Gaia mission data reveals a re-ignition of star formation in the Milky Way's disc about 5 billion years ago

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We use **Gaia DR2** and the Besançon Galaxy model to simultaneously infer the initial mass function (IMF) and the star formation history of the Galactic disc. **Our results show a decreasing trend of the SFR from 9–10 Gyr to 6–7 Gyr and a re-ignition starting at ~5 Gyr ago and continuing until ~1 Gyr ago.** The timescale and the amount of stellar mass generated during the Star Formation Rate enhancement event lead us to hypothesise that its origin, currently under investigation, is not intrinsic to the disc. **We hypothesise that an external perturbation is needed for its explanation.**

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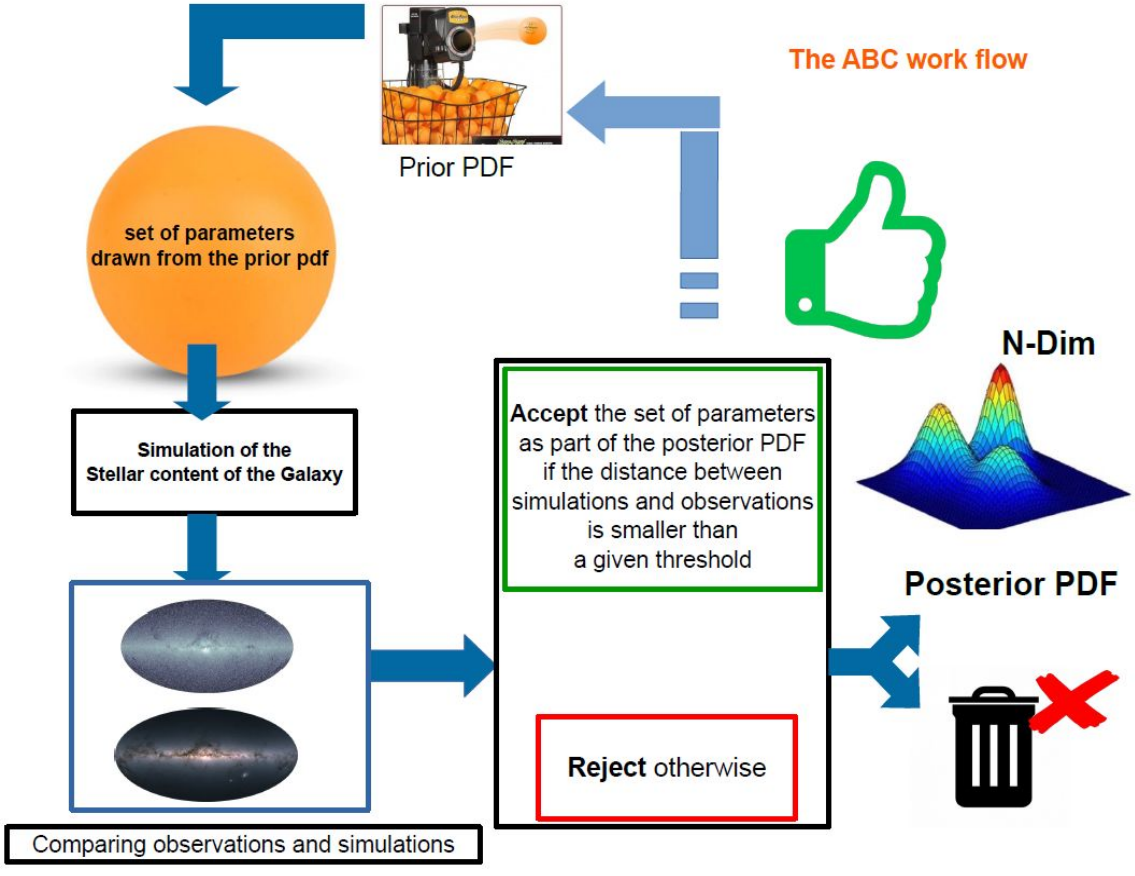
Methodology

This inference is performed by combining the Besançon Galaxy Model fast approximate simulations (BGM FASt) and an approximate Bayesian computation algorithm (ABC).

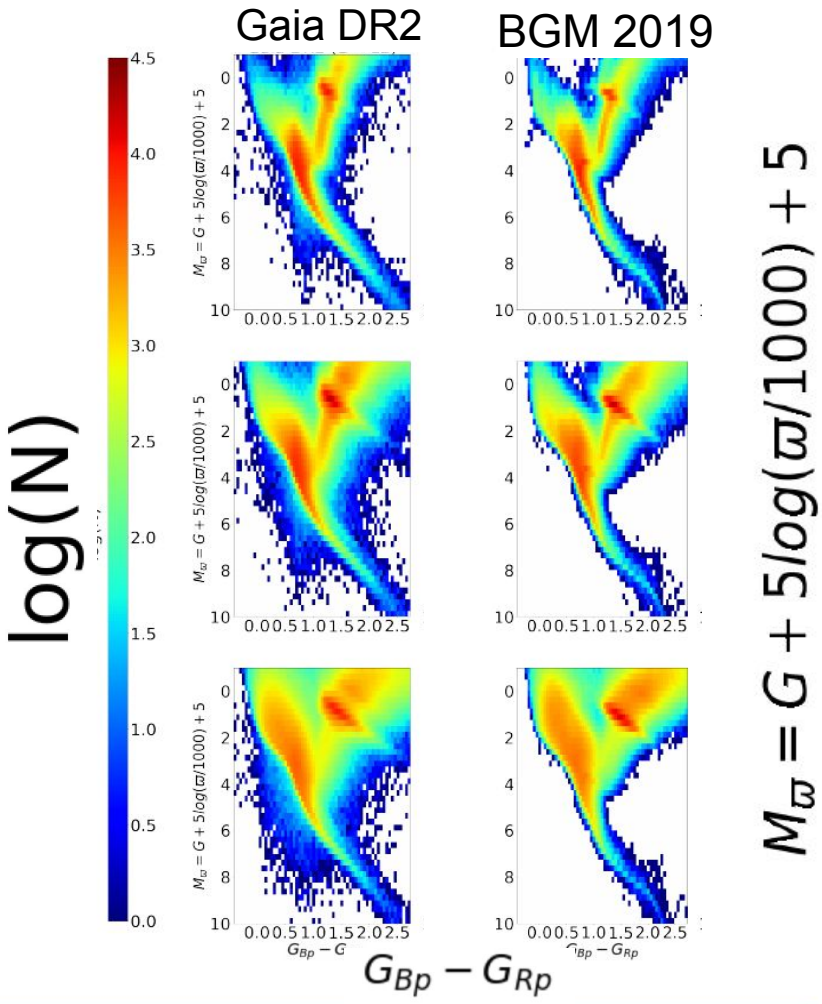
The work flow of the ABC algorithm is shown in the figure: We iterate the full loop until we get a good sampling of the posterior probability distribution function. We need to perform hundred thousand, or even million iterations.



Methodology

Figure: M vs. Gaia colour GBp−GRp for the stars with G < 12 divided into three latitude ranges: first row: 30 < |b| < 90; second row: 10 < |b| < 30;
third row: |b| < 10.

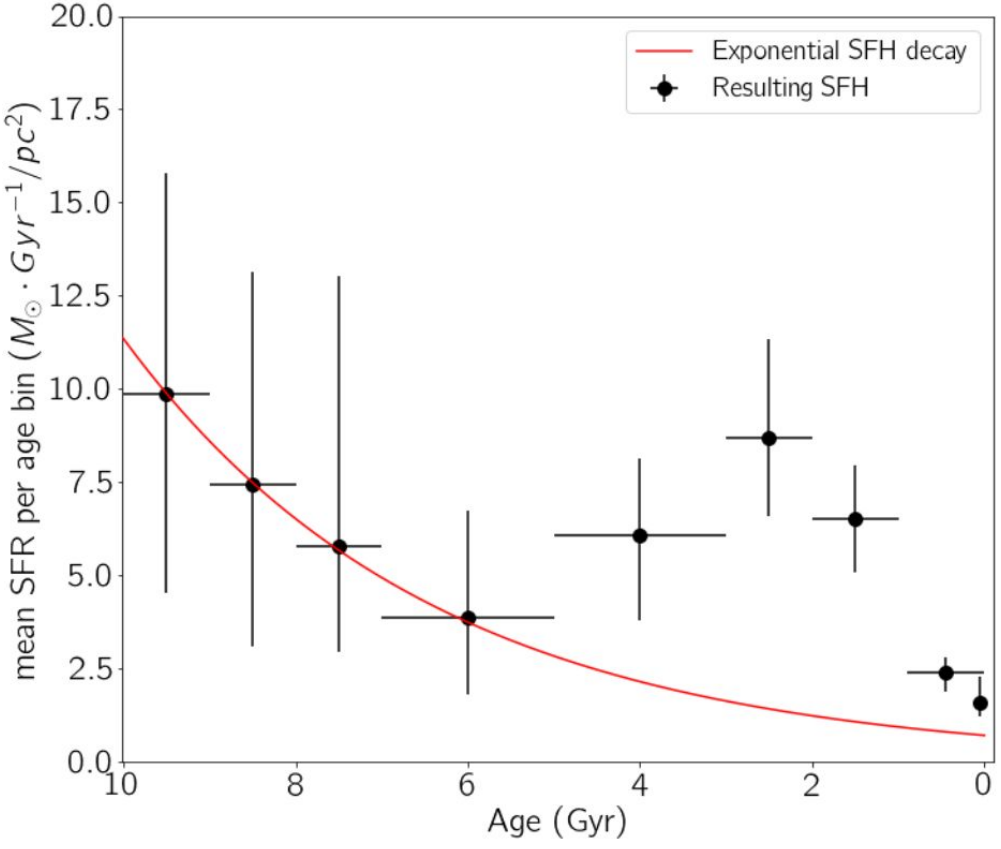
Inside the ABC workflow we compare observed (Gaia DR2) versus simulated (BGM 2019) colour-magnitude diagrams in three latitude ranges using a Poissonian distance metric to decide whether a combination of parameters is a good solution or not.



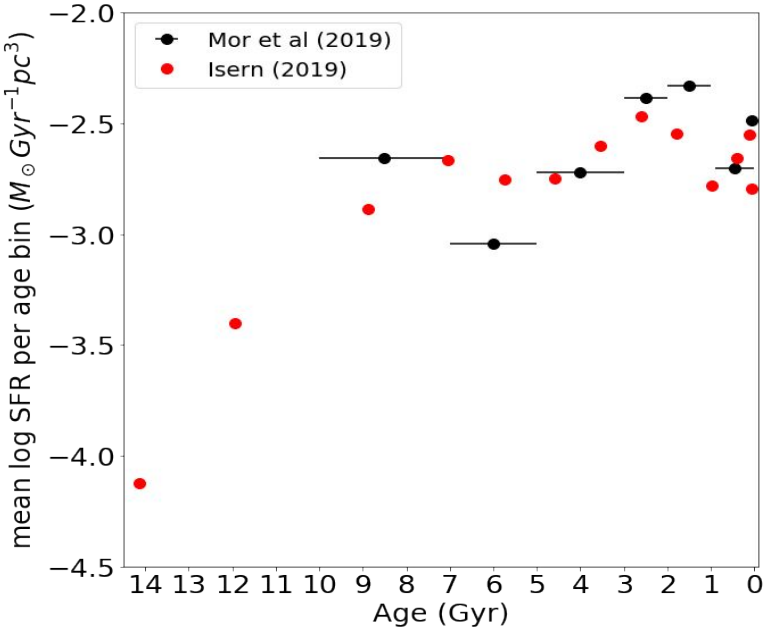
Results: Inferred SFH

Our results show a decreasing trend of the SFR from 9–10 Gyr to 6–7 Gyr and a re-ignition starting at ~5 Gyr ago and continuing until ~1 Gyr ago.

In our **hypothetical scenario** we link the quenching observed from 10 to 6 Gyr ago with a previous merger (Gaia enceladus?) that would happened at about 12 Gyr ago, and we also hypothesize that the re-ignition starting at about 5-7 Gyr ago was caused by an external perturbation.

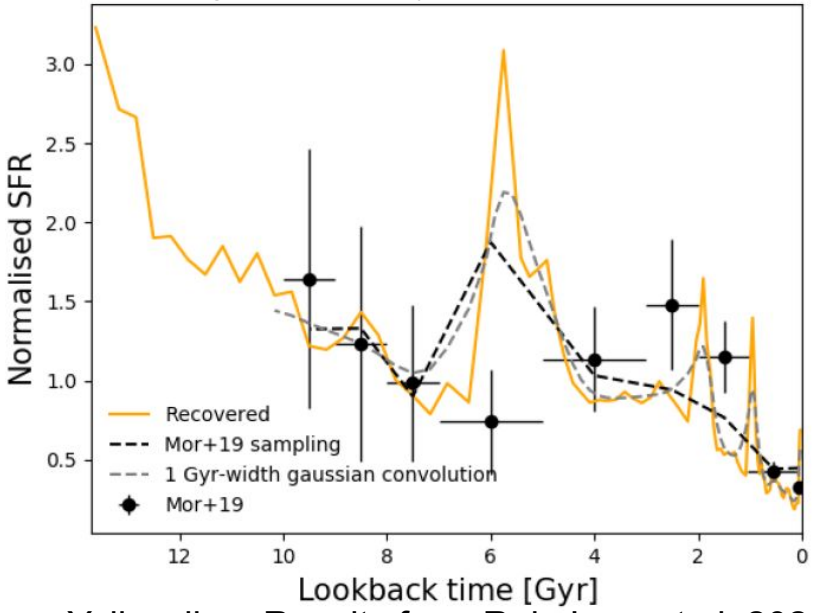


Comparison with other recent works



Our results are in good agreement with the work of Isern, J. 2019 where he determined the SFH using White Dwarfs

Figure courtesy of Ruiz-Lara, T.



Yellow line: Results from Ruiz-Lara et al. 2020

Please note that even discrepancies can be seen very well in the plot both works (this work and Ruiz-Lara+ 2019) obtain a re-ignition of the SFH from about 7 to 5 Gyr ago.

Results: Inferred IMF

$$\xi(m) = \begin{cases} k_1 \cdot m^{-\alpha_1}, & m < 0.5 \\ k_2 \cdot m^{-\alpha_2}, & 0.5 < m < 1.53 \\ k_3 \cdot m^{-\alpha_3}, & m > 1.53, \end{cases}$$

Values at high mass range compatible Salpeter IMF

Only 0,3% of our sample belongs to stars with M>10M_{sun}

Values at intermediate mass range In agreement with Ribizky and Just (2015)

Flat values of the IMF at low mass range in agreement with Dib and Basu (2018)

Only 0,1% of our sample belongs to the low mass range