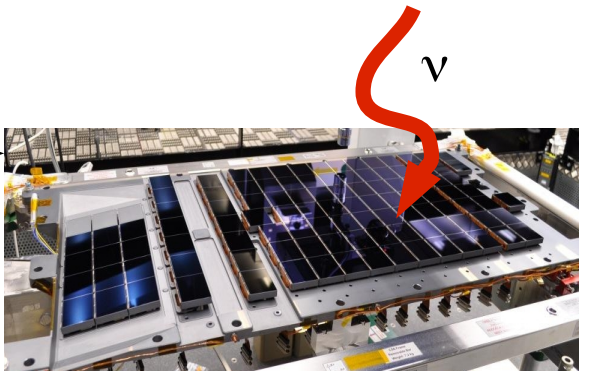
Gaia Errors

1. Gaia Error Model (astrometry, photometry, spectroscopy)
2. Code to simulate Gaia errors: public in github
3. Simulating Gaia data: GOG (Gaia Object Generation)
4. **Gaia intermediate releases and TGAS solution:**
   - **Errors expected**
   - **Simulated catalogue (BGM)**
5. Tutorial example:
   - Young Local Association (YLA)

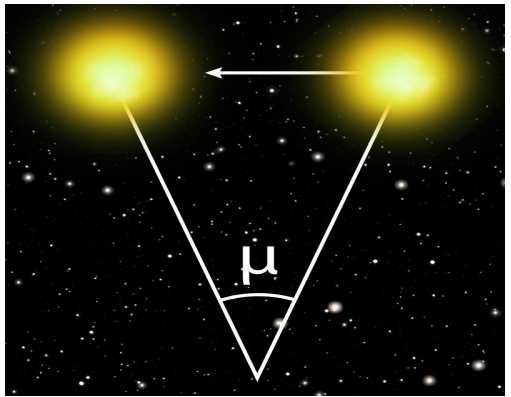
Errors for fraction of mission length (L)

included in Github

$$\sigma_{\pi}^{(L)} = \sqrt{\frac{5}{L}} \cdot \sigma_{\pi}^{(5)}$$



$$\sigma_{\mu}^{(L)} = \frac{5}{L} \cdot g_{ratio} \cdot \sqrt{\frac{5}{L}} \cdot \sigma_{\pi}^{(5)}$$



Tycho-Gaia Astrometric Solution (TGAS)

	INPUT	**Gaia Data**	**Output**
Tycho Only	(α, δ) From Tycho-2 Data	Several months of mission data	$(\alpha, \delta, \pi, \mu*_{\alpha}, \mu_{\delta})$
HIPPARCOS subset	$(\alpha, \delta, \pi, \mu*_{\alpha}, \mu_{\delta})$ From HIPPARCOS Data		

One unic solution for the whole TGAS

TGAS ERRORS

Mag.	Number[a]	Position [μas]	Parallax [μas]	Prop. motion [μas yr^{-1}]
Subset *Tycho* without HIPPARCOS				
6–7	411	244	399	198
7–8	8072	198	348	264
8–9	63 630	191	327	403
9–10	257 243	230	407	680
10–11	686 866	329	601	1145
11–12	993 139	379	722	1522
≥12	302 511	349	702	1615
all (≥6)	2 311 872	332	631	1259
Subset HIPPARCOS				
6–7	9381	116	180	17
7–8	23 679	120	192	21
8–9	40 729	125	198	29
9–10	27 912	133	217	39
10–11	8563	154	253	58
11–12	2501	128	211	87
≥12	630	151	248	135
all (≥6)	113 395	127	203	32

Michalik et al. 2015

TGAS errors subroutine

(available on request)

Simulated true equatorial coordinates of the star

α
δ
π
$\mu_\alpha{}^*$
μ_δ
Vr

V apparent magnitude

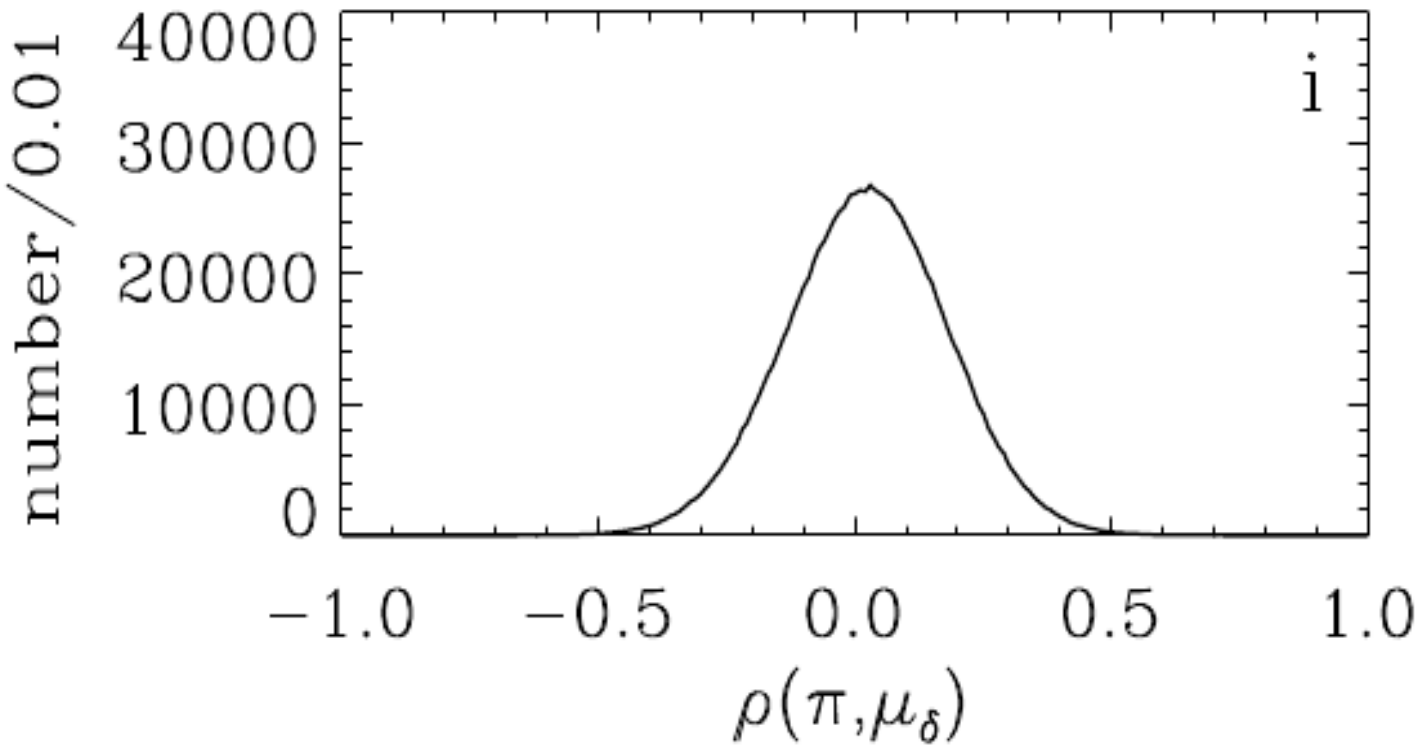
TGAS error model

Gaussian distribution (independent variables)

Observed equatorial coordinates of the star

α
δ
π
$\mu_\alpha{}^*$
μ_δ
Vr

Example of Tycho catalogue error correlations



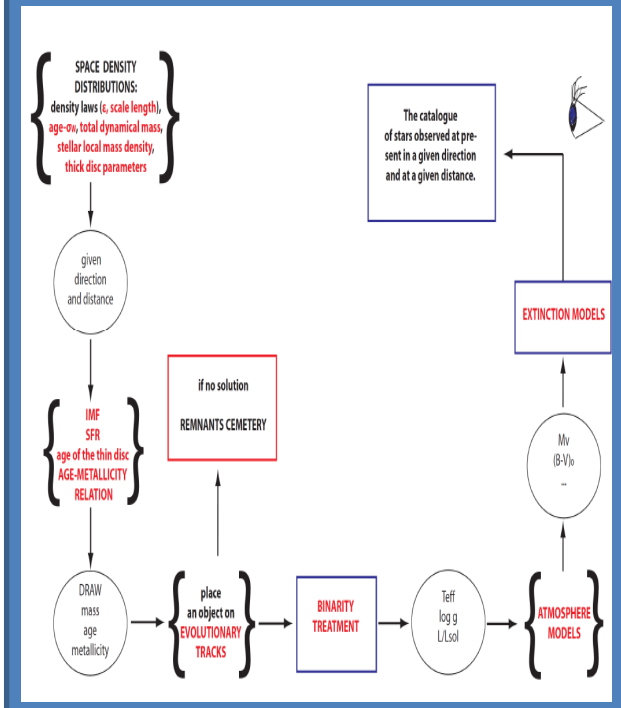
Work is in progress to implement TGAS error correlations

Significant biases can be induced if correlations are not taken into account when simulating data to be compared with TGAS.

Gaia error correlations are expected to be smaller

Catalogue Simulations

BGM

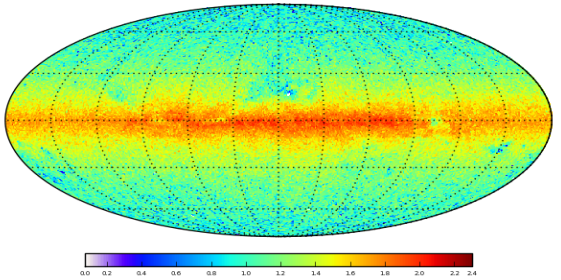


Tycho-2 Errors

TGAS Errors

1st and 2nd Releases Errors

Final Mission Errors

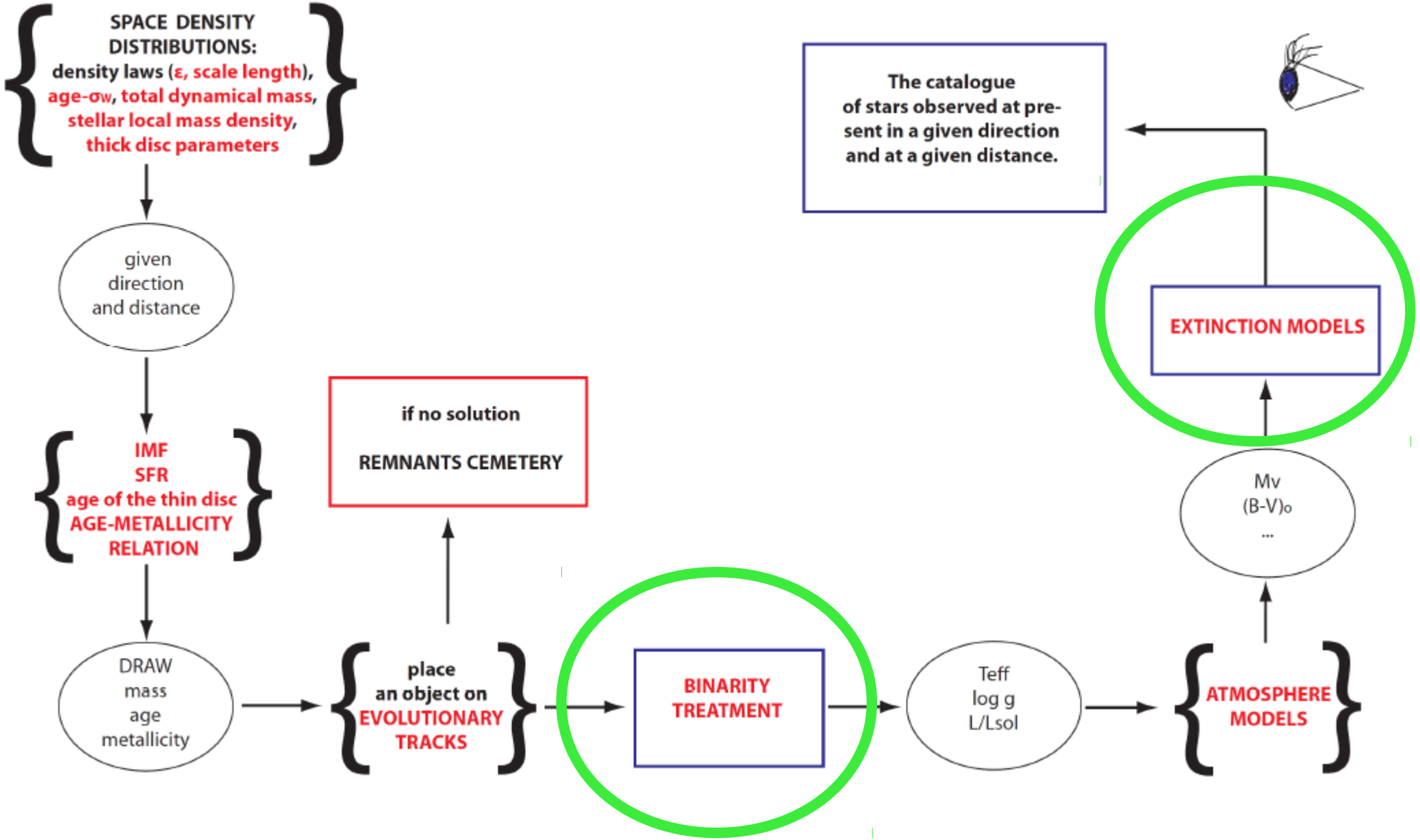


Whole sky comparison

Galaxy Modeling

Gaia data validation

Besançon Galaxy Model



Binarity is important

- for the astrometric solution for Gaia
- for the derivation of the Mass Model
- in studies based on star counts
- Etc...

Binarity implementation in BGM

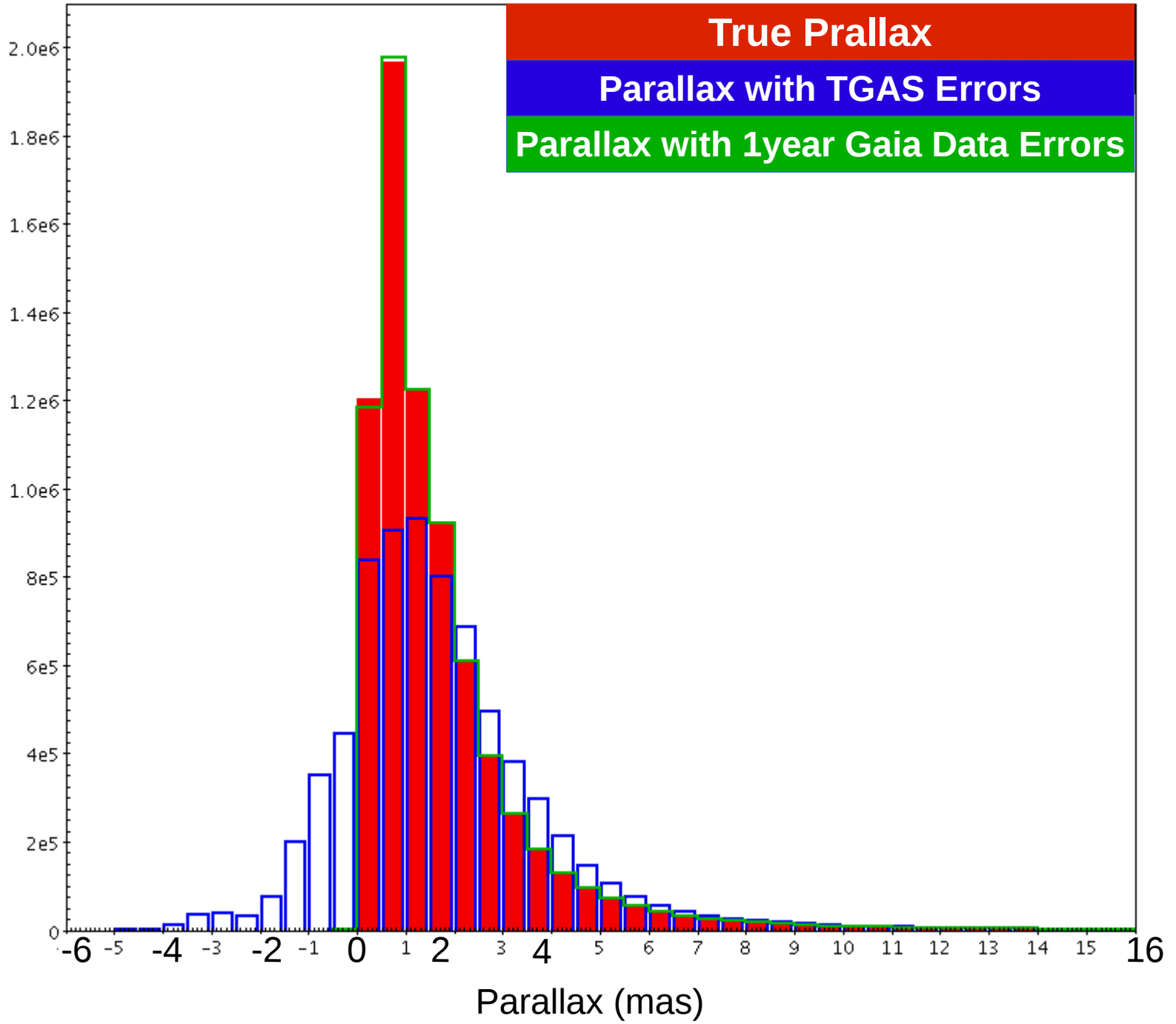
In the implementation we have used the scheme of F. Arenou from the Gaia simulator.

- Whenever a star is created BGM makes it single or a primary component of a binary system which depends on the mass of the star.
- This scheme is based on three functions derived from observations
  - The probability function derived from observations
  - The distribution of the semi-major axis
  - The mass ratio of the components

BGM allows to simulate the binarity according with a given resolution to mimic the desired instrument

For Gaia we assumed a resolution of 2 pixels → 120 mas

Parallax distribution of the BGMBTG 2.08 catalogue (units:mas) $G \leq 13$

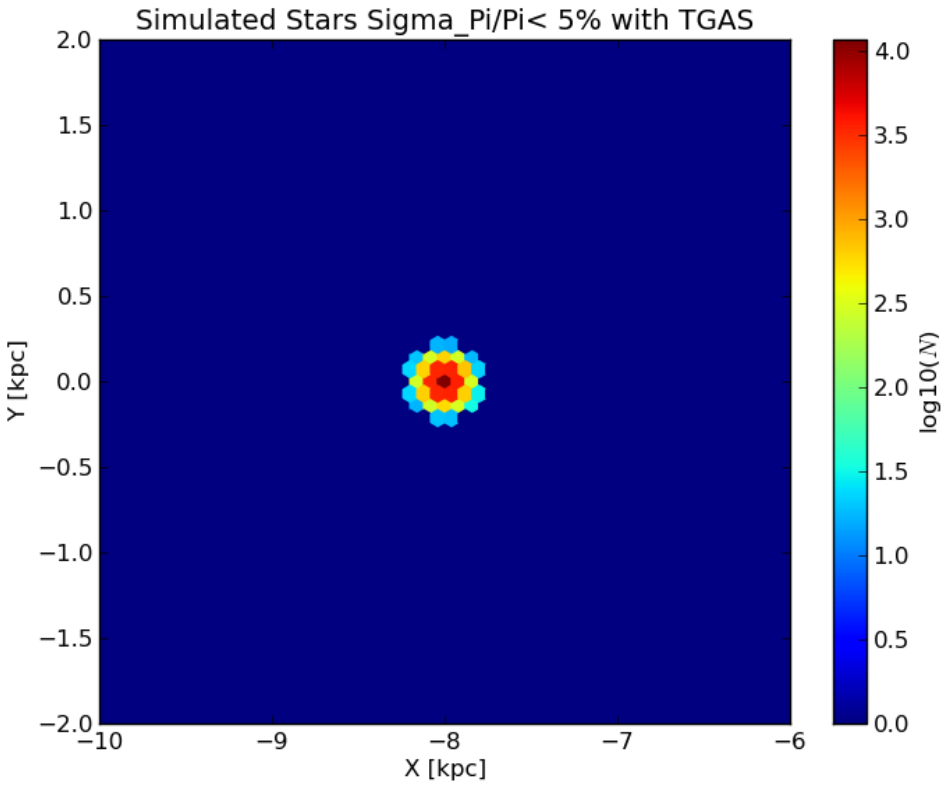


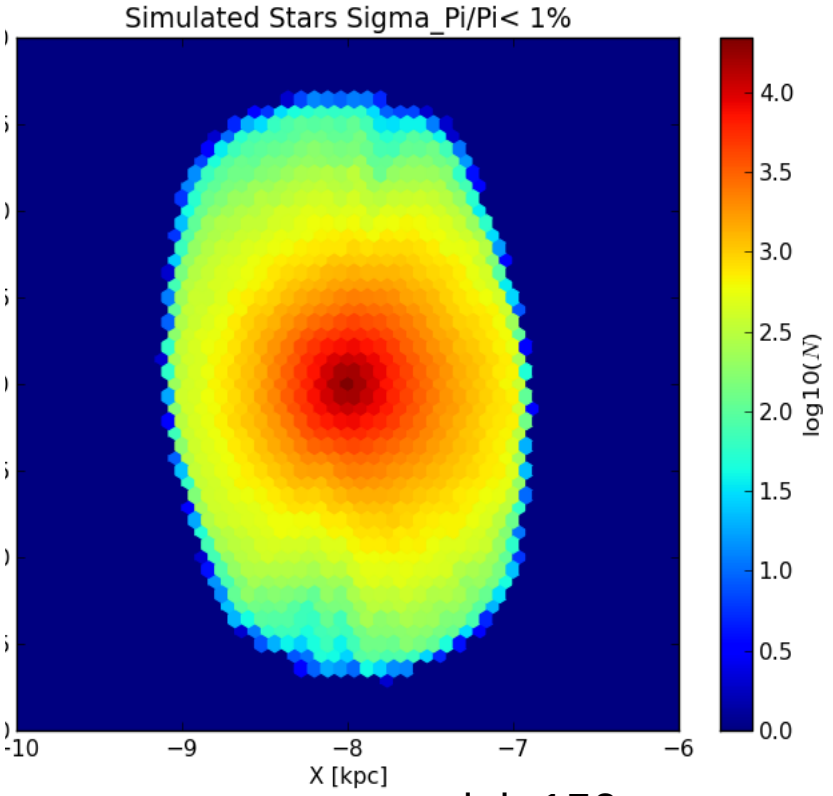
From TGAS to Gaia end-of-mission

5%

Up to V=12

1%





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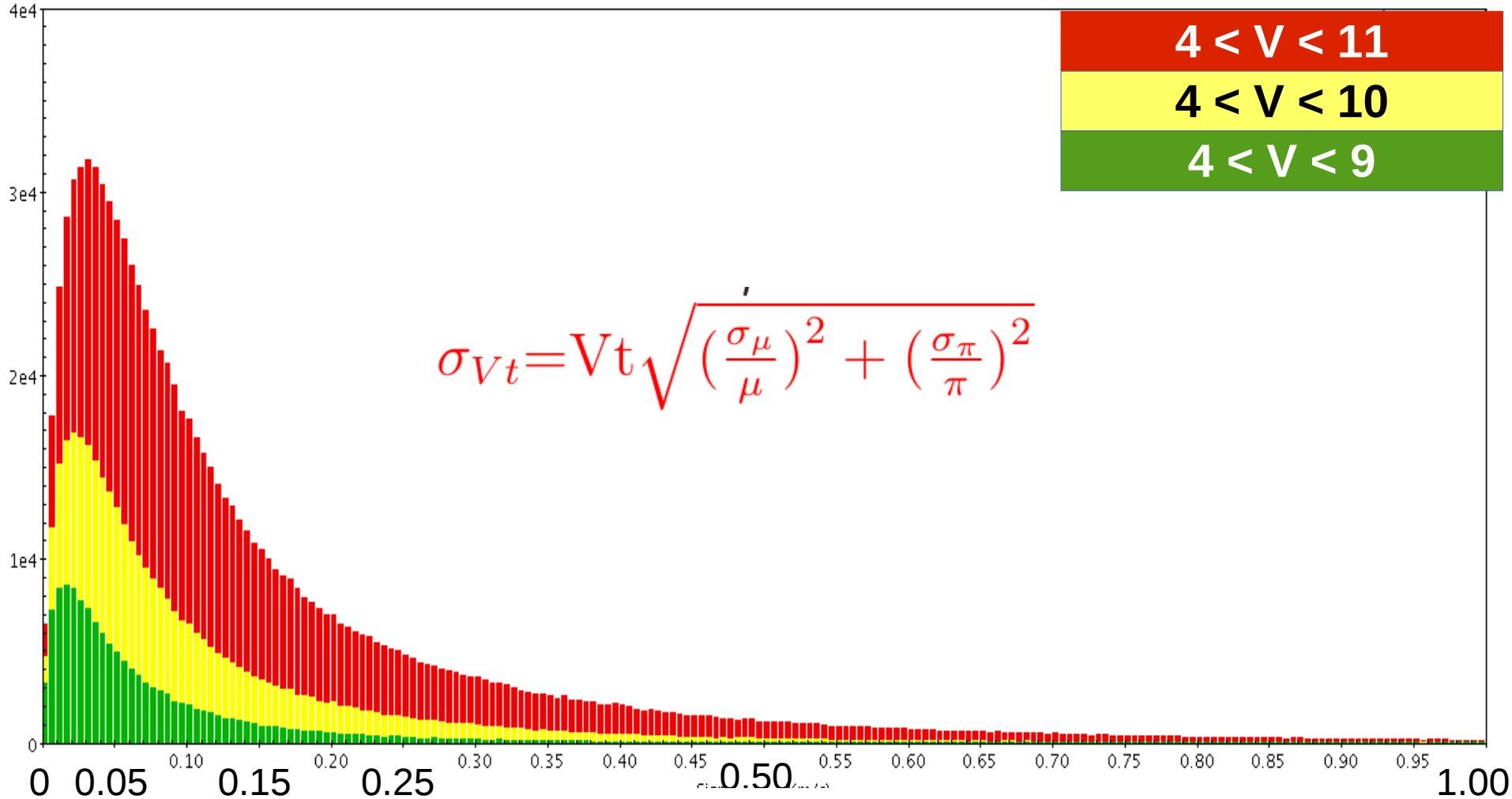
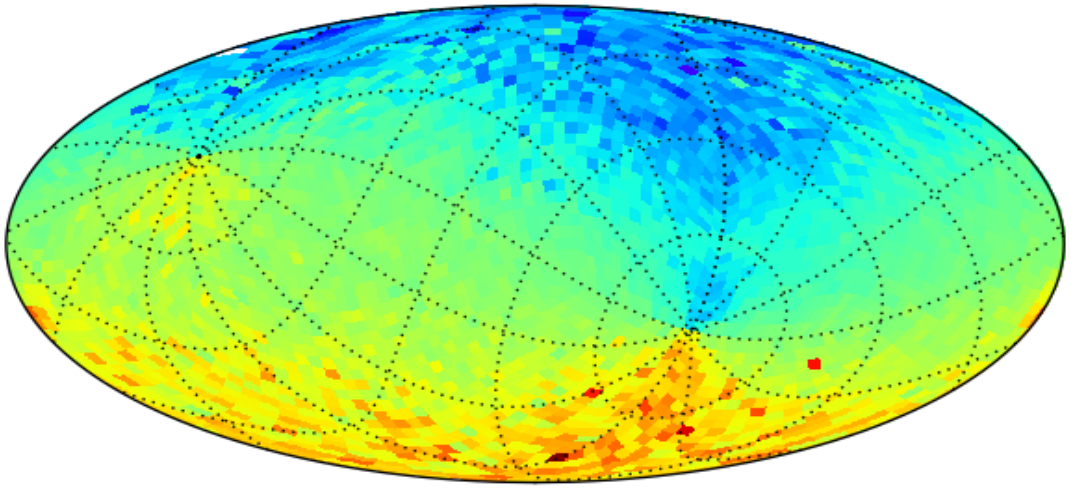
Gaia will provide parallaxes with accuracies better than 1% for more than 1 milion stars up to V=12

Gaia end-of-mission errors in tangential velocity for M main sequence type stars



Sigma Vtan (km/s)

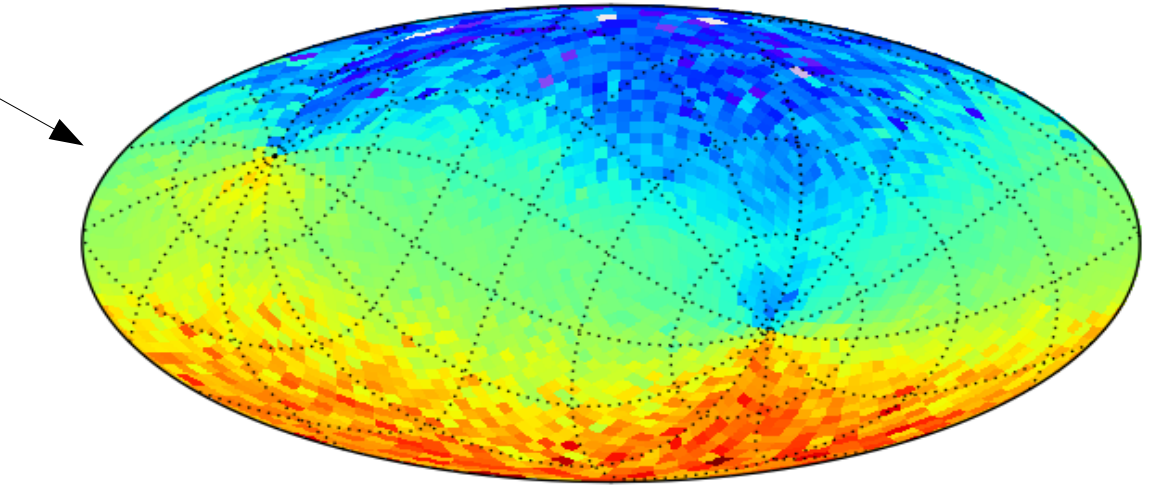
Mean μ_α values for Tycho-2 and simulated data up to $V_{Tycho} = 11$

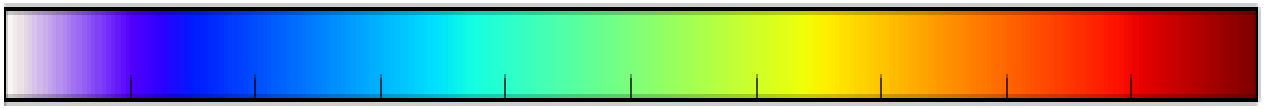


Tycho-2

Galactic coordinates with equatorial grid

BGM simulation





mas/yr