Star formation in the Gould Belt: paving the way for Gaia

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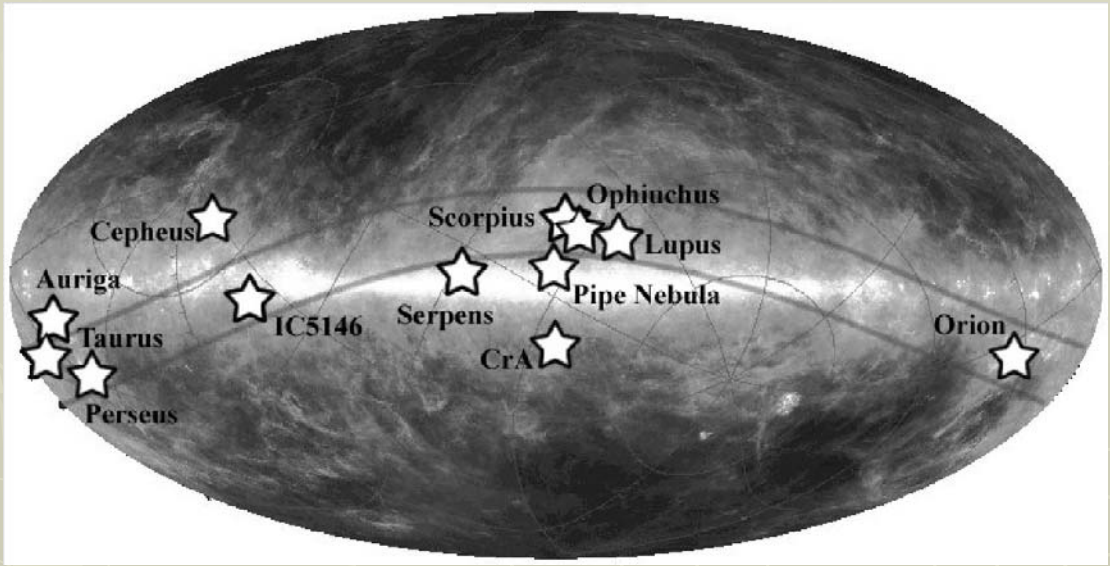
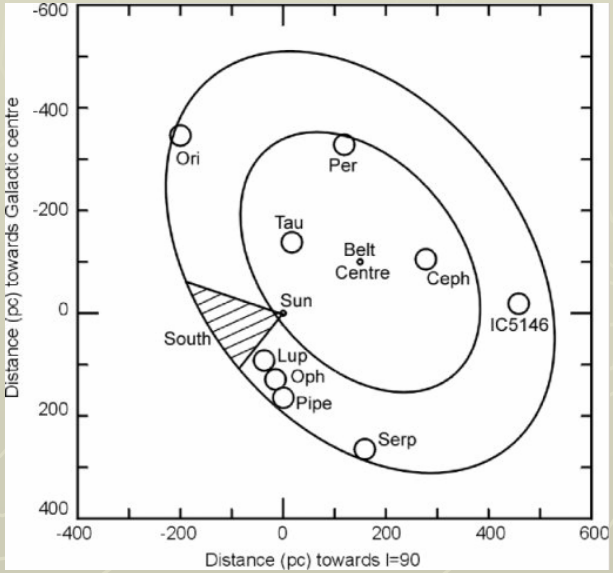
The Gould Belt

- Elliptical ring encompassing the brightest stars and most nearby dark clouds (~700x500 pc)
- Tilted 20º with respect to the Galactic plane
- Age: between 20 and 60 Myr
- Total mass ~2×10^5 M_{SUN}
- Origin: still uncertain
- Gaia will trace the Gould Belt structure and dynamics star by star
- Gaia will trace the groups of movement
- Gaia will determine what objects have been ejected and captured

The Gould Belt



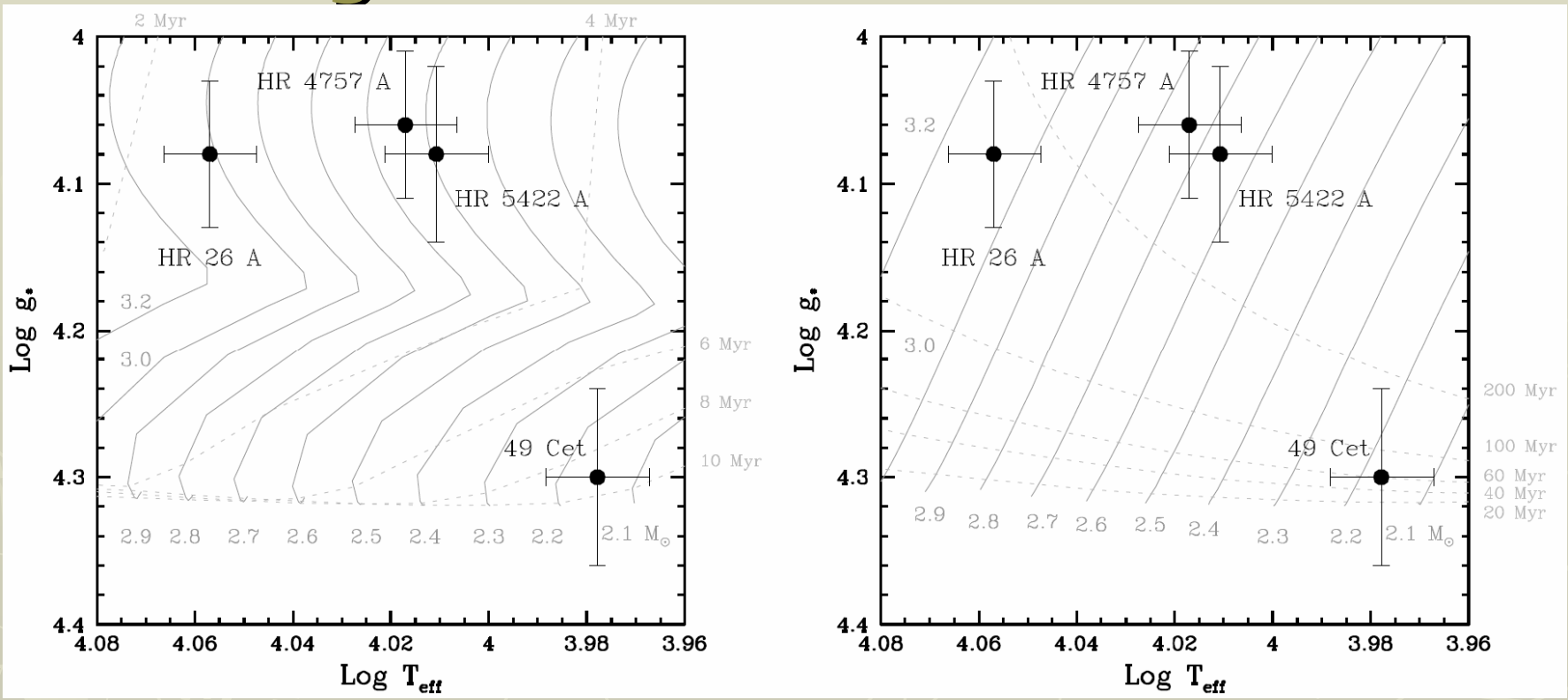


Ward-Thompson et al. 2007. PASP 119, 855

The Gould Belt: star formation

- Recent star formation (~1Myr) in many regions
- Low and intermediate mass stars
- Close to us: 140-500 pc ➔ ideal for Gaia
- Ideal to develop stellar evolutionary models
- Tracks: $T_{\rm eff}$ and $R_\star$ as a function of time and $M_\star$
  - Significant dependence of the metallicity
  - Isochrones vs empirical calibrators (e.g. LiI)
- The role of accretion rate ($\mathrm{d}M/\mathrm{d}t$) is still unclear
  - How does it evolve with time, mass, metallicity, …?

Evolutionary tracks: degenerate near the ZAMS

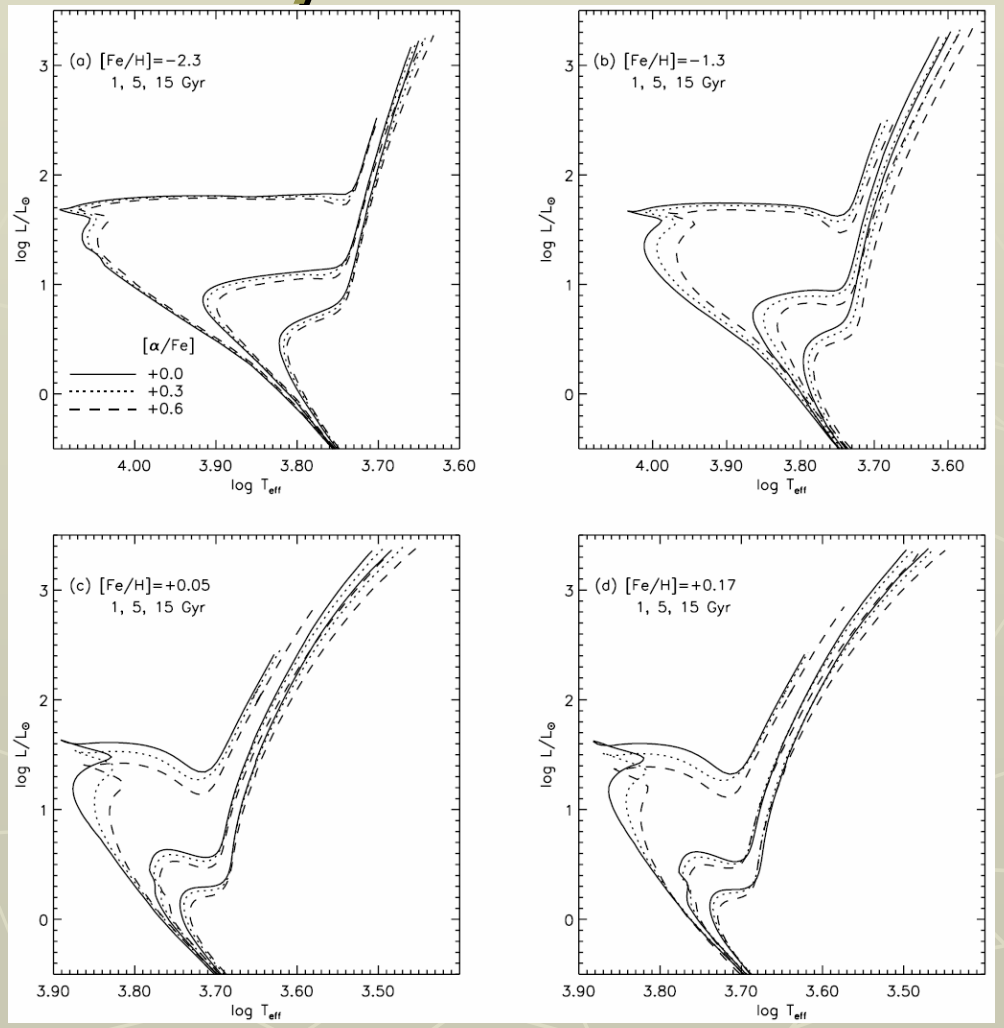


Montesinos et al. 2009. A&A 495, 901

Little knowledge near the ZAMS. PMS or post-MS?
Gaia will provide accurate radii ➔ degeneracy broken?

Evolutionary tracks: influence of the metallicity

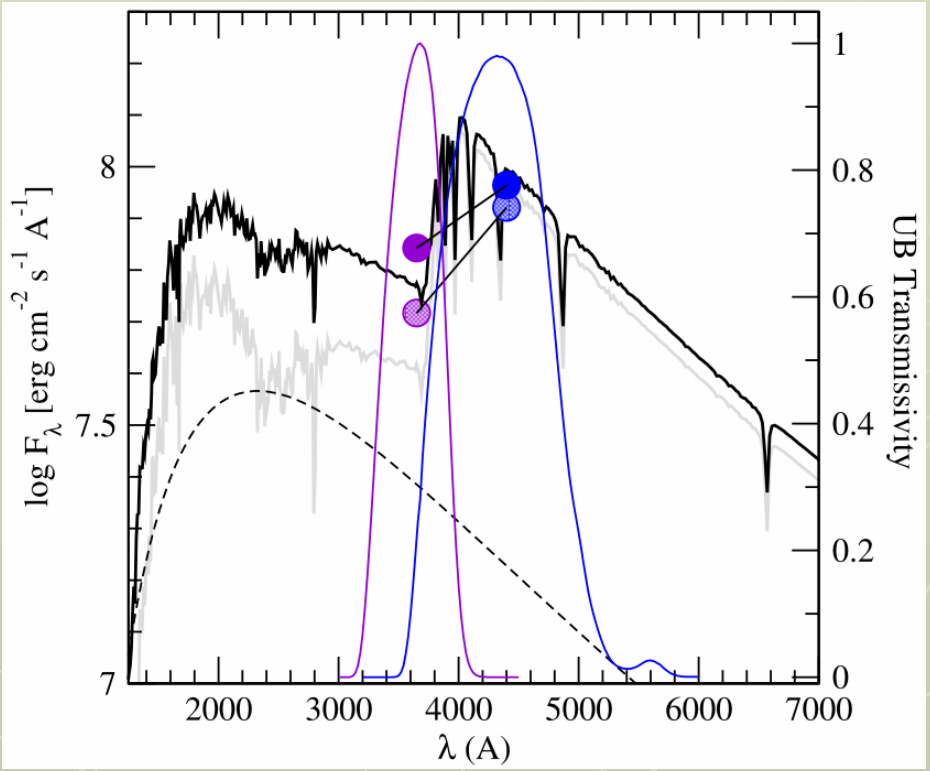
- Precise metallicities required to effectively break degeneracies near the ZAMS
- Gaia will not provide them for intermediate mass stars (too high rotation velocity)
- **Require high resolution spectroscopy**



Kim et al. 2002. ApJSS 143, 499

Accretion rate: veiling

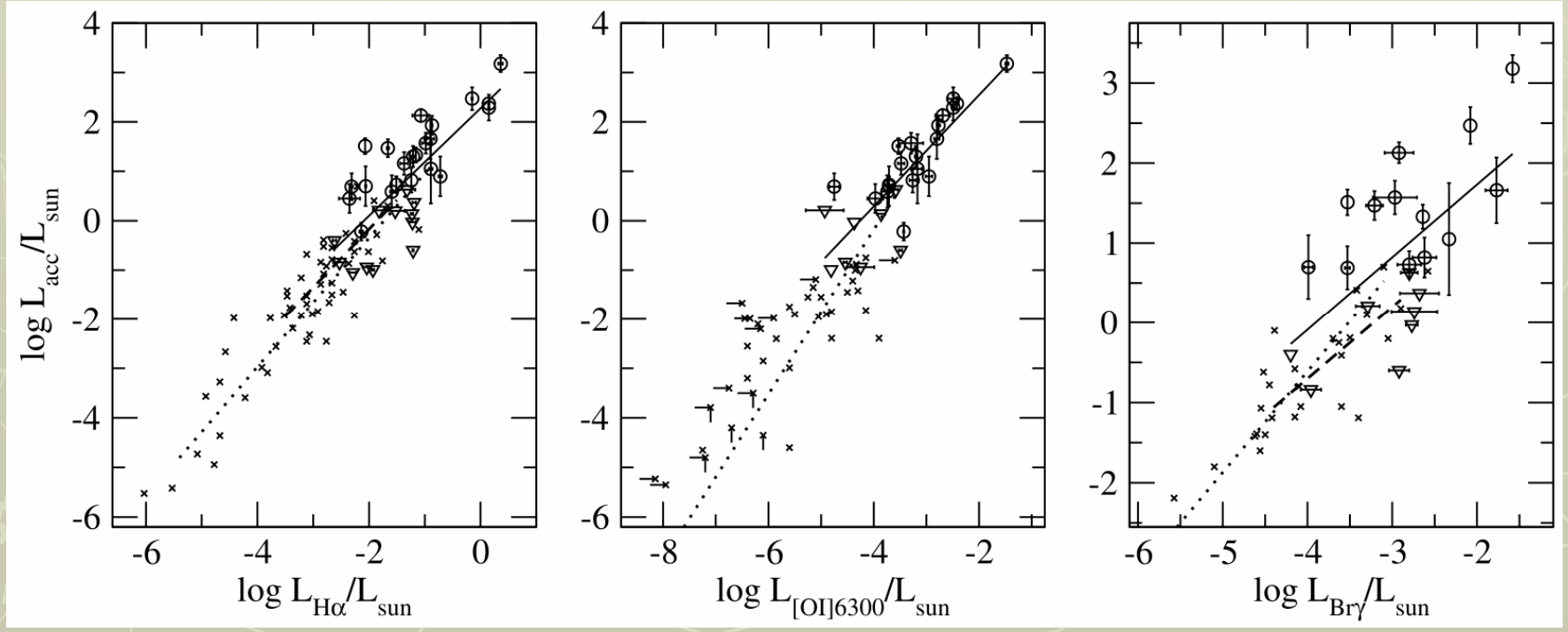
- Material is accreted from the disc during PMS phase
- Large amounts of energy released during the shock
- Veiling in *U* and *B* bands
- $\Delta(U\text{-}B)$ + models ➔dM/dt
- Models fail for large T_{eff}
- Gaia will measure $\Delta(U\text{-}B)$



Mendigutía et al. 2011. A&A 535, 99

Accretion rate: line luminosities

- Secondary tracers. cross-calibration with Δ(*U*-*B*)
- Validation and extension Δ(*U*-*B*) laws to higher masses
- Require simultaneous visible and NIR spectrophotometry



Mendigutía et al. 2011. A&A 535, 99

The Gould Belt: dynamics

- Gaia performance: bright stars (G~15) @ 300 pc
  - Parallaxes $\Delta\pi$ ~24 μas ➔ 2.2 pc
  - Proper motions $\Delta\mu$ ~ 13 μas/yr ➔ 19 m/s
  - Radial velocity ~3km/s
  - Young objects (~1 Myr): M ≥ 0.25 M_{Sun}
- Gaia performance: faint stars (G~20) @ 300 pc
  - Parallaxes $\Delta\pi$ ~290 μas ➔ 26 pc
  - Proper motions $\Delta\mu$ ~150 μas/yr ➔ 210 m/s
  - Radial velocity: no
  - Young objects (~1 Myr): M ≥ 12 $M_{Jupiter}$
- Detailed dynamics ➔ high precision radial velocities
- Require high resolution spectroscopy

http://www.rssd.esa.int/index.php?project=GAIA&page=Science_Performance

The role of 2-4m telescopes

- Gaia exploitation requires precursor studies. Most young stars in the Gould Belt could be characterised beforehand. Large scale surveys
- Next generation evolutionary tracks
- Stellar association internal dynamics
  - Both require high resolution spectroscopy. échelle if possible. Near infrared for substellar objects
  - Multiplexing required for large scale surveys similar to Gaia-ESO
- Cross-calibration of accretion rate tracers
  - Multi-epoch visible and near infrared spectrophotometry
  - Ideal instrument: Xshooter
  - Alternative: visible and NIR camera-spectrographs