

*Multiobject spectroscopy  
as a complement for Gaia*

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(Observatoire de la Cote d'Azur, Nice)*

# Outcome of a workshop gathering the French community involved in Galactic Archeology and stellar physics (founded by the AS Gaia)

<http://www.oca.eu/rousset/GaiaSpectro/>

**Spectroscopie multi-objets en complément à Gaia**

**ATELIER les 19 et 20 février 2009, Nice.**

[Contexte](#)

[Venue](#)

[SOC](#)

[LOC](#)

[Programme et présentations](#)

[Participants](#)

[Inscriptions](#)

## SOC

- Misha Haywood (GEPI, Paris)
- Vanessa Hill (Observatoire de la Côte d'Azur, Nice)
- Christophe Martayan (Bruxelles)
- Alejandra Recio-Blanco (Observatoire de la Côte d'Azur, Nice)
- Frédéric Royer (GEPI, Paris)
- Arnaud Siebert (Observatoire de Strasbourg)
- Caroline Soubiran (Observatoire de Bordeaux)



Observatoire  
de la CÔTE d'AZUR



**LOC: Vanessa Hill, A. Recio-Blanco, S. Rousset**

**Conclusions presented at the «ESO Spectroscopic workshop» 9-10 March 2009**

**<http://www.eso.org/sci/meetings/ssw2009/program.html>**

# BRIEF SUMMARY OF GAIA PERFORMANCES

c.f. D. Katz talk

Sky-average standard errors for **GOV stars** (single stars, no extinction)

Distance	<0.4	0.63	1.0	1.6	2.5	4.0	6.3	10	kpc
V magnitude	6 - 13	14	15	16	17	18	19	20	mag
Parallax	8	13	21	34	55	90	155	275	$\mu$ as
Proper motion	5	7	11	18	30	50	80	145	$\mu$ as/yr
Position @2015	6	10	16	25	40	70	115	205	$\mu$ as
Transversal velocity	<0.01	0.02	0.07	0,15	0,4	1	3	7.5	km/s
Radial velocity	< 1	2.0	6.0	14.0	-	-	-	-	km/s

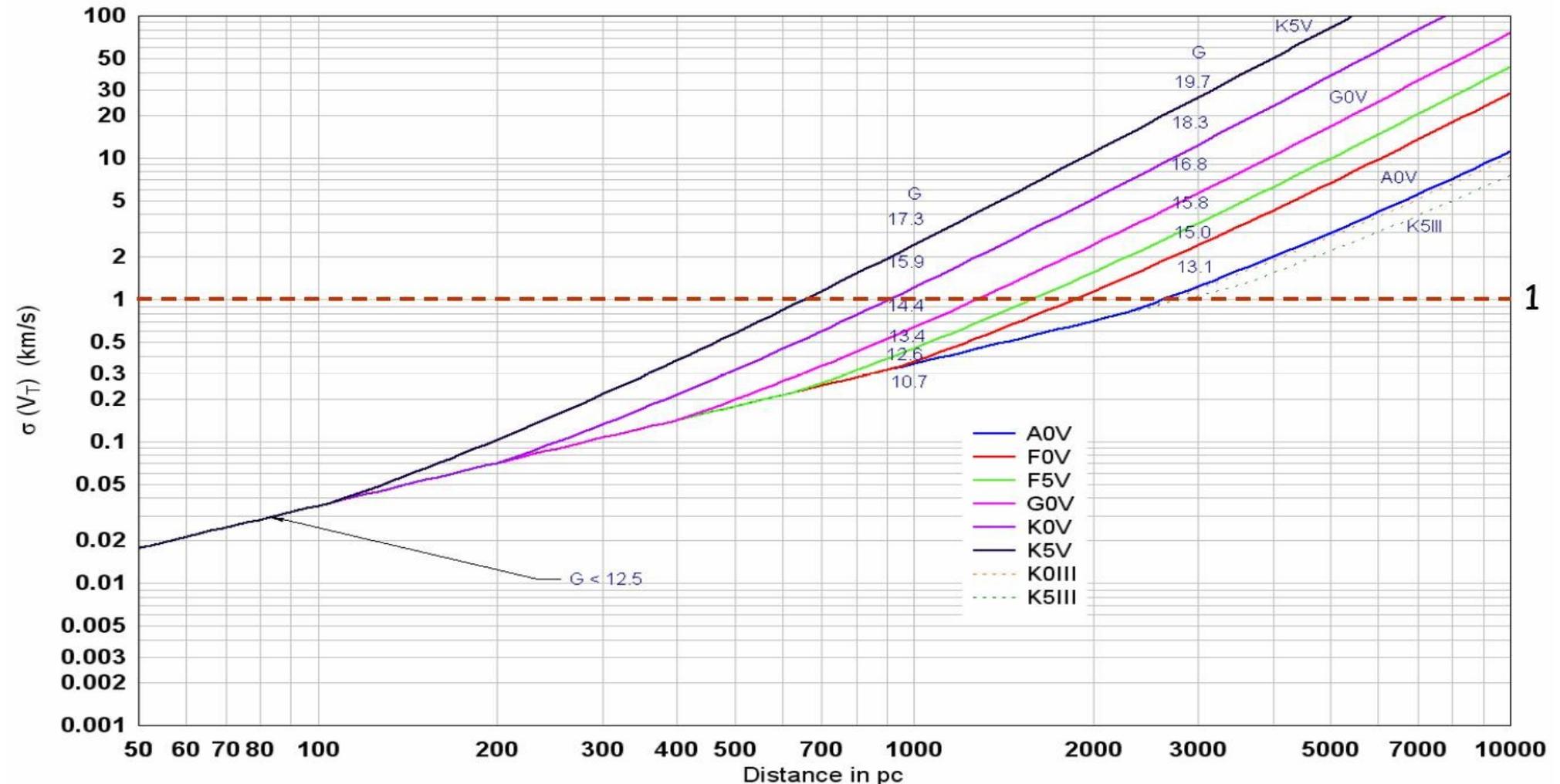
Atmospheric parameters,  $A_v$ , chemical abundances from BPRP and RVS

# BRIEF SUMMARY OF GAIA PERFORMANCES

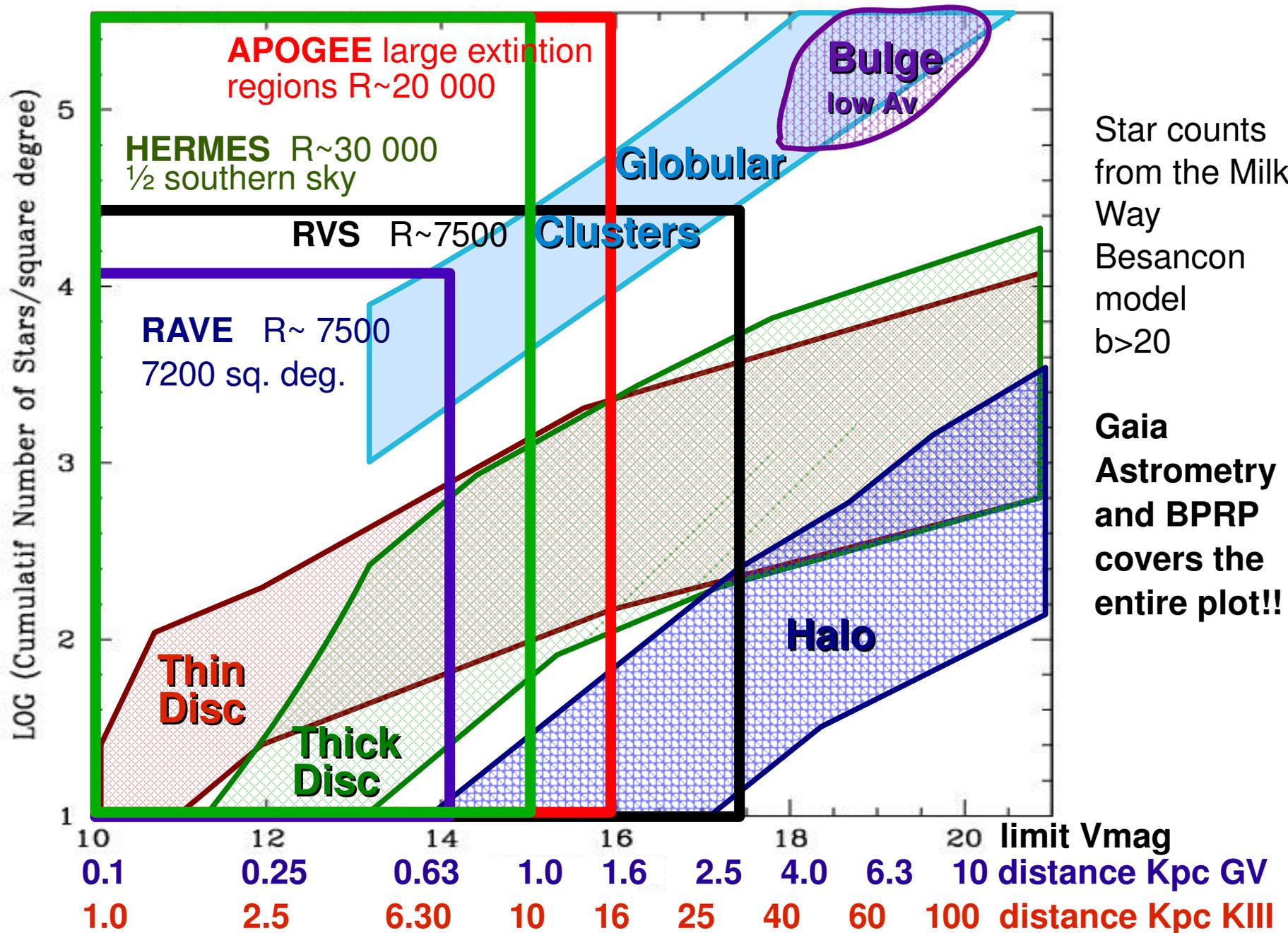
c.f. D. Katz talk

The lack of precise  $V_{rad}$  for stars with good transversal velocity is even worse for giants: for a KIII at  $V=18$  (40kpc),  $\sigma(V_T) \sim 10\text{km/s}$  but NO  $V_{rad}$ !

**Accuracy in Transverse Velocity**



# MILKY WAY SURVEYS PICTURE



Star counts from the Milky Way Besancon model  $b > 20$

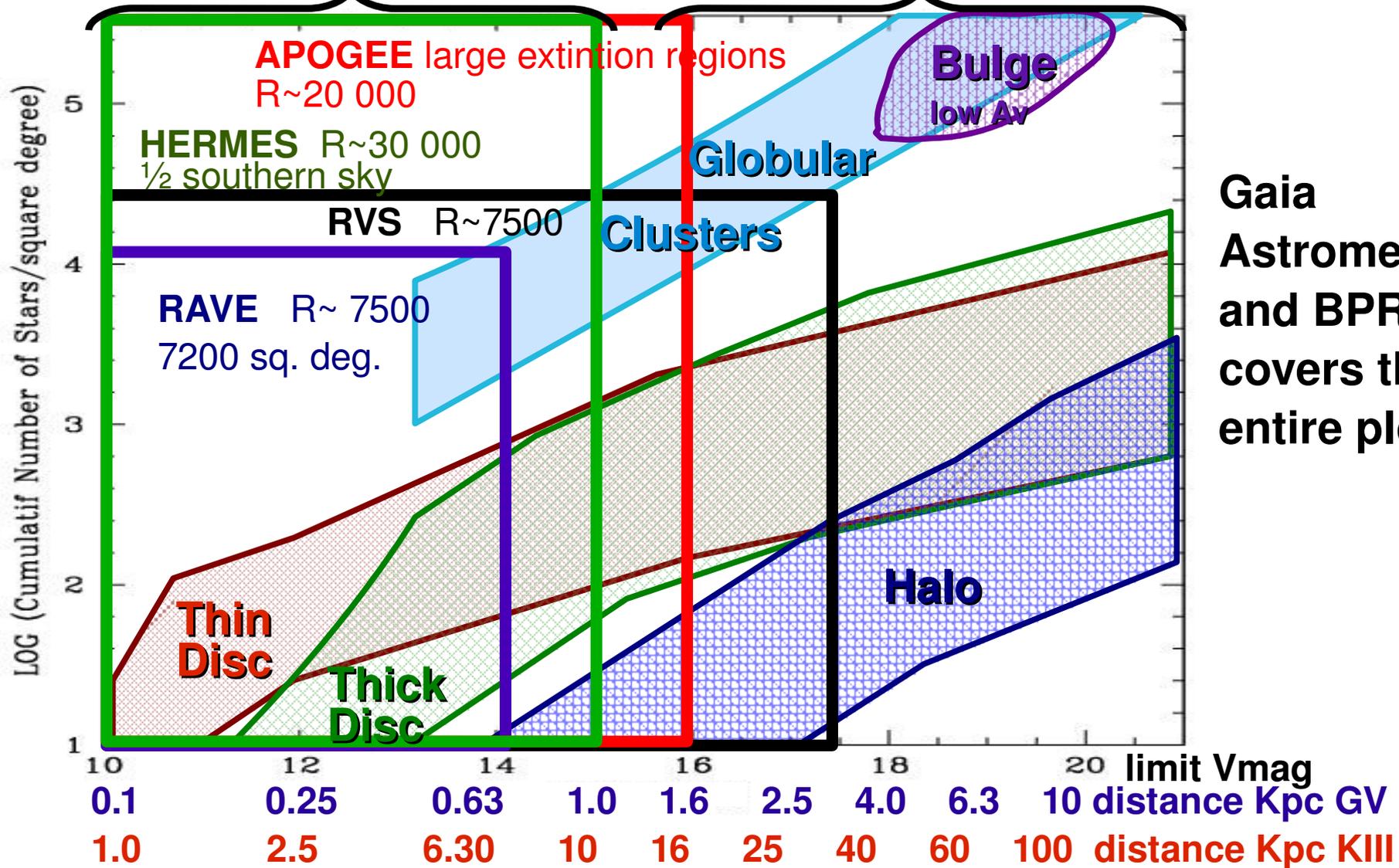
**Gaia Astrometry and BPRP covers the entire plot!!**

# MILKY WAY SURVEYS PICTURE

## What it lacks...

HR survey IN THE NORTH  
for  $V \lesssim 16$ , Gaia stars with geometric  
distances and good kinematics

HR and LR resolution  
surveys for faint sources



# SCIENCE CASES

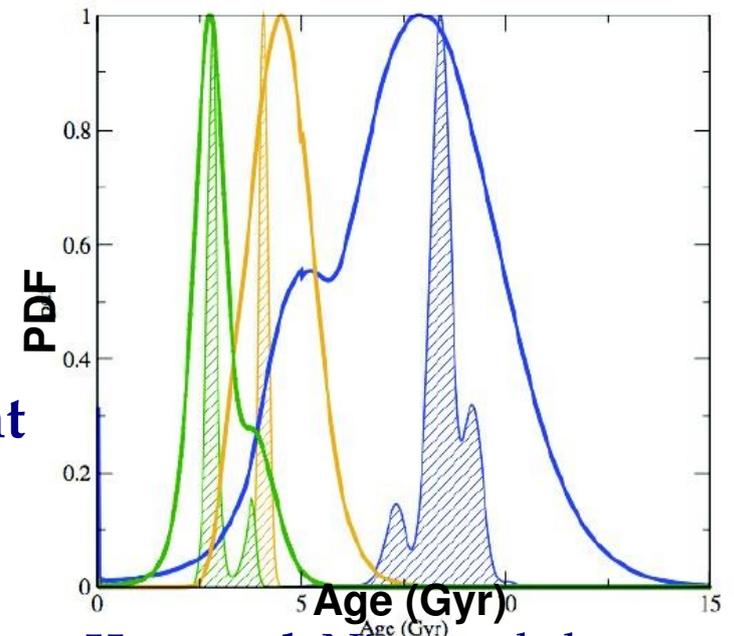
## THIN DISC

- Disc evolution constraints... as a function of stellar AGES!
  - SFR over several Kpc (inside-out scenario)
  - Chemical abundances - age dependence (infall evolution)

Improve Gaia stellar ages with better atmospheric parameters  $V > 16$

- Chemical abundance gradients:  
radial mixing?
- Cinematic groups and thin disc structure:  
chemical tagging

Improve Gaia chemical abundances for faint stars.

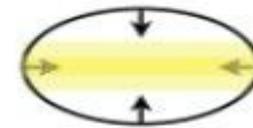
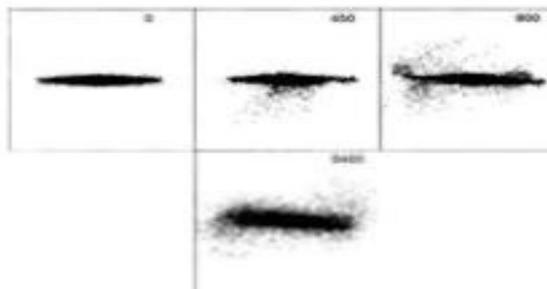
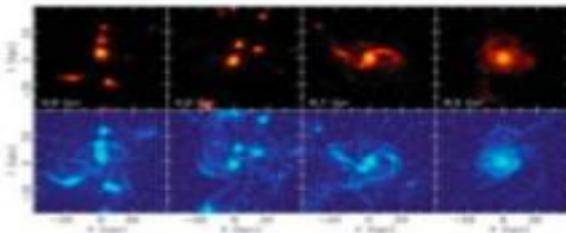
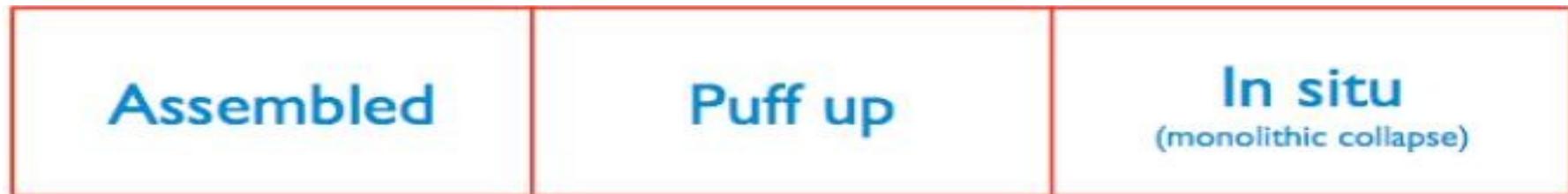


Haywood, Nice workshop  
Exemples pour une F6, G2IV, G2V  
 $\sigma_{\pi}/\pi=10\%$  ,  $[\text{Fe}/\text{H}]$  à 0.1 dex,  $T_{\text{eff}}$  à 2-3% ( $\approx 150\text{K}$ )

# SCIENCE CASES

## THICK DISC

- Characterization far from the solar neighbourhood
    - Radial and vertical chemical and velocity gradient
    - scale-height variation with Galactocentric distance
  - Detection of accretion events, inhomogeneities
  - Chemical evolution with age constraints
- Complement of Gaia Vrad and chemical abundances for faint stars



Brook et al. 2005 ApJ 630 298

Quinn et al. 1993 ApJ 403 74

Eggen et al. 1962 ApJ 136 748

Taken from Soubiran (Nice workshop)

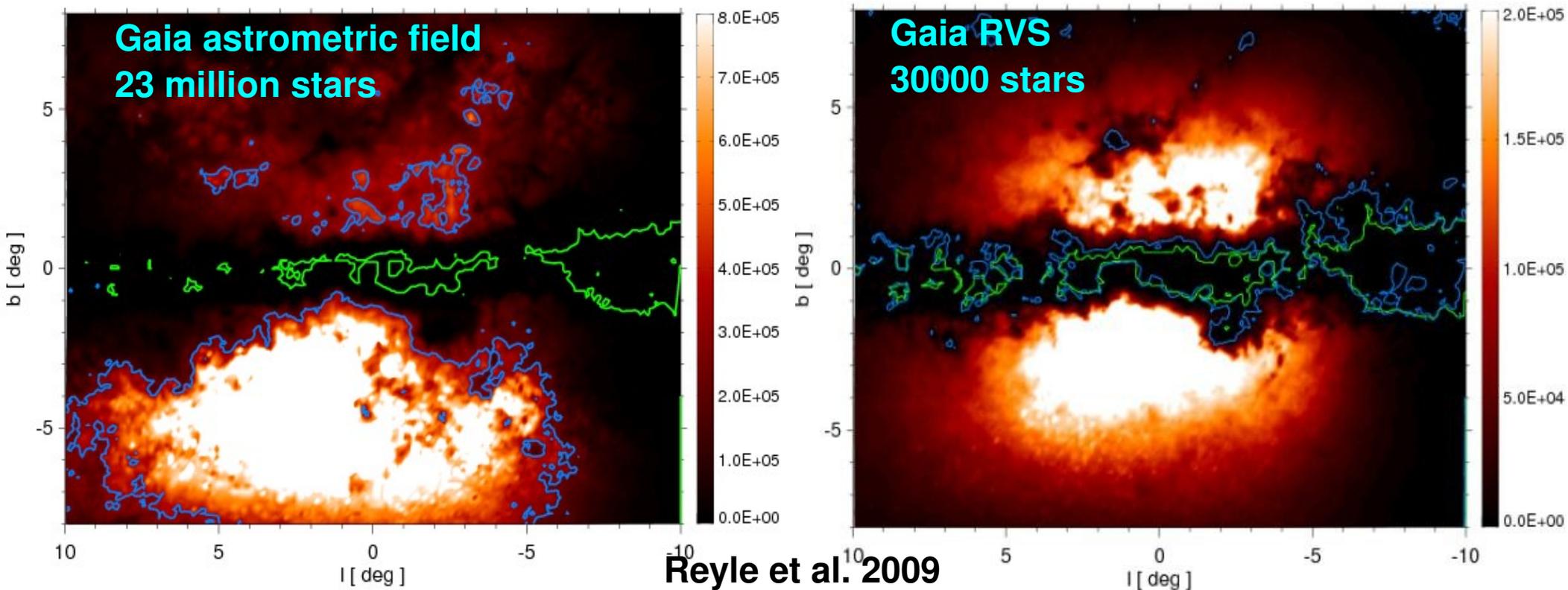
Burkert et al. 1992 ApJ 391 651

# SCIENCE CASES

## BULGE (Infra-red)

- Formation scenario: bulge vs. pseudo-bulge
- Matter accretion traces
- Star formation history
- Impact on disc chemical evolution and dynamics

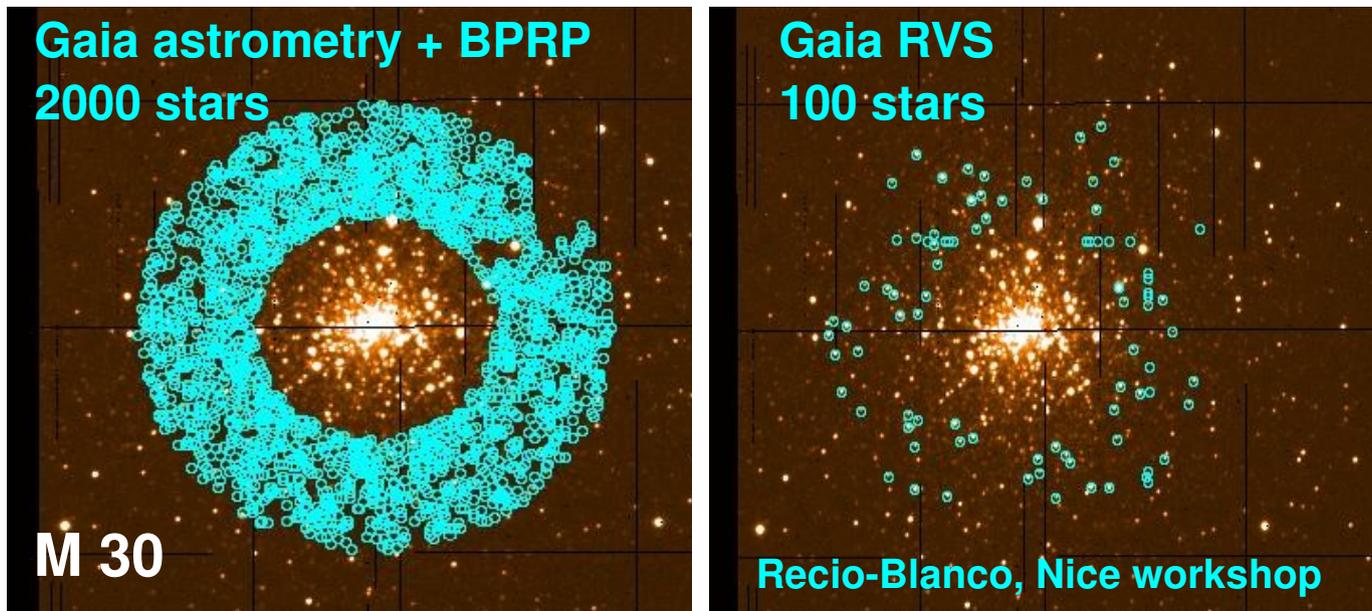
Complement of Gaia Vrad and chemical abundances for faint stars and larger (l,b) coverage



# SCIENCE CASES

## GLOBULAR CLUSTERS

- Internal dynamics: **Vrad complement to Gaia absolute proper motions**
- Multiple stellar populations identification vs. age, dynamics...
- Possible new GCs identified by Gaia: **chemical characterization**
- Galactic potential with tidal tails: **Vrad + abundances complement**



## HALO

M 30

- Fraction of accreted stars throughout the Halo
  - Field Halo – dwarfs galaxies comparison
- Chemical tagging and Vrad complement to Gaia, FOV ~ 1-2 deg<sup>2</sup>**

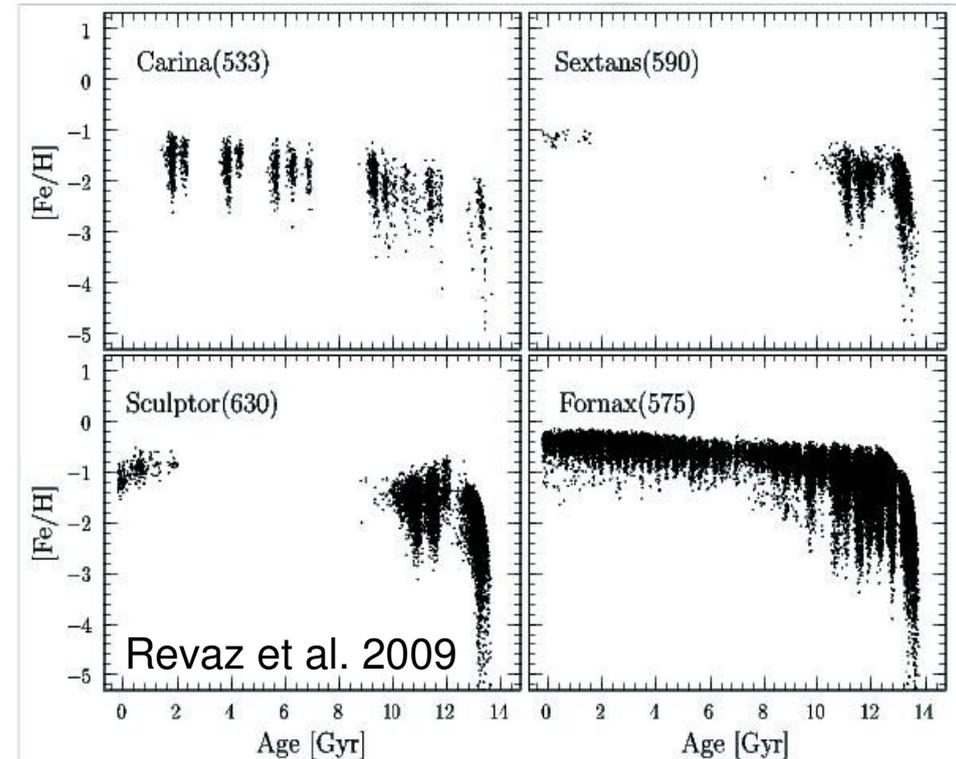
# SCIENCE CASES

## DWARF GALAXIES

- Kinematics and dark matter halos
- Nucleosynthesis conditions in external galaxies
- Precise tests to galaxy evolution scenarios

HR for chemical abundances

Vrad complement to Gaia

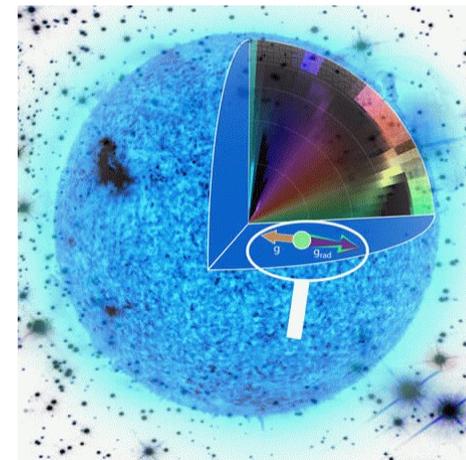


## STELLAR PHYSICS

- Non-standard mixing processes
- Nucleosynthesis
- Angular momentum evolution
- Clusters vs. field stellar evolution

Blue wavelength range for hot stars

HR complement for stellar rotation and chemical abundances



# CONCLUSIONS

**HIGH RESOLUTION :  $R=20000 - 40000$**

**FOV :  $0.25 \text{ deg}^2$  ok,  $1 \text{ deg}^2$  better (Halo)**

**MULTIPLEXITY : 250 fibers ok, 1000 better**

**WAVELENGTH RANGE : 3700 - 1200 (non-contiguous orders)  
>500Å in one single shot (the largest the better)**

**TARGET'S MAGNITUDE :**

★  $V < 16-17$  : HR complement for stars with good 3D Gaia kinematics

A HERMES-like survey in the north

★  $V > 16-17$  : Radial structure of the Disc, Halo substructure (selected follow up surveys with VLT in the Halo)

A VLT SUPER-GIRAFFE survey?



# CONCLUSIONS

**LOW RESOLUTION :  $R \sim 5000-10000$**

**FOV :  $0.25 \text{ deg}^2$  ok,  $1 \text{ deg}^2$  better (Halo)**

**MULTIPLEXITY : 250 fibers ok, 1000 better**

**WAVELENGTH RANGE : 3700 - 1200 (non-contiguous orders)  
>500Å in one single shot (the largest the better)**

**TARGET'S MAGNITUDE :**

★  $V > 16-17$  : Radial velocity complement to Gaia

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## Questions :

- Rôle of CFHT in a future survey
- Possible interest in the Bigboss survey? ( $R=2000-6000$ ,  $3400-9000\text{Å}$ )
- A possible VISTA survey ? GREAT meeting in Cambridge 8-9<sup>th</sup> July



Complementary  
Galactic Archaeology  
surveys