Reanalysing the Galactic open-cluster population in light of Gaia DR2

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Equipo GaiaUB

Gaia DR2 has revealed that previously existing catalogues of the Galactic open clusters (OCs) were both incomplete and impure. We determined new homogeneous physical parameters for OCs (including ages), and analysed how this changes our view of the recent chemo-dynamical history of the Galactic disc. In particular, we demonstrate how some key observables of the Galactic disc, such as the cluster age function, have to be revised. This affects previous estimates of the cluster formation and destruction rate and may yield further constraints on the efficiency of dynamical mixing processes over the extent of the Galactic disc.

Context: Our evolving view of the Galactic open-cluster system
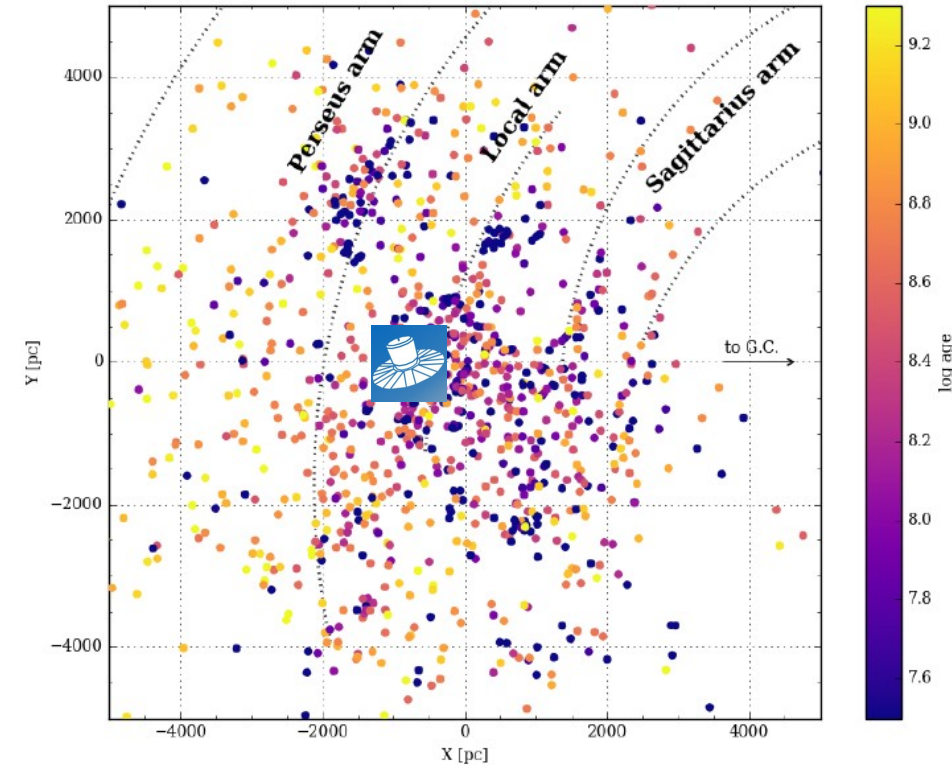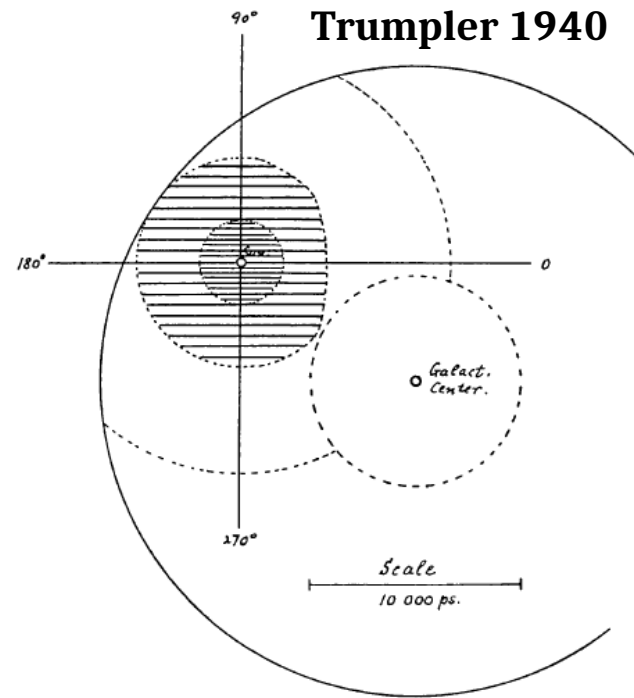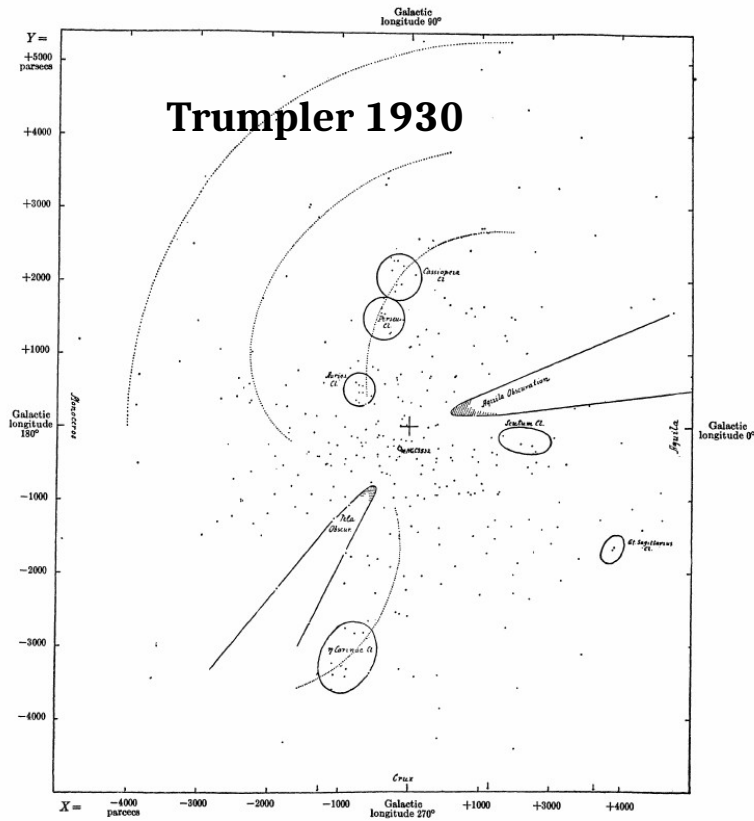
Cantat-Gaudin+2018

After almost a century of open-cluster research, we are still far from a complete view of the Milky Way's OC population. However, Gaia is revolutionising the field, enabling the discovery of hundreds of new clusters & disproving the existence of others.

The Galactic open cluster census revised by Gaia

Cantat-Gaudin+2018: First Gaia DR2 analysis of the OC population: the **census needs to be revised**
Castro-Ginard+2018, 2019, 2020, Cantat-Gaudin+2019, etc.: **Discovery of ~1000 new OCs**
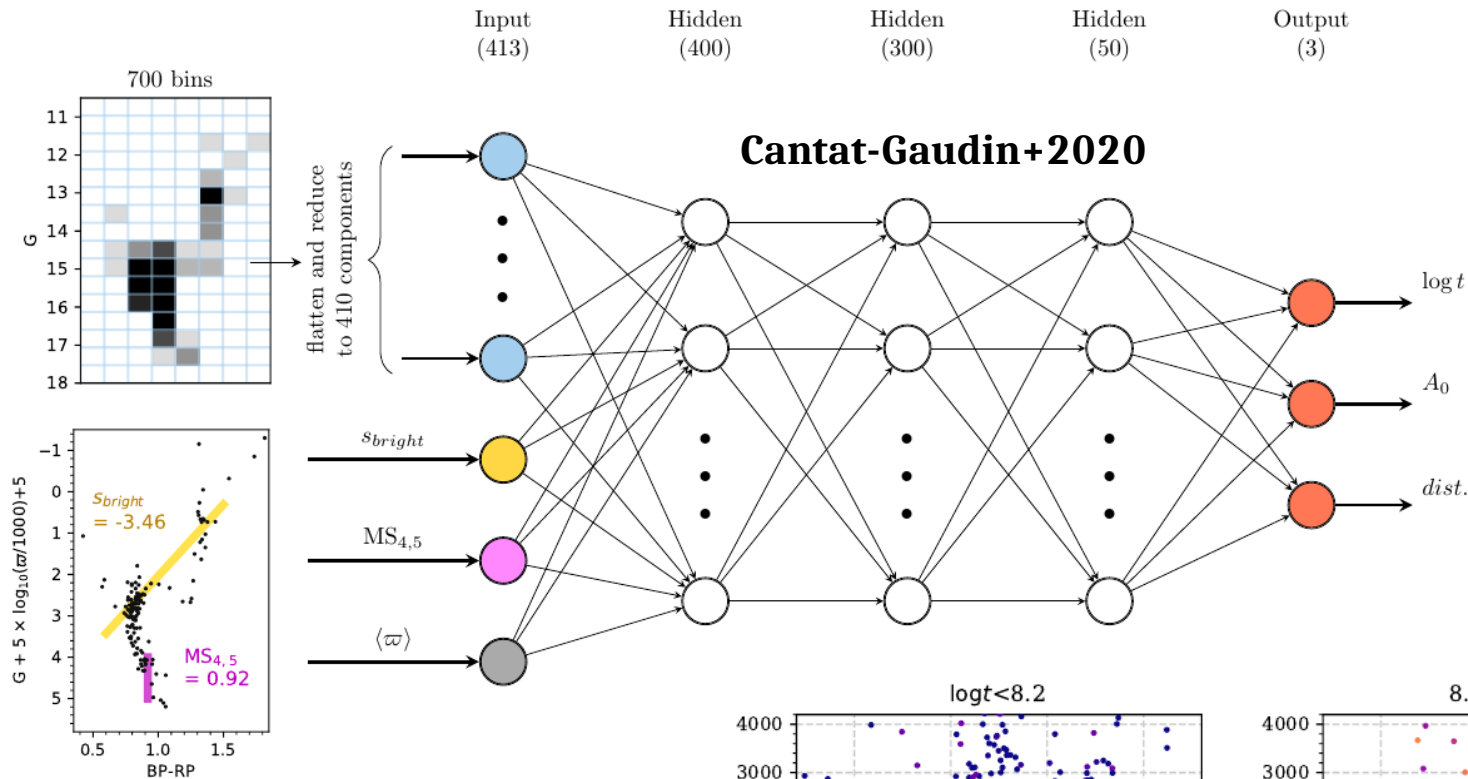Cantat-Gaudin+2020: **Homogeneous physical parameters for 1,867 OCs**

Cantat-Gaudin+2018, Cantat-Gaudin & Anders 2020: **The pre-Gaia OC census was significantly contaminated by asterisms. This led to a blurred view of the dynamical history of the disc.**


Cyan: High-latitude asterisms in MWSC

Red: NGC Asterisms

Black: Open clusters confirmed by Gaia DR2
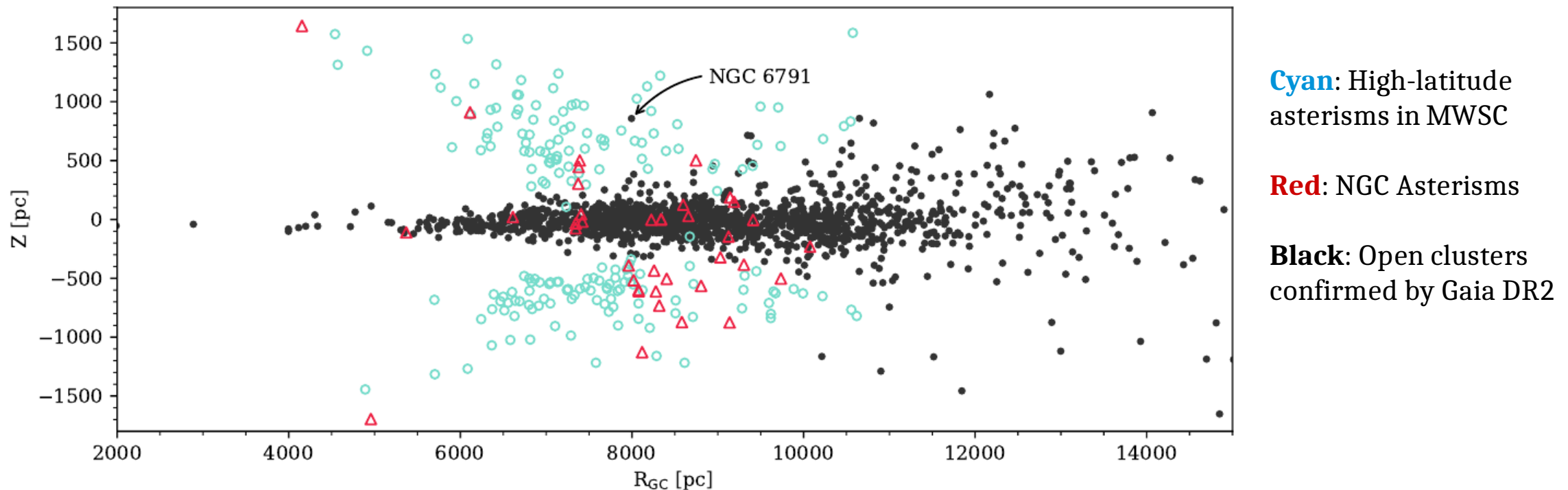
Homogeneous catalogue of OC ages, distances, & extinctions

Cantat-Gaudin+2020

We use a **neural network** trained on well-studied OCs (many observed with high-resolution spectroscopy) to determine **ages, distances, and extinctions for all Gaia DR2 OCs, based only on Gaia astrometry and photometry.**

The catalogue allows us to study spiral structure, the Galactic warp, the evolution of the disc scaleheight, etc.
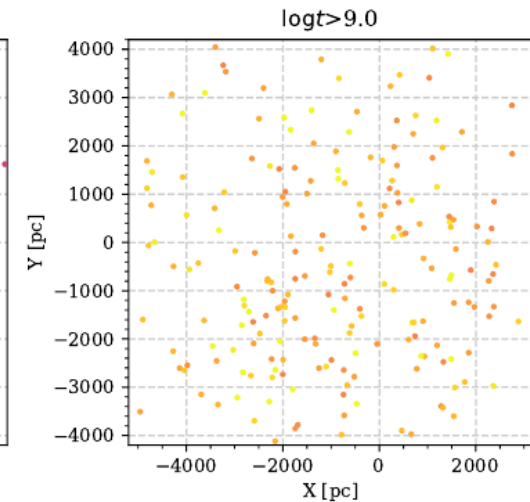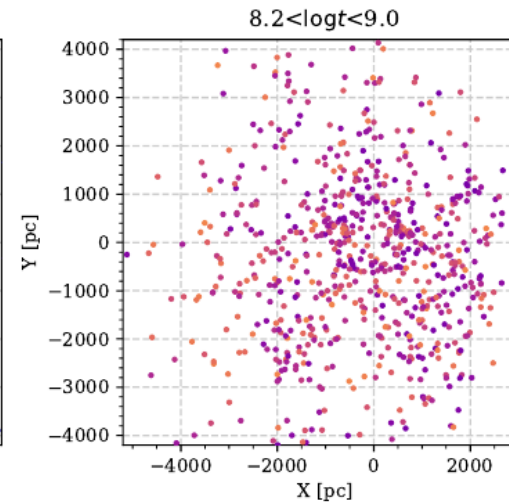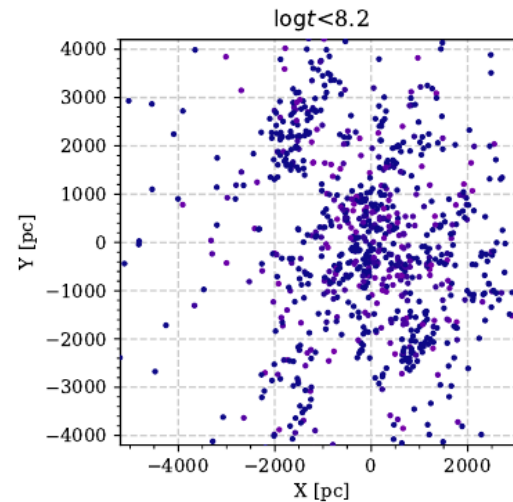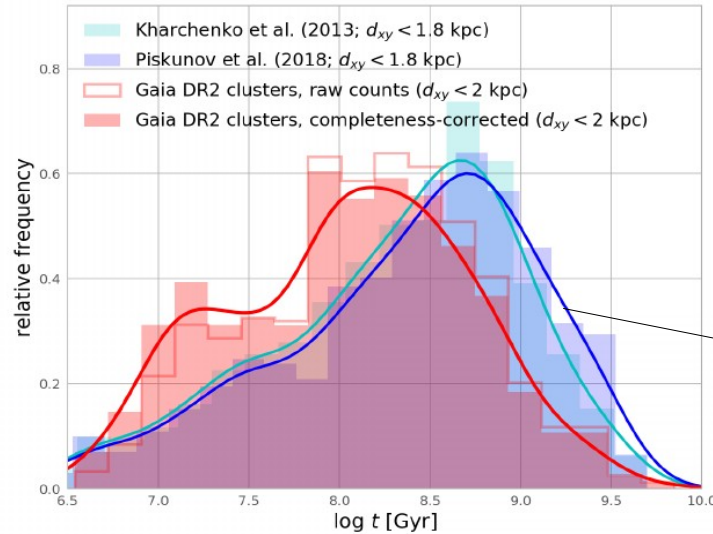
Cantat-Gaudin+2020

Revisiting the Milky Way's cluster age function

Cyan & blue: Pre-Gaia census (MWSC)
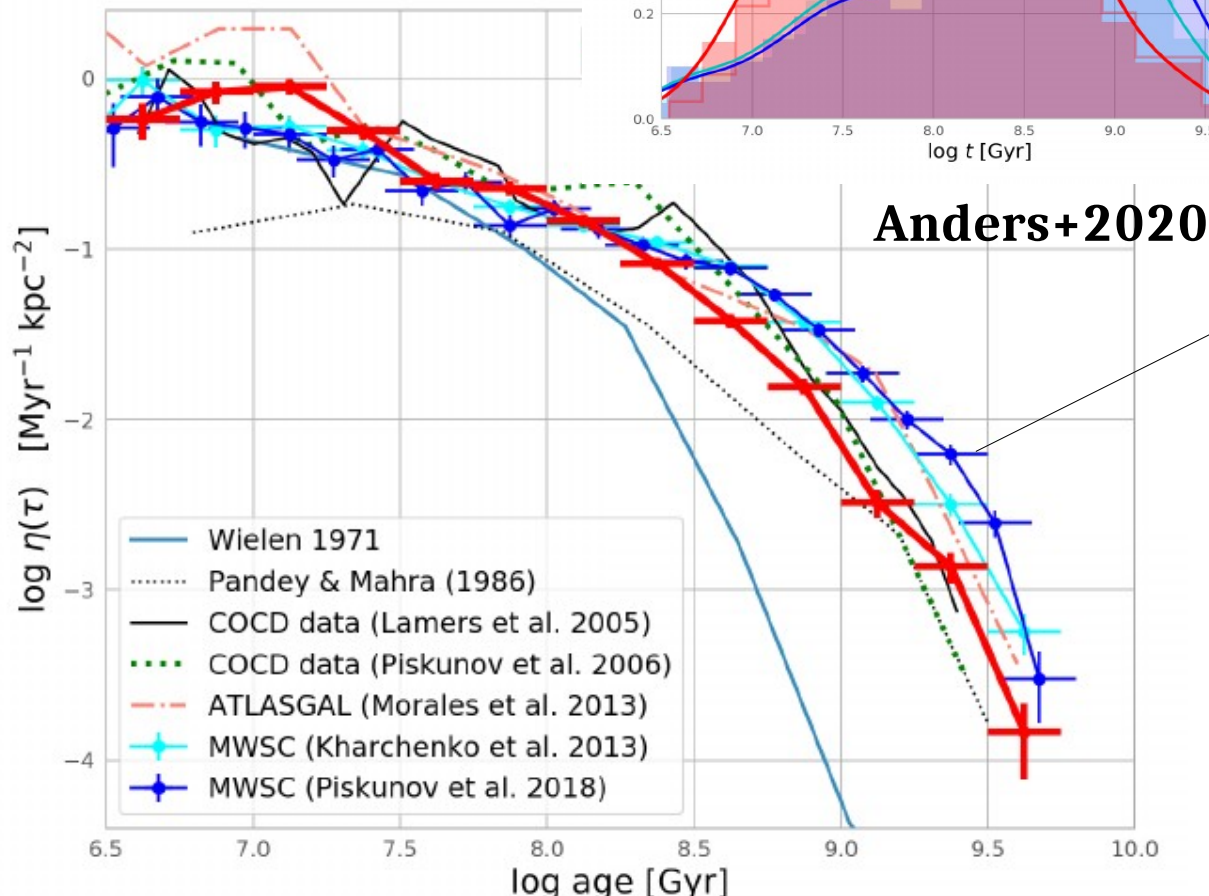
Red: Gaia DR2 Clusters

Anders+2020

We determine the **completeness** of the Cantat-Gaudin+2020 catalogue & **reanalyse the cluster age distribution within 2 kpc** from the Sun.

As expected, the **tail of old OCs disappears:** many of those objects could not be confirmed.

The cluster age function (log of the number of clusters per age per area) follows a Schechter or broken power law.

We find **excellent agreement with** the **dynamical cluster destruction models** of Lamers+2005 or Lamers&Gieles 2006. Our results indicate a present-day cluster-formation rate of ~ 0.6±0.1 Myr^{-1} kpc^{-2}.
→ **Only 8 – 15 % of all stars born in the solar neighbourhood form in bound clusters.**

Implications

1. We have a new catalogue of homogeneously derived ages, distances, and extinctions for 1867 Gaia DR2 open clusters:

Cantat-Gaudin et al. (2020), soon to appear on CDS!

2. Gaia allows us to decontaminate the OC census of asterisms (Cantat-Gaudin & Anders 2020), and discover hundreds of new OCs. In consequence, some of the key observables for Galactic evolution have to be revisited.

3. In Anders+2020 we reanalyse the cluster age distribution of the 834 open clusters contained in a 2 kpc cylinder around the Sun. And we find:
  → an earlier drop of the age function (by a factor of 2 − 3) with respect to the results obtained in the last five years
  → typical destruction time-scale of ∼ 1.5 Gyr for a 10^4 Msun cluster
  → a present-day cluster-formation rate of ∼ 0.6±0.1 Myr^{-1} kpc^{-2}
  → only 8 − 15 % of all stars born in the solar neighbourhood form in bound clusters