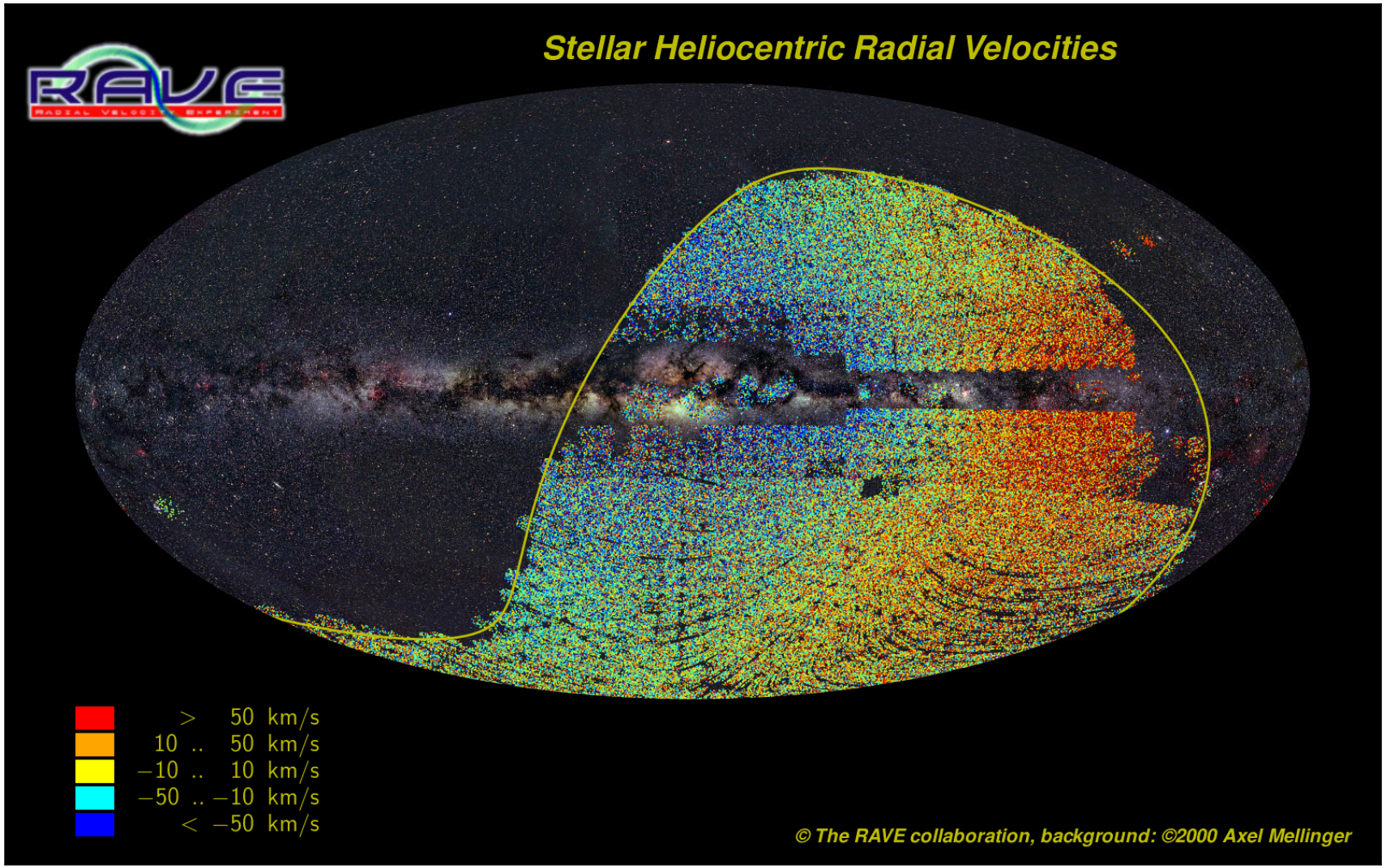
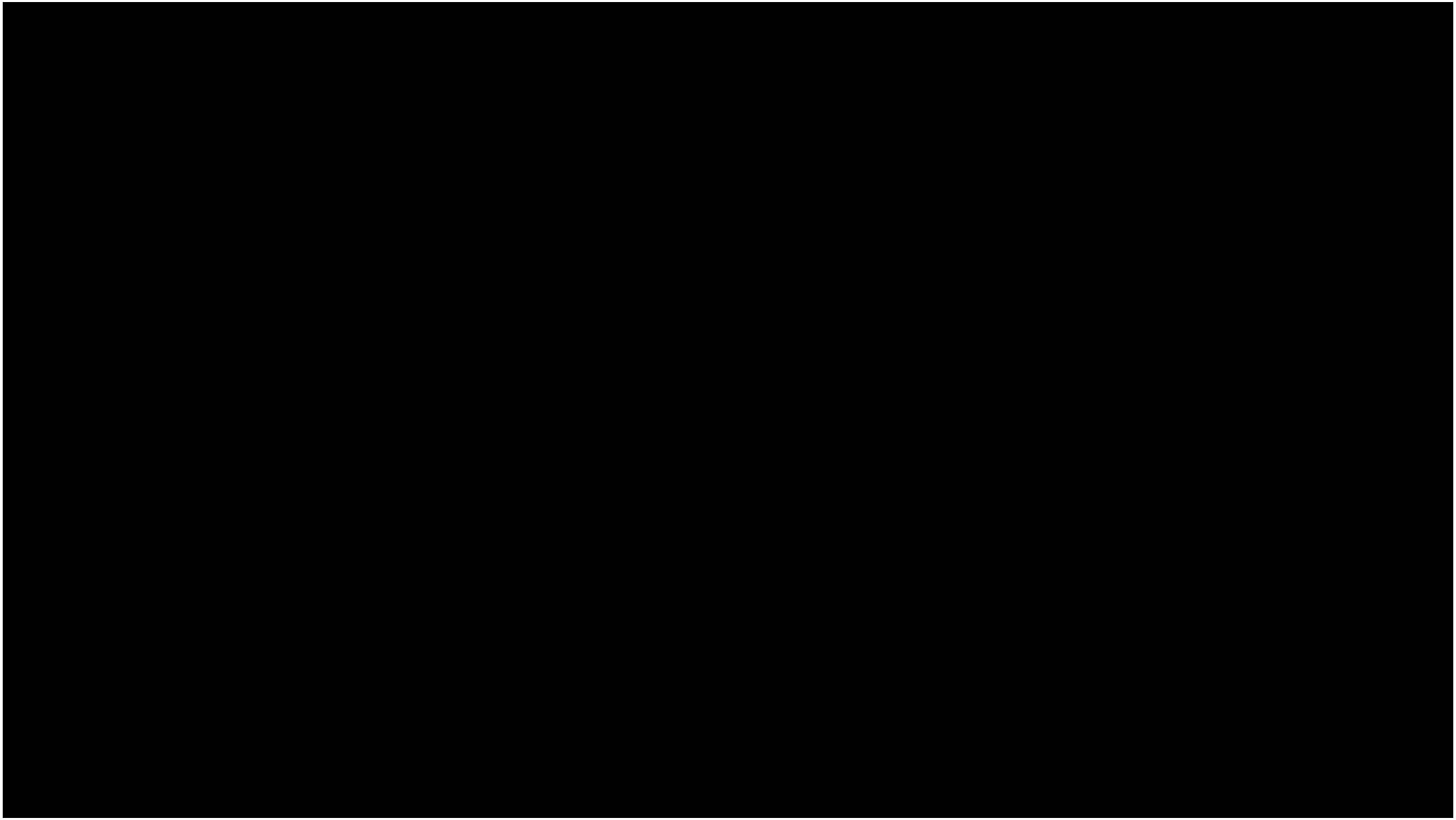
Spectroscopic Near Field Surveys What do we have, what is coming, what to do with the data?

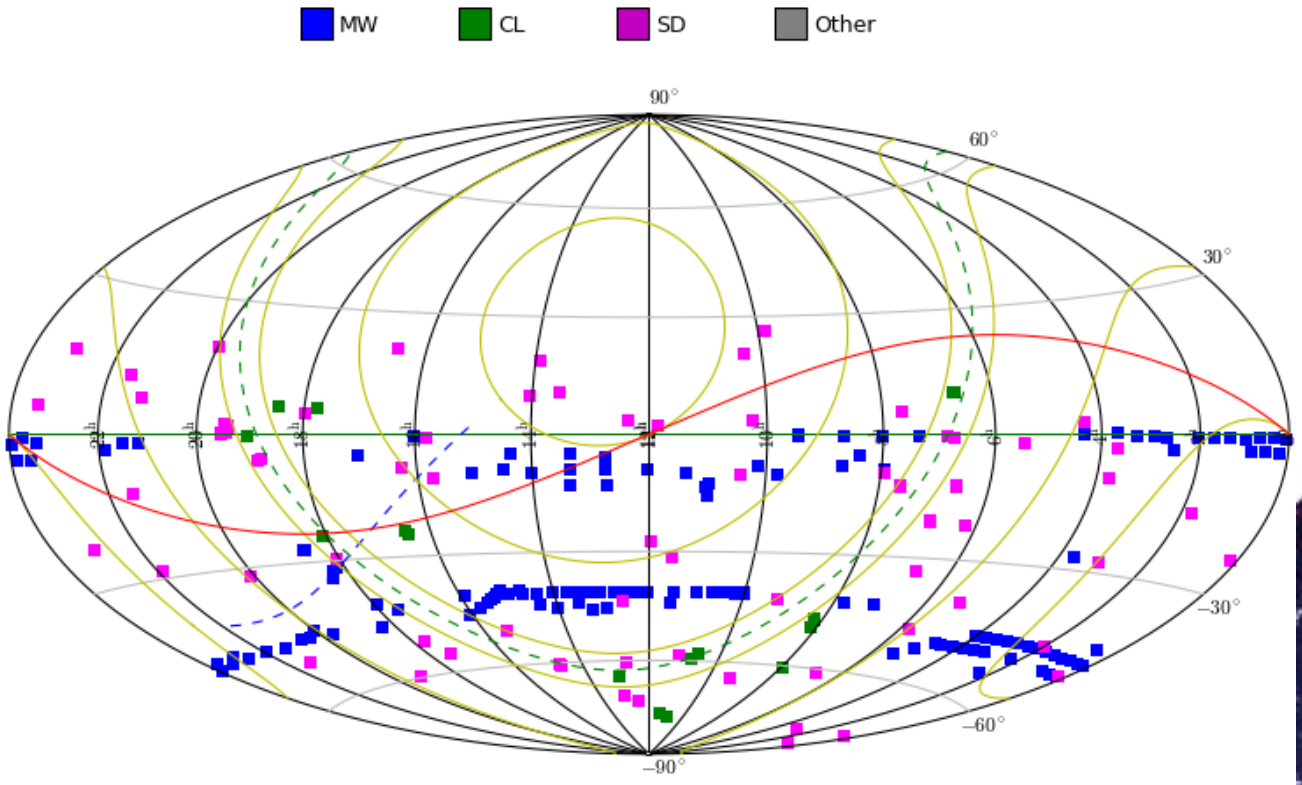


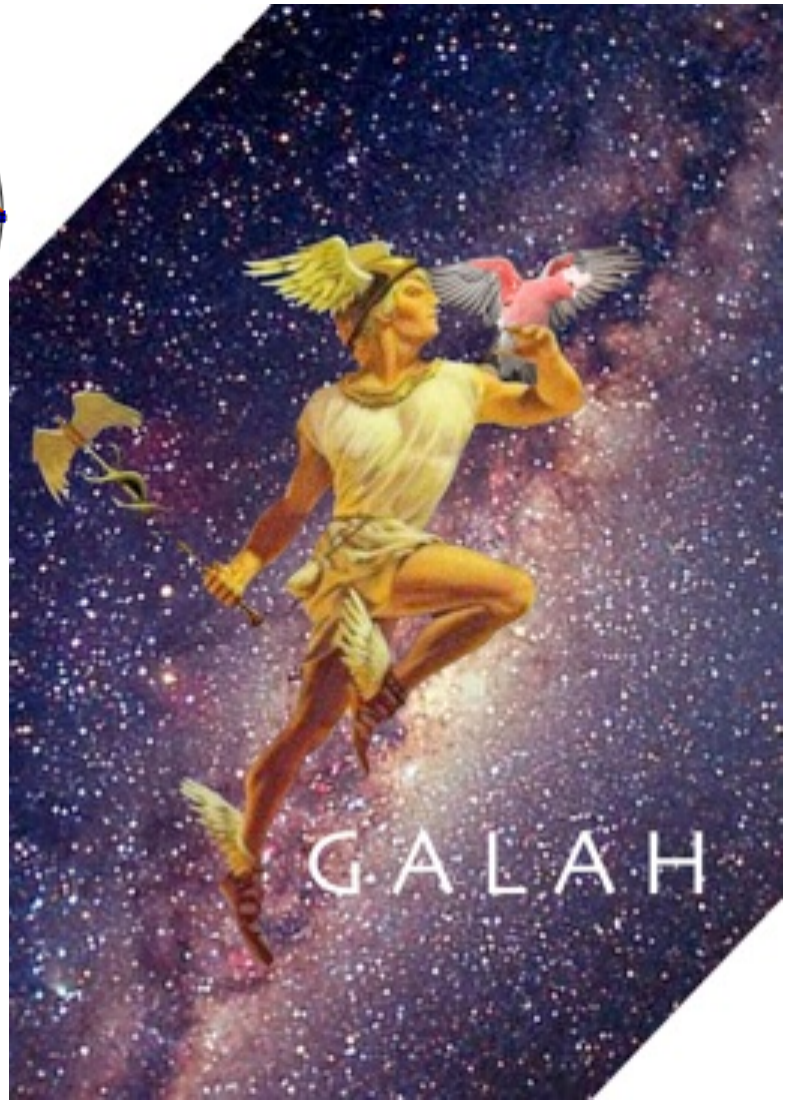
Systematic spectroscopic surveys 2004

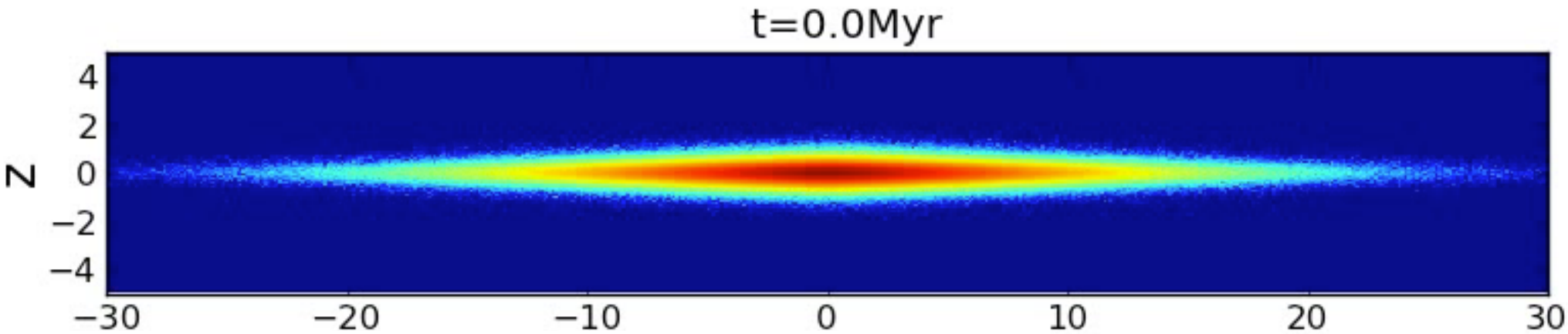
Systematic spectroscopic surveys 2014



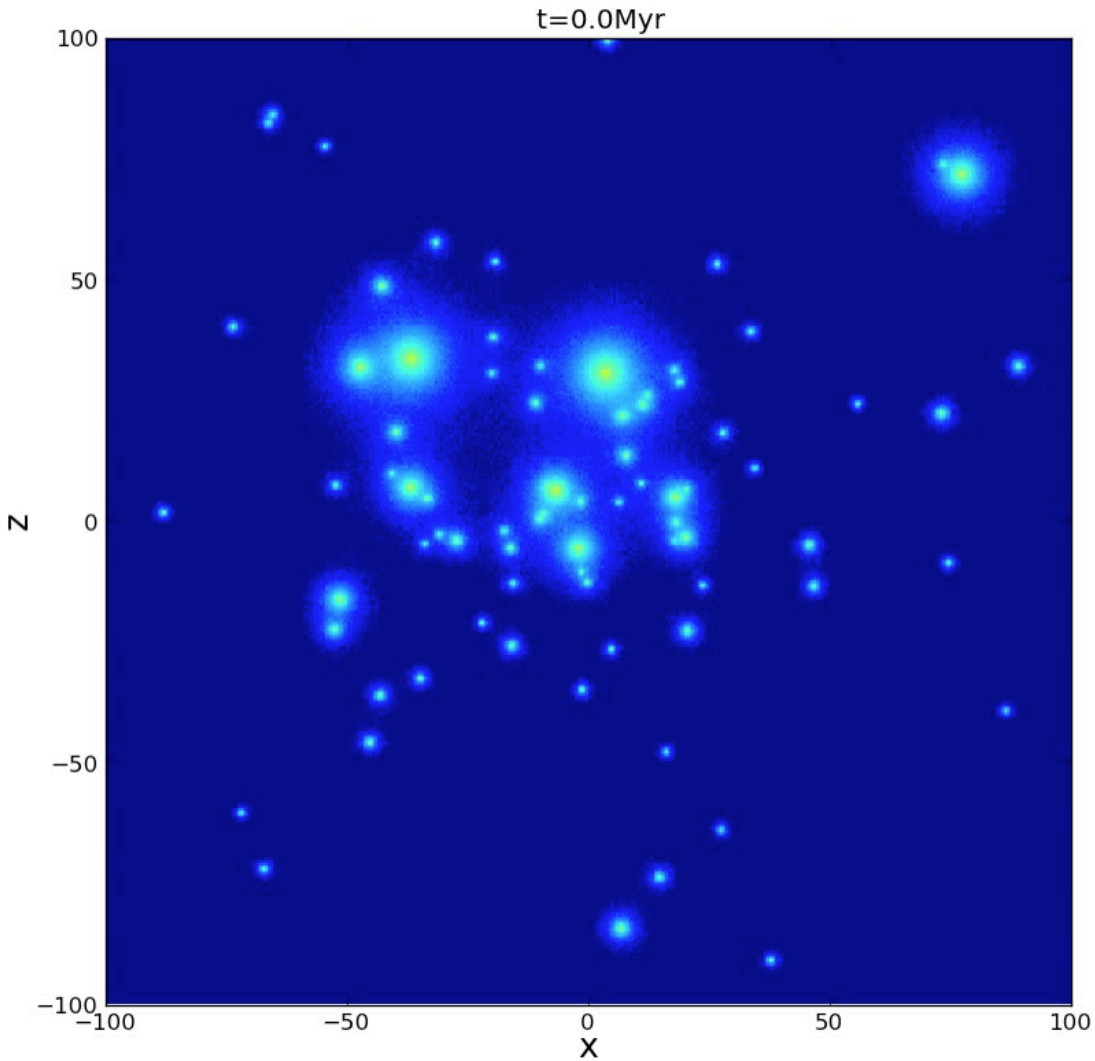
Running: Gaia-ESO and Galah

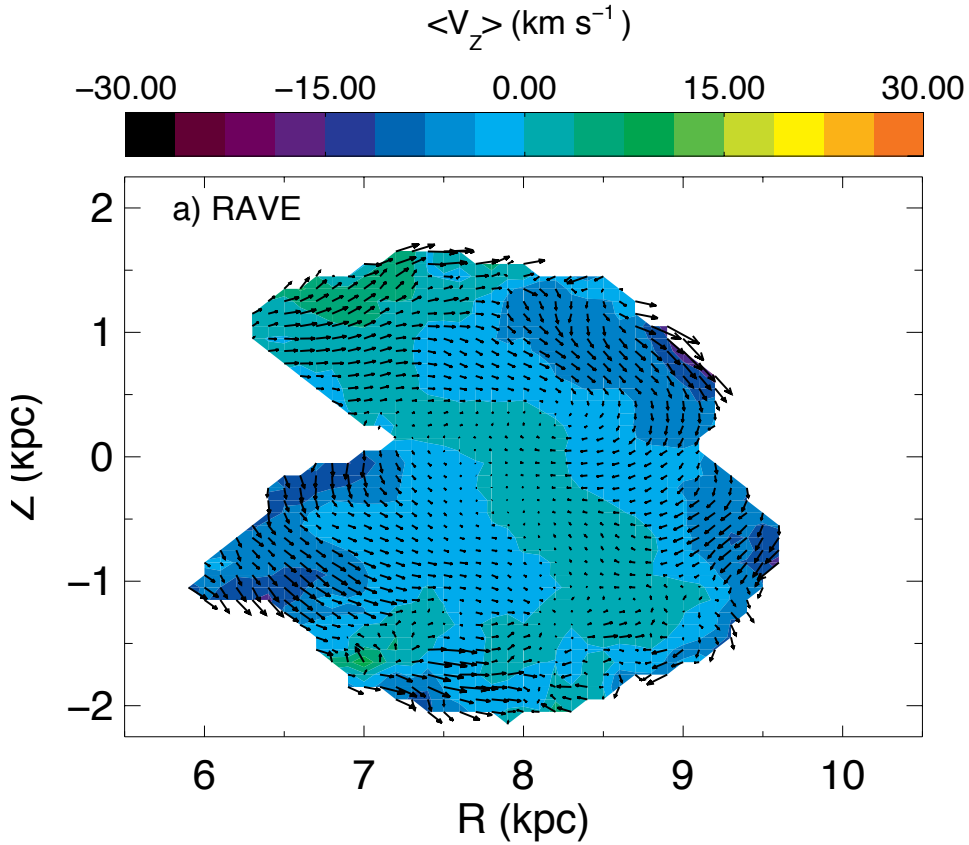






D'Onghia et al. 2014





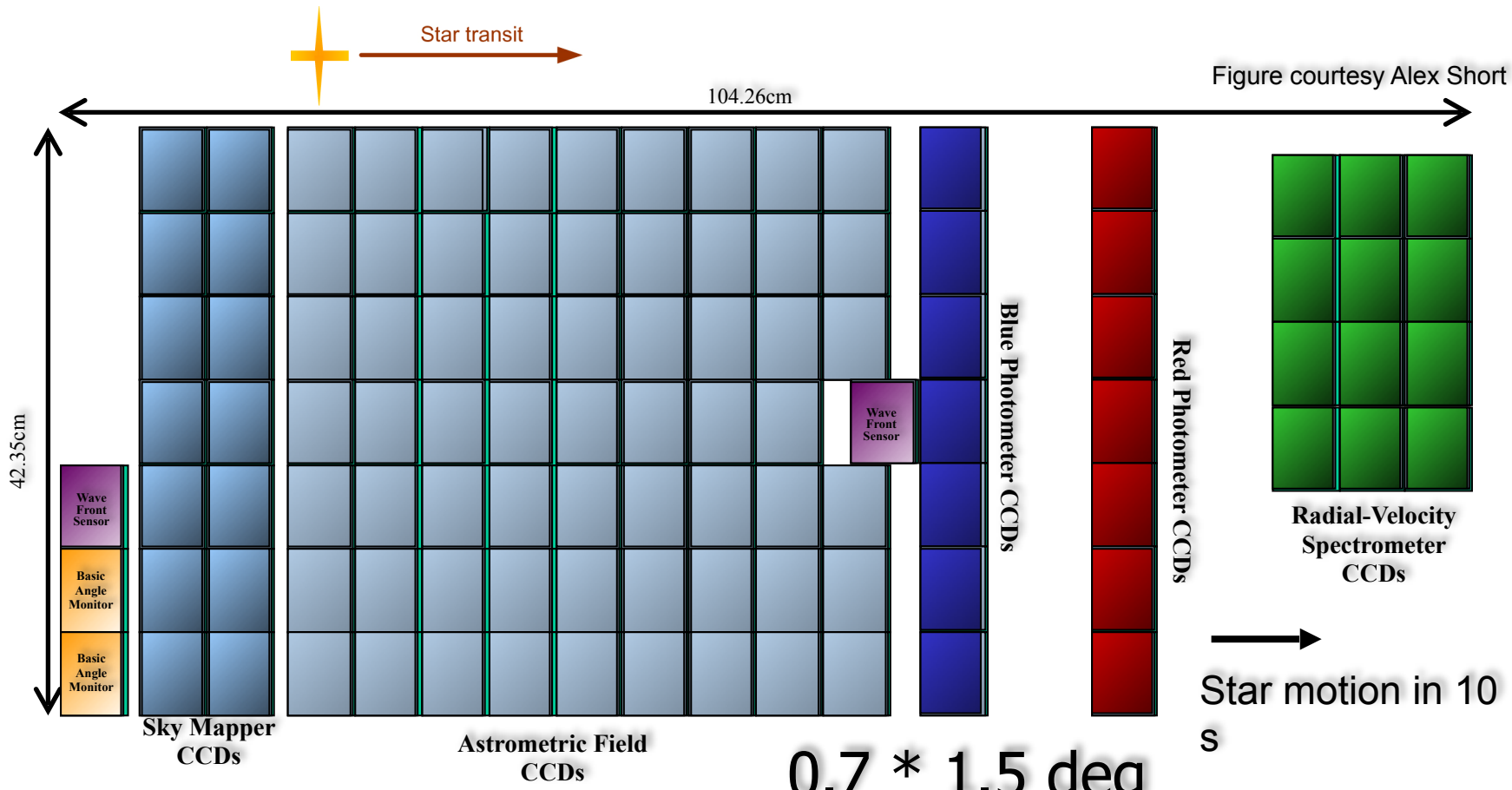
Williams et al. 2013

How to compare simulations and surveys?

- Far field (cosmology): mildly non-linear clustering, x, v and $\nabla\Phi$ basically the same quantity
- Near field (Galactic dynamics): Without the assumption of equilibrium any DF in (x,v) is consistent with a potential Φ
  - Equilibrium probably a reasonable assumption for MW, good starting point
  - we know there are non-equilibrium features (spiral arms, warps, tidal streams, wobbling disk) $\Longrightarrow$ should show up as differences to equilibrium model
  - describe simulations and observations as pdf (proper coordinates?) and see to what extent pdfs are consistent with each other
  - this has not been done in a systematic way!

Gaia

Gaia's focal plane



0.7 * 1.5 deg

Total field:

- active area: 0.75 deg^2
- CCDs: 14 + 62 + 14 + 12
- 4500 x 1966 pixels (TDI)
- pixel size = 10 μm x 30 μm = 59 mas x 177 mas

Sky mapper:

- detects all objects to 20 mag
- rejects cosmic-ray events
- FoV discrimination

Astrometry:

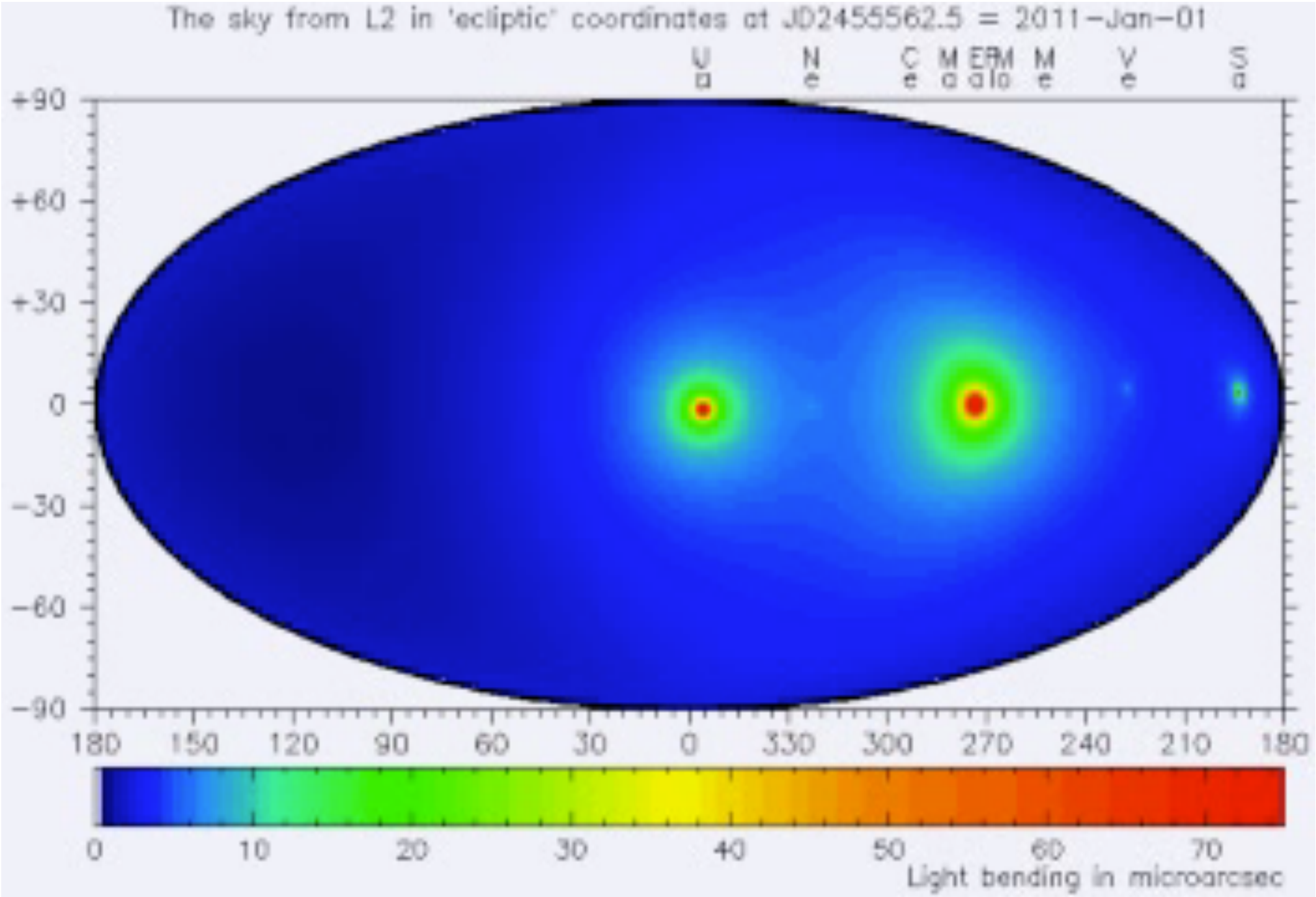
- total detection noise: 6 e$^-$

Photometry:

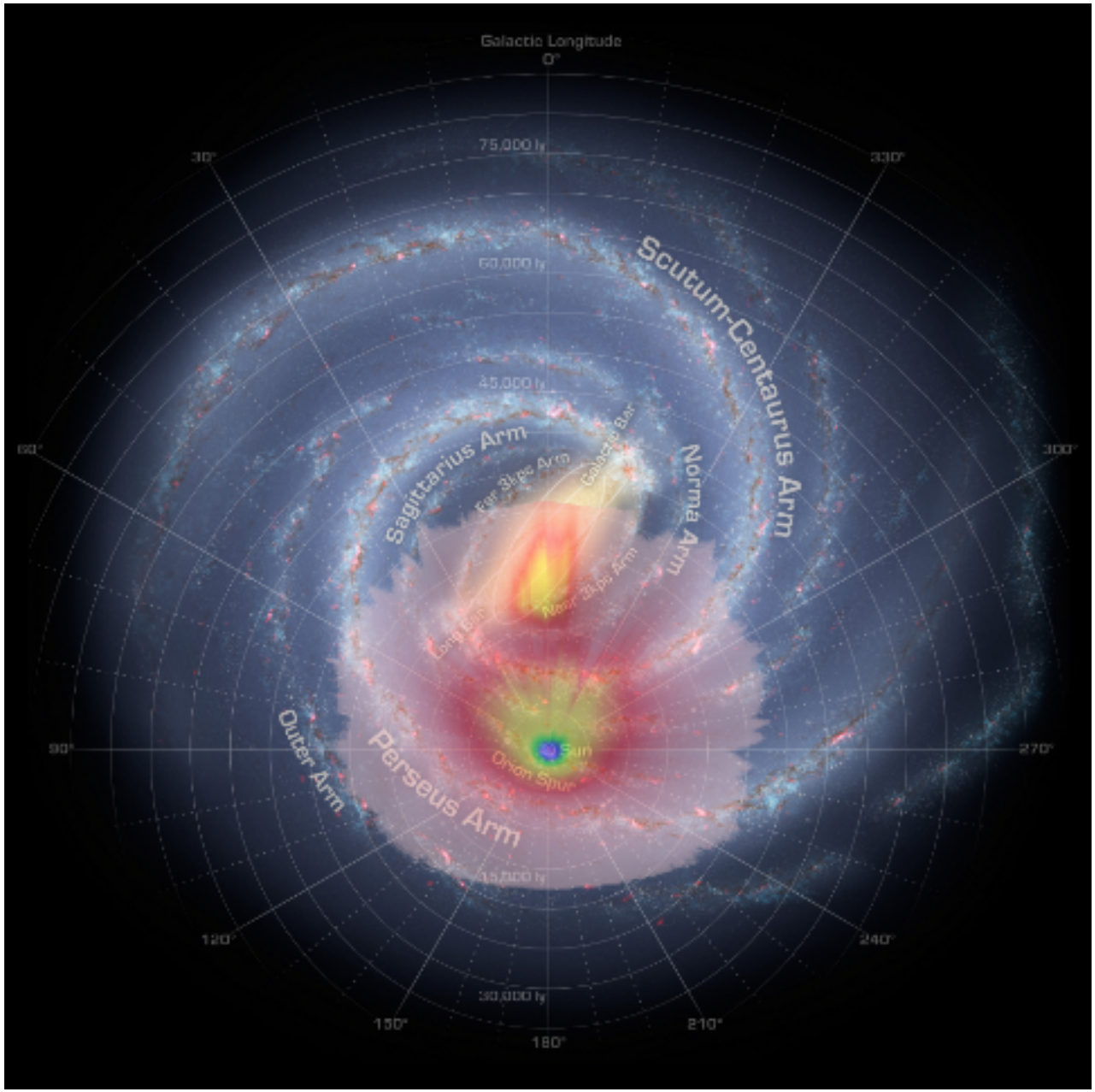
- two-channel photometer
- blue and red CCDs

Spectroscopy:

- high-resolution spectra
- red CCDs


The sky from L2 in 'ecliptic' coordinates at JD2455562.5 = 2011-Jan-01
U N C M EM M V S
+90
+60
+30
0
-30
-60
-90
180 150 120 90 60 30 0 330 300 270 240 210 180
0 10 20 30 40 50 60 70
Light bending in microarcsec

The Gaia Sphere



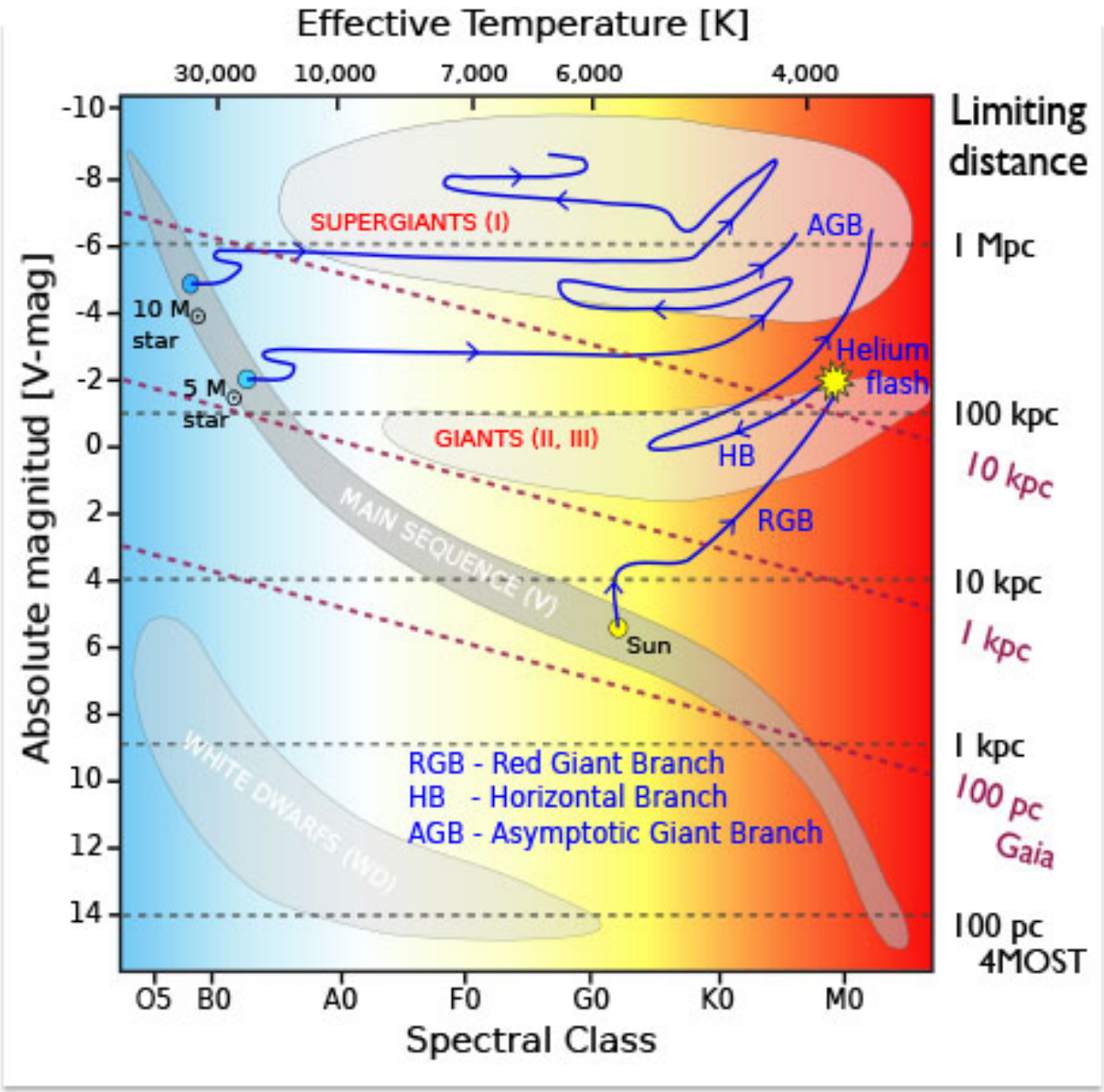
Gaia Schedule

- 19 December 2013: Launch date
- May 2014: Begin of regular measurements
- Science Alerts
- Launch+22 months: (α, δ) positions only, G magnitudes, proper motion for 100 000 stars common with Hipparcos. Release of Ecliptic Pole data.
- Launch+28 months: Five parameter solution for single stars. Integrated BP/RP photometry. Radial velocities for bright non-variable stars.

Gaia Schedule

- Launch+40 months: Five parameter solution for single stars + orbital solutions for binaries with appropriate periods. Object classification, BP/RP spectra + RVS spectra for well behaving objects.
- Launch+65 months: Additionally variable star classification, solar system objects, non-single star catalogue.
- Launch+7 or 8 years: Final catalogue.

Gaia needs spectroscopic follow-up!



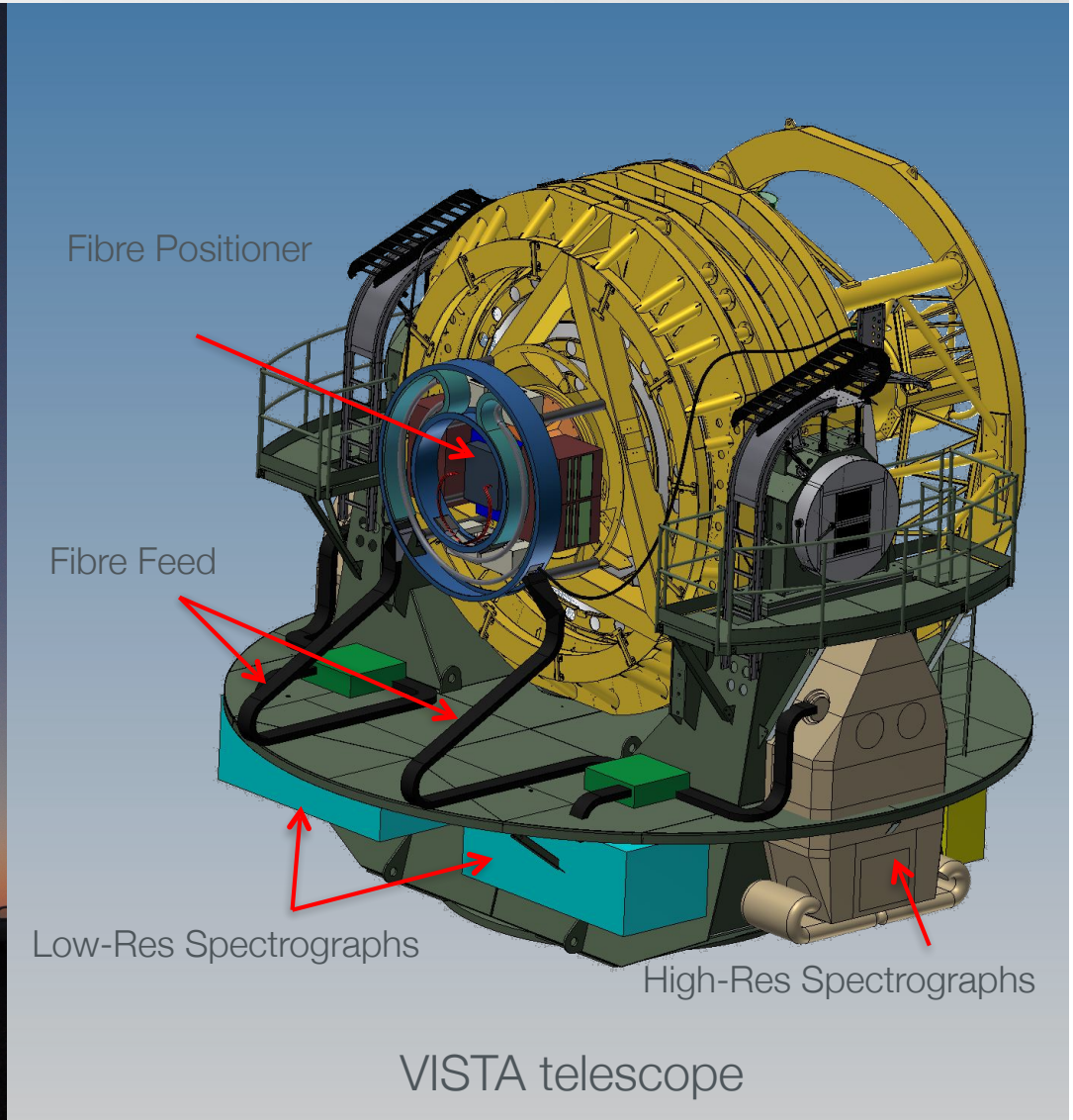
4MOST extents the Gaia volume by 1000x in the red and 1 million in the blue!

Cover the bulge/halo interaction and the Magellanic Clouds

4MOST – 4m Multi-Object Spectroscopic Telescope

Roelof de Jong (AIP)
4MOST PI

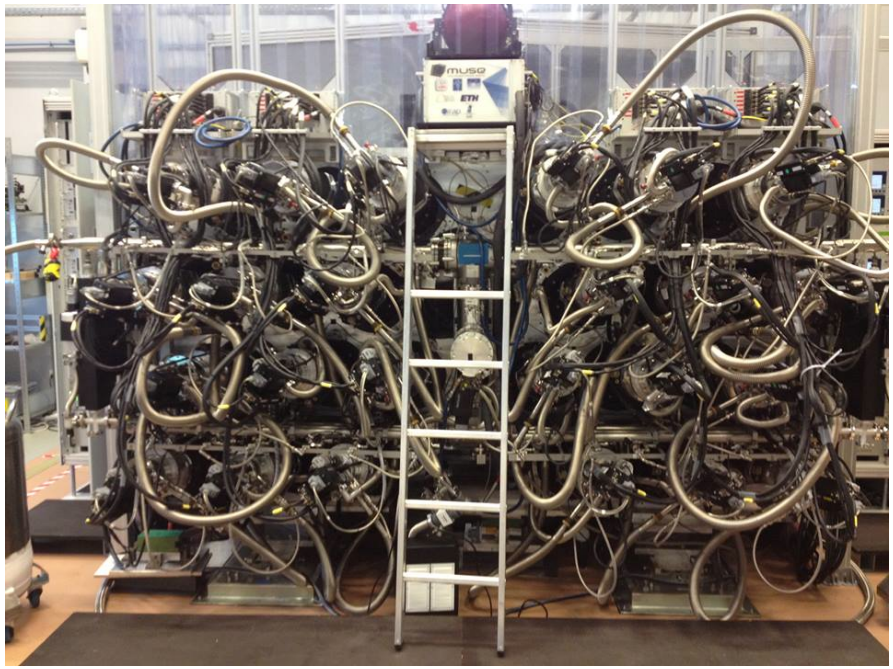
www.4most.eu



Instrument Specification

Specification	Concept Design value
Field-of-View (hexagon)	>4.0 degree
Multiplex fiber positioner	~2400
Medium Resolution Spectrographs # Fibres Passband Velocity accuracy	R~5000-8000 1600 fibres 390-930 nm < 2 km/s
High Resolution Spectrograph # Fibres Passband Velocity accuracy	R~20,000 800 fibres 395-456.5 & 587-673 nm < 1 km/s
# of fibers in ⌀=2' circle	>3
Area (5 year survey)	>2h x 16,000 deg
Number of 20 min science spectra (5 year)	~100 million

MUSE@VLT: Near Field meets Far Field



- λ: 465nm-960nm
- R: 3600@960nm
- FoV: 60"×60"
- Sampling: 0.2"×0.2“
- throughput: 35% (including telescope)
- First Light: 31.1.2014
- Commissioning I: 7.2.-22.2.2014
- Available: 1.10.2014
- near field: crowded field spectroscopy

Summary

- We have exquisite data sets for near field cosmology (CGS, RAVE, SEGUE, APOGEE), many are public
- How to compare advanced (simulation) models to data? we are already data rich and model poor!
- Gaia will change the landscape, in particular with additional follow-up (e.g. 4MOST)
- integral field brings far and near closer together (e.g. MUSE, VIRUS/HETDEX)