Simple Galactic Rotation

A non-modelling perspective

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Galactic Parameters - methods

Solar azimuthal V $V_{g,\odot} = V_\odot + V_c$ Disc circular velocity

Local Standard of Rest

Methods

Proper motion of Sgr A* (Reid et al. 2004) – requires R_0

HI terminal velocity (see McMillan 2011)

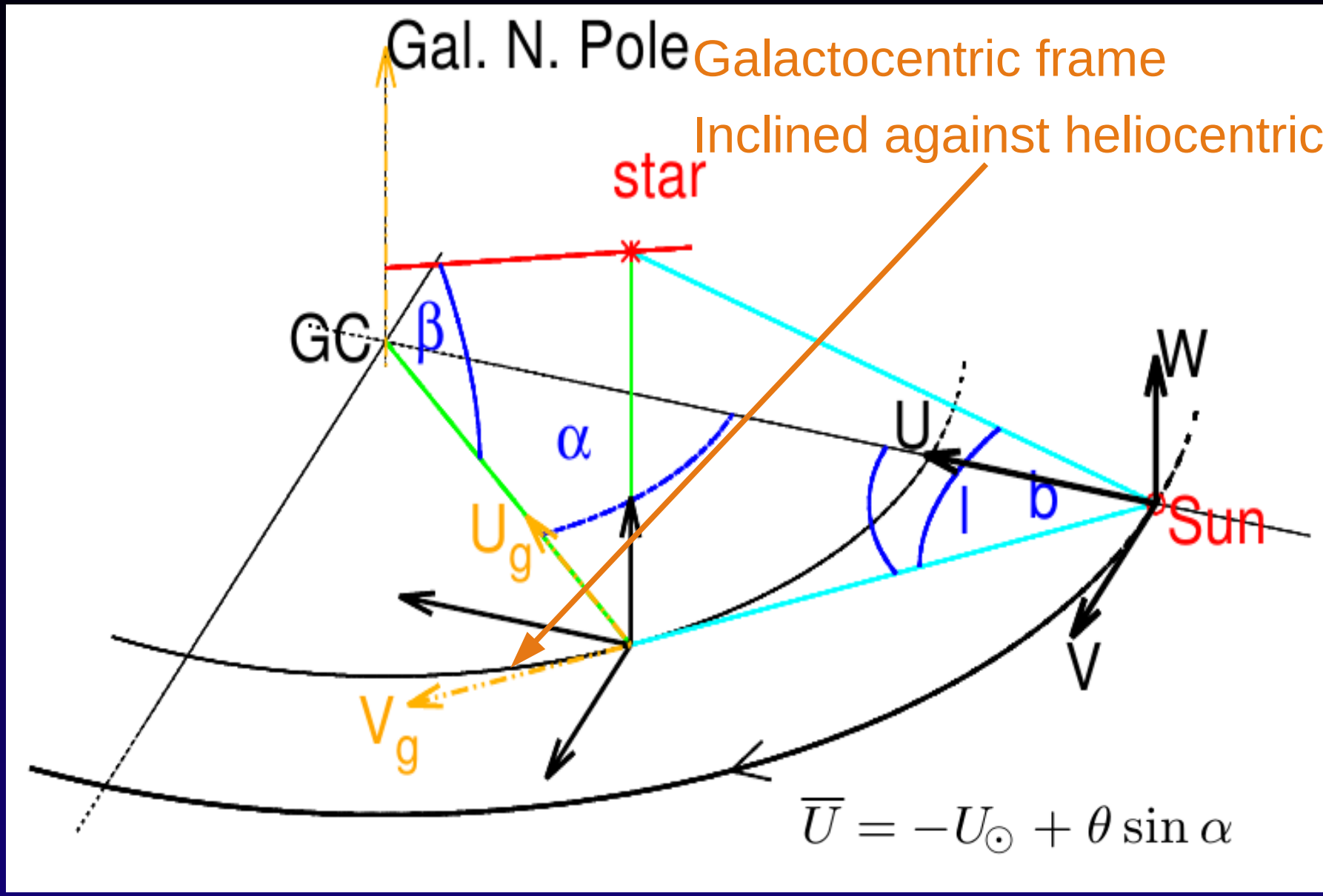
Molecular clouds / MASERs (Reid & Brunthaler 2004)

Halo Streams (Ibata et al. 2001, Majewski et al. 2006)

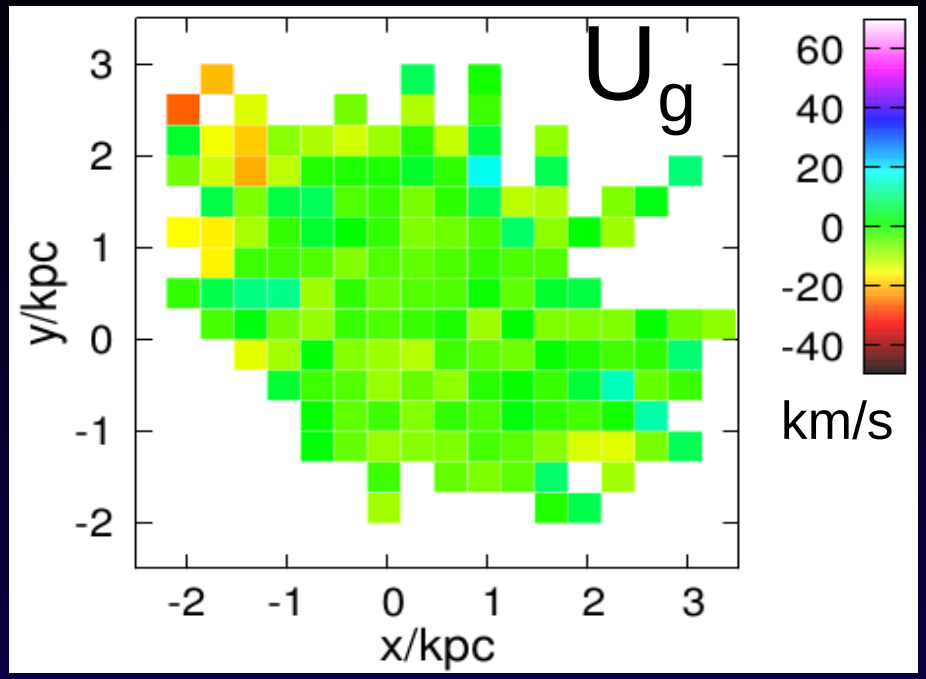
Oort constants (Oort 1927)

LSR (Strömberg 1947, Schönrich, Binney & Dehnen 2010)

Rotation – the dry view

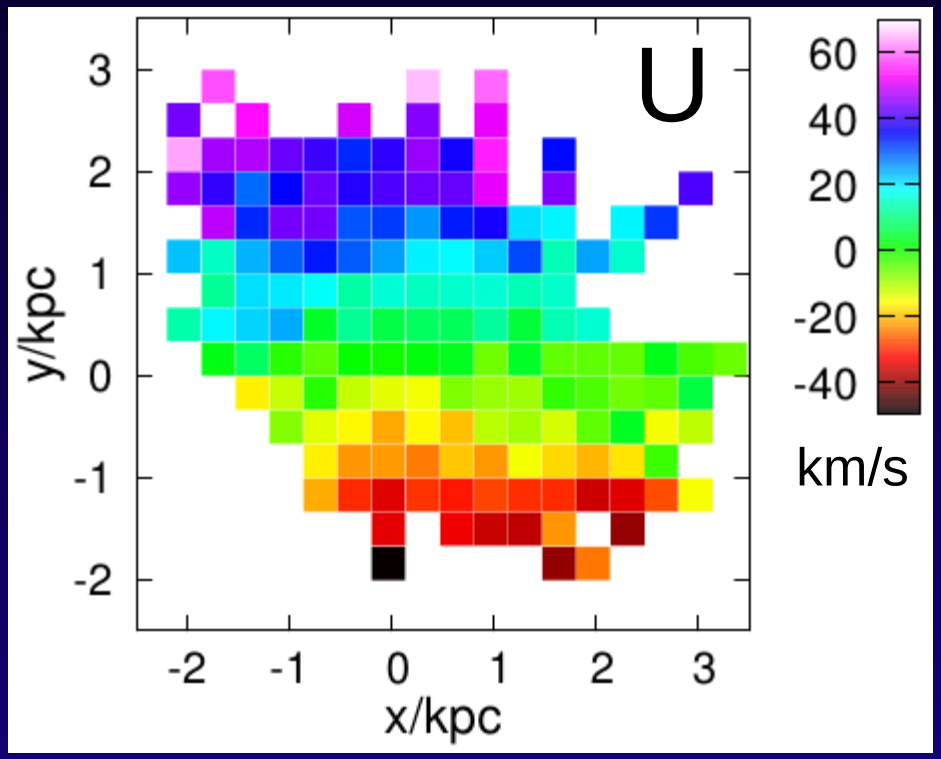


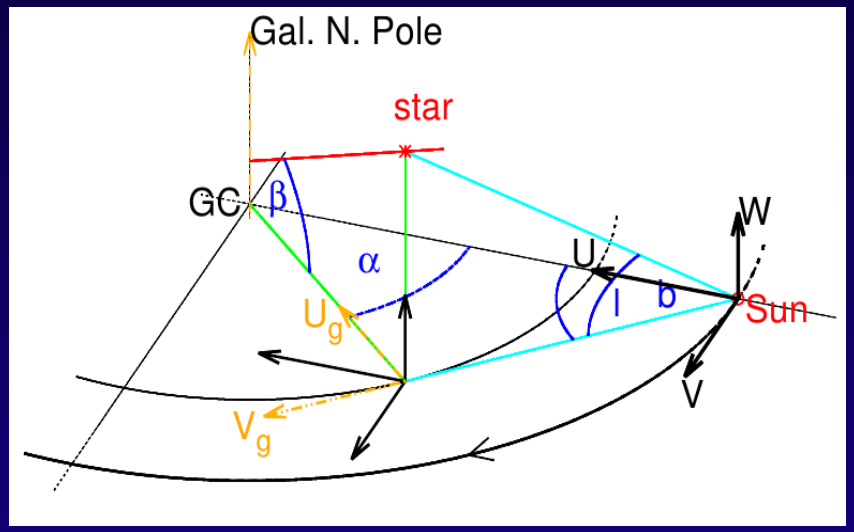
Radial velocities in the plane from SEGUE



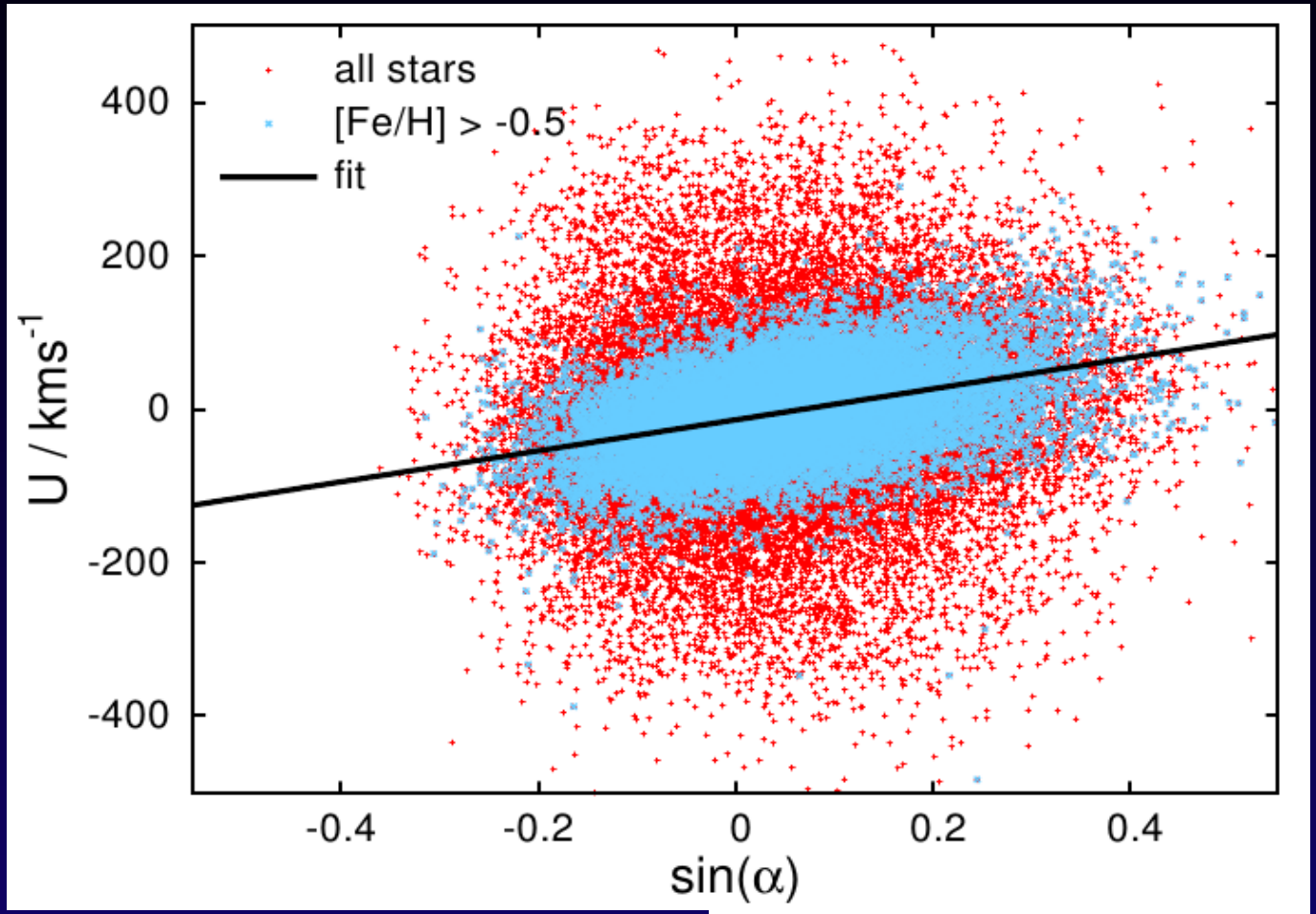
galactocentric

heliocentric





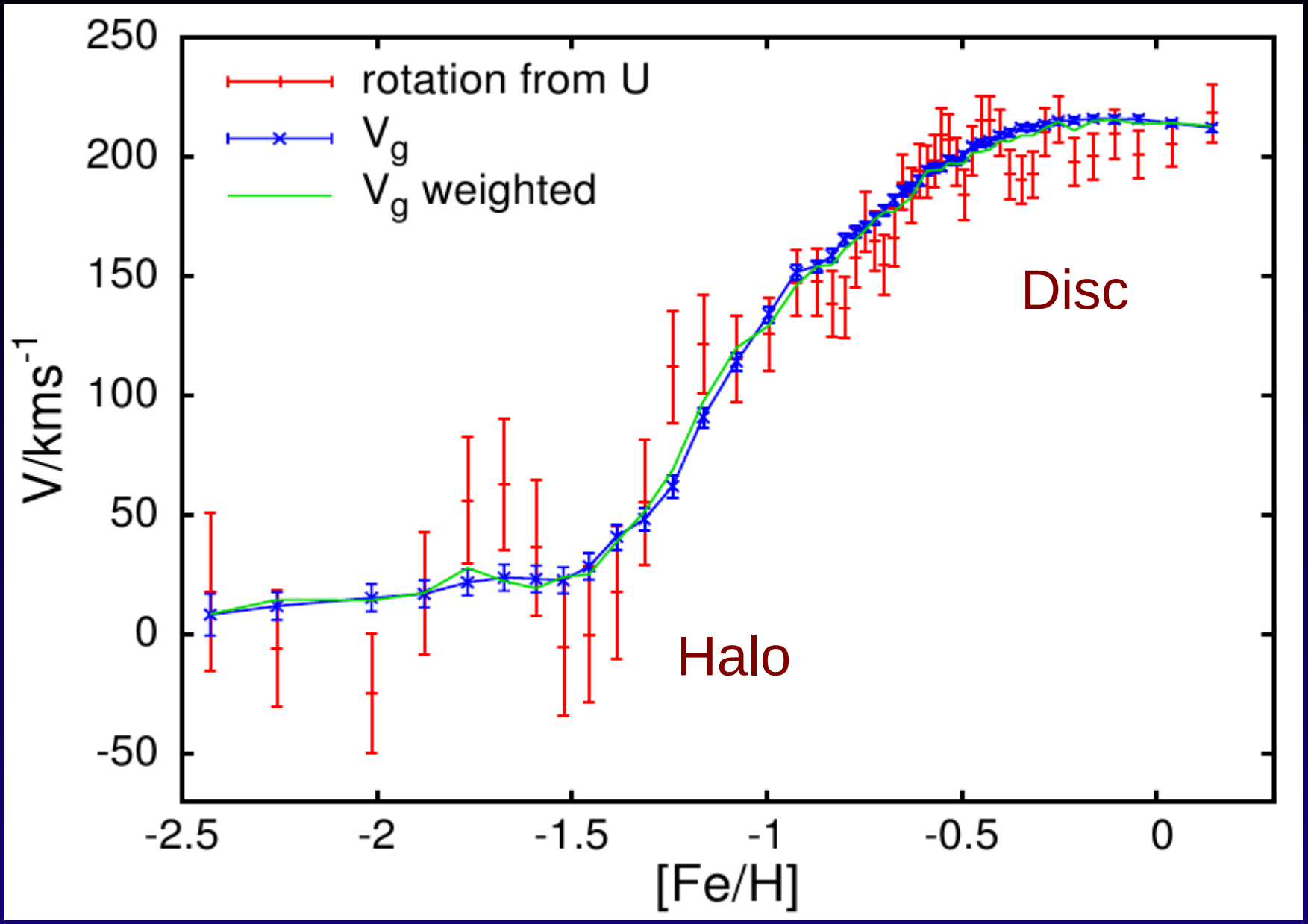
Rotation: A danger when measuring the solar motion



$$\overline{U} = -U_{\odot} + \theta \sin \alpha$$

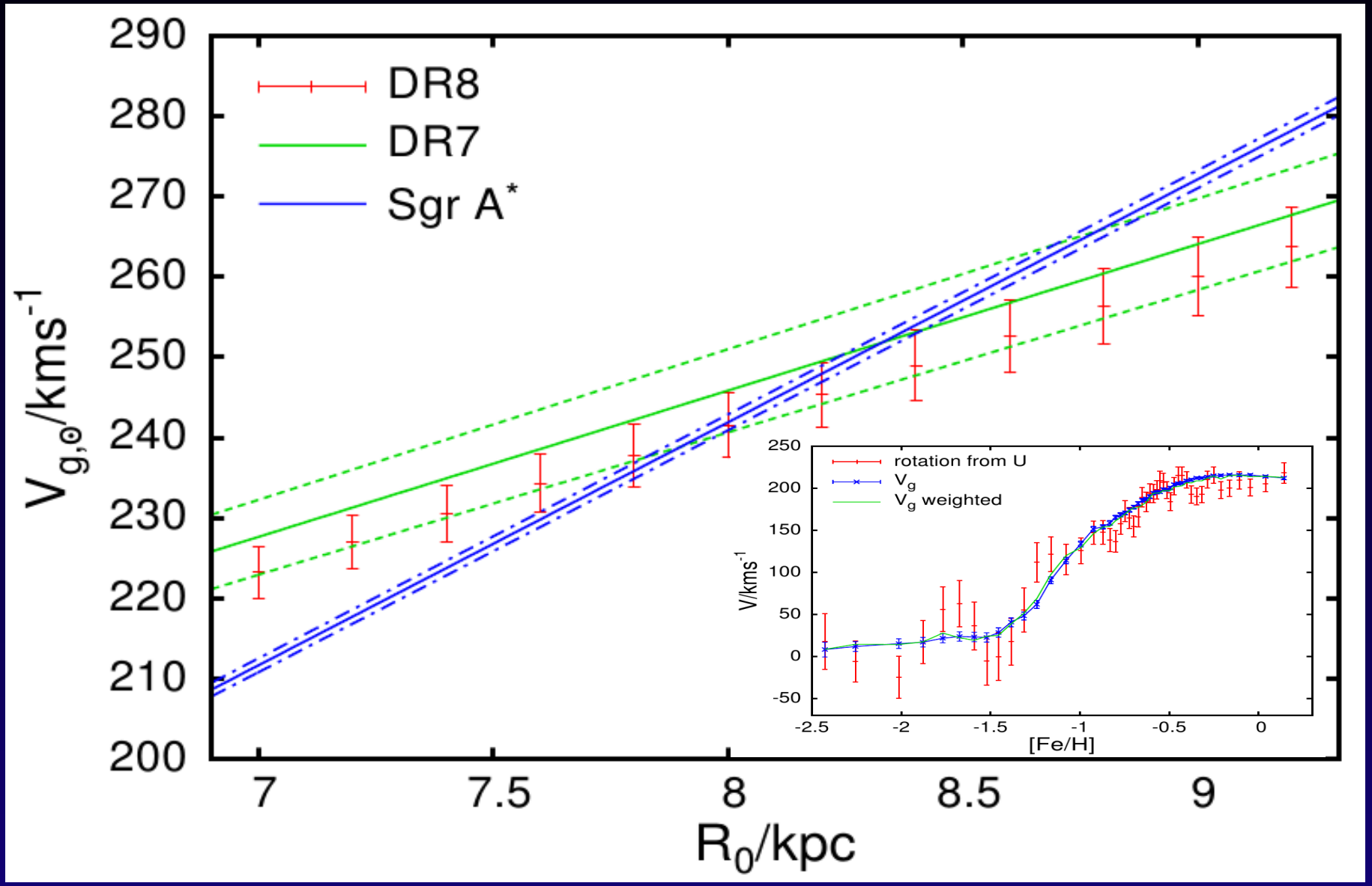
Samples are lopsided (northern/southern sky) → rotation bias

Behavioural differences



Get the absolute solar velocity

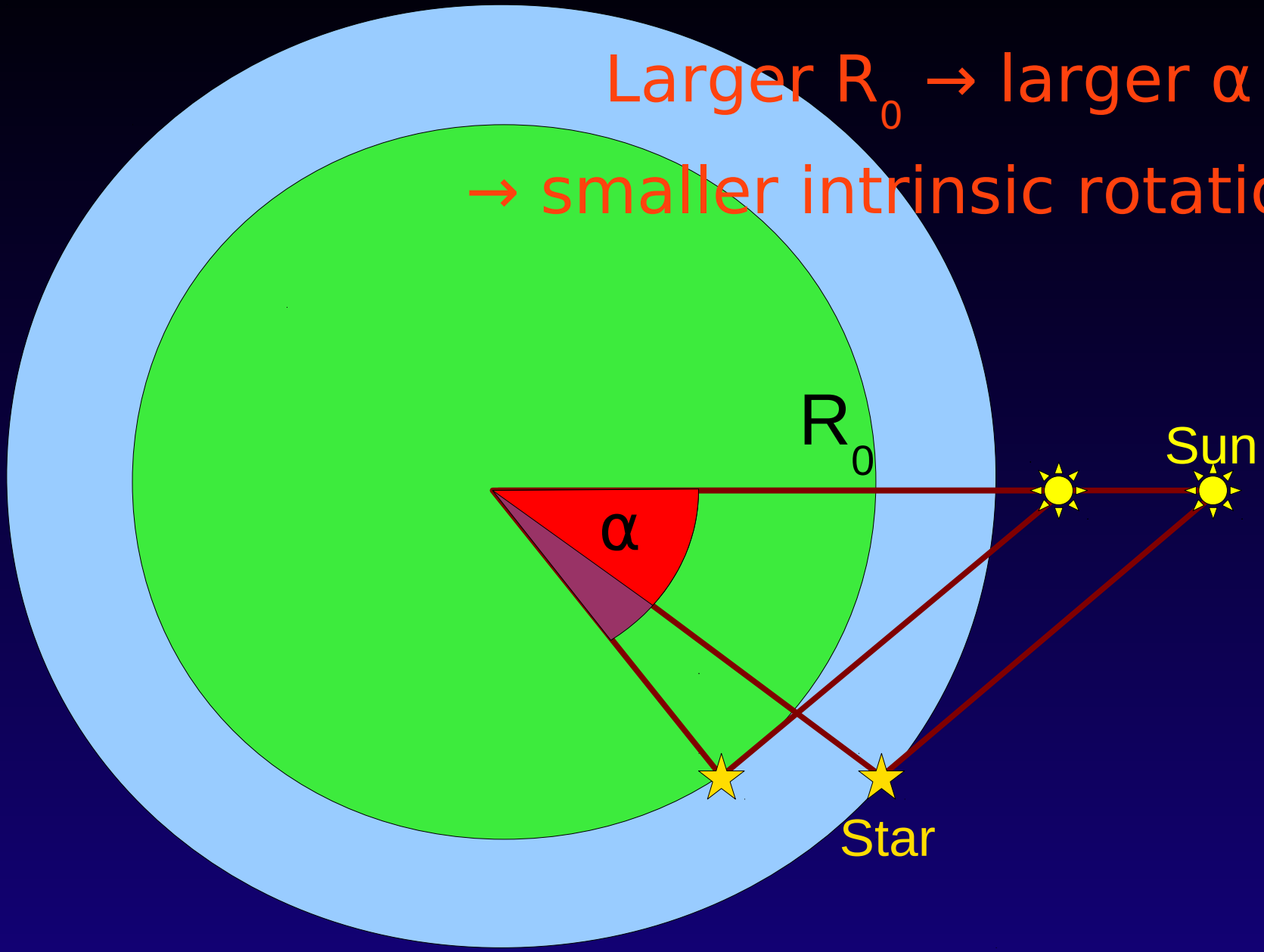
Simple: azimuthal velocities must match the absolute rotation



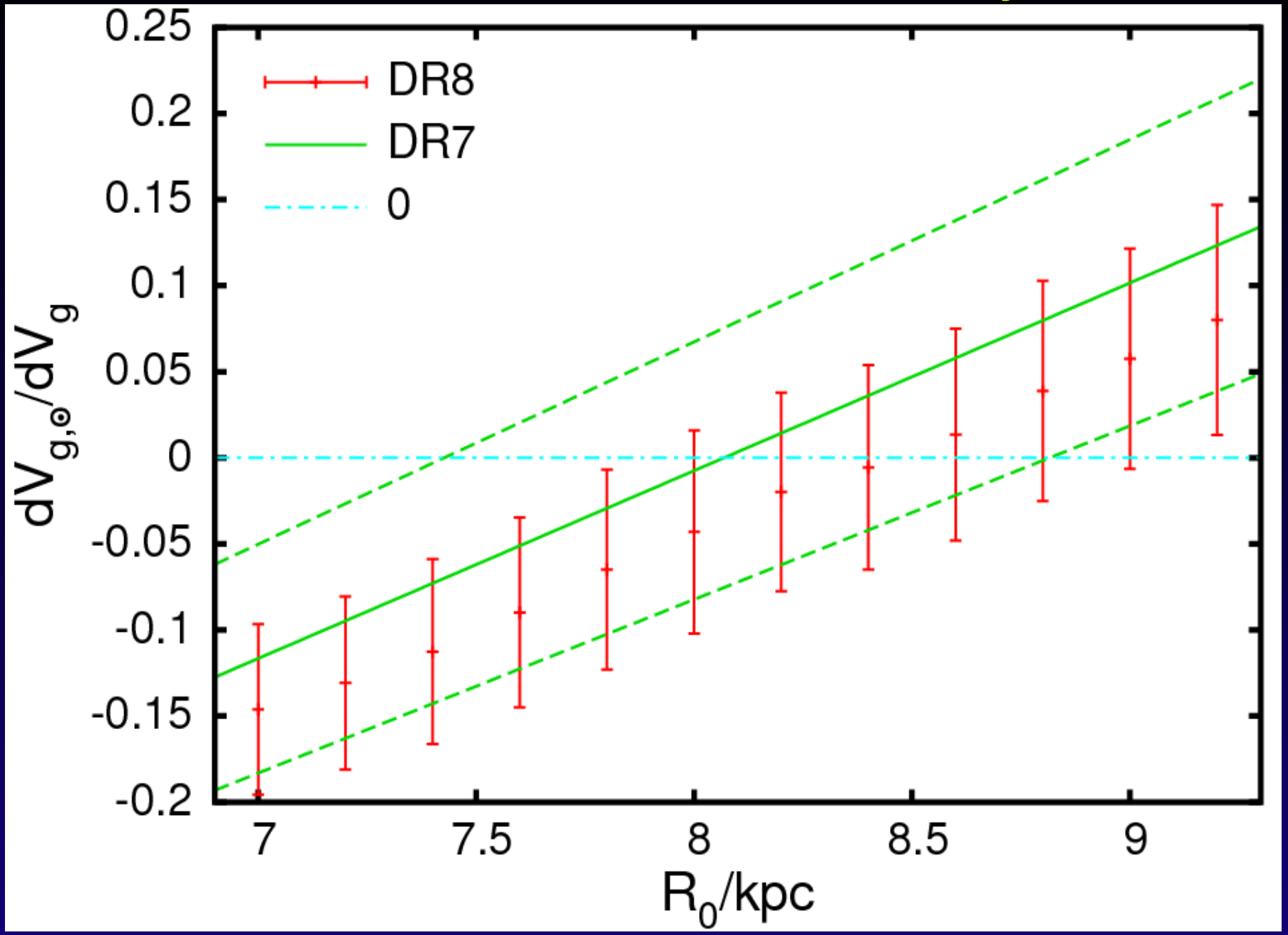
Behavioural differences

Larger R_0 → larger α

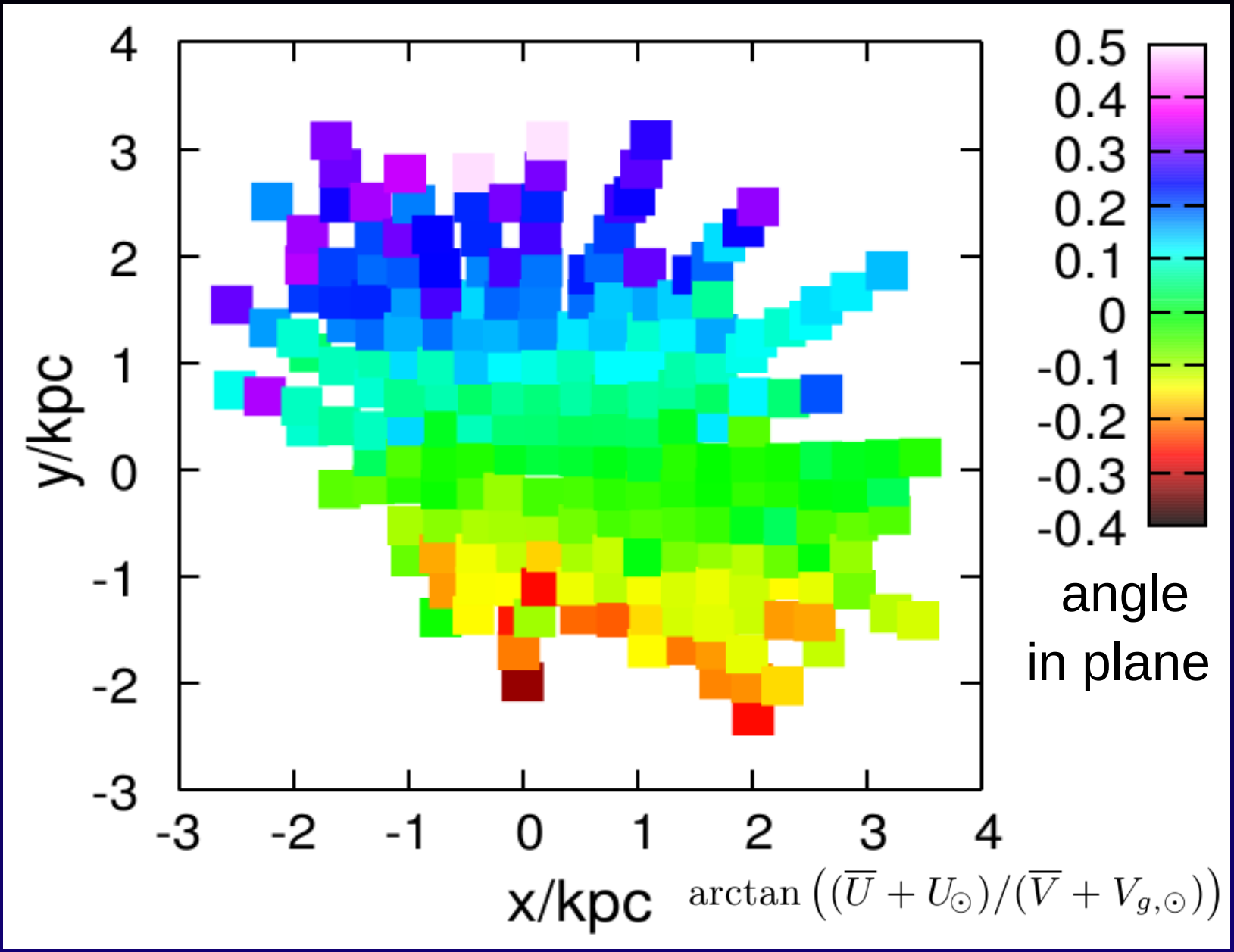
→ smaller intrinsic rotation



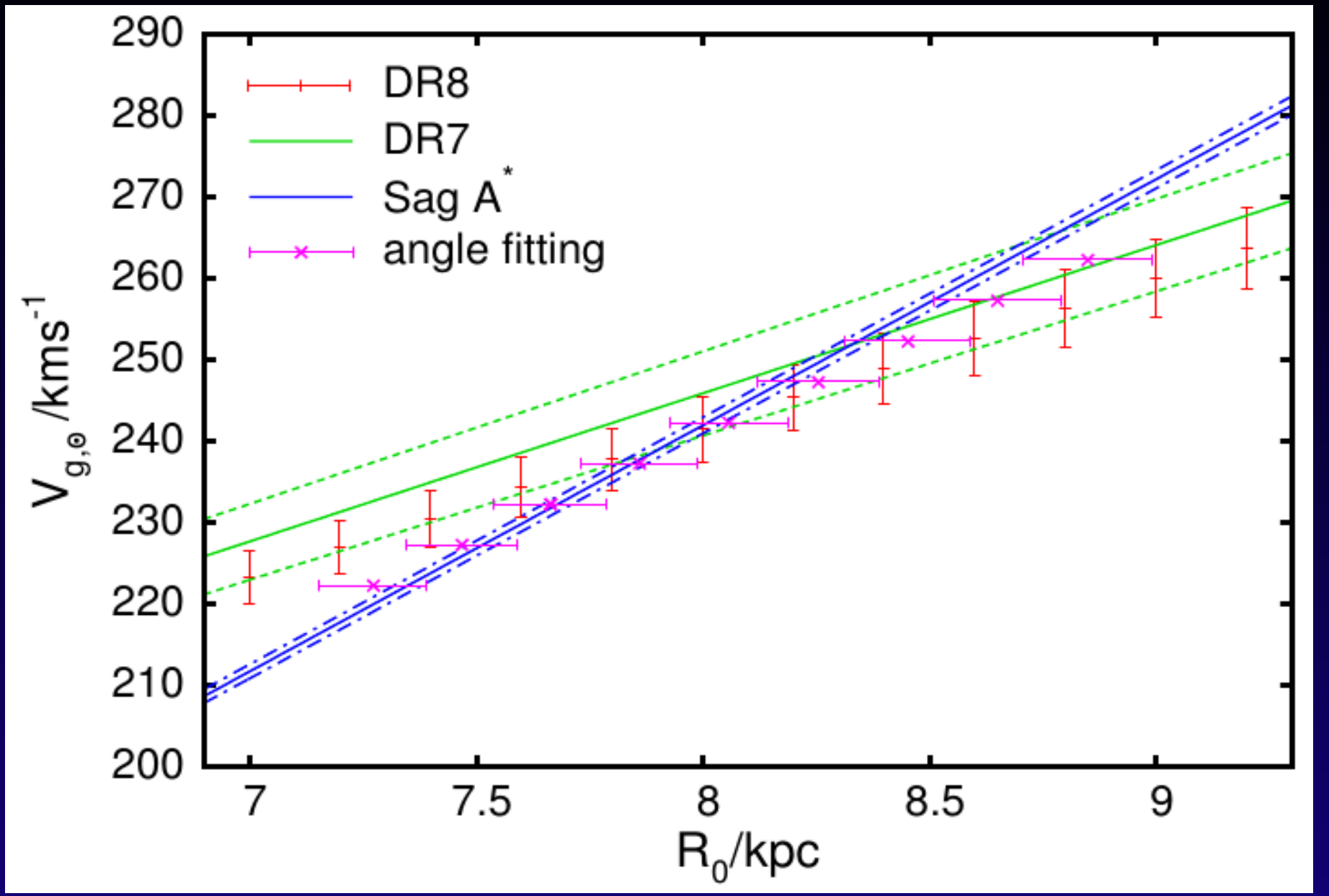
On the slide – radius from velocity trend



Quo vadis? Using the direction of motion

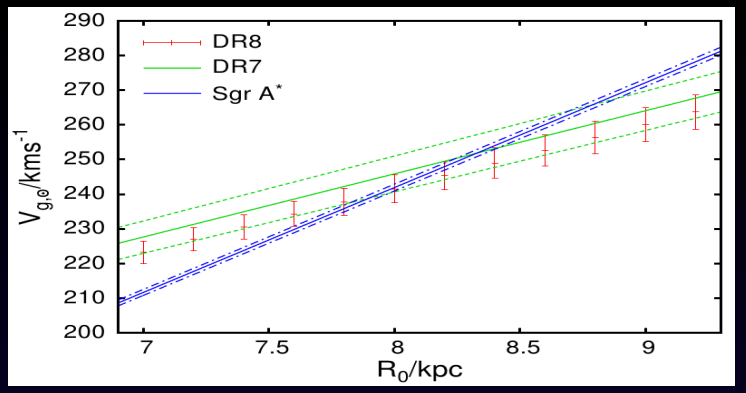


Applying the motion angle



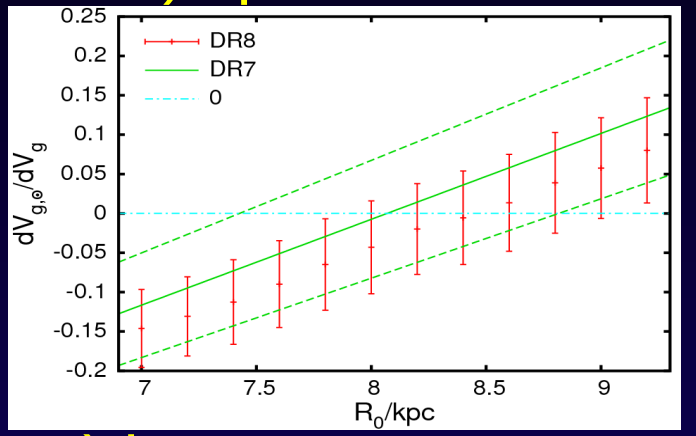
preliminary

Values



Velocity match + Sgr A*

V_{Sun} = (241 ± 10) km/s R_0 = (7.97 ± 0.35) kpc



Velocity trend

R_0 = (8.43 ± 0.57) kpc

Combined

V_{Sun} = (245 ± 9) km/s R_0 = (8.11 ± 0.29) kpc

V_C = (233 ± 9) km/s

Blended with McMillan(2011)

V_{Sun} = (249.5 ± 4.2) km/s R_0 = (8.25 ± 0.14) kpc

V_C = (237 ± 5) km/s

Summary

- Heliocentric radial velocities provide easy and less biased access to the rotation of components, without modelling

- Three new and independent estimators for Galactic rotation and solar position, competitive at SEGUE

- Requires large samples with significant spatial extent, hence far better with Gaia

- Radial velocity determinations for the Sun must account for the rotation of components

- method requires a low systematic distance error (reddening, metallicities, helium enrichment, etc.), currently using Schönrich, Binney & Asplund (2012)

- vulnerable to systematic proper motion errors

- requires approximate axisymmetry