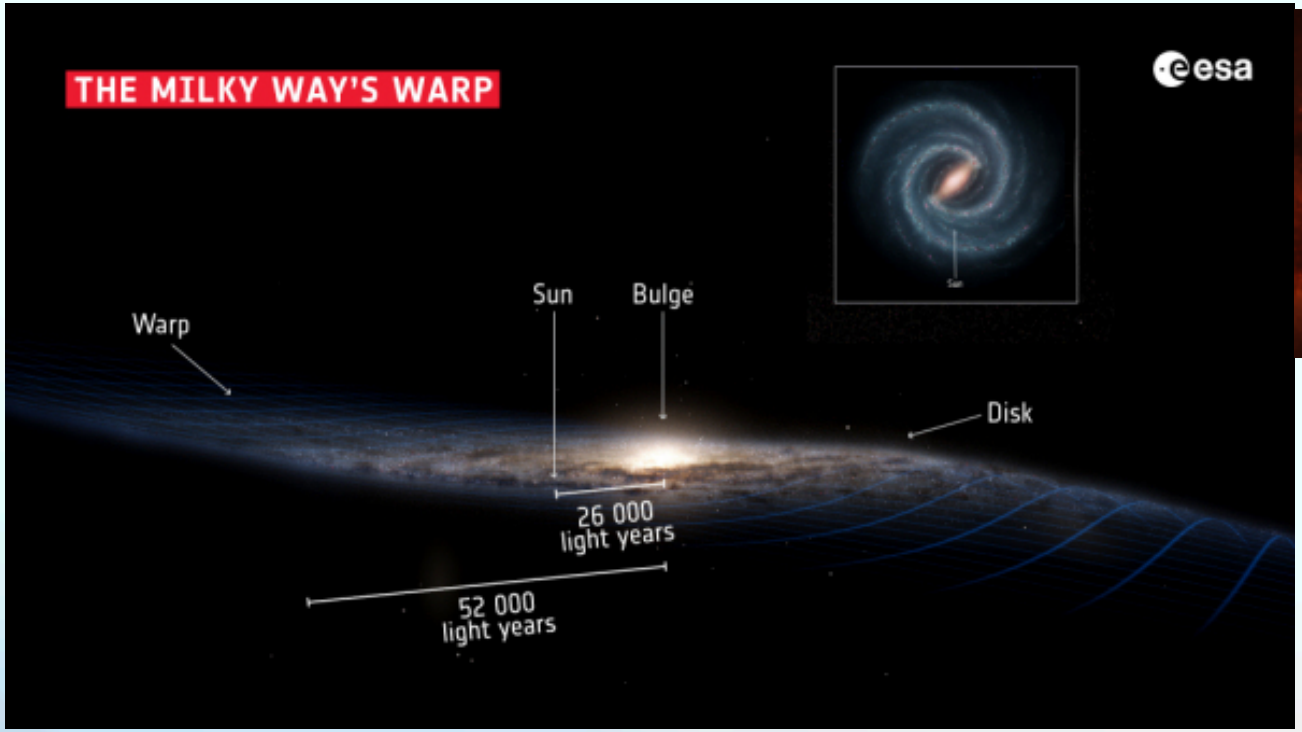
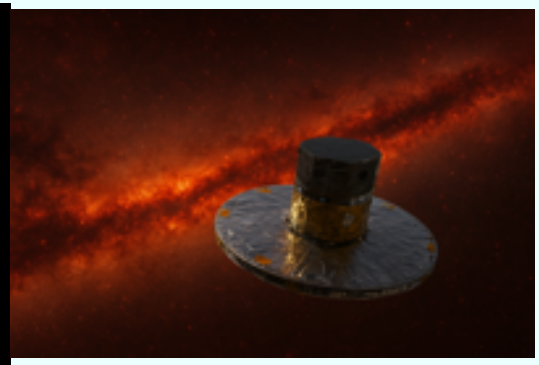
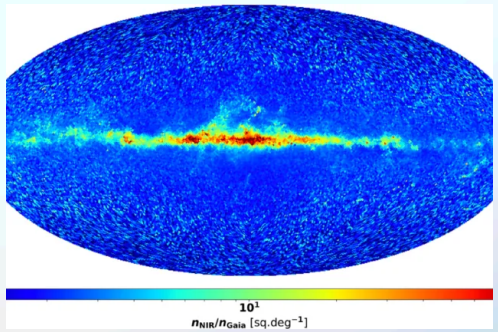
Vertical kinematics of young clusters in the Local Arm: from Gaia to GaiaNIR

Linking astrostatistics, Galactic structure and future IR astrometry







M.C. Sánchez-Gil, Emilio J. Alfaro & Bruce Elmegreen

(UCA & IAA-CSIC)

GaiaNIR Spanish community meeting.

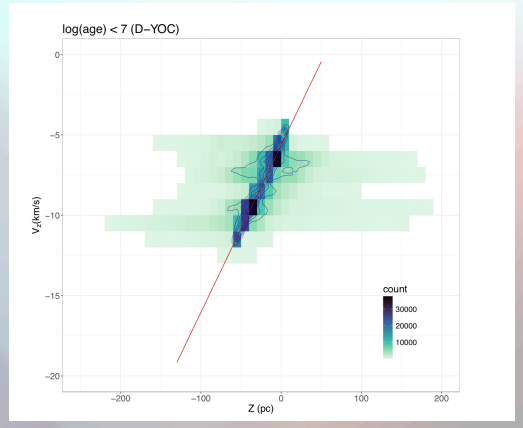
28-30 Enero 2026 , Sevilla

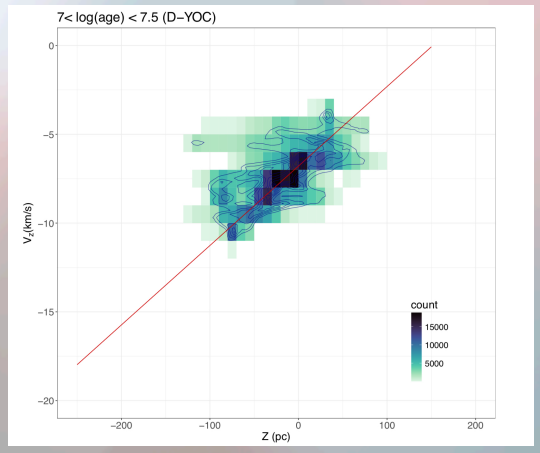
UCA Universidad de Cádiz

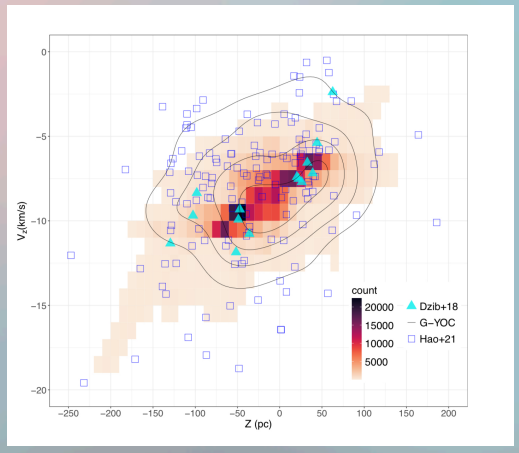
IAA Instituto de Astrofísica de Andalucía — CSIC

Key result from Gaia:
Young clusters as vertical oscillators

- Gaia + recent catalogues of **young open clusters** and **star-forming regions**
- Focus on clusters **younger than ~30 Myr** in the solar neighbourhood, sampling young clusters associated with the Local, Perseus and Sagittarius arms
- These clusters define a **tight linear relation in the Vz–Z plane**
- Consistent with **vertical harmonic motion**
- Provides an **independent estimate of the local mass density**
  (Alfaro, Sánchez-Gil & Elmegreen 2025, MNRAS, 537, 3066)

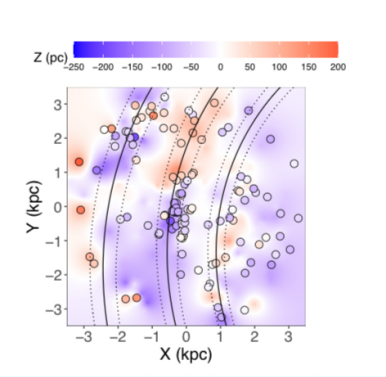


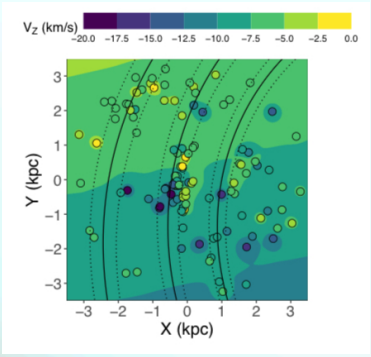




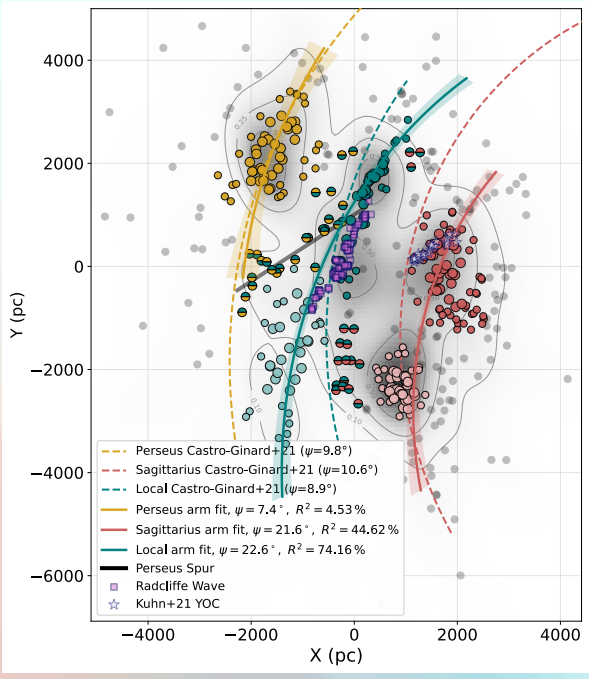
Beyond the solar neighbourhood

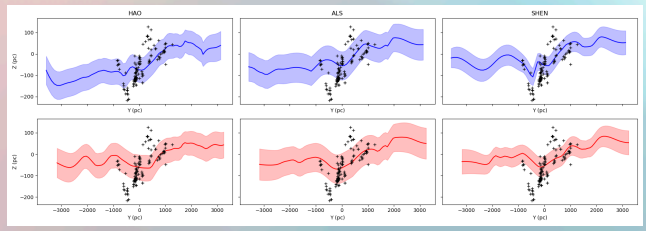
Extending to the full Local Arm





- We build **4D (X, Y, Z, Vz) maps** of young tracers in the **Solar neighbourhood**, in the **Local, Perseus & Sagittarius arms**
- Include **OB associations** and **molecular clouds** in addition to clusters
- We see **vertical waves / corrugations** linked to spiral-arm structure





- But Gaia alone is **limited in dusty, crowded regions**
  - Strong extinction
  - Incomplete sampling of embedded populations

Why GaiaNIR matters:
From Gaia to GaiaNIR: what we need

Near-IR astrometry turns our partial vertical maps into a complete picture of the young disc.

- **Gaia (today):**
  - 🔴 Limited in dusty, crowded regions
  - 🔴 Misses deeply embedded young populations
  - 🔴 Incomplete vertical picture of spiral arms
- **GaiaNIR (tomorrow):**
  - 🟢 Access to obscured segments of Local, Perseus & Sagittarius arms
  - 🟢 Better tracers for the local mass budget
  - 🟢 Time evolution of vertical corrugations

Take-home message

- Young clusters behave as **vertical oscillators** in spiral-like arms
- We are mapping **4D vertical structure** and **corrugations** with Gaia
- **GaiaNIR** is key to complete the picture in **dusty, embedded regions**