

The bumpy first year of GBOT

Martin Altmann
ZAH Heidelberg
GaiaFUN 2014
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GBOT



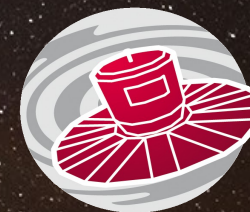
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Outline

- Gaia's brightness
- Theoretical foundations
- Measurements
- Recommendations
- Current status
- Triggered Mode
- Towards the re-reduction phase
- GBOT finds asteroids



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Gaia's Brightness

- Directly after launch: Gaia is 21 instead of 18!!!!
 - Major impact on GBOT operations
- Final L2 brightness range needed
 - By GROND multicolour- and GBOT's own photometry
 - Because of distance and EAA variations: brightness range
- Assumptions about long term development
 - Theoretical considerations
 - monitoring



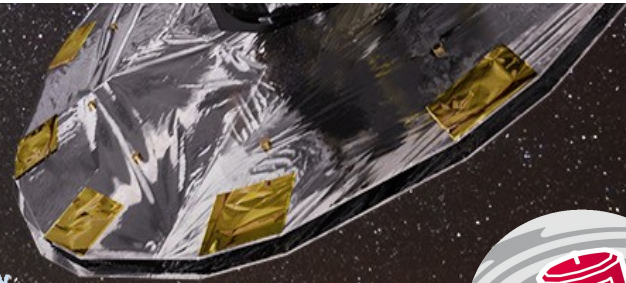
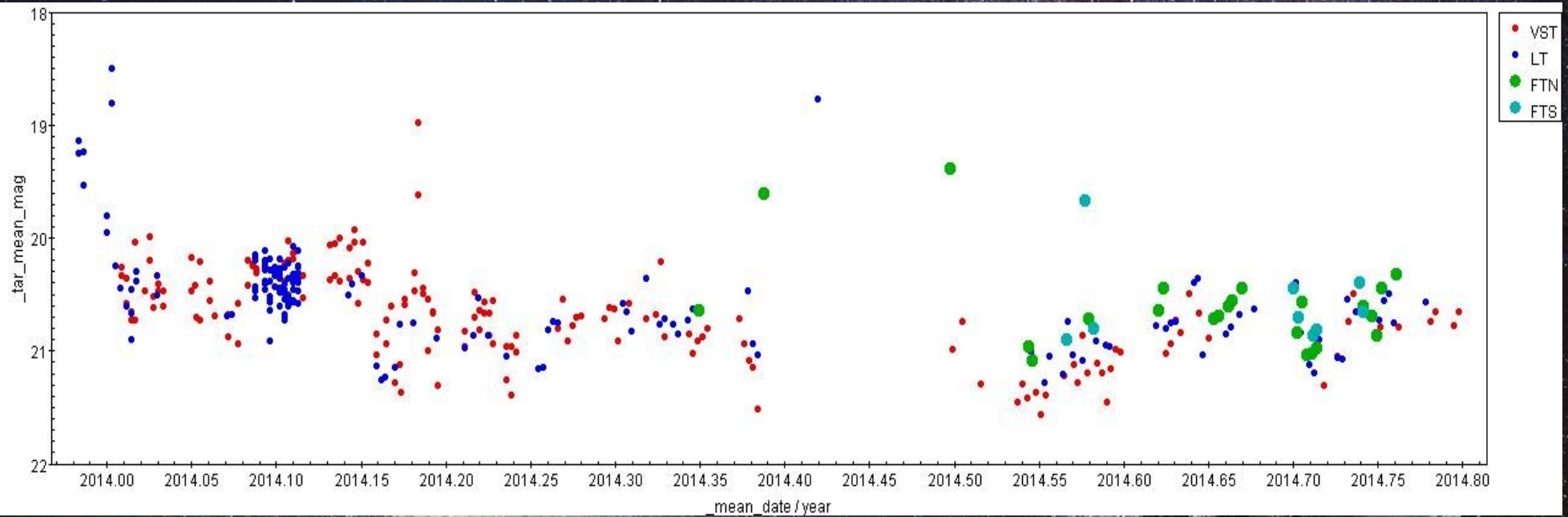
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Gaia's Brightness

- GBOT's own photometry



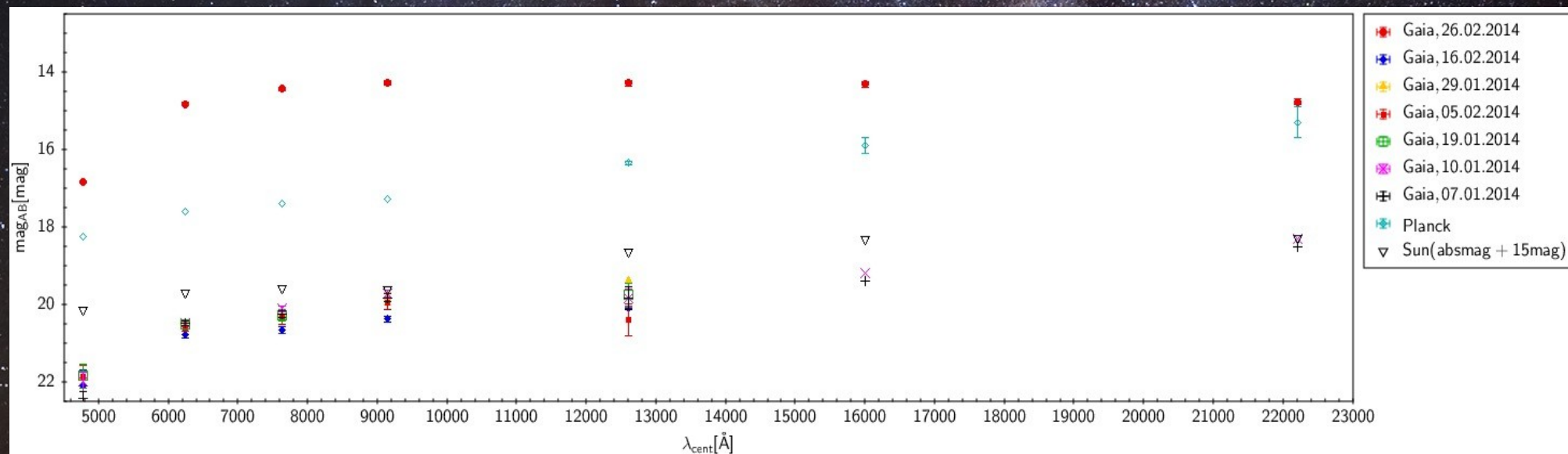
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Gaia's Brightness

- GROND grizJHK simultaneous photometry

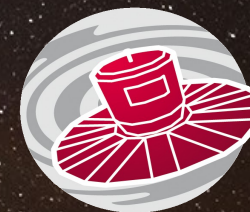


Gaia's Brightness

- No unexplainable trends in Brightness
- Distance, elongation and EAA play a role
- Brightness ranges between 20.2 and 21.6



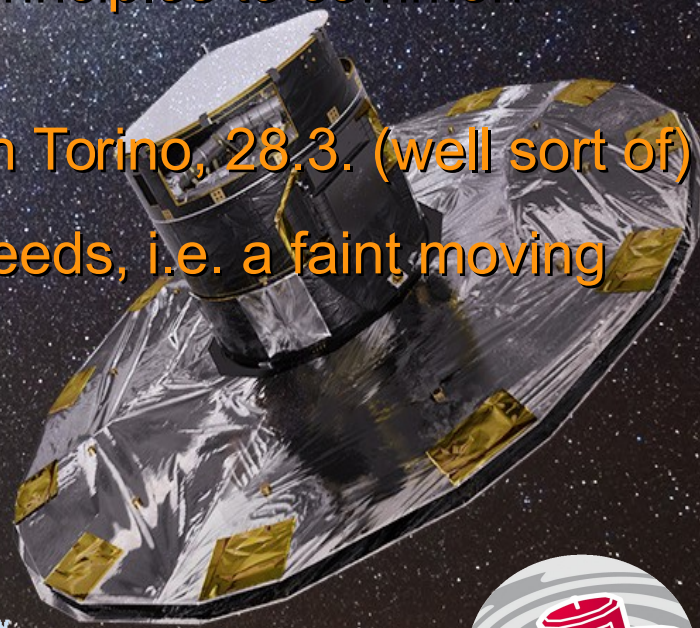
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Theoretical foundations

- Sub-sky level forced brightness us to explore the limits one can reach with our means
- Cramer Rao lower boundary provides theoretical limit of what can be achieved.
- Mendez et al. (2013) have applied these principles to common astrometric scenarios
- Meeting with Mendez of MA, SB, RS, AA in Torino, 28.3. (well sort of)
- Bouquillon is extending this study to our needs, i.e. a faint moving object

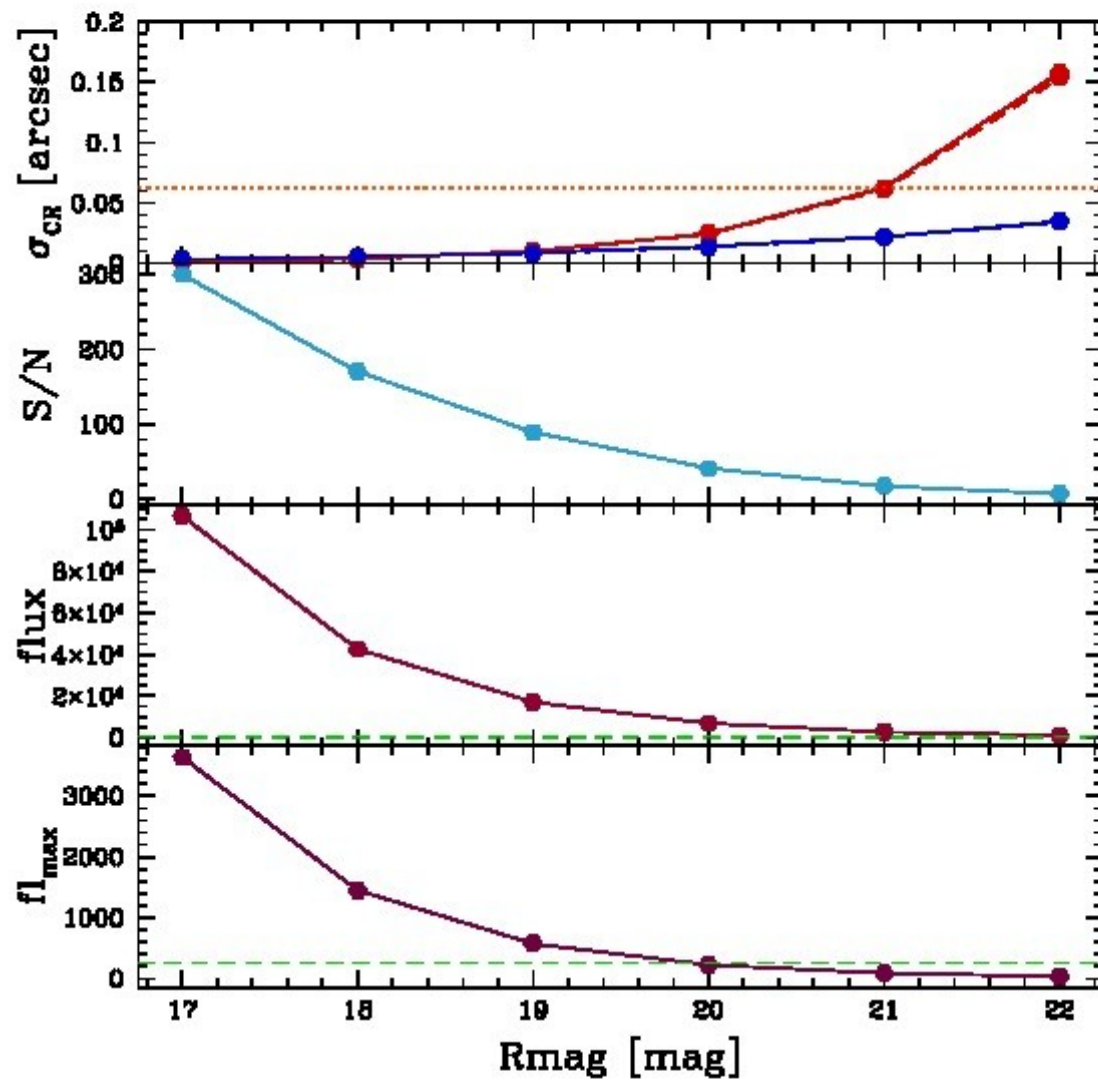


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Theoretical foundations

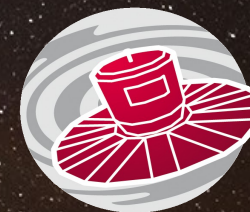


Theoretical foundations

- 2m+ telescopes needed
- For 2.6 m VST 10x60 secs is adequate
- For smaller telescopes, CRLB is near the limit
- 15x60 secs may be the better deal
- Sebastien Bouquillon: exptime might be optimised
- **We are still in business!**



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Measurements

- VST is backbone
- LT delivers useful data in 40%
- Faulkes less, reason still not clear
- Telescopes are obtaining data at nominal rate
- Observing strategy needs to be optimised for optimal usage of resources
- Other telescopes might be considered, Calar Alto, UHawaii, etc.

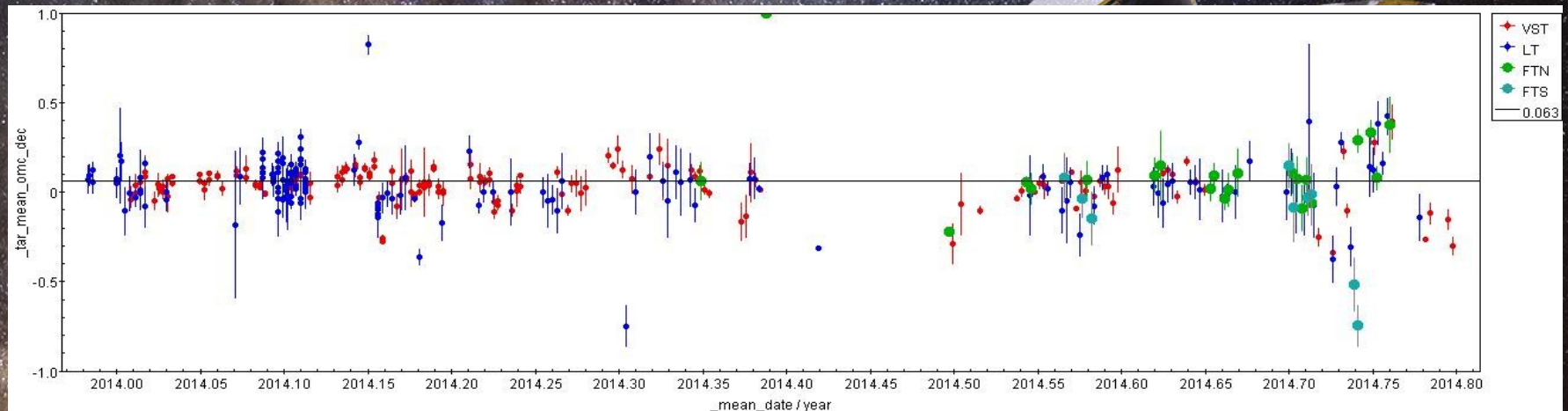
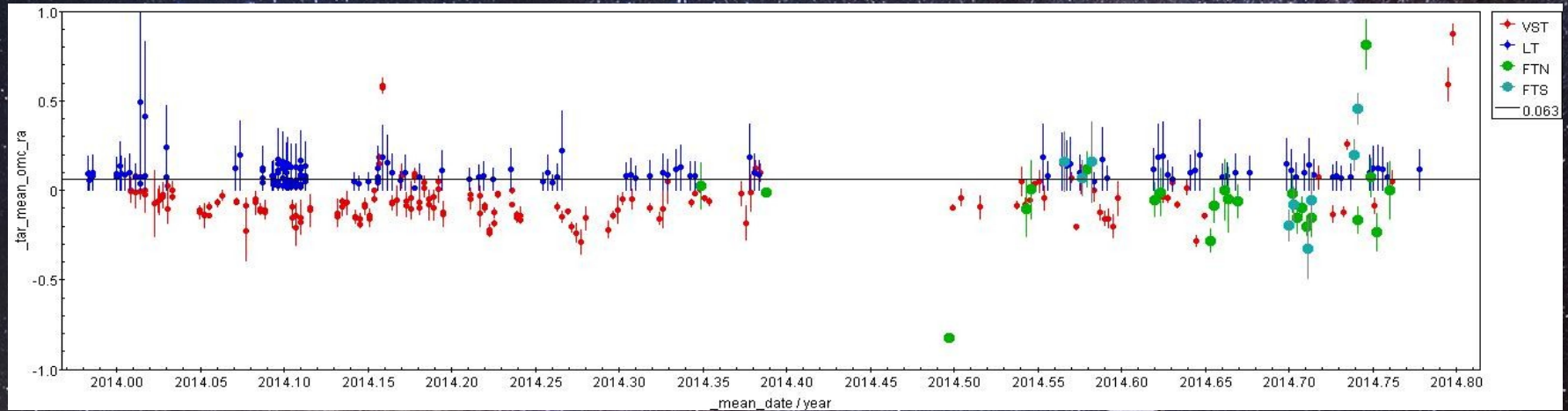


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Measurements

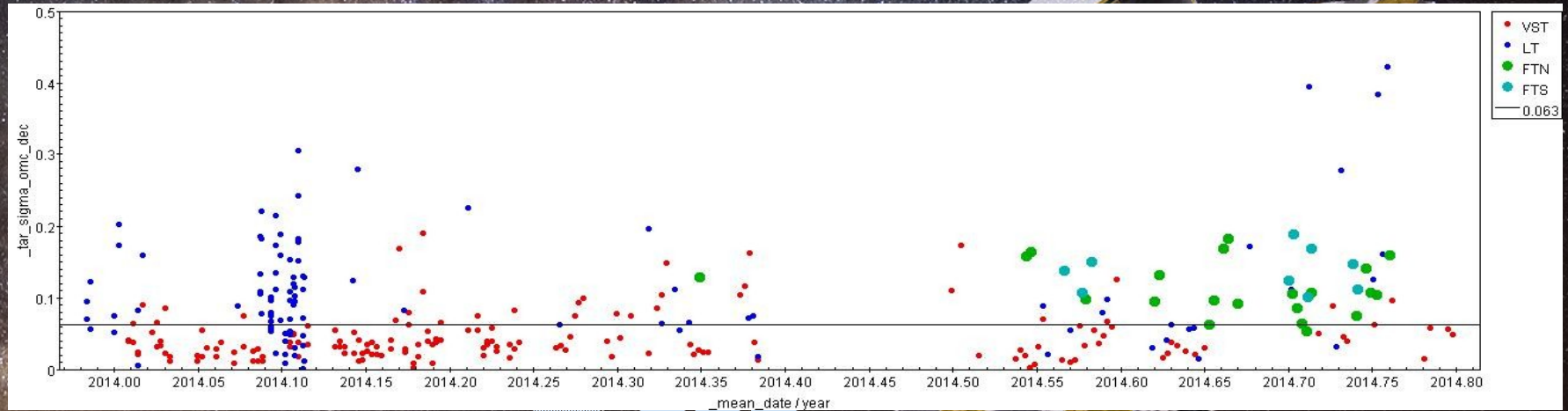
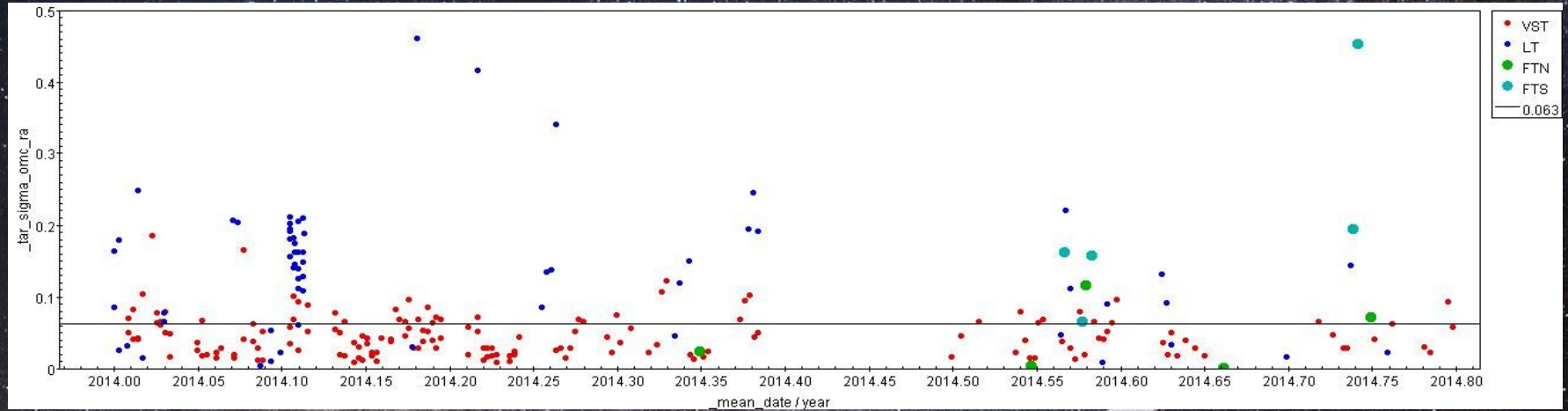


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Measurements

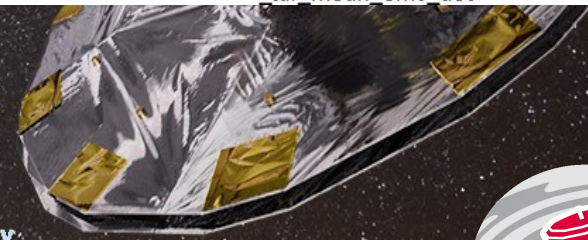
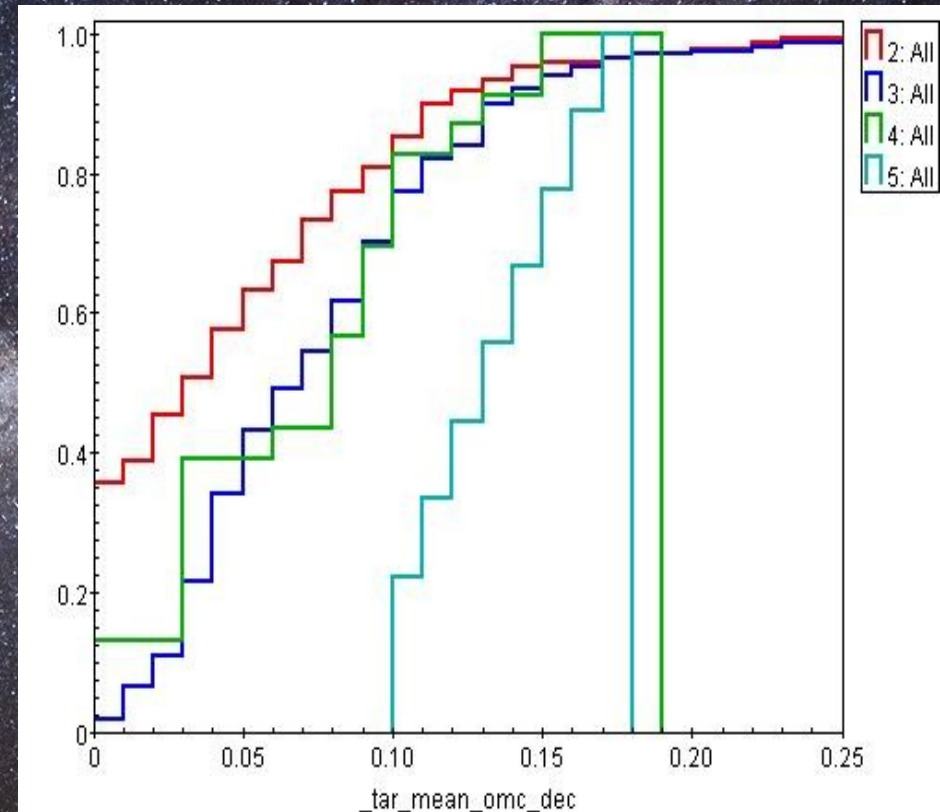
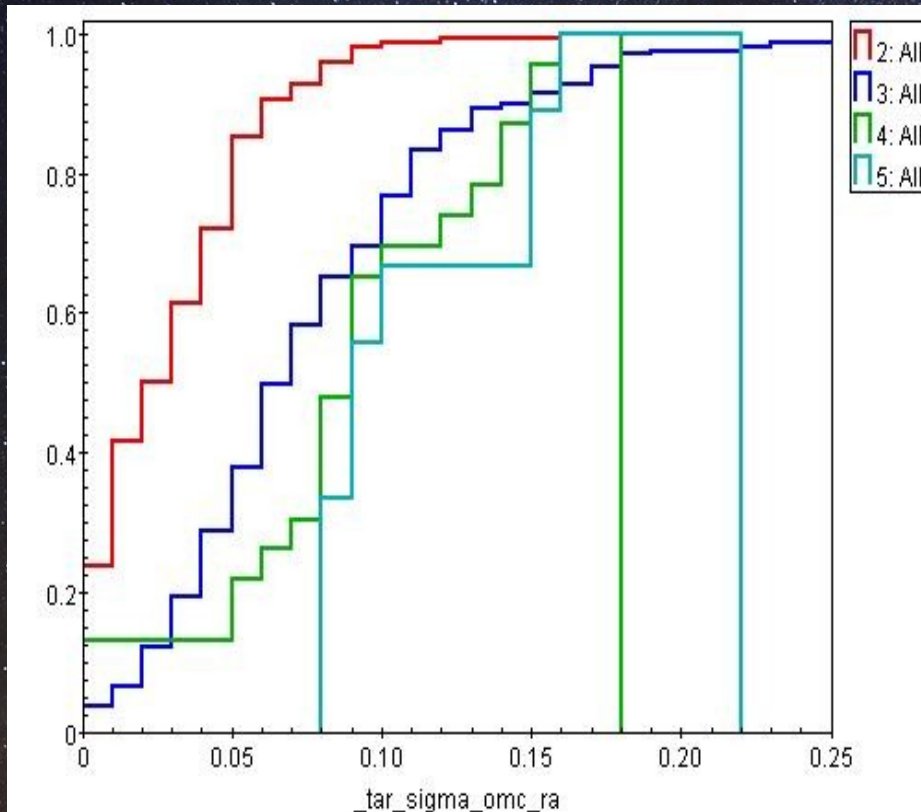


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Measurements

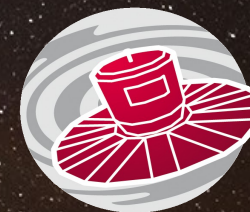


Measurements

- VST delivers useful data for about 65% of the nights (incl. FM break)
- LT somewhat less
- VST sufficient precision
- LT should be enhanced to 15x60 secs
- Both can deliver GBOT grade data
- FTs like LT?
- Compromises
 - Larger Full moon break
 - More bad data, i.e. Ambient conditions more important
 - Background stars larger problem



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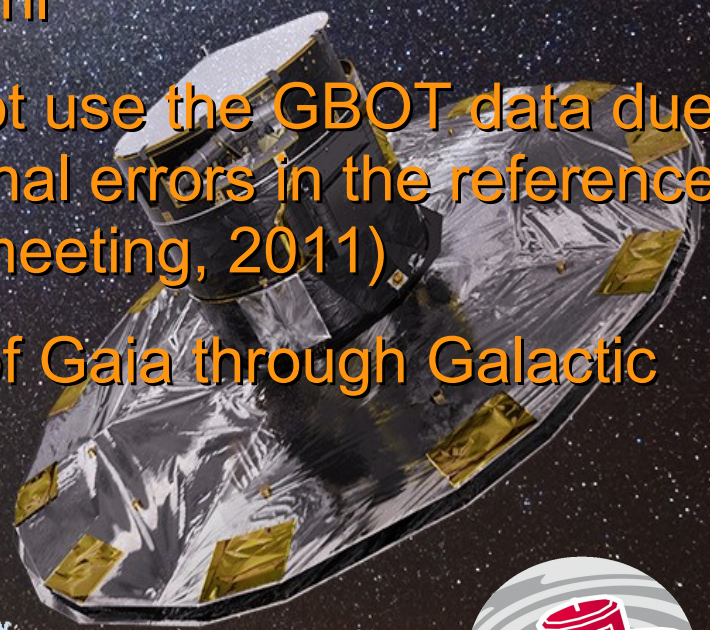
Recommendations

- Current network: VST, LT, FTS, FTN
- Adjustments of observing sequence
 - 2.0 m telescopes: 15x60 sec instead of 10x60, better would be even more exposures per sequence; VST: okay
- Adjustment of operations mode
 - VST being backbone facility
 - LT/FT being triggered, when VST is not available (bad weather, visitor observations, technical reasons)
 - Significantly increasing sequence cadence
 - Trigger mode being tested now
- Aim is 75% within specs for each delivered sequence

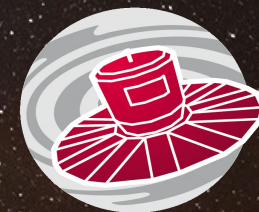


Current status

- Nominal operations, 21-24 days/month, full moon break 7 nights (VST: 5 nights)
- Reassessment phase ongoing, moving from overall feasibility to optimisation, until March 2015
- Monthly deliveries to ESOC since April
- FD team at ESOC does at current not use the GBOT data due to the accuracy issues caused by zonal errors in the reference catalogue (to be expected, GBOT2 meeting, 2011)
- June difficult month, due to pasage of Gaia through Galactic centre



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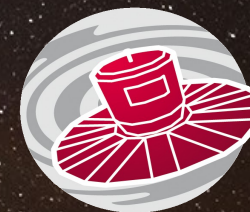
Triggered mode

- VST delivers data in sufficient precision, but has gaps, due to weather, visitor observers (seldom, since VM is not generally offered for VST), technical problems
- Other telescopes have difficulties reaching criteria with 10 or 15 exposures
- Sequence with more exposures desirable
 - Time budget limits
 - Longer sequences make daily exposures difficult or less feasible
 - Duplicate sequences
- Better organisation of GBOT resources required → Triggered mode
 - Closes gaps in VST data
 - Allows longer sequences at LT/FT if not daily observations



Triggered mode

- VST most reliable source, quantity, quality → backbone of GBOT operations
- Other telescopes are backup, triggered when VST is not available
- Trigger events
 - ESO Paranal weather forecast
 - 1 night without VST data
 - Information from ESO (technical downtime, visitor mode (VST normally not offered in VM))
- GBOT office does coordination
 - Daily consulting of Paranal weather forecast
 - Communication with ESO
 - Invoking triggers at LT/FT
- Currently triggered mode is being tested

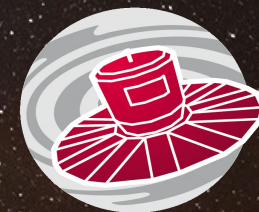


Towards the Re-Reduction

- Current results only preliminary
 - Limits of reference material astrometric accuracy
 - Photometry of the background stars (DCR)
- Final results with Gaia data
 - First release mid-2016
 - Photometry somewhat later
- 2015 GBOT will prepare for this crucial phase
 - Optimisation of pipeline & database
 - Roadmap



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GBOT goes asteroid hunting

- Gaia is located near the plane of the ecliptic
 - Many main belt asteroids in this region of the sky
 - Some will be recorded on the GBOT data
- Search for asteroids can be conducted automatically with some moderate adjustments to our pipeline
- Not a huge scientific impact expected, but some new findings and improvements to orbits possible
- Decision: not hi-priority but “why not”
- Paris group and Jon Marchant (LJMU) implemented asteroid search



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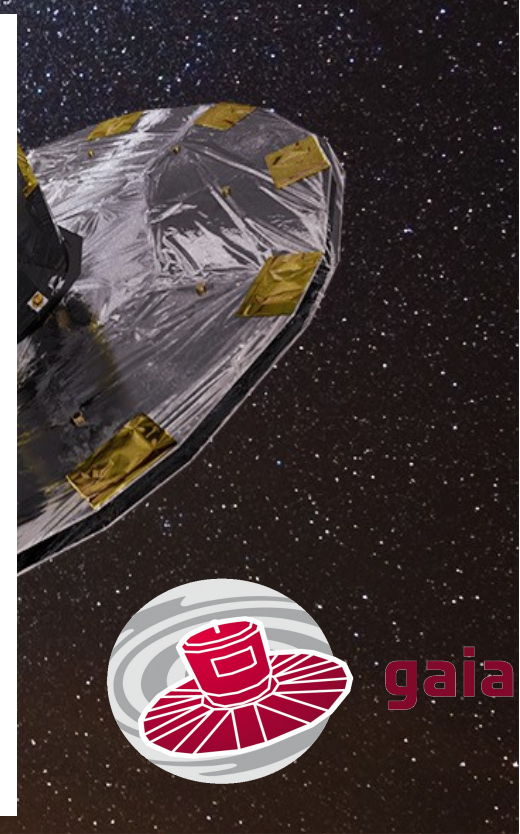
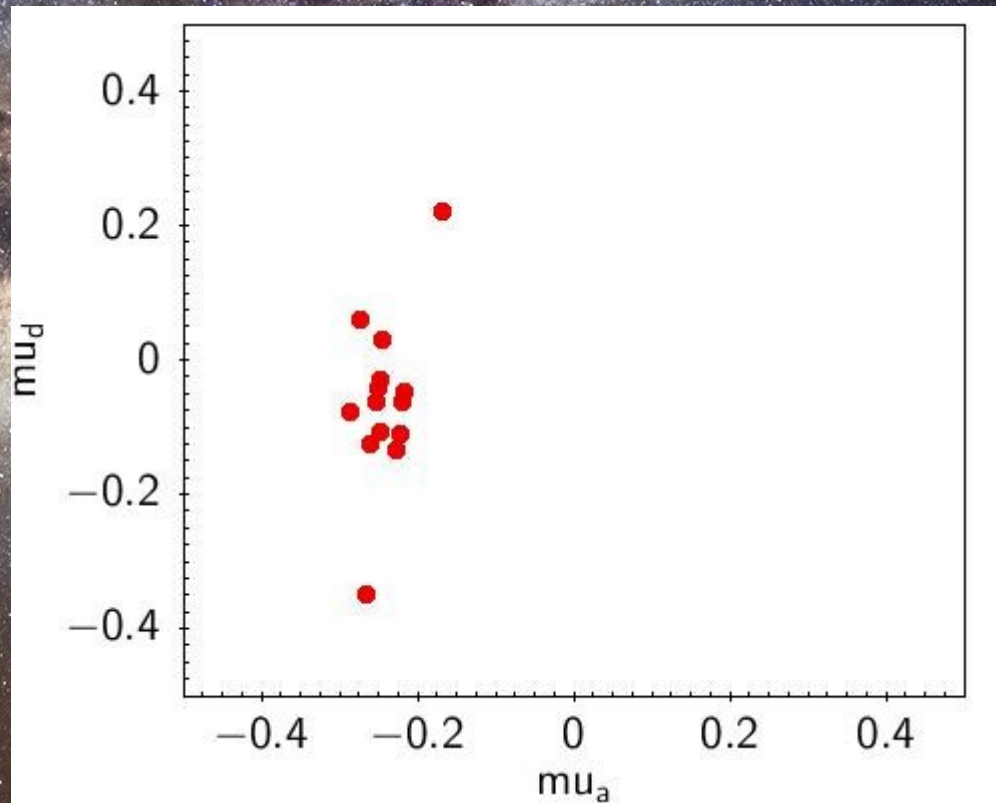
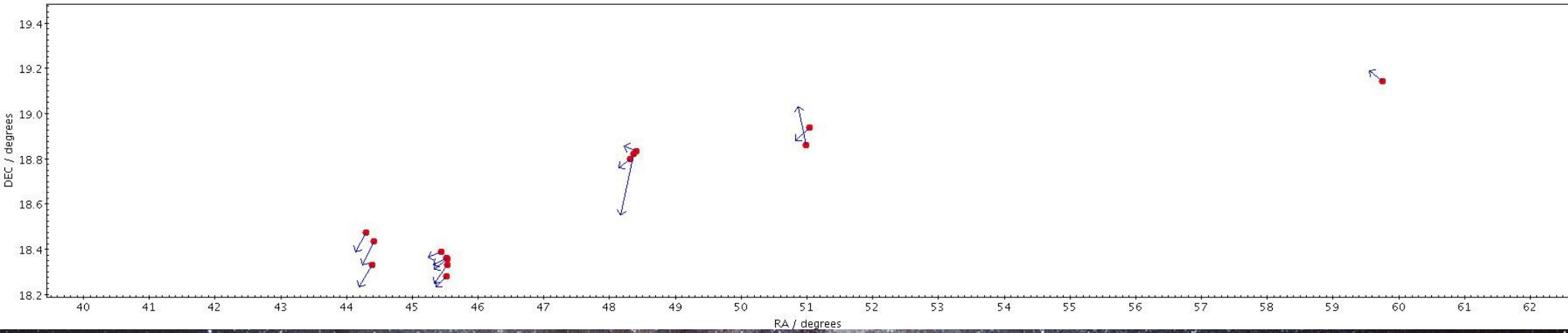
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GBOT goes asteroid hunting

- Since 30.10. about 25 objects found
 - 16 not yet registered at MPC
 - Rest recent discoveries with preliminary ID
 - Magnitudes 18 to 22
 - Data sent to MPC
- Problem, GBOT can only provide one epoch
- Follow up needed
- Potential larger than originally anticipated



GBOT goes asteroid hunting

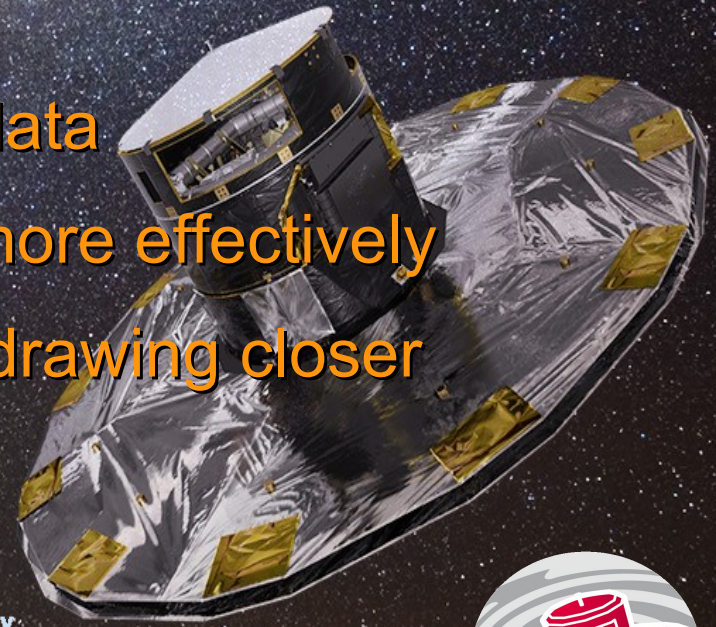


Gaia
DPAC

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Summary & outlook

- Since launch magnitude shock, GBOT has gone through a rigorous reassessment process
- Reassessment ongoing, also to cover one full orbit
- With some compromise GBOT can still reach the aims in terms of precision
- Larger gaps and more discarded data
- Fewer resources are being used more effectively
- The hour of truth (re-reduction) is drawing closer
- GBOT finds asteroids :-)



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We are not quite there yet...
... but getting there!

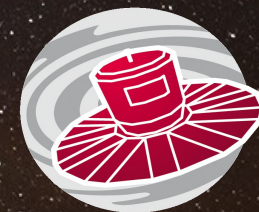
HAPPY

Pharrell Williams

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