Kinematics of the Galactic Bar: Gaia capabilities

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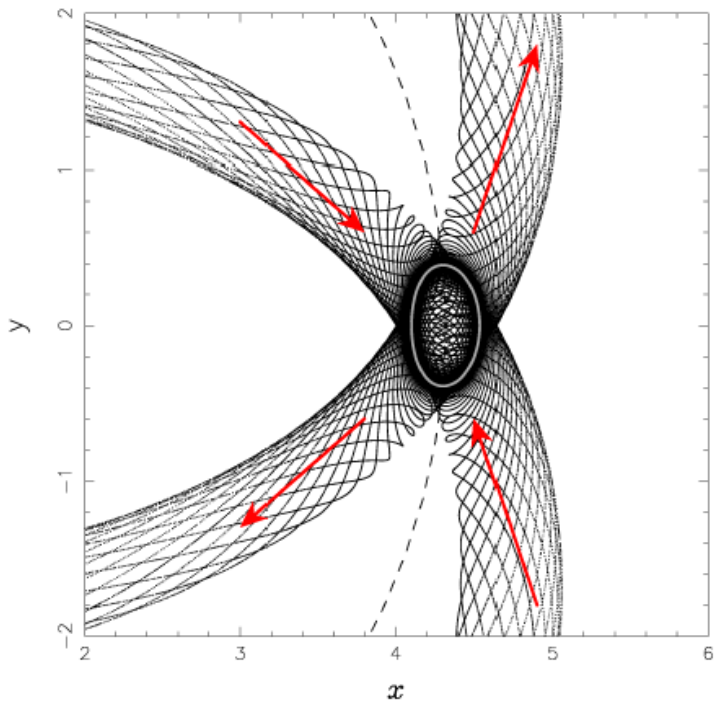
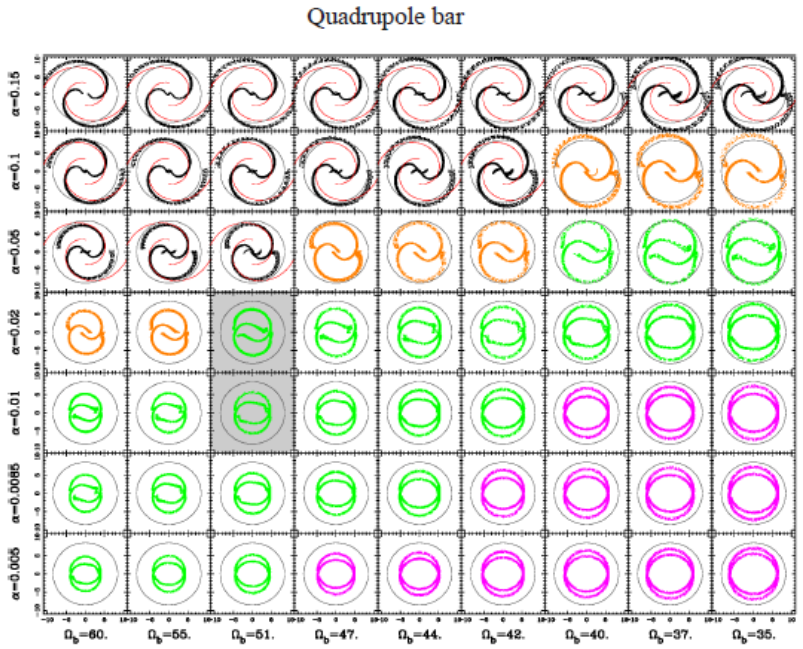
Galaxy Modelling with a Gaia mock catalogue
Barcelona, 29th Feb – 2nd March

Bar-driven dynamics in the inner part of the MW by using invariant manifolds

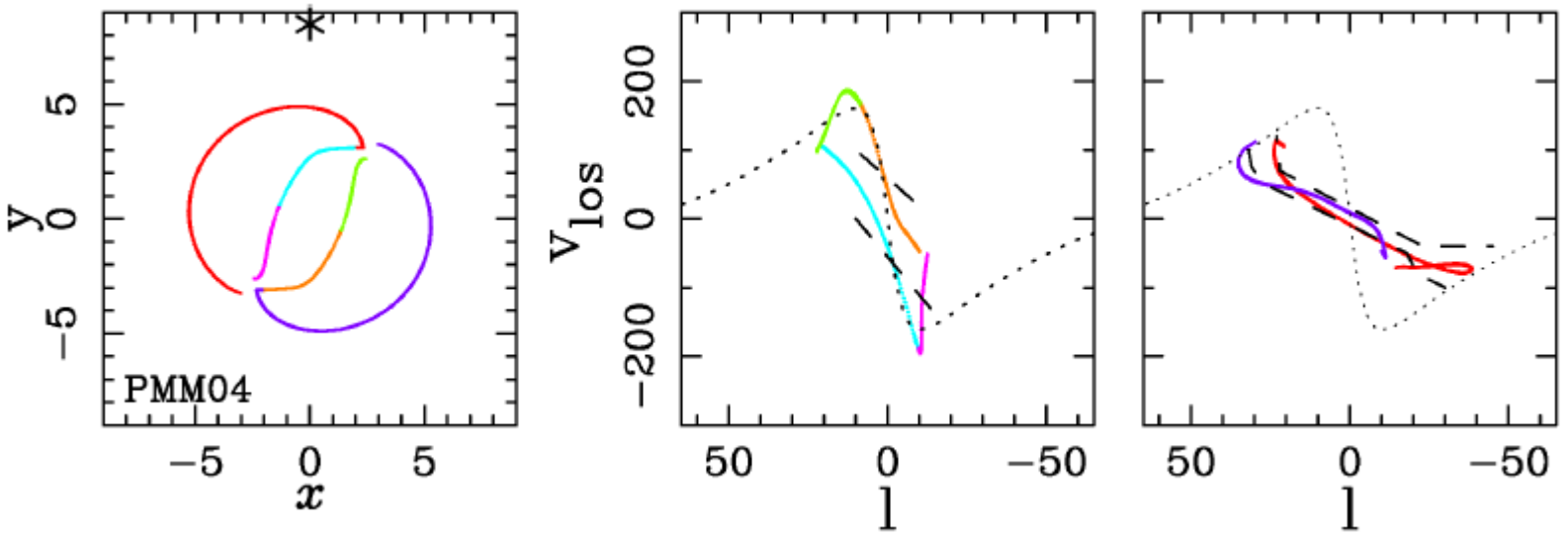
Orbits are confined by the invariant manifolds of the unstable periodic orbits located at the ends of the bar.

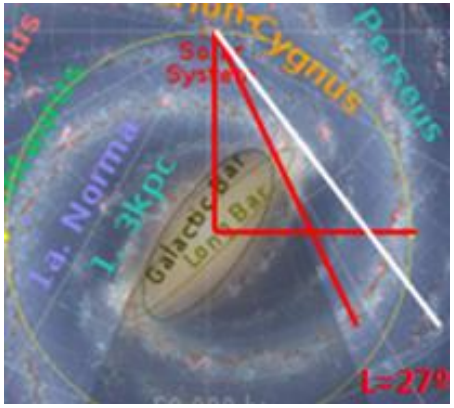


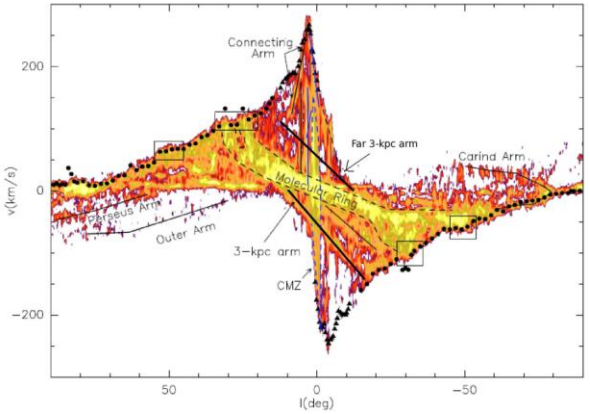


Spiral arms morphology in the manifold framework? Only with a more complex potential with one or two bars in the inner part and a spiral further out

Up to now, we have tested models with the line-of-sight velocity

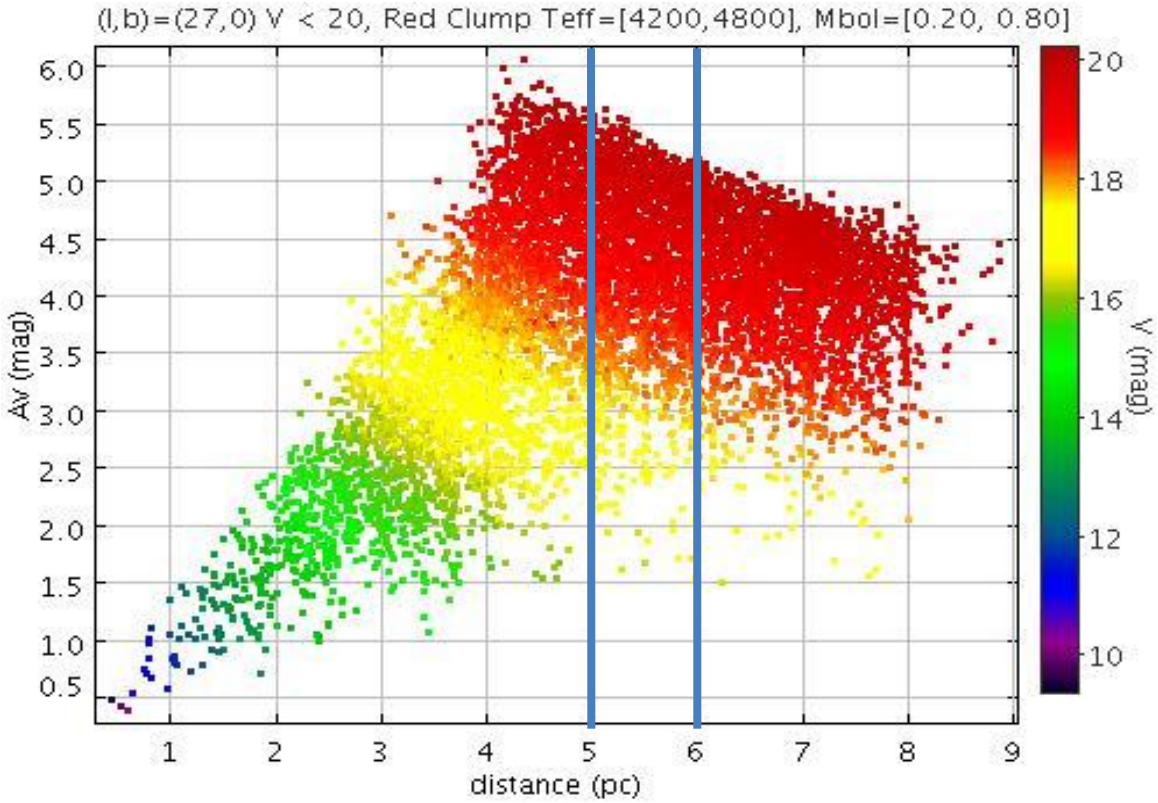






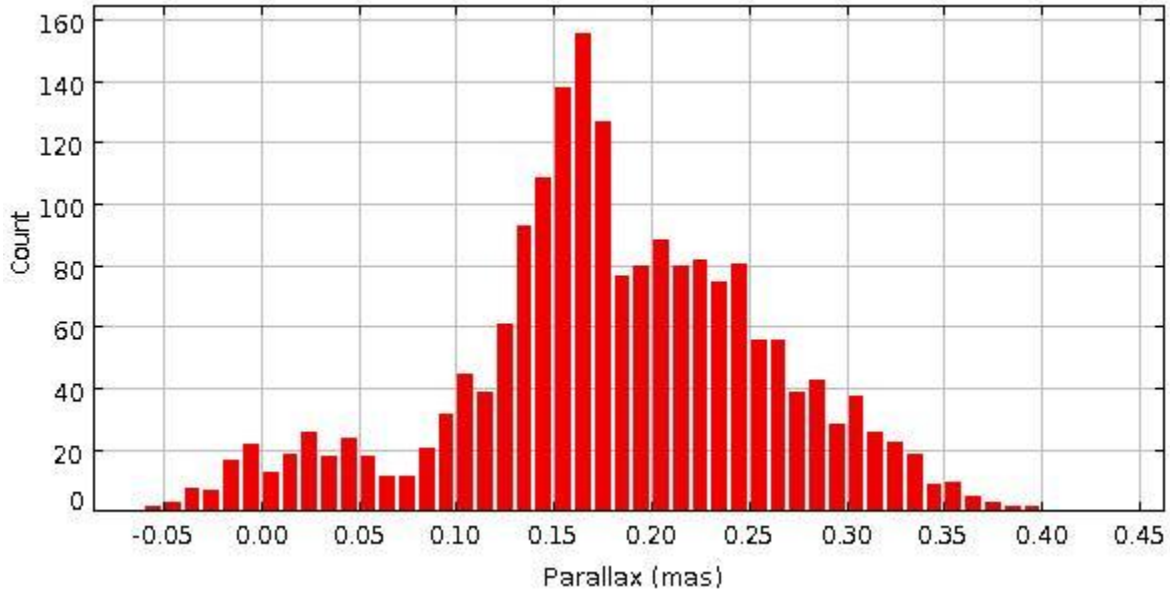
Which Gaia astrometric data will we have to test models at the end of the bar (l~27º), in the connexion between bar and spirals?

Kinematic tracers: Red Clump Stars (RC)

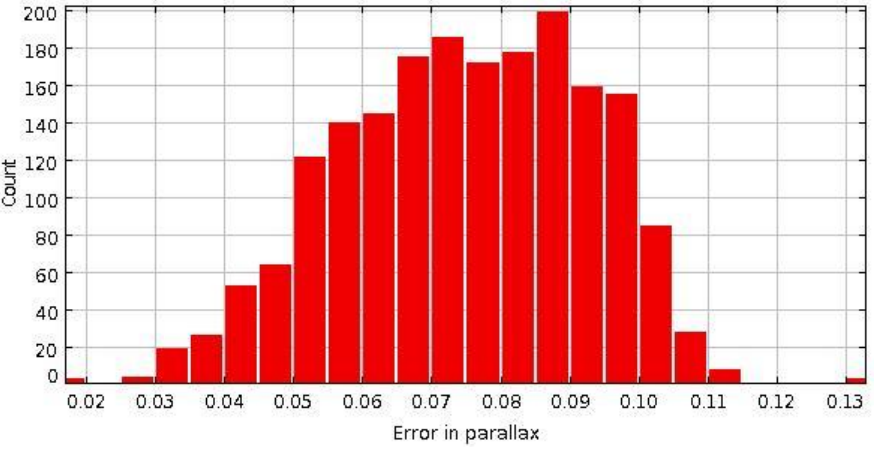


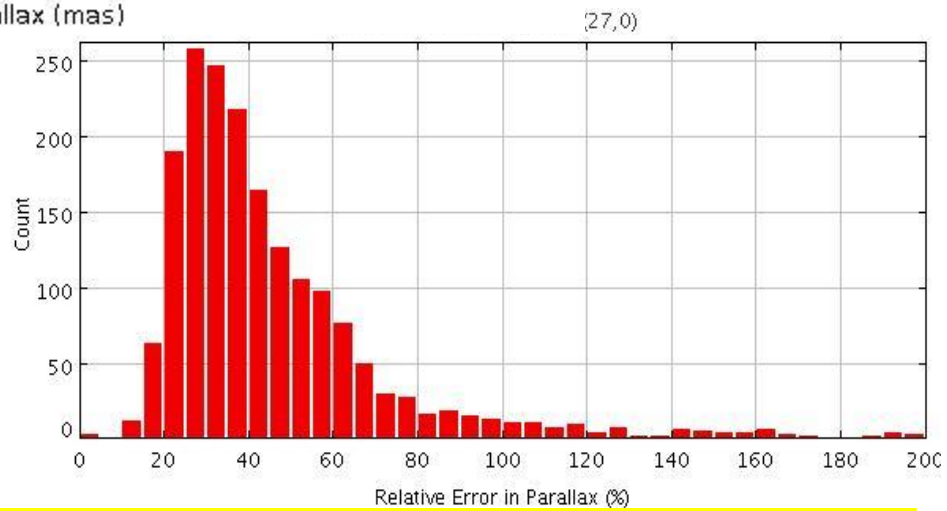
~2000 RC stars deg $^{-2}$ at (l,b)=(27,0) with V < 20 at distances r=[5,6] kpc from the Sun (Source: BGM)

Gaia Relative error in Parallax RC stars at distances r=[5,6] kpc (GOG)



Real parallax
[0.16-0.2]mas

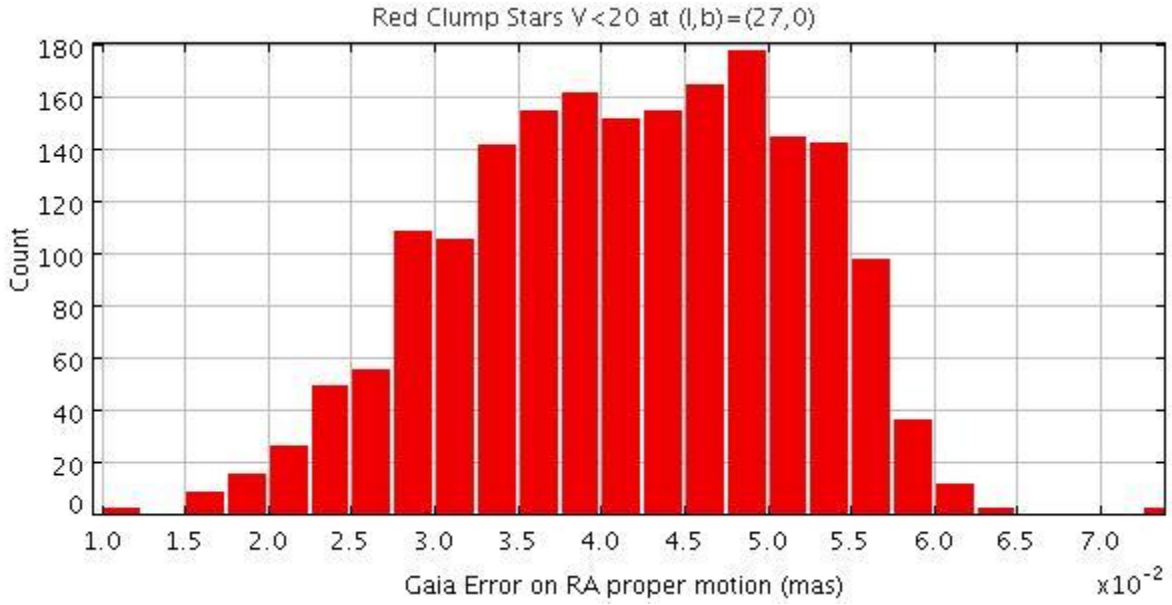




1-2 kpc error in distance!
Astrometry shall be combined with IR data (JHK bands)

V=18-20, r=5000-6000, pi=200-166 uas,
De Bruijne (2009): err_pi= 40. (V=18) 66. (V=19), 111. (V=20)

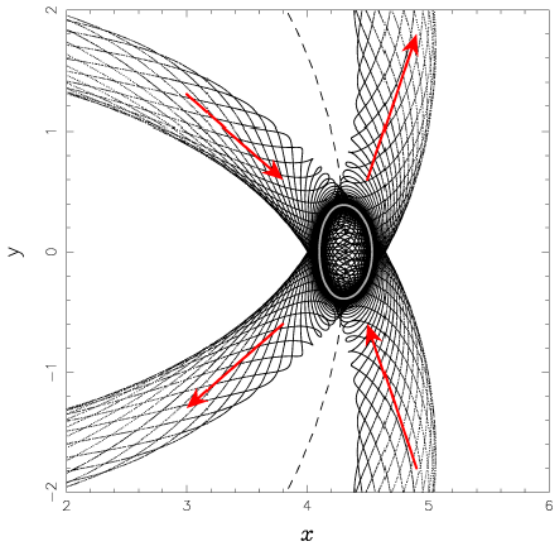
Gaia error in proper motion RC stars at distances r=[5,6] kpc (GOG)



$$\sigma_{\mu} = 0.526 \cdot \sigma_{\varpi}$$

RC stars: range for mu_a: 0-3000uas/yr
Range of error in mu_a: 20-60 uas/yr
Relative error in mu_a: 1-6 %
BUT the critical point is the error is in parallax

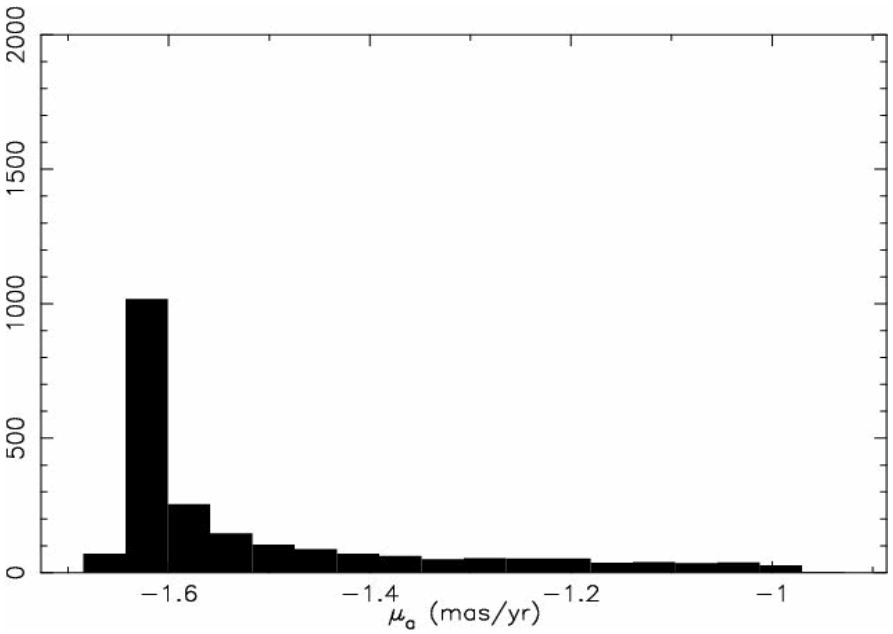
Proper motions of stars located at the ends of the bar: work in progress

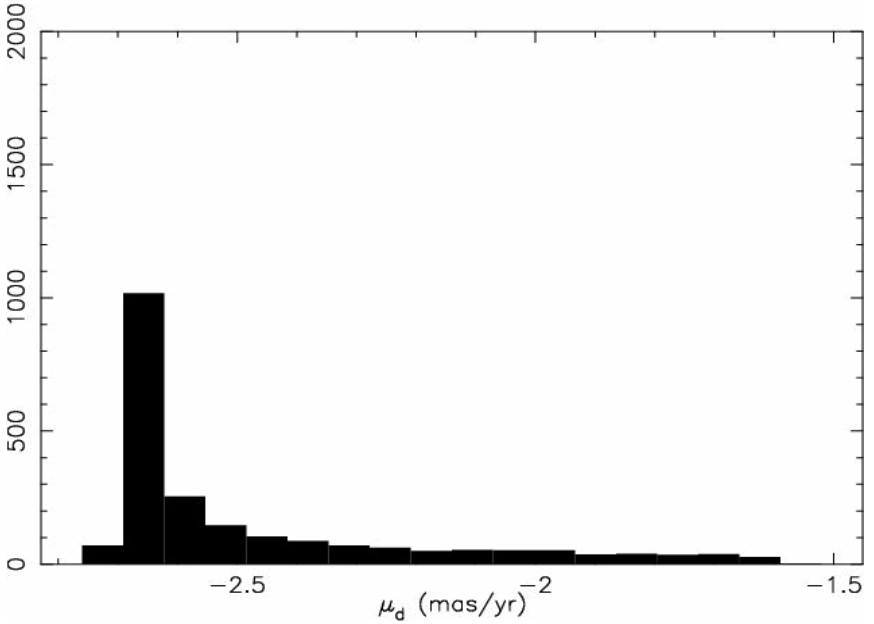


+ signal from test particle simulations

+ signal from N-body simulations

We estimate that in order to discriminate among models:
we need a signal of the order of 10-30km/s (If no error in parallax ~0.5mas/yr)

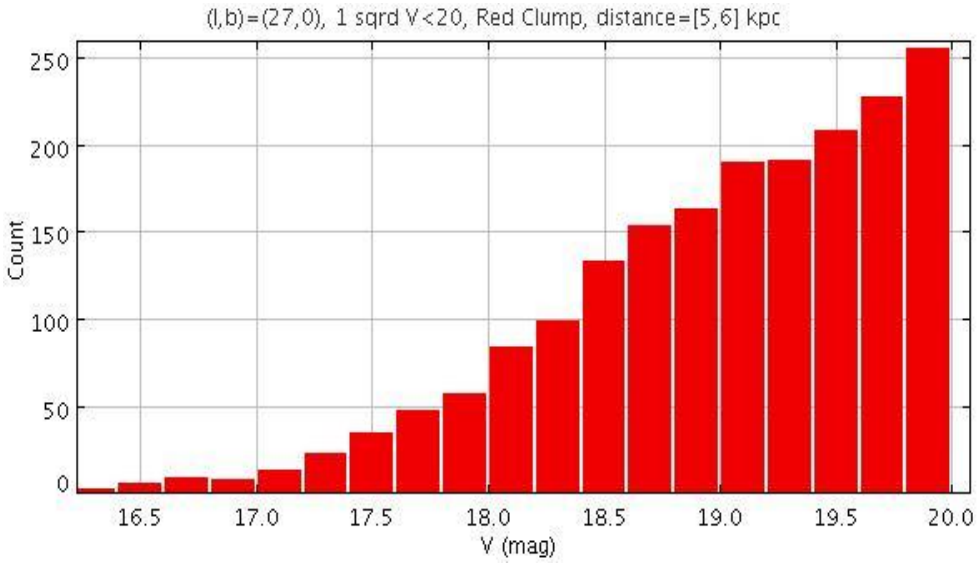

0
500
1000
1500
2000
−1.6
−1.4
−1.2
−1
μ_α (mas/yr)


0
500
1000
1500
2000
−2.5
−2
−1.5
μ_δ (mas/yr)

RC Radial Velocities : only from on-ground spectra (GES, EMIR, WEAVE, ...)

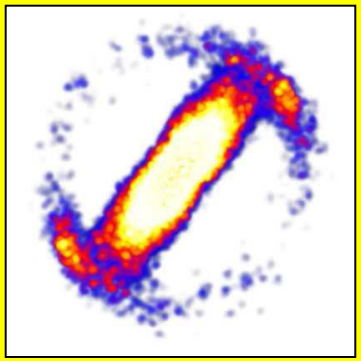
Data from RVS spectrograph

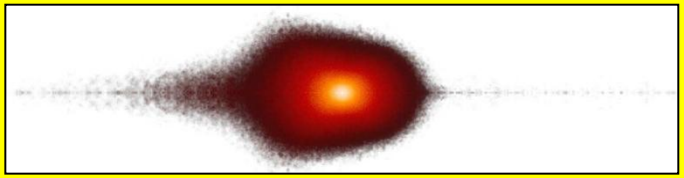
Teff	logg	V	RV-error
4500	2.5	15.0	1.8 km/s
4500	2.5	15.5	2.7
4500	2.5	16.0	4.2
4500	2.5	16.5	6.7
4500	2.5	17.0	10.3
4500	2.5	17.5	18.0



GES, WEAVE, … chemical composition for these objects are needed

One or two bars?





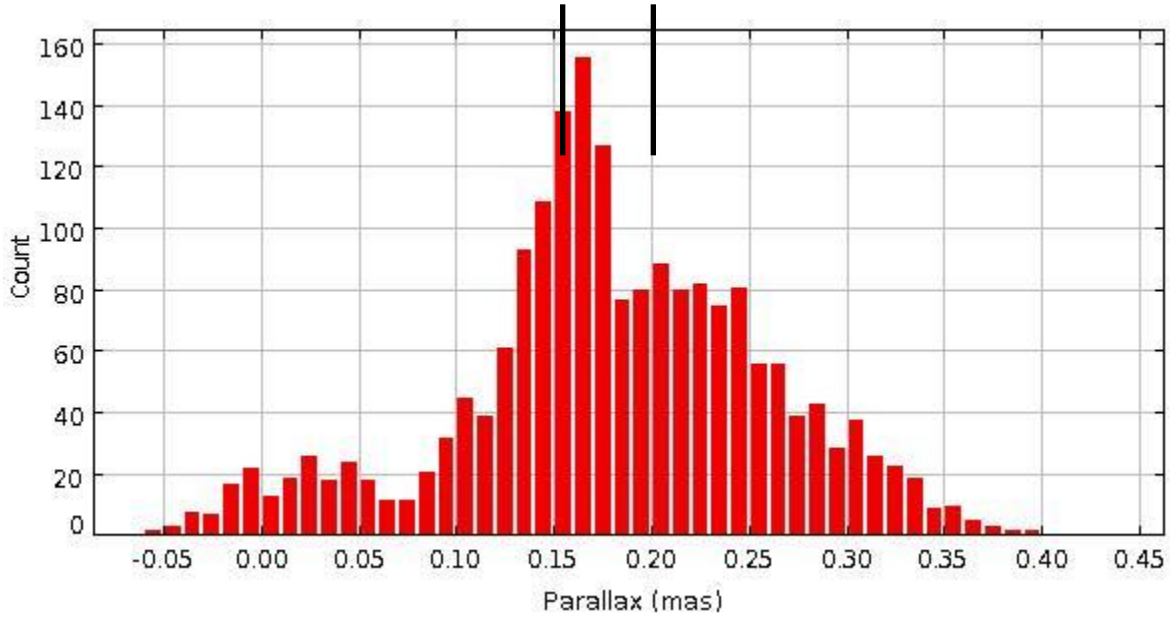
És en aquestes gràfiques de la transparencia anterior on hauriem de superposar els efectes deguts a la presencia de la barra

Amb els teus models calculaves Vr (vista des de el Sol)
Podem calcular la velocitat tangencial? (vt=sqrt(vtot**2 -vr**2)
Vtot ja ha de ser relatiu al Sol
Si tenim una mitjana d'aquesta velocitat tangencial, la podriem passar a mov propi (mu = vt/r/4.741, r=5-6 kpc)

Aprox:
Si omega-barra = 50 km/s/kpc
El material del disc també va a 220/5 = 55 km/s/kpc
Quina cinemàtica afegida indueix la manifold?

A l=27, Vr=120 → vt=sqrt(x**2-120**2) = y km/s
mu = 7/5500/4.741=→ mas/yr

GAIA (GOG) Parallaxes RC stars at distances r=[5,6] kpc (GOG)



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