The Gaia-ESO survey: Galactic Astrophysics via VISTA Imaging, Gaia Astrometry, and Eso SpectrOscopy

Gerry Gilmore

the steering group

the team

1 The Gaia-ESO survey: Galactic Astrophysics via VISTA Imaging, Gaia Astrometry, and Eso SpectrOscopy

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Gaia-ESO survey: strengths

- Focuses on key ESA-ESO-AstroNet science
- Focuses on key ESO facilities
- Includes a very broad and strong ESO community
- Has a plausible mix of proven leaders, strong research groups/places, and younger people.

- Timetable now:
- LoI response early 2011 → merger? Descope?
- Full proposal end-March 2011
- Review and management plan soon after
- Prepare first OBs summer 2011!
- First observations October 2011!!

LoI science: very broad! Realistic?

- In the Plane – looking for kinematic signs of high-frequency dynamical structure: bar, ...
- Only a few `windows' possible, but important
- Towards the bulge – quantify gradients, distribution functions, as far in as feasible: how far is that?
- Outer disk – quantify gradients, DFs as far out as feasible
- High latitude – quantify the thick disk and inner halo DFs to test assembly models
- General: produce kinematic-several-element chemistry DFs for clump giants to V=16 (d=5+kpc) (SE2)
- Produce kinematic-chemistry DFs for TO stars to V=19+, d=8kpc+ in thick disk and inner halo/bulge (SE1)
- ➔ gradients, substructure, DF shapes, warp...
- Two good ideas merged into one excellent idea.

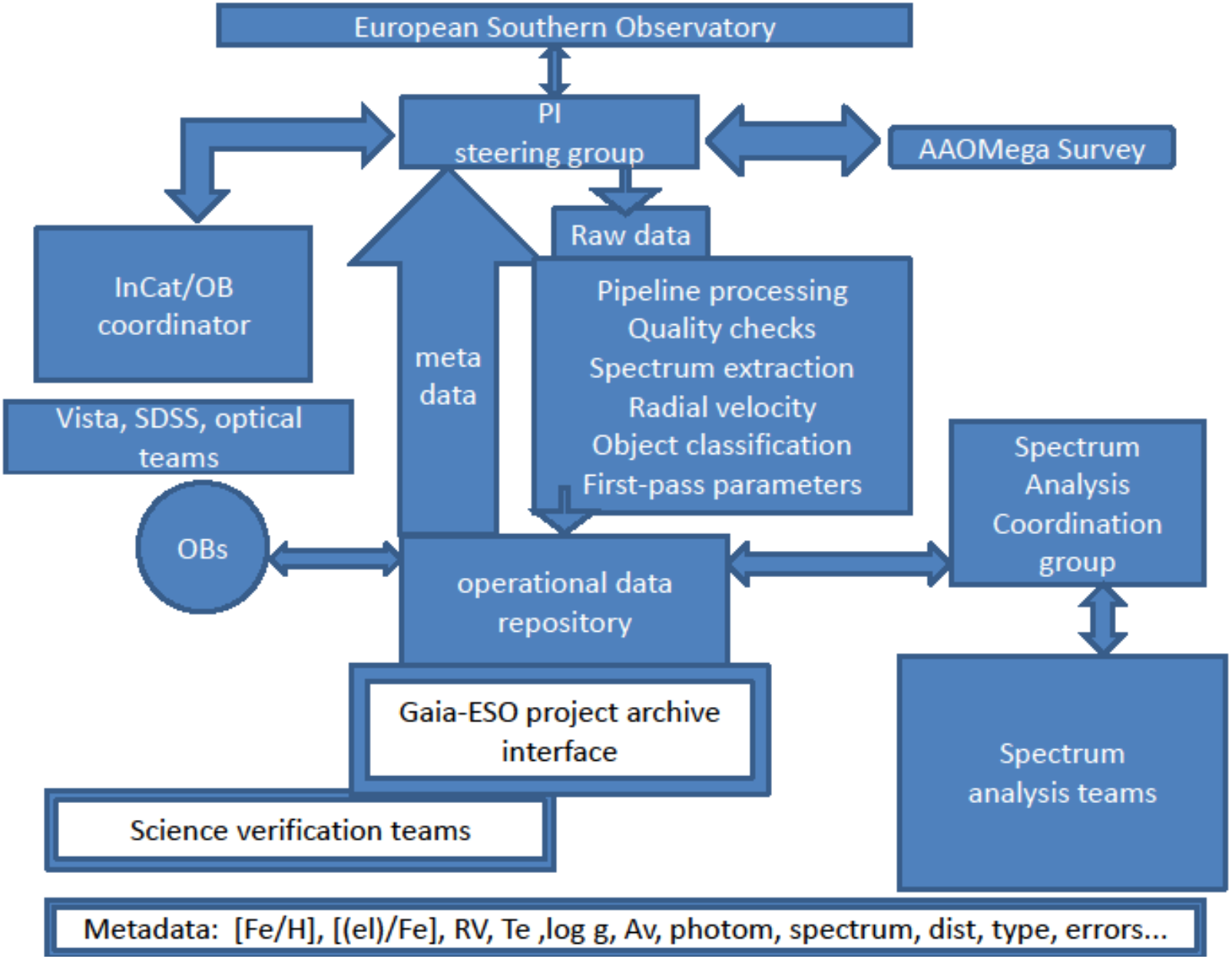
Science case drivers

- Key Gaia-related science
- Much better than other surveys → faint, precise
- Very broad interest to a wide community
- Will be enhanced by Gaia, not made obsolete
- Gaia-ESO will run 2012-2014/15/16?
- Gaia first data release 2015/16
- Do we need PMs before then? Distances?
- Is technically feasible← **this is critical*****

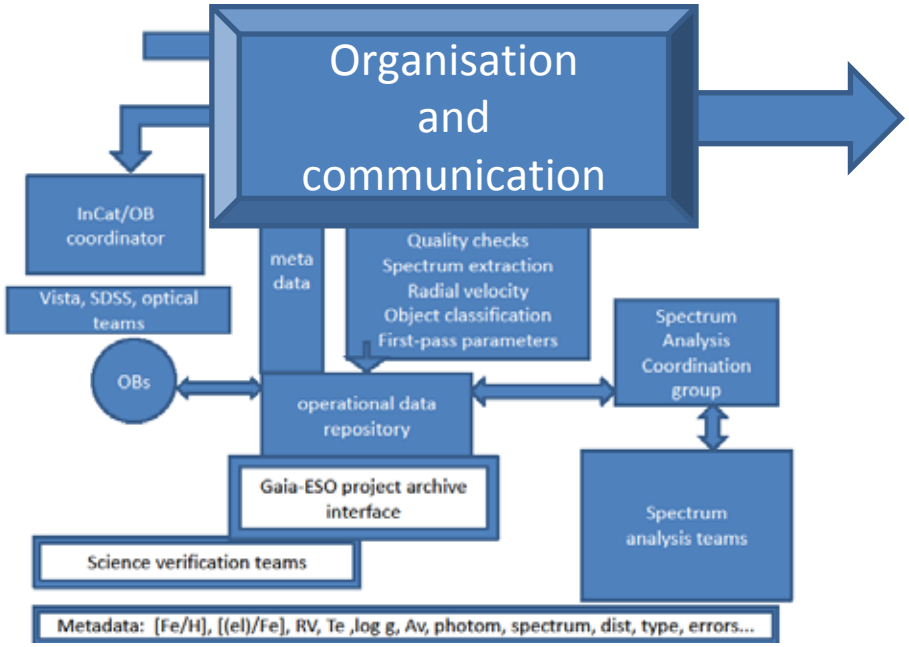
The LoI was the easy bit...

- Focus the proposal on what is achievable:
- ➔ what targets can we actually identify?
- ➔ what additional information is critical?
- ➔ organise a data flow system
- ➔ organise a data reduction consortium
- ➔ develop a real management plan
- ➔ who does what, when, how

We have an outline: now we need a plan.



Consortium organisation.



Plausible consortium management is a critical requirement –
for ESO and for success

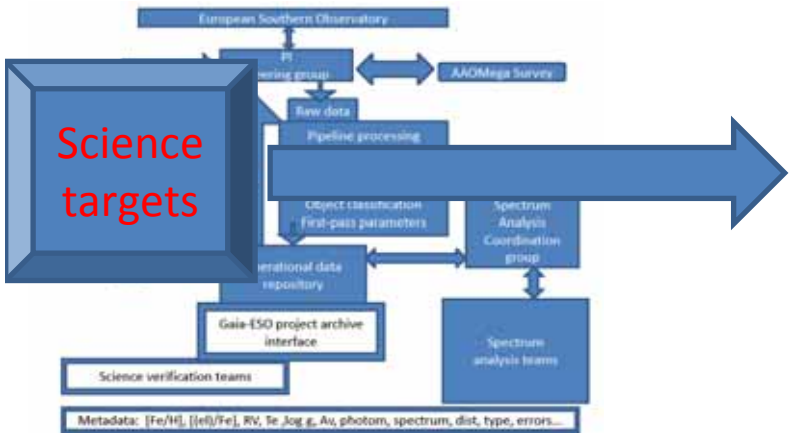
We have proven leaders of large projects and leading groups➔ credibility

Will build a steering group of leaders and critical-path contributors
when plans settle, post-proposal

We need a steering group which steers;
Working groups which work;
Data flow which flows;
Science verification which verifies.

Excellent communications are essential
➔key continuing role for GREAT
➔specialist team meetings
➔annual full consortium meetings.

Step 1: match the science case to what we can really deliver



Need clear realistic algorithms for at least:

1)Disk with b<5deg
2)Bulge with b<10deg
3)Inner galaxy, 10<b<30deg
4)Outer galaxy, 10<b<30deg
5)All, b>30deg
6)Specials: Sgr dSph tail
7) other dSph/tails
8) calibrations/GCs/Ocs
9) UVES targets
10) other?

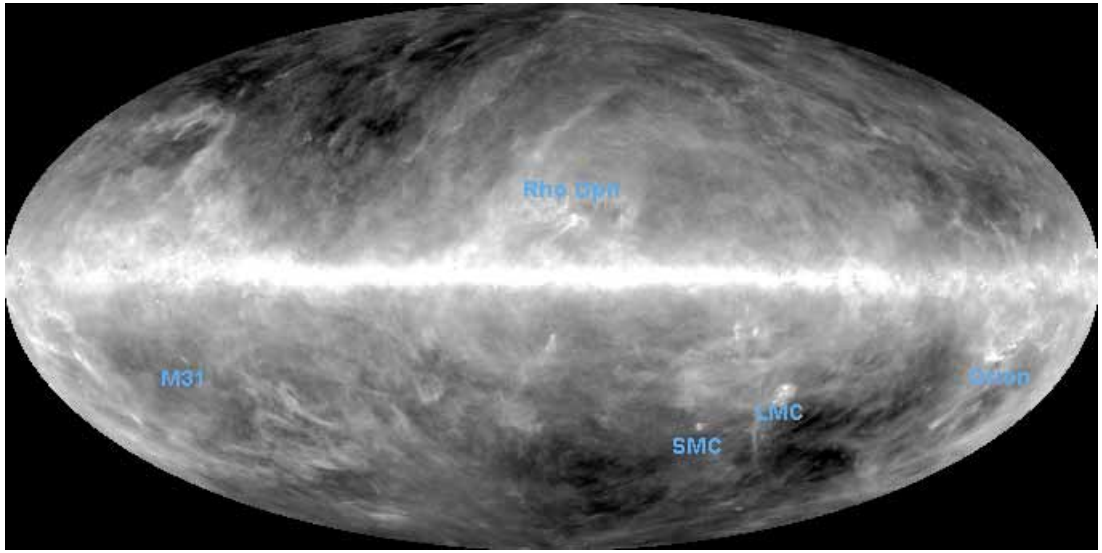
There is no single magic answer
Whatever algorithms are feasible/optimal must be automated 300N = 3000 OBs
The input catalogues must (partly) exist and be useable by August 2011.
The algorithms must use VLT time extremely efficiently

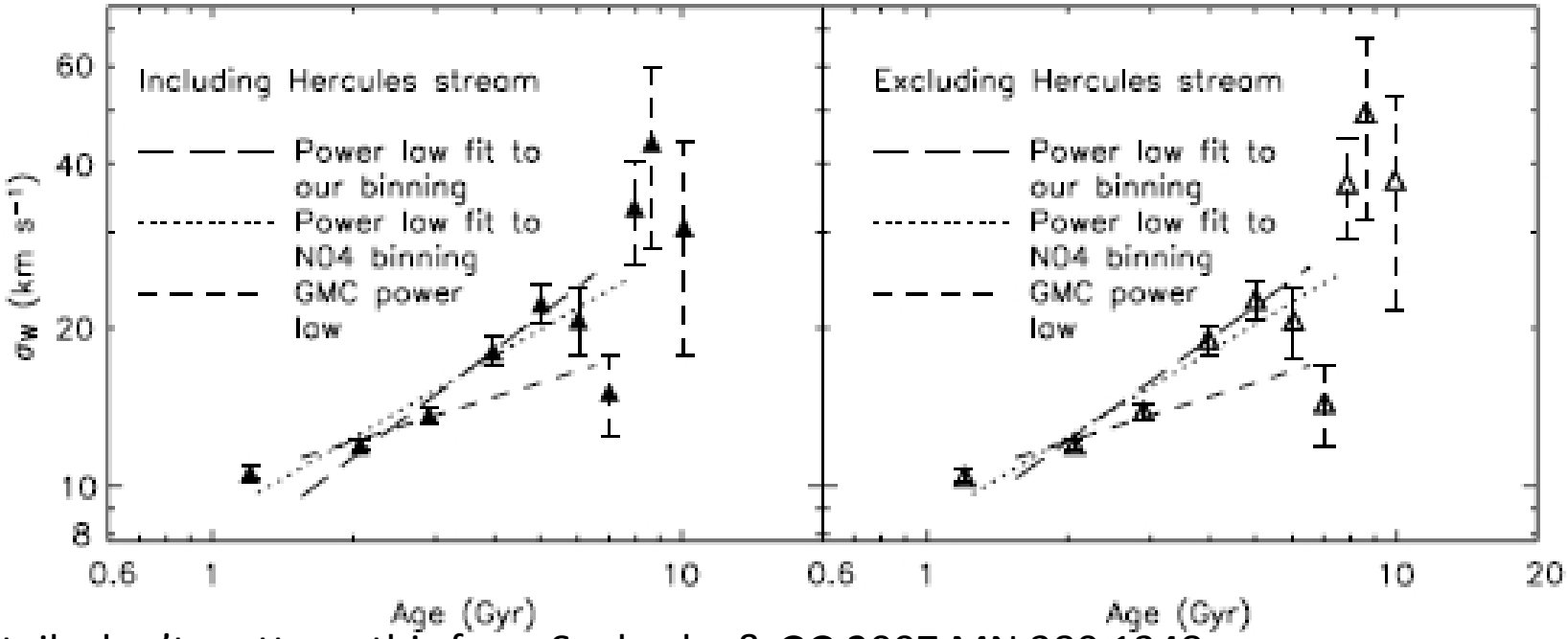
We need several different teams to be involved here

Focus the science: points to ponder

- What bits of age-metallicity-velocity space can we survey, and how well?
- Critical issues are Age-Velocity Relation and dust
- In the Plane cannot see beyond a few 100pc, except in special windows: neither will Gaia.
- → we cannot study the young disk efficiently.
- We can look at ALL available special windows. But there are very few, → need clusters for ages<2Gyr?
- Special – warp/Mon/outer disk region is possible, as the warp lifts the disk above the local dust.
- Using what input catalogue at low latitudes?

Key astrophysical constraint:
Dust plus the stellar age-velocity dispersion relation ➔ an unavoidable bias against the young



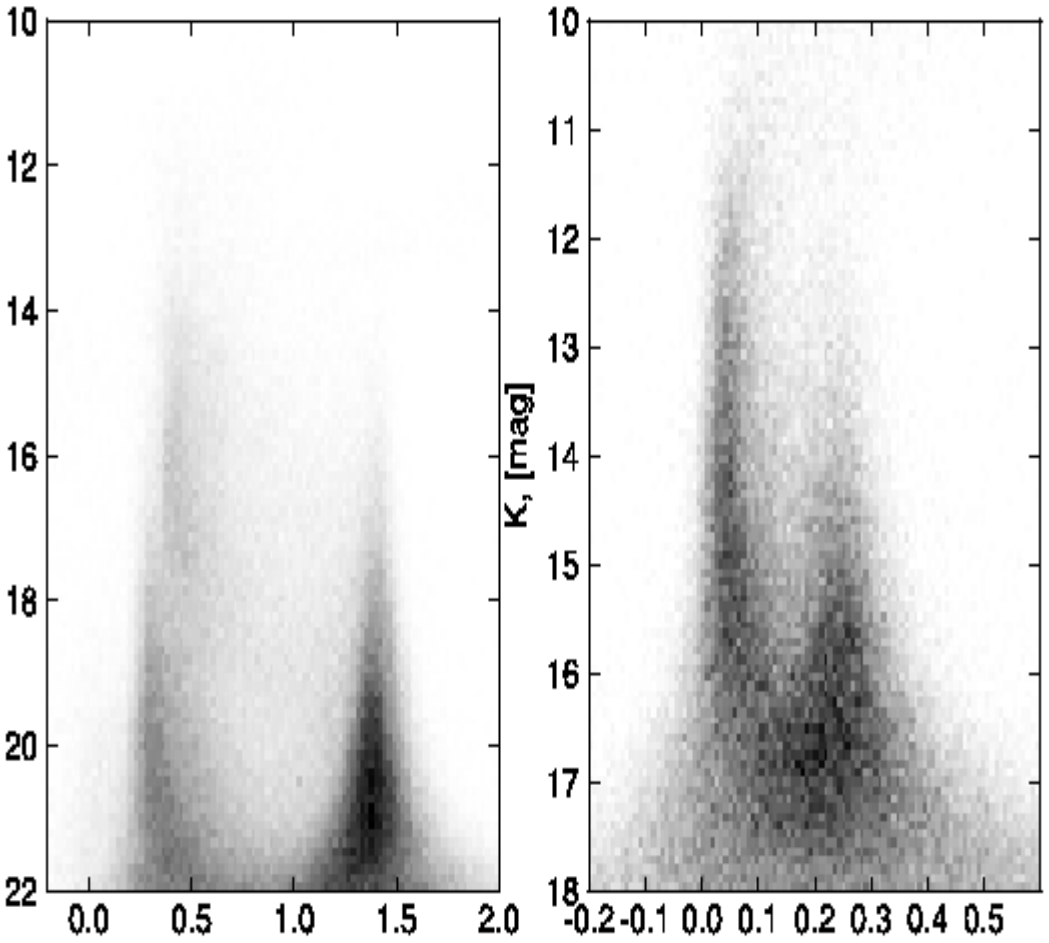


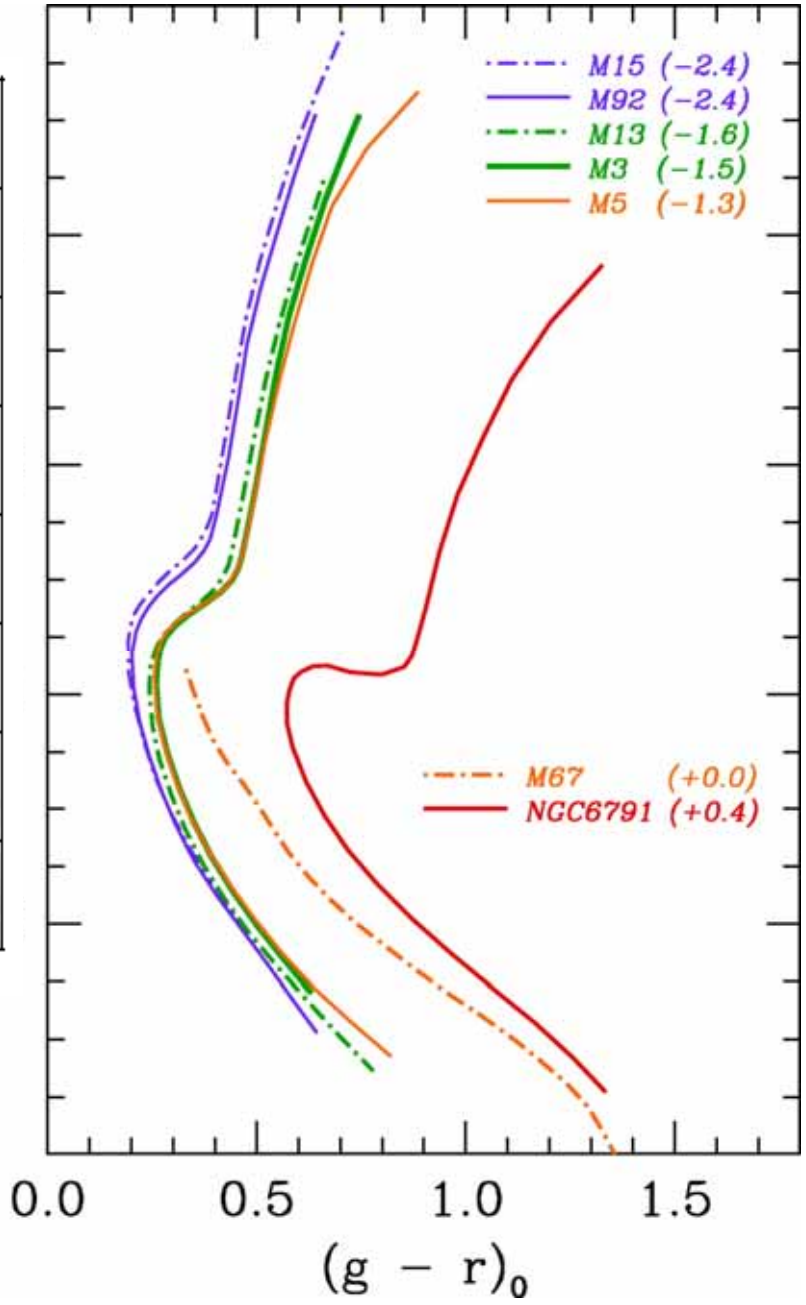
Details don't matter – this from Seabroke & GG 2007 MN 380 1348

More points to ponder

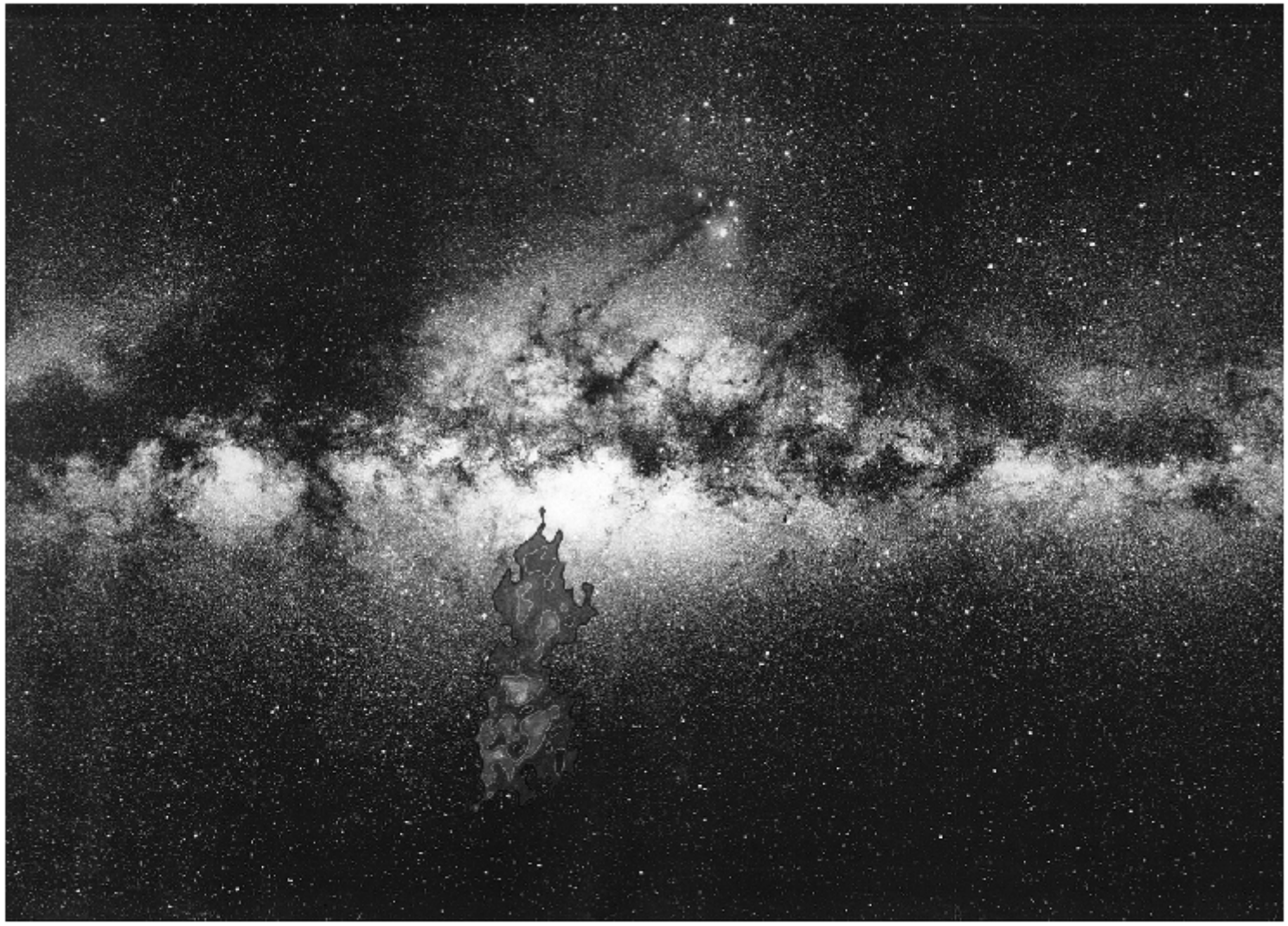
- look at CMDs – and star count-distances. If limit to V=16 F/G local volume only – is this a major advance on targeted analyses?
- RC go to useful dists, but only far from the Plane: at b=20, d=5kpc, z=1.7kpc – not seeing the thin disk or main bulge there! Or halo.
- Does RC age-metallicity-luminosity rel'n bias this science too much?
- OK for radial grads in TD/halo.
- can one select interesting targets reliably at low lats? Or mess of foreground dK? Looking in towards centre: How close to the bulge can we really get above b=10deg (note AAO survey) – ``in plane'' ogle/eros CMDs. Top science! Is it feasible?
- F/G stars: how red to avoid bias – solar old TO is very red – but CMD star count limits do not see such a TO there. So don't waste spectra looking for very rare signal?

Is it worth looking for old metal-rich stars?





The inner Galaxy is of exceptional science interest – but is exceptionally difficult to study



In the inner galaxy, are there (too) many targets and (too) much foreground?
An old RC giant at the bulge has V=17 [if Av is low]. Can we do that??
What input catalogues which cover the inner galaxy exist today?

Sgr – discovery CMD, from Ibata, Gilmore, Irwin

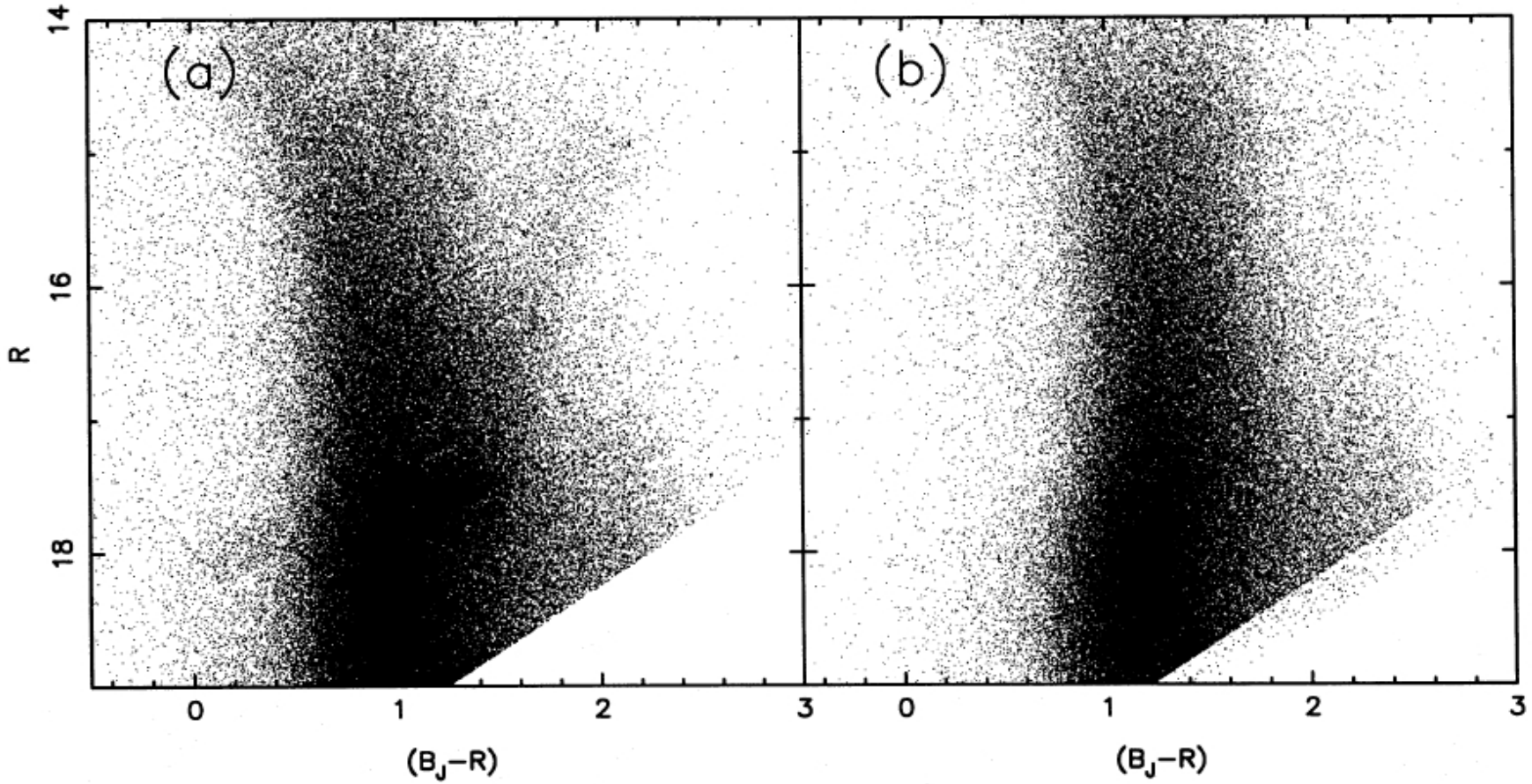


Figure 5. Photographic colour–magnitude diagrams (CMDs) covering 2°.5 × 2°.5 of sky. To aid visual inspection, we show the CMDs (a) and (b) with different point widths. The CMD in (a) is centred at $18^h51^m.9$, $-30°33'$ (B1950) ($\ell = 5°.5$, $b = -14°.1$). Note the dense population at $R = 17.7$, $B_J - R = 1.4$, the blueward extension to $B_J - R = 0$ and a steeply rising feature extending to $R = 14$, $B_J - R = 3.0$ (the reddest, brightest stars are seen also in Fig. 4). In contrast, the CMD in (b), from the same UKST plate, but centred at $18^h54^m.5$, $-27°49'.6$ (B1950) ($\ell = 8°.4$, $b = -13°.5$), shows only expected features (cf. Fig. 6).

SDSS imaging avoids the inner Galaxy – wrong hemisphere!

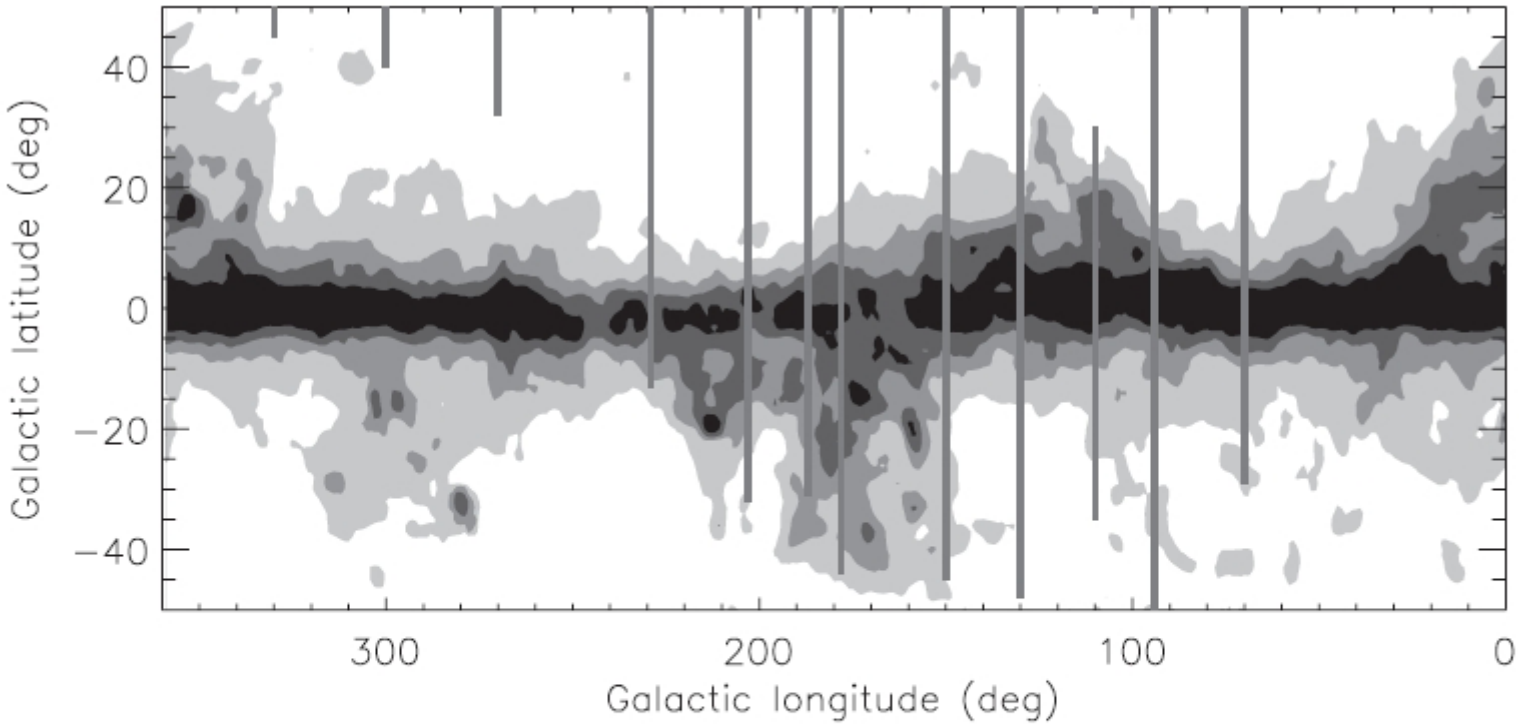
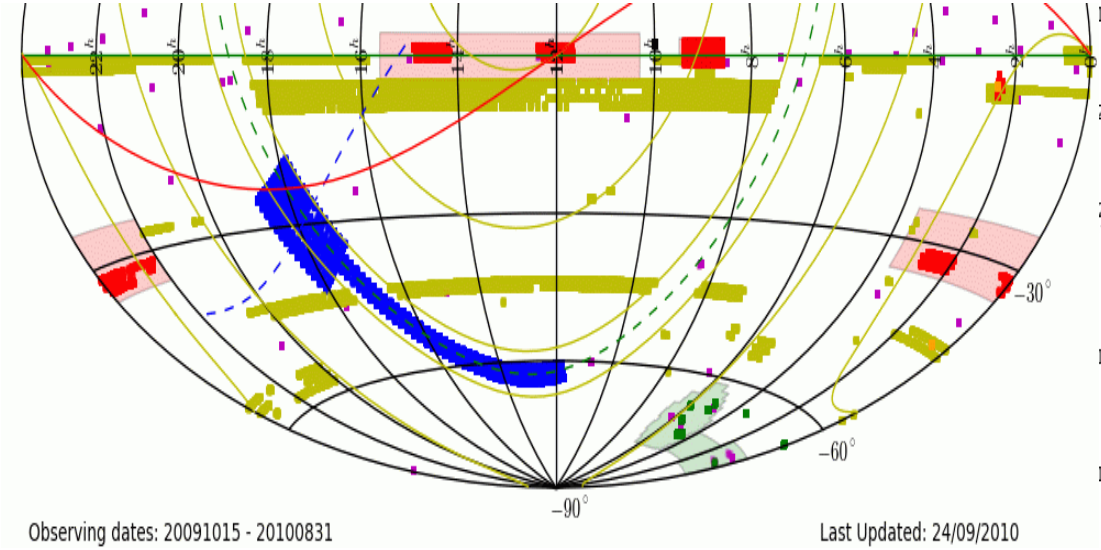
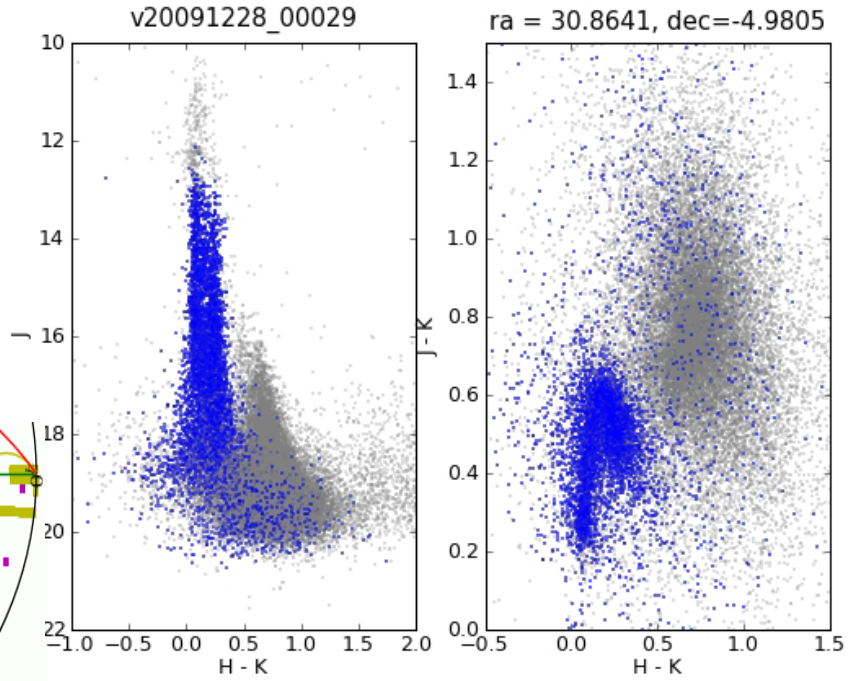
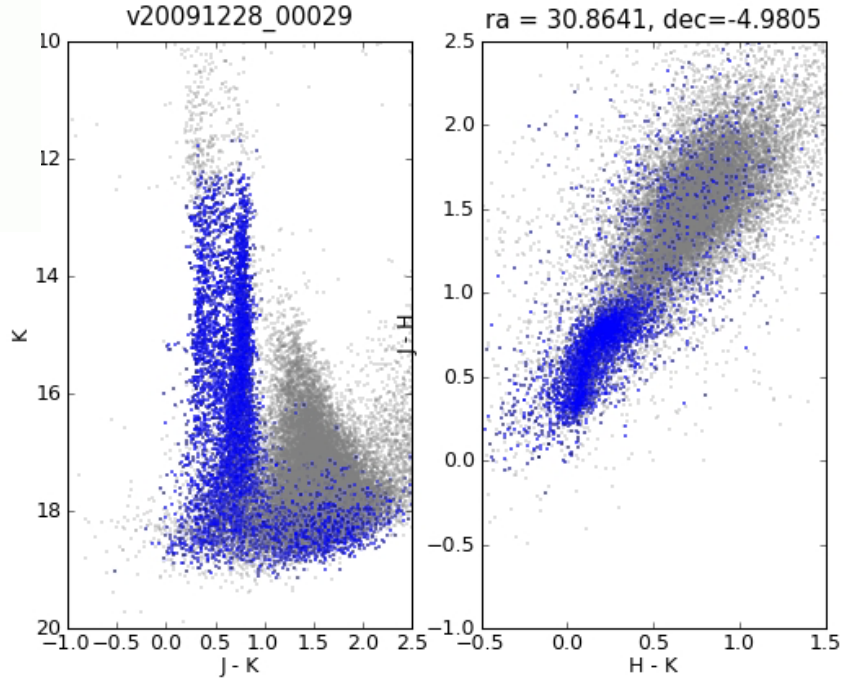


Figure 1. Overview of low-latitude imaging scans from SEGUE (Yanny et al. 2009a) used for this analysis, shown as the vertical lines in Galactic coordinates. The grayscale shows dust reddening estimates based on the extinction maps from Schlegel et al. (1998), with increasingly dark regions corresponding to $E(B-V) > 0.1$, 0.25, 0.5, and 1.0 mag. Only regions with $E(B-V) \leqslant 0.25$ are used in the analysis.

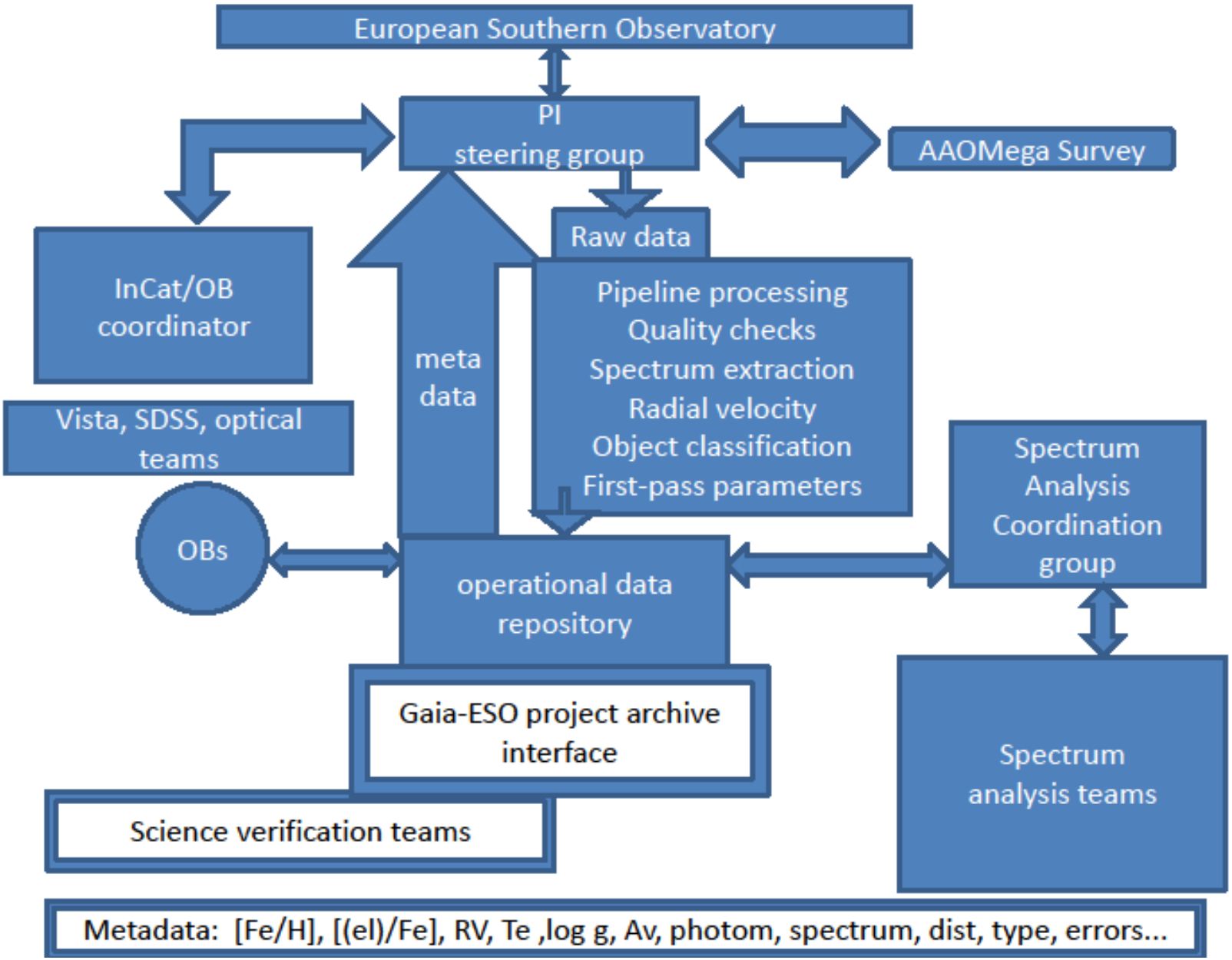
The good news:
Vista data are available, and look good



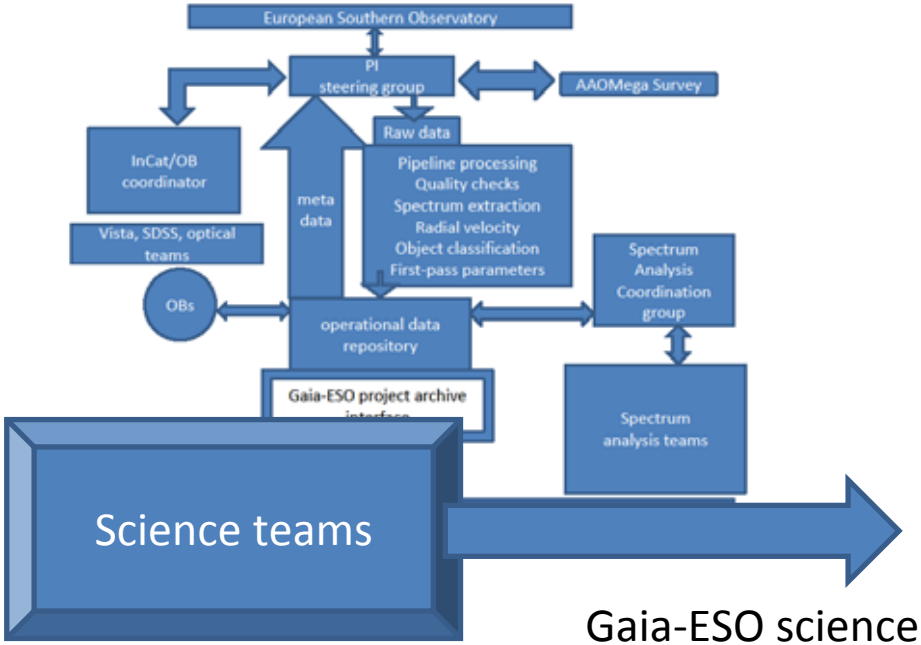




Back to survey structure: where are we?



Science teams are in good shape

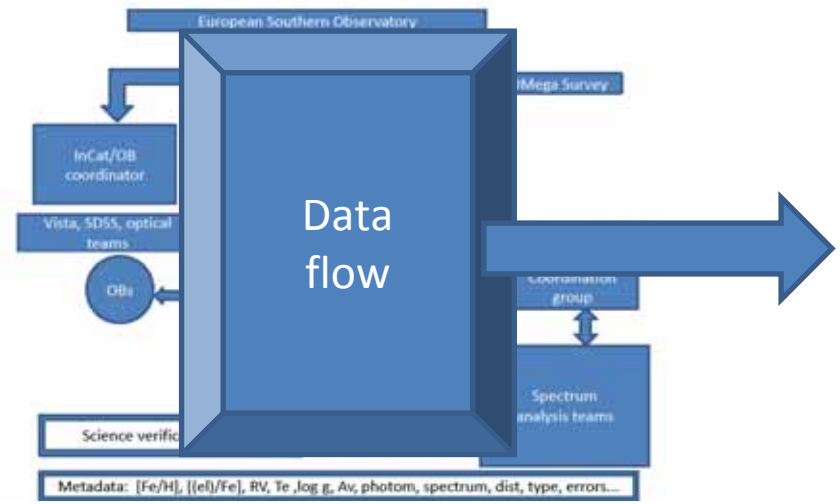


Gaia-ESO science teams a real strength

1)Established leadership reputations
2)Broad range of skill & interests
3)Cover the whole ESO community
4)Sufficient range to manage most science types
5)Excellent record in publishing survey science
6)Considerable specialist expertise.

7)We are in excellent shape here

Managing the data flow, and supplementary data



There is a second demand here
➔first-pass data processing,
➔and housekeeping

Manage regular data checks
process data ➔ RVs, spectra,
classification (s),
parameter estimates...

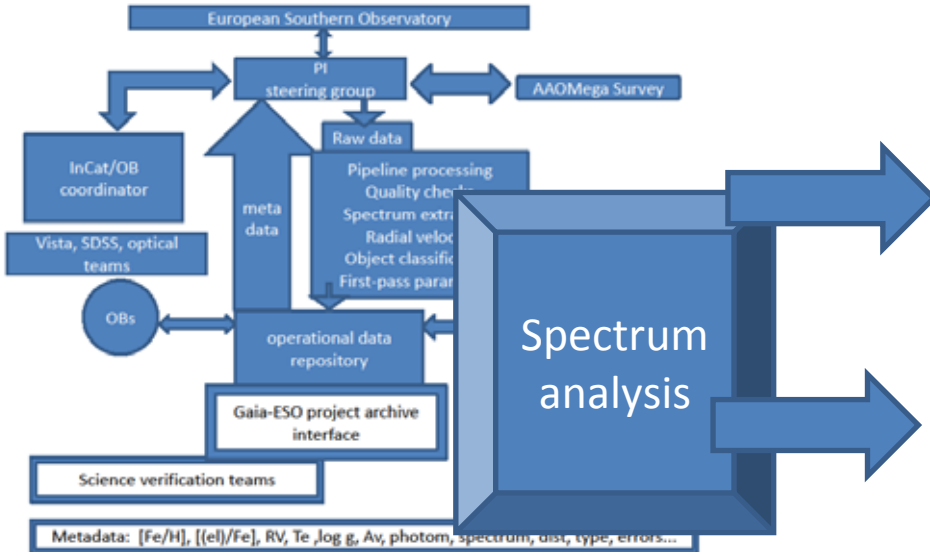
Data flow is a well-defined challenge

This is high-workload effort
1)Design a data system
2)Implement/fund it
3)Make it user-friendly for the data teams
4)Interface to science teams

Using it:
manage new associated data from external surveys (VST, PS1, DES, ...);
package (meta)data as ESO require

All this is understood and feasible:
and is a lot of effort.

The hardest challenges of all



UVES data processing:
1)is the ``best'' method agreed?
2)how long will it take?
3)relation to Flames targets?
4)Who is going to do this?

Flames Spectroscopic processing
1)VERY Many teams interested
2)Too many potential methods
3)Range of target types
4)Range of S/N – different processes?
5)What about extinction
6)Is supplementary data essential
7)What about special objects?
8)What about problem cases
9)What about special demands (eg DIB)

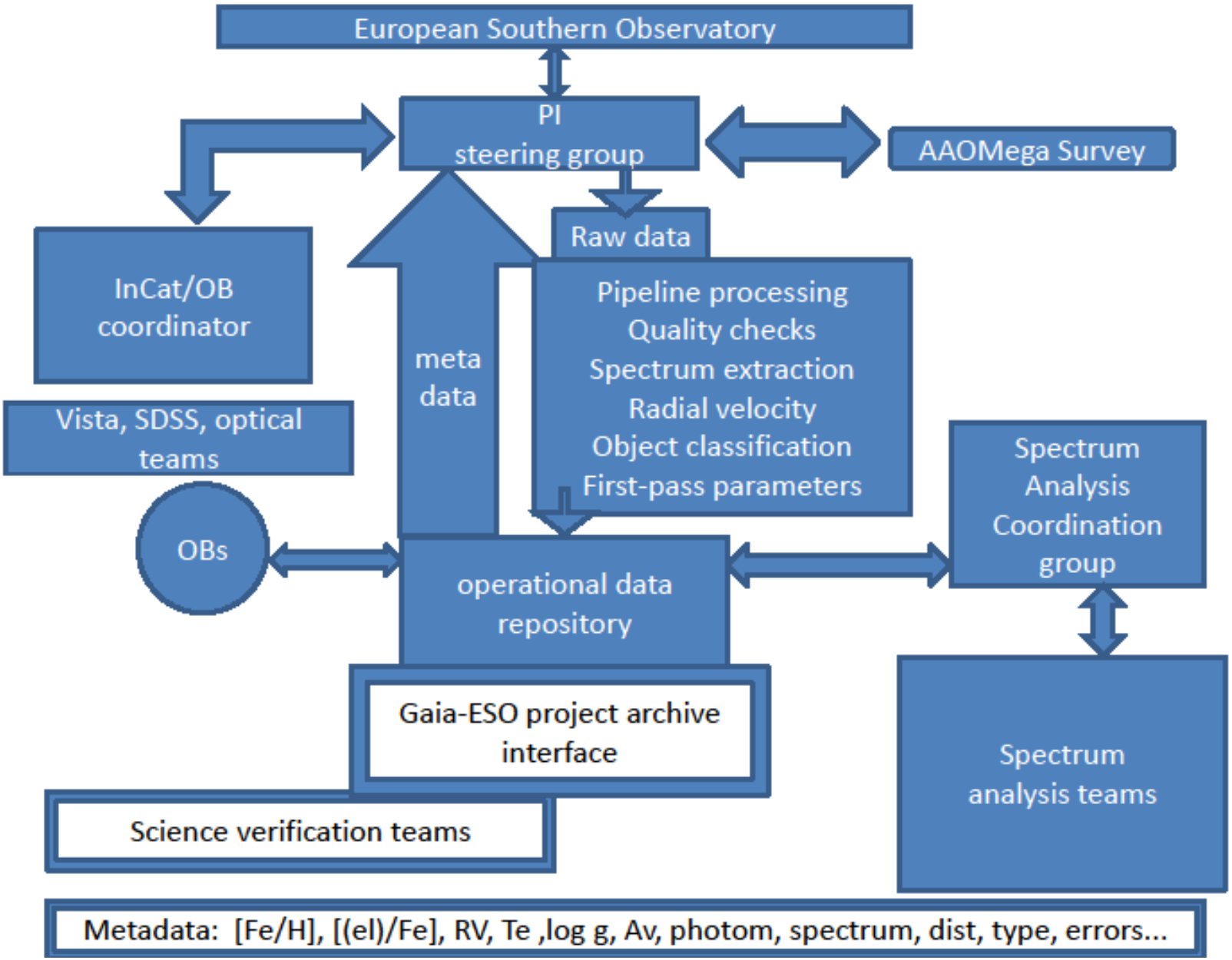
10)How to distribute the work, yet retain a coherent (set of) processes
➔well-defined parameters and ranges

We have here not les 3 mousquetaires, mais les 30 mousquetaires

Les 30 Gaia-ESOs : Un Pour Tous !



We are in excellent shape as an ambitious project. Now to get real.



The LoI was the easy bit...

- Focus the proposal on what is achievable:
- ➔ what targets can we actually identify?
- ➔ what additional information is critical?
- ➔ organise a data flow system
- ➔ organise a data reduction consortium
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- ➔ agree who does what, when, how