

**Preliminary
report**

3D evolution of the Gould Belt

Christophe Perrot & Isabelle Grenier
Université Paris VII & CEA Saclay

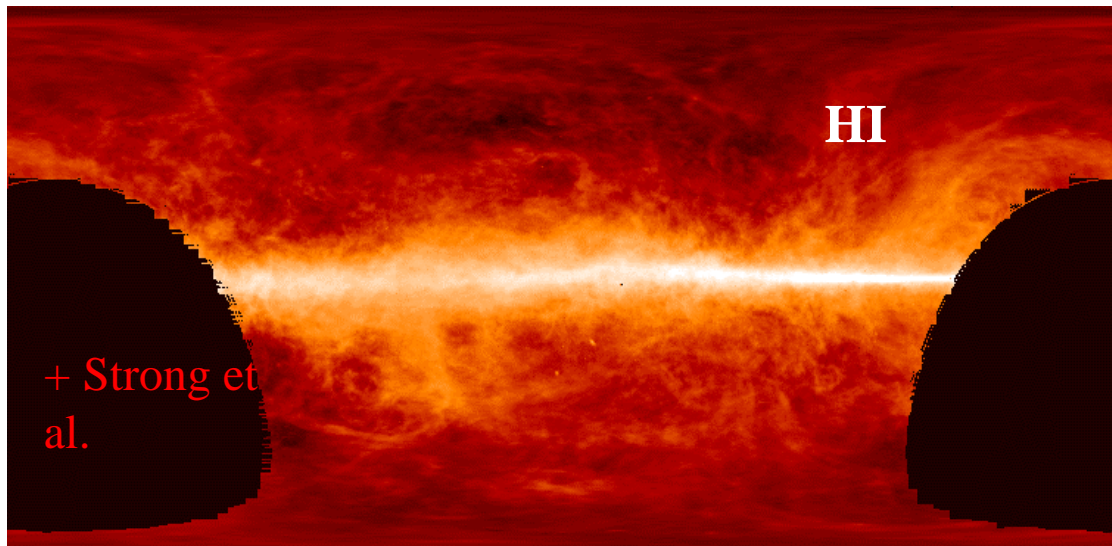
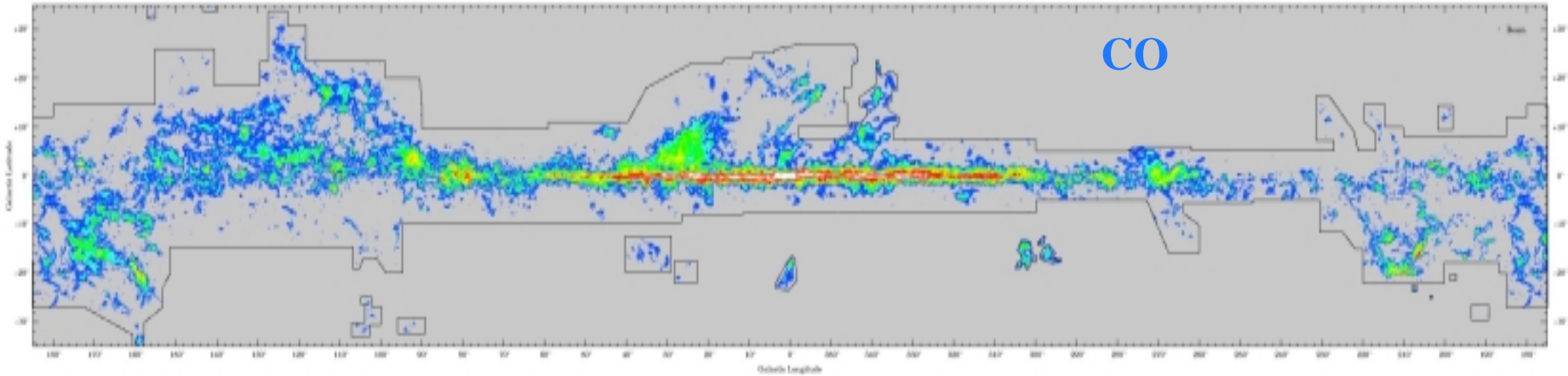
cperrot@cea.fr, isabelle.grenier@cea.fr

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the Belt dynamical evolution: data

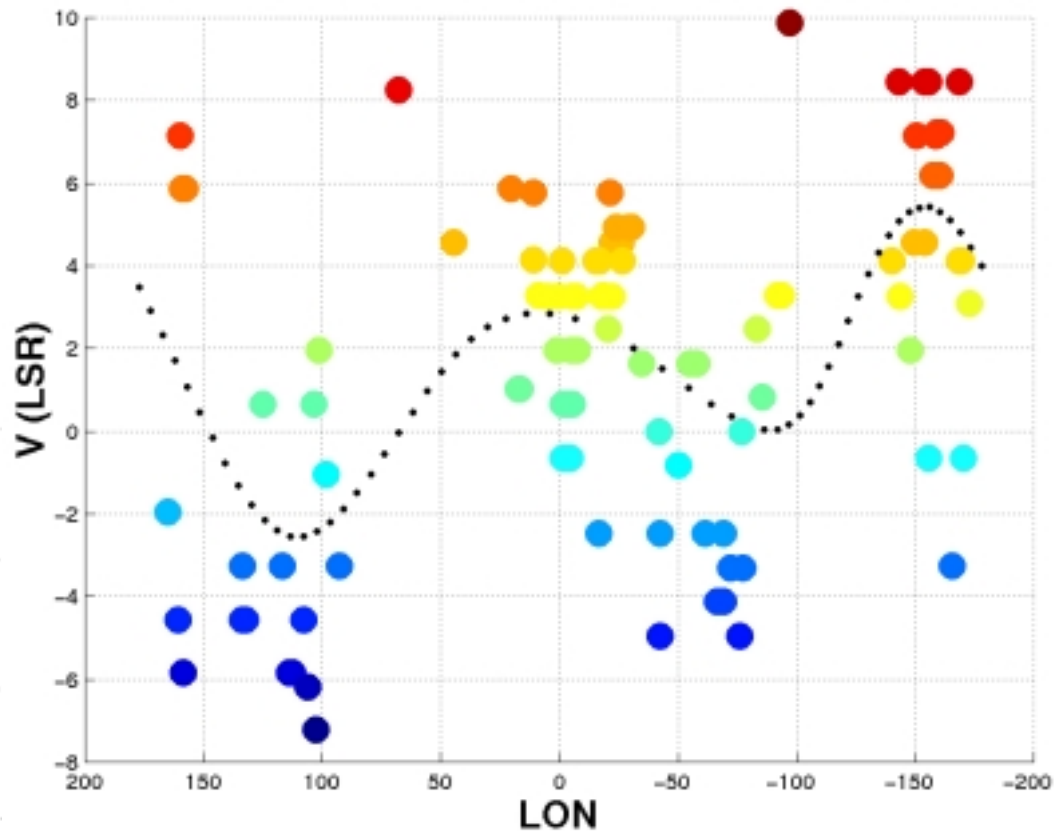
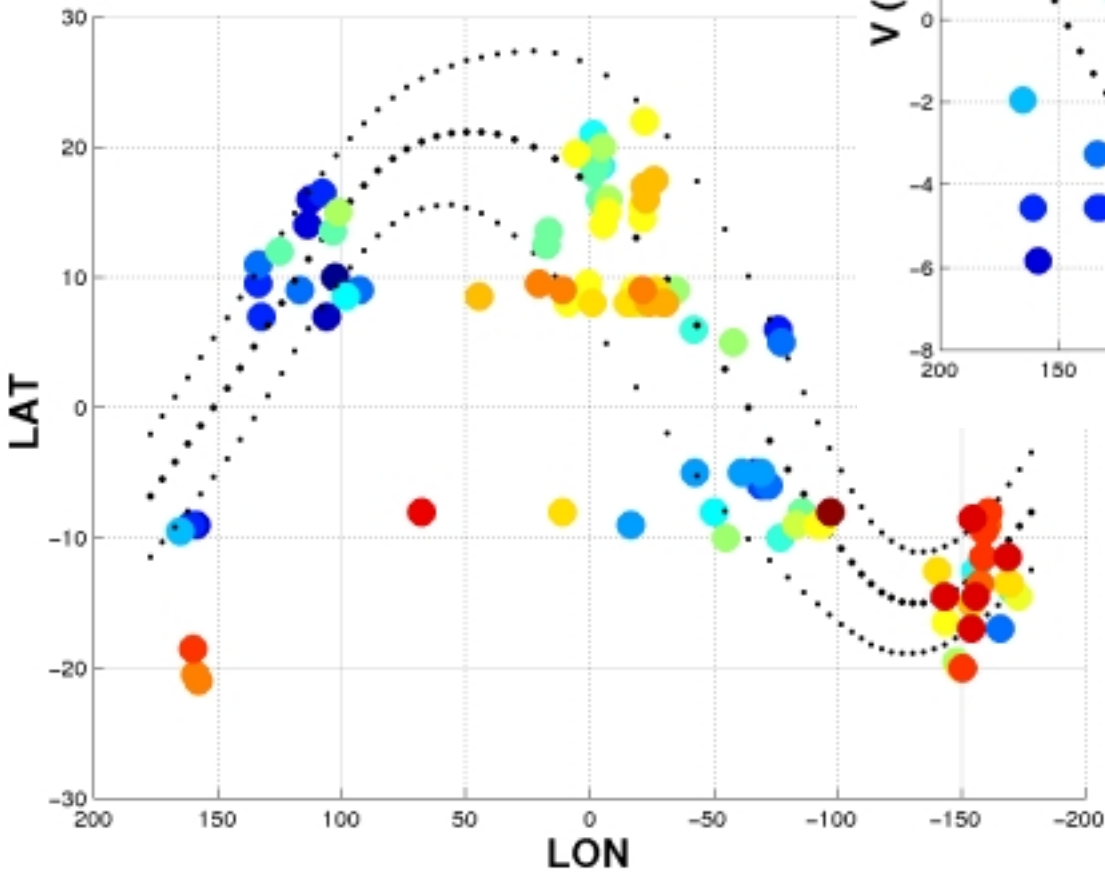
Position (l,b) and velocity $v_{||}$ from all HI and H₂ clouds

all clouds within ~ 500 pc (Dame 1987, Hartmann 1996 + others) ← "clumpfind"
few selections (v & low b cuts to remove bkgd clouds in the disc & in the local arm)



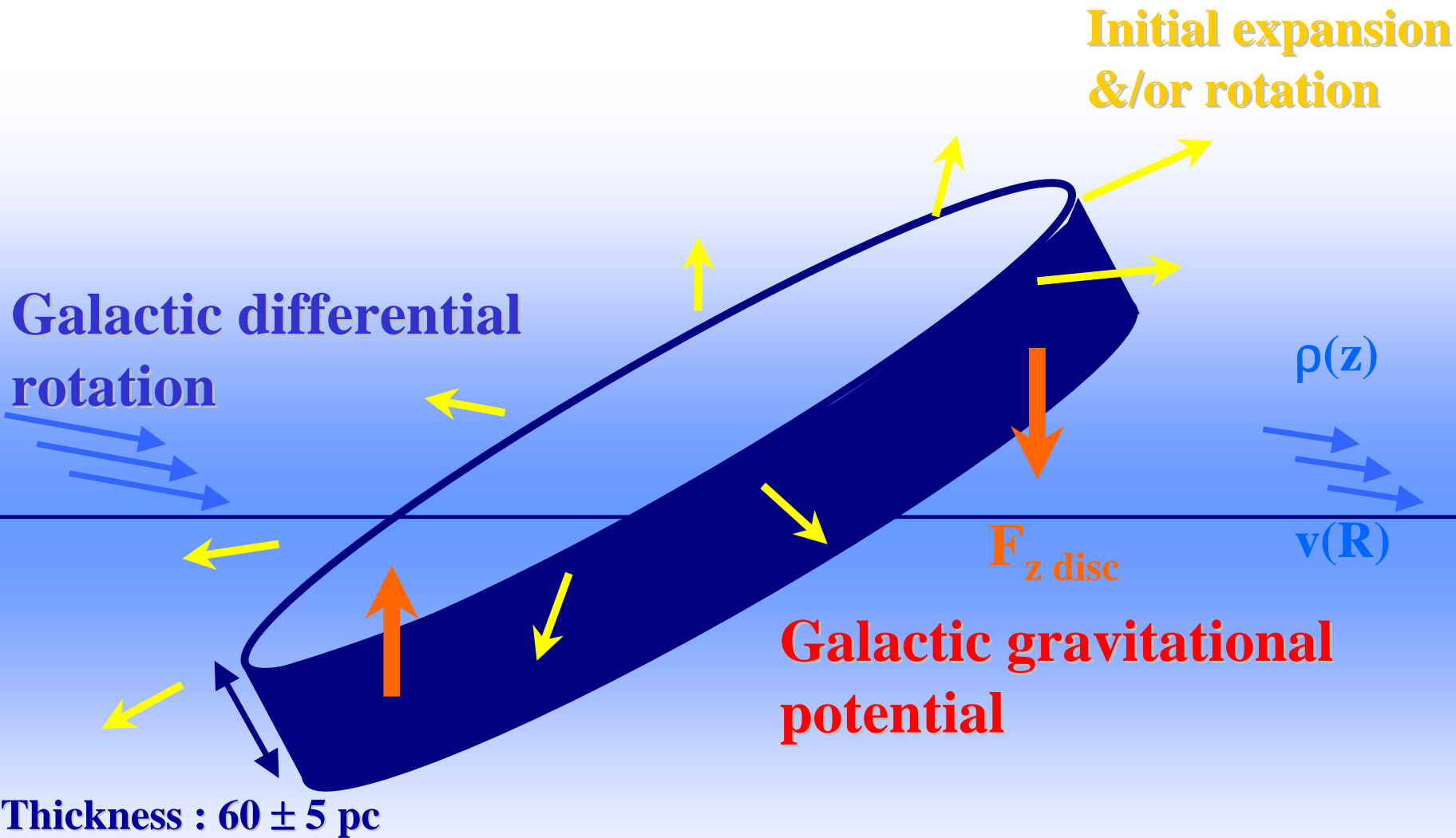
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I, b, v footprint



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Modelling the Belt dynamical evolution



the Belt dynamical evolution: model

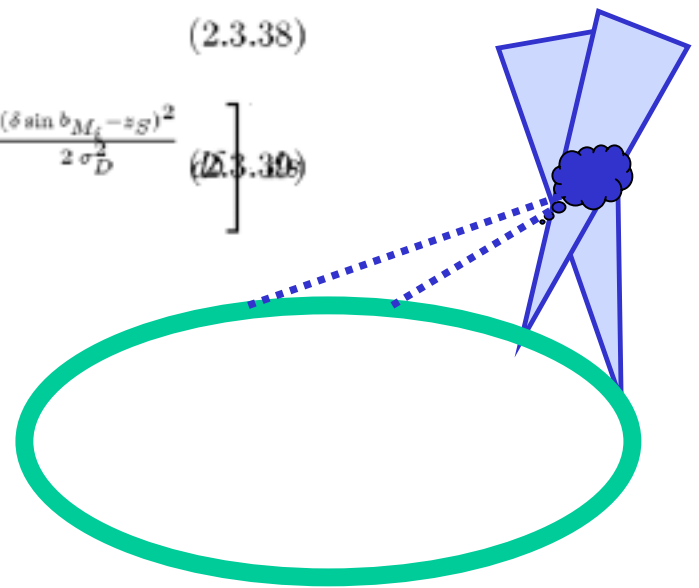
- ✚ Contiguous clumps in **initial expansion** &/or rotation
- ✚ Sweeping momentum from IS gas :
 - ✚ local **density gradient** in galactocentric radius
 - ✚ **z scale height** (combination of 2 gaussian + 1 exponential)
- ✚ Torque from Galactic **gravitational potential**
 - ✚ $\rho_* = 7.6 \cdot 10^{-2} M_{\odot} \text{ pc}^{-3}$ (Crez , 1998)
 - ✚ $z_* = 260 \pm 60 \text{ pc}$ (Ojha, 1996)
- ✚ fragmentation of the shock surface (porosity)
& drag force at late stages
 - ✚ $v > 20 \text{ km/s}$: "snowplough" evolution
 - ✚ $v < 5 \text{ km/s}$: drag force on clumps, porosity up to 0.5

maximum-likelihood fit

- * P(proba of observing each cloud at v_{obs} toward $l_{\text{obs}}, b_{\text{obs}}$)
 - ▶ from anywhere on the Belt ring
 - ▶ at any distance toward $l_{\text{obs}}, b_{\text{obs}}$
- * \times P(proba of observing each cloud at v_{obs} toward $l_{\text{obs}}, b_{\text{obs}}, D_{\text{obs}}$)
 - ▶ from anywhere on the Belt ring
 - ▶ for those clouds with known distance range

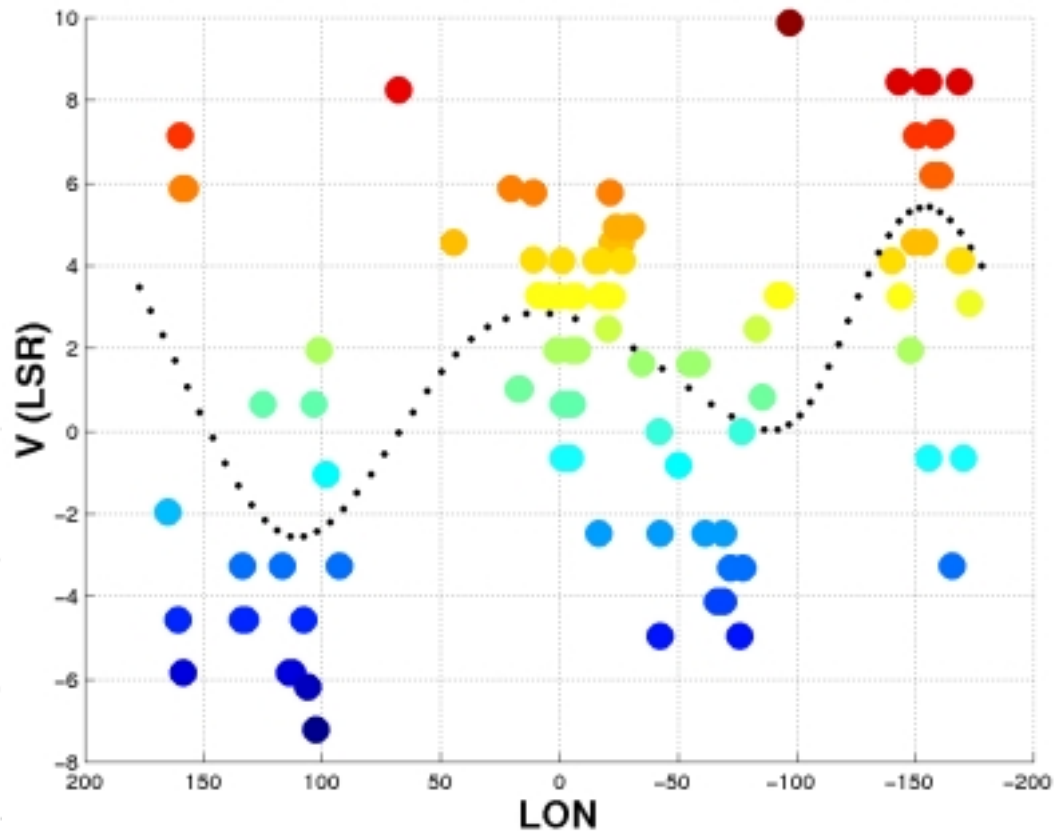
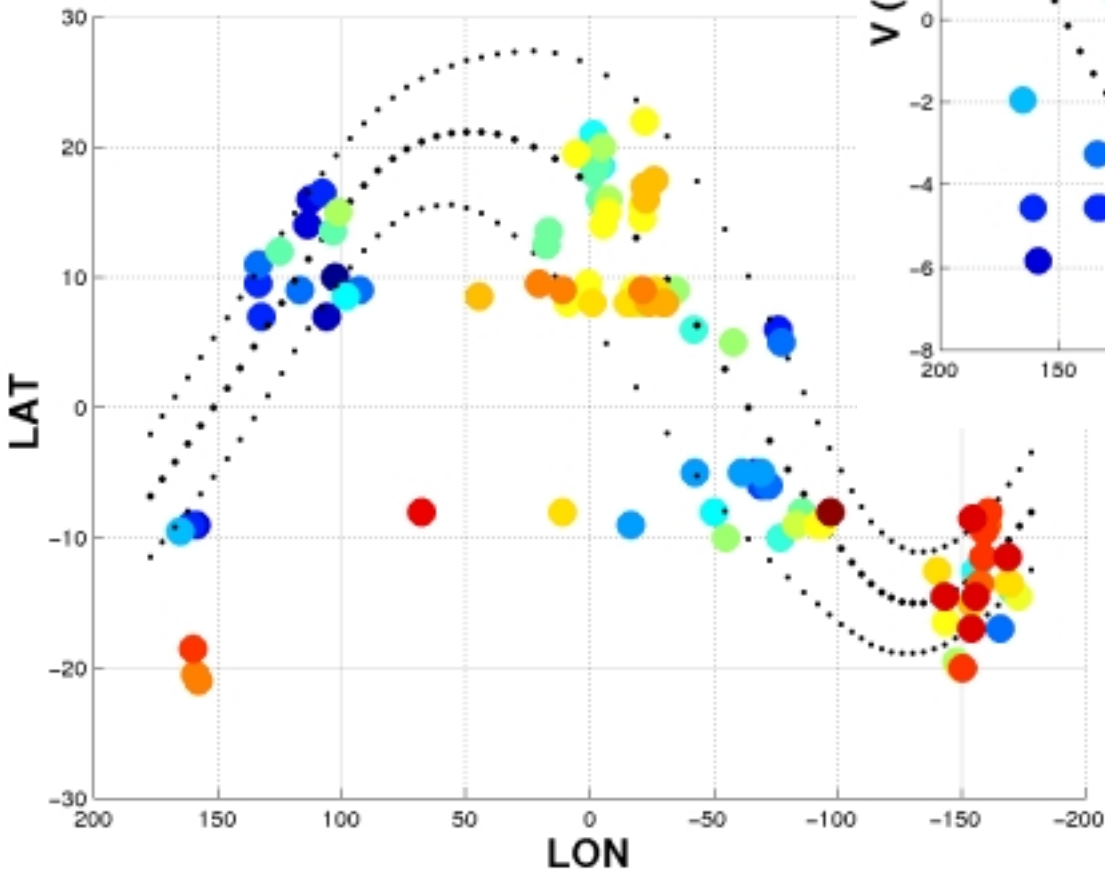
$$\mathcal{L}_{M_i} = \int_{\text{Ceinture}} \left[\frac{gS}{4 \pi^2 \sigma_D^3 \sigma_v} e^{-\frac{(v_{M_i} - v_S)^2}{2 \sigma_v^2}} \Delta \Omega_{M_i} \Delta v_{M_i} \dots \right. \quad (2.3.38)$$

$$\left. \int_{\delta=0}^{+\infty} \delta^2 e^{-\frac{(\delta \cos l_{M_i} \cos b_{M_i} - r_S)^2}{2 \sigma_D^2}} e^{-\frac{(\delta \sin l_{M_i} \cos b_{M_i} - v_S)^2}{2 \sigma_D^2}} e^{-\frac{(\delta \sin b_{M_i} - z_S)^2}{2 \sigma_D^2}} \right] \quad (2.3.30b)$$



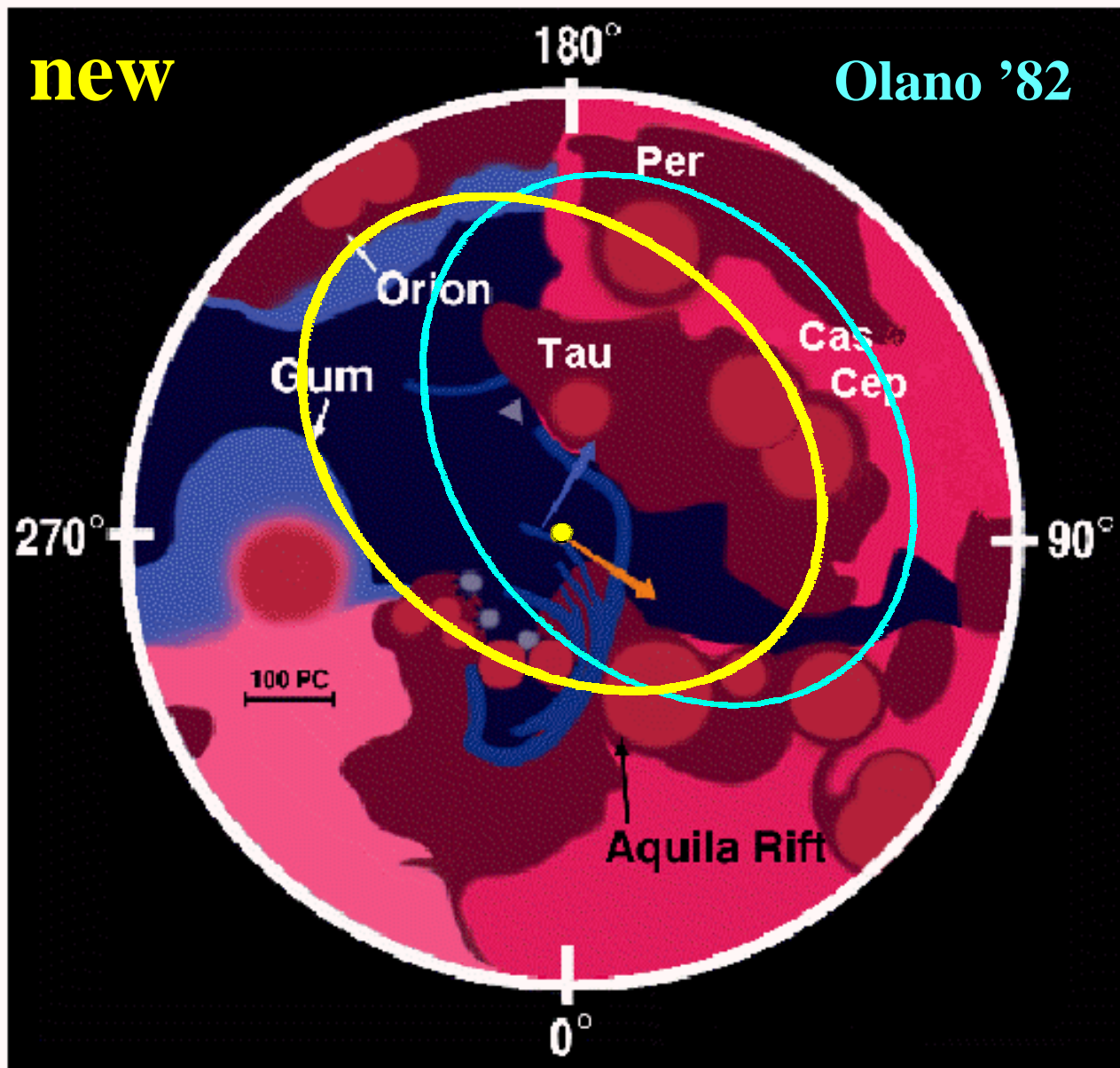
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I, b, v footprint



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New Belt location



**Projection
onto the
Galactic
plane**

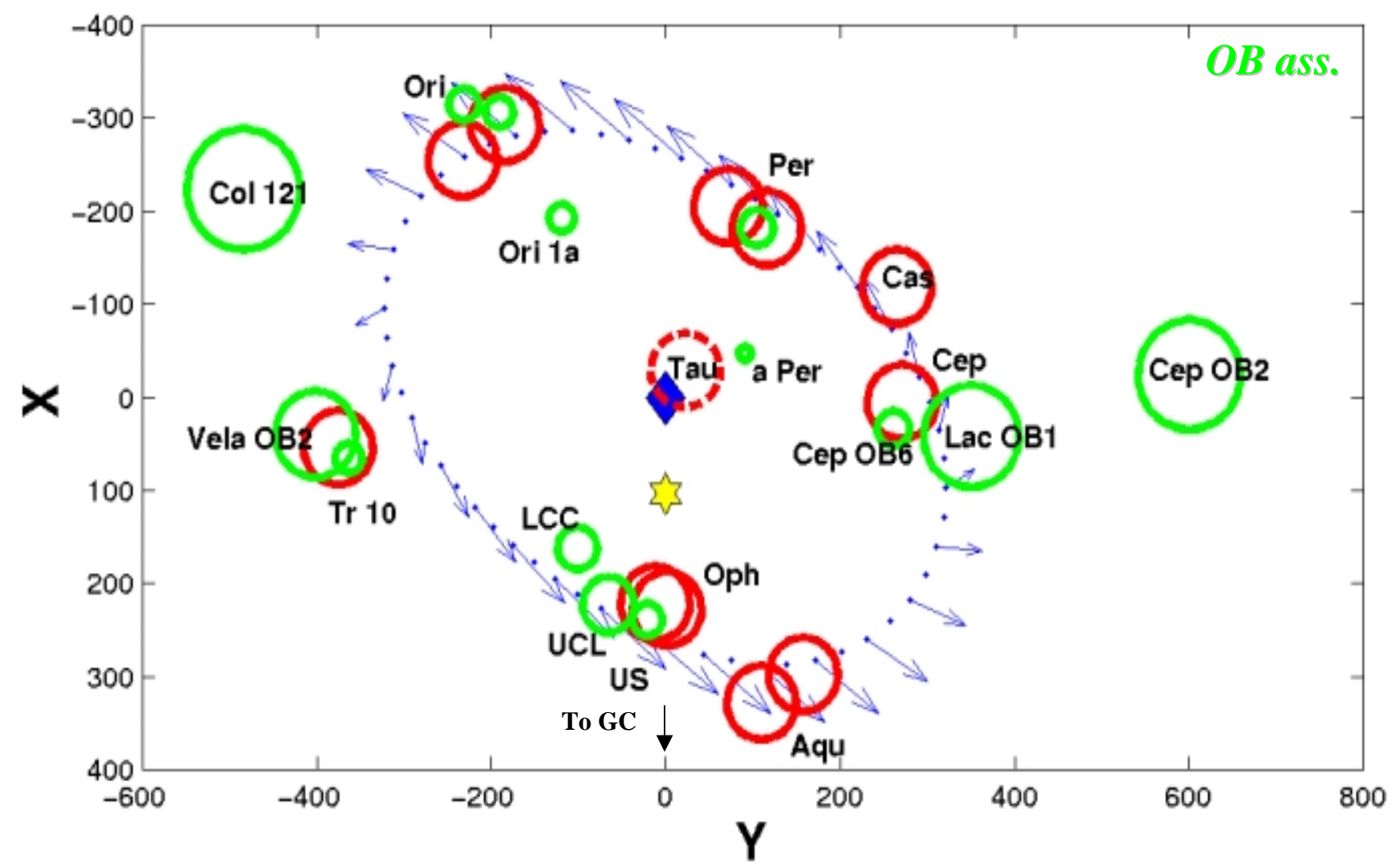
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Belt parameters

Sun

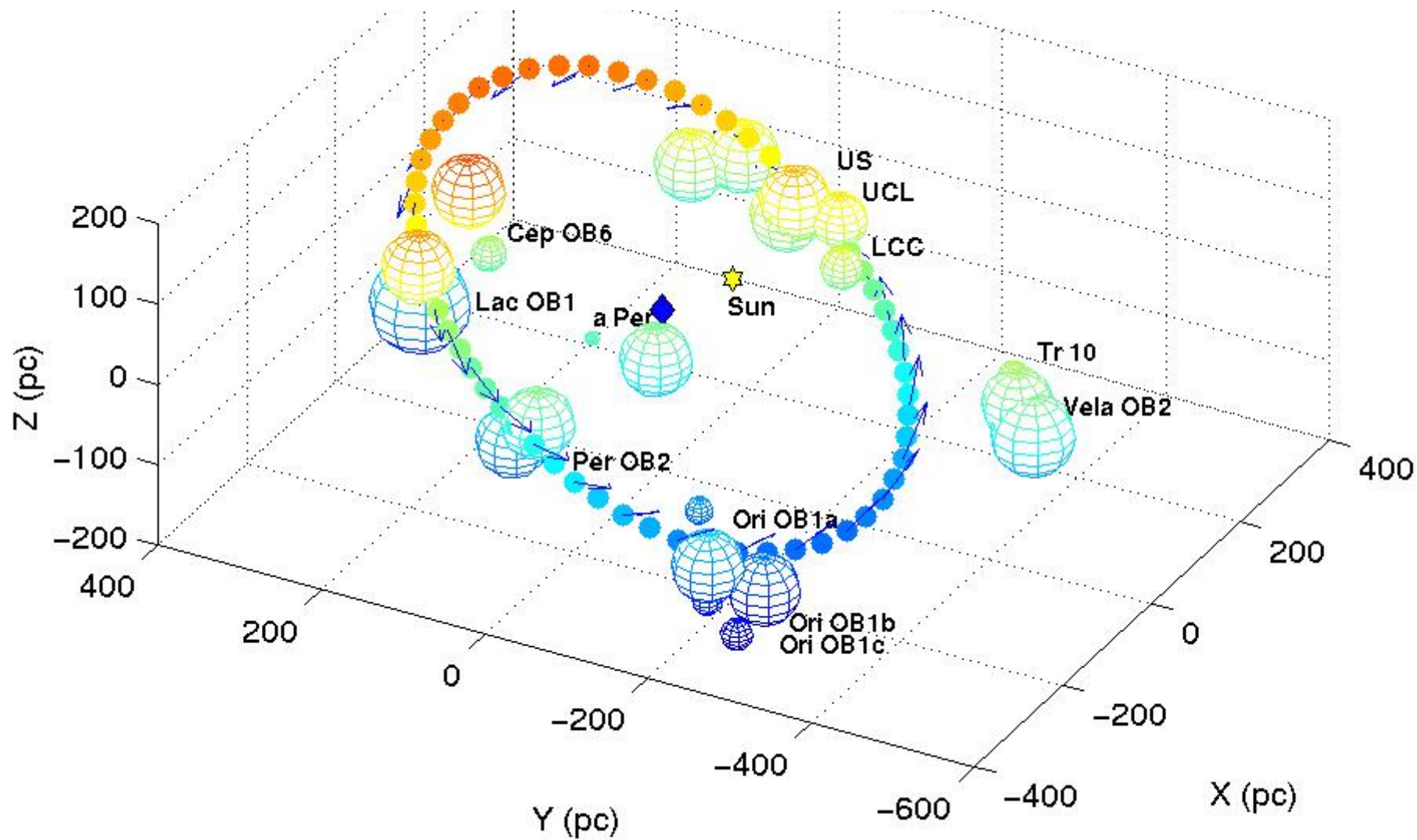
Cloud

OB ass.



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The Gould Belt in 3D



Belt parameters

✚ Age

- 26.4 ± 0.4 Myr

✚ Initial energy

- $1.0 \pm 0.1 \cdot 10^{52}$ erg

✚ Belt center

- $l = 180^\circ \pm 2^\circ$
- $D = 104 \pm 4$ pc

✚ Present ellipse

- $a = 354 \pm 5$ pc
- $b = 232 \pm 5$ pc

✚ Present inclination

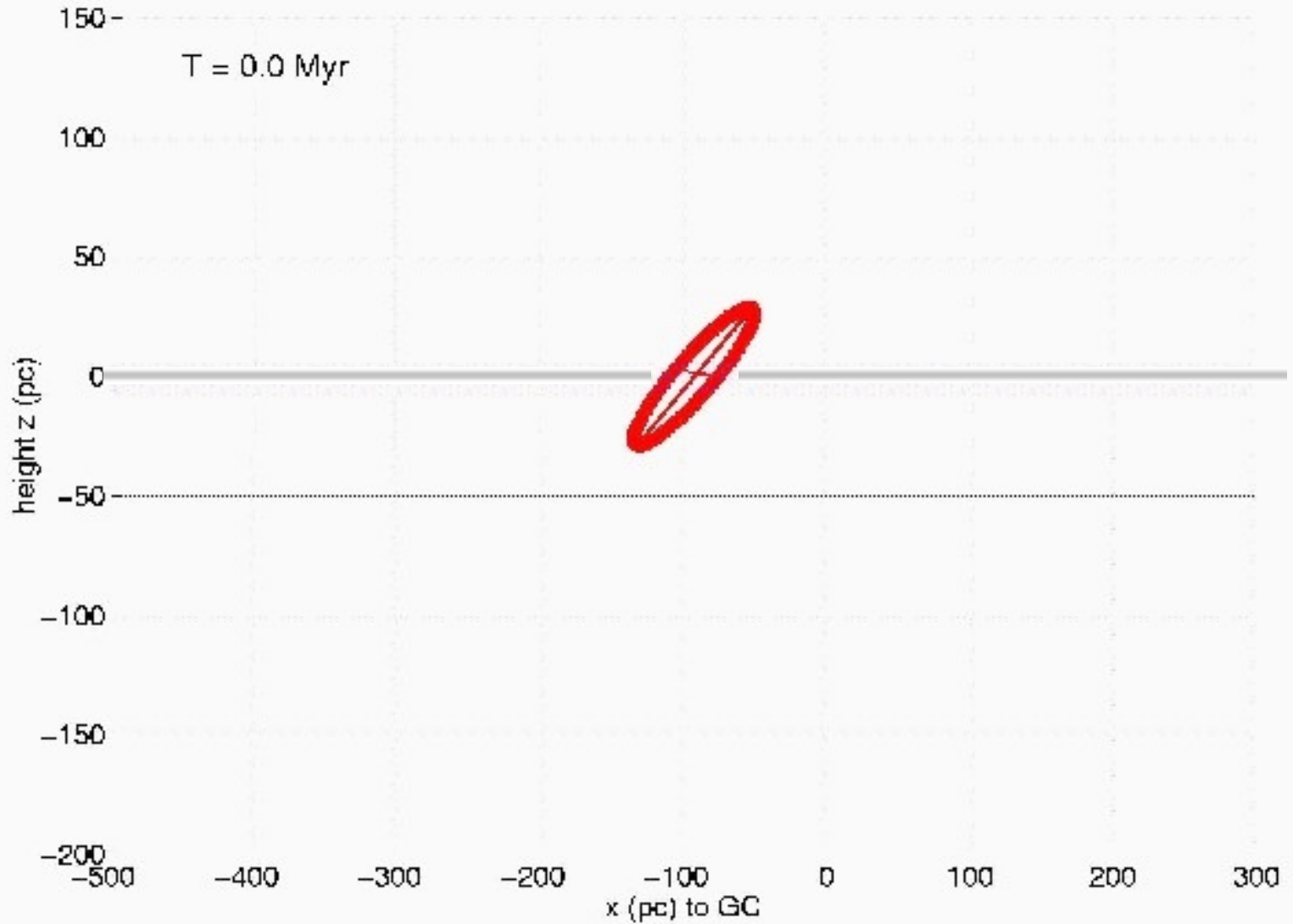
- $17.2^\circ \pm 0.3^\circ$

✚ Ascending node

- $296^\circ \pm 2^\circ$

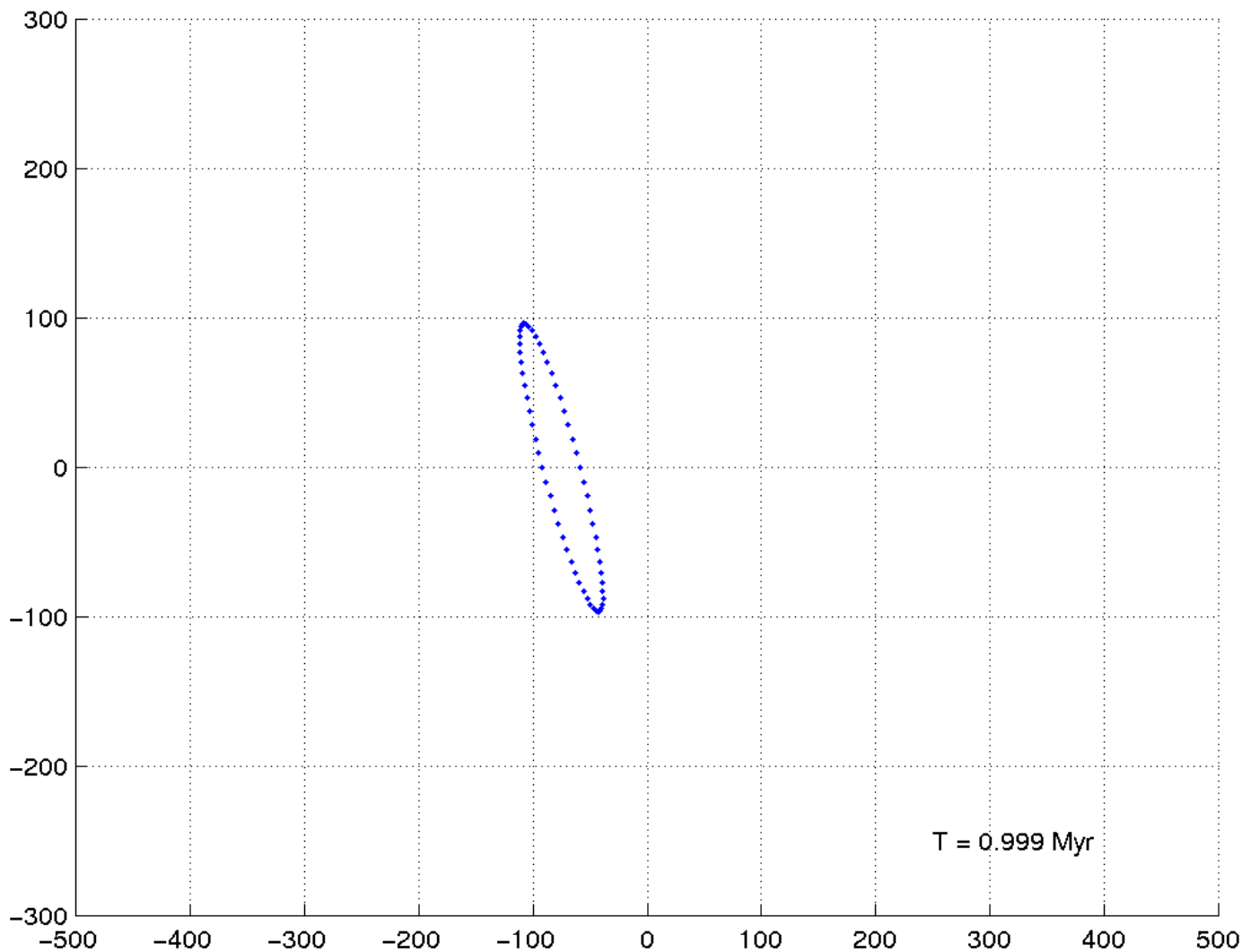
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Goald Belt evolution



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evolution through the Gal. plane



conclusions

* age of 26.4 ± 0.4 Myr

- ▶ ok with Olano '82, Comeron '99, Moreno '99 based on hydro evolution
- ▶ significantly less than stellar estimates (25-50 Myr from spectral types, > 30 Myr in X)

effect of stellar rotation on age estimate: overestimated by 40%?

* Energy input of $(1.0 \pm 0.1)10^{52}$ erg

- ▶ ok with previous estimates

* the Belt peaks in the 1st quadrant ($l_{\Omega} = 296^{\circ}$)

- ▶ new Cepheus, Cassiopeia, Polaris complexes most probably part of the Belt

* velocity dynamical range too small

- ▶ no influence of initial parameters, thickness, distance information or not, ISM gradients, initial rotation or not, drag force, nor porosity
- ▶ continuous energy input vs. impulsive event ? (under test)
- ▶ local Oort constant A ??