

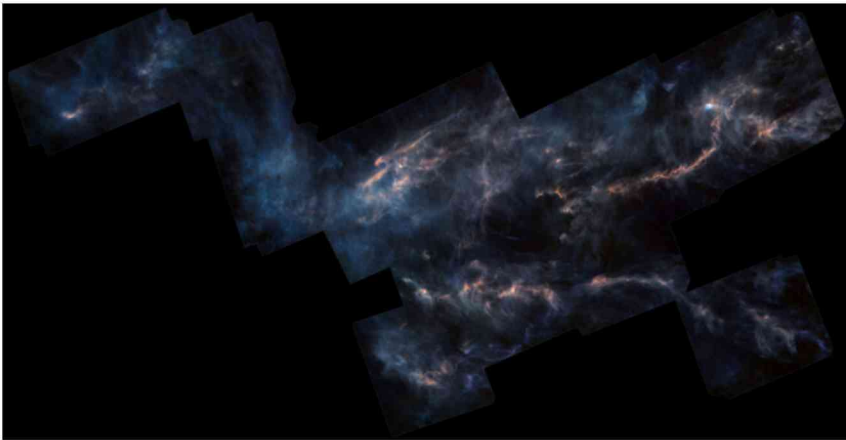
Close companions to young stars

Marina Kounkel, Kevin Covey,
APOGEE Collaboration

Western Washington University

Multiplicity Fraction

Taurus



Companions at separations >3 au in
excess by a factor of 2 relative to the field
(Kraus+11)

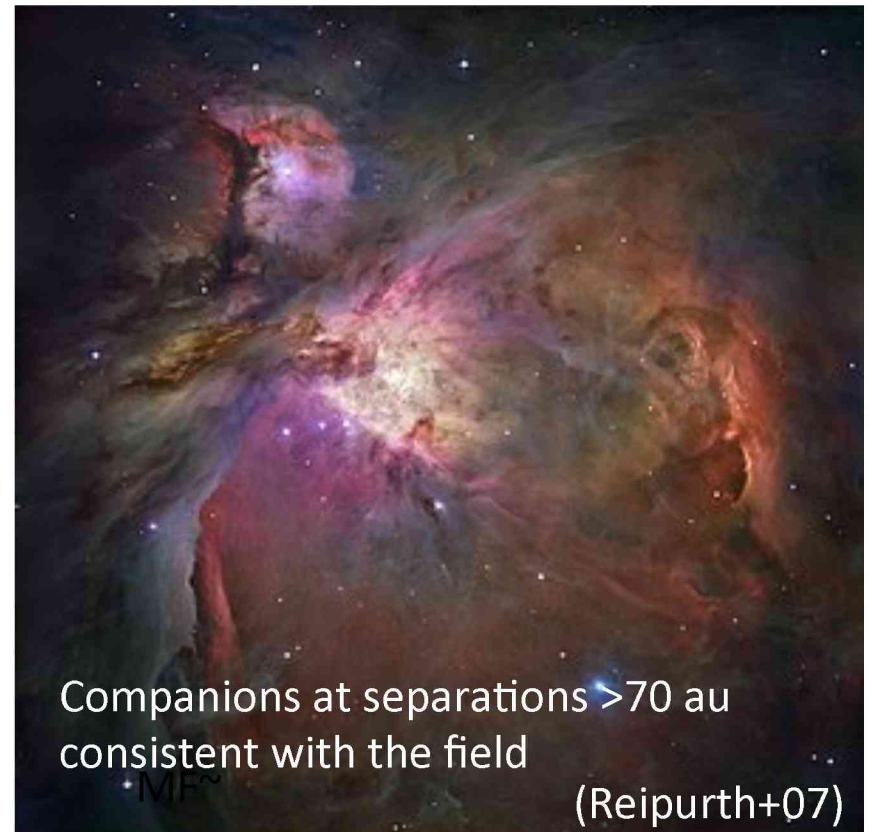
Multiplicity Fraction

Taurus



Companions at separations >3 au in excess by a factor of 2 relative to the field (Kraus+11)

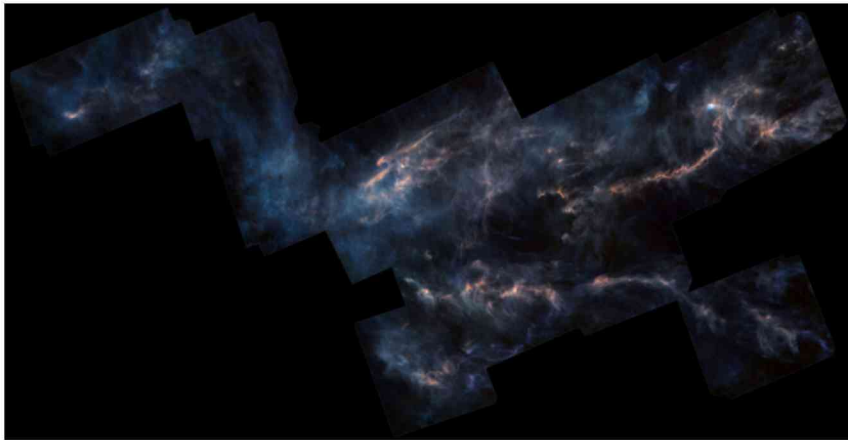
ONC



Companions at separations >70 au consistent with the field (Reipurth+07)

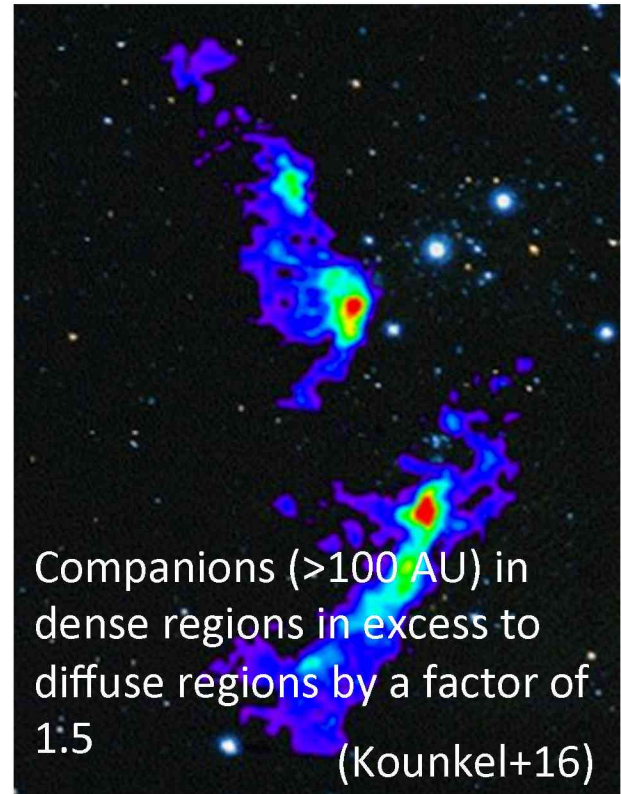
Multiplicity Fraction

Taurus



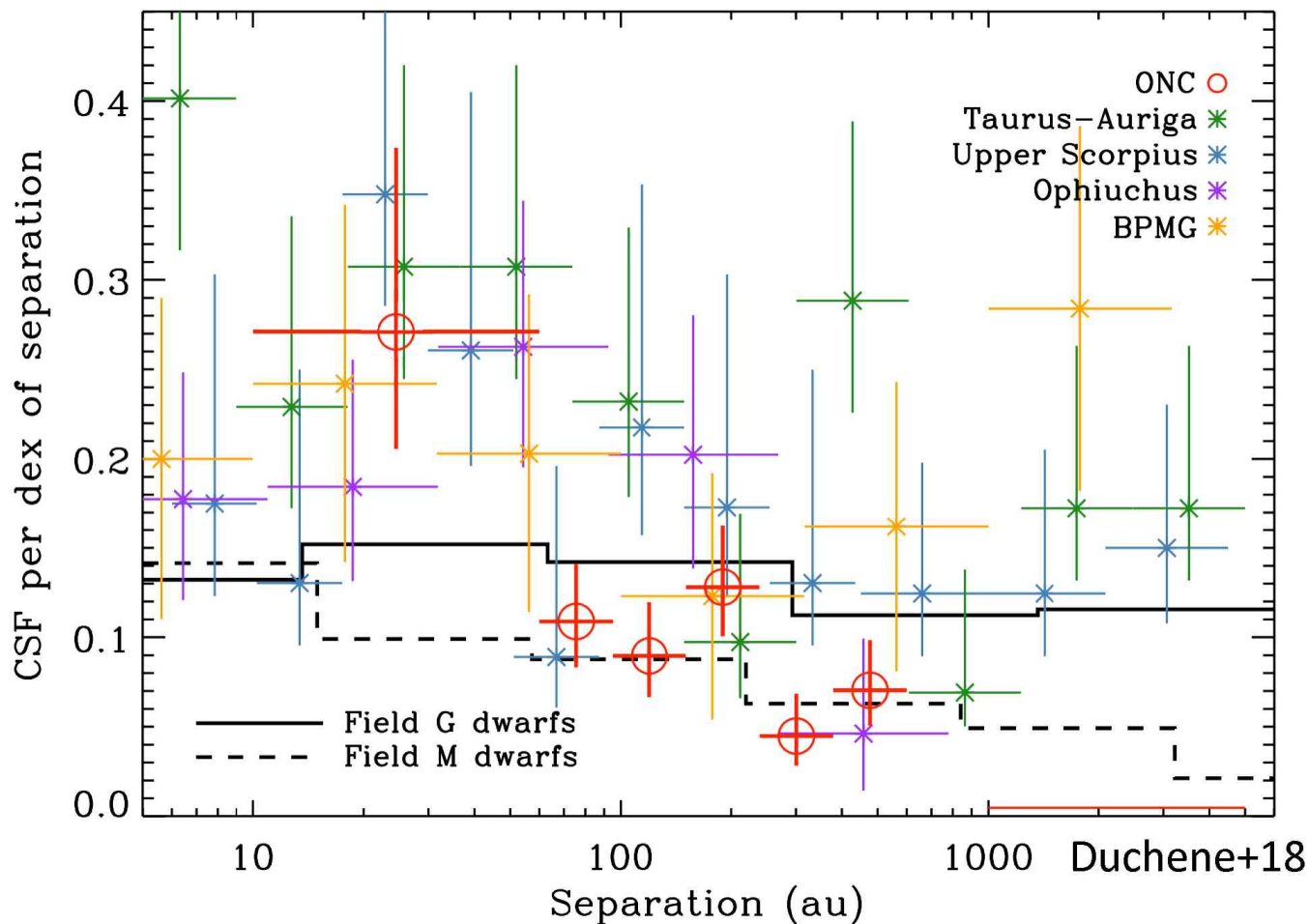
Companions at separations >3 au in excess by a factor of 2 relative to the field (Kraus+11)

Orion Molecular Clouds



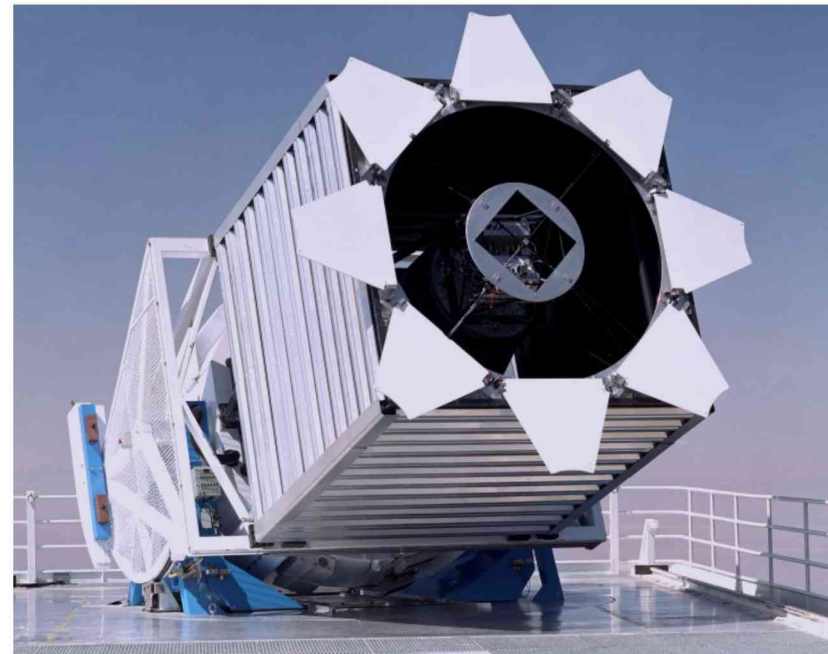
Companions (>100 AU) in dense regions in excess to diffuse regions by a factor of 1.5 (Kounkel+16)

Distribution of wide companions around YSOs is inconsistent with the field

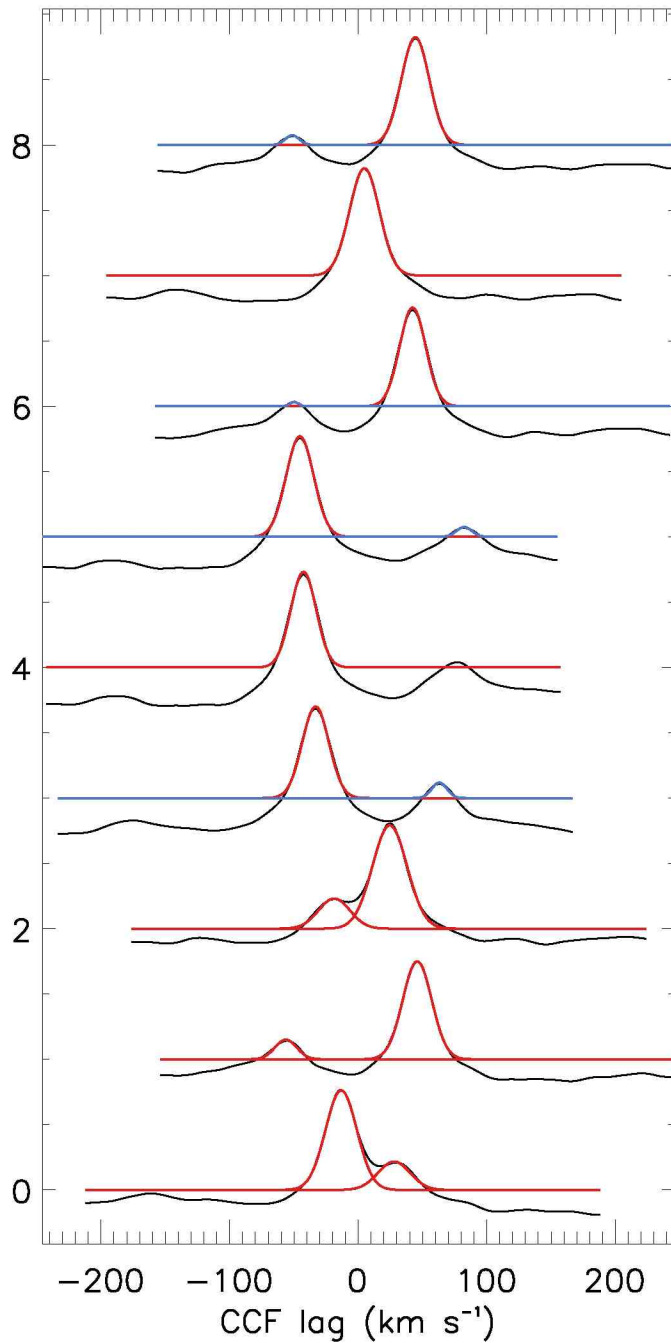


APOGEE Young Clusters Survey

- 5000 YSOs, 19,000 unique spectra
- ~ 0.3 km/s resolution
- Regions
 - Orion Complex
 - Taurus Molecular Clouds
 - Perseus (NGC 1333, IC348)
 - NGC 2264
 - α Per (70 Myr)
 - Pleiades (120 Myr)



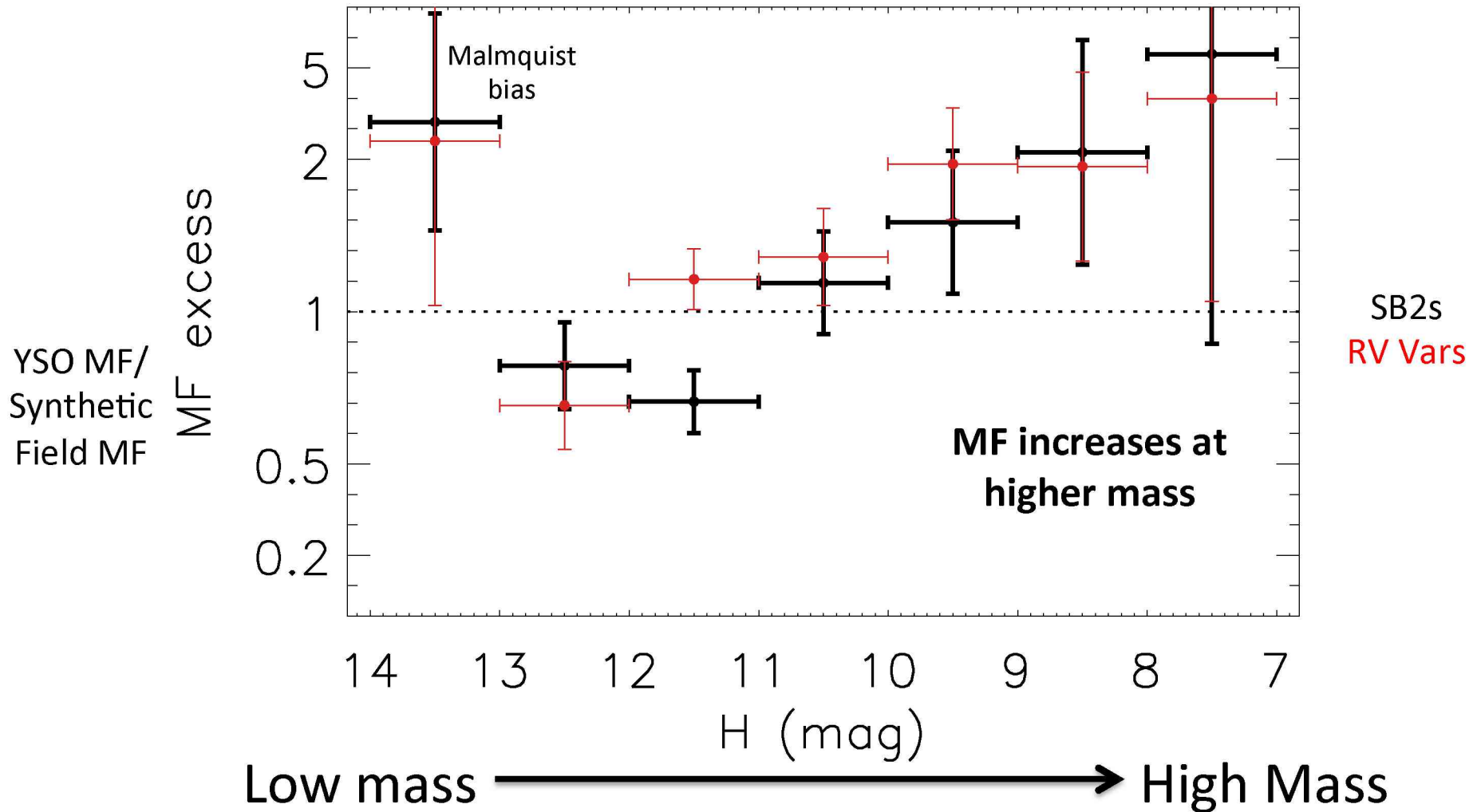
2M03454440+2413132



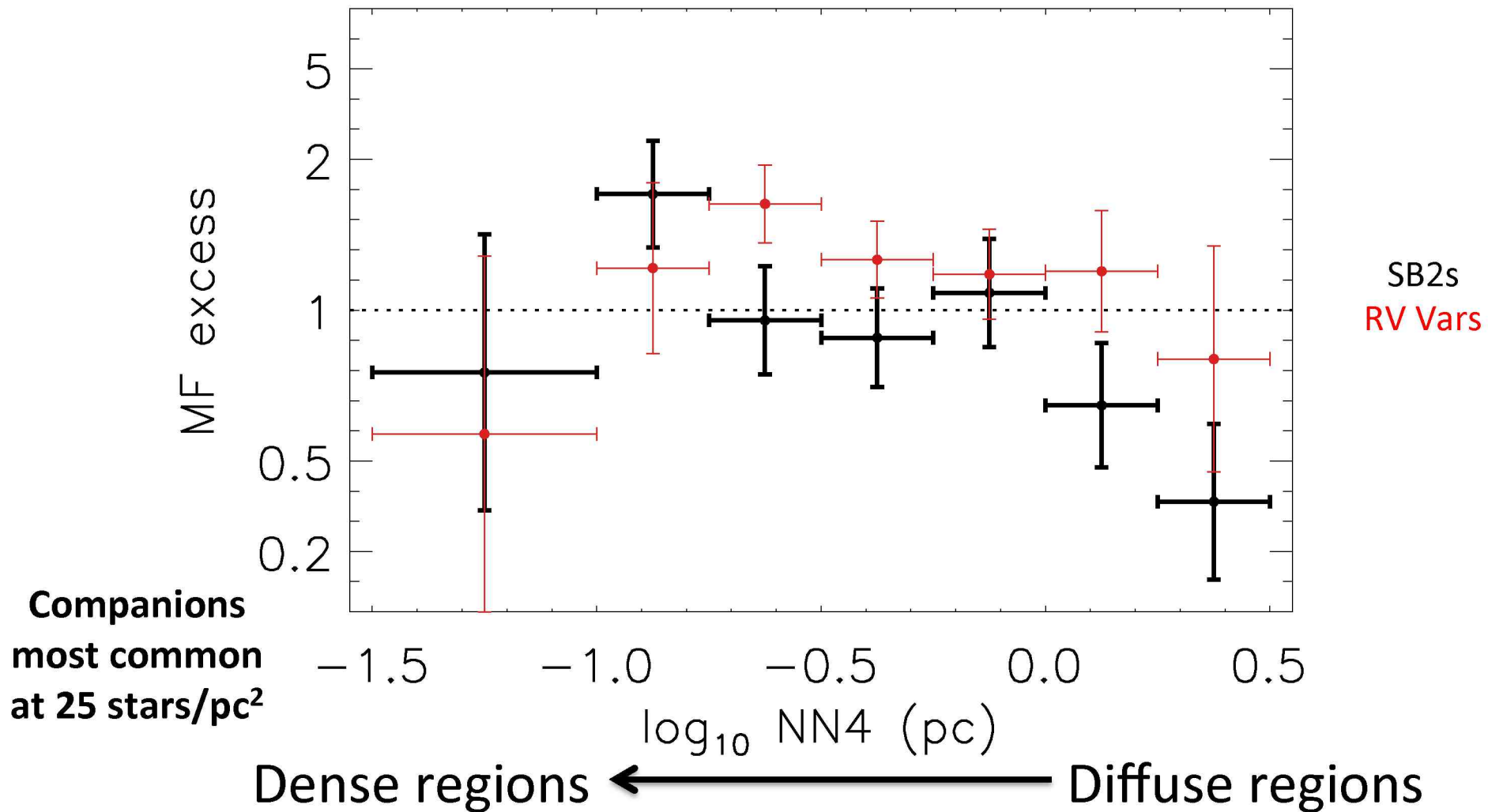
RV Variables + SB2

- Autonomously deconvolved CCF to search for flux from both stars using GaussPy
- Constructed spectra of synthetic binaries to replicate the data

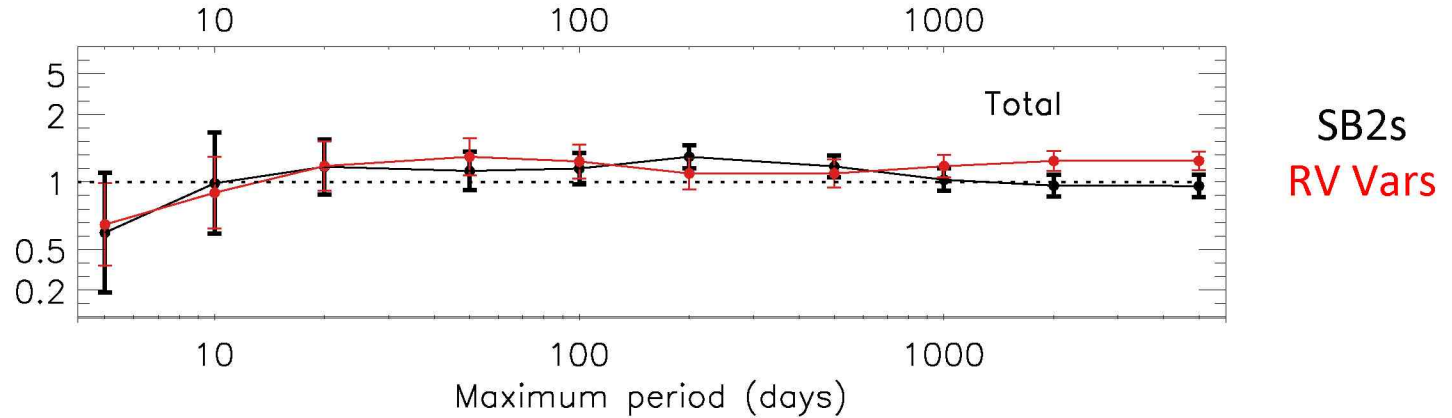
Mass of the Primary



Stellar Density Dependence

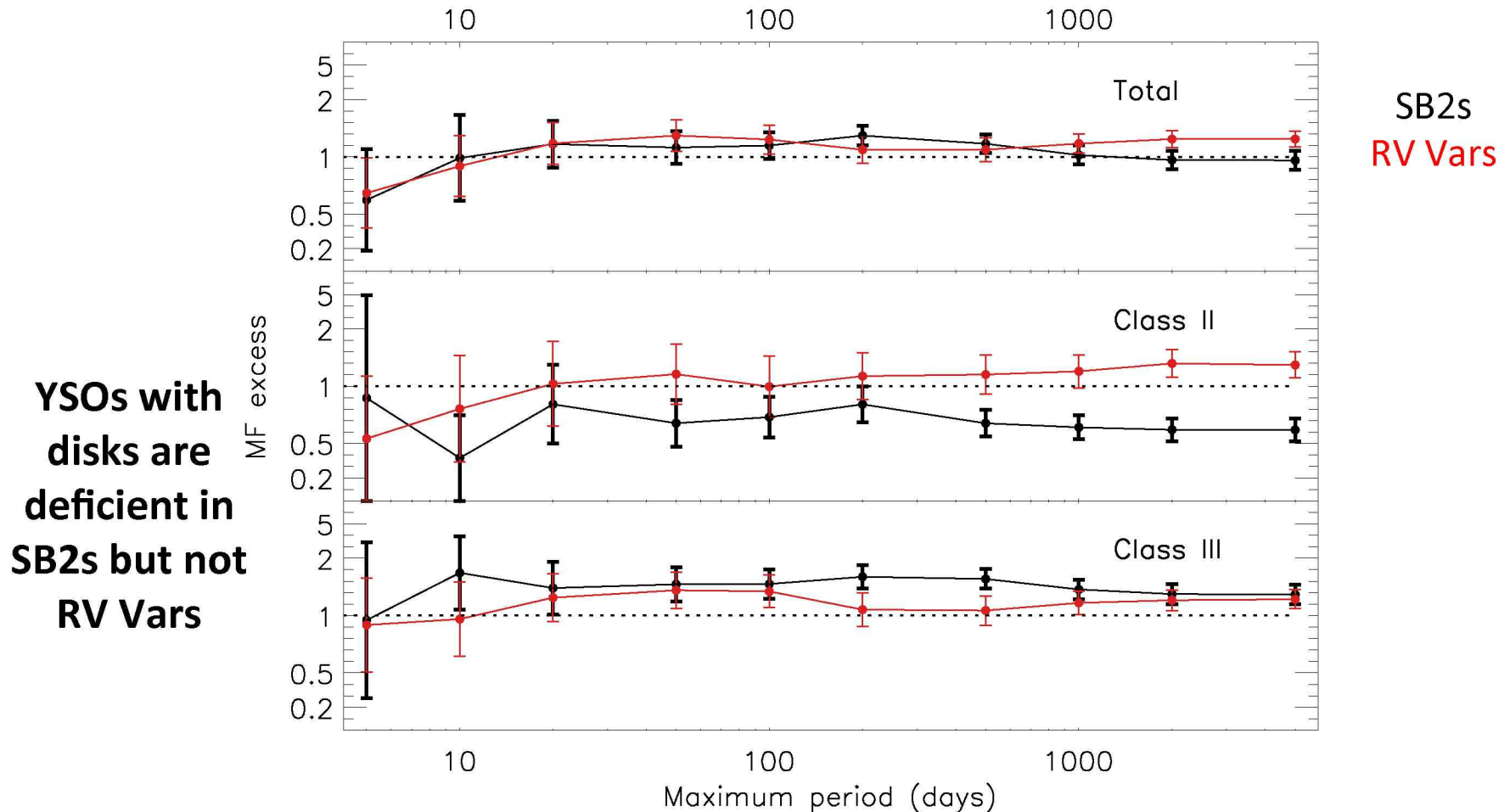


Orbital Period dependence

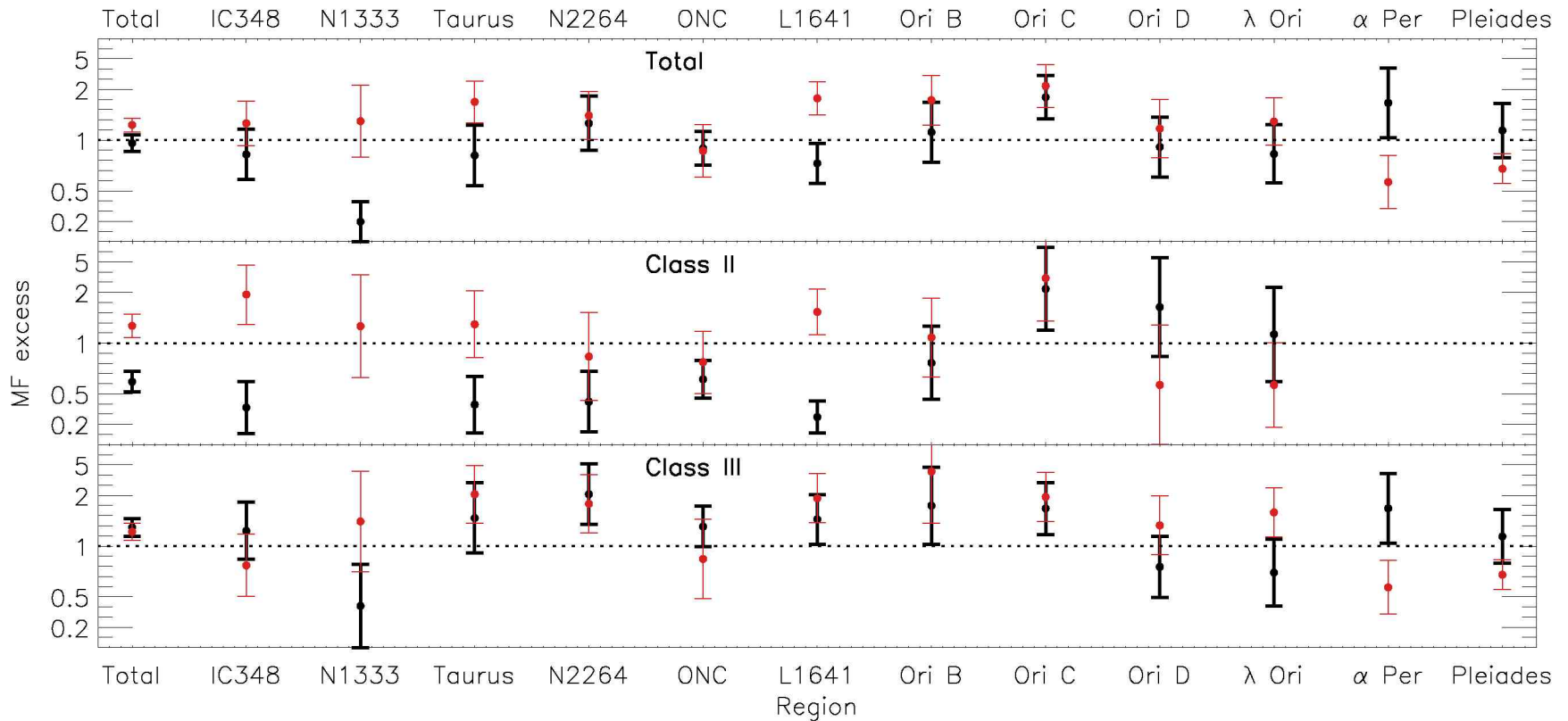


**On average,
up to 10 AU,
YSO MF is
consistent
with the field**

Orbital Period Dependence on MF



Region Dependence on MF

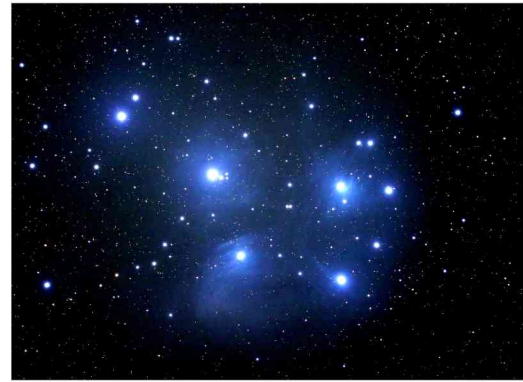
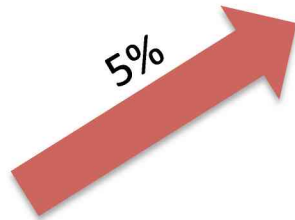
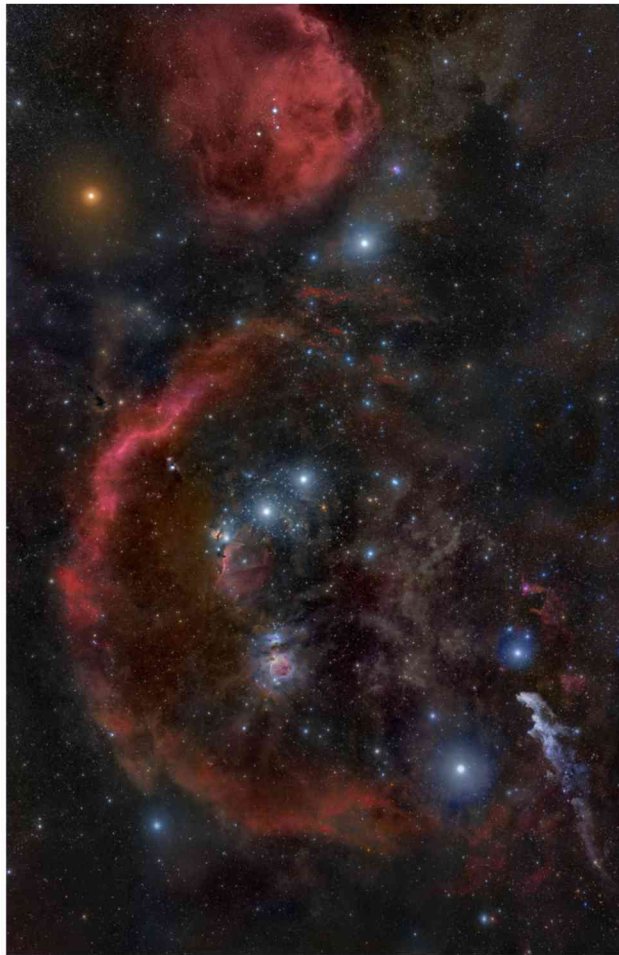


~Age

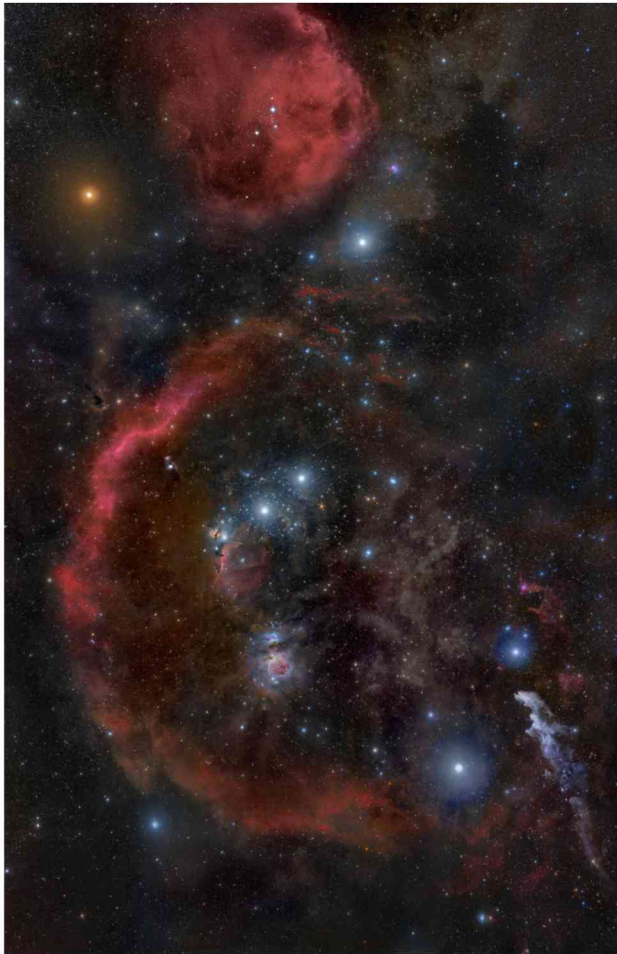
SB2s
RV Vars

**No strong dependence
on MF between
different regions,
or as a function of age**

Most clusters do not survive past 10 Myr
Few make it to 100 Myr



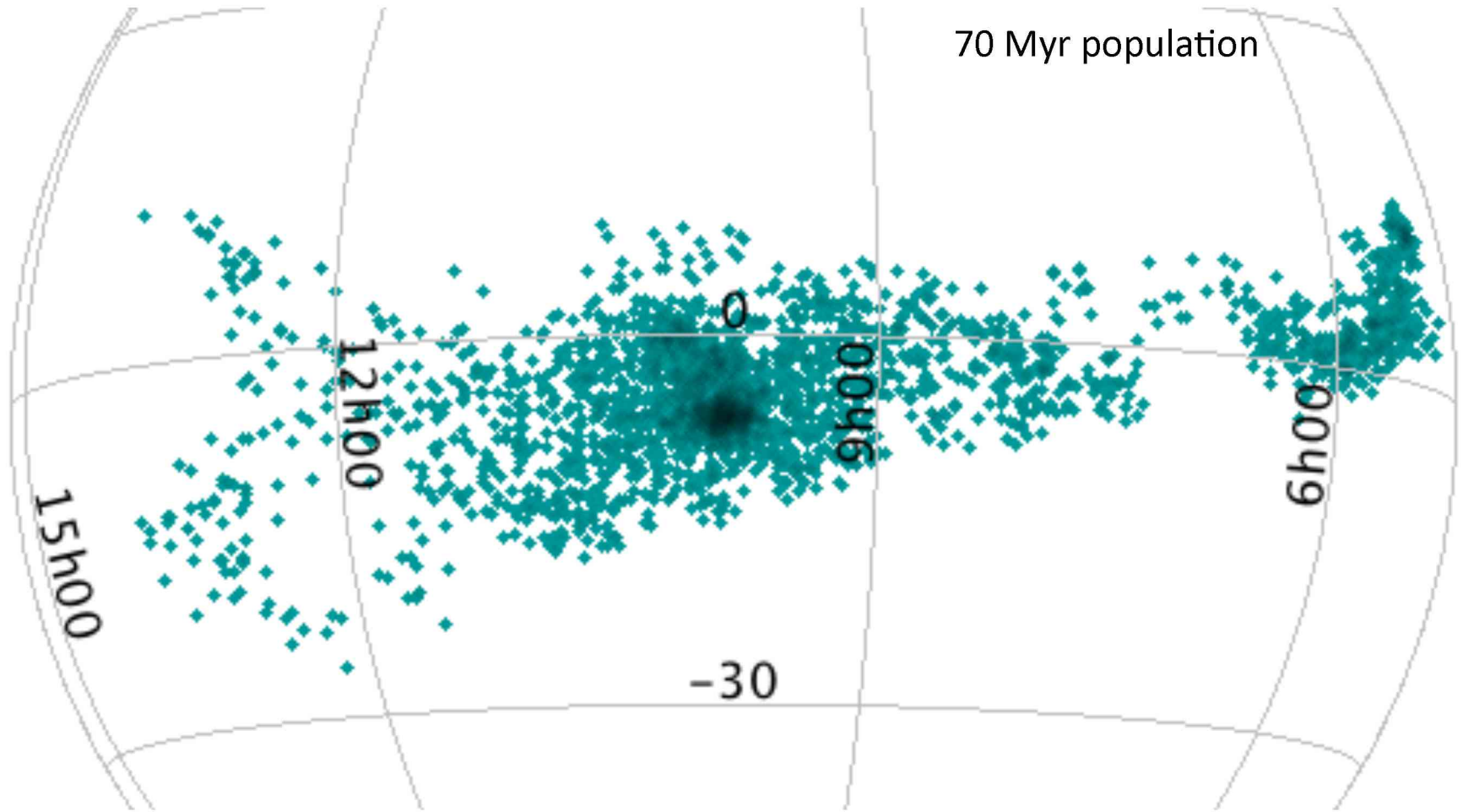
Most clusters do not survive past 10 Myr
Few make it to 100 Myr



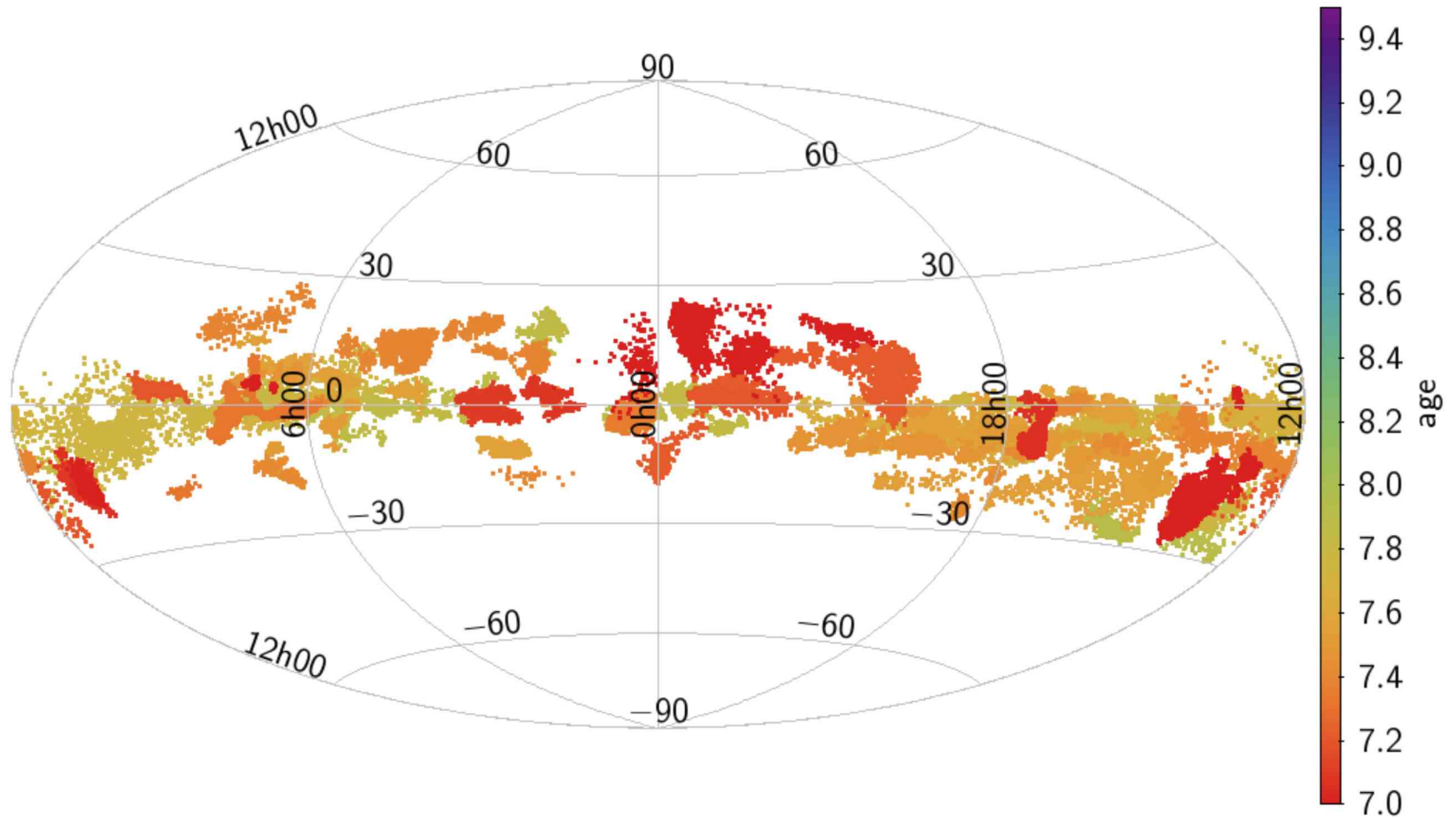
Does this hold up in
the age of Gaia?

Are clusters still the
most fundamental
type of evolved
stellar population?

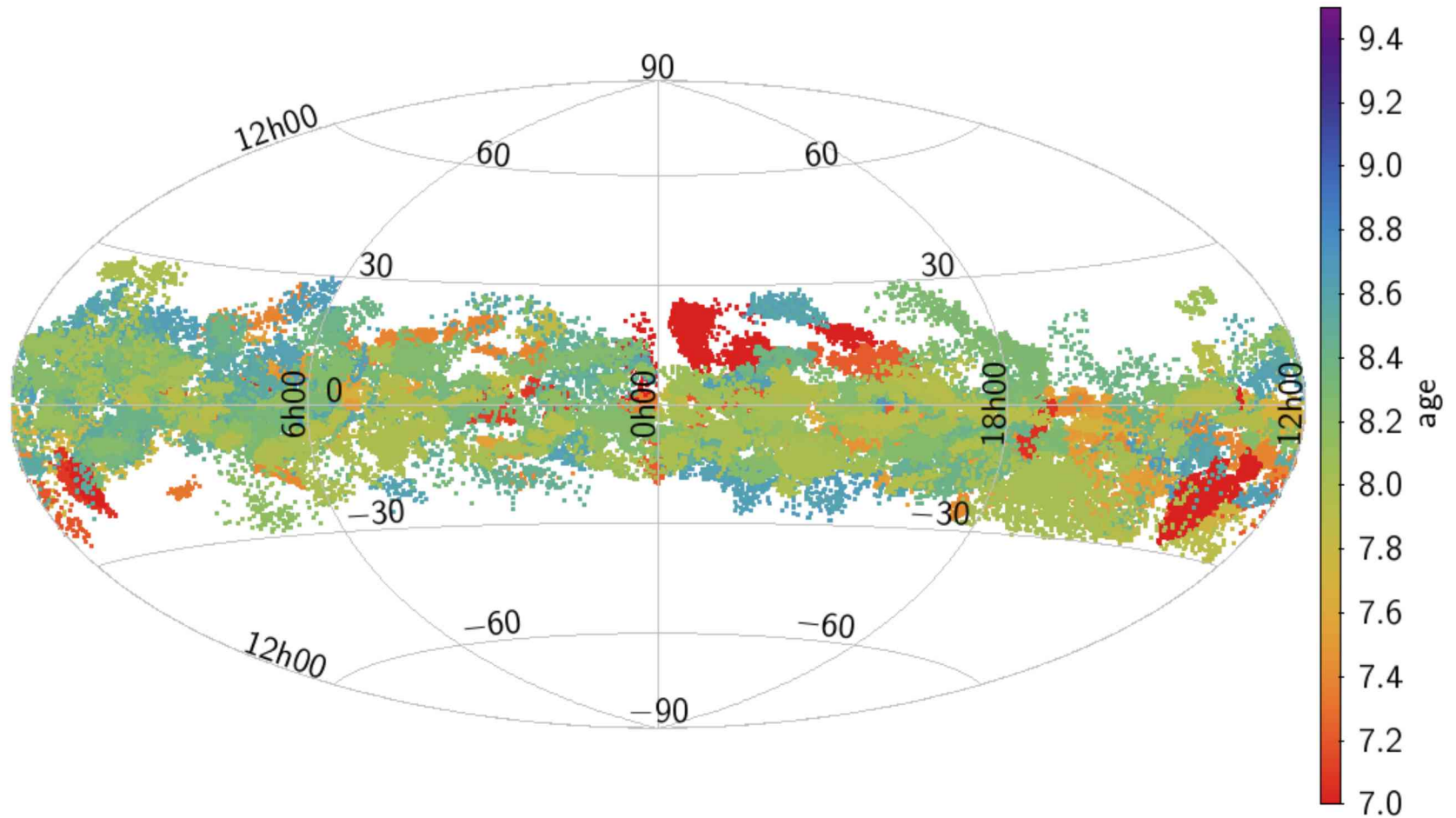
Alpha Per



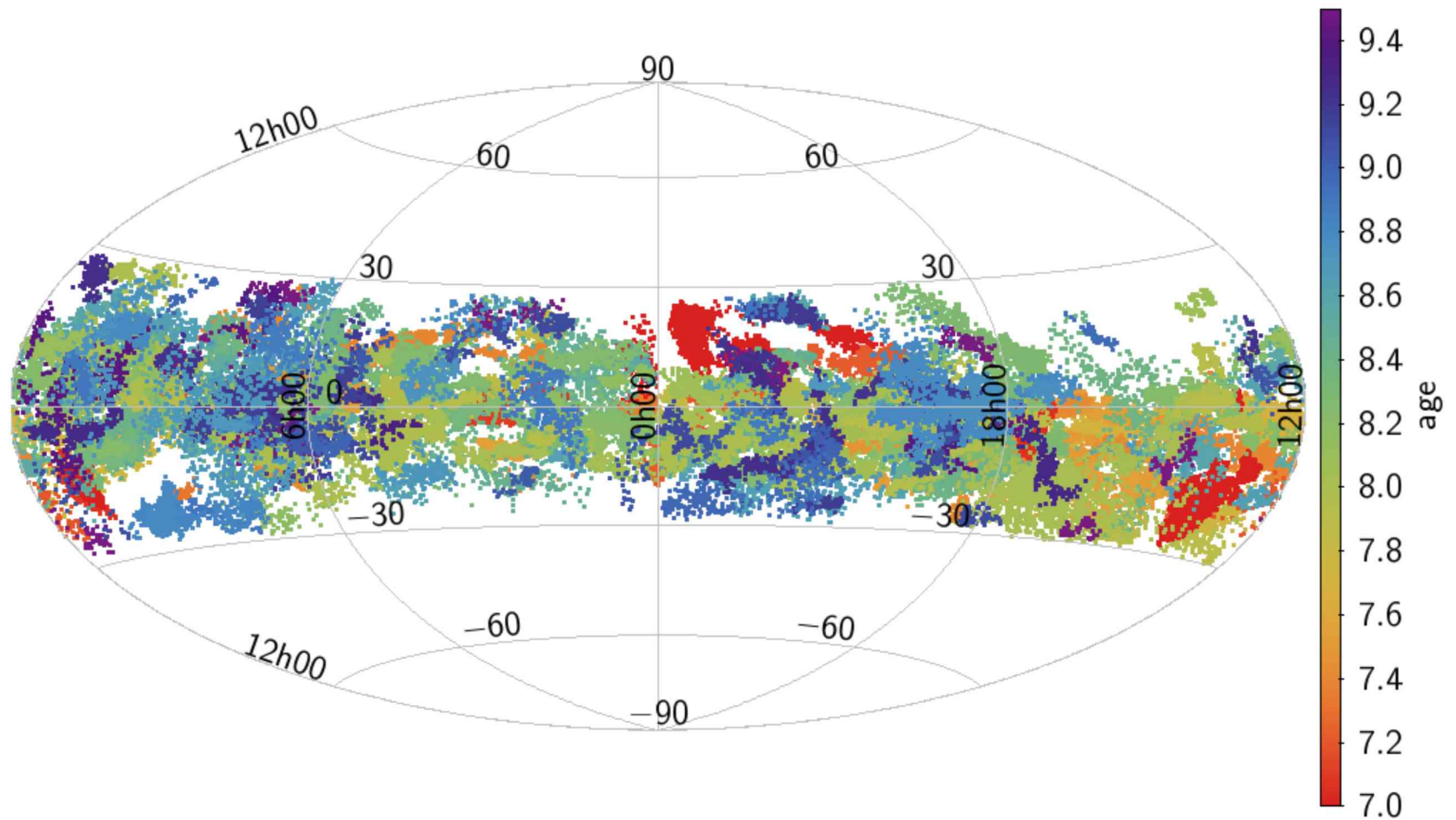
Extended structure within 1 kpc



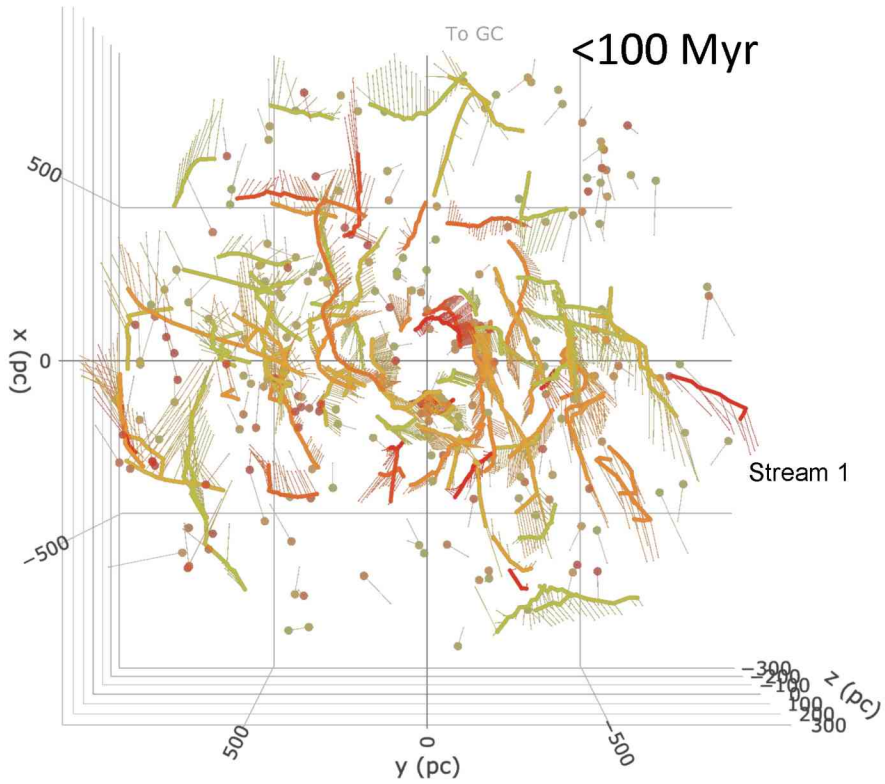
Extended structure within 1 kpc



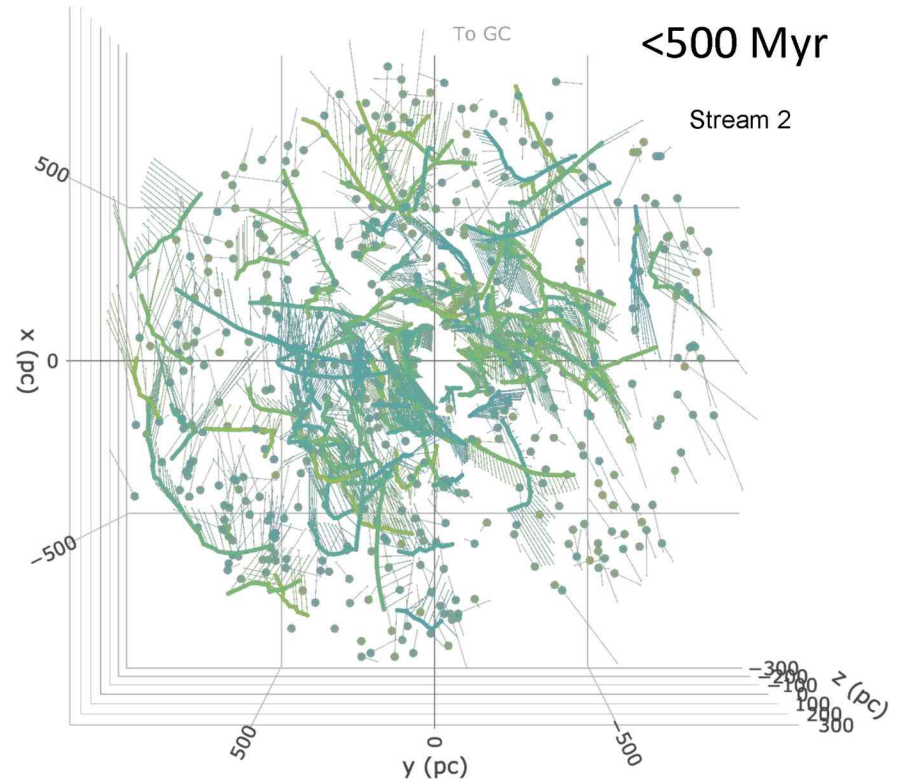
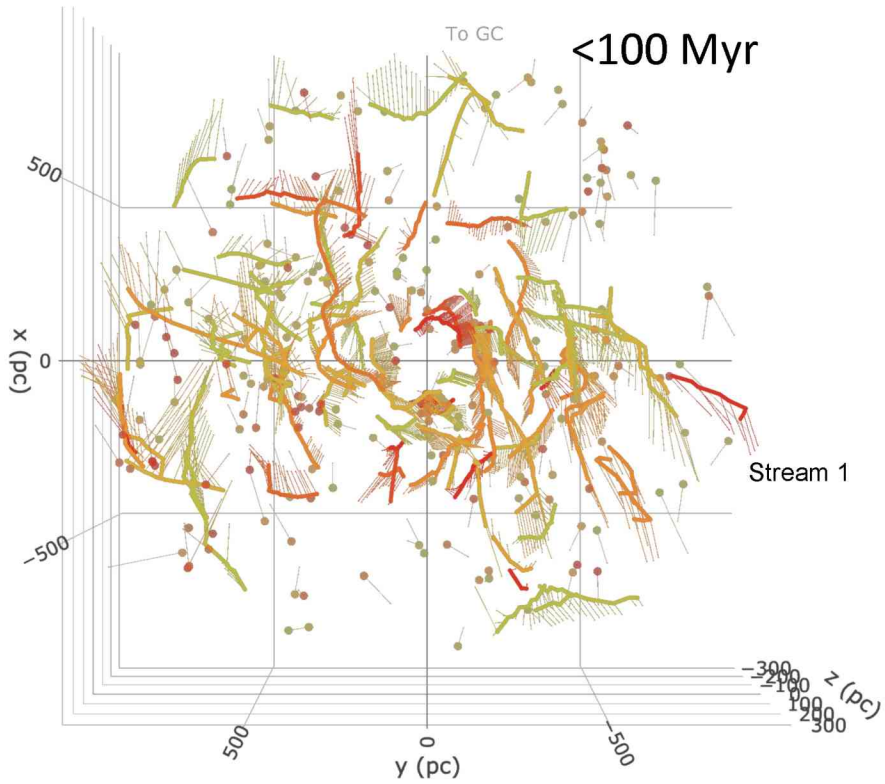
Extended structure within 1 kpc

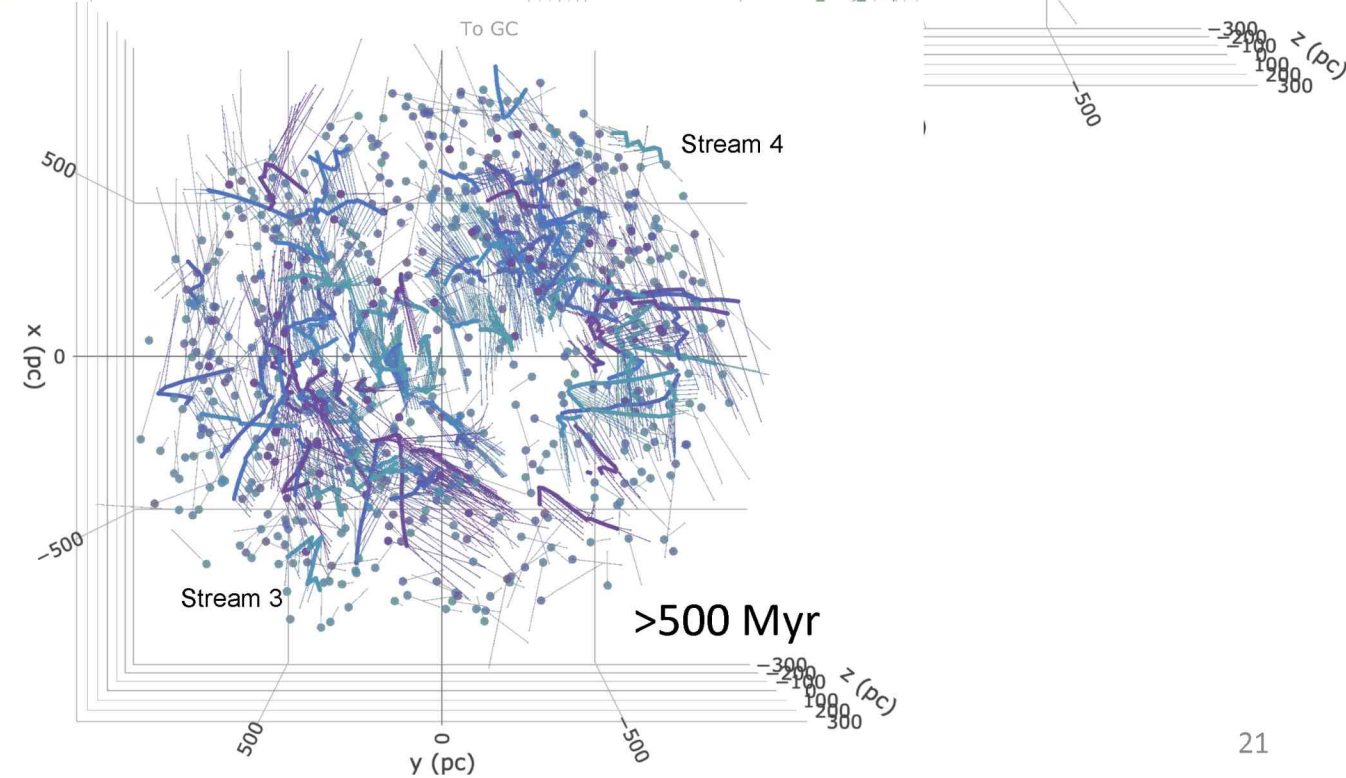
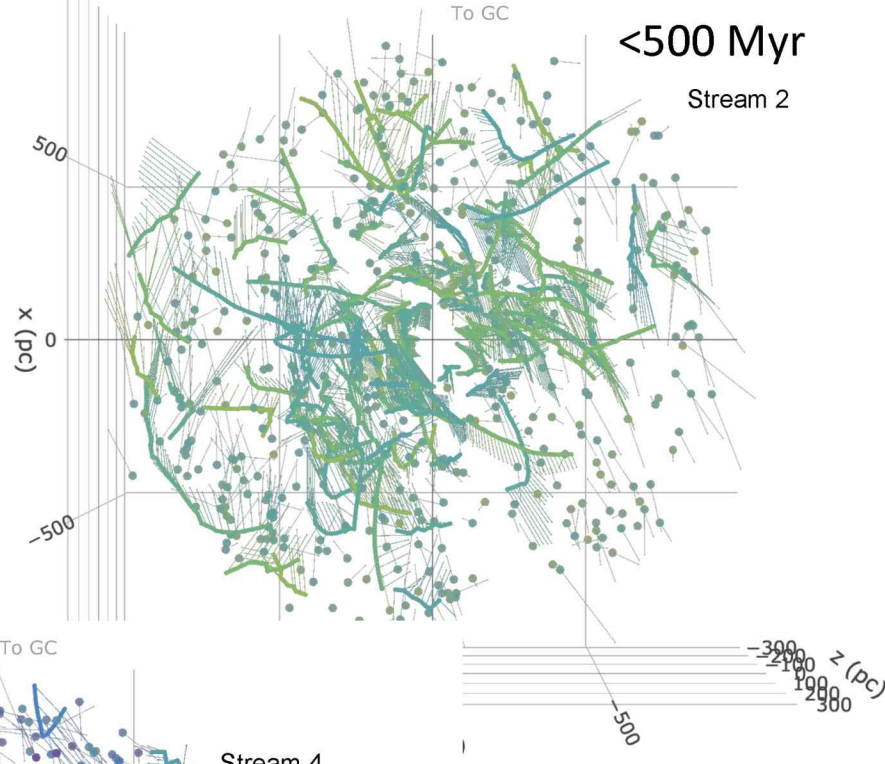
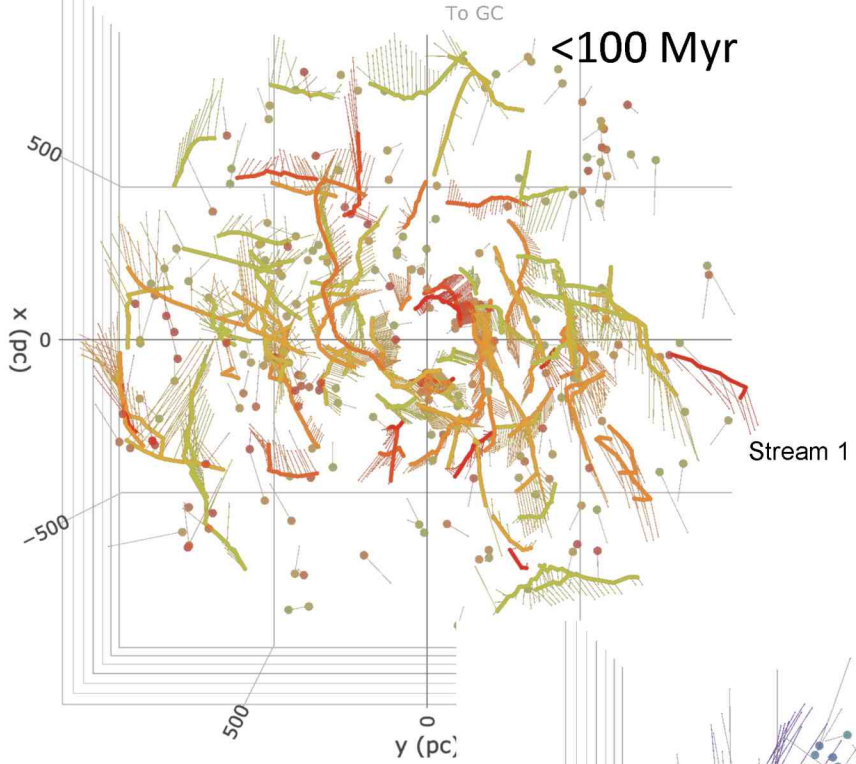


Galactic view



Galactic view





Conclusions

- On average, up to 10 AU, YSO MF is consistent with the field
- YSOs with disks are deficient in SB2s but not RV Vars
- No strong dependence on MF between different regions, or as a function of age
- Companions most common at 25 stars/pc²
- MF increases at higher mass

- Remnants of extended star forming regions can be traced for >100s Myr and provide a significant constraint for the structure and star-forming history of the Milky Way