

- 1) Real-time alert verification
for Gaia-CU5
- 2) Gaia community input to
observatory future planning

Gerry Gilmore

- 1) This concerns only verification of the first few weeks/months of candidate alerts detected by the Gaia alert system, to verify the alerts are reliable, before the alert system is `turned on`. Once alerts are public they are no longer relevant to DPAC/gbog.
- 2) This is happening now, and all of us should be involved.

Planning for Gaia follow-up post-launch [not GBOG]

- Assumption 1: nothing will happen unless someone plans it*.
- *first law of planning – make sure all your text fits on a single line

general context – relevant to DPAC members, and all Gaia science follow-up

- Assumption 1: Gaia data will revolutionise most of astrophysics – in a few years *every proposal will be based on Gaia data. And all Gaia data go public with no priority access.*
- Assumption 2: nothing will happen unless someone plans it.
- Assumption 3: telescopes and research funding are already heavily oversubscribed: to get a lot of Gaia exploitation, we need to get organised: scientifically, financially, politically.

- Context one: Gaia data products will be staged releases. We need to match plans appropriately: full astrometry is a decade away...
- Context two: Europe's mid-sized telescopes are being restructured right now, with Gaia science as a primary driver for their continued operation and development.

Gaia-related data

- Since Gaia affects almost all astrophysics, almost everything is Gaia-related – there is nothing ‘special’ about being Gaia-relevant, or ‘enhancing’ Gaia science
- Exclude here pure ‘calibration’ [GBOG] – see below
- **All science advances advance Gaia science***
- **And *vice versa*****

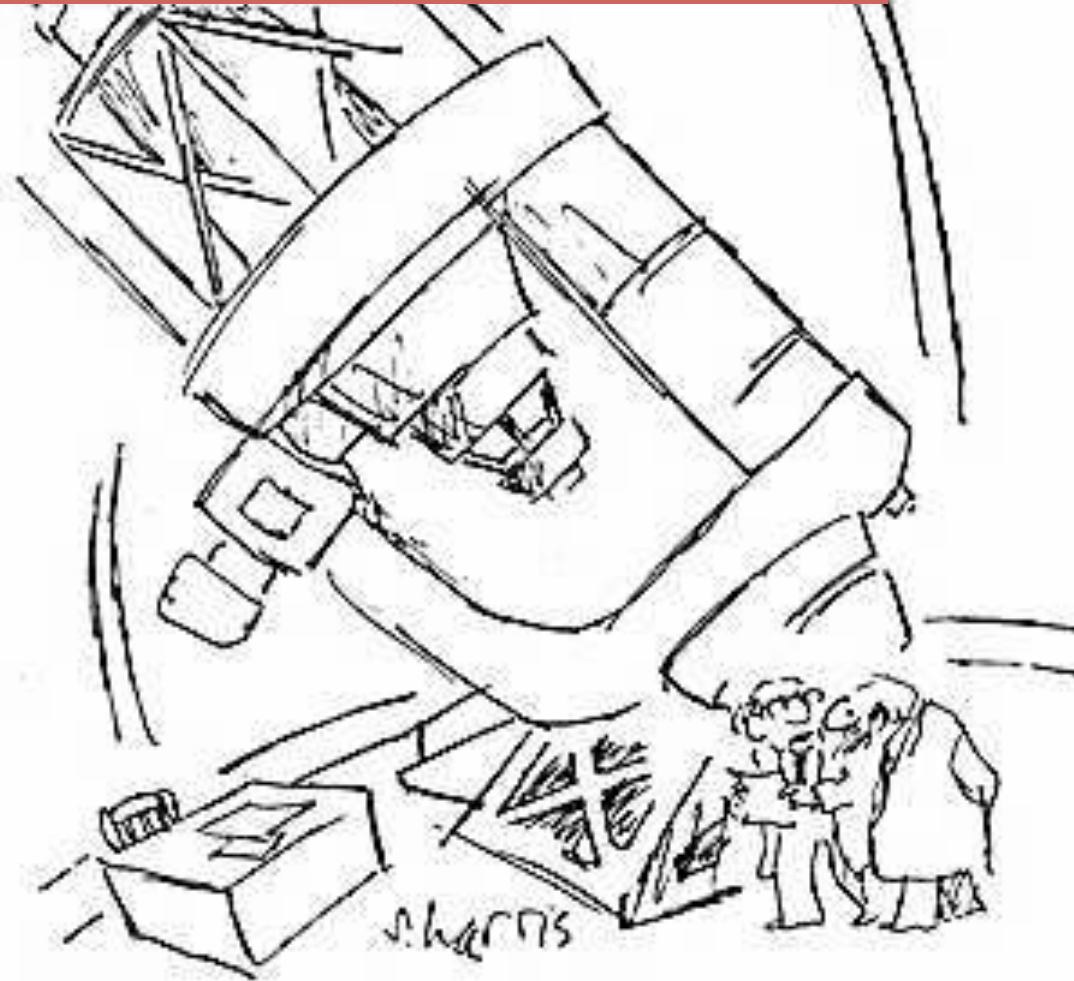
- So here just consider sources detected by Gaia, and being ***studied because of a Gaia detection***

- *** people complain scientific euro-english has a vocabulary of only 100 words – actually, even fewer are apparently adequate...**
- **** Latin doesn’t count**

European telescope strategy review committee

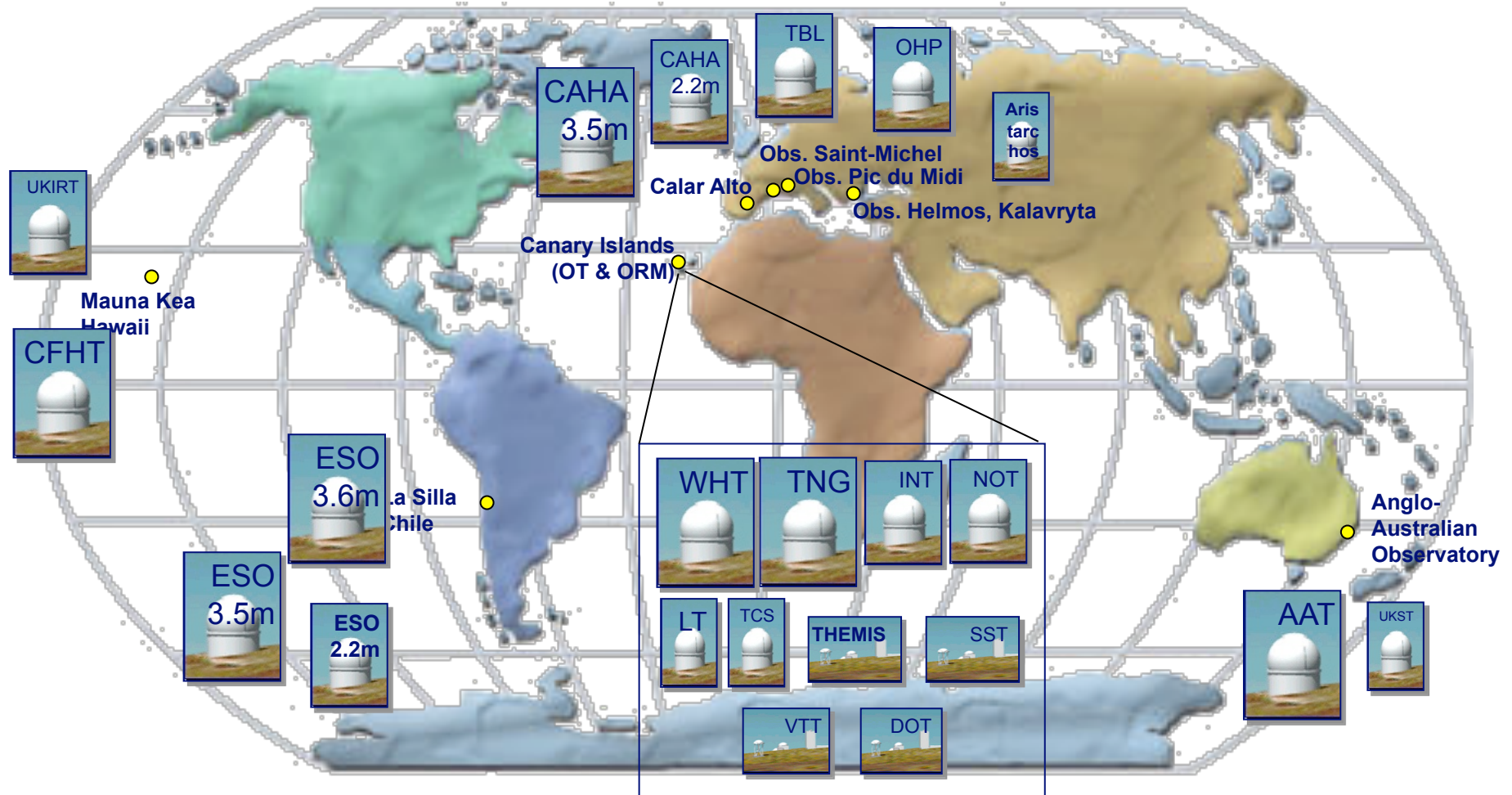
- Europe's 2-4m telescopes are being reviewed
- *To identify those goals of the Astronet Science Vision that are most effectively delivered by 2-4m optical/infrared telescopes;*
- *Identify which observational capabilities are required;*
- ...
- *Among the science tasks, consider the appropriate balance between large-scale survey-type projects, including complementary ground-based programmes in support of European space missions, and individual access;*
- *It is anticipated that a similar pan-european exercise will be done around 2015-2018 for 8-10m telescopes with significant European ownership. ETSRC should take this into account.*
- *A similar analysis of European wide-field spectroscopy capability is about to be started*

Why is there a review?



"THE ONLY PART OF THE UNIVERSE WHICH ISN'T EXPANDING IS THE BUDGET FOR THIS PLACE."

European agencies (part) own ~20 2-4m telescopes
[these are the OPTICON Access Programme], and VST, VISTA
plus VLT,LBT,GTC,Gemini ,SALT,HET (PanStarrs)



There are also about 20 1m-2m telescopes operational with european involvement

European Telescope Strategy Review Committee

AstroNet body, Opticon implementation assistance

- **PEOPLE**

- Janet Drew (chair)
- Jacqueline Bergeron (Co-Chair)
- Jerome Bouvier
- Margarida Cunha
- Angeles Diaz
- Geza Kovacs
- Andreas Quirrenbach
- Clive Tadhunter
- Massimo Turatto
- Pepe Vilchez

- **TELESCOPES**

- CAHA 3.5m, CAHA 2.2m
- CFHT
- OHP 2.2m
- TBL
- WHT, INT
- UKIRT
- LivTel
- ESO 3.6, ESO NTT, ESO VISTA, ESO VST
- Rohzen 2m
- Aristarchos
- TNG
- NOT
- MPG (ex-ESO) 2.2
- AAT +UKST already assumed lost to europeans;
- ESO restructuring presuming panel outcomes

European telescope strategy review committee

- *Among the science tasks, consider the appropriate balance between large-scale survey-type projects, including complementary ground-based programmes in support of European space missions, and individual access;*
- *GAIA science is accepted as a primary driver for future telescope use.*

- The current TAC model, one per telescope in isolation, will end
- Telescopes will be more coordinated, more collaborative, more specialised
- *Faster, cheaper, better.....*

- We may assume that significant observing resources, if necessary on many observatories, will be made available as a strategic priority, to properly-prepared projects: just like cosmology surveys

- New optimised instrumentation proposals can be considered: a specific need for massive spectroscopic surveys is recognised, and a new WG is planned.

- In that context, the Gaia community needs to plan its requirements now.

We are not doing enough – eg recent CFHT new instrument call had no serious WFS prop

Now to GBOG:

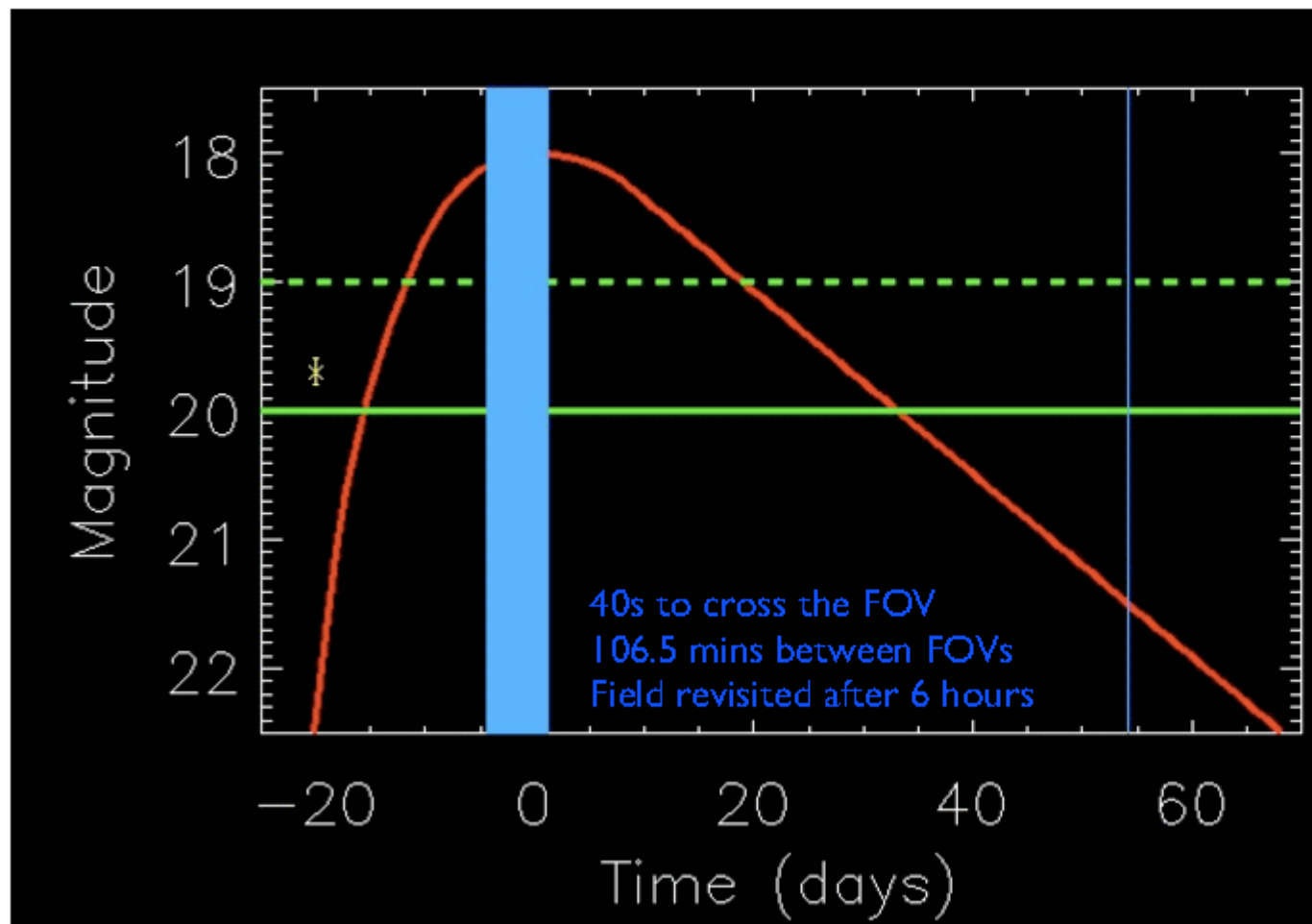
Gaia data products – alerts

- Alerts: quasi real-time flux alerts, starting early
- How will/can we prepare for these?
- alert verification process, which is DPAC/GBOG/CU/DU internal
- Start-up of alert verification process?
 - It needs a lot of observing time, much to identify sources of no special interest... → teams are needed?;
 - It can be pre-planned – like SNaE factory – so needs special arrangements with observatories
 - It really needs all-sky coverage, and a lot of time – perhaps 1-2m imaging systems `on-call` are essential?
 - We need to organise this.
 - Most first sources will be uninteresting: asteroids, blends...
 - Hopefully, it will be over quickly, so real alerts will dominate science and activities – of course, verification involvement will be an easy way in to later science exploitation: that is the reward we can offer

SNaE are the basic Dark Energy calibration, through Gaia Cepheids → critical science
should we have a cosmology/Dark Energy WG, for distance indicators...?

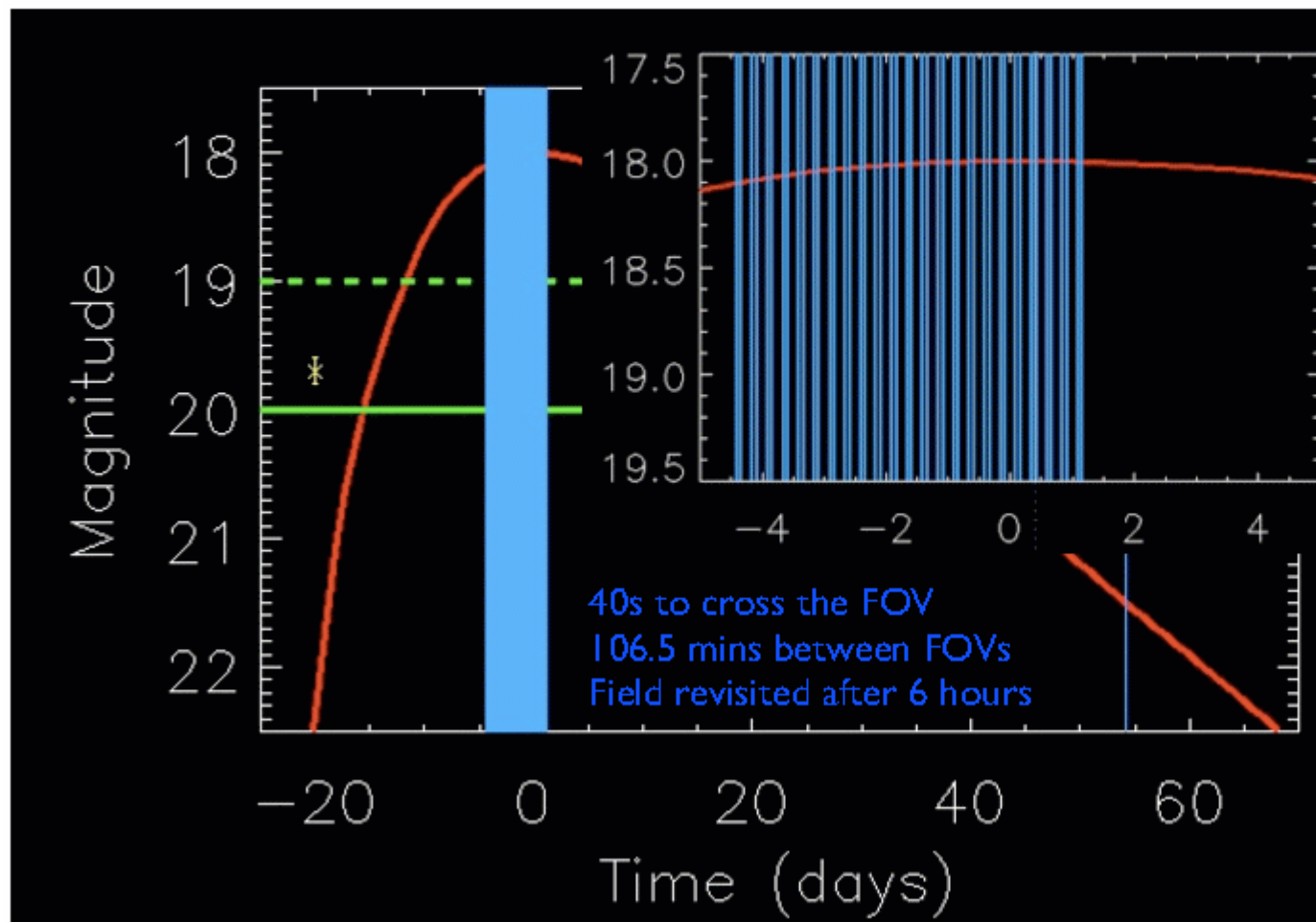
Test Case: Supernova Ia

Science case: map the true SN luminosity DF, from Cepheid distances



- Host galaxy contribution determines whether source is new to Gaia.
- Successive transits will measure consistency and slope.
- Threshold for new source detection - about 1 mag above GAIA limit.

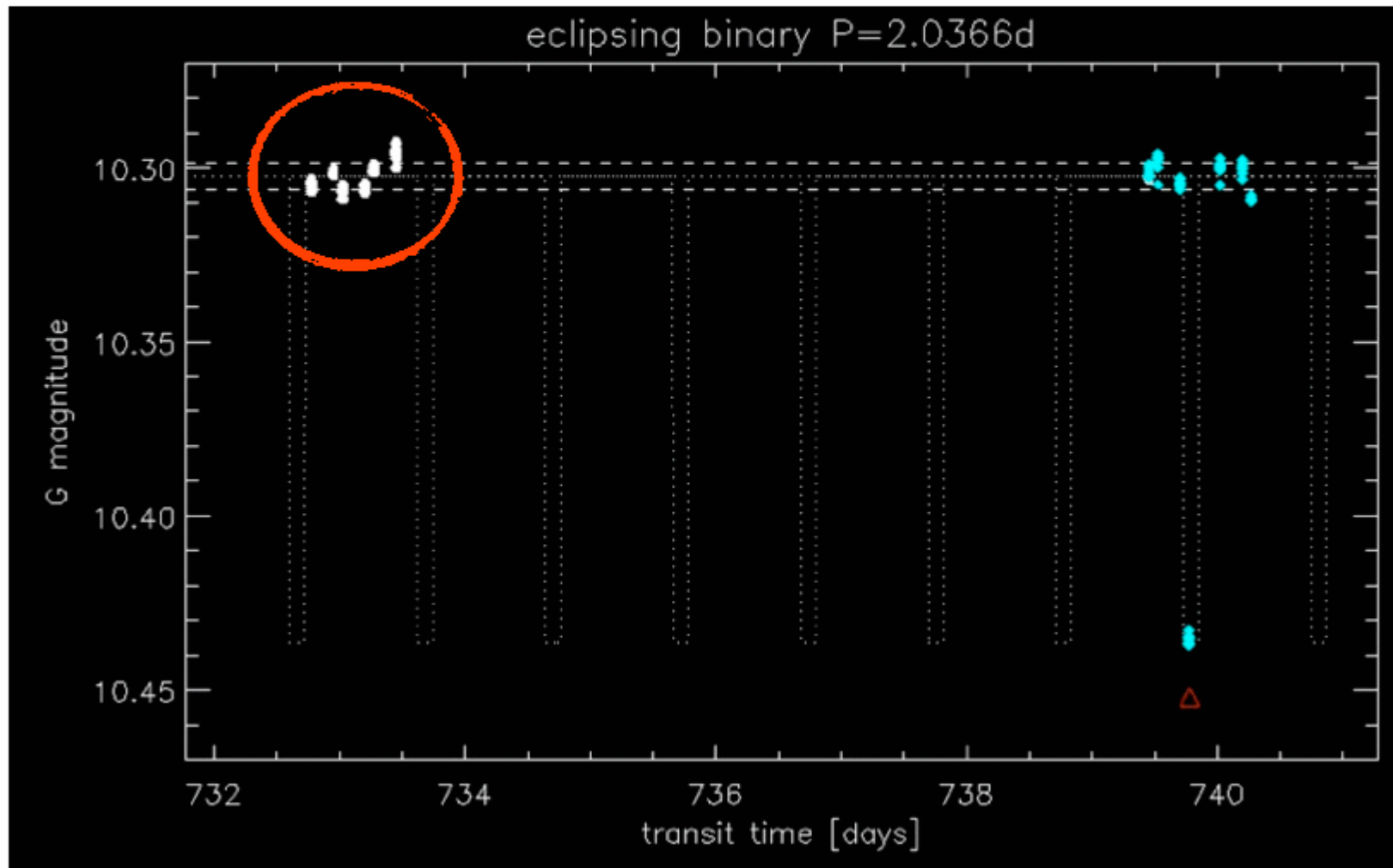
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Of course, lots and lots and lots of different variables will be found – stars to QSOs

Cycle3Fv example



SNaE alert verification

Even if the source is a high-contrast SN, the galaxy will be differently blended as a function of scan orientation, etc ,

Gaia data alone will not always be conclusive.

We will need to optimise the trade-off between completeness and reliability

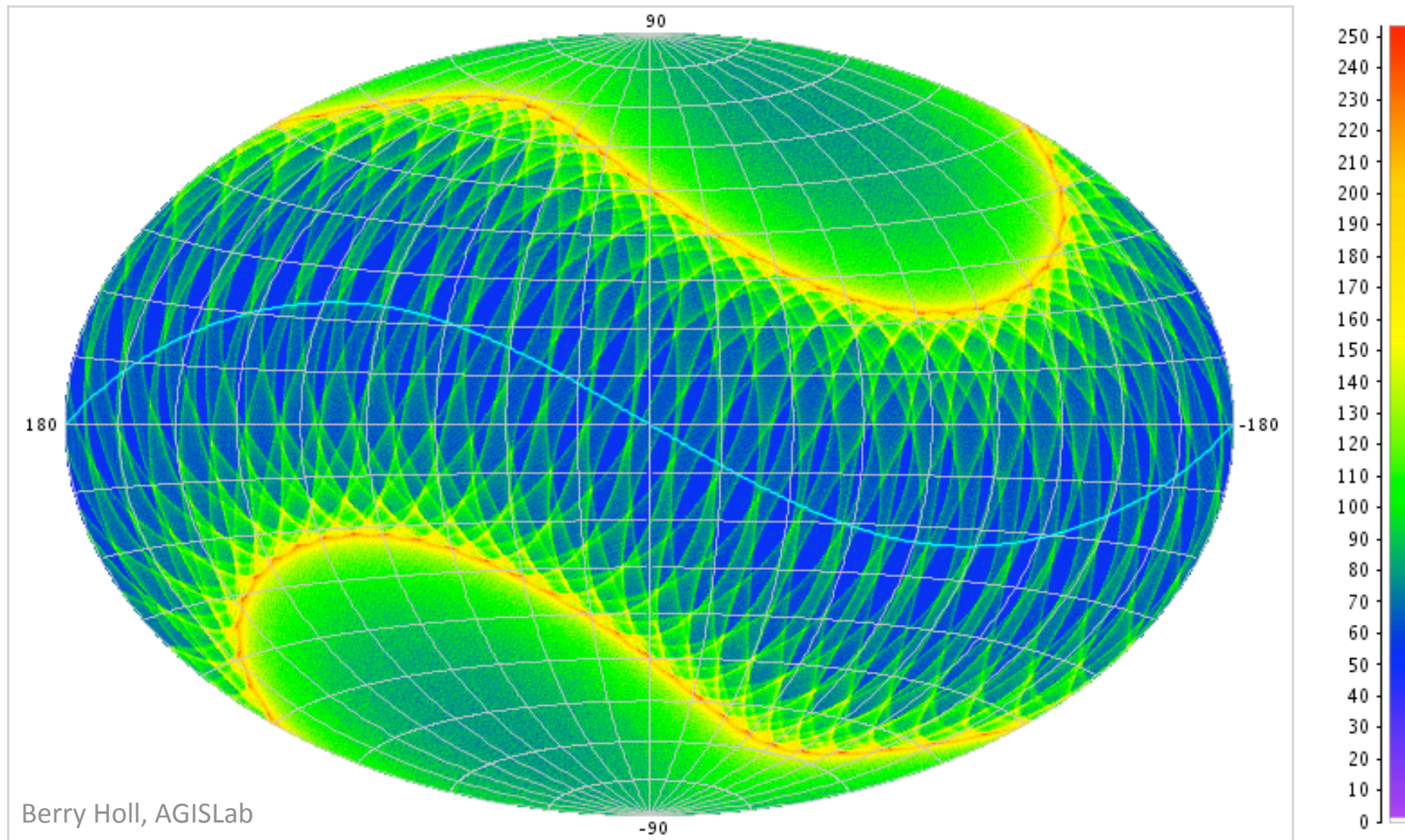
We also do not yet know just what alerts will be released, so it is hard to plan in detail the verification program now – but we must!! We may assume faint sources (18-19) dominate.

Full detail awaits CU9, but pre-launch observations must be organised now

Should we prepare ``follow-up'' surveys along the high cadence areas?

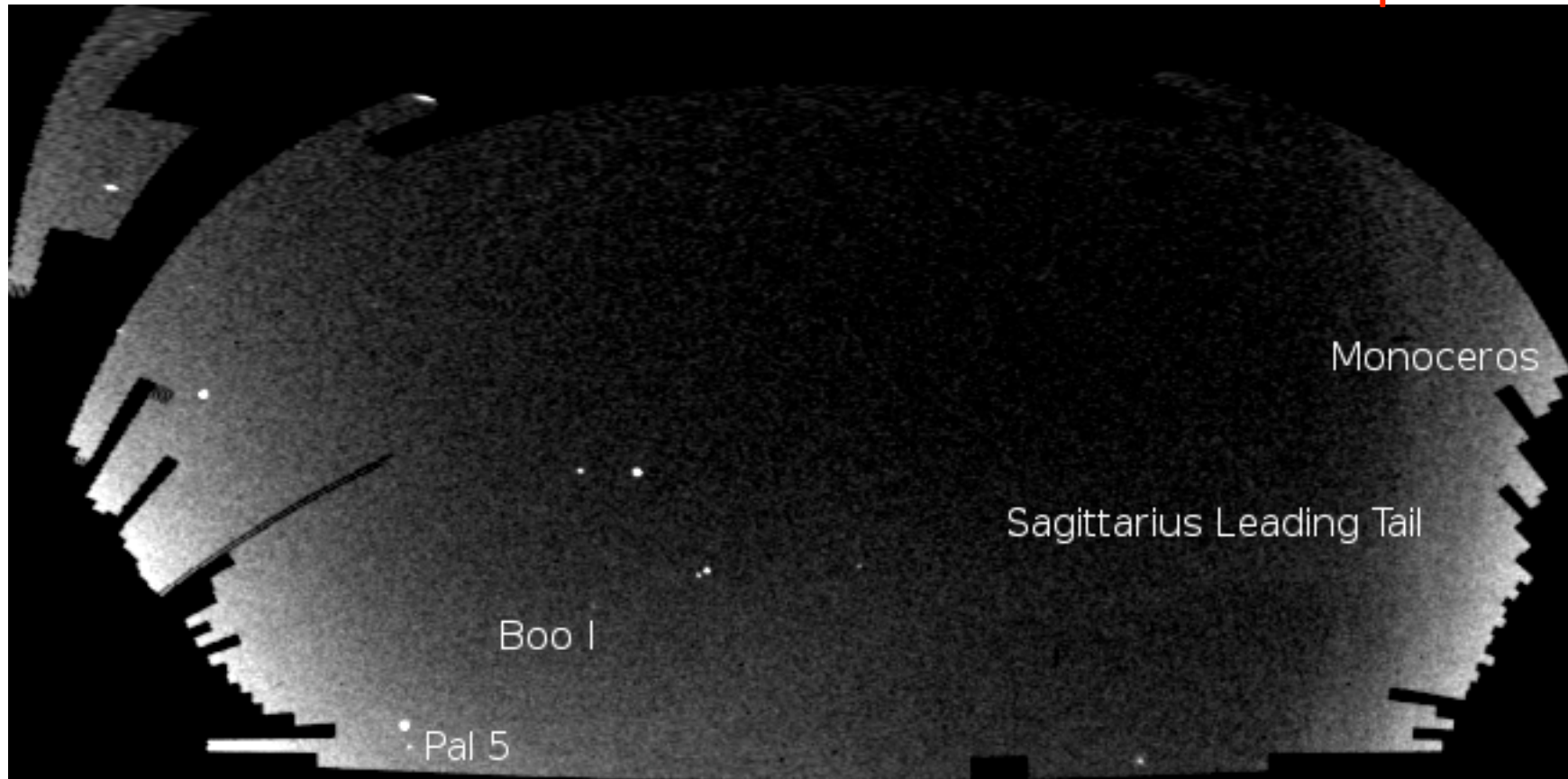
The Nominal Scanning Law

Gaia field transits (ICRS) for 5 years



This is the Gaia view – photometry only to $g=20$
In some areas we already have a good first-look check
At low latitudes it will be much more complex

SDSS Field of Streams – the SDSS stellar sample



How will Gaia behave in crowded regions? We have no prior data!
much of the sky is complex.. But LMC and M31 interestingly seen



Summary- preparing for science

- Getting full value from Gaia will take considerable organisation
- The observatory `system' is being reorganised, with Gaia science a driver – this is a valuable opportunity to negotiate Gaia needs with observatories and agencies
- There are aspects of high-priority science which can be delivered only with coordinated large-scale follow-up.

Summary early alert verification

- The observatory `system' is being reorganised!! We cannot assume business as usual
- Verifying candidate alerts early will be essential, and very time-consuming: several full-time telescopes will be needed.
- The science return from this will be negligible compared to the effort
- It will have to happen soon after operational start, when everyone in the CU/DUs will be totally busy fine-tuning Gaia data processing – who will do this service?
- This work will be an excellent way-in to later Gaia science alerts follow-up. We need to realise/use this

