THE VERTICAL STRUCTURE OF THE STAR FORMATION HISTORY ACROSS THE SOLAR CYLINDER

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SCAN ME

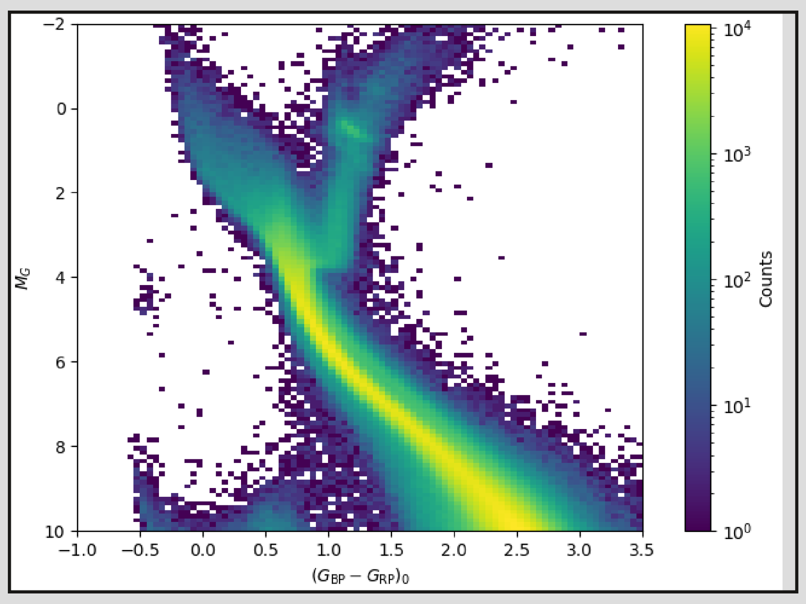
AIMS

Determining the SFH of the solar neighbourhood is among the key goals of the Gaia mission.
With this work, we set out to:

- determine the SFH of the solar cylinder
- derive a relation between the scale height of the disk and the age of the stars
- test improving the solution with spatial correlations

DATA

We collect Gaia DR3 data (Gaia Collaboration et al., 2016b; Gaia Collaboration et al., 2023j) using the Gaia Archive and select all stars in a cylinder spanning 1.3 kpc above and below the midplane of the Galaxy and with radius of 200 pc. In this operation we keep into account the vertical position of the Sun, which we assume to be 17.7 pc.

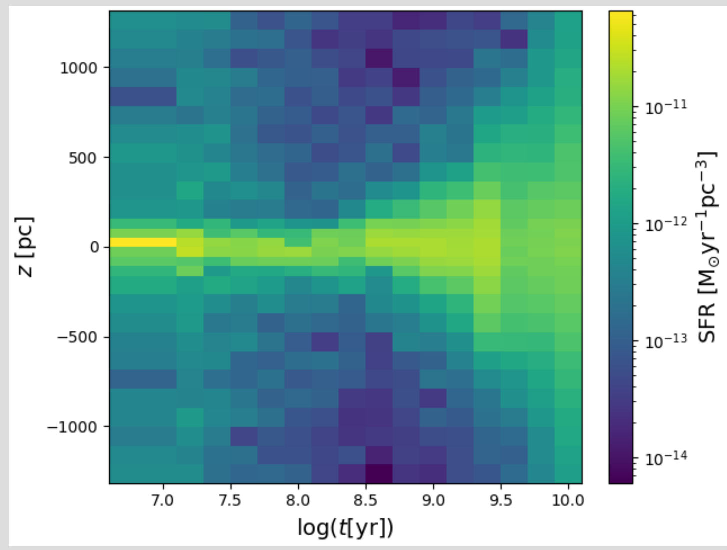


We clean the sample using only the corrected phot_bp_rp_excess_factor as described in Riello et al. (2021).

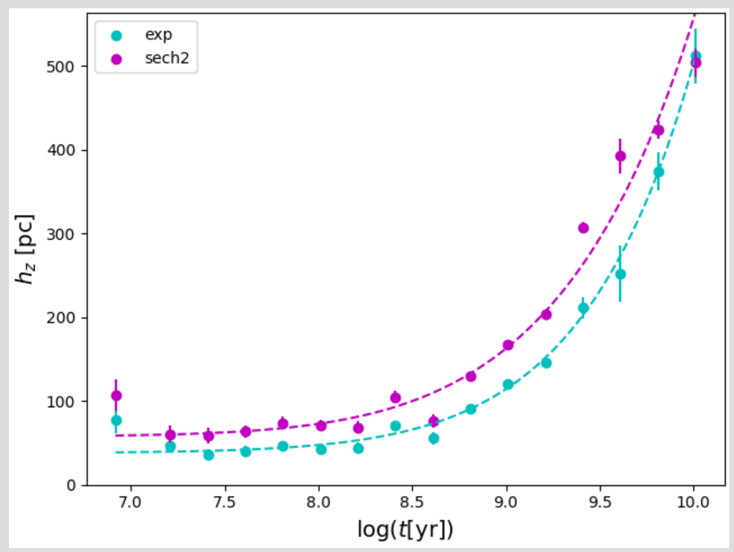
The distance to each star is determined from its parallax, and this information is used to derive the extinction from the Vergely et al. (2022) 3D extinction map.

Finally, we slice the cylinder in 28 separate discs parallel to the Galactic Plane, with a thinner slicing close to the Plane thanks to the large number of stars available as low heights.

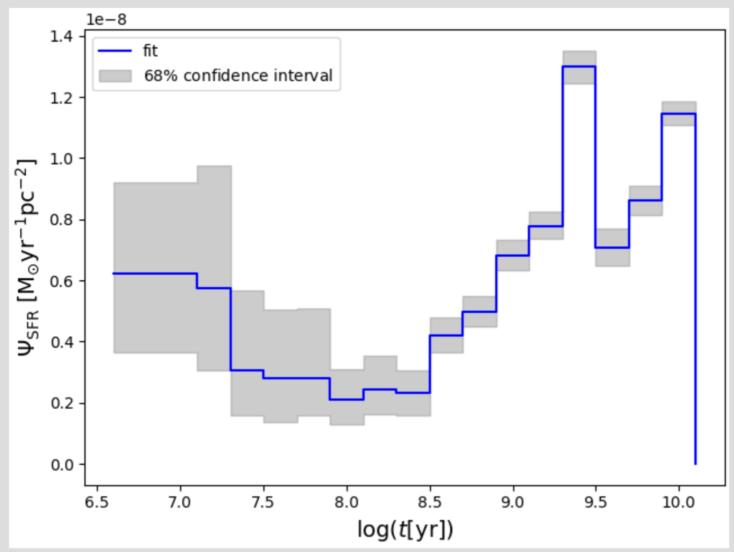
RESULTS



SFR of the solar cylinder at all ages and all heights from the Galactic midplane



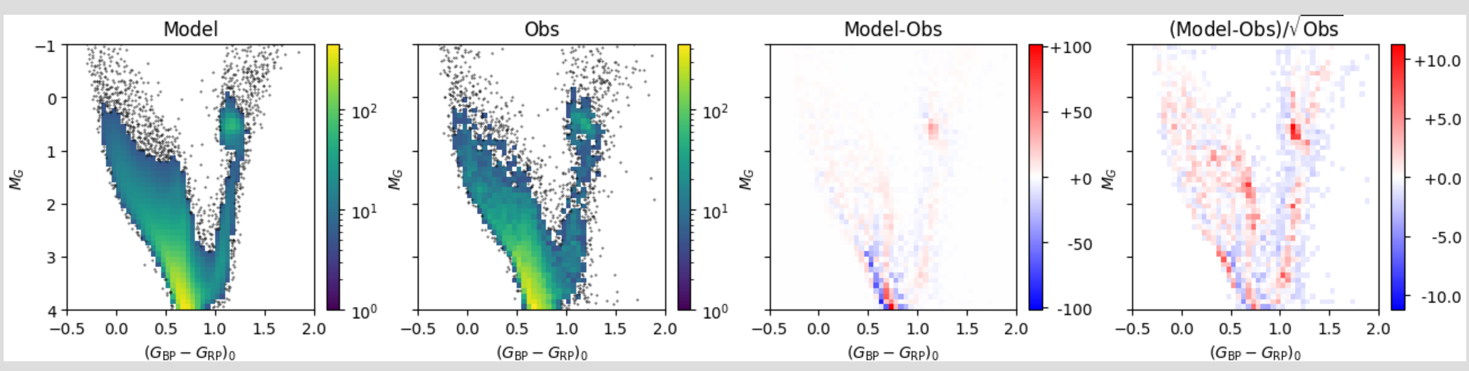
Trend of $h_z(t)$ with age



Surface density of SFR

METHODS

Models are computed with the TRILEGAL population synthesis code (Girardi et al., 2005) for 16 age bins and for 7 sets of metallicity. Photometric errors and the effects of incompleteness are added "a posteriori", on the Hess diagrams.
Binaries are simulated with BINaPSE (Dal Tio et al, 2021) module of TRILEGAL, which handles the evolution of the binary systems. Most importantly, resolvability is accounted for.



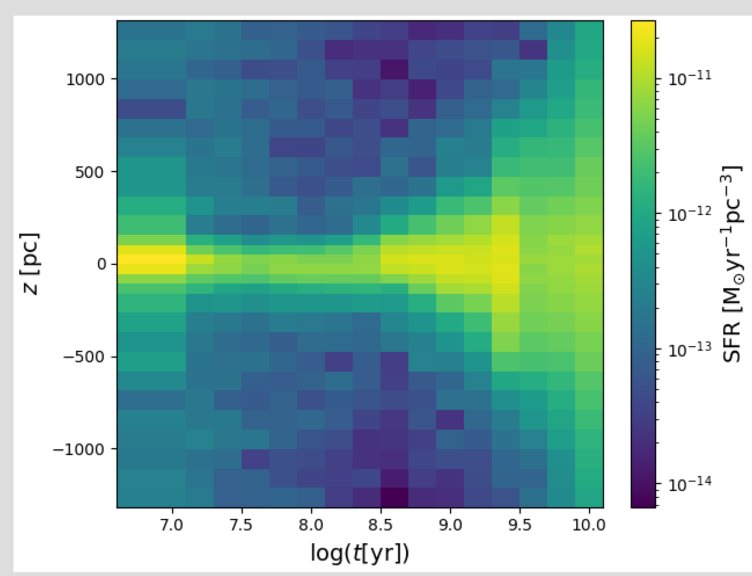
SPATIAL CORRELATION

We attempt to improve the solution by using a spatially correlated prior for the SFR.

$$\mathbf{R}_{n,m;i} = r(\boldsymbol{x}_n, \boldsymbol{x}_m, l_i) = \exp\left\{-\frac{|\boldsymbol{x}_n - \boldsymbol{x}_m|^2}{2l_i^2}\right\}$$

Importantly, the correlation length l_i depends on age, as we assume that the older stars had more time to travel and get mixed.

Overall, the solution appears less noisy compared to the un-correlated one, and more symmetric with respect to the plane



CONCLUSIONS

- We determined the best fitting SFH for the solar cylinder, finding a peak in SFR at 2-3 Gyr.
- We computed the Disc's scale height at each age bin and derived its trend with age -> hz(t).
- We tested the spatially correlated prior and observed it results in an overall better solution.

REFERENCES

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