

# **The IMF from Gaia Archive: the seed of the Milky Way evolution.**

*a Grand Challenge*

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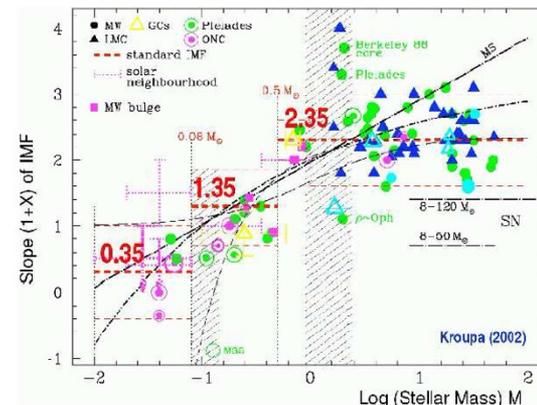
# The Initial Mass Function (IMF)

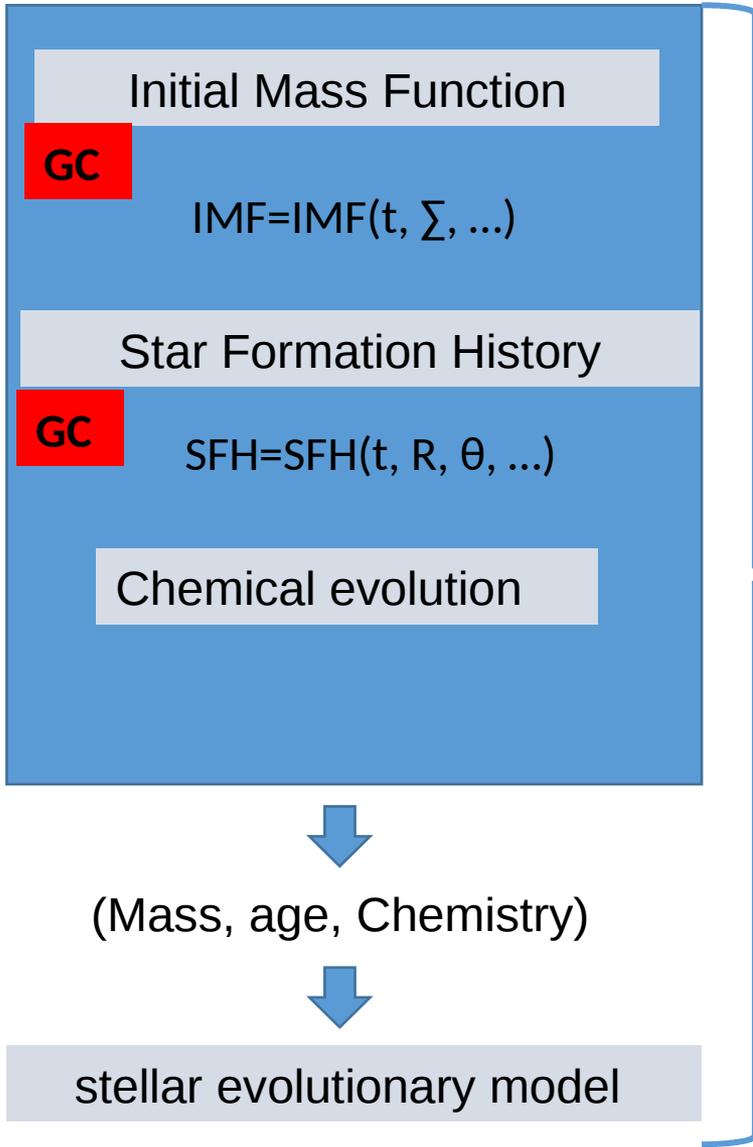
*The properties and evolution of a star are highly related to its mass, so **the IMF controls the evolution of the chemical composition and the luminosity of the stars so the Universe***

At present:

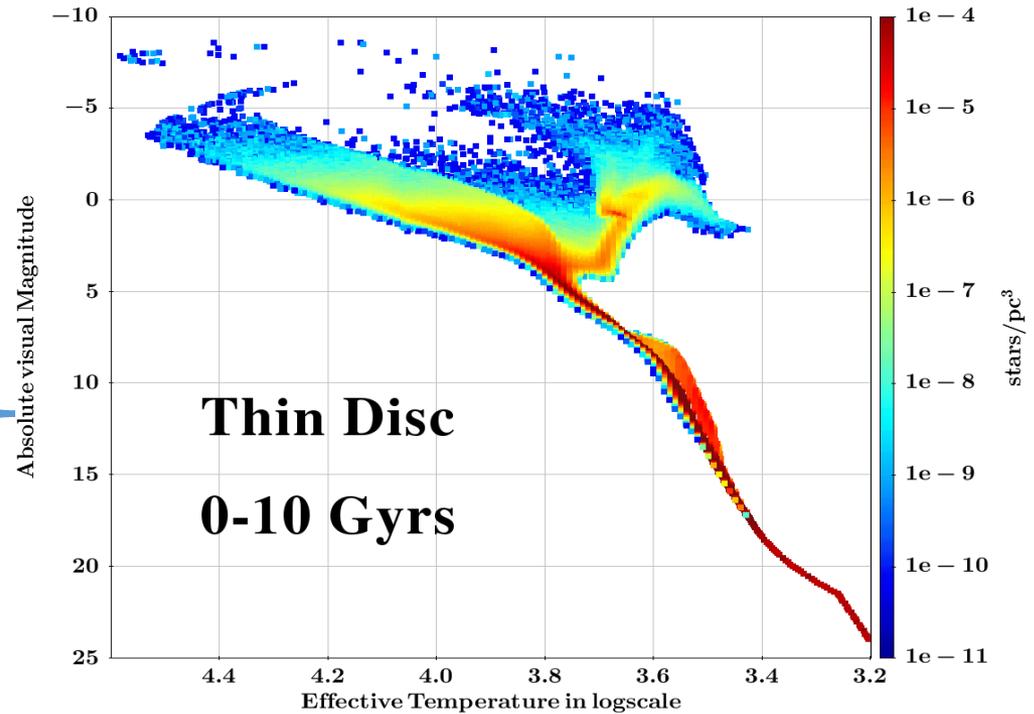
- Is the IMF universal? invariant on space, time and metallicity ?
- large uncertainties in the high, intermediate and very low mass regime
- are there different modes of star formation at substellar mass range?
- Parametric vs non parametric IMF

$$\Phi(M) = \frac{dN}{dM} = A M^{-(1+X)}$$





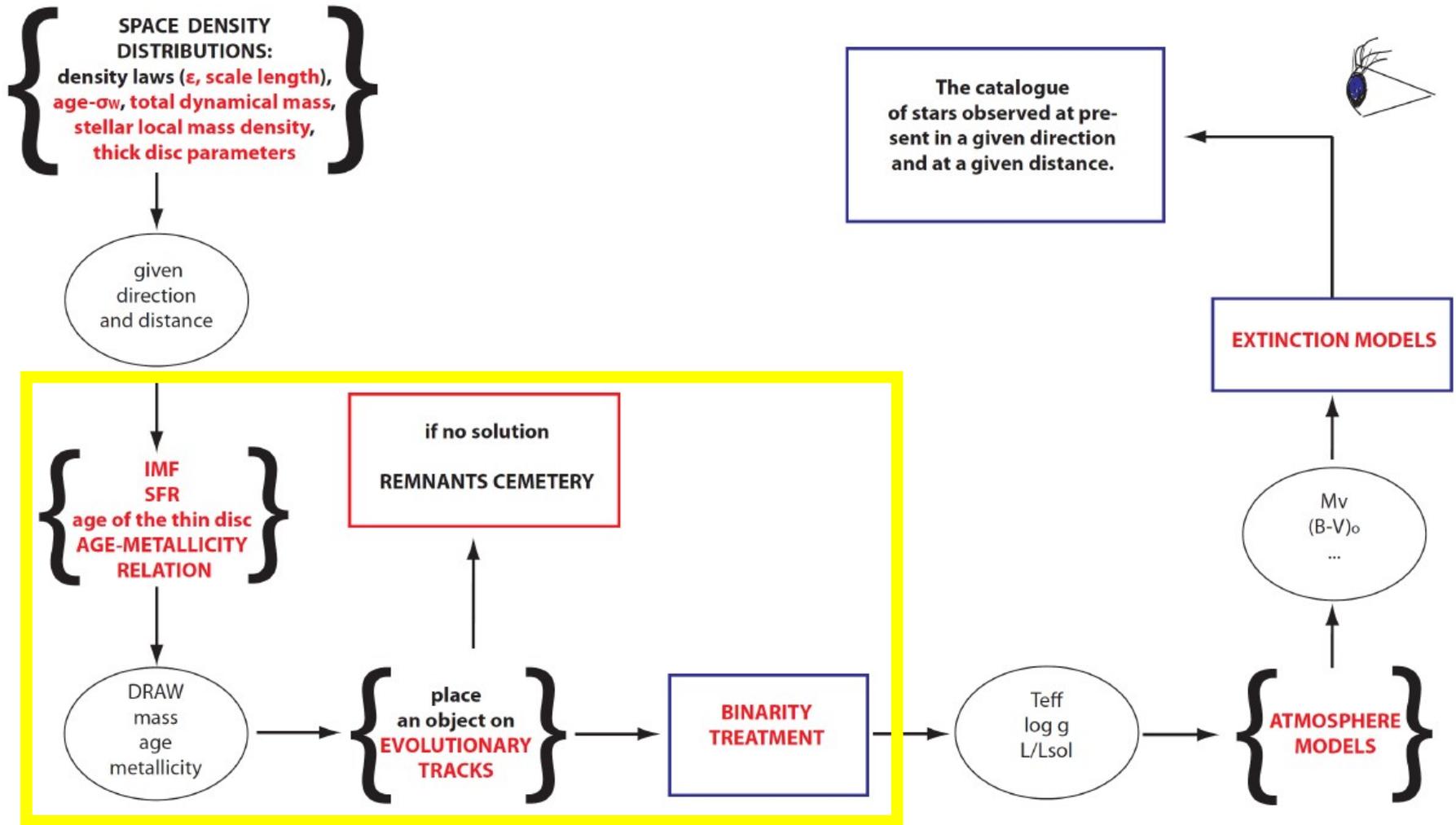
For each population



Gaia will provide the at present *in situ* Luminosity Function (LF)

**The Gaia Archive**

# BGM model: the starting tool for the Grand Challenge



The Challenge:

to deal with complexity, degeneracy and the continuous update of the puzzle pieces

## **GC Requirements:**

- High Computational demanding
- Access to the whole sky (full Gaia Archive)
- Model data (simulations) up to  $G=20$  available (GOG and updates), a monster

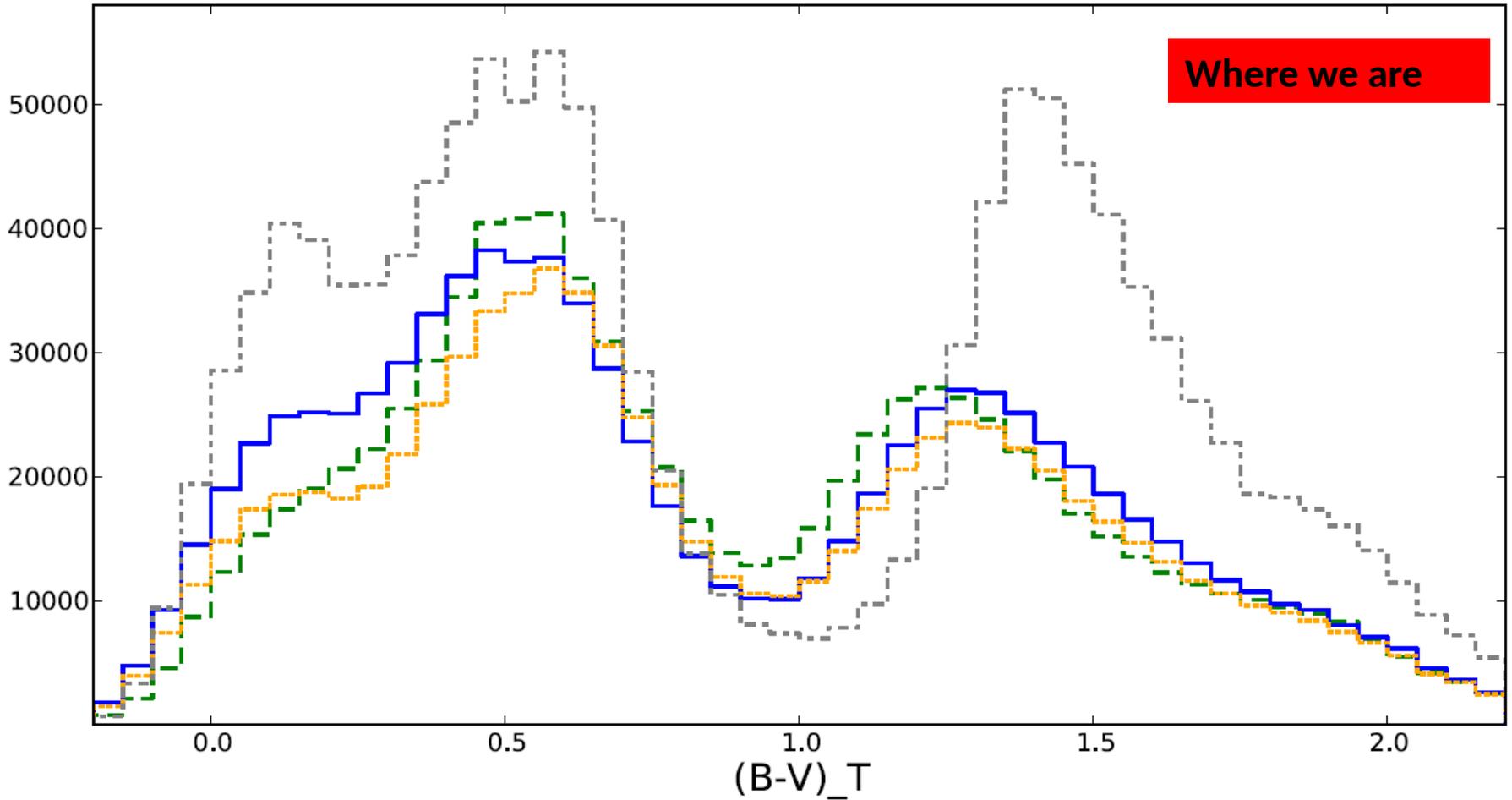
## **From now to the GC:**

1. Data: from TGAS (DR1) to Final Release
2. Model: from exploring only the thin disc parameter space to whole Gal. Populations
3. Tools: from parametric to non parametric description of the parameters
4. Methods: from 2-D to n-D likelihood MCMC
5. Strategy: weighting system to avoid full re-simulations at each iteration

## **Available at present:**

- The Gaia Data Analytic Framework (GDAF)
  - Allows direct contact with the cluster
  - It is thought for work flow and iterative processes
  - It is thought to work with Gaia catalogues

# BGM vs Tycho (V<11)



model A: Haywood-Robin IMF (OK in the plane)

model B: Kroupa-Haywood v6 IMF. (OK at intermediate latitudes, a bit better for whole sky? )

# Inferring the IMF and SFH using MCMC

initial guess for IMF, SFH, Scale Length

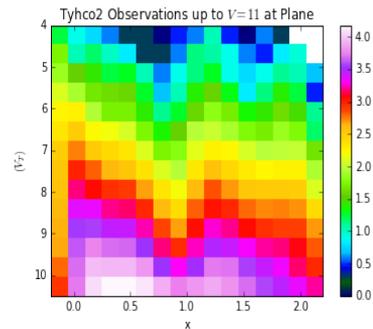
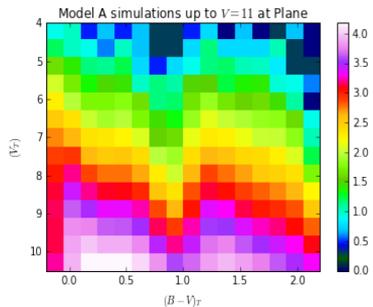
Besançon Galaxy Model Simulation

TGAS

New BGM Simulation  
with new set of parameters

Dynamical Statistical  
Equilibrium with new  
IMF, SFH + scale length

MCMC  
New guided IMF, SFH, Scale Length



Colour magnitude diagram likelihood  
Model vs data in the observational space

initial guess for IMF, SFH, Scale length...

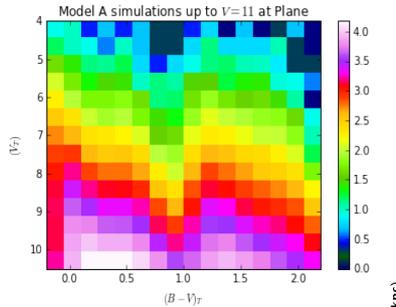
Besançon Galaxy Model Simulation

Gaia releases:  
Likelihood in 3D space  
( $G$ ,  $\pi$ , (BP-RP)+...)

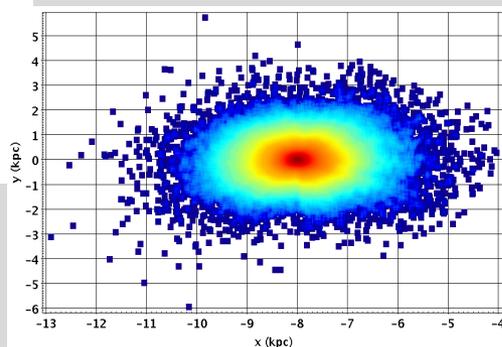
BGM Simulation  
with the new parameters

Dynamical Statistical  
Equilibrium with new  
IMF, SFH + scale length

New guided  
IMF, SFH and Scale length



( $G$ ,  $\pi$ , (BP-RP))



Likelihood in a n-dimensional space

Muchas Gracias!