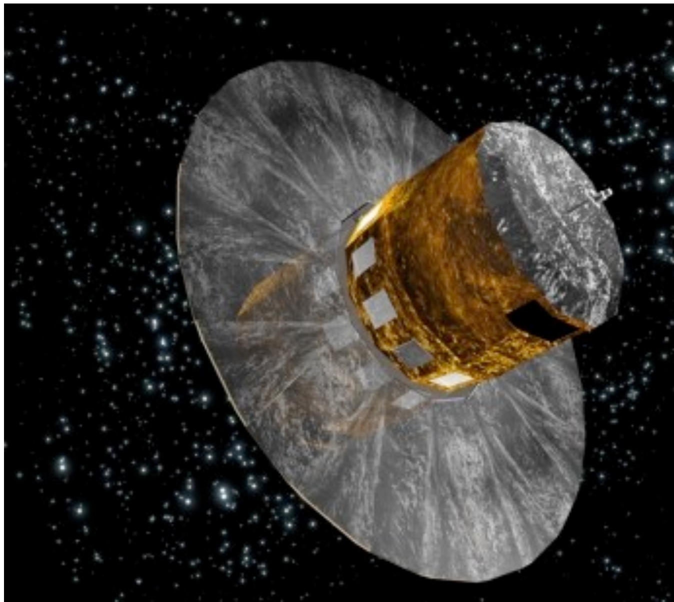
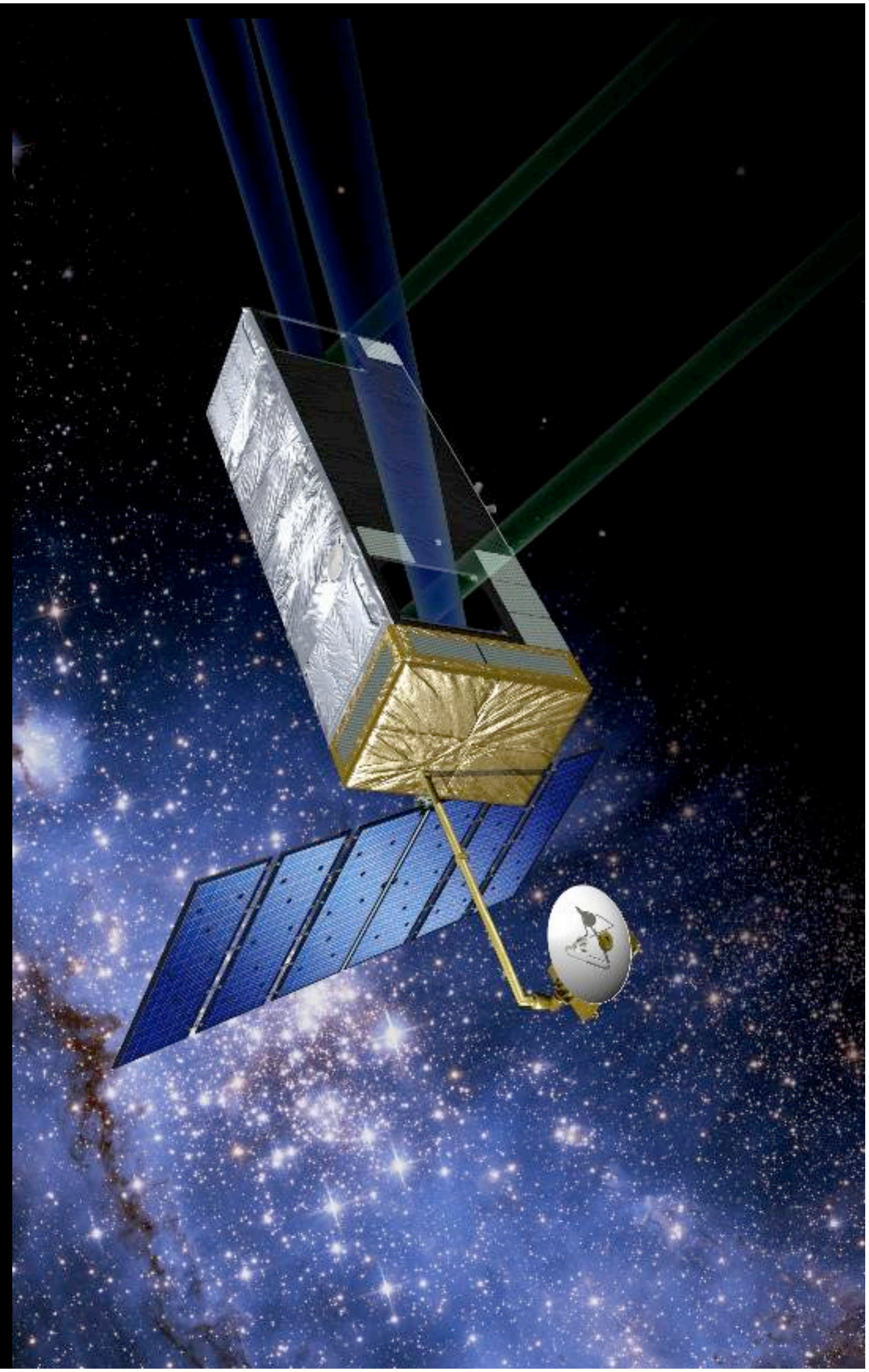




Gaia-SIM legacy project

Guillem Anglada-Escudé

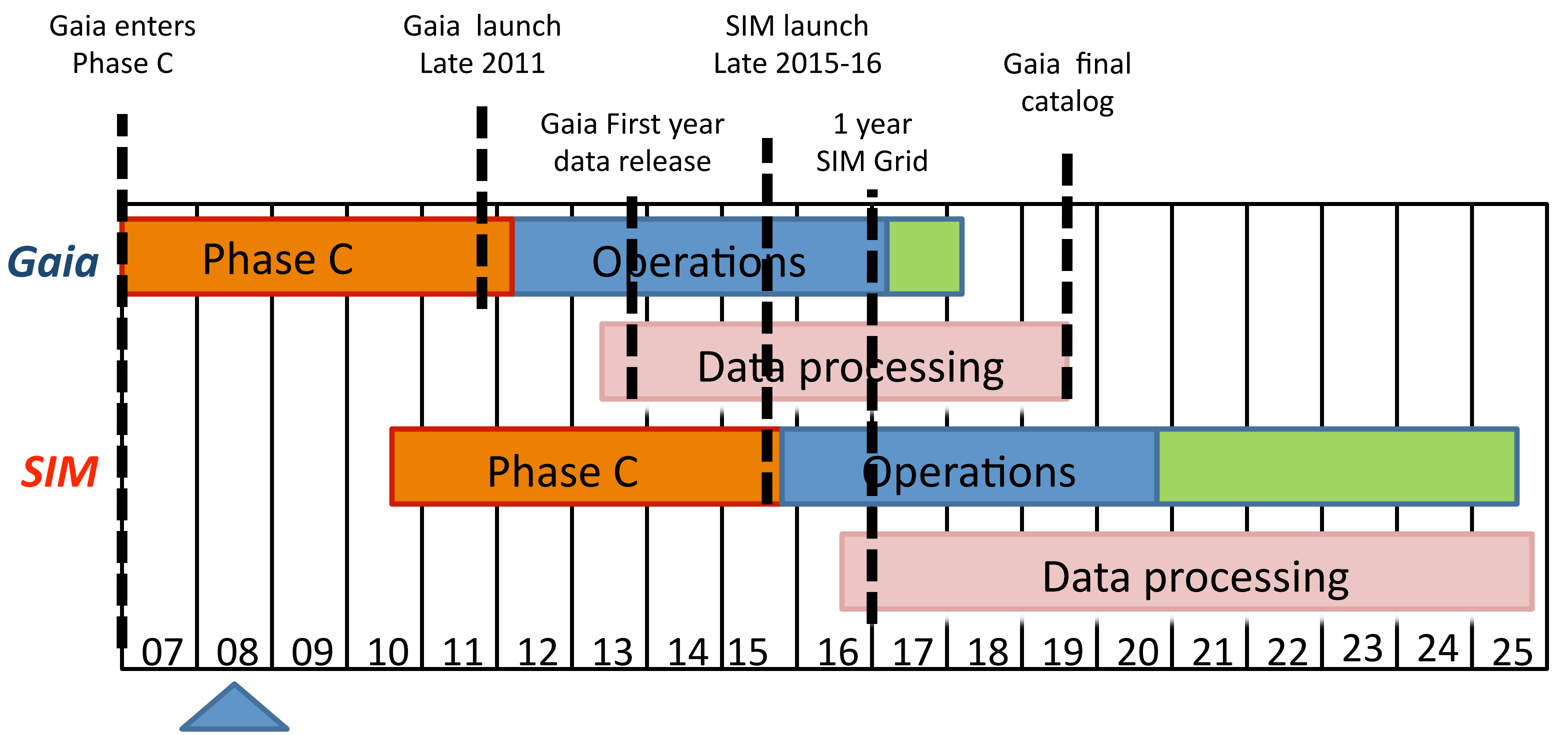
John H. Debes

Department of Terrestrial Magnetism

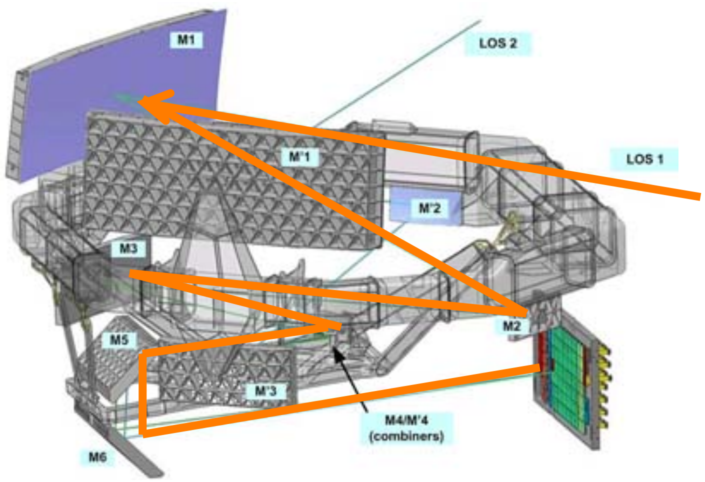
Carnegie Institution for Science

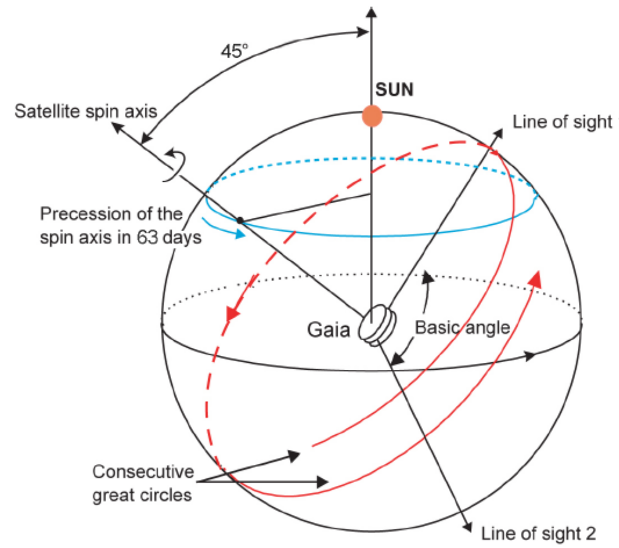
Aims of this study

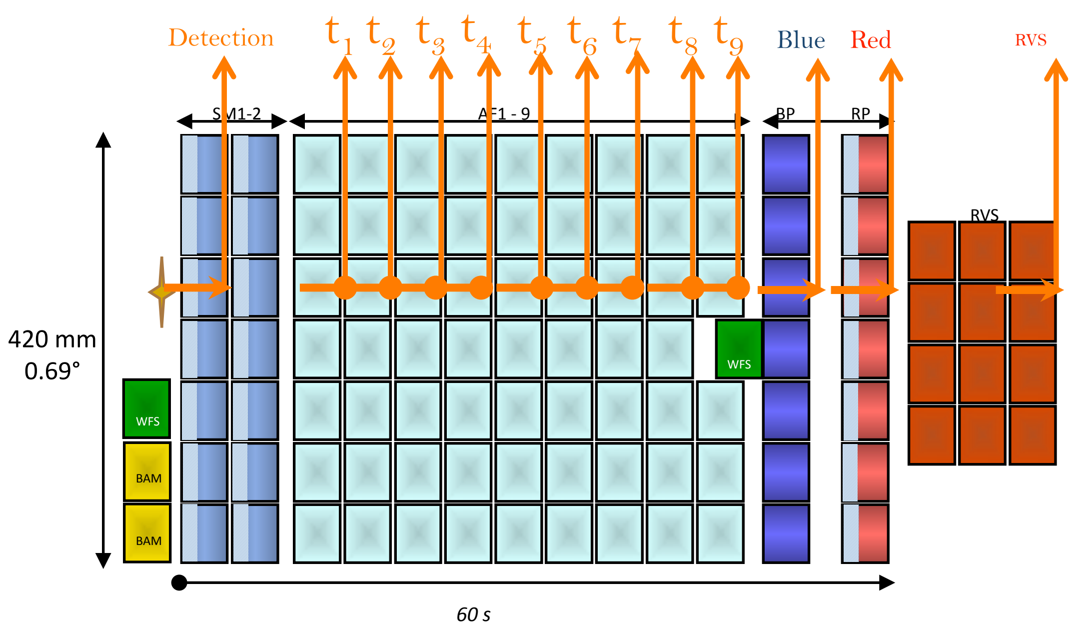
- Explore **<u>the benefits for long time</u>** baseline astrometric observations
- Define the **<u>strategies to combine Gaia + SIM</u>** observations
- Address a **<u>few representative science cases</u>** of interest
- Evaluate how SIM projects can benefit from the knowledge acquired from the Gaia dataset



How does Gaia work?







80 astrometric epochs

80 Blue+Red low resolution spec

50 Ca triplet spectra

What's going to be available at SIM launch (2015-2016)

- Full sky survey, complete up to V~20. Data processing NOT finished
- One bilion objects 10^9. Each source observed ~80 times in a 5 years baseline.
- Accuracy as a function of magnitude

50 μas/epoch at 10<V<13

200 μas/epoch at V~15

500 μas/epoch at V~19

- Simultaneous spectrophotometry (Blue + Red)
- Simultaneous Radial velocities at moderate accuracy (V<16)

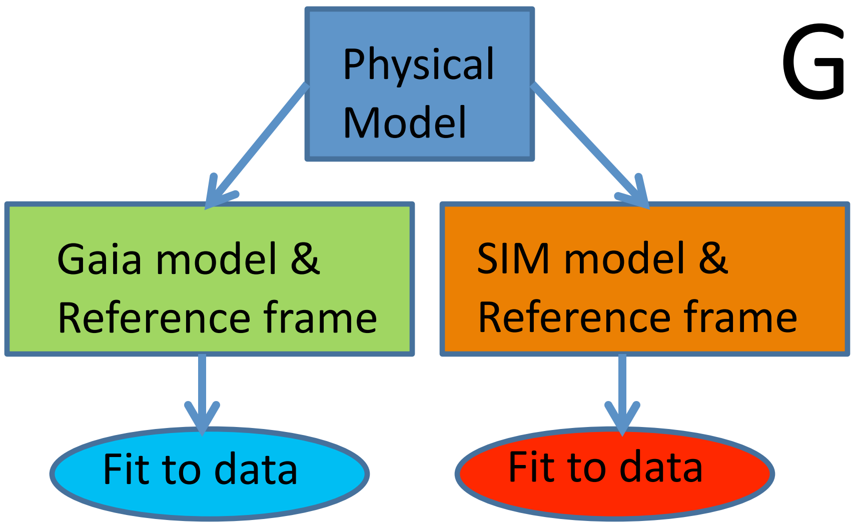
\+ A few SIM dedicated observations after 6-7 years

Small proper motions Δt

Non linear terms : accelerations, perspective terms. Everything that grows Δt^2 or better constrained orbits (of all kinds).

Very precise orbits of solar system objects

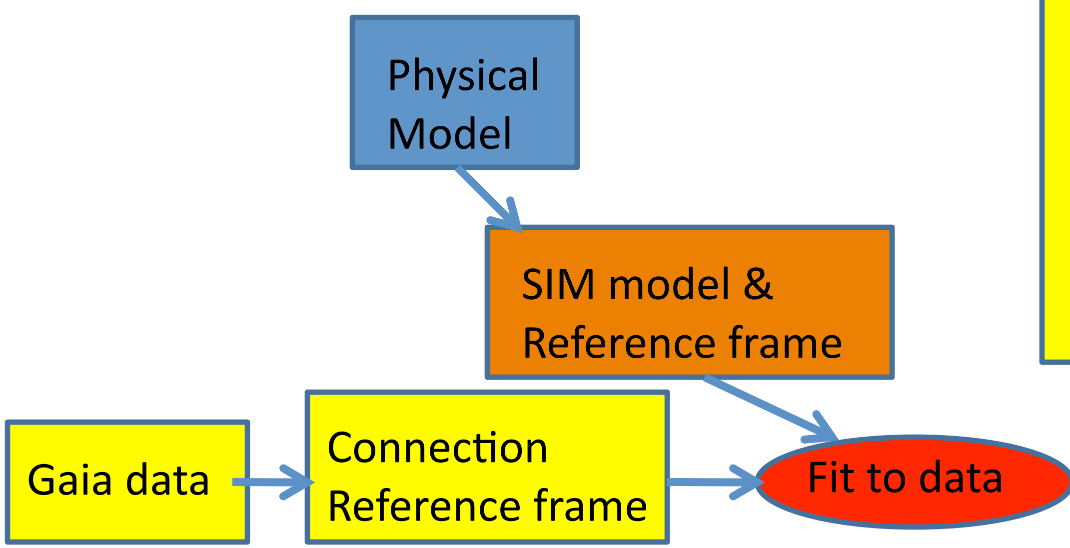
Gaia-SIM connection



Connection reference frame?

SIM grid stars (may be too bright)
Nearby M darfs, and white dwarfs, and F,G, K stars at ~100-500 pc
OB stars in clusters
Red supergiants
Bright quasars

In general stars within 10<V<15



Nearby White dwarfs : true masses and relic planetary systems

Gaia will complete the sample of white dwarfs out to 100 pc, 5x further than current ground based efforts (Holberg et al., 2008, Torres et al., 2005), Spectrophotometry, accurate astrometry will provide accurate measures of T_{eff}, log g

Direct masses : perspective acceleration method

True radial velocity and Doppler shift do not match. The difference is due to the gravitational redshift

$$\delta v_r = v_r^{true} - v_r^{spec} = \frac{GM}{c}\frac{1}{R_*}$$

40 km/s

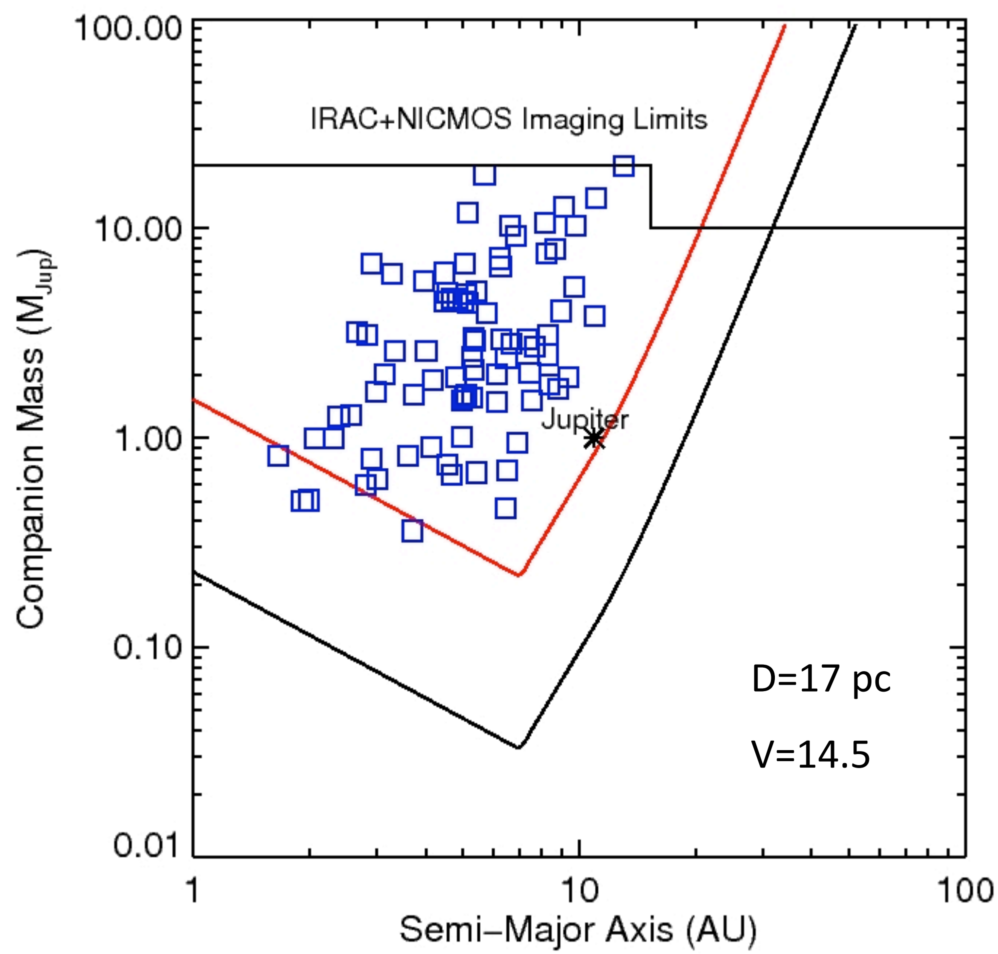
This induces an astrometric "deficit" which grows quadratically with time

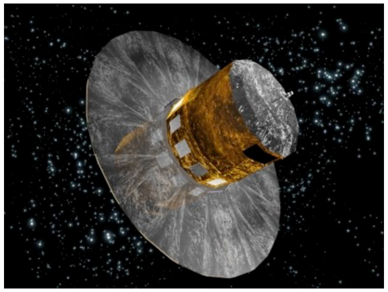
$$\delta \sim \mu \frac{\delta v_r}{d} \Delta t^2$$

	Distance	5yrs (µas)	10yrs (µas)
GD 408	36 pc	7	27
G74-7	17 pc	70	275
Van Maanen	**4 pc**	**711**	**2845!**

Relic planetary systems: Fully testing the effects of P-MS evolution

- Planetary systems adiabatically expand orbits under the influence of P-MS mass loss of central star, possible instability of formerly stable planetary architectures
- Gaia+SIM crucial for finding Solar System analogues at longer periods
- Direct comparison with main sequence stars





Other science cases…

- Refining the SIM grid
- Long period planets around nearby faint dwarfs
- Prediction of astrometric gravitational microlenses to be targeted by SIM
- Measure of accelerations : direct measure of mater content in clusters, dark matter clumps
- Measure of the acceleration of the Solar System
- Improved orbits of Solar system minor bodies (beyond the asteroid belt)
- Accurate orbits of asteroids : Testing general relativity
- Long term maintenance of the optical ICRF and its link to the radio version
- ….

Gaia data will be around by 2015… so what!
Use it to your advantage

look fainter,
look brighter,
look further,
increase your numbers,
push your accuracy

And visit your European colleagues!