

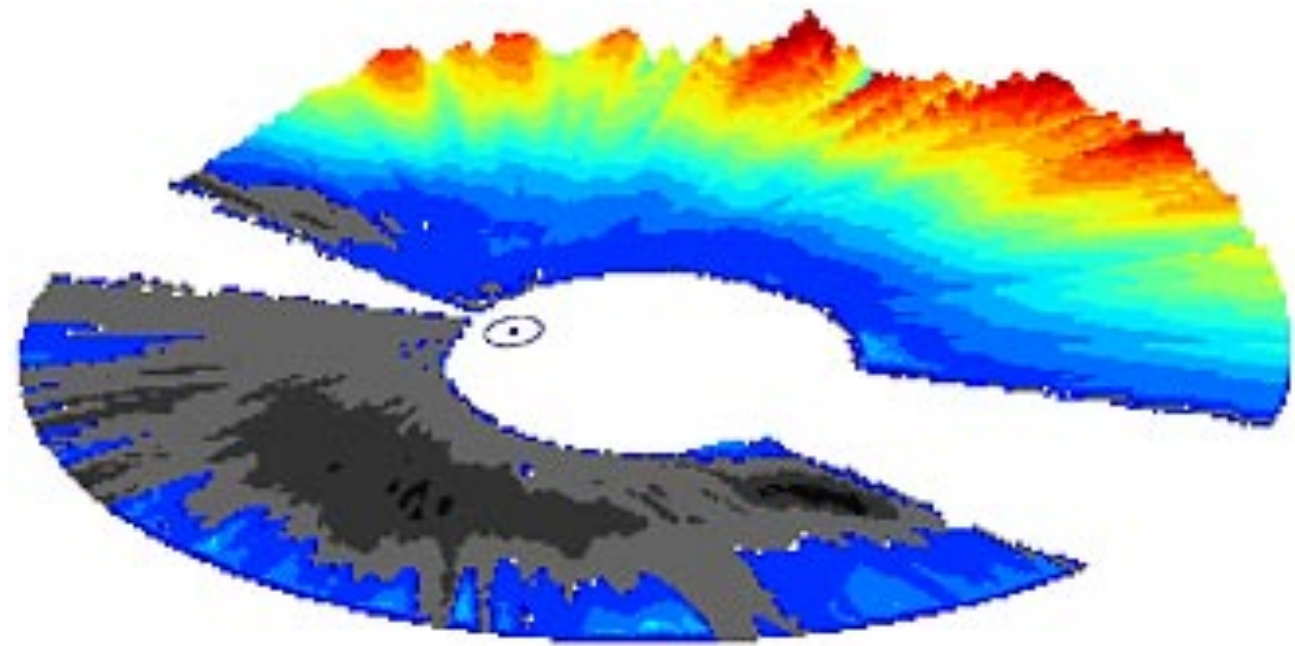
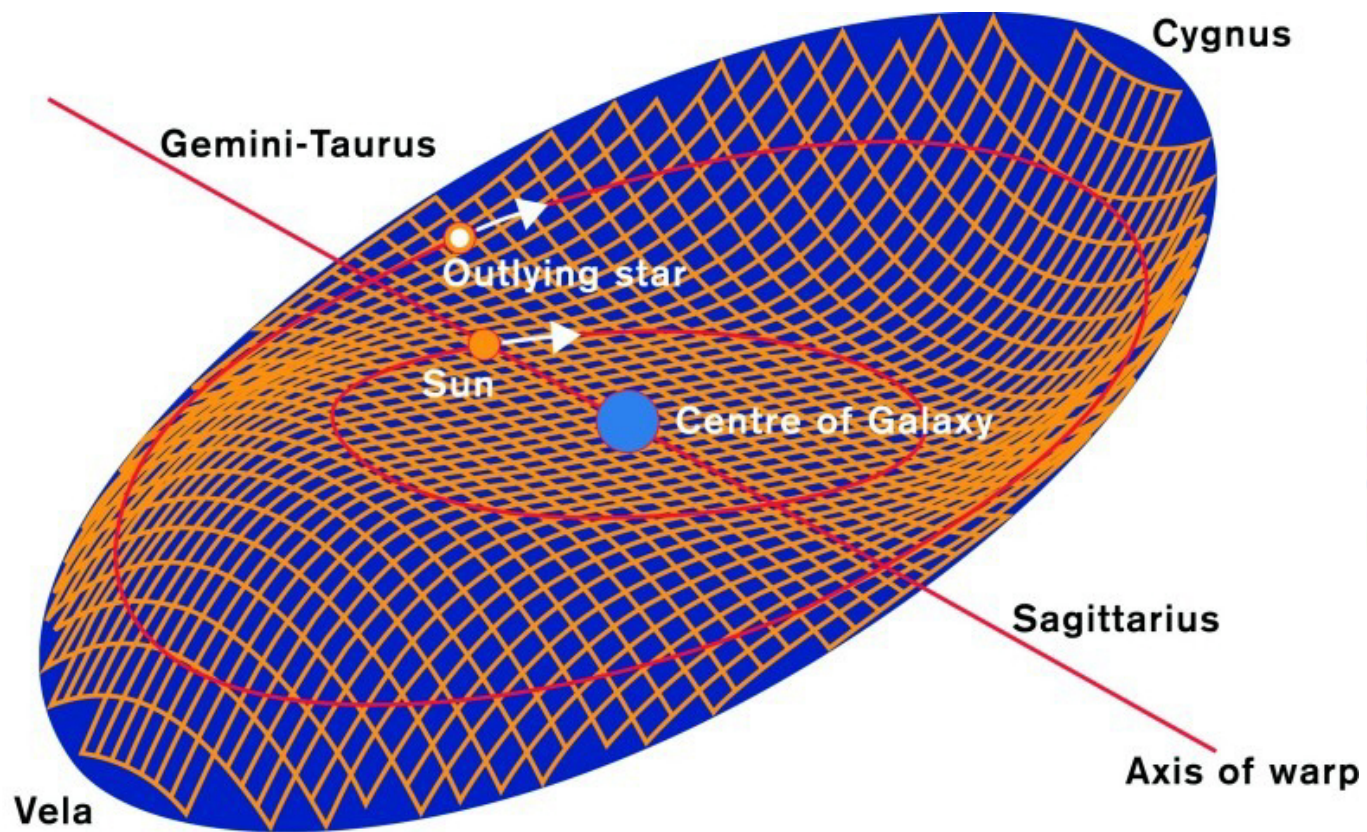
The Analysis of Gaia capabilities to trace the dynamics of the Galactic warp

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*(Credit: Leo Blitz/Carl Heiles/
Evan Levine-UC Berkeley)*

Can Gaia detect the kinematic signature of the warp?

Procedure

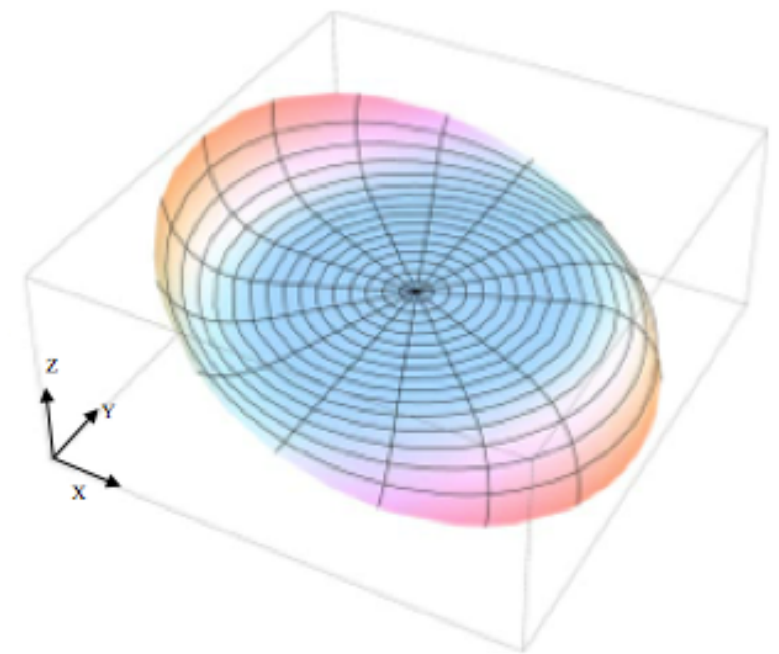
- ✧ Simulate the Galactic warp (80×10^6 test particles)
 - ✧ 3D Potential, warp geometry, adiabatic warping
- ✧ Check for statistical equilibrium
- ✧ Map our model to Gaia observable space
 - ✧ Apply Drimmel extinction model
 - ✧ Add Gaia errors
- ✧ Check the significance level of the warp kinematics as seen by Gaia

The geometric model of the warp

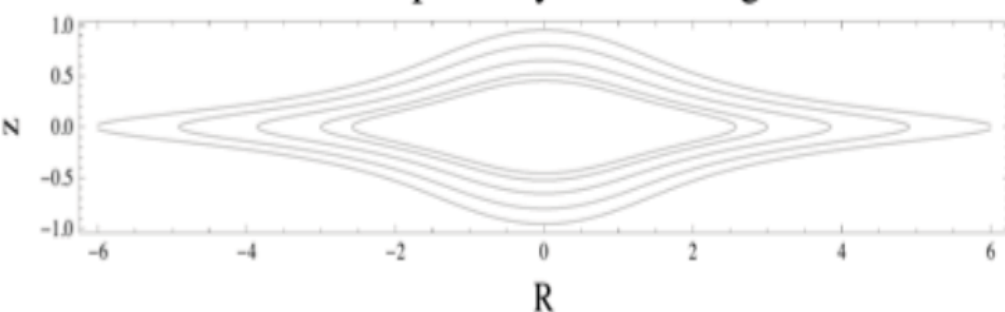
To warp the system, we bend the potential of the disc using a simple geometry transformation.

$$\Psi(R; R_1, R_2, \psi_2, \alpha) = \Psi_{\max} \left((R - R_1) / (R_2 - R_1) \right)^\alpha, \quad R > R_1$$

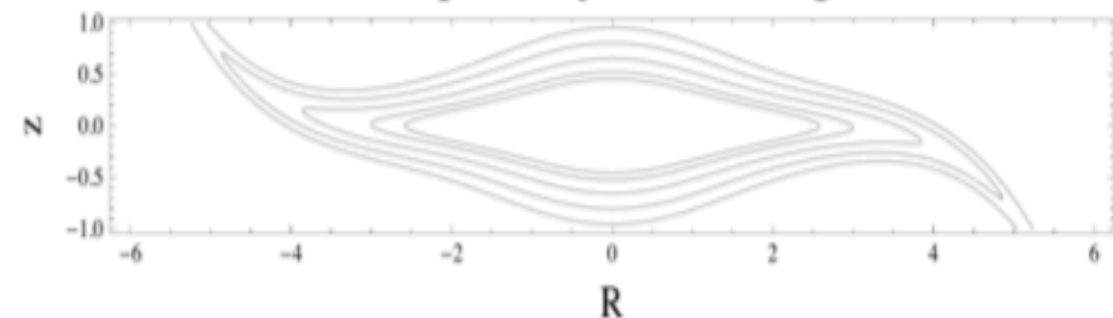
The tilt is applied beyond R_1 . The resulting warp is such that the tilt angle increases as a power law whose exponent is α and such that at R_2 it has a value equal to Ψ_2 .



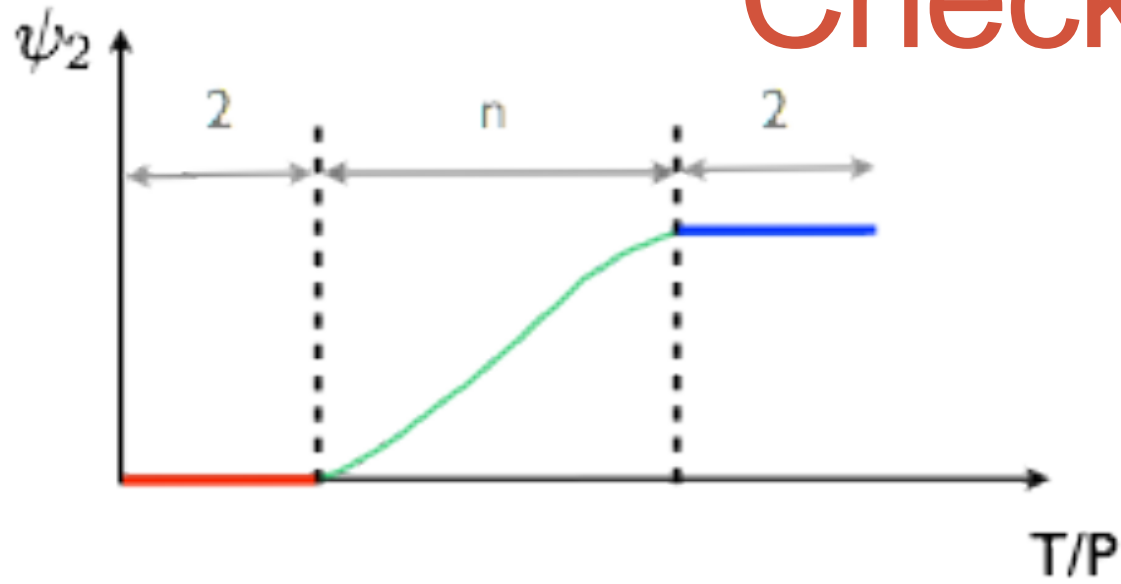
Unwarped Miyamoto–Nagai



Warped Miyamoto–Nagai

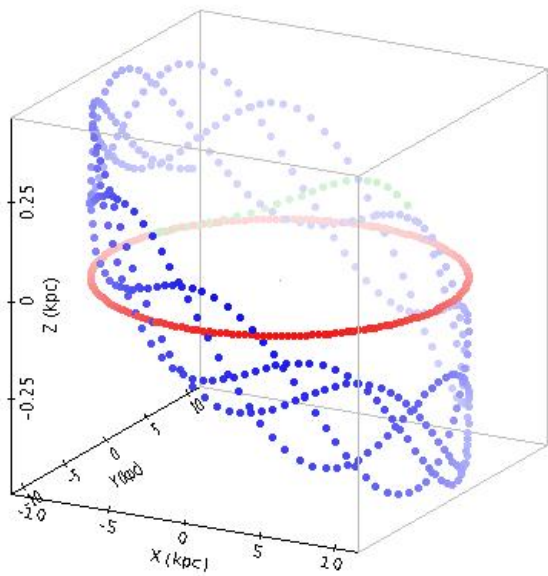


Check for stability

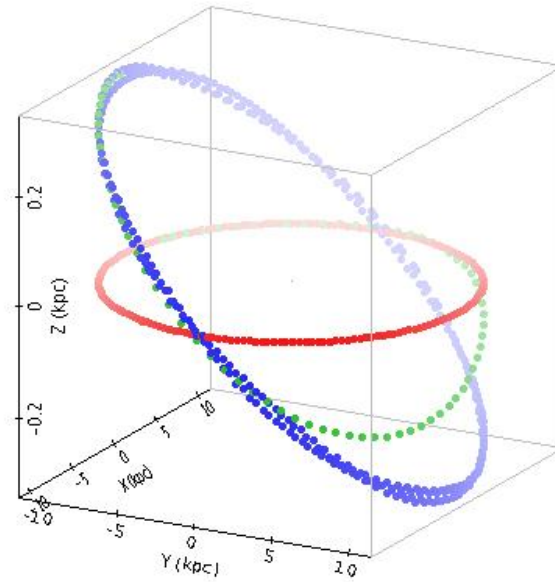


P = orbital period of a star at $r=20$ kpc

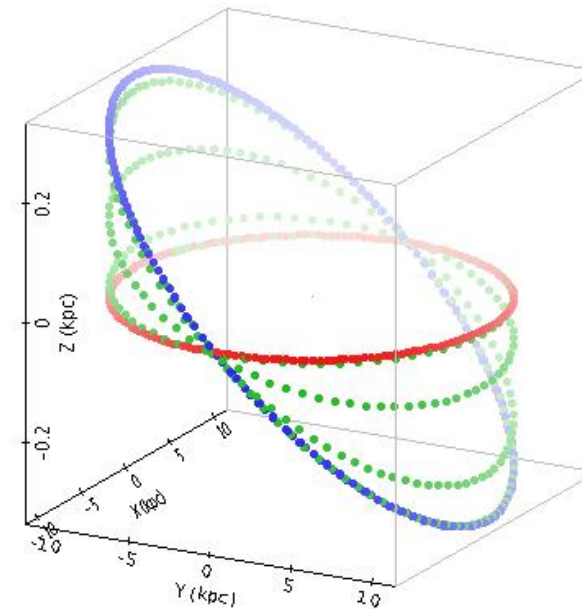
$n=1/8$



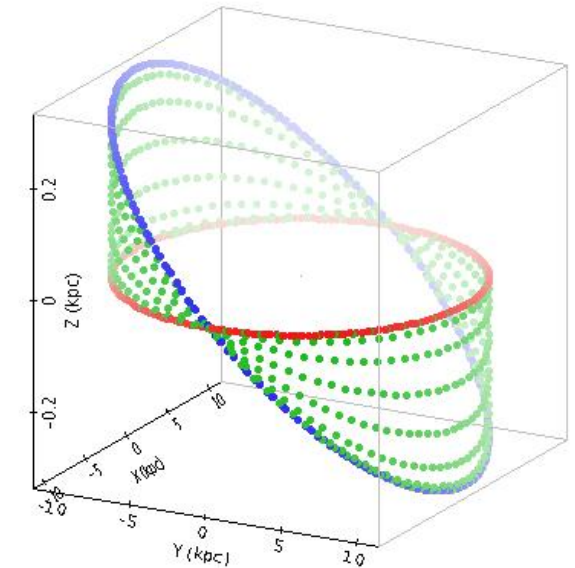
$n=1/2$



$n=2$



$n=4$

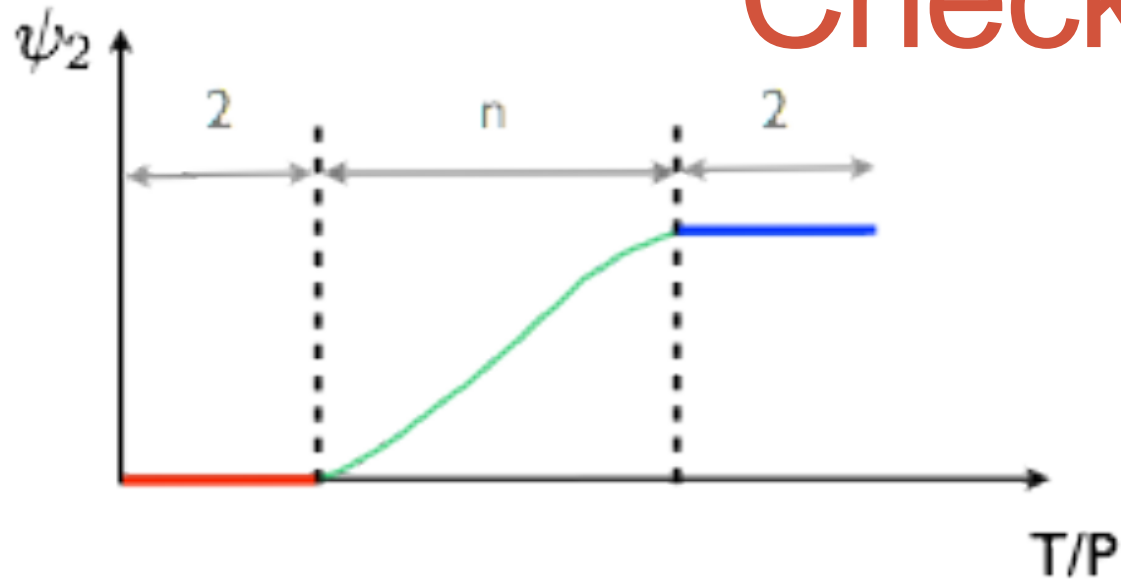


Impulsive

Adiabatic

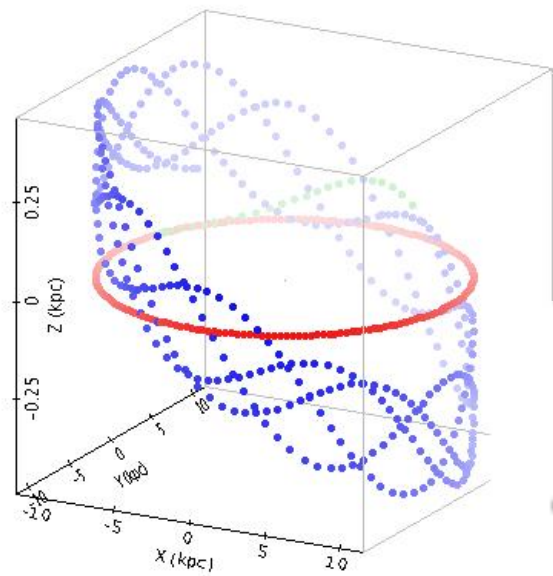


Check for stability

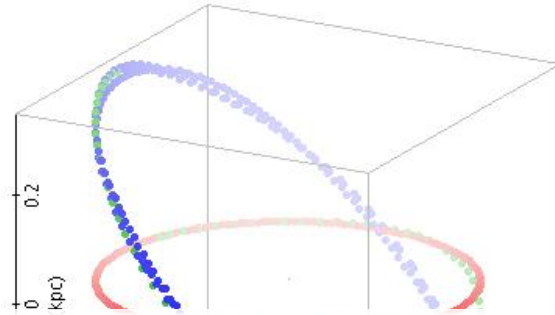


P = orbital period of a star at $r=20$ kpc

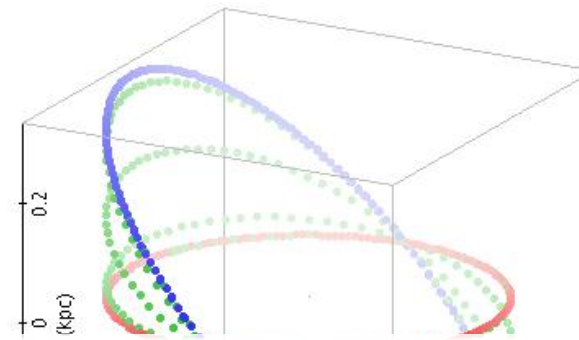
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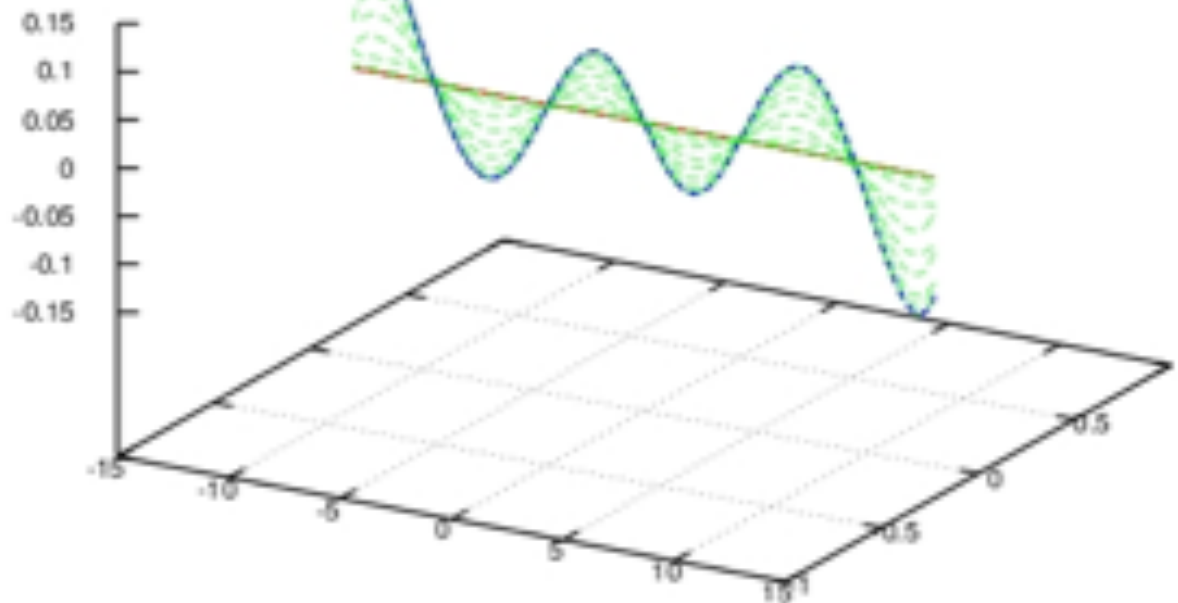
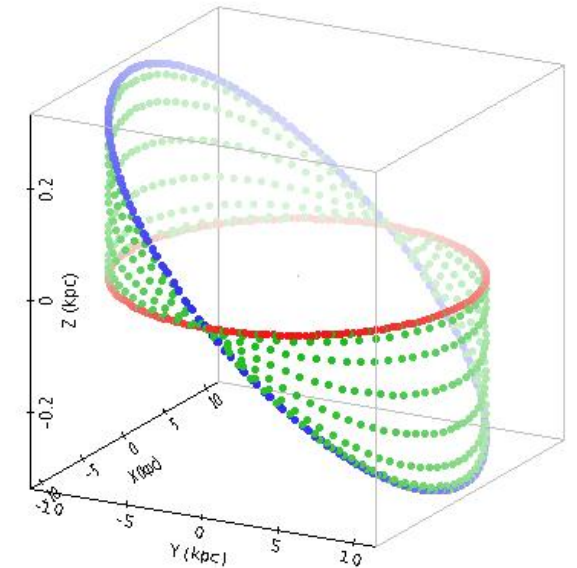
$n=1/2$



$n=2$



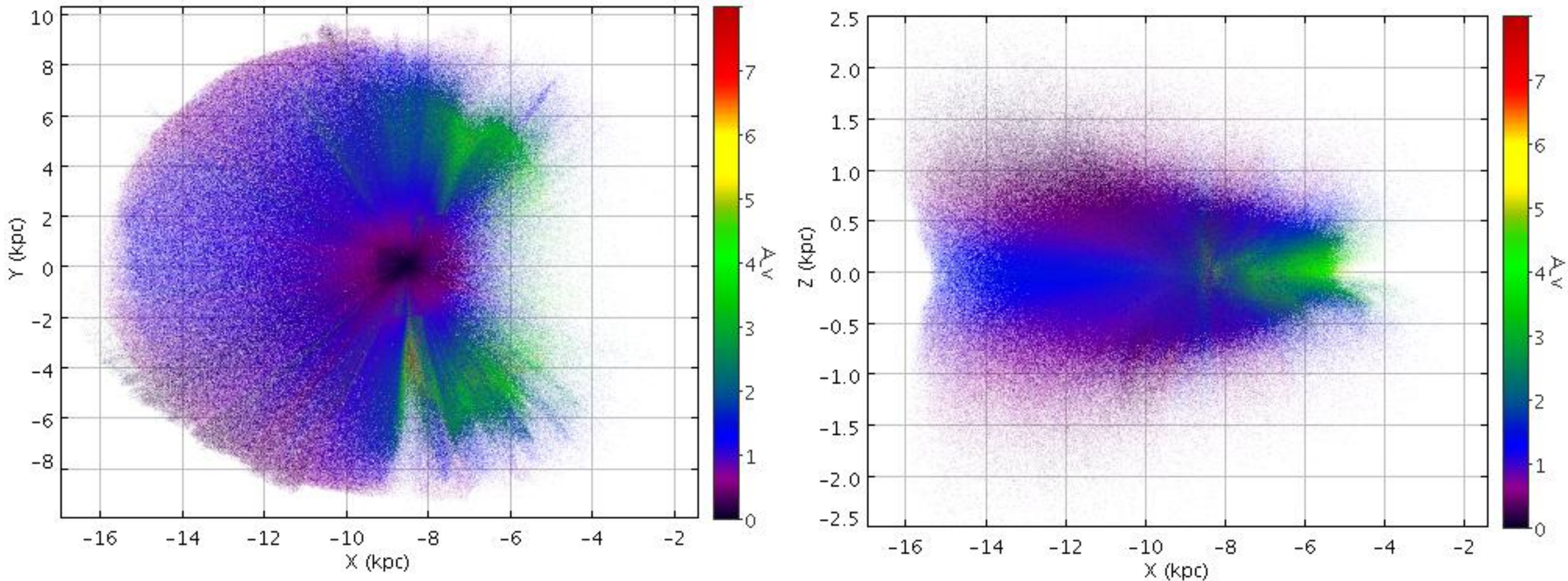
$n=4$



C



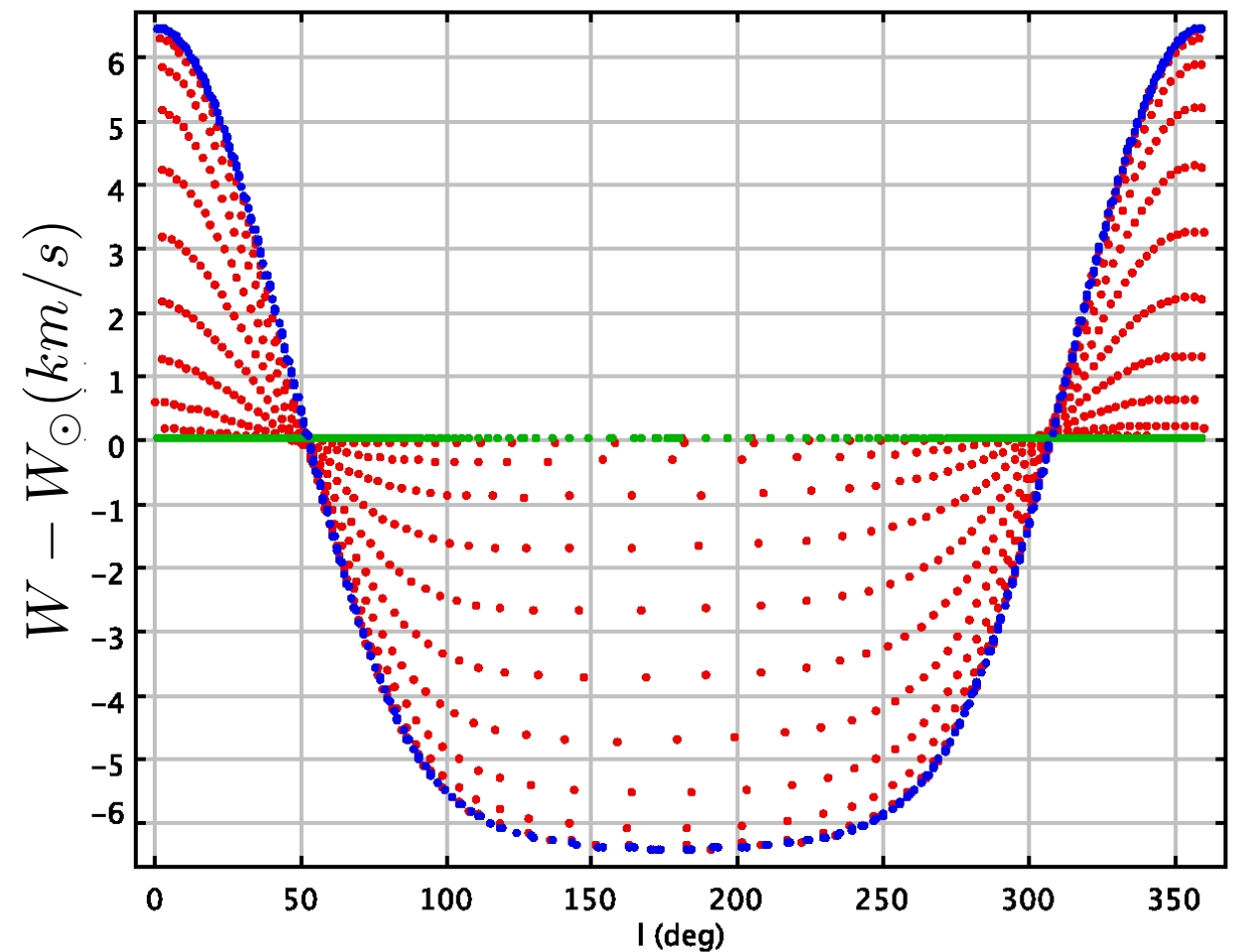
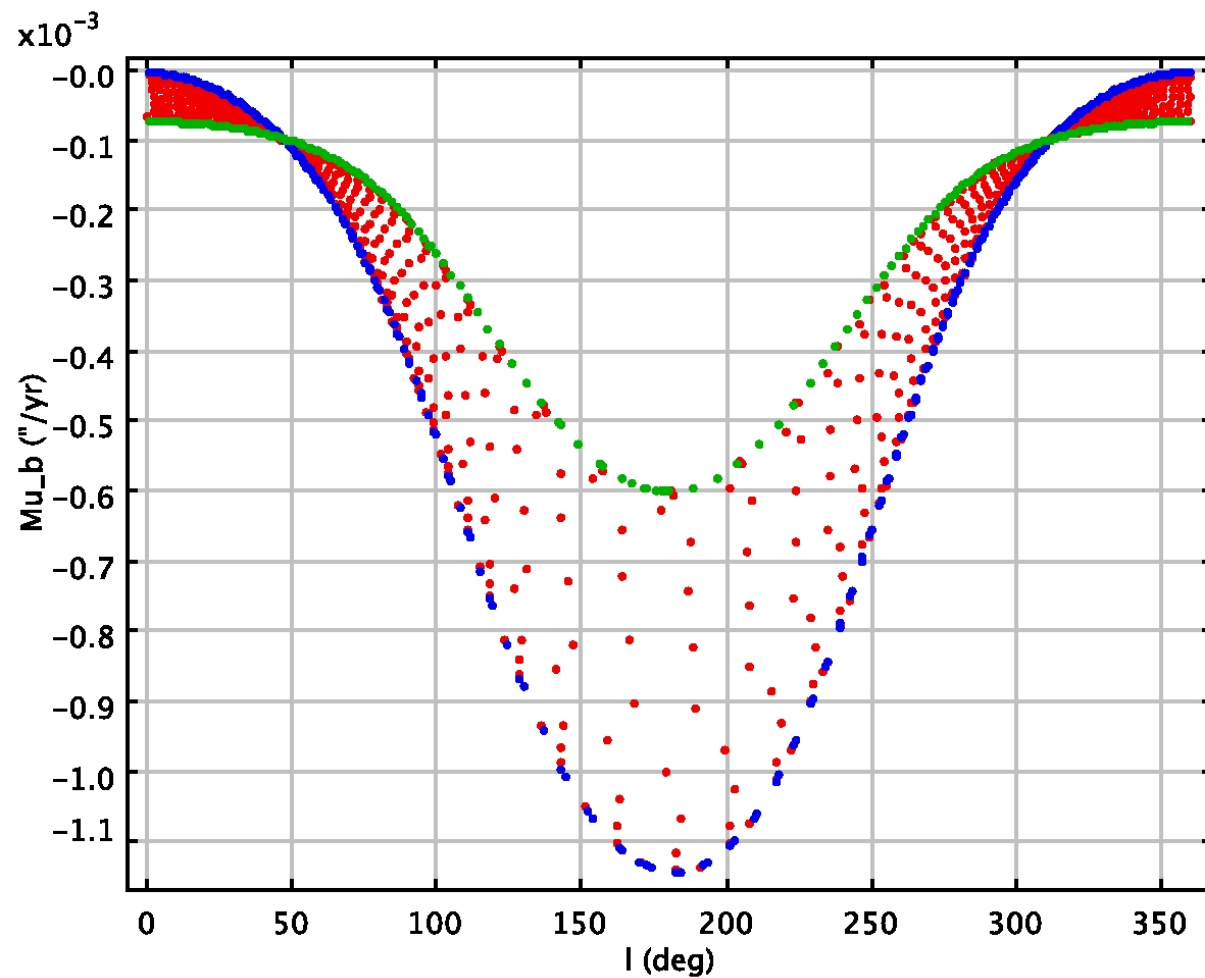
Map to Gaia observable space using Drimmel extinction law



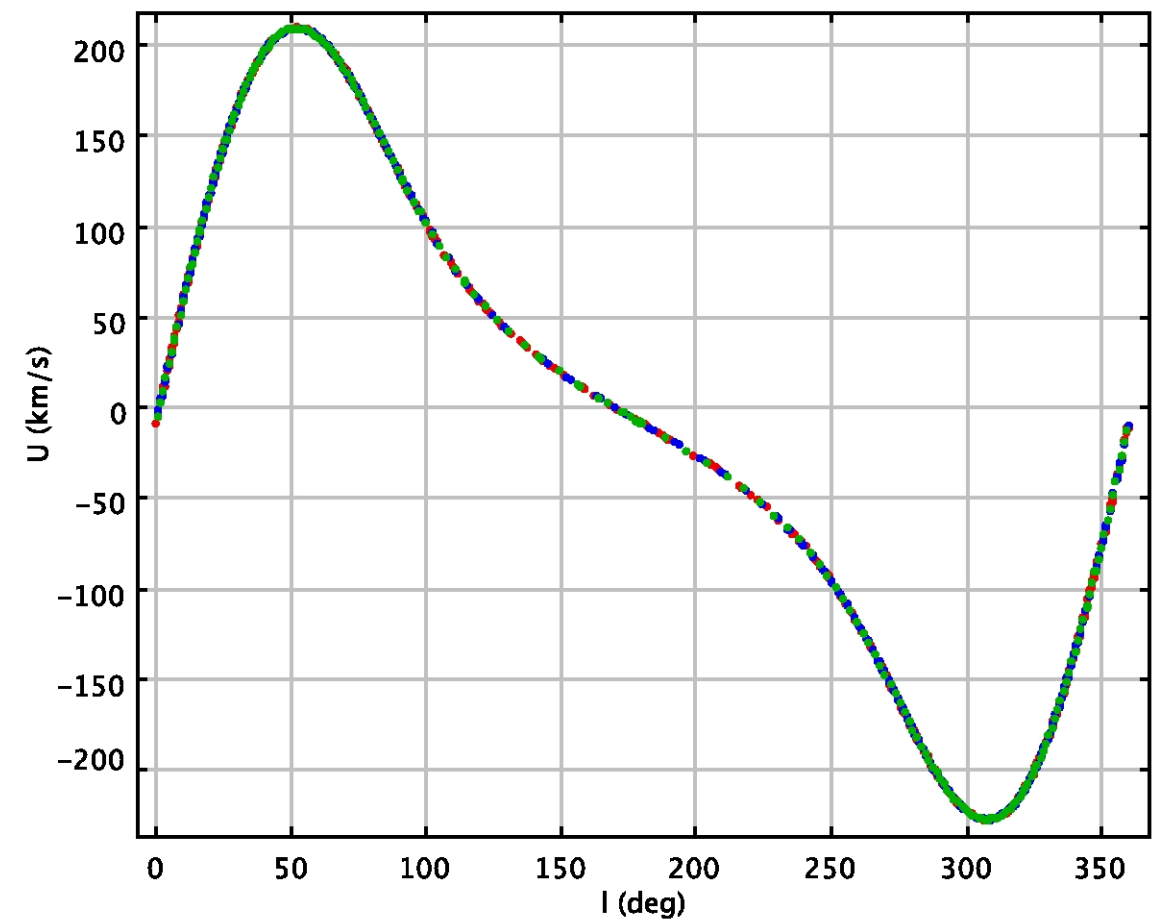
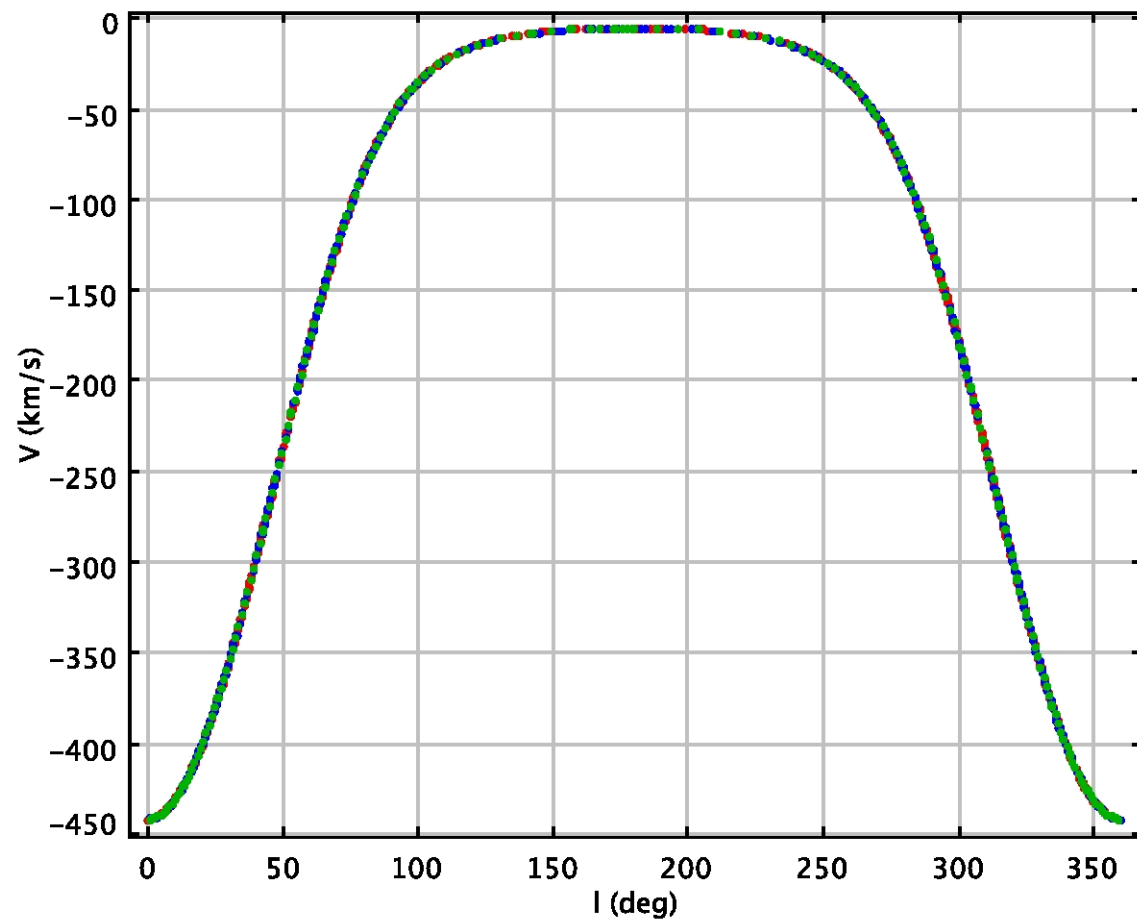
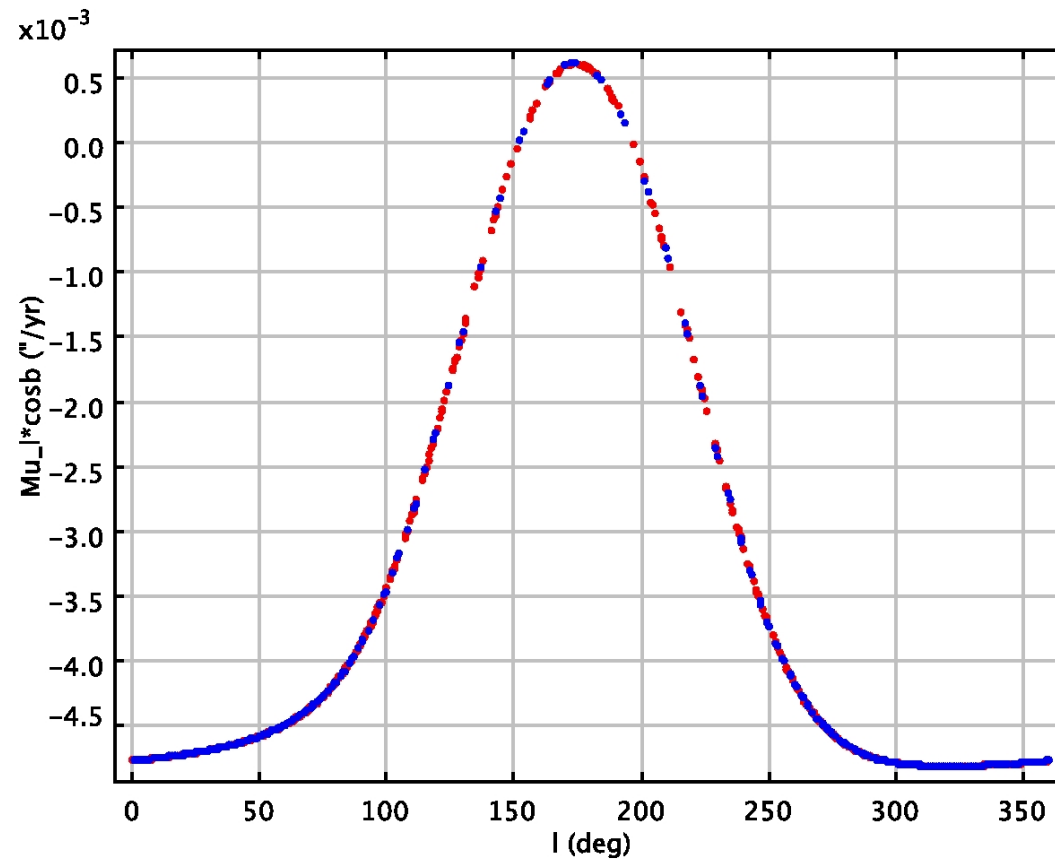
$G < 20$, Error in parallax $< 20\%$, $G_{RVS} < 16$

Can Gaia detect the kinematic signature of the warp?

As a test: A circular orbit at $r=11$ kpc

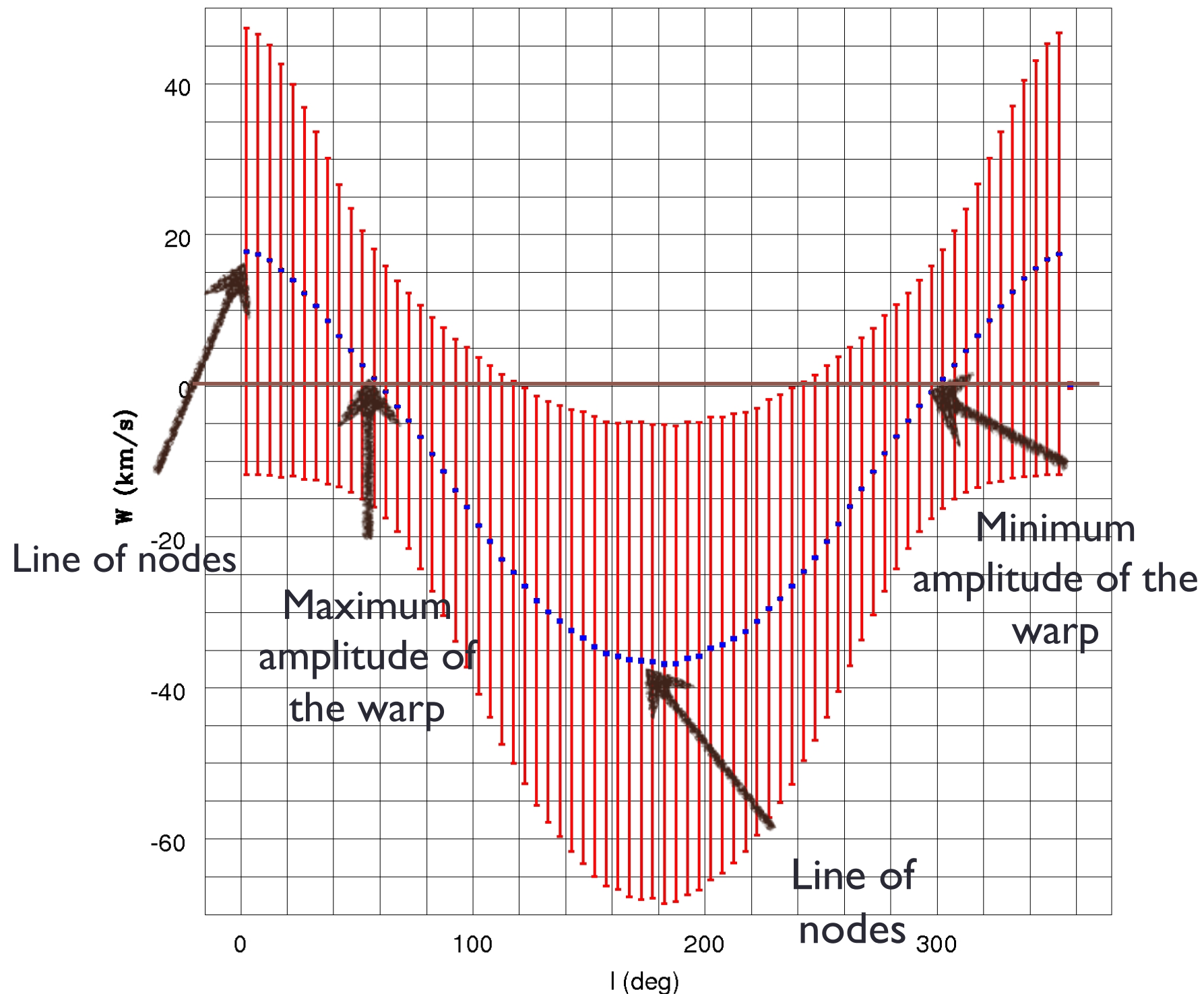


Can Gaia detect the kinematic signature of the warp?



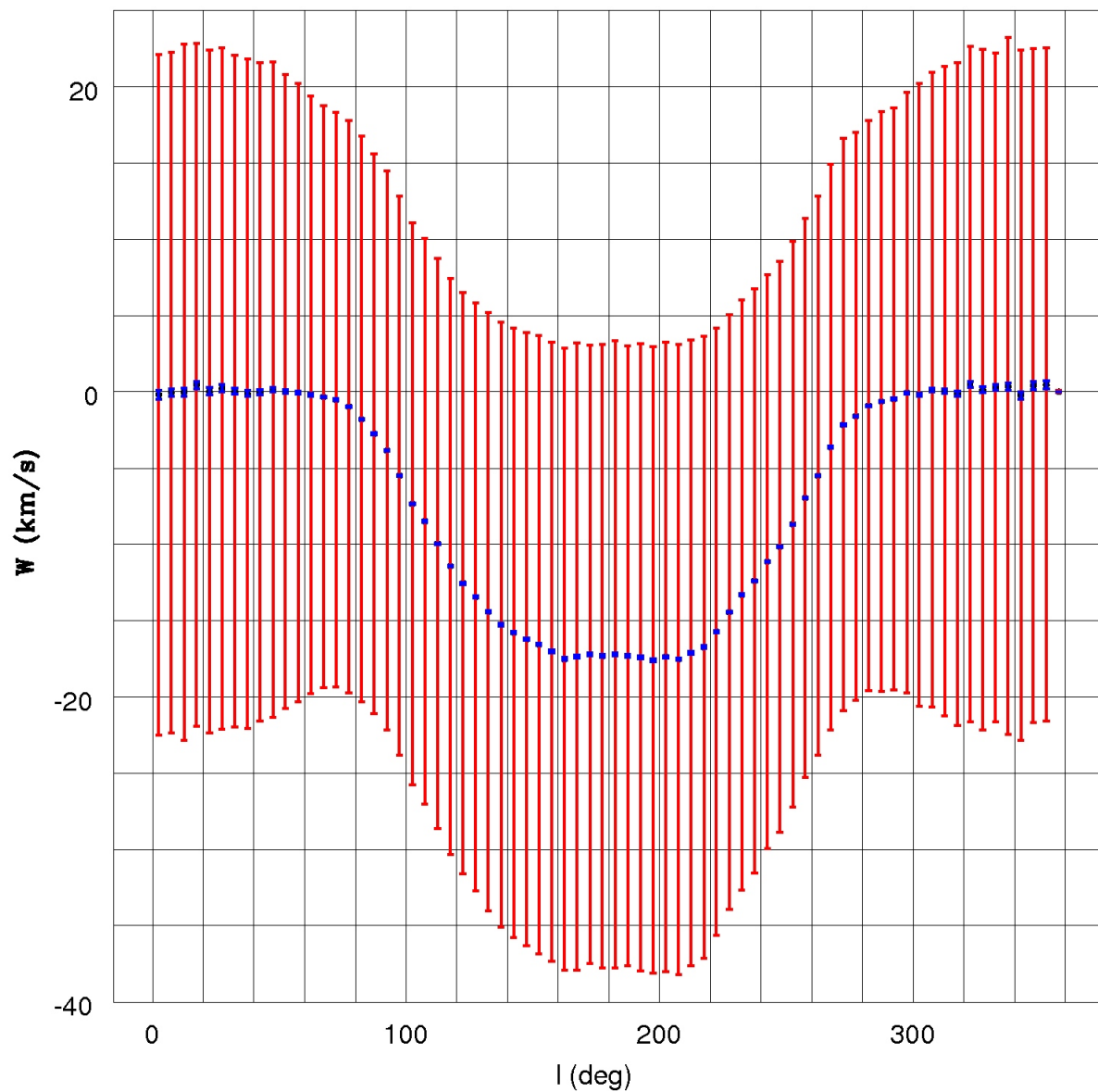
Can Gaia detect the kinematic signature of the warp?

- By looking at W component of heliocentric velocity of stars

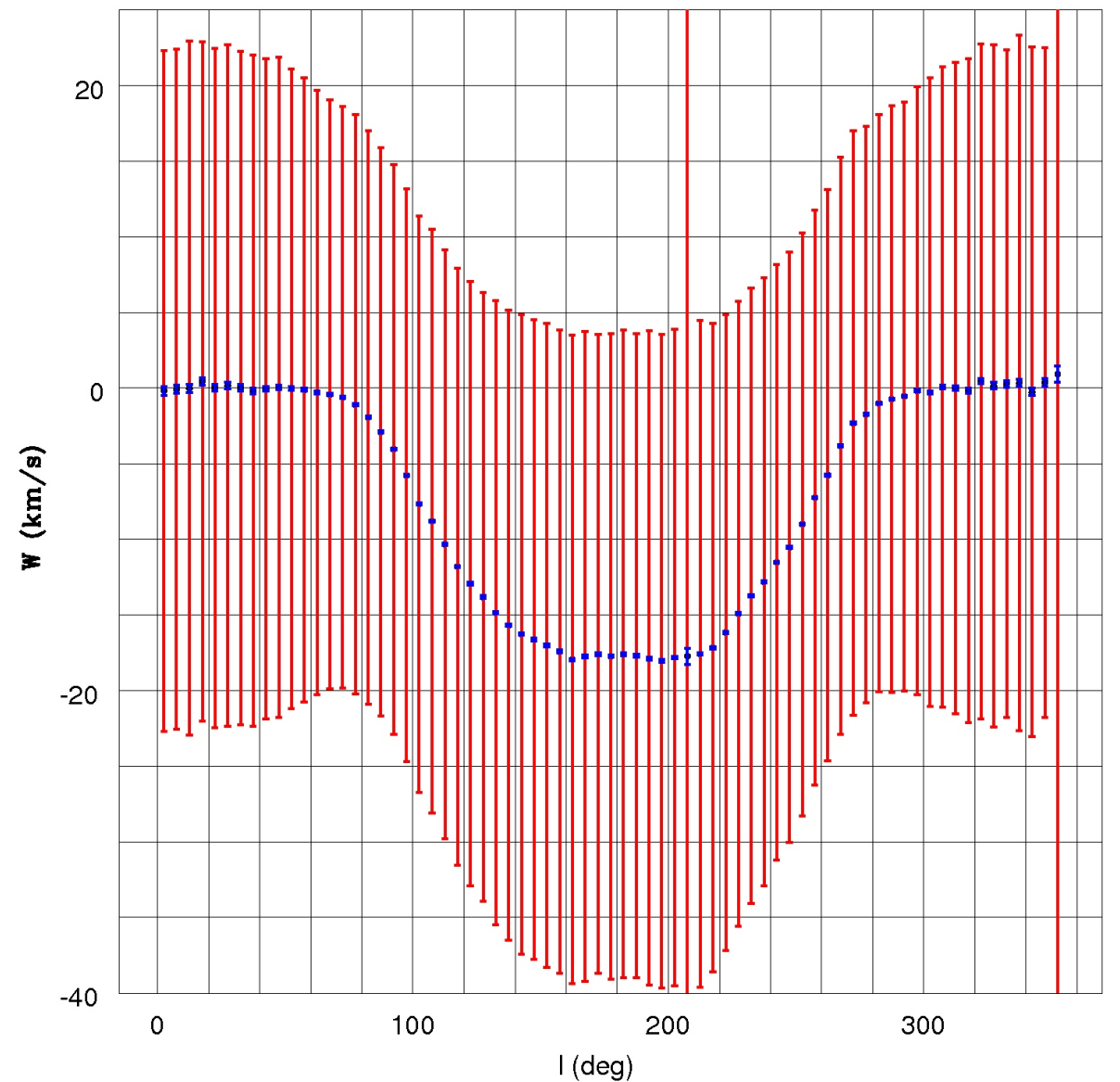


From simulation- no errors

Can Gaia detect the kinematic signature of the warp?



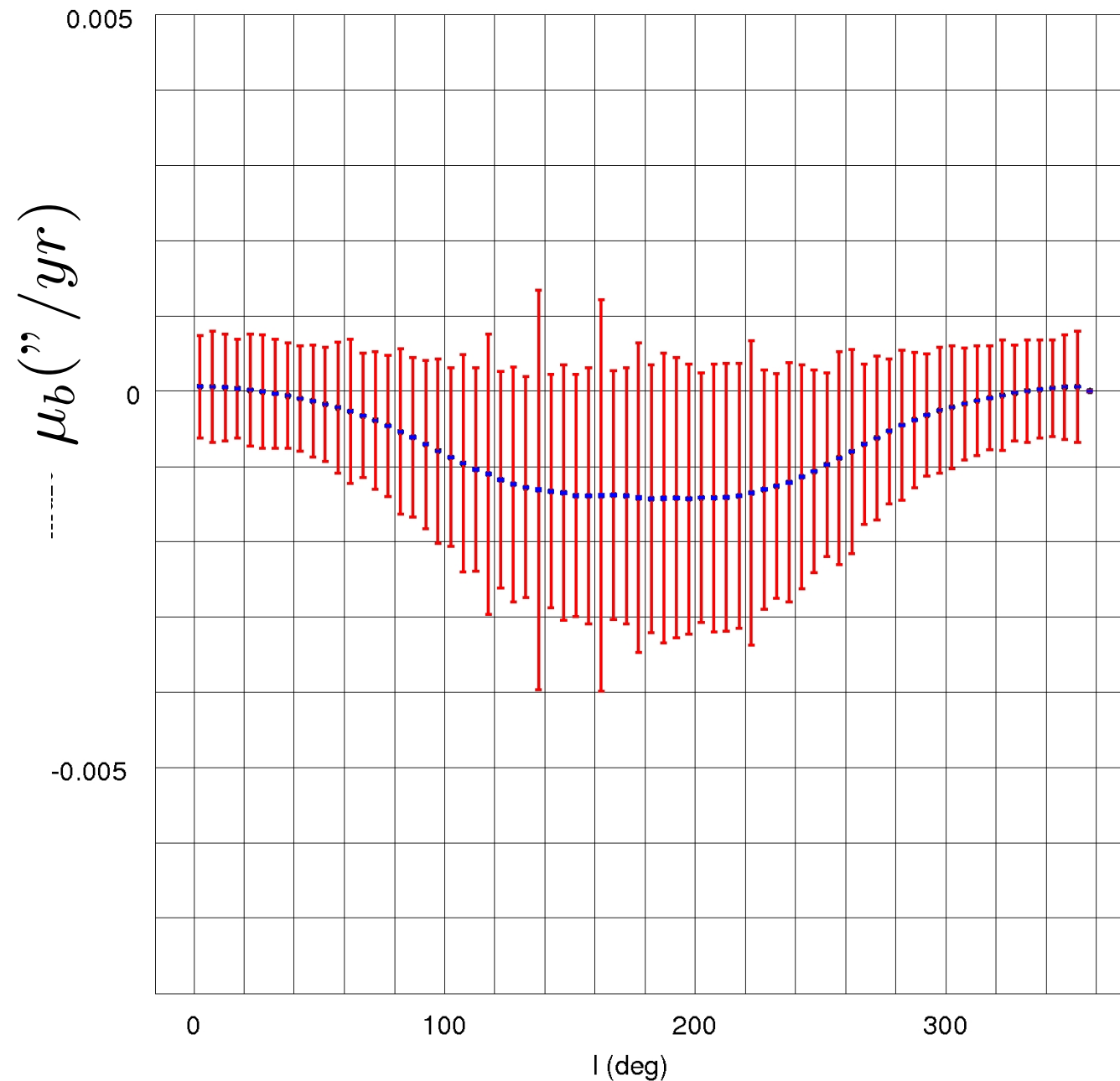
Observational constraints added,
no errors



Gaia error and
constraints added

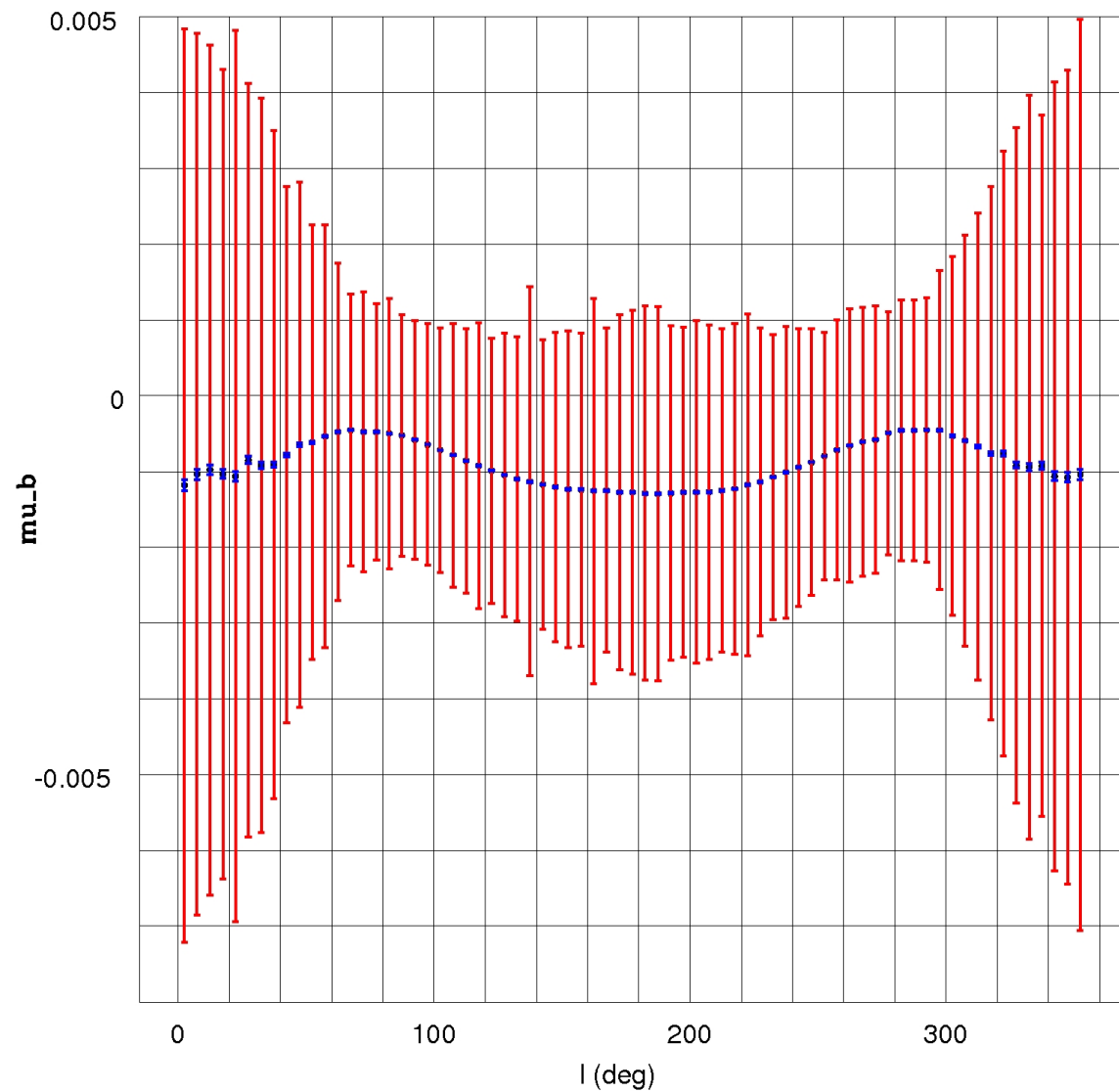
Can Gaia detect the kinematic signature of the warp?

- By looking at the proper motions towards Galactic latitude (μ_b)

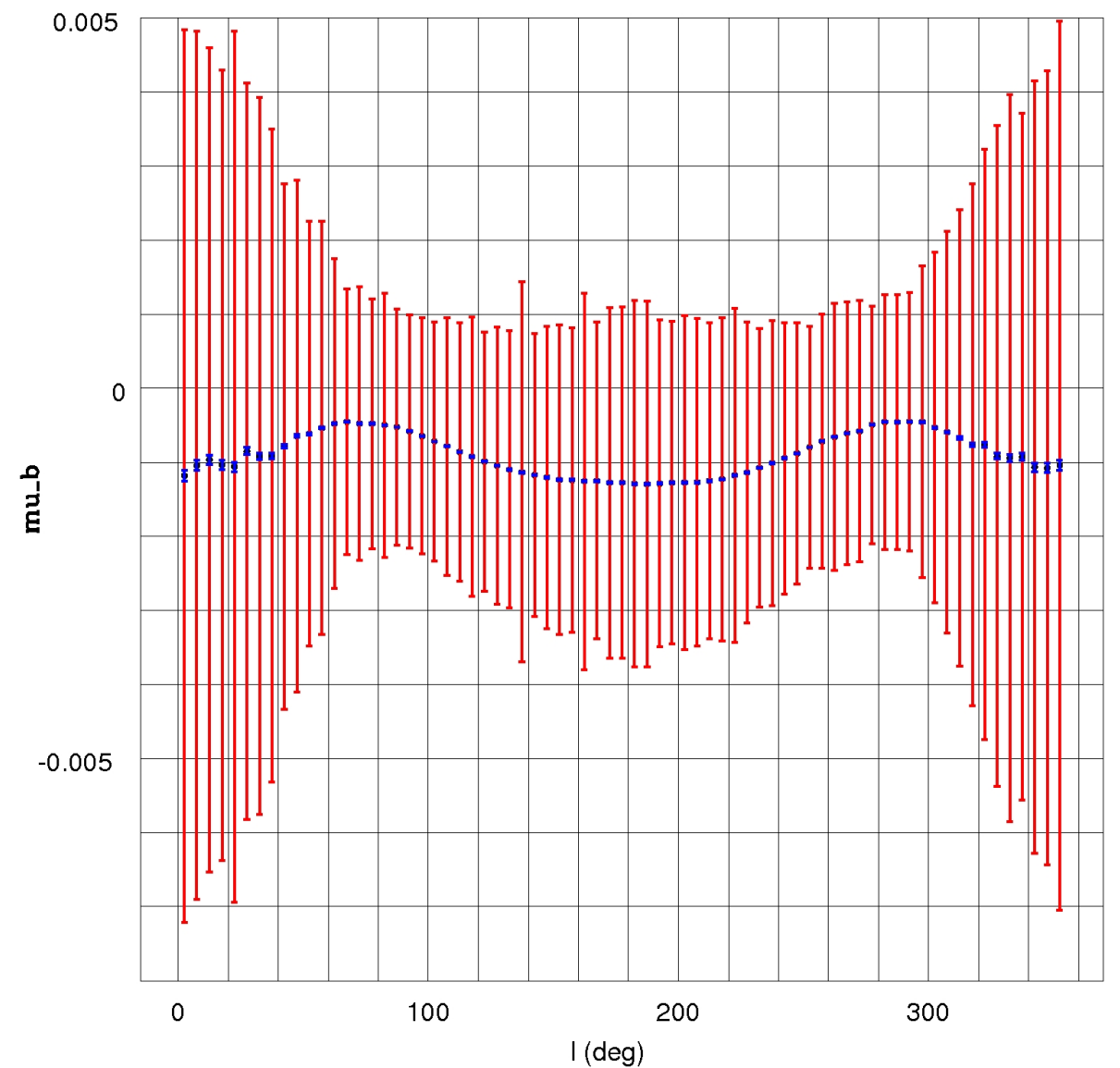


From simulation

Can Gaia detect the kinematic signature of the warp?



Observational constraints added
,without Gaia errors



Gaia error and
constraints added

Next steps

- To look for kinematic signatures with and without statistical equilibrium in the new sample that mimics the MW.
- To analyze deeply the space of Gaia observables

Thank you!