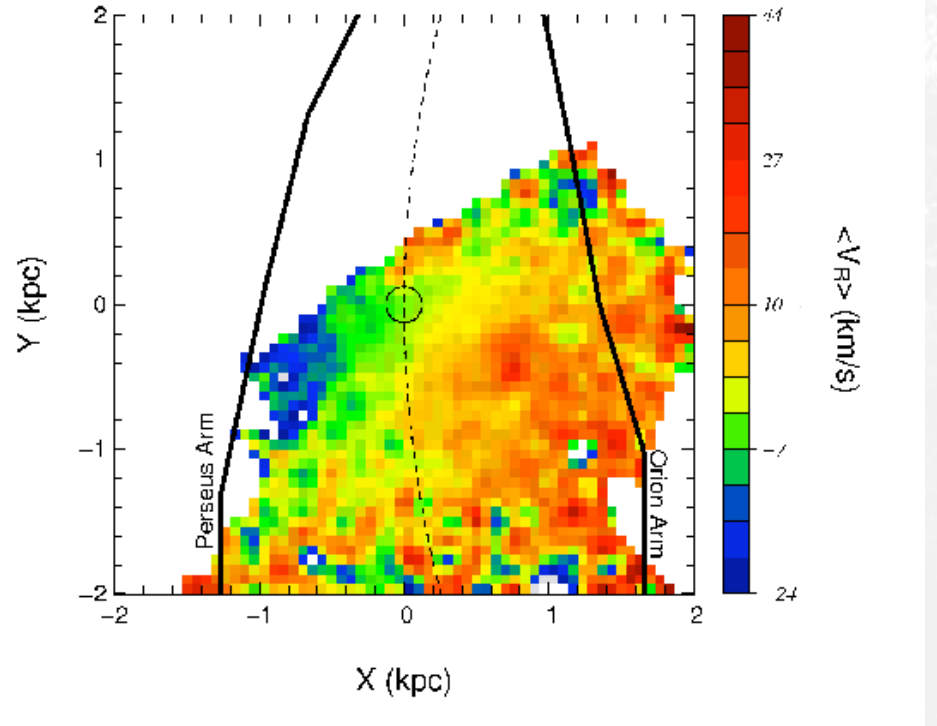
RAVE science: structure

Observatoire astronomique de Strasbourg

SF2A, Nice, June 6th 2012

- Latest results:
  - Siebert et al. 2011

    velocity field shows departure from axisymmetry

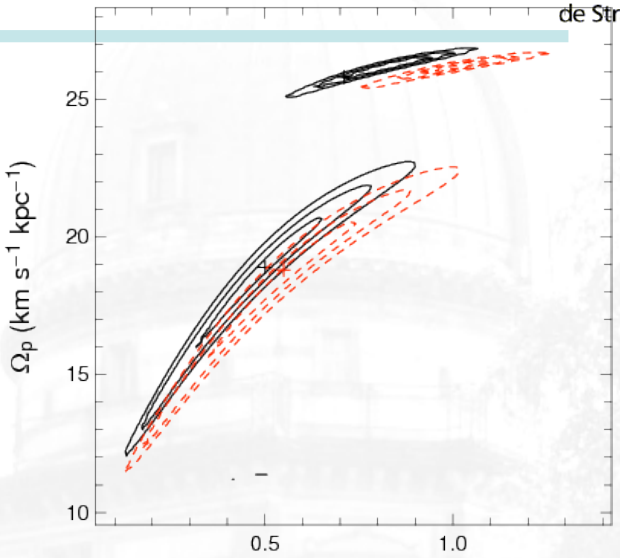


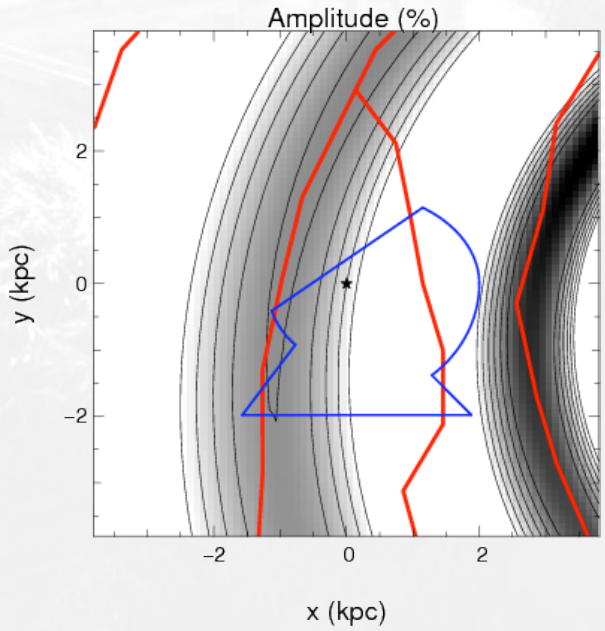
RAVE science: structure

Observatoire astronomique de Strasbourg

SF2A, Nice, June 6th 2012

- Latest results:
  - Siebert et al. 2011
    - velocity field shows departure from axisymmetry
  - Siebert et al. 2012 (submitted)
    - velocity field -> signature of the spiral arms?

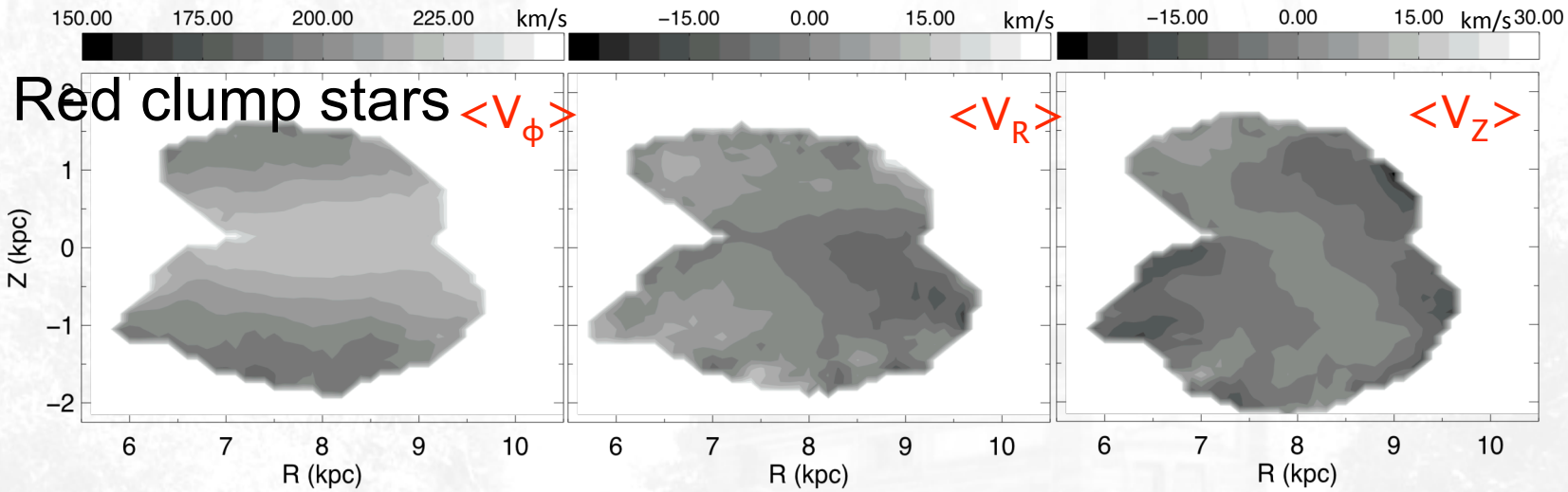




RAVE science: structure

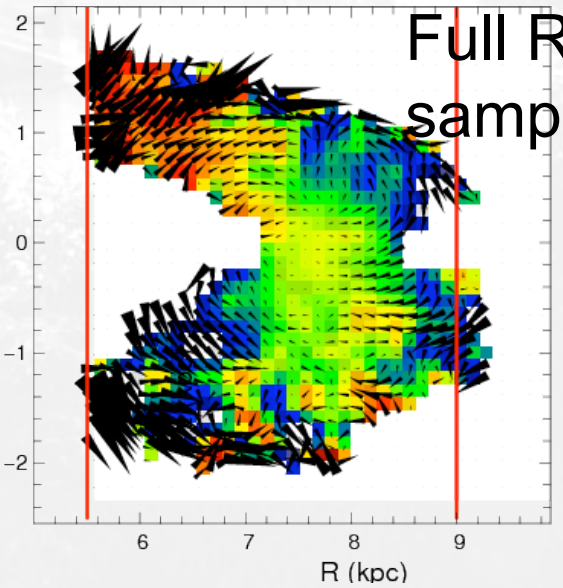
Observatoire astronomique de Strasbourg

SF2A, Nice, June 6th 2012



- Latest results:
  - Williams et al. 2012 (in prep)

    complex 3D velocity field -> Rossby/ridge instability/non stationnary effects (vertical waves see Widrow 2012)?



RAVE science: substructure

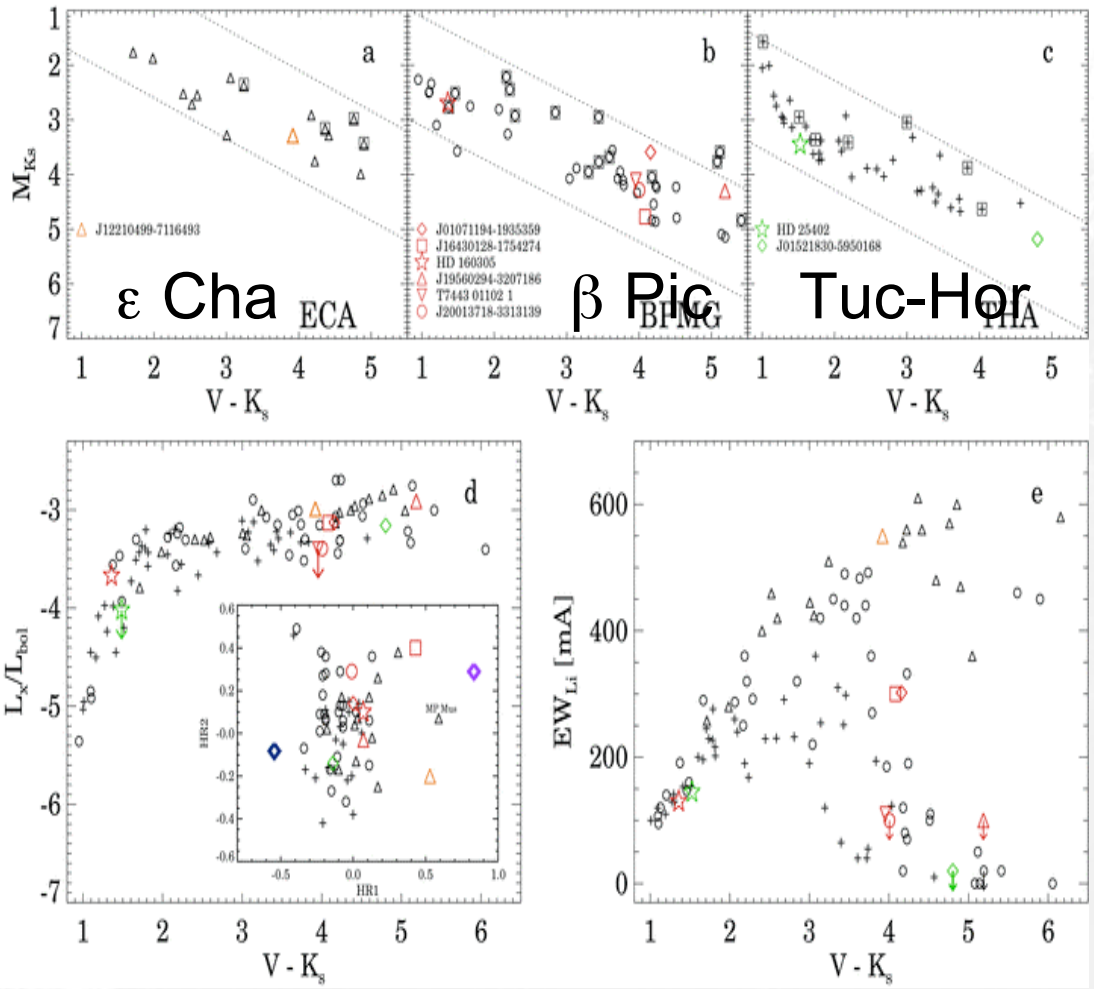
Observatoire astronomique de Strasbourg

SF2A, Nice, June 6th 2012

- Earlier results:

Kiss et al. 2010

new members of 3 moving groups combining RAVE, high-resolution spectroscopy and ray diagnostics



RAVE science: substructure

Observatoire astronomique de Strasbourg

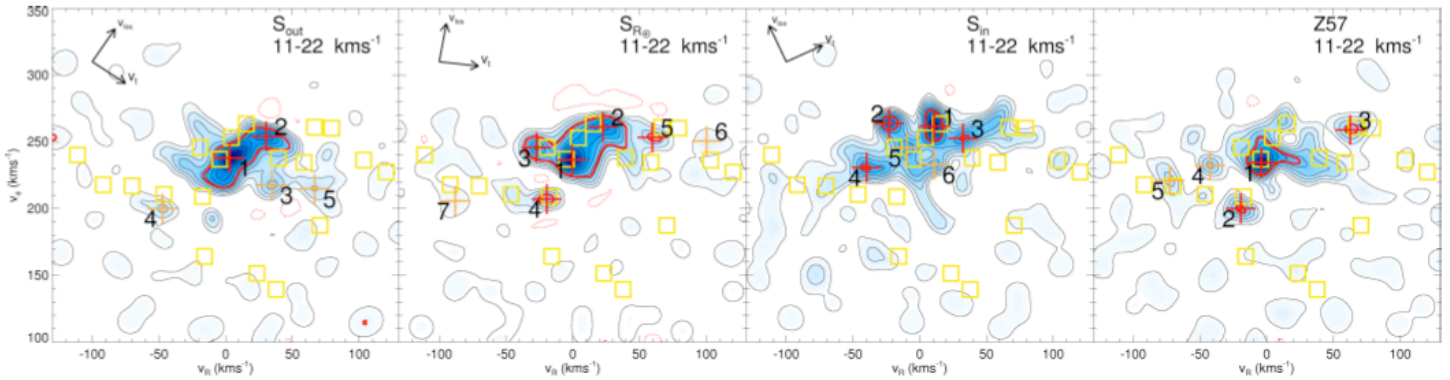


Figure 3. Velocity structures at scales of 11-22 $\mathrm{km\,s^{-1}}$ in cylindrical velocities for the subsamples S_{out} (outside Solar circle), $S_{R_\odot}$ (Solar circle), S_{in} (inside Solar circle), and Z57 ($-700 \leqslant Z \leqslant -500$ pc). Yellow squares show the positions of the local sample (LS) groups. Colour code is the same as in Fig. 2b.

- Latest results:
  - Antoja et al. 2012 submitted

    moving groups can be traced outside the immediate solar neighbourhood
  - Also Karatas & Klement 2012, Hahn et al. 2011, Klement et al. 2011 , Klement et al. 2008

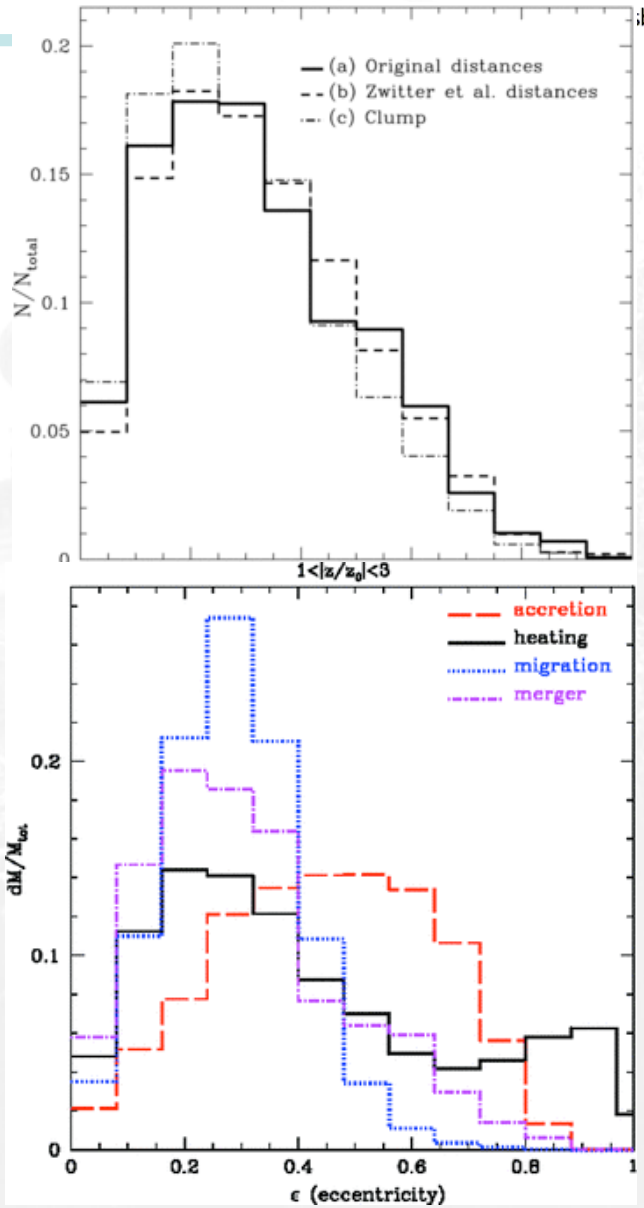
SF2A, Nice, June 6th 2012

RAVE science: thick disc

Observatoire astronomique
bourg

SF2A, Nice, June 6th 2012

- Wilson et al 2011
  - eccentricity distribution of thick disc stars selected from RAVE
  - favours an in-situ formation scenario of the thick disc
  - gas-rich mergers or radial migration are the preferred scenarios



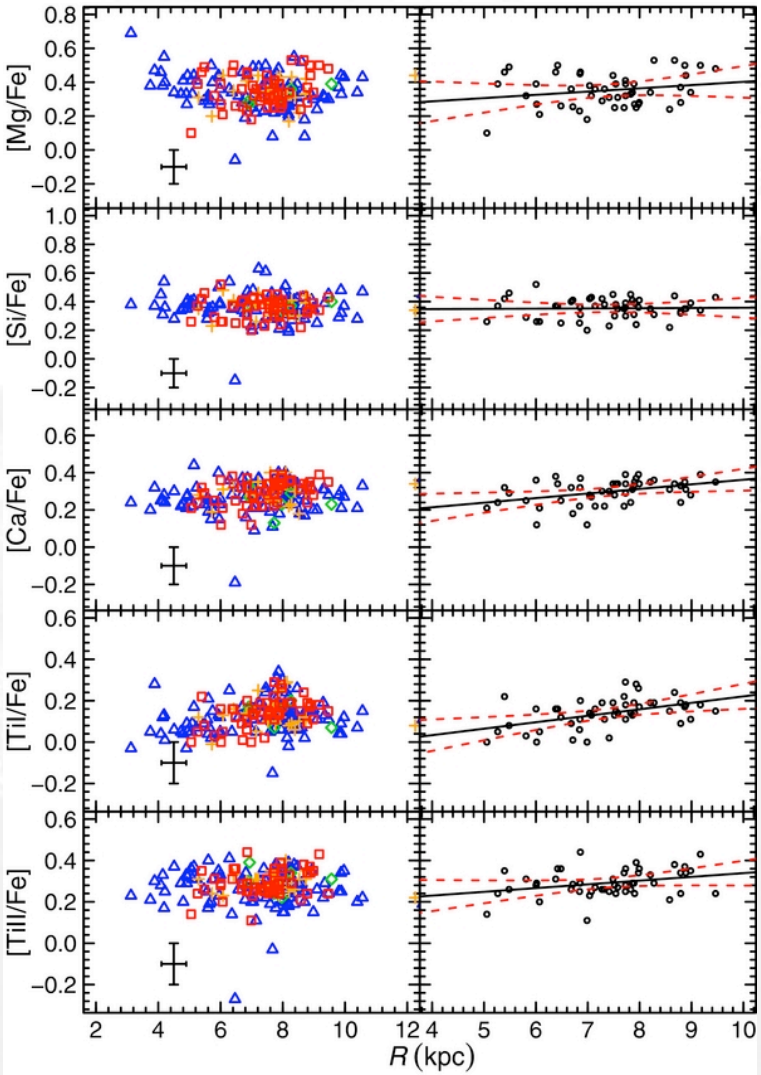
RAVE science: thick disc

Observatoire astronomique de Strasbourg

SF2A, Nice, June 6th 2012

Ruchti et al 2010/2011

- abundance gradients of thick disc stars with [Fe/H]<-1.2
- lack of scatter in [α/Fe]
- favours an in-situ formation scenario of the thick disc
- gas-rich mergers or radial migration are the preferred scenarios
- same conclusion as previous study

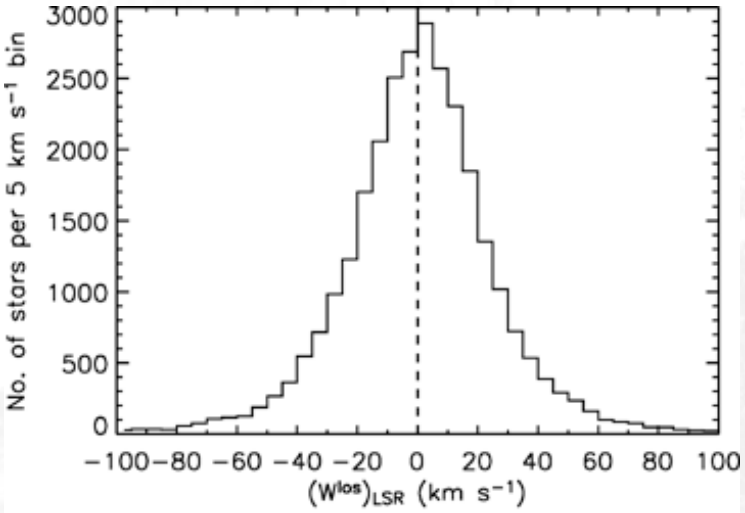


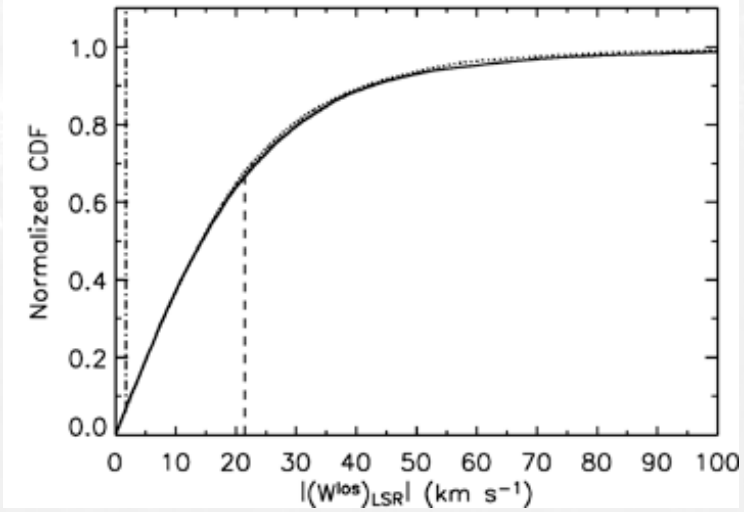
RAVE science: accretion

Observatoire astronomique de Strasbourg

SF2A, Nice, June 6th 2012

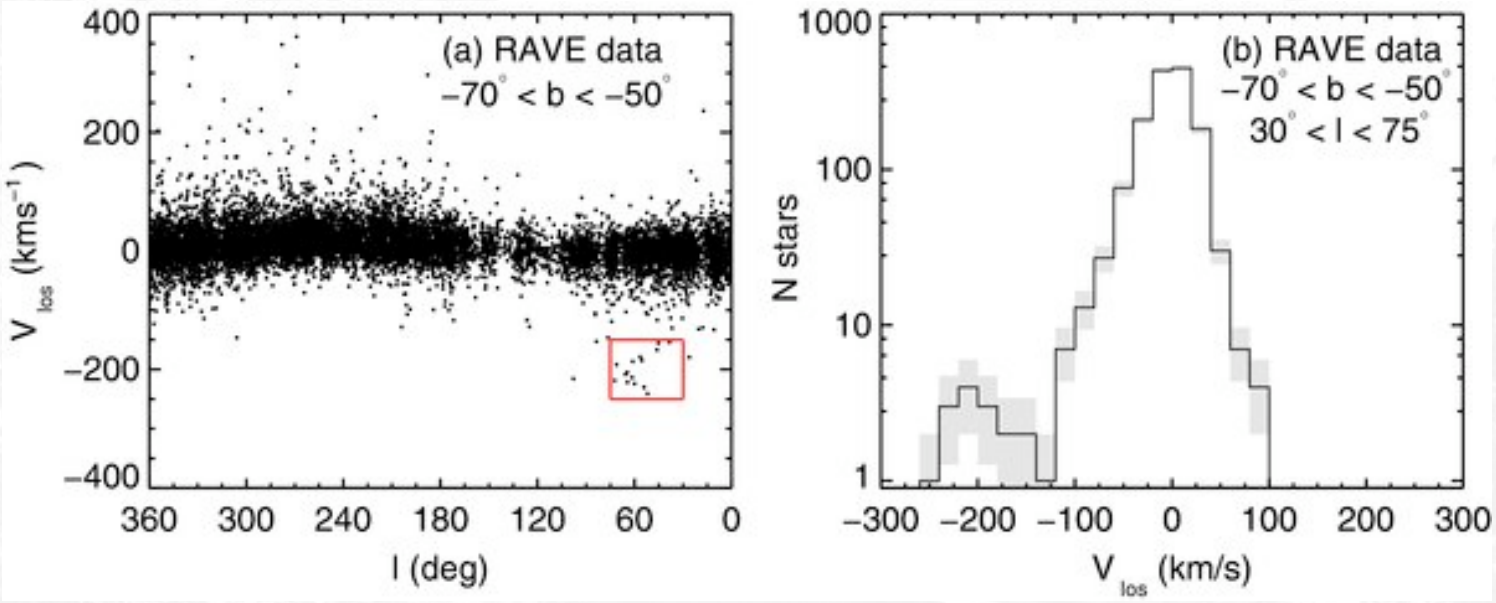
- Early results:
- Seabroke et al 2008
  - no traces of the Sagittarius stream in RAVE + CORAVEL data based on the symmetry of the vertical velocity distribution.





RAVE science: accretion

Observatoire astronomique de Strasbourg



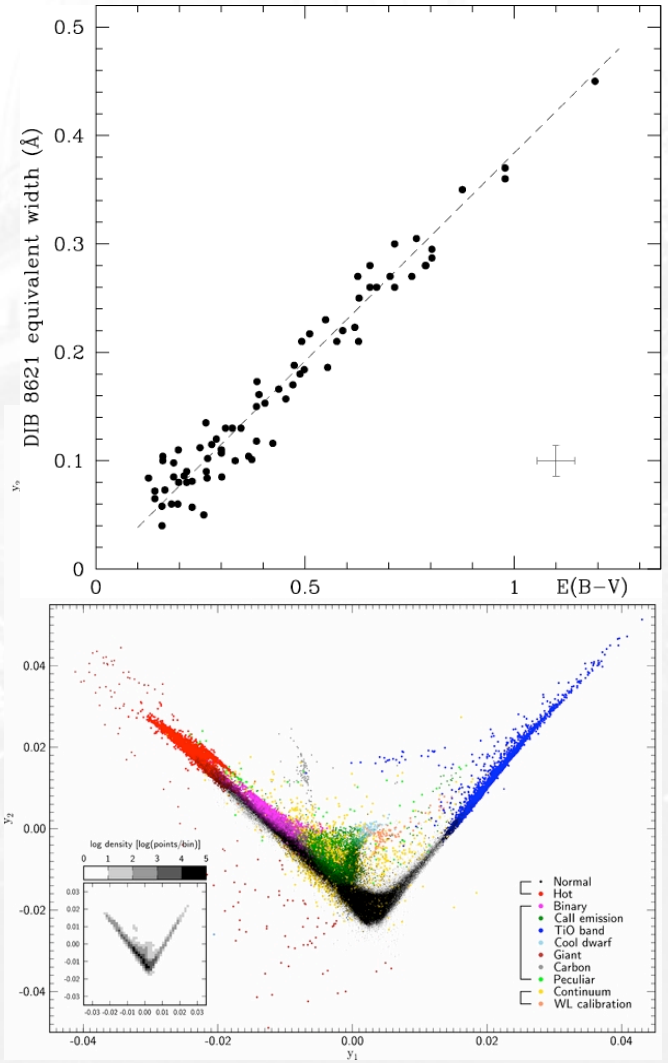
- Williams et al 2012
  - detection of a new, nearby (d<10kpc), overdensity of stars in the Vlos vs l diagram.
  - potentially an accretion event or disrupted globular cluster (astroph today -> GC)

RAVE science: stars & ISM

Observatoire astronomique de Strasbourg

SF2A, Nice, June 6th 2012

- Munari et al 2008:
  - DIB in RAVE spectra
- Munari et al 2009:
  - LBVs in the LMC
- Matijevic et al 2009:
  - SB2 in RAVE
- Fulbright et al 2010:
  - metal poor stars in RAVE
- Matijevic et al 2011:
  - SB1 in RAVE
- Matijevic et al 2012:
  - morphology and automated classification of RAVE spectra



Conclusions & Prospects

Observatoire astronomique de Strasbourg

- Thanks to the newly available distance estimates -> probe the detailed 3D structure of the extended solar neighbourhood
- RAVE catalogues used for many purpose
- End of observations late 2012/beginning of 2013: ~ 500-550k stars will have been observed
- DR4 planned end of 2012:
  - new IC based on Denis I magnitude: cleaner selection are possible
  - 1 year of observation at full capacity: doubles the number of stars in DR3
  - 2 years of observation at full capacity: 136k new stars w/ DR3.