Gaia for spectro surveys
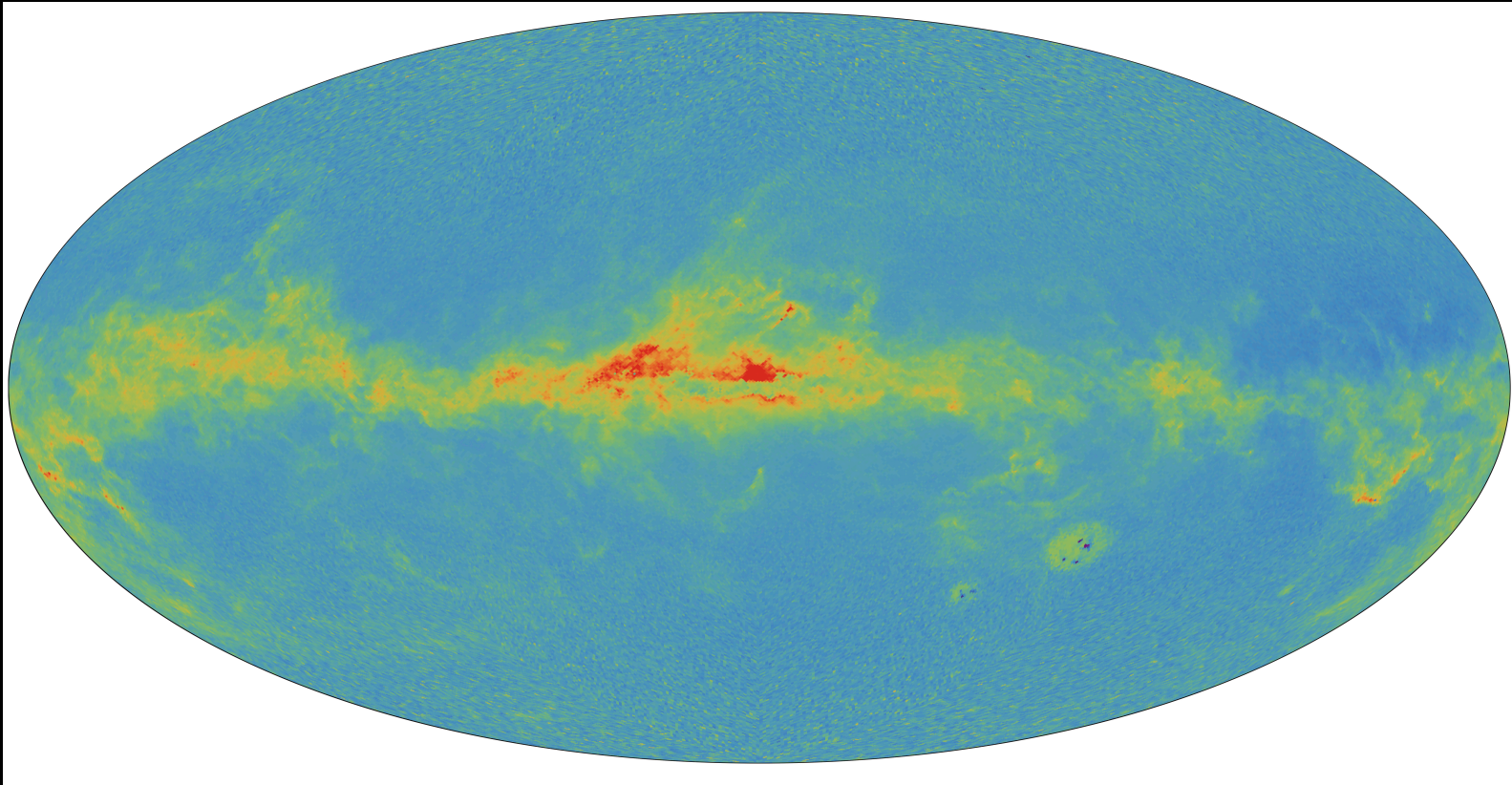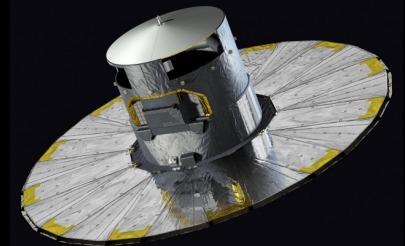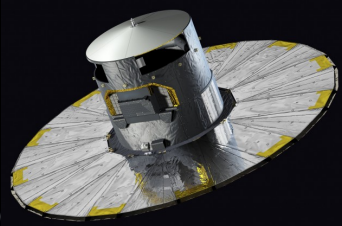

by Elena Pancino
INAF – Osservatorio Astrofisico di Arcetri
Space Science Data Center – ASI
(Gaia image credits: ESA and the Gaia DPAC)
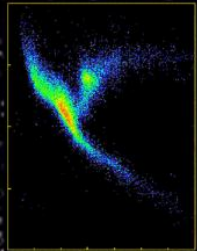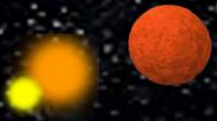
Science goals

Stellar Astrophysics

gaia
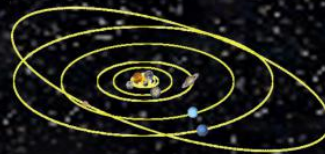
Star Formation History of the Milky Way

Galactic Structure

Binaries and Brown Dwarfs

Fundamental Physics

Extrasolar Planets

Solar System

Reference Frame

ESA astrometric mission

- Launch Dec 2013
- All Sky scanning
- 5yrs of operation
  - Plus extensions
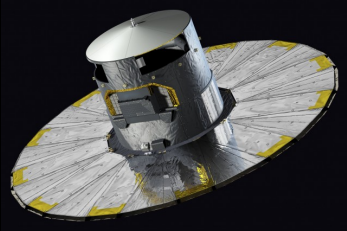- $2 \cdot 10^9$ point-like objs

Stellar kinematics

- 3D positions
  - w/ distances
- 3D motions
  - w/ l-o-s velocity

Focus on Milky Way

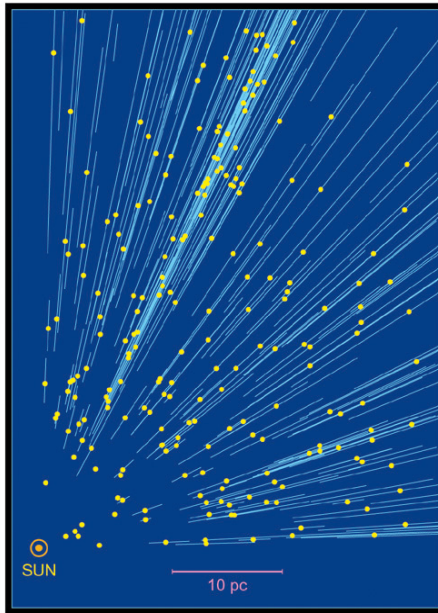- Fundamental physics
- Distance ladder
- Wide range of science

Astrometry

>100 x deeper, >1000 x accurate, >10000 x populated than Hipparcos
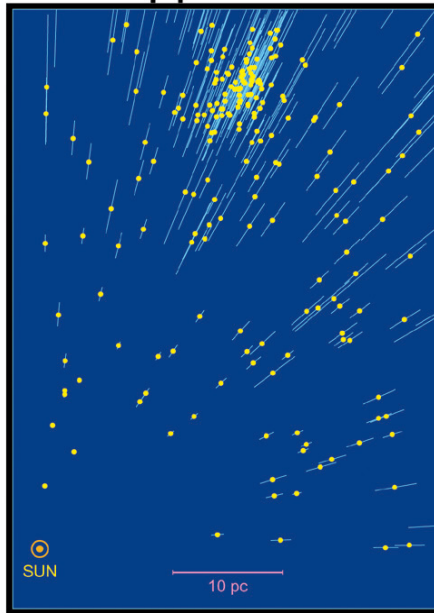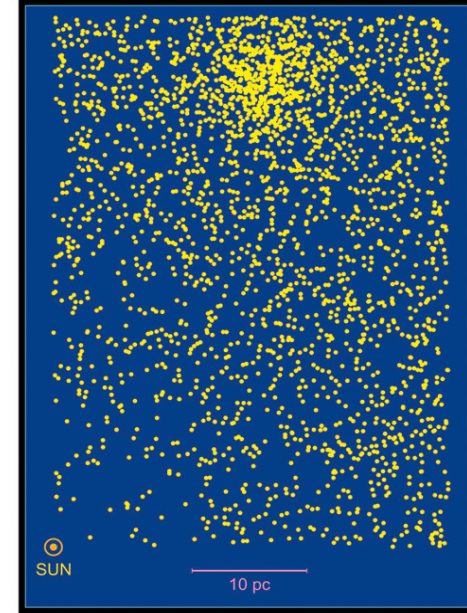absolute astrometry and reference frame redefinition

Hyades
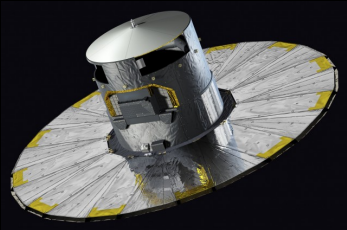

Ground
errors ≈ a few mas

Hipparcos
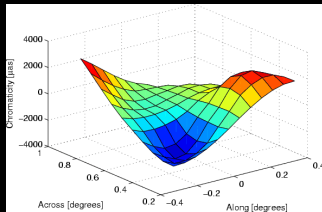errors ≈ 0.6-1 mas
V<12 mag

Gaia
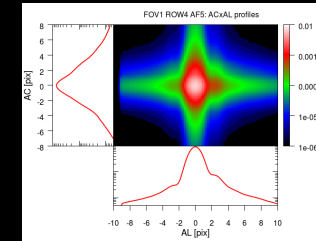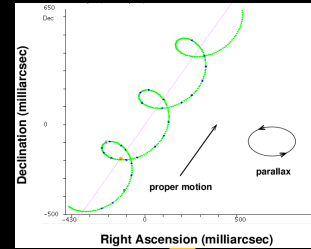errors ≈ 5 μas – 0.6 mas
V<20 mag

Much more than 6D

To correct for chromaticity

To sample full 6D phase space

Colors from dispersed images

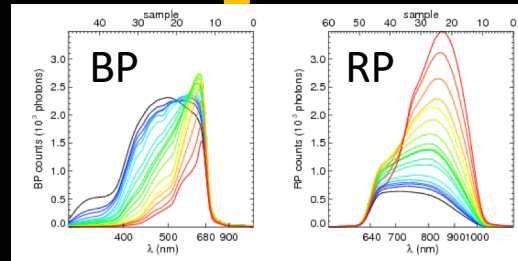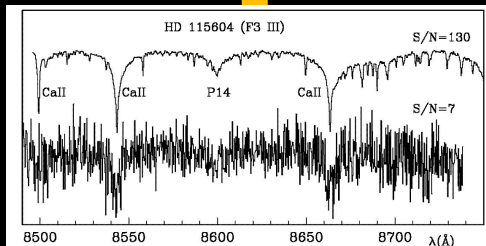To break parallax-p.m. degeneracy

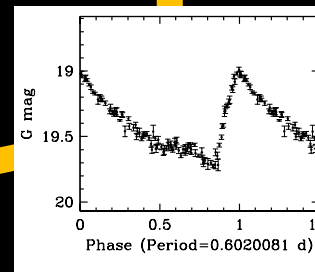To catch as many stars as possible

Line-of-sight velocity

Time coverage (5yrs – 70 times)

Pick up all point-like sources:
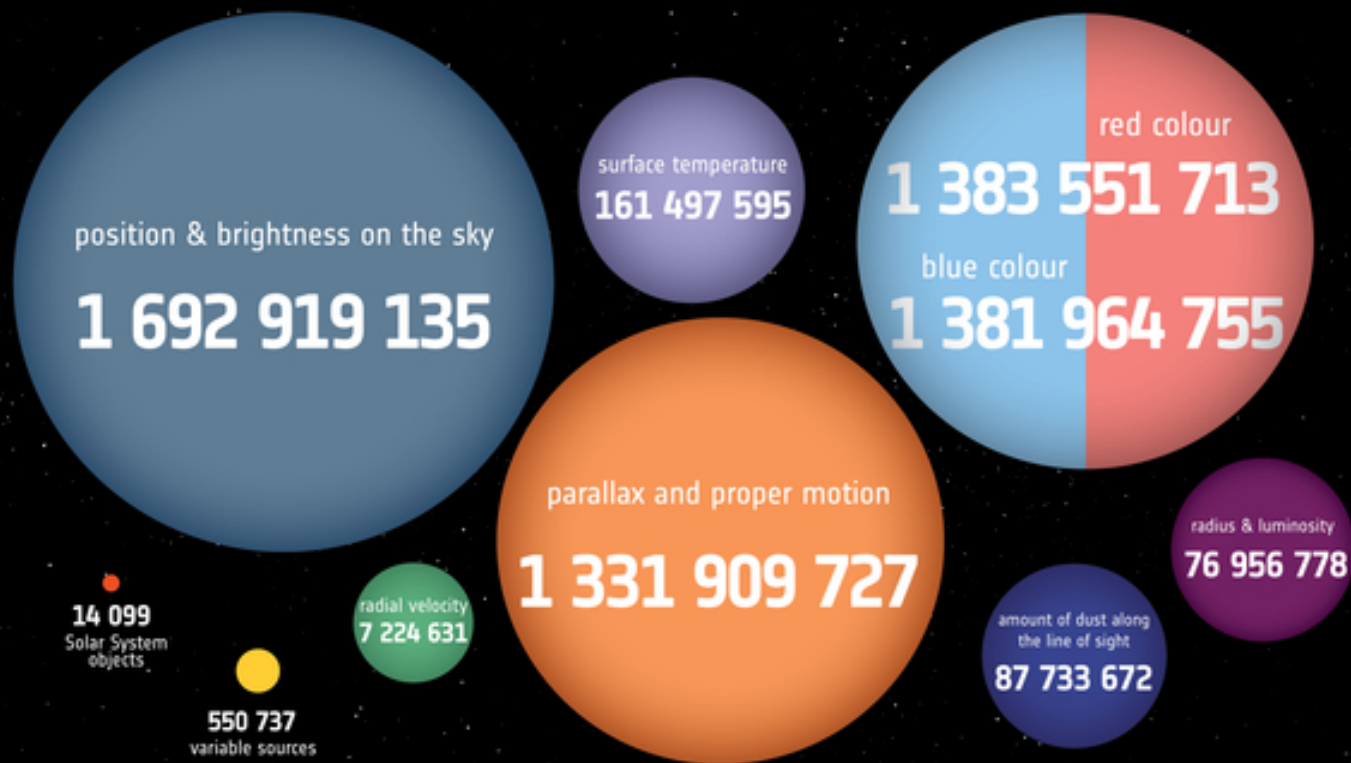- Quasars
- Galaxies
- Asteroids

Astrophysical Parameters

The 2ⁿᵈ data release

>1 paper/day since 2016!

position & brightness on the sky
1 692 919 135

surface temperature
161 497 595

red colour
1 383 551 713

blue colour
1 381 964 755

parallax and proper motion
1 331 909 727

14 099 Solar System objects

radial velocity
7 224 631

550 737 variable sources

amount of dust along the line of sight
87 733 672
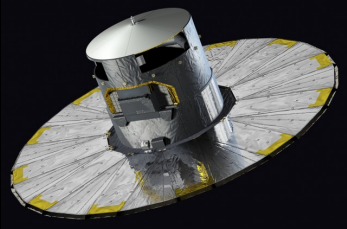
radius & luminosity
76 956 778

DR1 in Sep 2016
DR2 in April 2018
- Two years of data
- Preliminary release
- Many loops open
- Many new items

New items in DR2
- Gaia-only astrometry
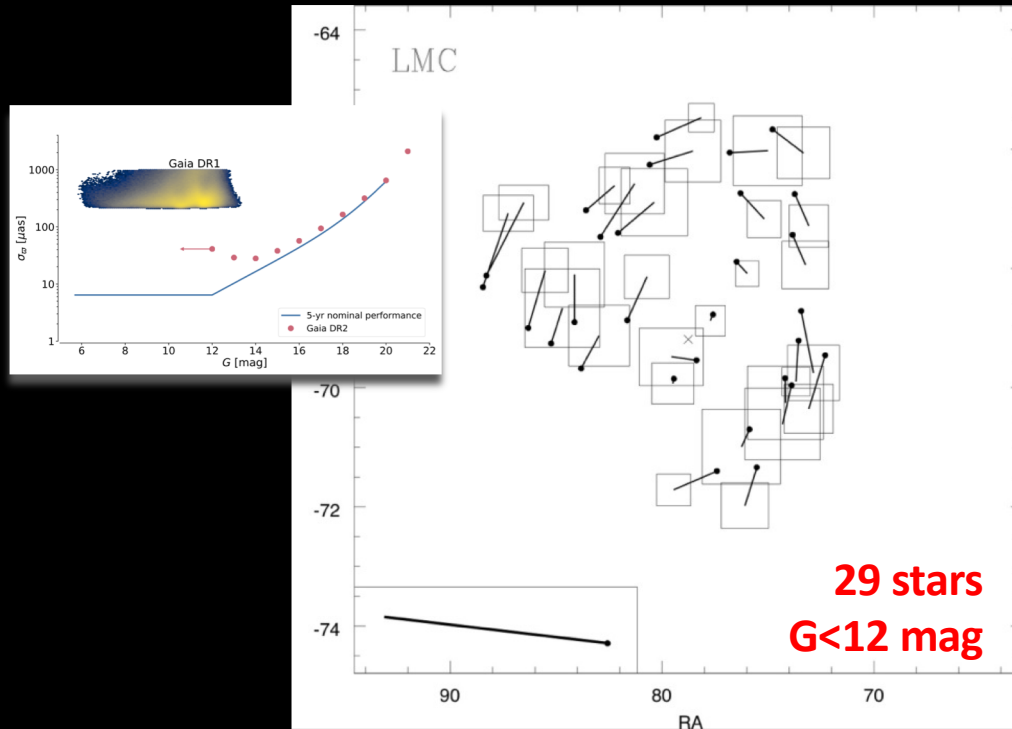- Colors
- LOS velocities
- Asteroids
- Astrophysical Parameters

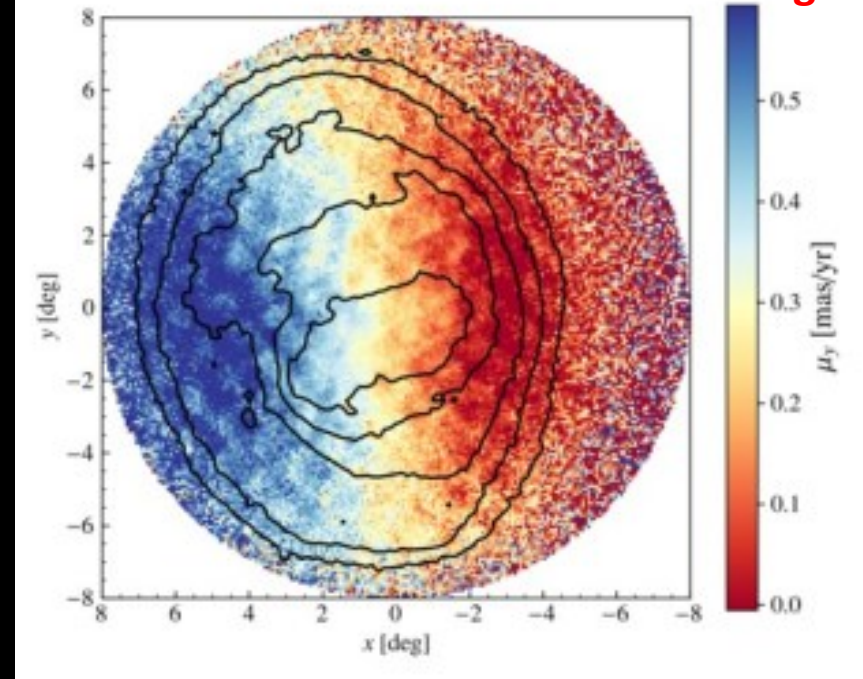*Elena Pancino – Revolution in stellar physics – Warsaw 2018*

Astrometry - LMC

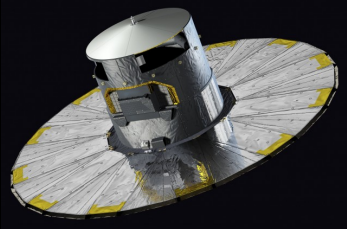**DR1 – TGAS proper motions**

29 stars
G<12 mag

Van der Marel + 2016

DR2 – Gaia proper motions
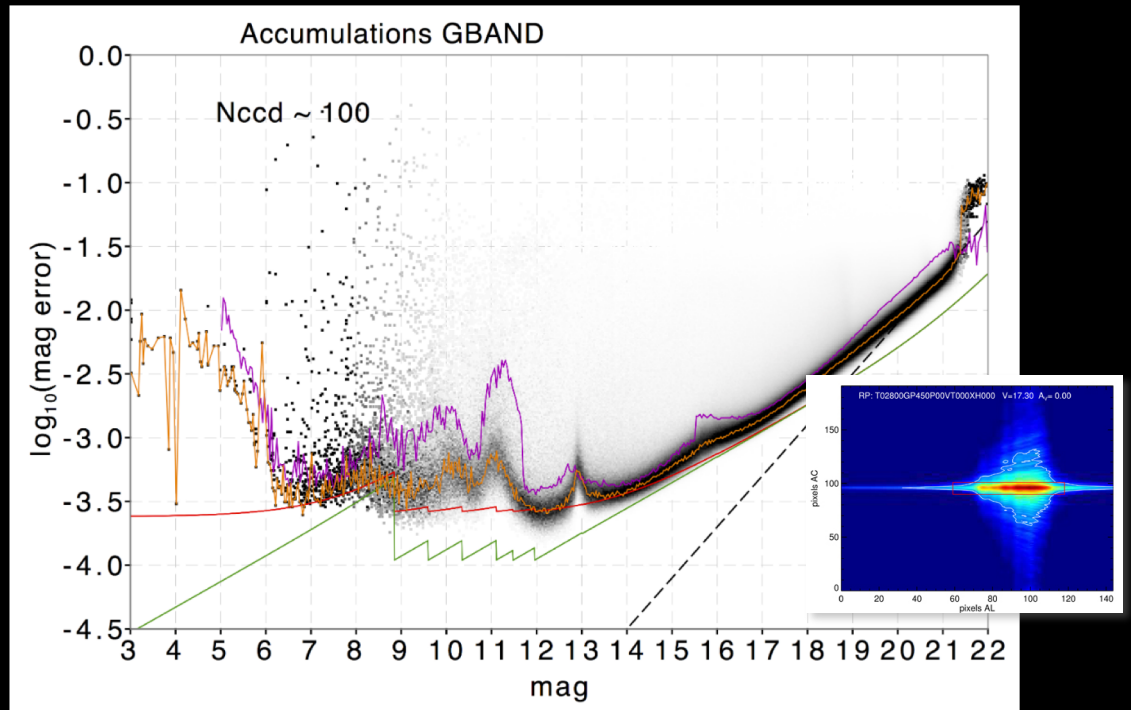
more than 8 million stars – G<20.7 mag

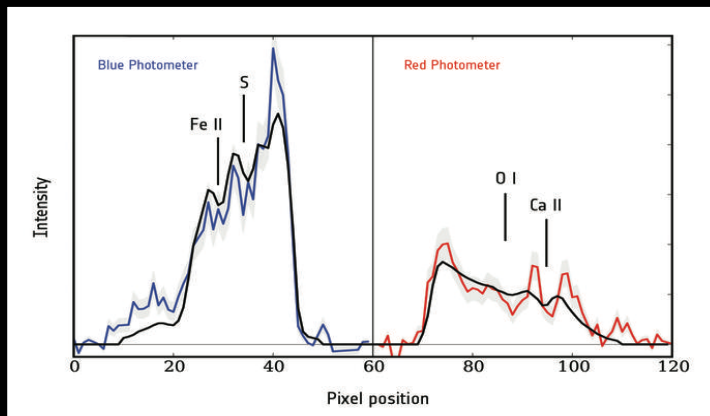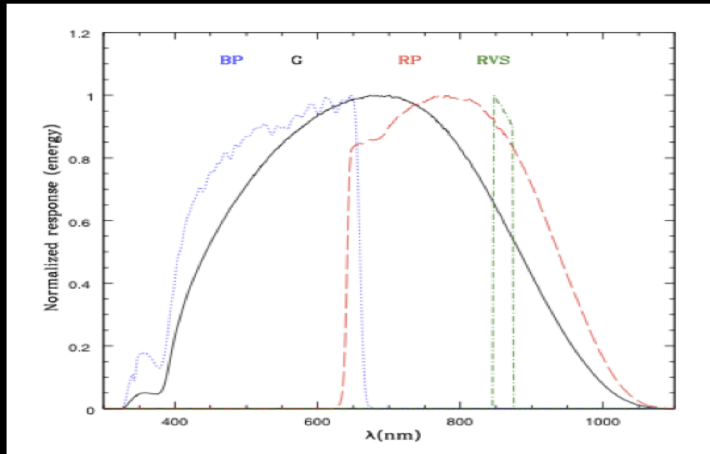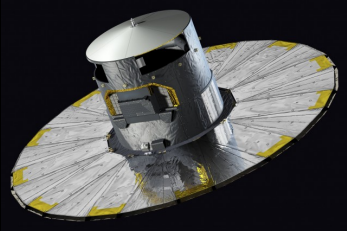*Gaia collaboration, Helmi + 2018*

BP/RP spectroscopy

G-band from white light (astrometry) – G<20.7mag

BP/RP integrated magnitudes from R≈100 spectra

Calibrated on Vega with standards by Pancino+2012

Evans + 2018

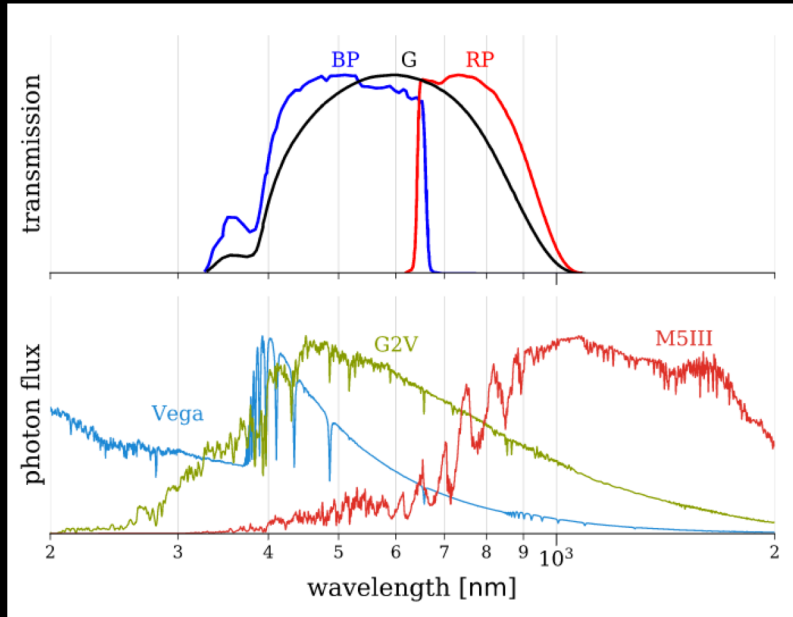# Parameters

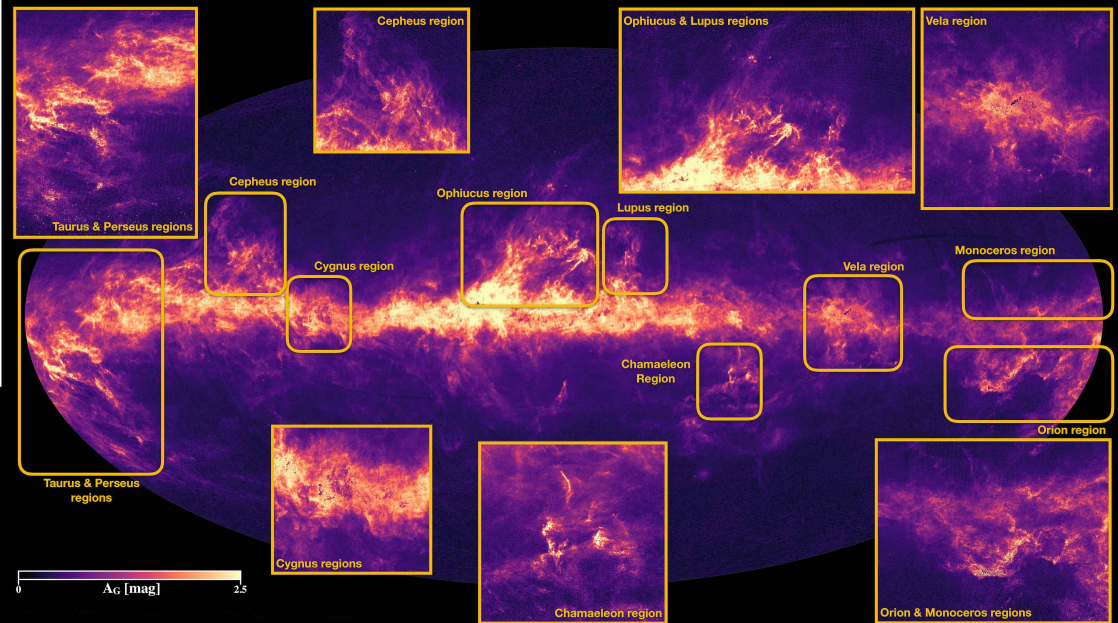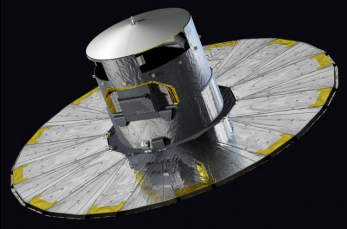
With G, G_{BP}, and G_{RP} plus parallax and a BC
T_{eff} (161 10^6 stars) and A_G (80 10^6 stars)
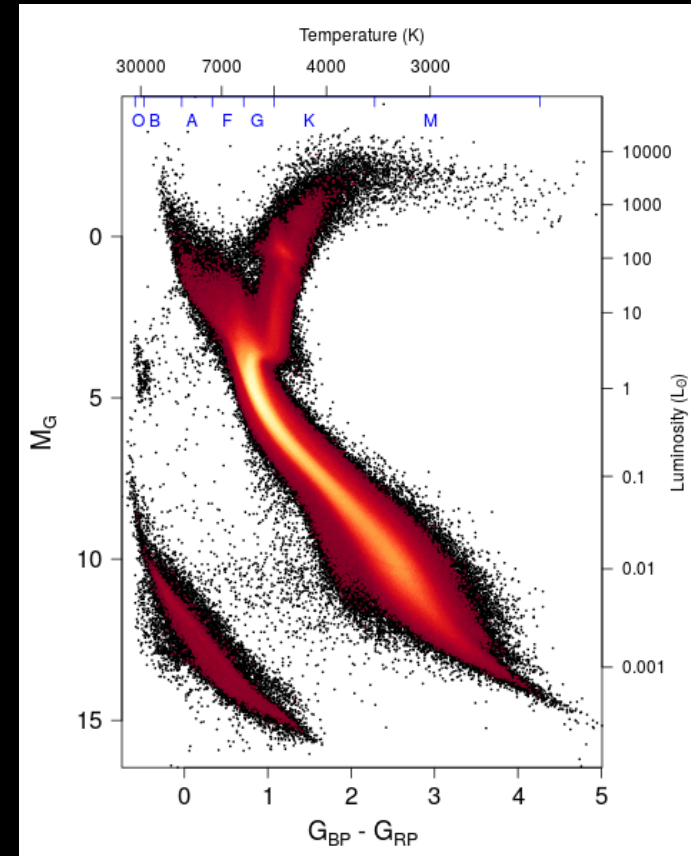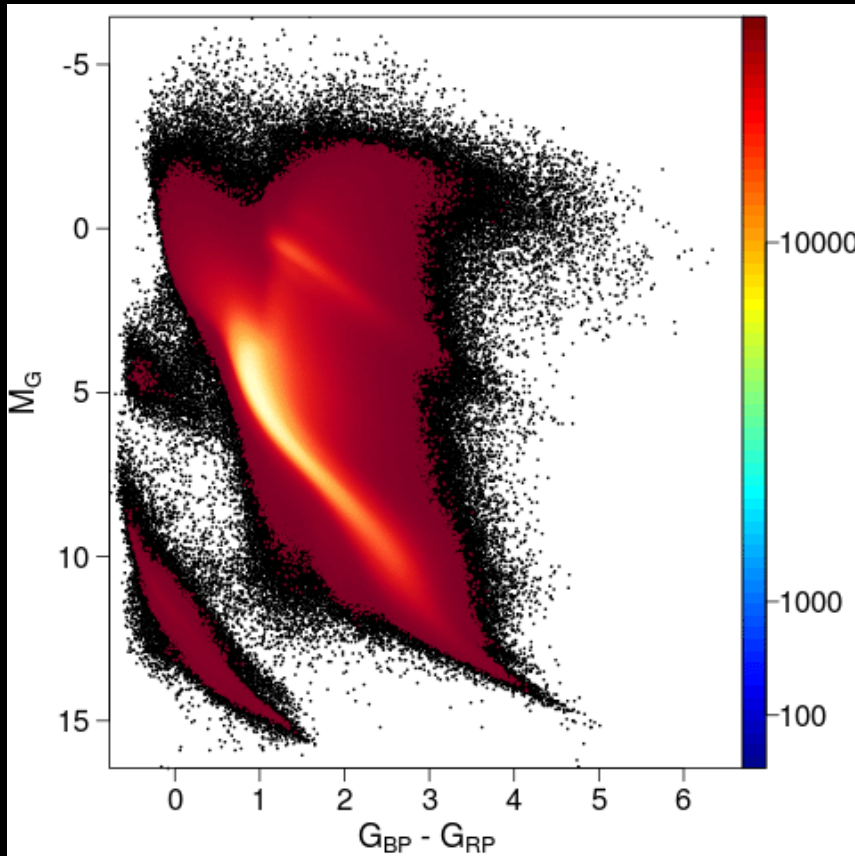Together with radius and luminosity estimates

Uncertainties:
T_{eff} 324 K
A_G 0.46 mag, E(BP-RP) 0.23 mag
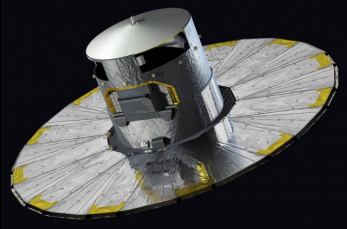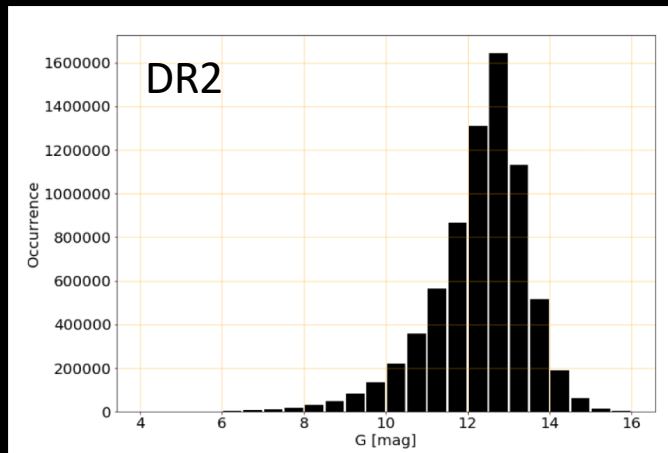luminosity 15%, radius 10%

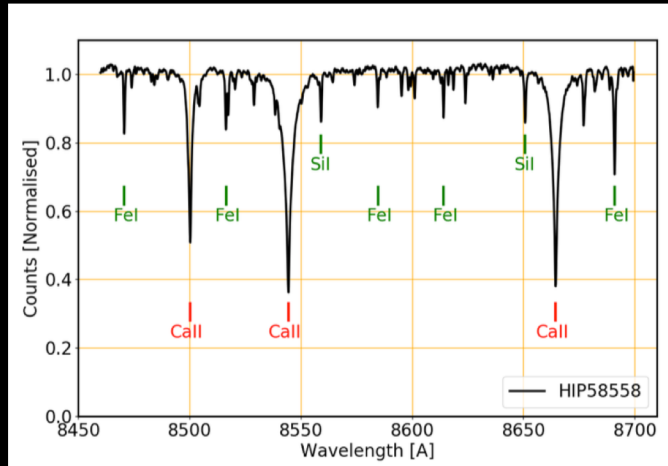Andrae + 2018

H-R diagram

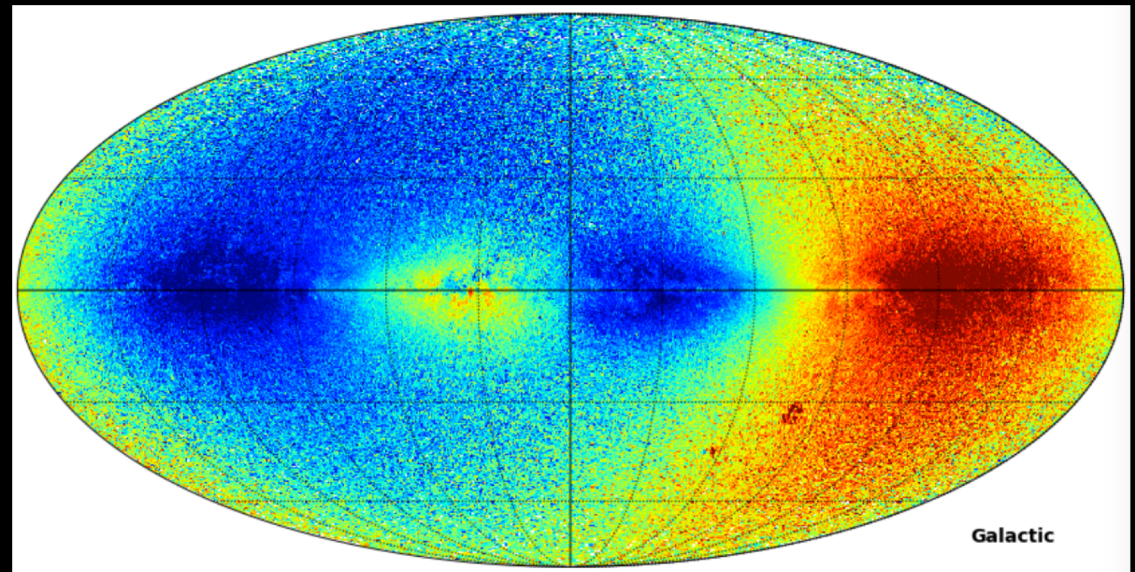
Gaia collaboration, Babusiaux + 2018
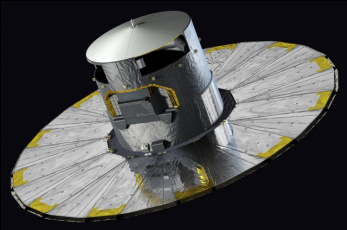
Line-of-sight velocity

Wavelength range 847-874 nm (Ca triplet)
R=11500 – V<13 mag – 7 million stars in DR2
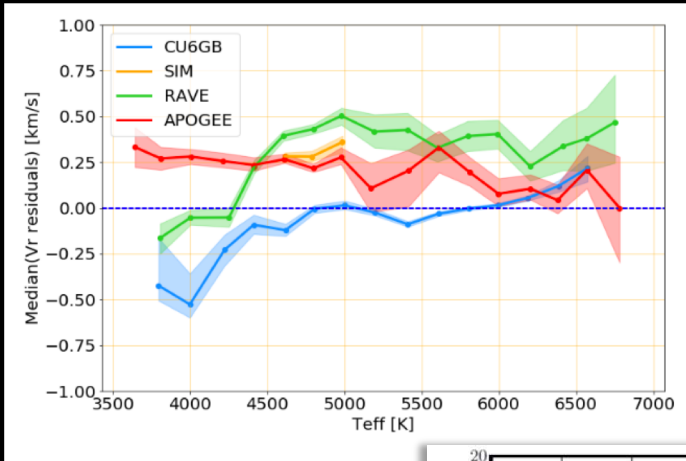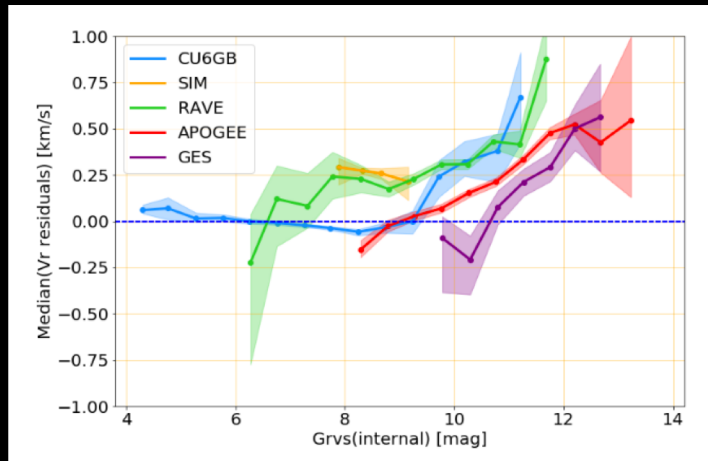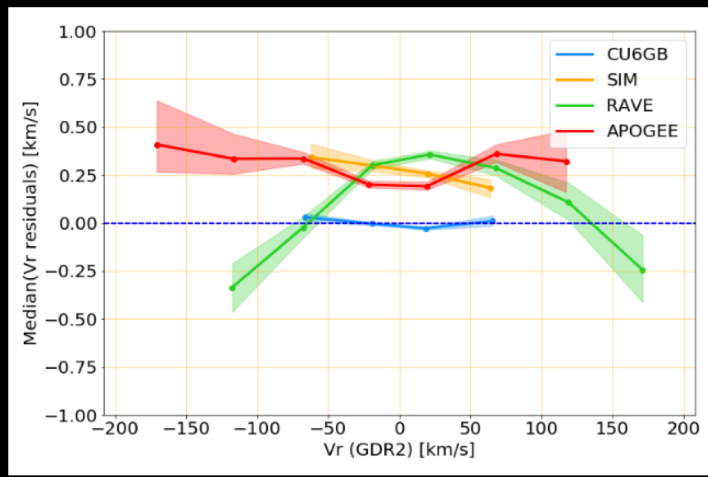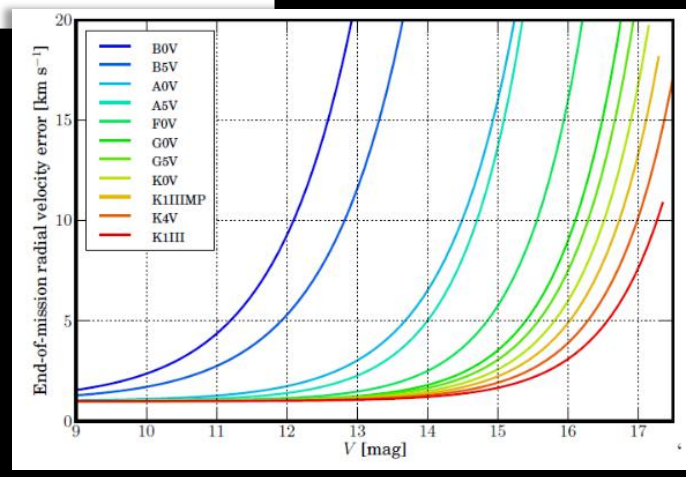Calibrated with RV standards by Soubiran+2013

Katz+2018

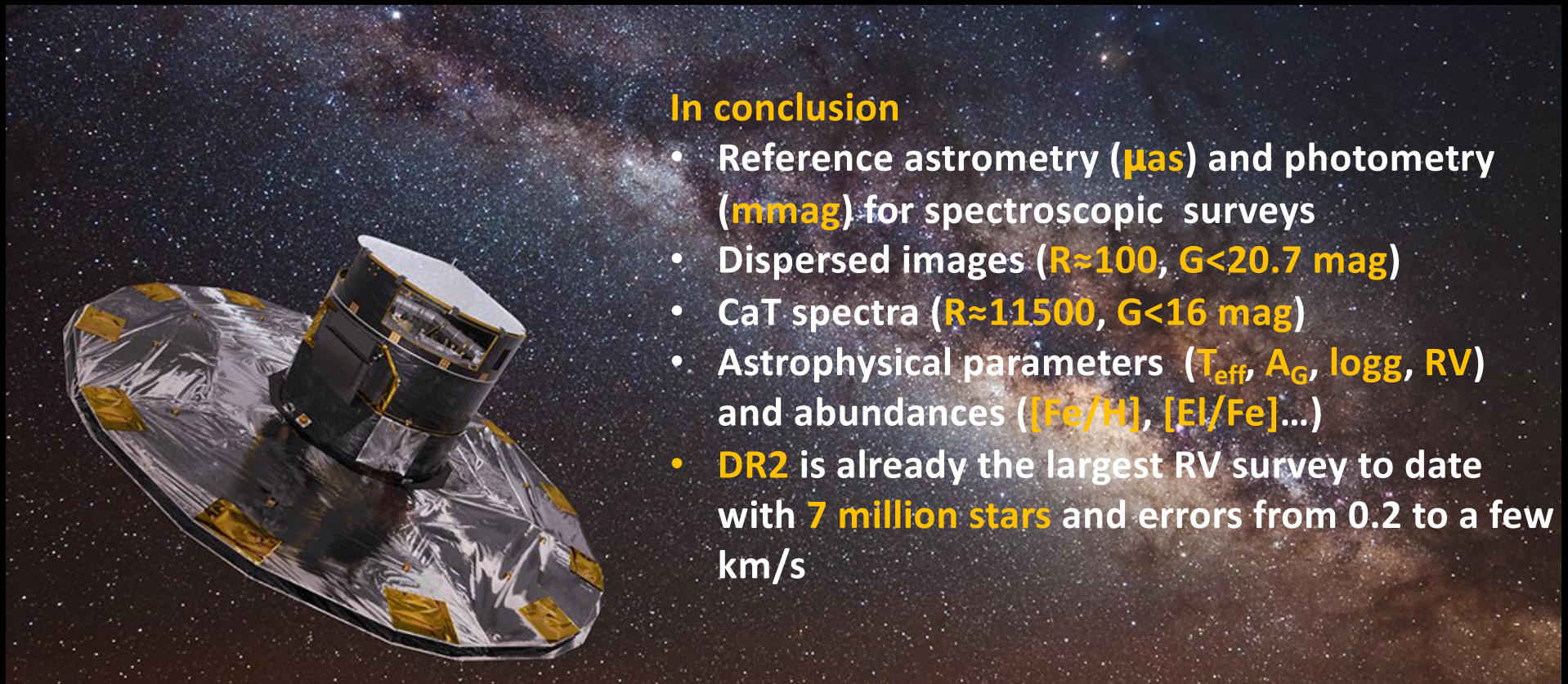# Line-of-sight velocity

Expected performances (end-of-mission)

Katz+2018
on DR2 RVs

Thank you !

In conclusion

- **Reference astrometry (μas) and photometry (mmag) for spectroscopic surveys**
- **Dispersed images (R≈100, G<20.7 mag)**
- **CaT spectra (R≈11500, G<16 mag)**
- **Astrophysical parameters (T_{eff}, A_G, logg, RV) and abundances ([Fe/H], [El/Fe]…)**
- **DR2 is already the largest RV survey to date with 7 million stars and errors from 0.2 to a few km/s**

Elena Pancino – Revolution in stellar physics – Warsaw 2018