

La persistència de la memòria, Salvador Dalí (1931)

# Synchronising stellar clocks

Núria Miret Roig

From star clusters to field populations – 20–23 Nov 2023





## Determining stellar ages









### Evolution

![](_page_1_Figure_6.jpeg)

![](_page_1_Figure_7.jpeg)

![](_page_1_Figure_8.jpeg)

![](_page_1_Figure_9.jpeg)

### Kinematics

## Dynamical traceback ages

![](_page_2_Figure_1.jpeg)

Miret-Roig et al. 2020

![](_page_2_Figure_4.jpeg)

[see also Miret-Roig et al. 2022, Galli et al. 2023, Crundall 2019, Squicciarini 2021, Kerr 2022a,b, Quintana 2022, Žerjal et al. 2023, Couture 2023]

![](_page_2_Picture_6.jpeg)

## Systematic offset ( $\Delta_{Age}$ )

![](_page_3_Figure_1.jpeg)

Dynamical traceback ages are younger than ages from evolutionary models

![](_page_3_Figure_3.jpeg)

![](_page_4_Picture_0.jpeg)

### The gas prevents the free expansion of stars until dispersed.

Similar offset in extragalactic studies, see Chevance et al. 2020 Similar offset in simulations, see Dobbs et al. 2022, Guszejnov et al. 2022, Jeffreson et al. 2023

## Synchronising stellar clocks

FREE EXPANSION  $t_{dynamics} = 0$  Myr

pre-main sequence stars

Miret-Roig et al. 2023

Published on Thursday 23.11

![](_page_4_Picture_8.jpeg)

## Synchronising stellar clocks

![](_page_5_Picture_1.jpeg)

The Sun

I accreted most of my gas 23 Myr ago.

> But I left my family 19 Myr ago.

> > Miret-Roig et al. 2023

Published on Thursday 23.11

β Pictoris

![](_page_5_Picture_8.jpeg)

![](_page_6_Picture_0.jpeg)

![](_page_6_Picture_1.jpeg)

![](_page_6_Figure_2.jpeg)

Dynamical Evolutionary

![](_page_6_Picture_4.jpeg)

## $\Delta_{Age}$ and environment

![](_page_6_Picture_6.jpeg)

![](_page_6_Picture_7.jpeg)

![](_page_7_Figure_0.jpeg)

![](_page_7_Figure_1.jpeg)

[see also Drew 2021, Maíz Apellaniz 2022]

## $\Delta_{Age}$ and environment

### Num. members

#### NGC 6618

≤1–2 Myr; 5\*10<sup>3</sup> M<sub>☉</sub>

[Stoop et al. 2023b]

#### NGC 6611 1−2 Myr; 2\*104 M<sub>☉</sub> [Stoop et al. 2023a]

## Evaporation ages

![](_page_8_Picture_1.jpeg)

Х

Pelkonen, Miret-Roig, Padoan 2023

Y

Evaporation age individual stars

![](_page_8_Picture_5.jpeg)

Distance to cluster centre

## Evaporation ages

![](_page_9_Figure_1.jpeg)

Pelkonen, Miret-Roig, Padoan 2023

![](_page_9_Figure_3.jpeg)

## New benchmark sample

![](_page_10_Figure_1.jpeg)

![](_page_11_Picture_0.jpeg)

La persistència de la memòria, Salvador Dalí (1931)

### Summary

Synchronising stellar clocks will shed light on the early stages of cluster formation, the timescale of the gas-embedded phase, and the dispersion of stars into the Galaxy.

![](_page_11_Picture_4.jpeg)

![](_page_11_Picture_5.jpeg)