

Circumstellar discs in the Arches cluster



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The starburst cluster connection

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Circumstellar discs in the Arches cluster

Outline

Proper motion membership

Disc indicators:

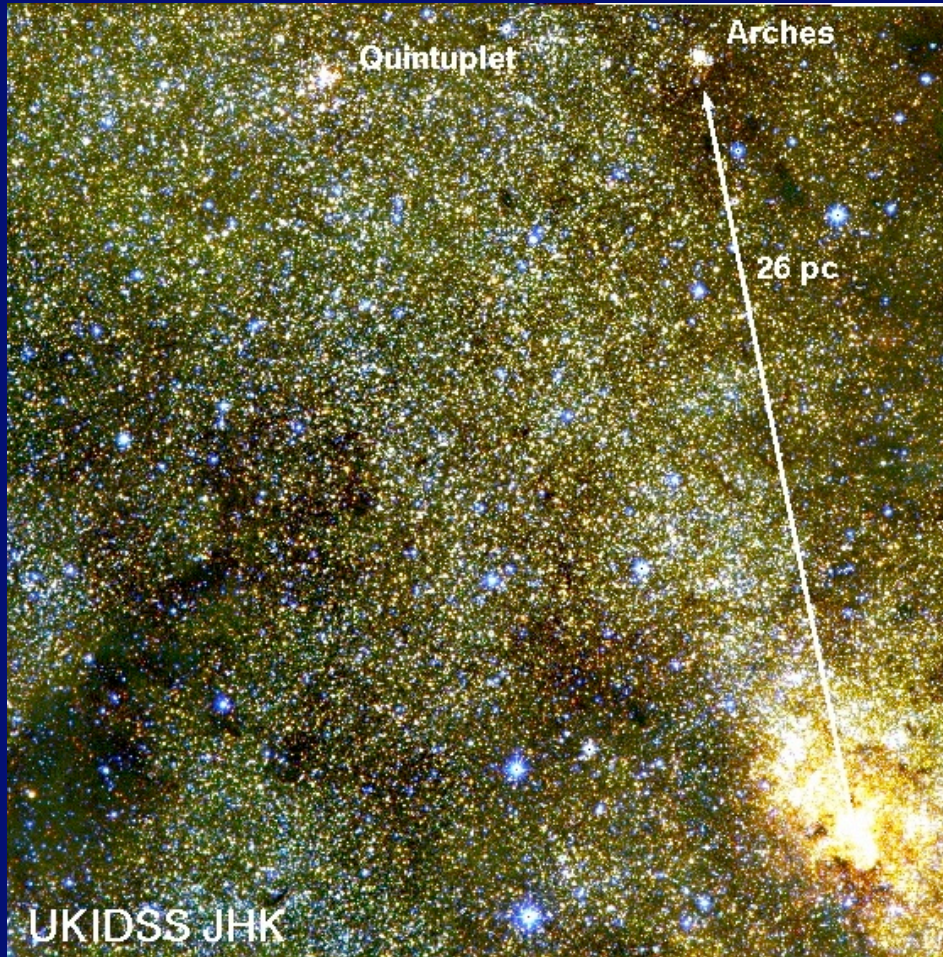
- L-band excess sources
- CO bandhead emission

Herbig Be stars & disc fractions

Summary

Starburst clusters near the Galactic centre

UKIDSS JHK image of the Arches/Quintuplet region



The Arches cluster:

- **> 10,000 solar masses**
- **~120 O-type stars**

Figer et al. 1999, Stolte et al. 2005

- **core density $2 \times 10^5 \text{ Msun/pc}^3$**

Espinoza et al. 2009

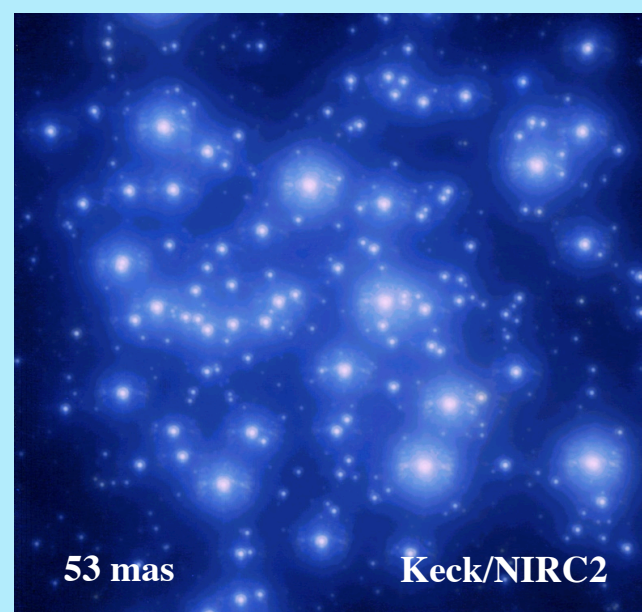
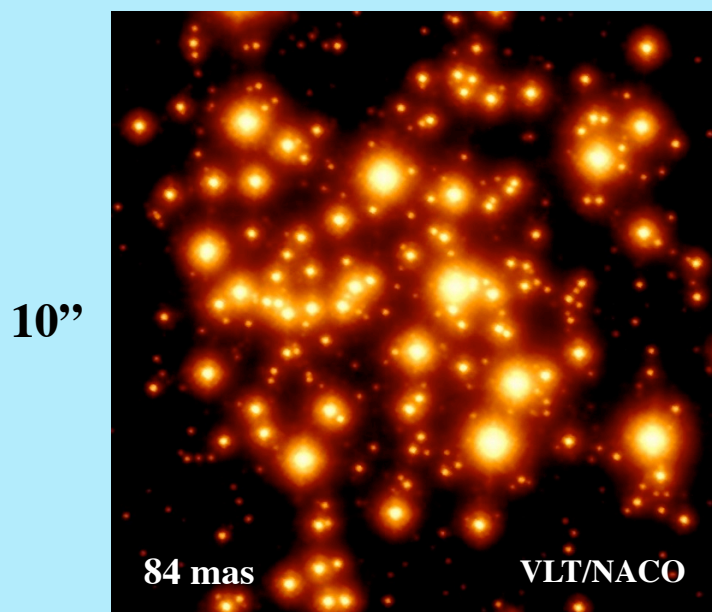
- **age 2.5 Myr**

Martins et al. 2008

The Arches cluster proper motion with Keck and VLT

NGS-AO

LGS-AO



March, 2002

July, 2006

VLT/NAOS-CONICA 84 mas

Keck/NIRC2 LGS 53 mas

faint natural guide star 15.3^m
20 % Strehl

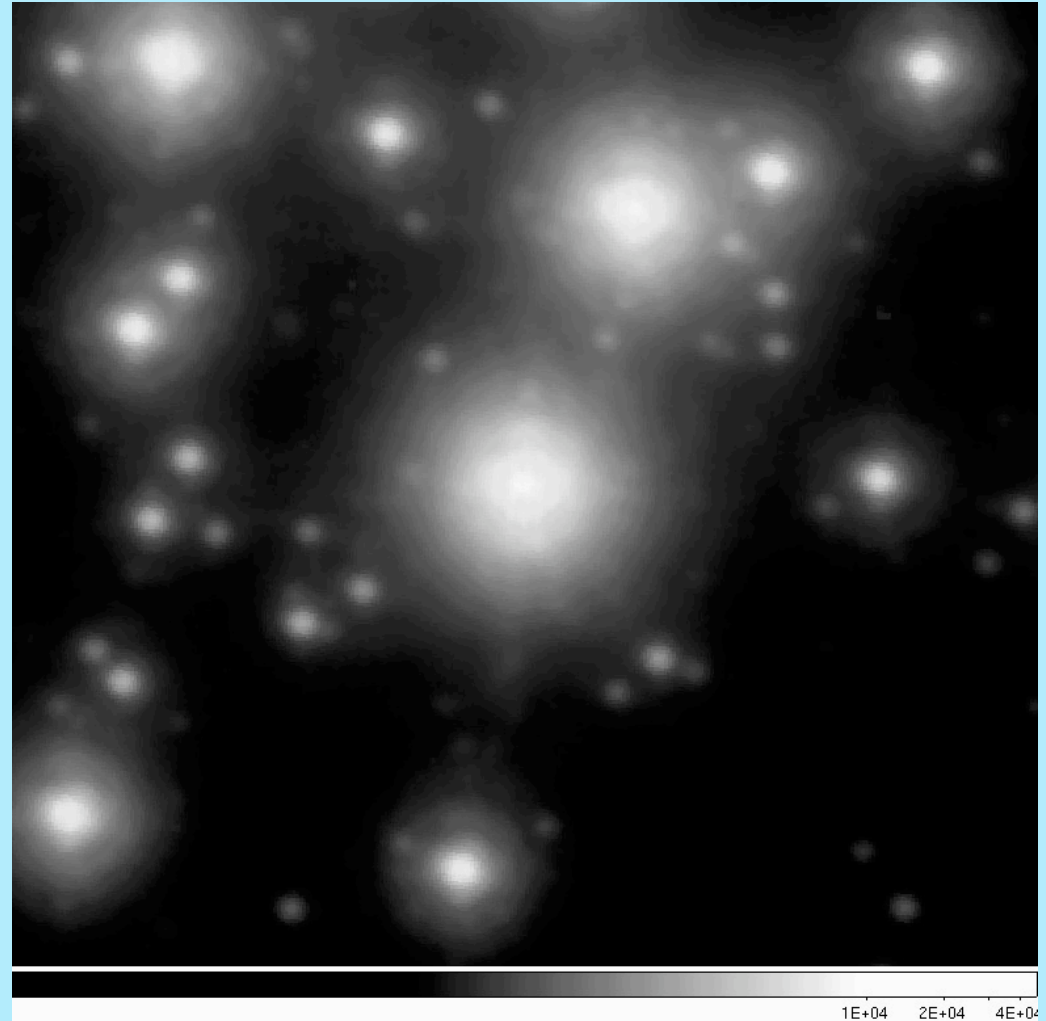
laser guide star 10^m
34 % Strehl

The Arches cluster proper motion with Keck and VLT

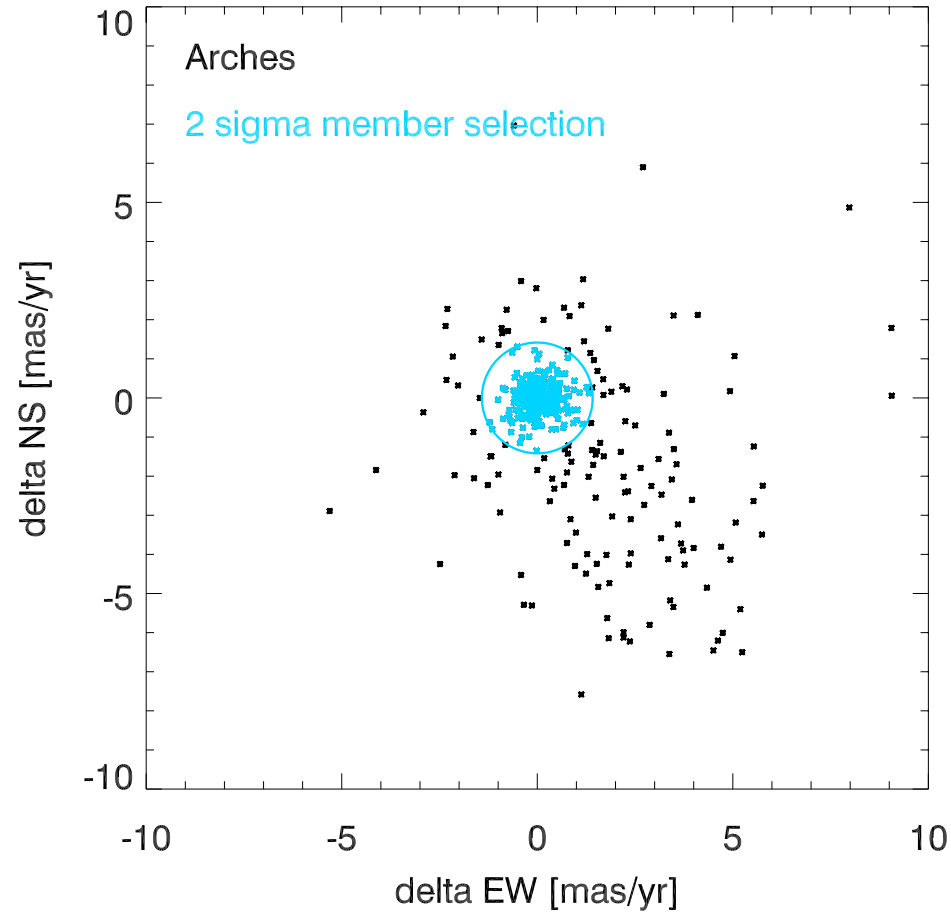
3 epochs

- NACO 2002
- NIRC2 2006
- NIRC2 2008

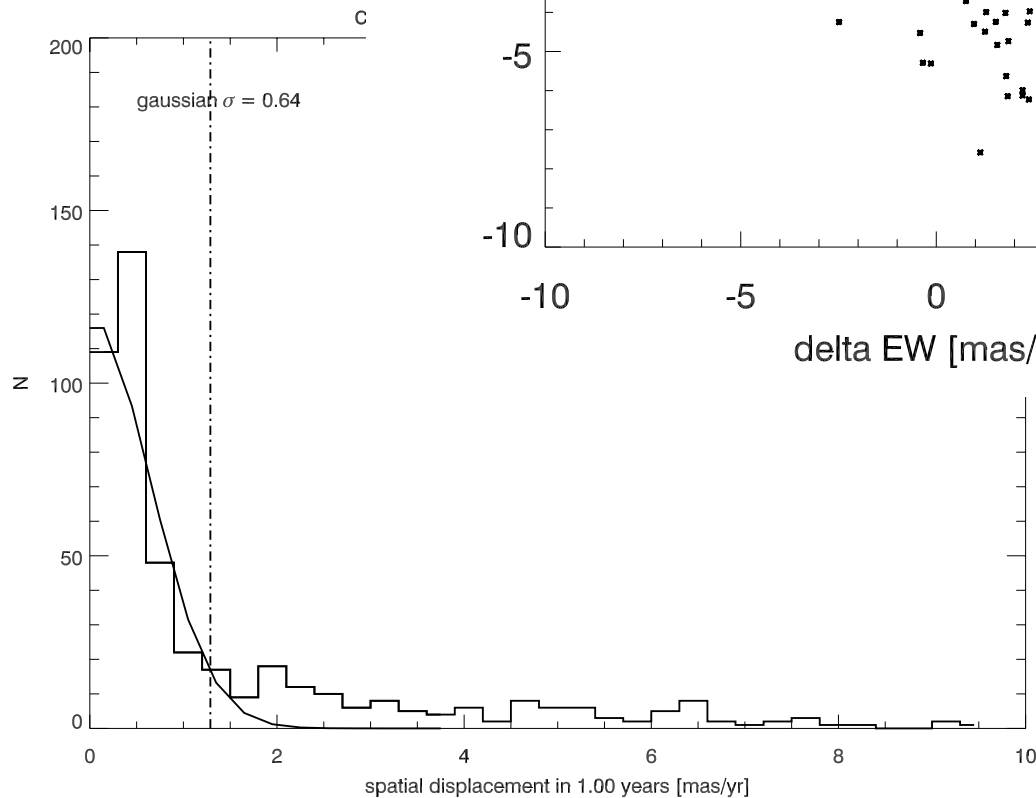
to be continued...



Proper motion membership in the Arches cluster

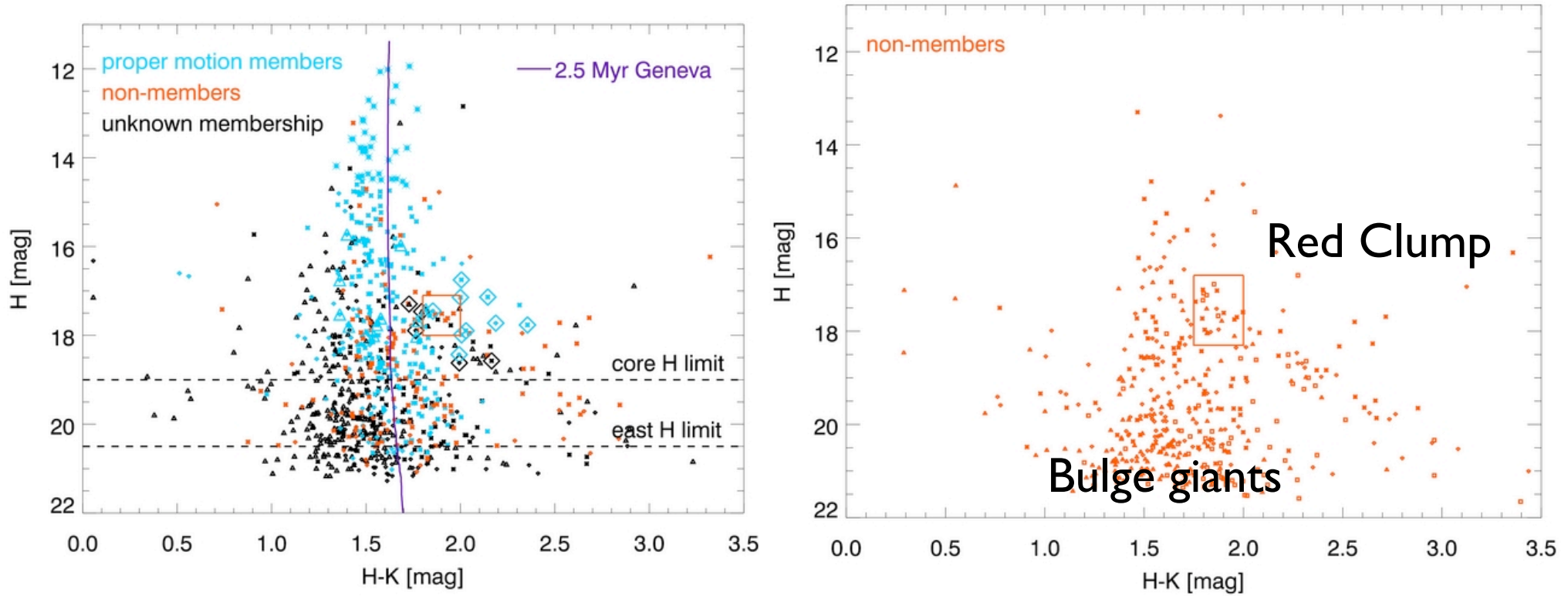


membership can be used to obtain an unbiased sample of cluster stars

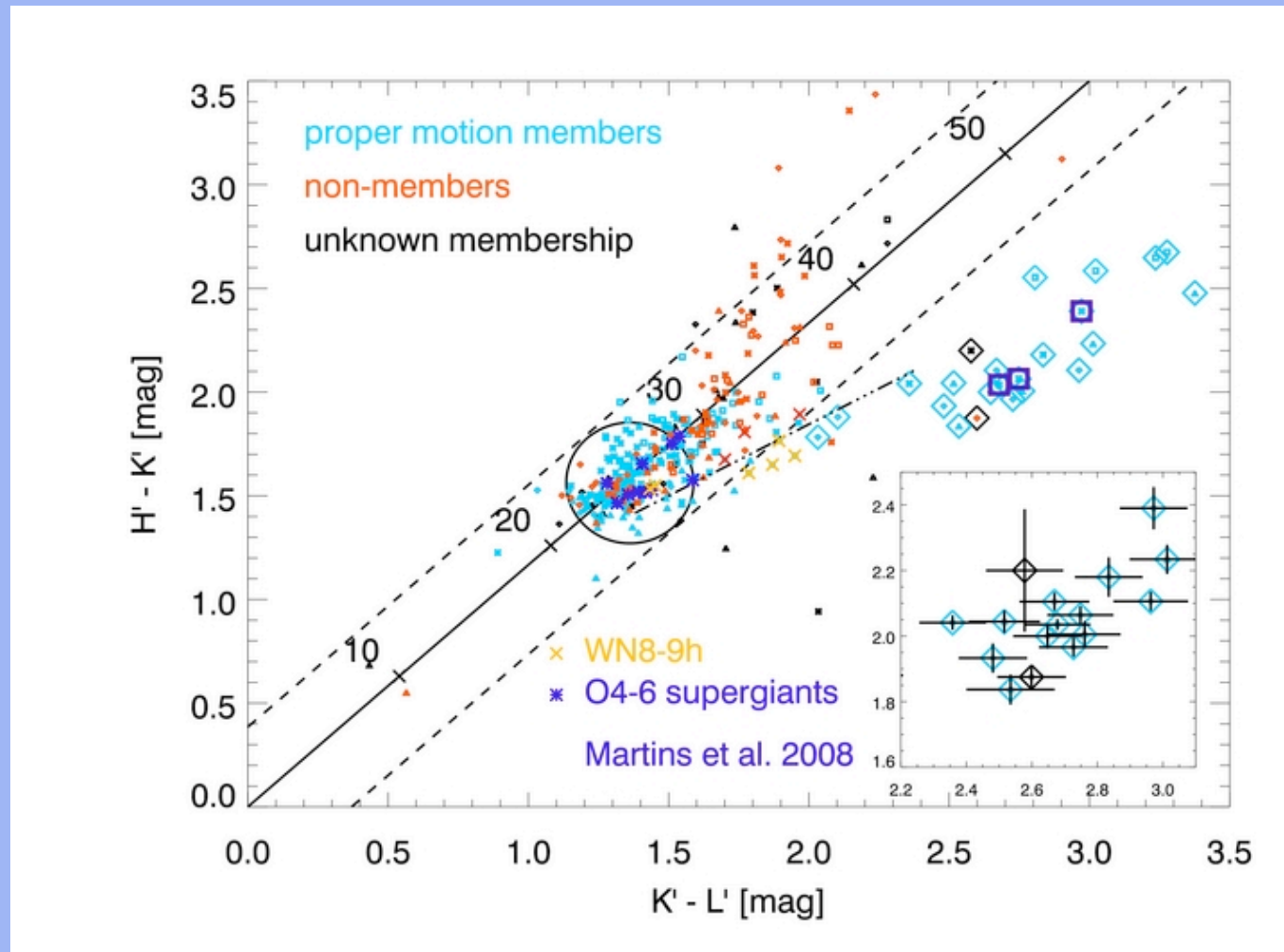


Proper motion membership in the Arches cluster

Efficiently remove red clump stars and bulge giants from the sample

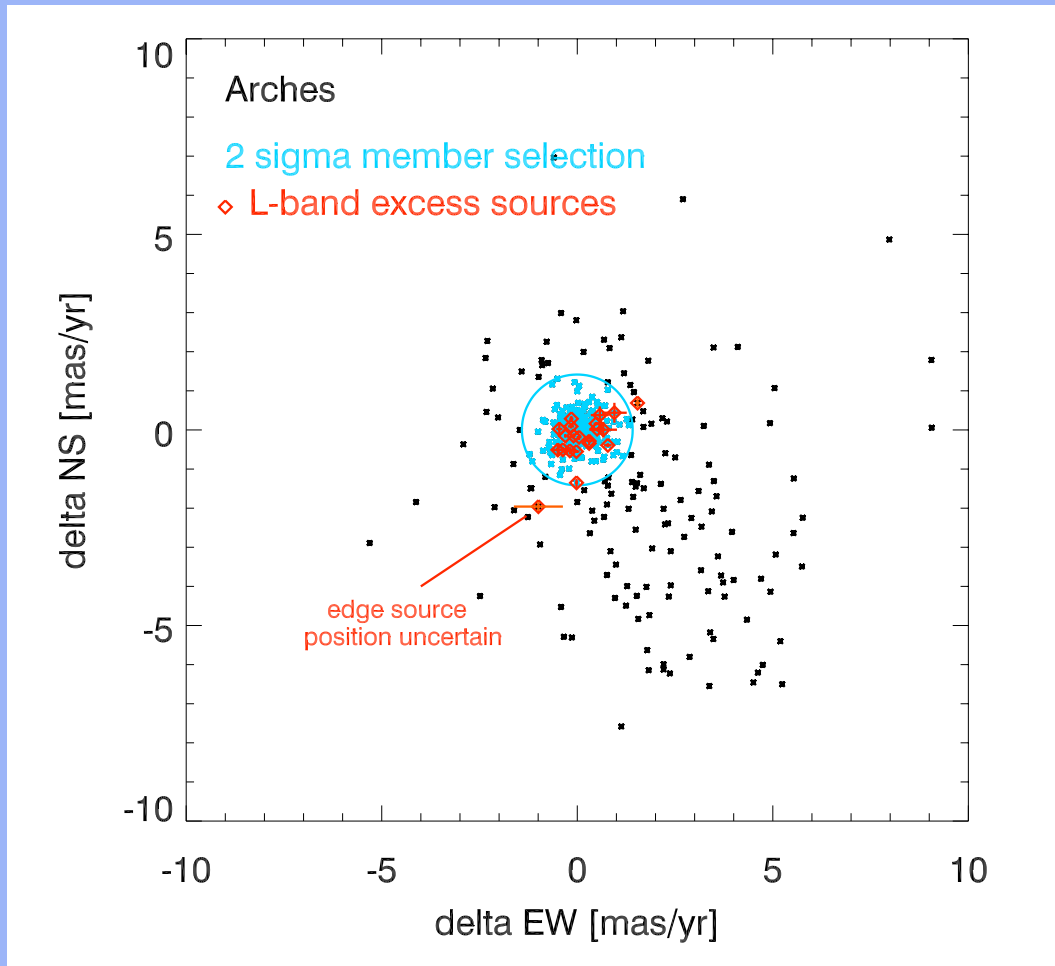


Detection of L-band excess sources... a surprise!



and their relation to the Arches...

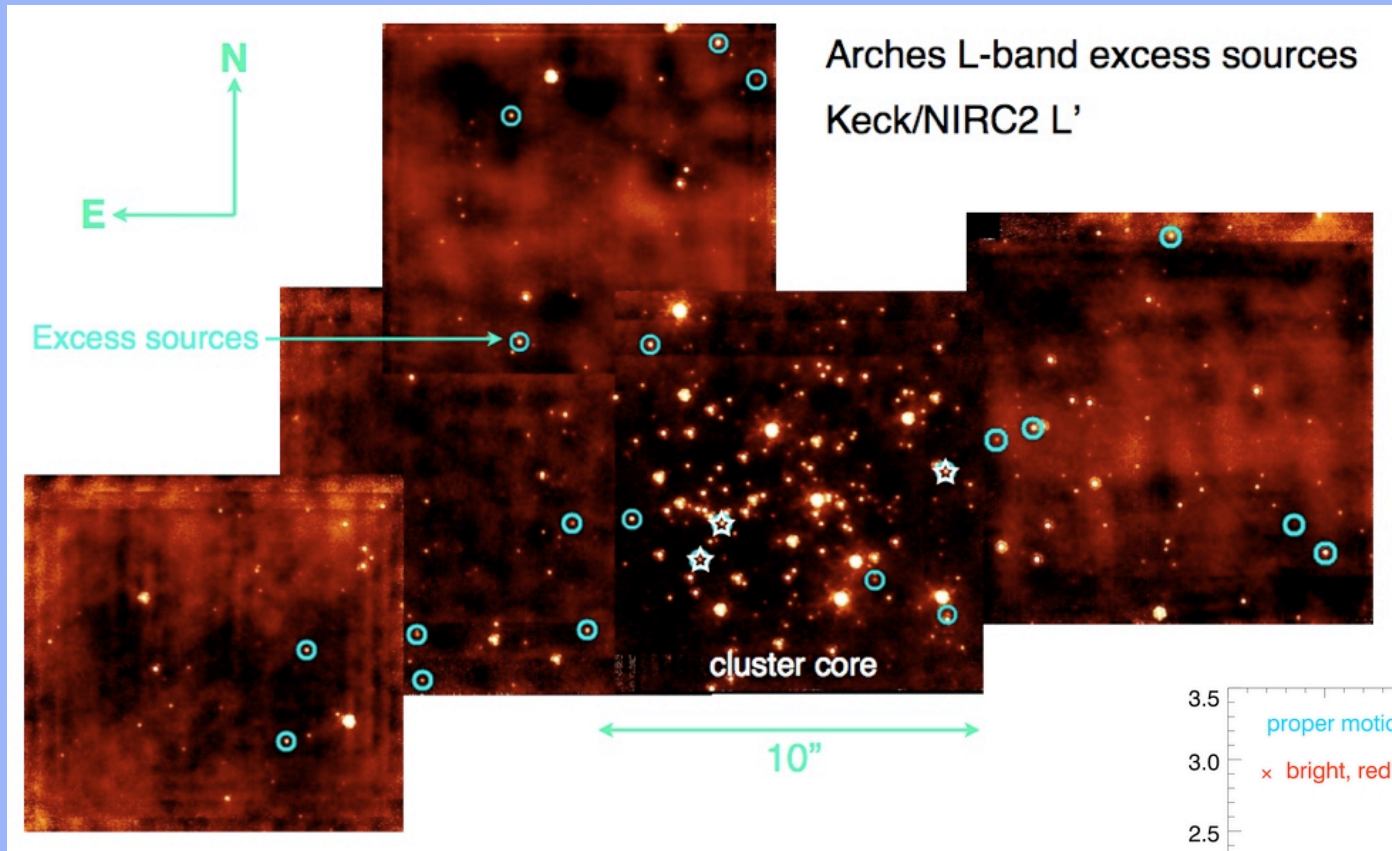
L-band excess sources and proper motion membership



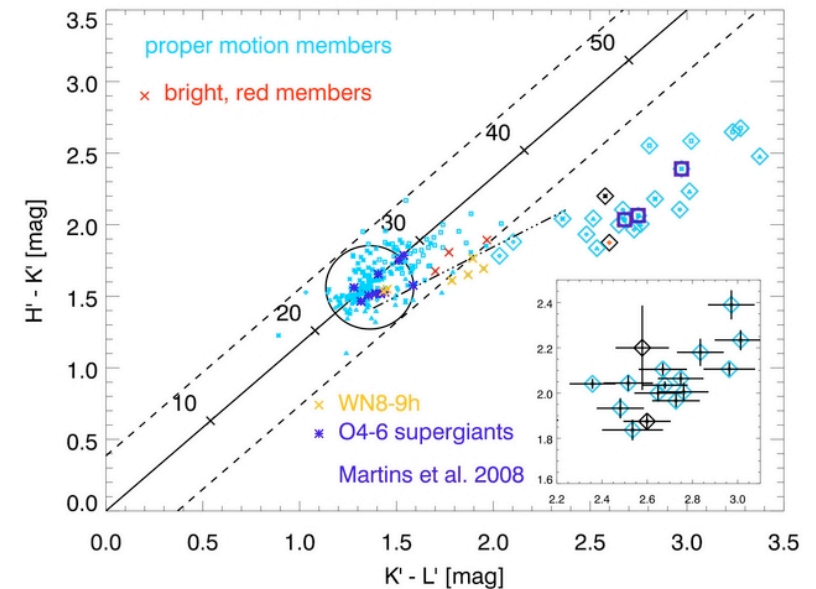
All excess sources with reliable proper motion ARE MEMBERS !!!

Survival of circumstellar discs in starburst clusters

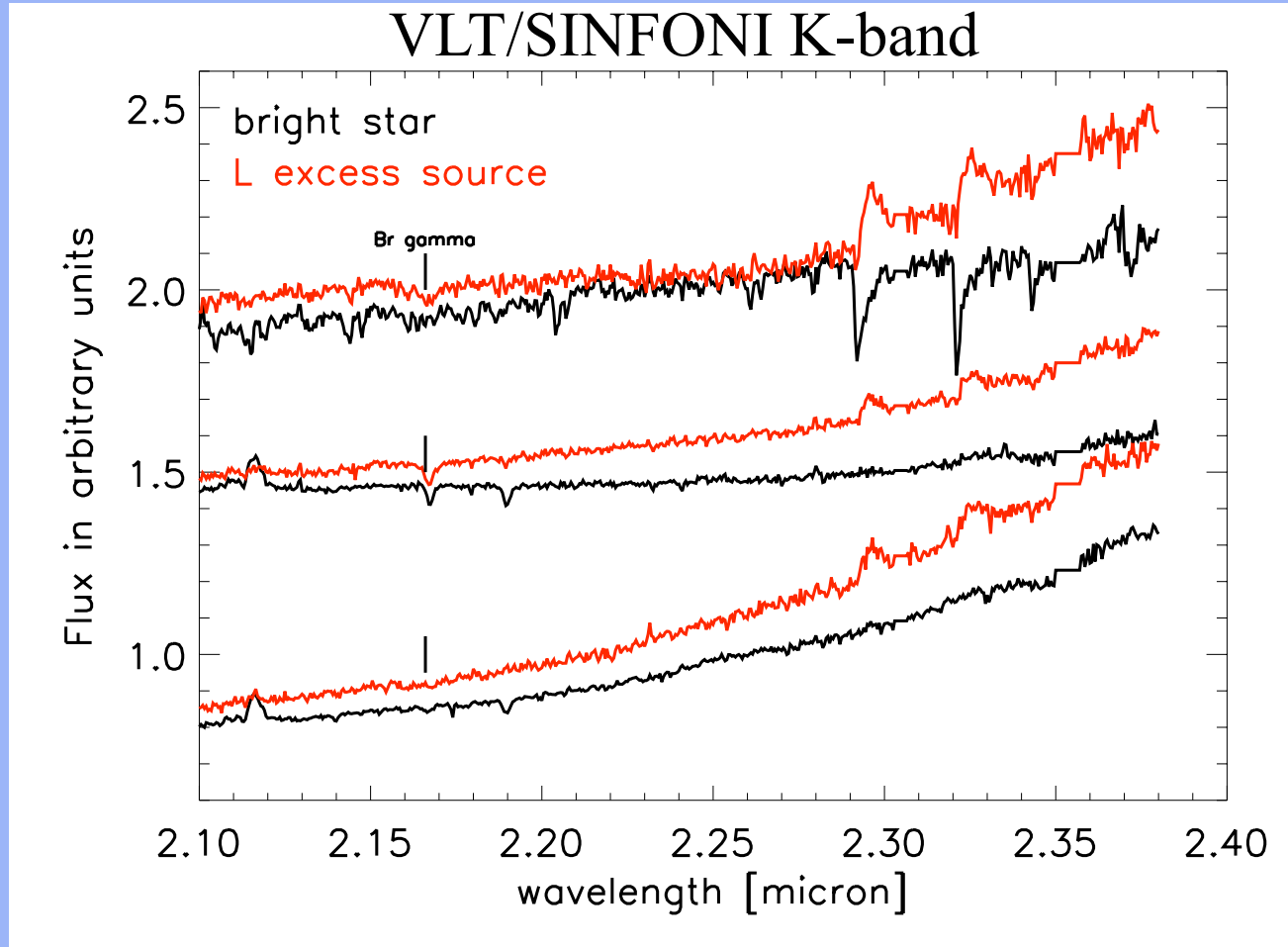
L-band excess sources in the Arches extend far beyond the known terrain



34" ~ 1.3 pc

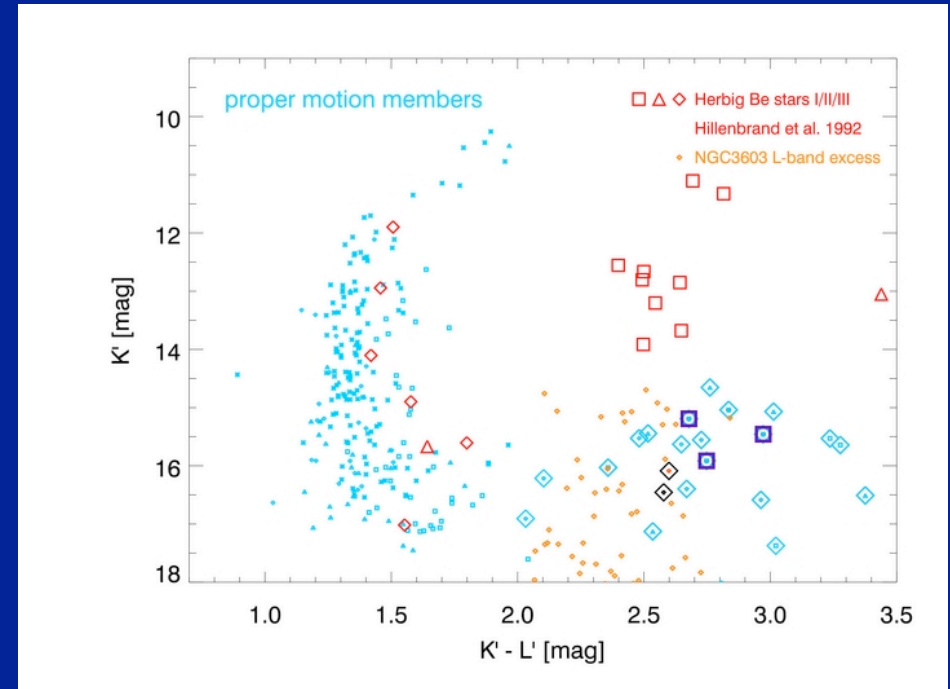
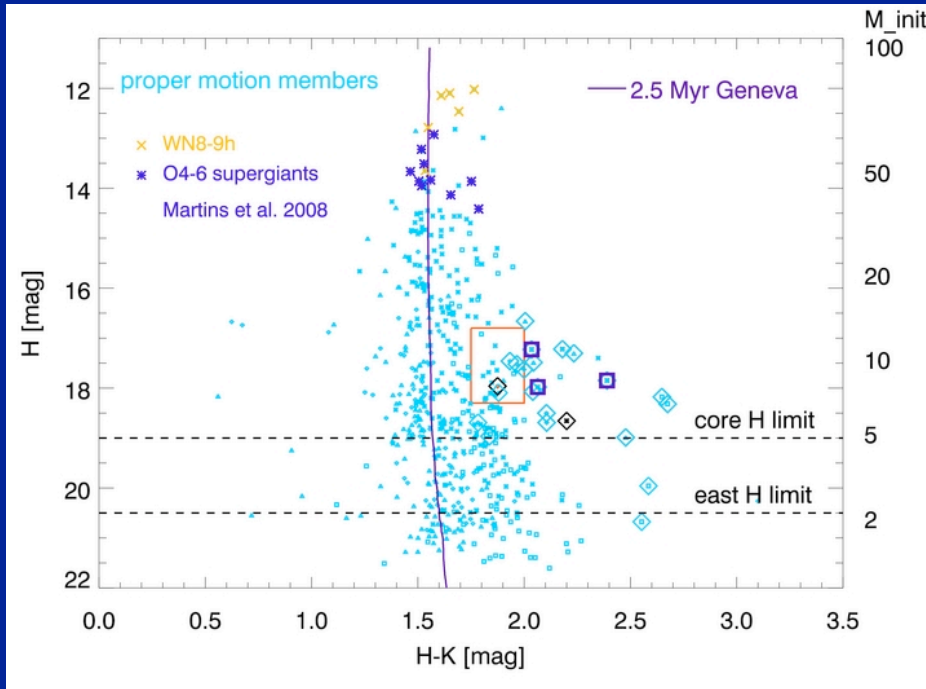


Herbig Be discs in starbursts - a new window to disc evolution



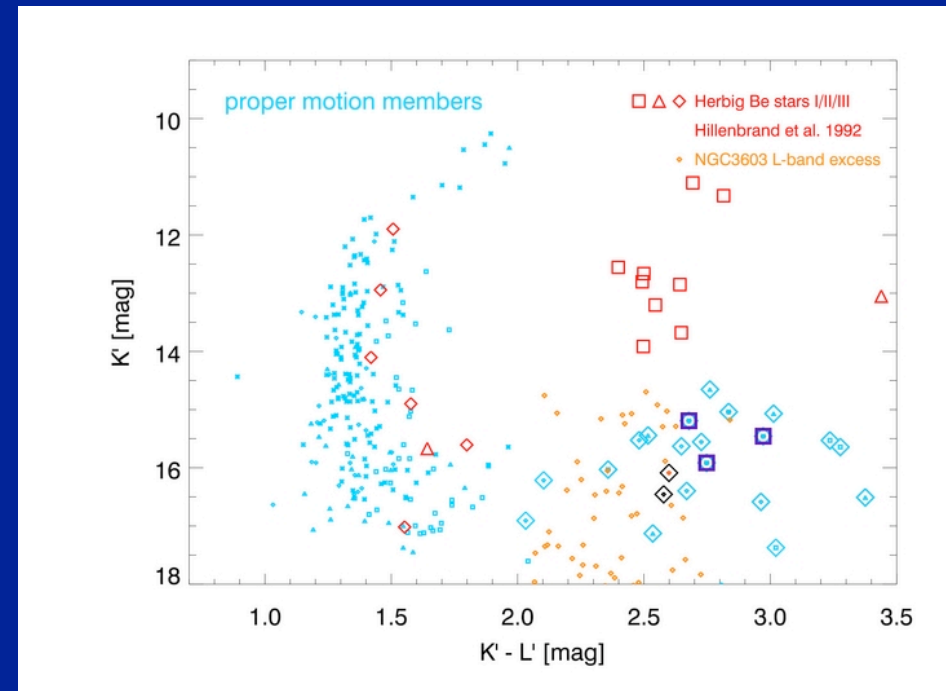
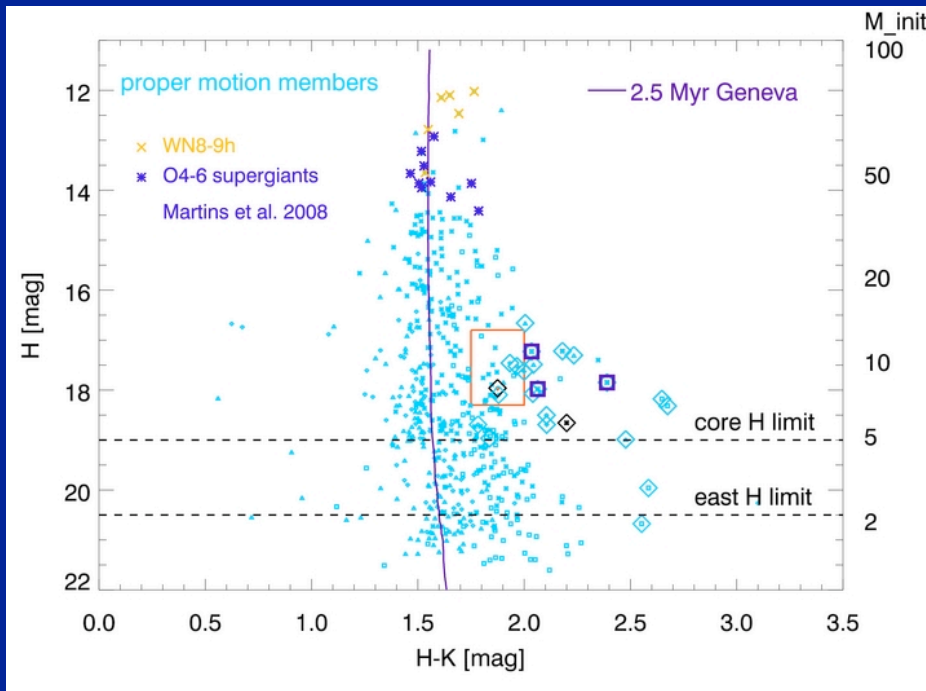
All excess sources with spectra display CO emission !!!

Excess sources are Herbig Be stars



Hillenbrand et al. 1992
Stolte et al. 2004

Excess sources are Herbig Be stars



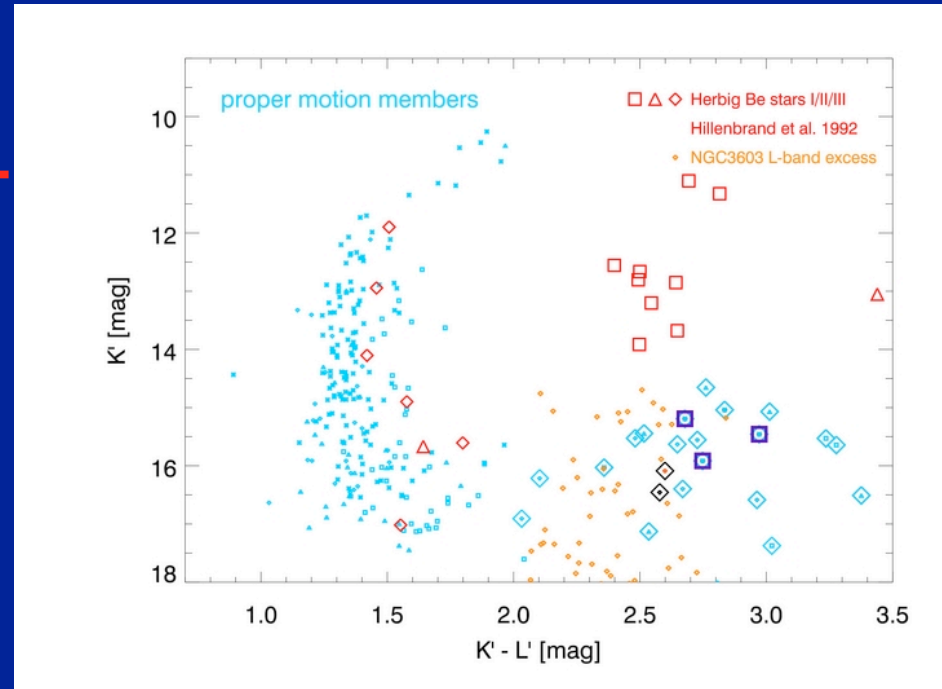
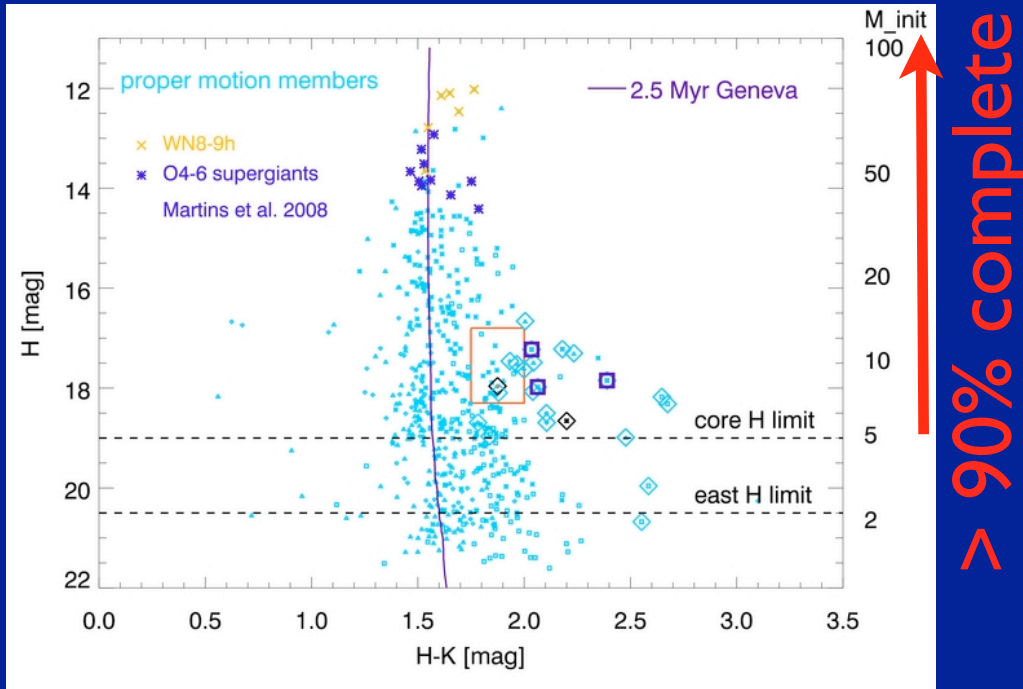
Properties of excess sources:

- $K-L \sim 2.3 - 3.3$ mag
- H mag suggests 3-20 Msun

⇒ Herbig Be stars with massive discs

Hillenbrand et al. 1992
Stolte et al. 2004

Excess sources are Herbig Be stars



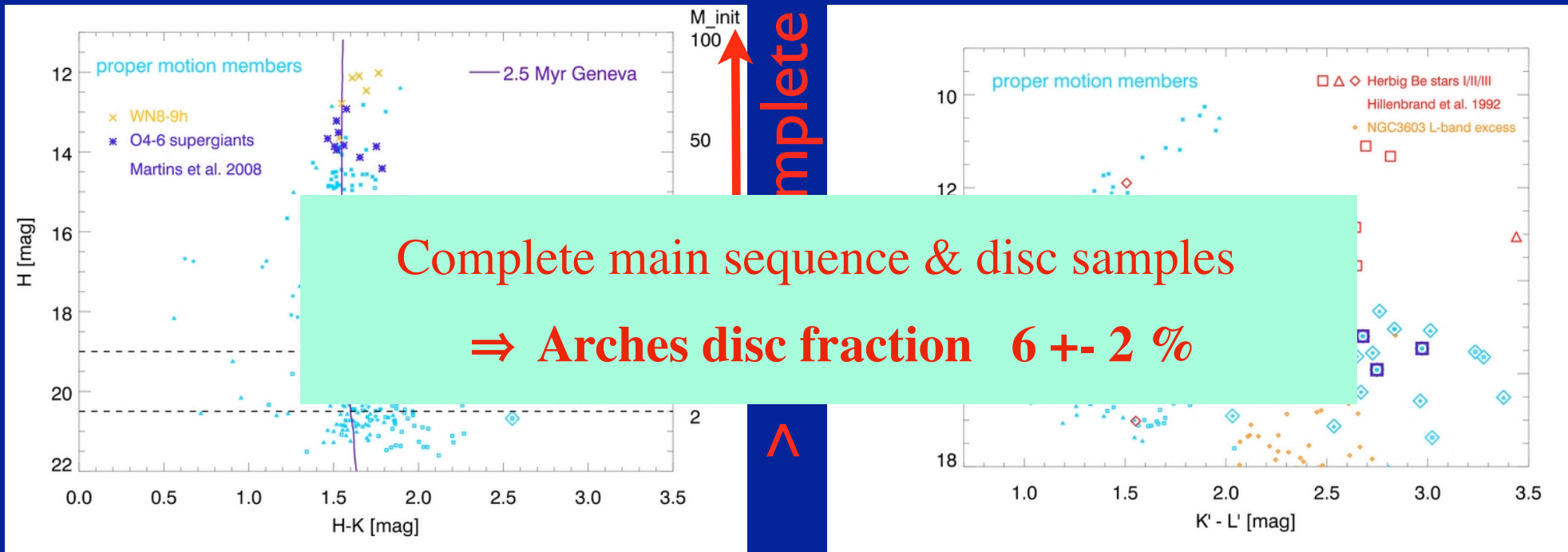
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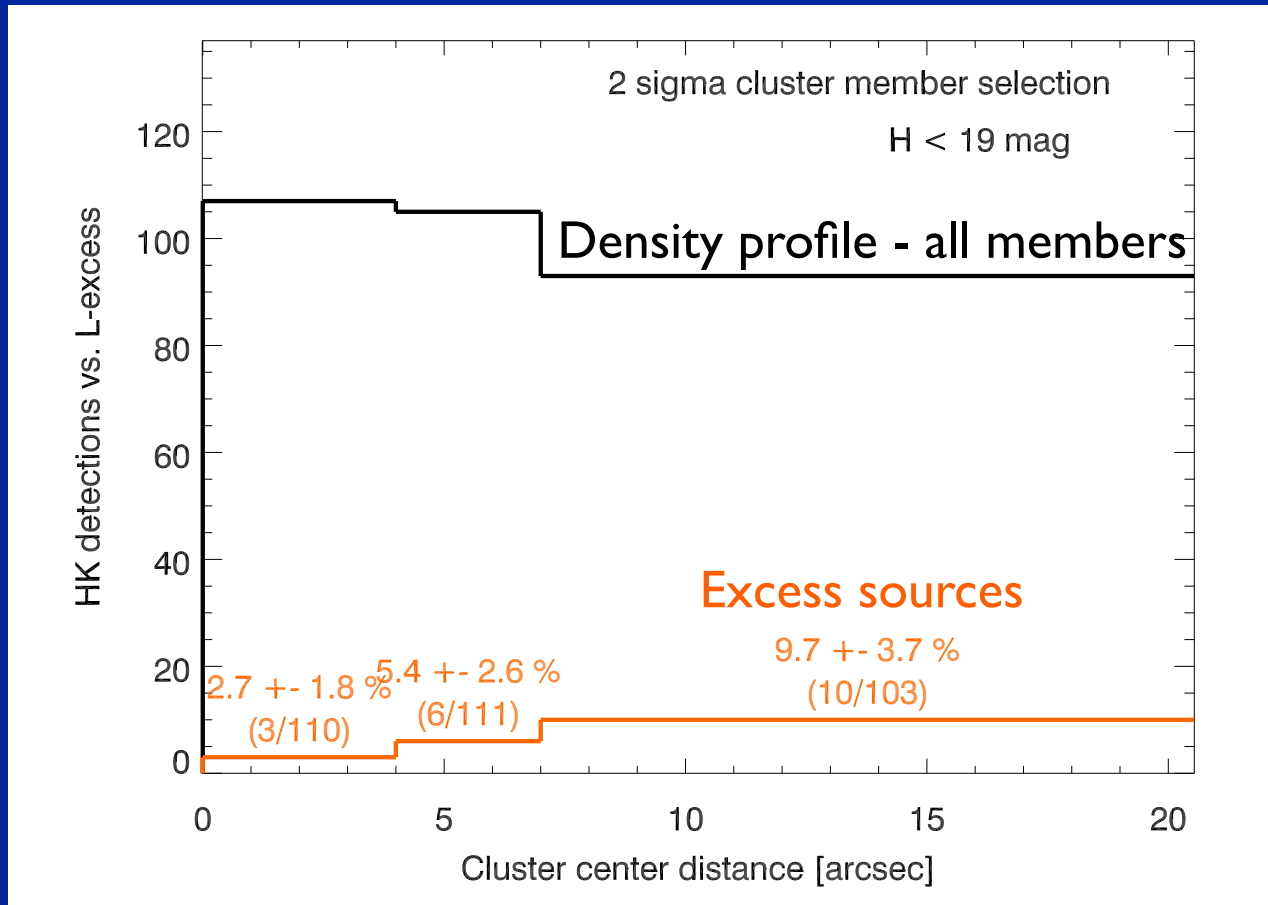
Properties of excess sources:

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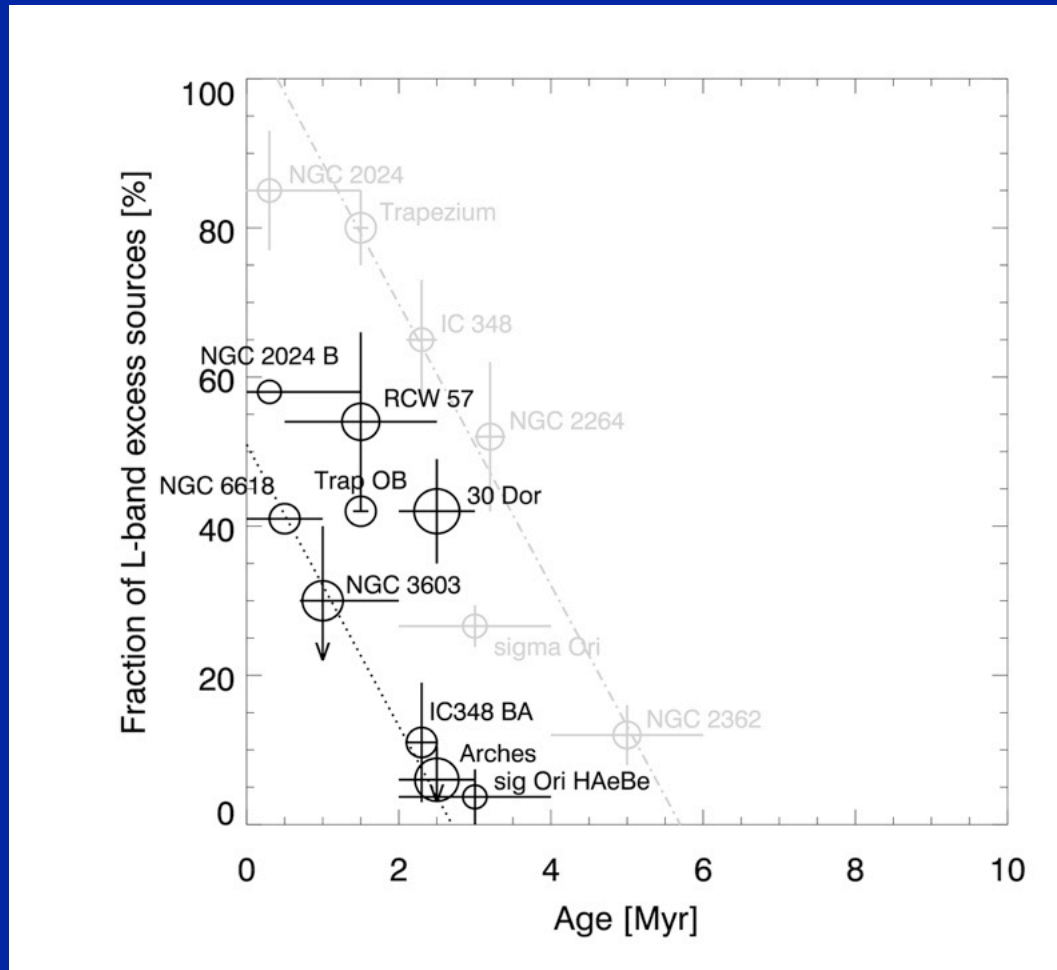
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Preliminary indication of disc depletion in the cluster core...



Do starburst clusters have their own disc depletion timescale ?



Haisch et al. 2001

Hernandez et al. 2007

Hoffmeister et al. 2006

Maercker & Burton 2005

Maercker et al. 2006

Implications:

- low disc fraction at very early ages < 1 Myr => environment?

- the loss rate might be similar to low-density sf regions

=> dictated by the central star ?

Summary

- 1. L-band excess sources in the Arches are circumstellar discs**
 - CO emission = gas content
 - L-band emission = hot dust at inner disc rim
- 2. Disc survival for 2.5 Myr in the densest young Milky Way cluster**
 - even in extreme environments, depletion of the *inner* disk might be dominated by the central star
- 3. Spatial extent suggests we know only a small fraction of the Arches**
 - => extend the HKL survey out to the tidal radius
 - => observe disc fractions in several starburst clusters

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Thanks !!!