



gaia

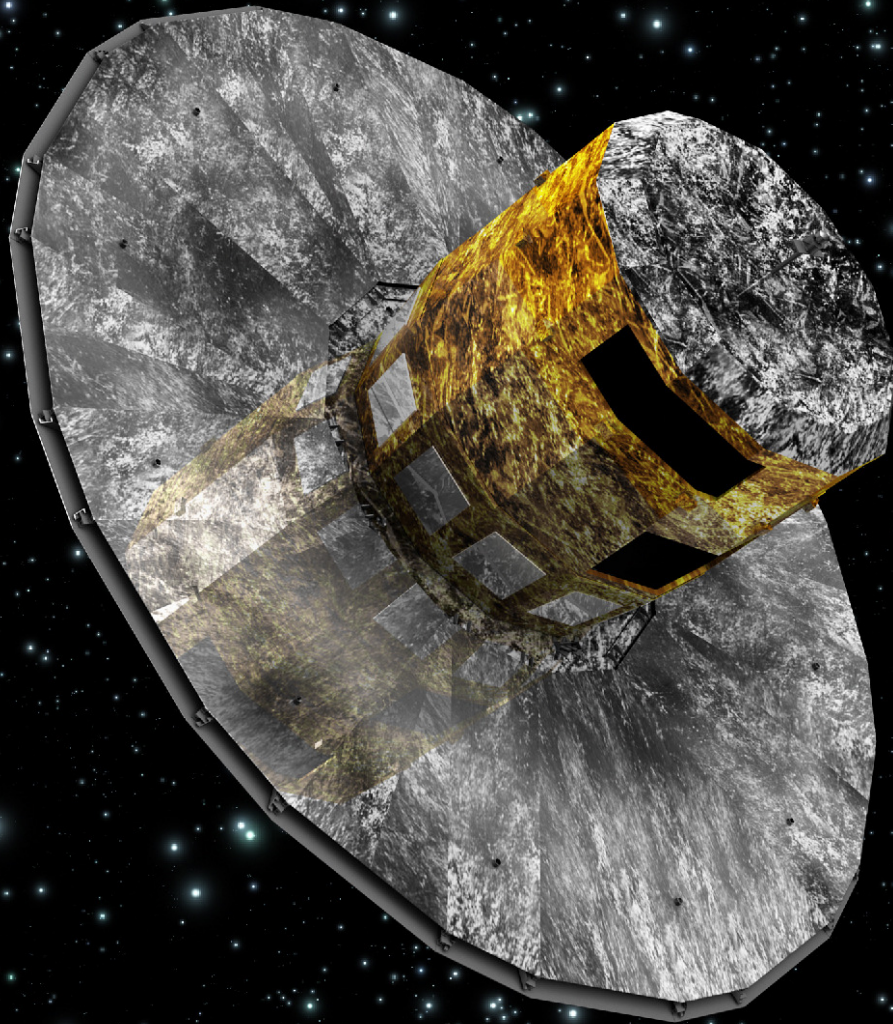


Gaia as a Tool for JWST Target Selection

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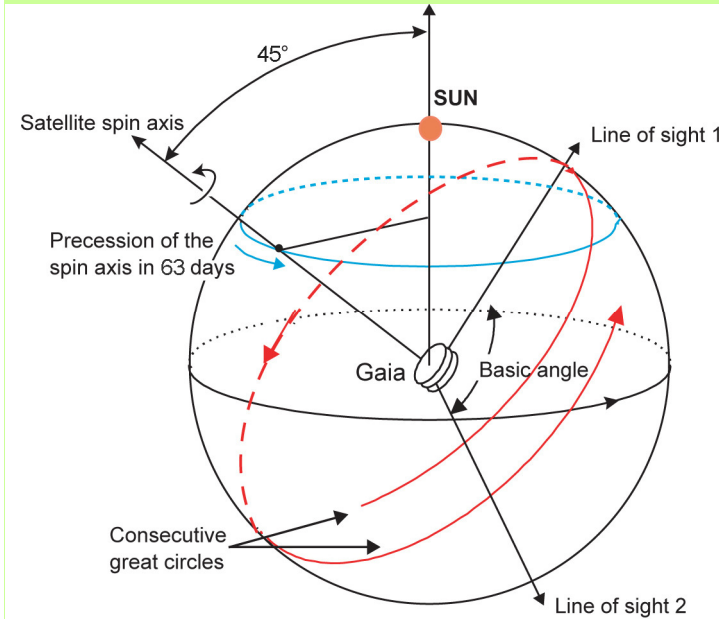


Successfully launched on December 19th, 2013!



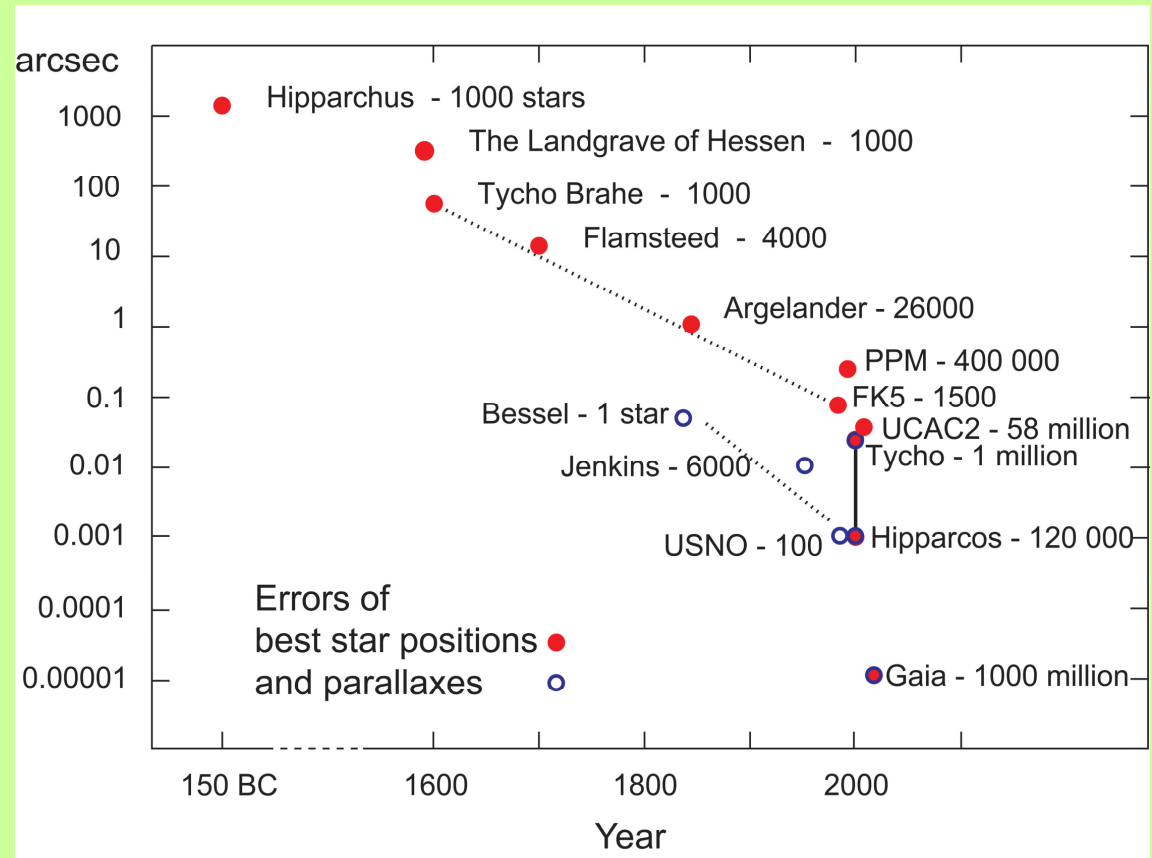
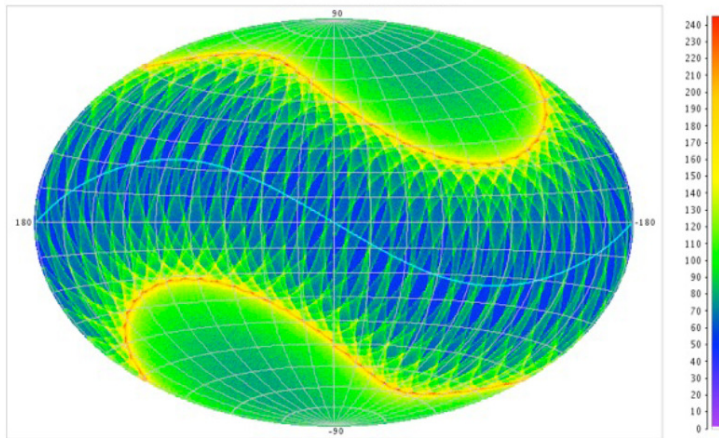
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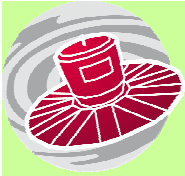
Gaia: a 10 μ as machine!



**At the V=20 survey limit:
>1 billion stars observed!**

Number of FoV crossings per star (5 yr)



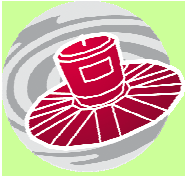


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Intermediate Data Releases

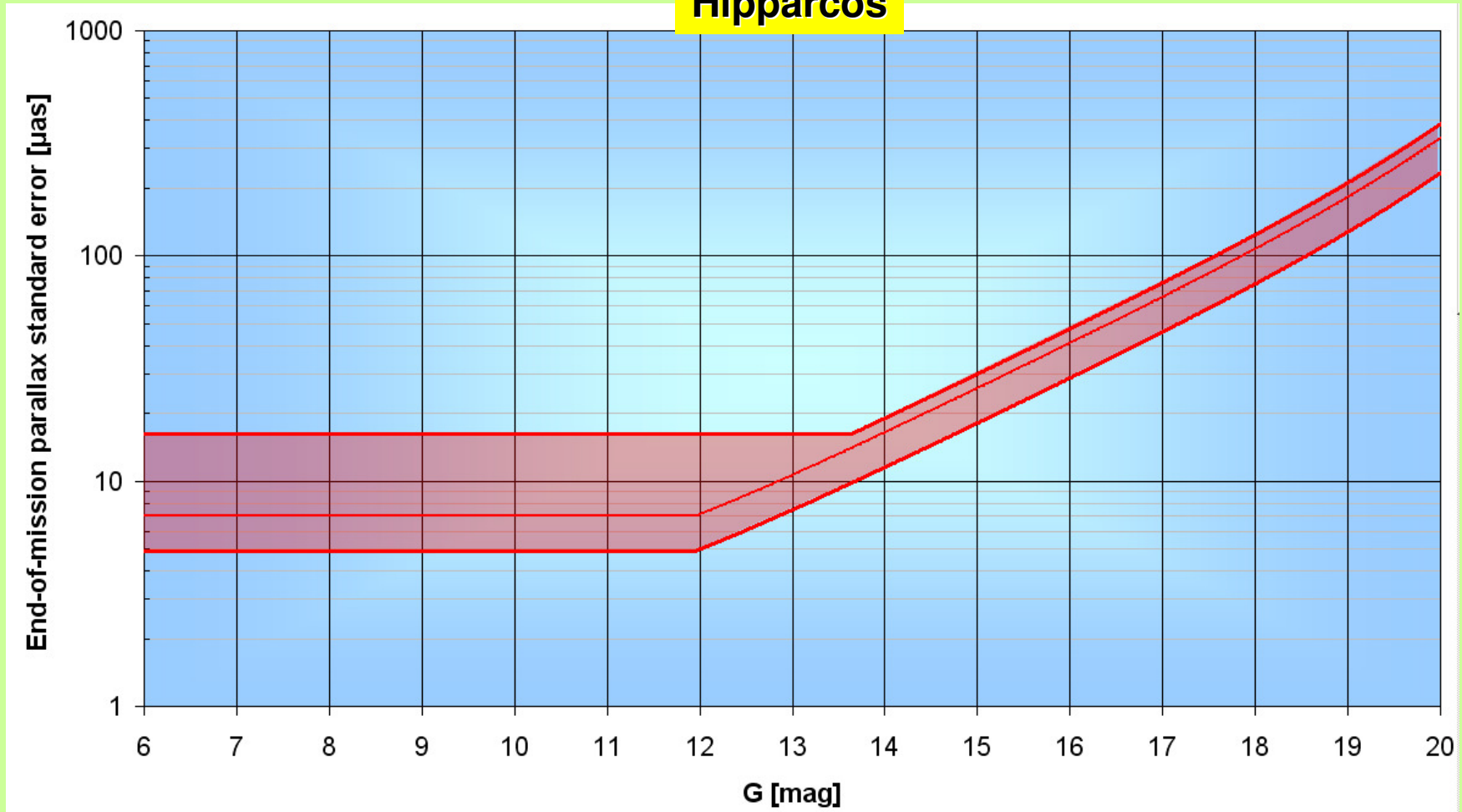
- Intermediate Data Release Scenario agreed with inputs from Data Release Policy and DPAC Operations Plan
 - Science Alerts as soon as possible
 - L+22m positions, G-magnitudes, proper motions to Hipparcos stars, ecliptic pole data
 - L+28m + first 5 parameter astrometric results, bright star radial velocities, integrated BP/RP photometry
 - L+40m + BP/RP data, some RVS spectra, astrophysical parameters, orbital solutions for short period binaries
 - L+65m + variability, solar system objects



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Hipparcos



1. (2?) $6 < G < 12$: bright-star regime (calibration errors, CCD saturation)
2. $12 < G < 20$: photon-noise regime (sky-background and electronic noise at $G \sim 20$ mag)



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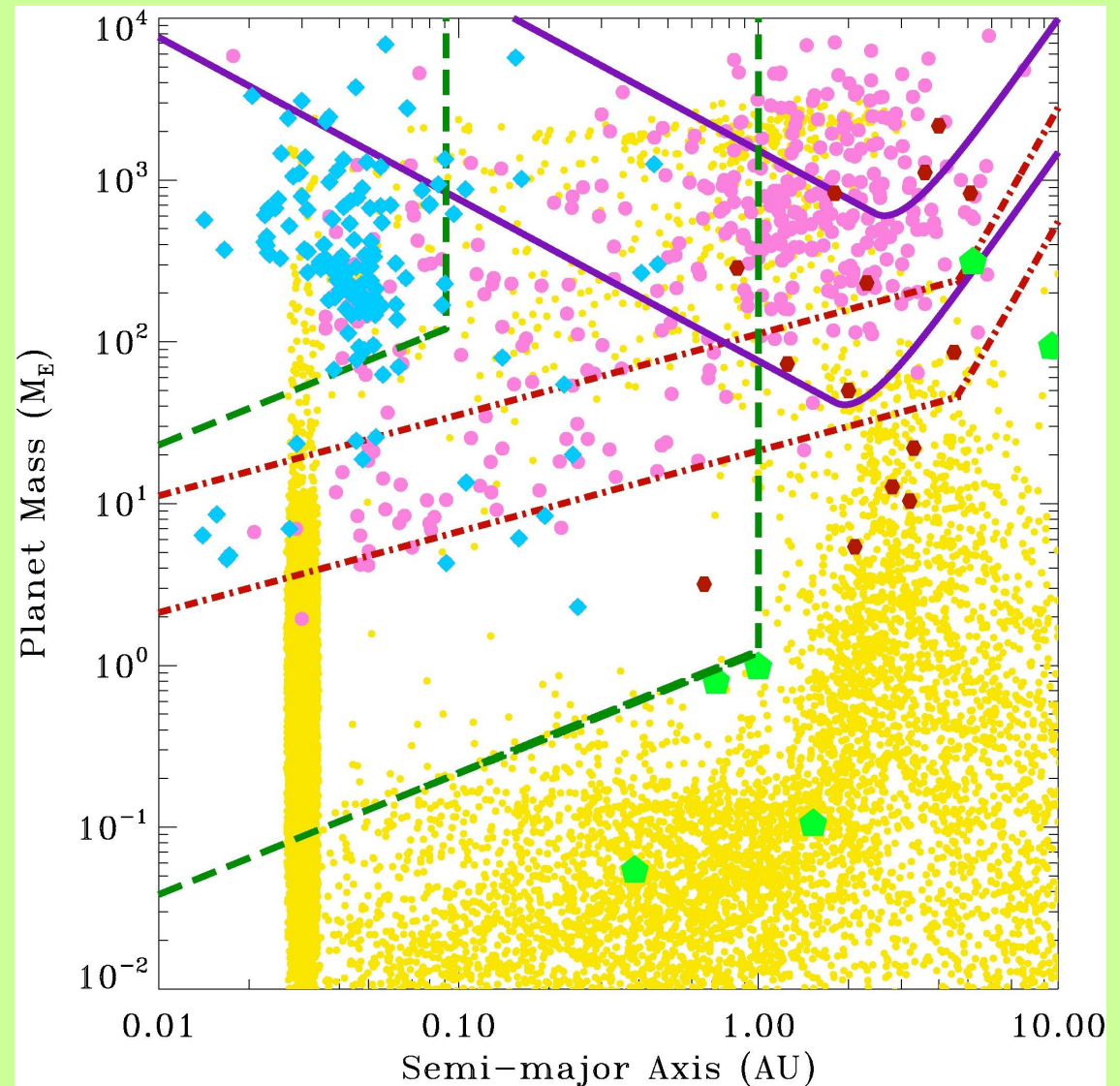
Gaia Discovery Space

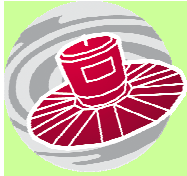


- 1) 2-3 M_J planets at $2 < a < 4$ AU are detectable out to ~ 200 pc around solar analogs
- 2) Saturn-mass planets with $1 < a < 4$ AU are measurable around nearby (< 25 pc) M dwarfs

For Gaia: $\sigma_A \sim 15-20 \mu\text{as}$

Sozzetti 2011



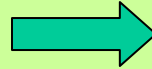


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How Many Planets will Gaia find?



F-G-K Star counts ($V < 13$),
 $F_p(M_p, P)$,
Gaia completeness
limit



Δd (pc)	N_\star	Δa (AU)	ΔM_p (M_J)	N_d	N_m
0-50	~10 000	1.0 - 4.0	1.0 - 13.0	~ 1400	~ 700
50-100	~51 000	1.0 - 4.0	1.5 - 13.0	~ 2500	~ 1750
100-150	~114 000	1.5 - 3.8	2.0 - 13.0	~ 2600	~ 1300
150-200	~295 000	1.4 - 3.4	3.0 - 13.0	~ 2150	~ 1050

Casertano, Lattanzi, Sozzetti et al. 2008

How Many Multiple-Planet Systems will Gaia find?

F-G-K Star counts ($V < 13$),
 $F_{p,mult}$
Gaia detection
limit

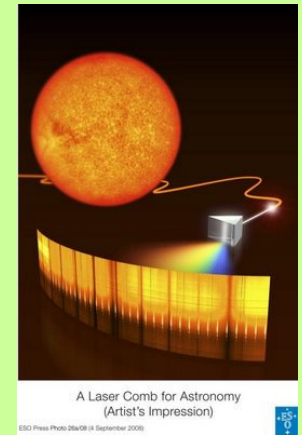
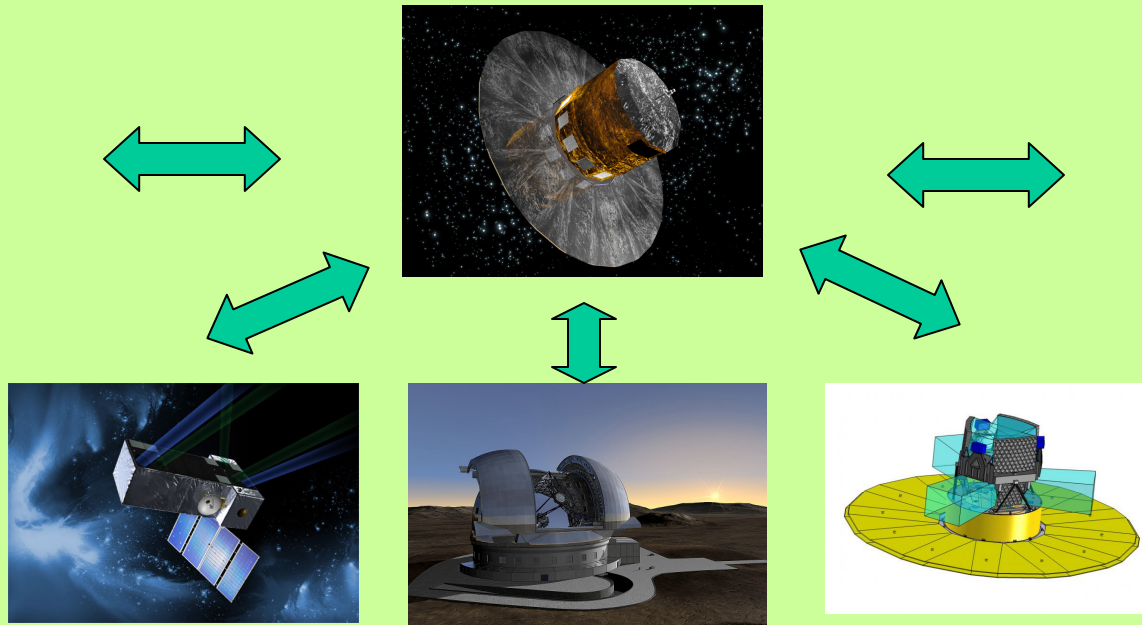
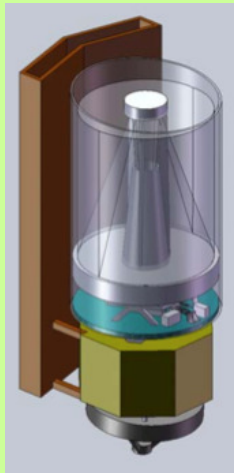


Case	Number of Systems
Detection	~ 1000
Orbits and masses to better than 15-20% accuracy	~ 400 - 500
Successful coplanarity tests	~ 150

Unbiased, magnitude-limited planet census of $>10^5$ F-G-K dwarfs



Gaia - Synergies



- **Gaia & spectroscopic characterization observatories (e.g., JWST)**
- **Gaia & transit surveys from the ground (e.g., S-WASP, APACHE, NGTS) and in space (CoRoT, Kepler, CHEOPS, PLATO)**
- **Gaia & direct imaging observatories (e.g., SPHERE/GPI, PCS)**
- **Gaia & RV programs (e.g., HARPS(-N), ESPRESSO, CARMENES, and the likes)**
- **Gaia & ground-based (VLT/ELT) and space-borne astrometry (NEAT)**

Objectives of study within the GREAT ESF-RNP/FP7-ITN



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Gaia transiting candidates?



- Low-cadence of the observations a serious limitation
- It's not hopeless if you have the right tools! (Dzigan & Zucker 2012)
- It can work for early detections of (1000?) short-period transiting Jupiters, BUT:
 - A) It will depend upon the actual content of Gaia early data releases
 - B) It will require the definition of transit candidates as Science Alerts (TBD)
 - C) It will require a dedicated follow-up network
 - D) Confirmation efforts will be limited by V mag (typically, $V > 14$ mag)

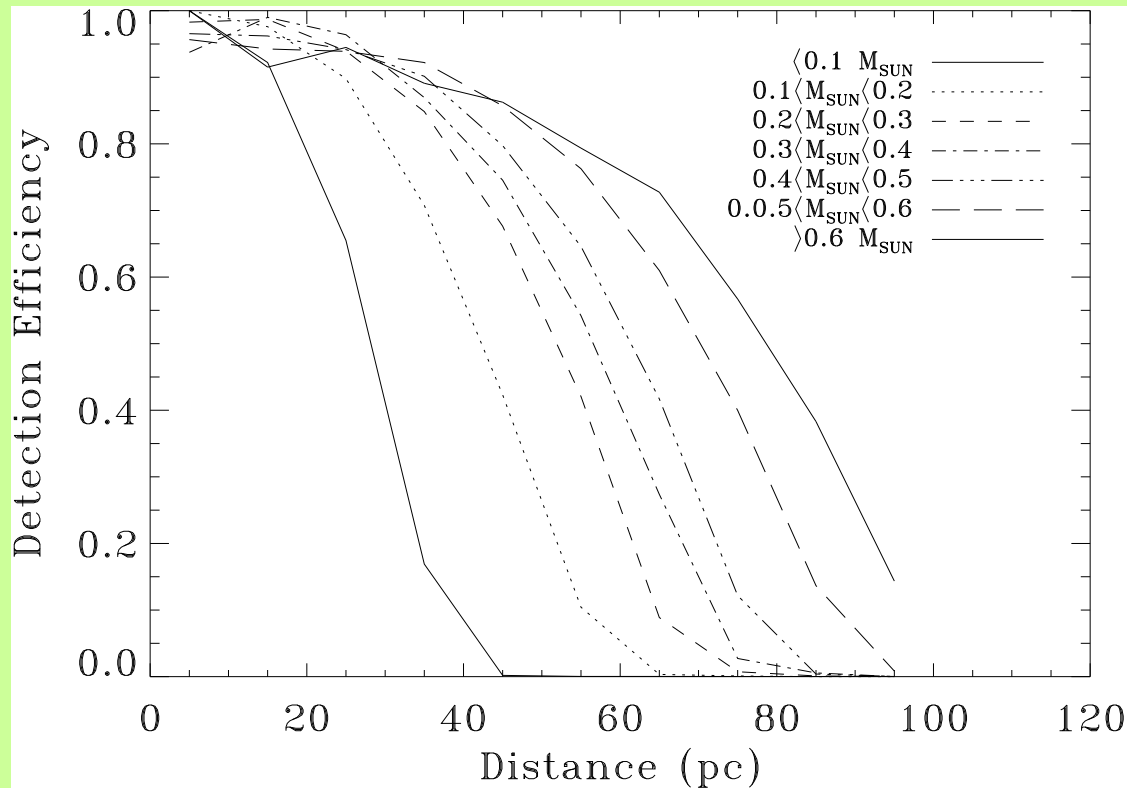


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Gaia & Low-Mass Stars



- M dwarfs starcounts to $G=20$ within 100 pc: ~500k stars
- Expect >2500 giants detected, ~1000 accurate orbits



Sozzetti et al. 2014



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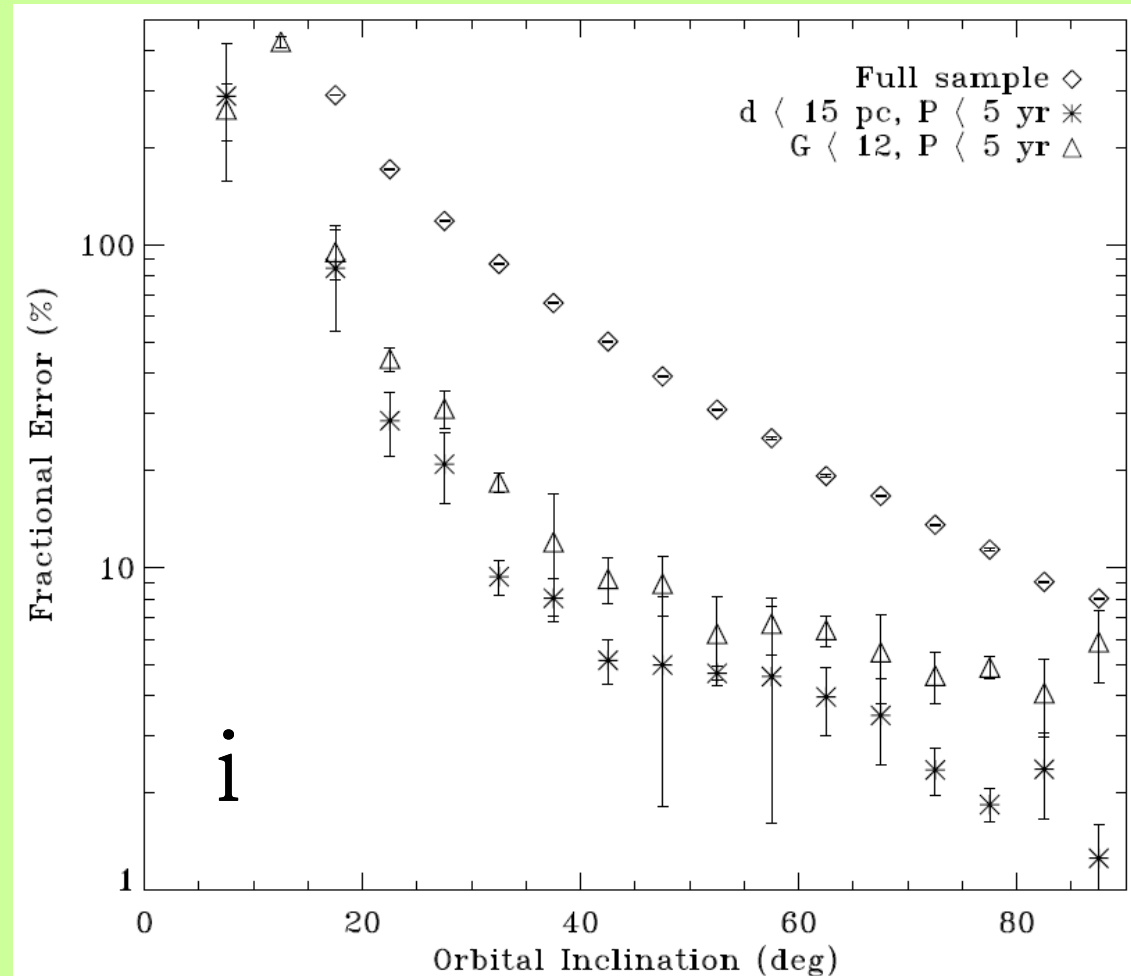
Finding Nearby Transiting Wide-Separation Giants



Sozzetti et al. 2014

For well-measured, quasi-edge-on orbits, i is measured to ~3%

Gaia may find hundreds of candidate transiting giant planets around M dwarfs. Some may be really transiting!



Follow-up efforts, possible targets for JWST



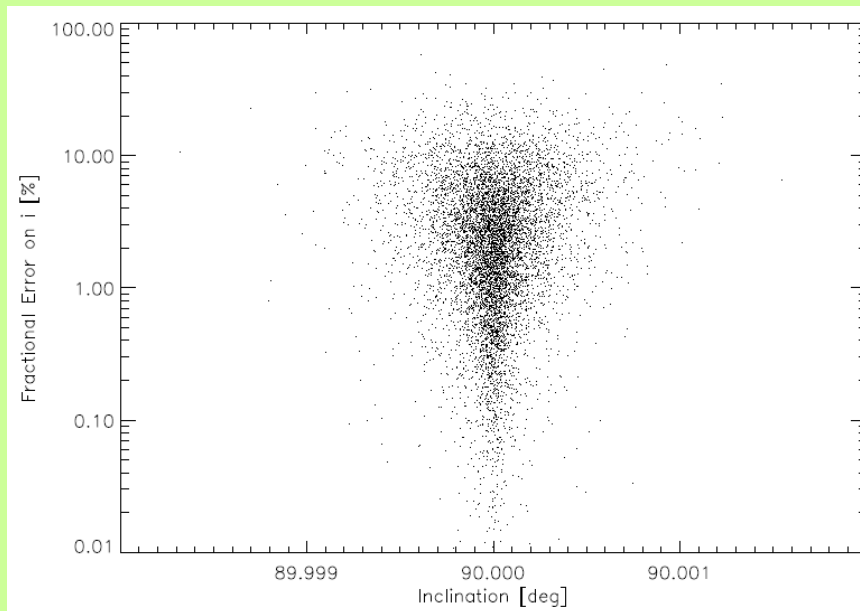
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Focus on Bright M Stars

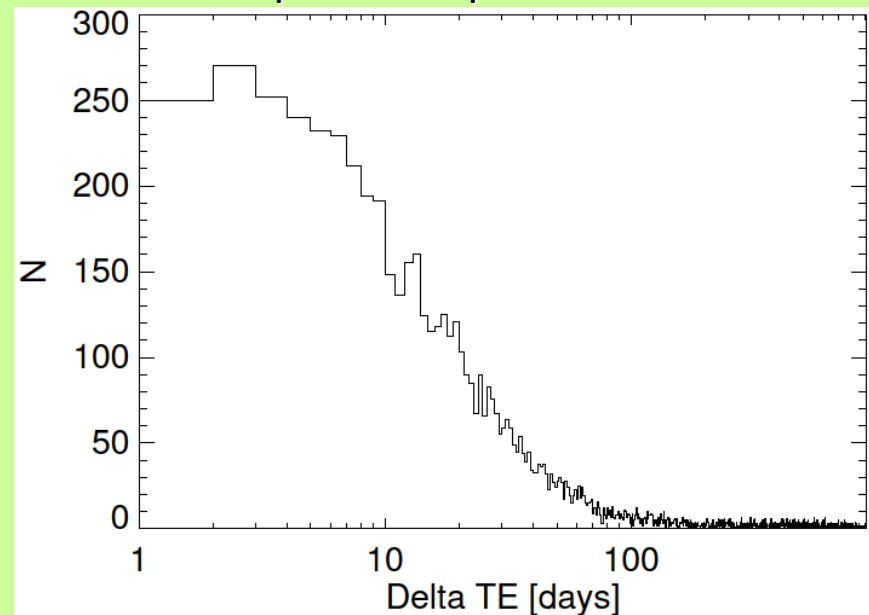


10^4 J<9 dwarfs from Lepine & Gaidos (2011)

Inclination determination



Ephemeris prediction



- Typically, determine $i = 90 \pm 2$ deg
- Typically, determine TE with ~ 20 days accuracy for periods up to 2 yrs



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Gaia Contribution



- > Saturn-mass planets with $P > 60$ d or so (Cold)
- Some maybe transiting, some maybe very eccentric
- Hosts with all spectral types, metallicities, ages (bright-ish, $V < 14$)
- (Possibly) transiting Hot Jupiters and Saturns (faint-ish, $V > 14$)