Cl1813-178: A new young massive stellar cluster in the Milky Way
&
Identification of new massive stars

Maria Messineo

MPIfR (Bonn)

A new massive cluster: Cl 1813-178

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MASSIVE STARS IN THE Cl 1813-178 CLUSTER: AN EPISODE OF MASSIVE STAR FORMATION IN THE W33 COMPLEX

Maria Messineo[1,2], Ben Davies[3,4,5], Donald F. Figer[3], R. P. Kudritzki[6,7], Elena Valenti[8], Christine Trombley[3], F. Najarro[9], and R. Michael Rich[10]

[1] European Space Agency (ESA), The Astrophysics and Fundamental Physics Missions Division, Research and Scientific Support Department, Directorate of Science and Robotic Exploration, ESTEC, Postbus 299, 2200 AG Noordwijk, The Netherlands; messineo@mpifr-bonn.mpg.de
[2] Max-Planck-Institut fuer Radioastronomie, Auf dem Huegel 69, D-53121 Bonn, Germany
[3] Center for Detectors, Rochester Institute of Technology, 74 Lomb Memorial Drive, Rochester, NY 14623, USA
[4] School of Physics & Astronomy, University of Leeds, Woodhouse Lane, Leeds LS2 9JT, UK
[5] Institute of Astronomy, University of Cambridge, Madingley Road, Cambridge CB3 0HA, UK
[6] Institute for Astronomy, University of Hawaii, 2680 Woodlawn Drive, Honolulu, HI 96822, USA
[7] Max-Planck-Institute for Astrophysics, Karl-Schwarzschild-Str. 1, 85748 Garching, Germany
[8] European Southern Observatory, Karl Schwarzschild-Strasse 2, D-85748 Garching bei Munchen, Germany
[9] Centro de Astrobiología (CSIC-INTA), Ctra. de Torrejón a Ajalvir km4, 28850, Torrejónde Ardoz, Madrid, Spain
[10] Physics and Astronomy Building, 430 Portola Plaza, Box 951547, Department of Physics and Astronomy, University of California, Los Angeles, CA 90095-1547, USA

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ABSTRACT

Young massive ($M > 10^4\,M_\odot$) stellar clusters are a good laboratory to study the evolution of massive stars. Only a dozen of such clusters are known in the Galaxy. Here, we report about a new young massive stellar cluster in the Milky Way. Near-infrared medium-resolution spectroscopy with UIST on the UKIRT telescope and NIRSPEC on the Keck telescope, and X-ray observations with the *Chandra* and *XMM* satellites, of the Cl 1813-178 cluster confirm a large number of massive stars. We detected 1 red supergiant, 2 Wolf-Rayet stars, 1 candidate luminous blue variable, 2 OIf, and 19 OB stars. Among the latter, twelve are likely supergiants, four giants, and the faintest three dwarf stars. We detected post-main-sequence stars with masses between 25 and 100 $M_\odot$. A population with age of 4–4.5 Myr and a mass of $\sim$10,000 $M_\odot$ can reproduce such a mixture of massive evolved stars. This massive stellar cluster is the first detection of a cluster in the W33 complex. Six supernova remnants and several other candidate clusters are found in the direction of the same complex.

Key words: infrared: stars – stars: evolution

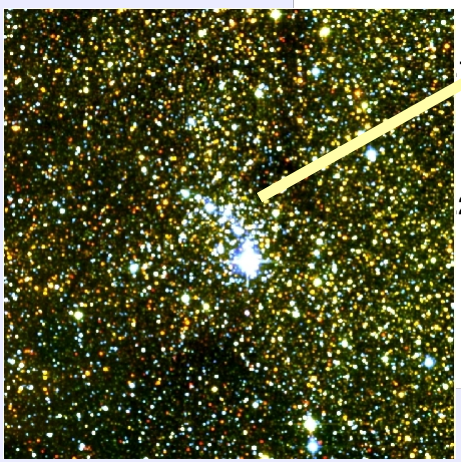
Online-only material: color figures

1. INTRODUCTION

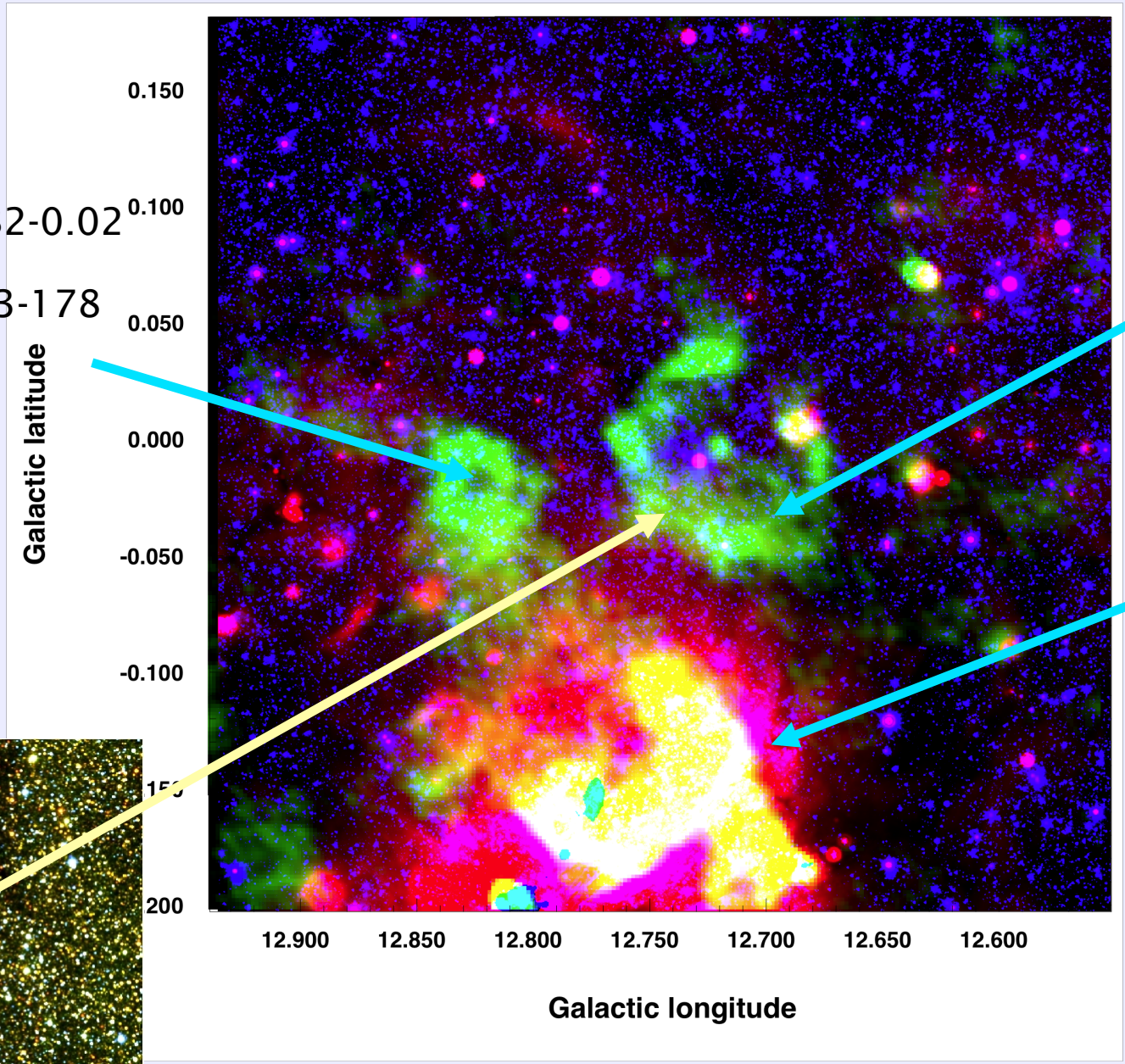
An understanding of the mechanisms of formation, evolution, and end state of massive stars is fundamental for the studies of

with the TeV γ-ray source HESS J1813−178. Interestingly, the W33 complex appears to contain several other candidate stellar clusters and several SNRs. Clusters do form in large complexes (e.g., Beuther et al. 2007), and their spatial distribution varies

Cl 1813-178



2MASS



SNR G12.82-0.02

HESS J1813-178

SNR G12.72-0.0

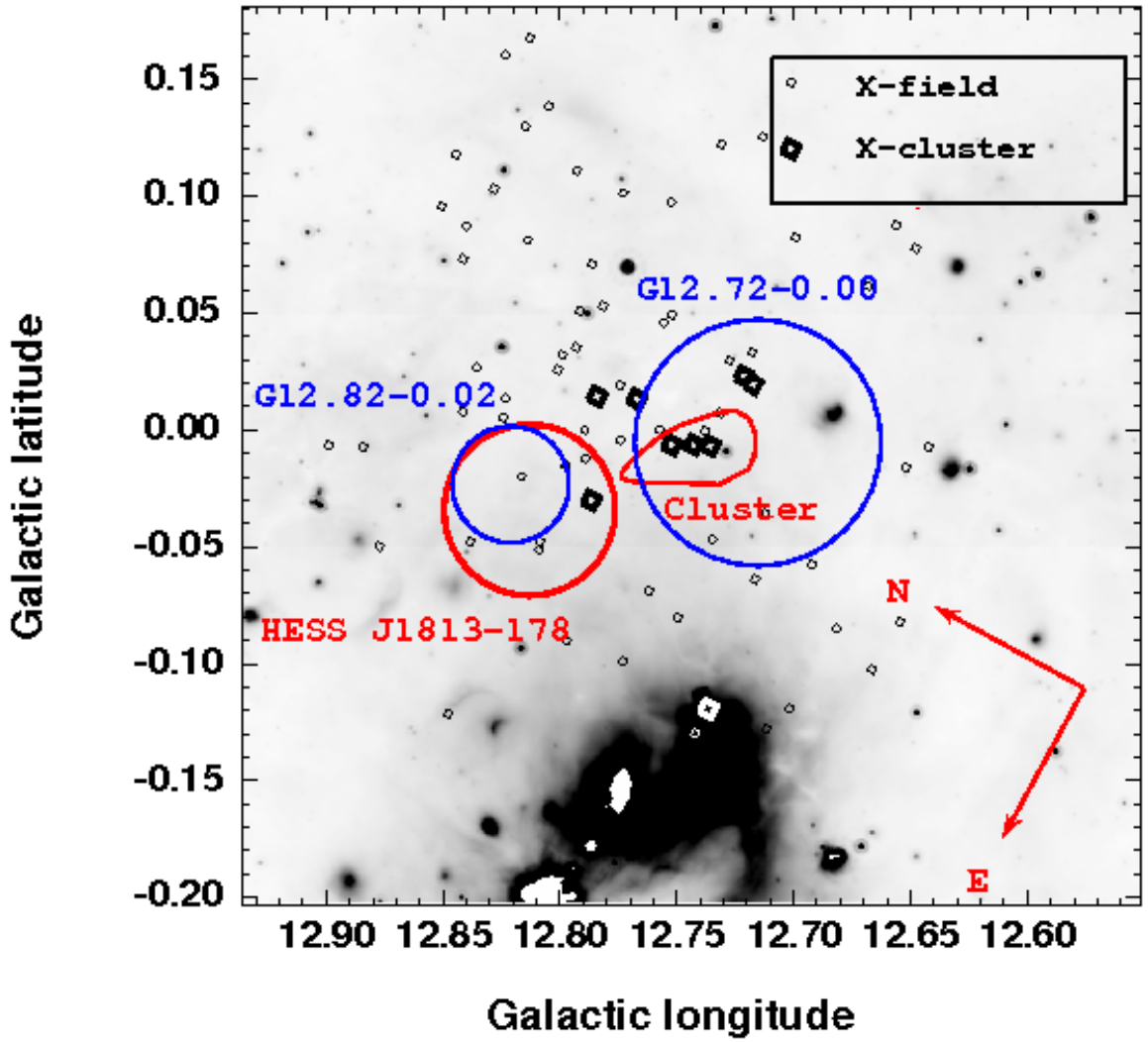
W33

3.6 um

8 um

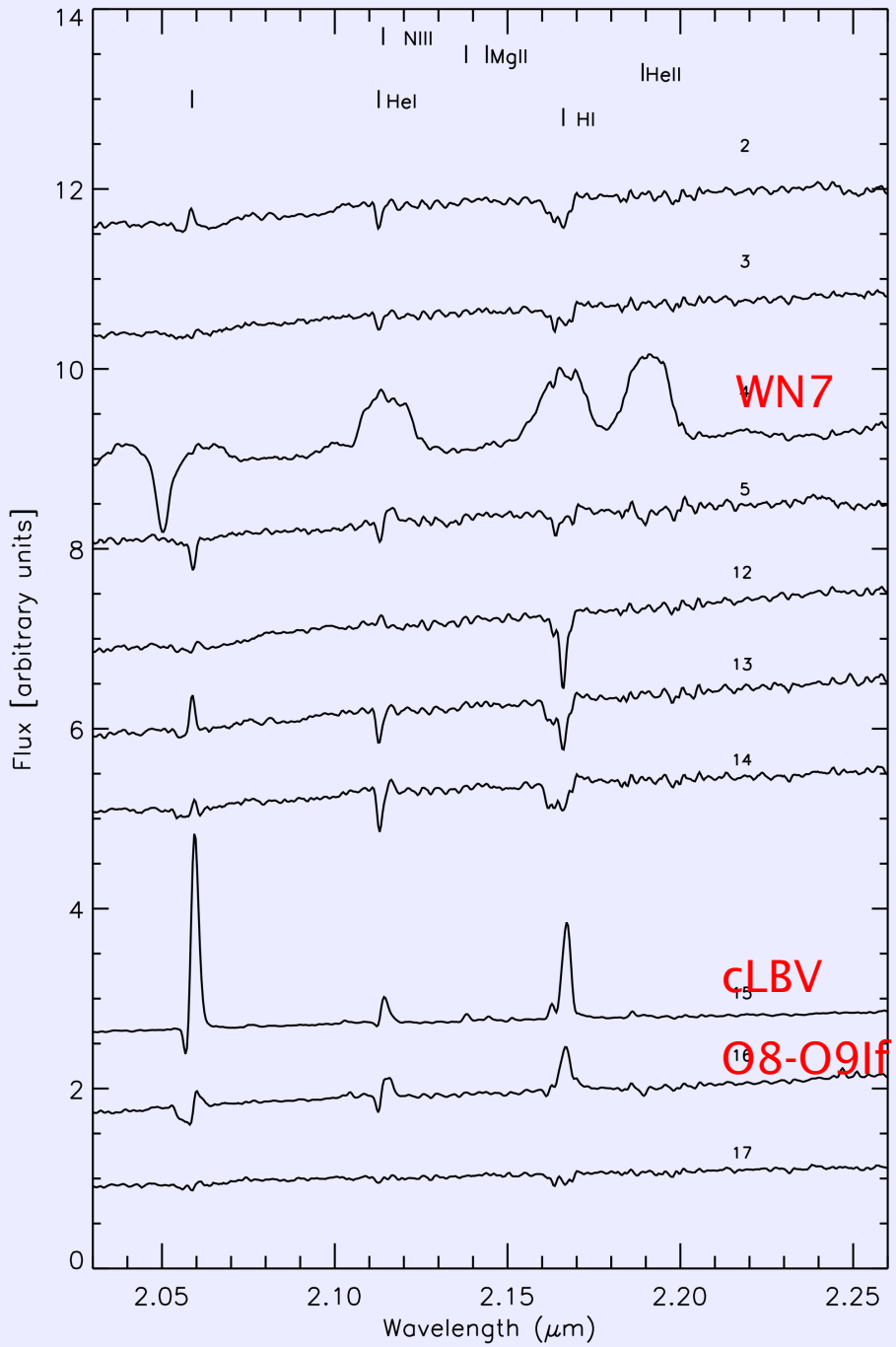
90 cm

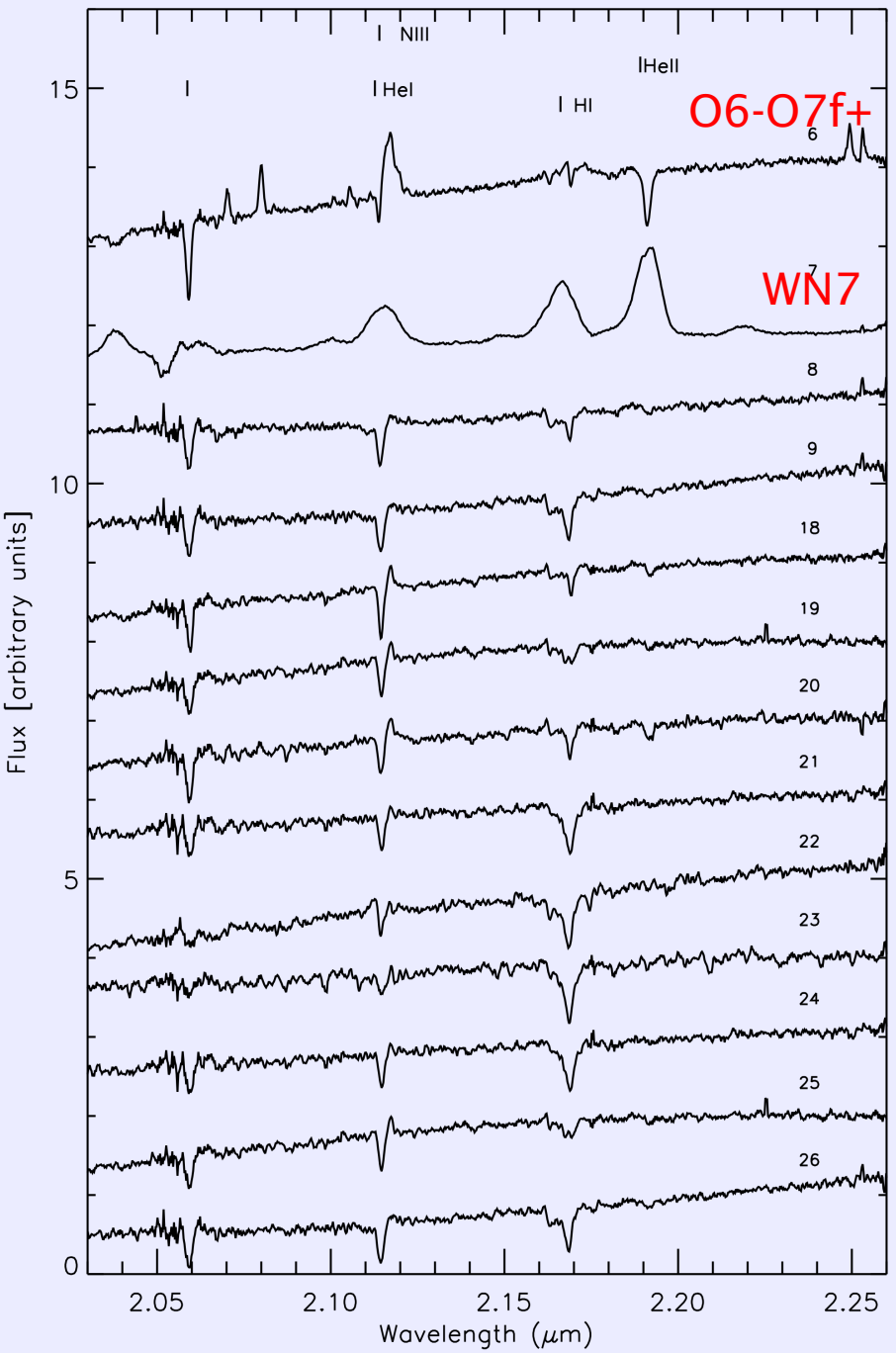
Cl 1813-175



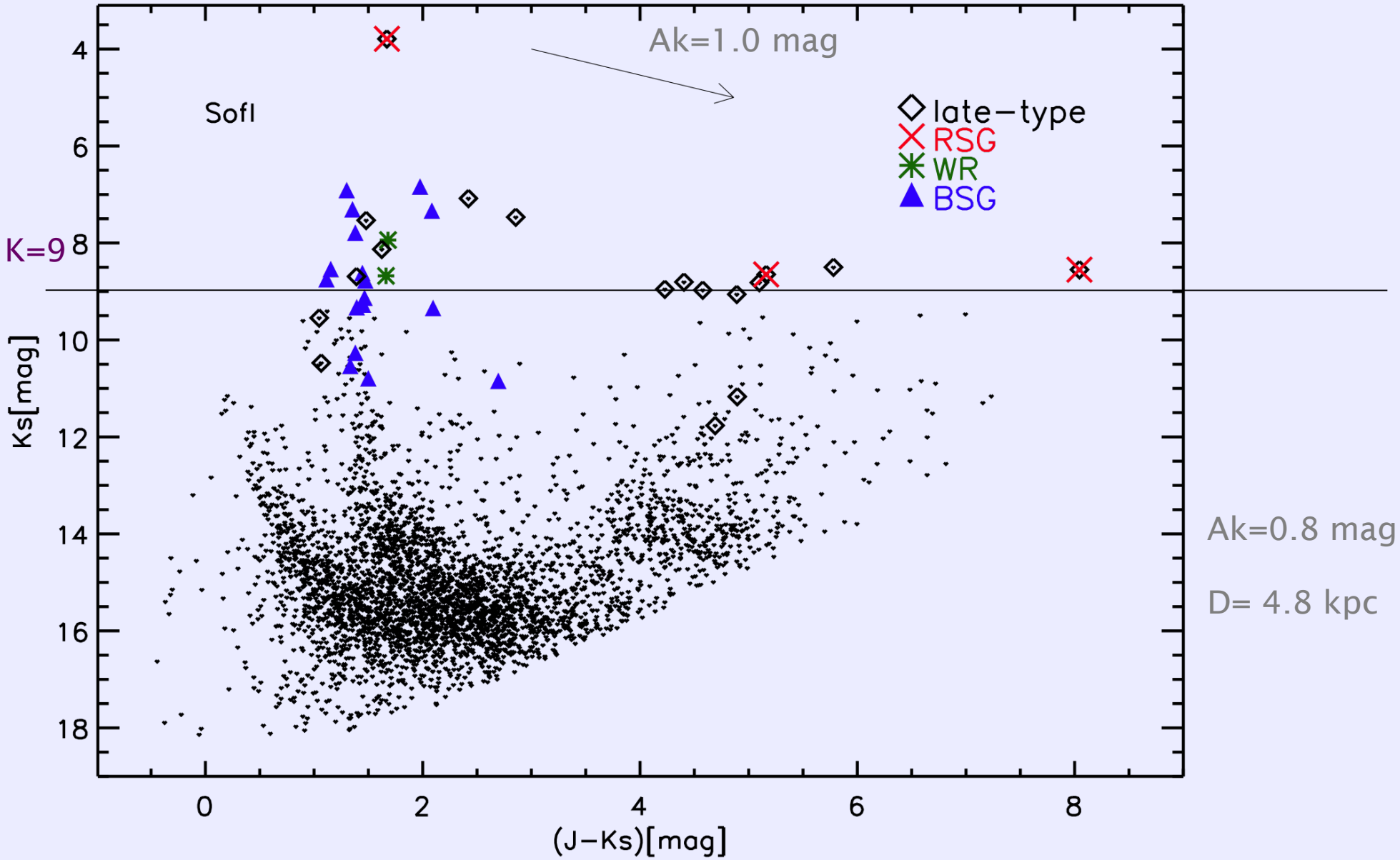
74 Chandra point sources from Helfand et al. (2007)

All but one new detections.

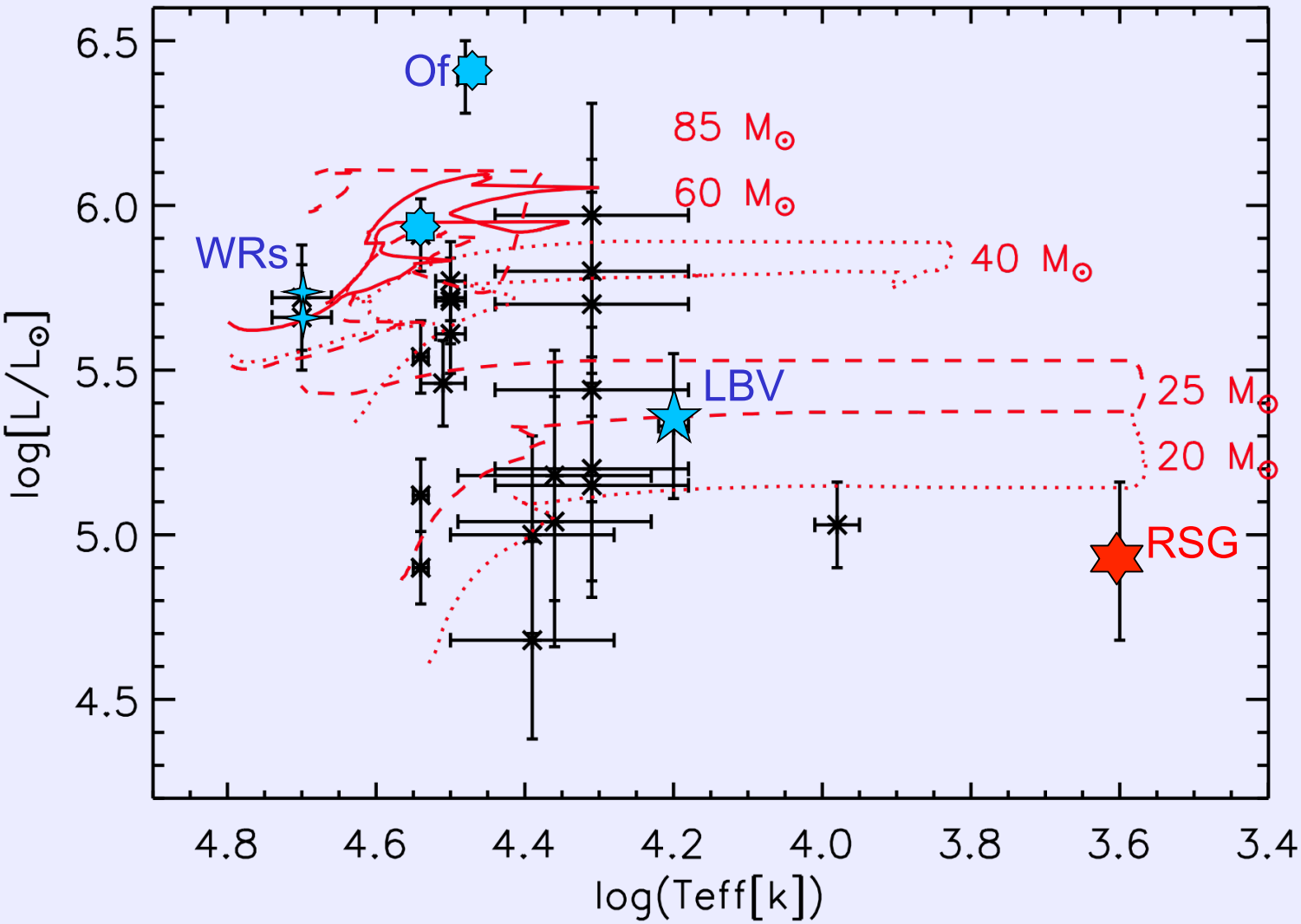




Cl 1813-178


Ak=1.0 mag
SofI
late−type
RSG
WR
BSG
K=9
Ks[mag]
(J−Ks)[mag]
Ak=0.8 mag
D= 4.8 kpc

Cl 1813-178



Ak = 0.8 mag

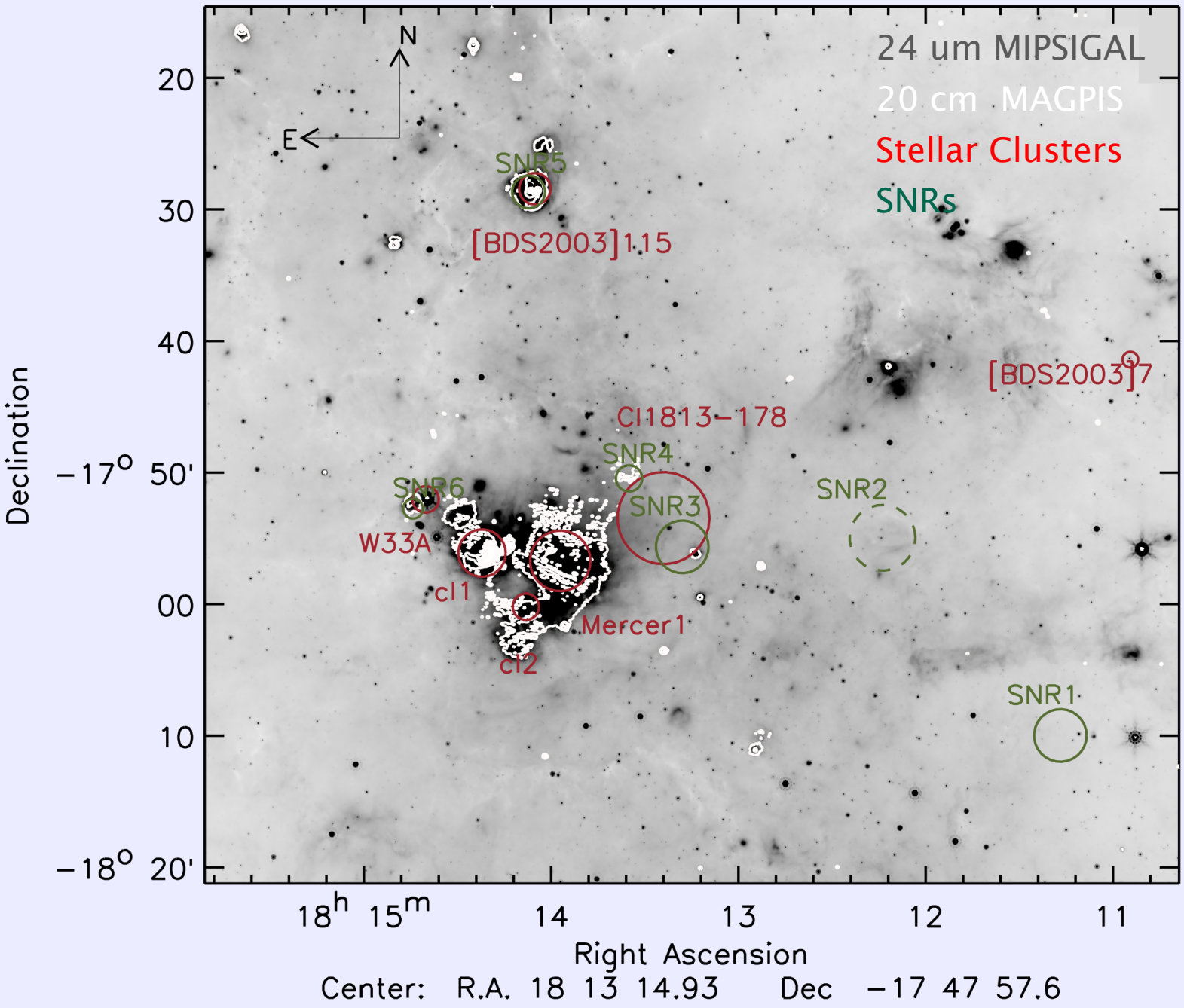
D = 4.8 kpc

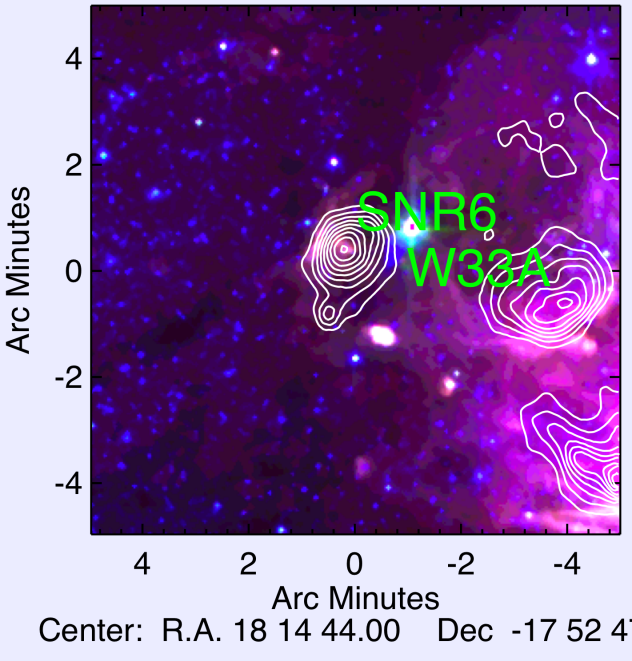
Age= 4-4.5 Myr

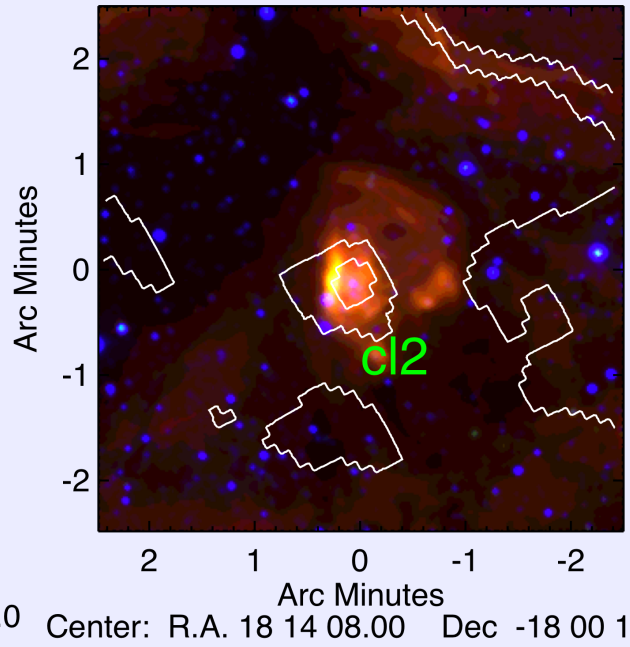
Mass ~ 10,000 Msun

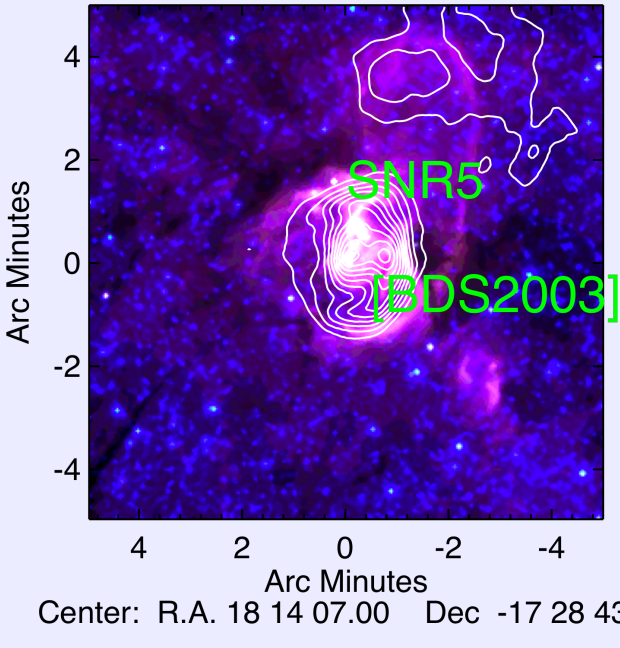
Meynet & Maeder (2000)

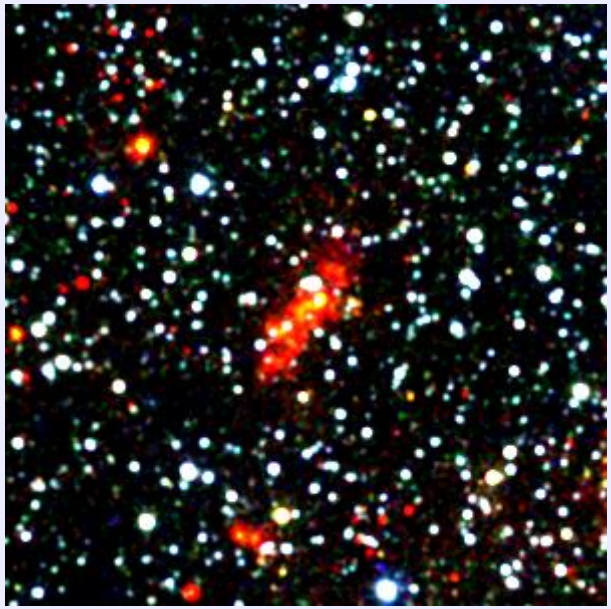
W33 complex

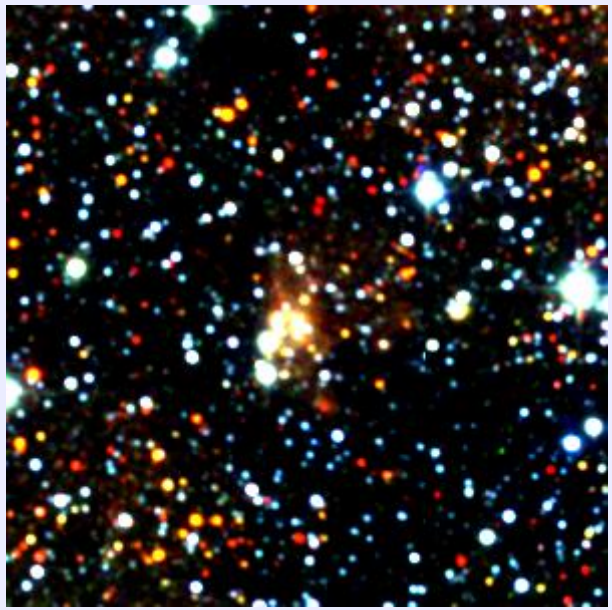

24 um MIPSIGAL
20 cm MAGPIS
Stellar Clusters
SNRs
N
E
SNR5
[BDS2003]1.15
[BDS2003]7
CI1813−178
SNR4
SNR6
SNR3
SNR2
W33A
cl1
Mercer1
cl2
SNR1
Declination
−17° 50'
00
10
−18° 20'
20
30
40
18h 15m
14
13
12
11
Right Ascension
Center: R.A. 18 13 14.93 Dec −17 47 57.6

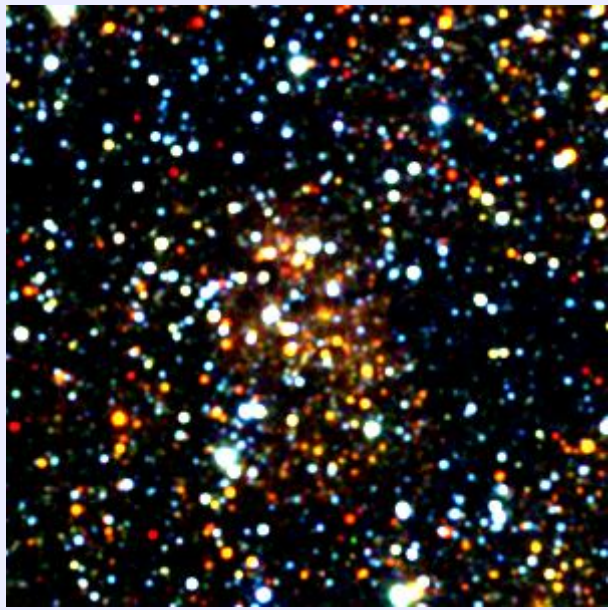








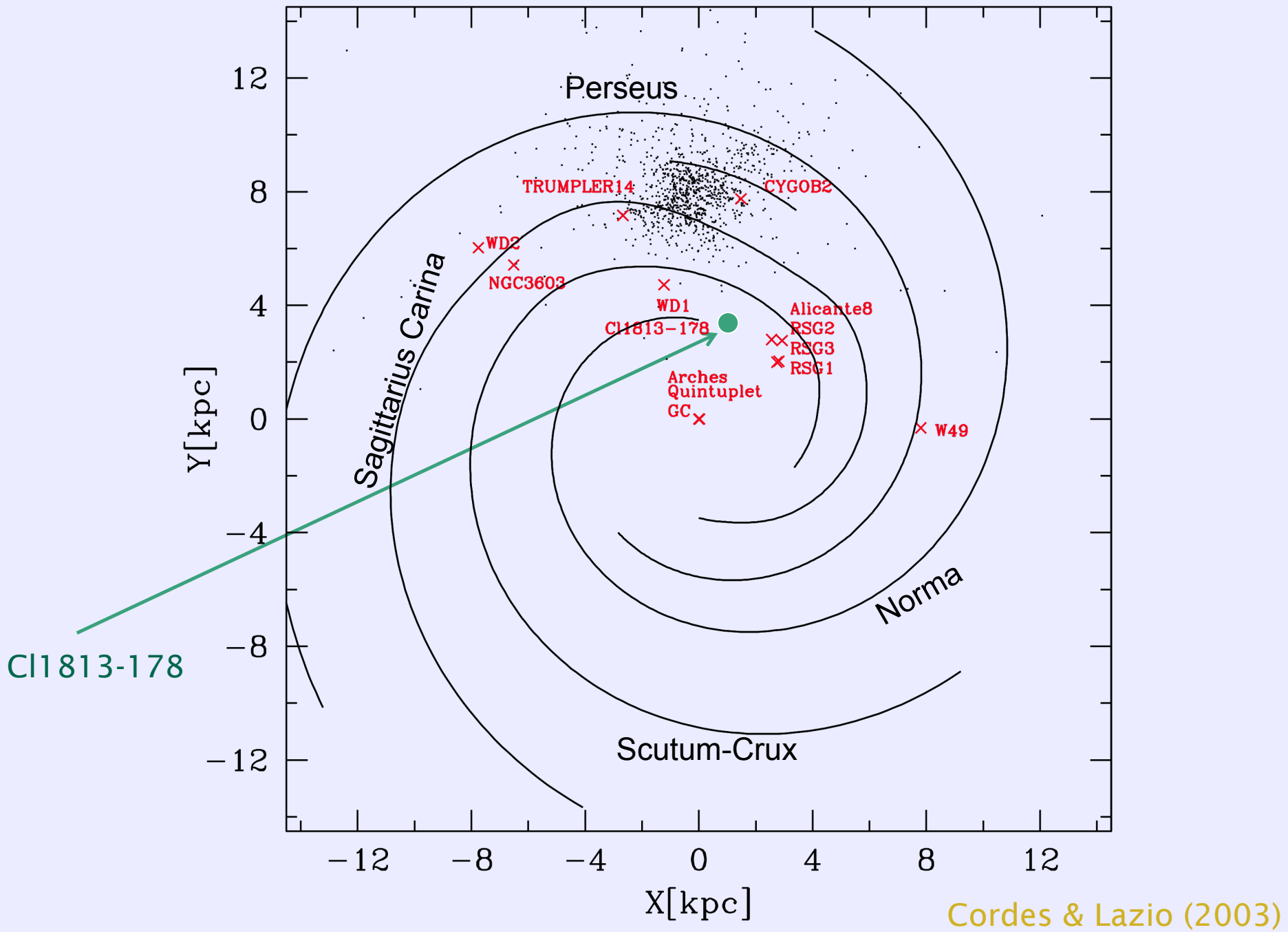




SINFONI program ongoing

3-Colors 2MASS images

Co-I Messineo M., Figer D., Davies B., Menten K., Ivanov V., Clark S



Cordes & Lazio (2003)

15 MASSIVE CLUSTERS IN THE MILKY WAY.

Revised version of Table 4 in Messineo et al. (2009, ApJ 697, 701)

Table 1. Galactic massive clusters ($> 10^4$ Msun).

Cluster	Lon [deg]	Lat [deg]	Distance [kpc]	Age [Myr]	Mass [10^3 $M_\odot$]	References
RSGC2	26.2	0.0	$5.8^{+1.9}_{-0.8}$	17 ± 3	40 ± 10	Davies et al. (2007)
Westerlund1	339.5	−0.4	3.6 ± 0.2	3.6 ± 0.7	36 ± 22	Brandner et al. (2008)
RSGC1	25.3	−0.2	6.6 ± 0.9	12.0 ± 2.0	30 ± 10	Davies et al. (2008)
RSGC3	29.2	−0.2	6 ± 1	18.0 ± 2.0	30 ± 10	Clark et al. (2009)
Arches	0.1	0.0	7.62 ± 0.32[a]	2.5 ± 0.5	~ 20	Figer (2008); Figer et al. (1999a)
Quintuplet	0.2	-0.1	7.62 ± 0.32[a]	4 ± 1	~ 20	Figer (2008); Figer et al. (1999a)
GC central	0.0	0.0	7.6 ± 0.3[a]	6.0 ± 2.0	20	Martins et al. (2007)
NGC3603	291.6	−0.5	6.0 ± 0.8	< 2.5	13 ± 3	Harayama et al. (2008)
Trumpler14	287.4	−0.6	~ 2.8	3.25 ± 2.75	10 ± 1	Ascenso et al. (2007b)
Cyg OB2	80.2	0.8	~ 1.5	~ 2.5	~ 10[b]	Negueruela et al. (2008)
W49A	43.2	0.0	11.4 ± 1.2	1.2 ± 1.2	~ 10	Homeier & Alves (2005)
Cl1813-178	12.7	0.0	3.6 ± 0.7	4.5 ± 0.5	> 10	Messineo et al. (2008,2011)
Alicante 7-RSGC5	29.2	−0.2	6 ± 1	18.0 ± 2.0	> 10	Negueruela et al. (2011)
Alicante 8-RSGC4	24.6	0.4	6.6 ± 0.9	20	~ 10	Negueruela et al. (2010)
Westerlund2	284.3	−0.3	~ 2.8	2.0 ± 0.3	> 7[c]	Ascenso et al. (2007a)

Note. — For each cluster, names and Galactic coordinates are followed by distances, ages, masses, and references.

[a]Distance to the Galactic center as given by Eisenhauer et al. (2005).

[b]A mass of 10000 $M_\odot$ is estimated using a number of 50 stars more massive than $20M_\odot$ (Negueruela et al. 2008), and a Salpiter

Cluster identification is not an easy task.

Spectroscopy is expansive and only possible for a limited number of targets.

New efficient searches based on photometric classification of bright targets are mandatory.

Near and mid-IR Galactic Survey

Two Micron All Sky Survey (2MASS)	470.992.970 P.S.
The Deep Near-Infrared Survey (DENIS)	355.220.325
The UKIRT Infrared Deep Sky Survey (UKIRT)	2 X 10^9
The VISTA survey	similar to UKIRT
The ISO infrared survey of the Galactic Plane (ISOGAL)	106.150
The Midcourse Space Experiment (MSX)	177.860
The Galactic Legacy Infrared Mid-Plane Survey Extraordinaire (GLIMPSE)	104.240.613

In the Milky Way, we know about:

500 (1000) RSGs (119 in clusters) 5000 M-type RSGs

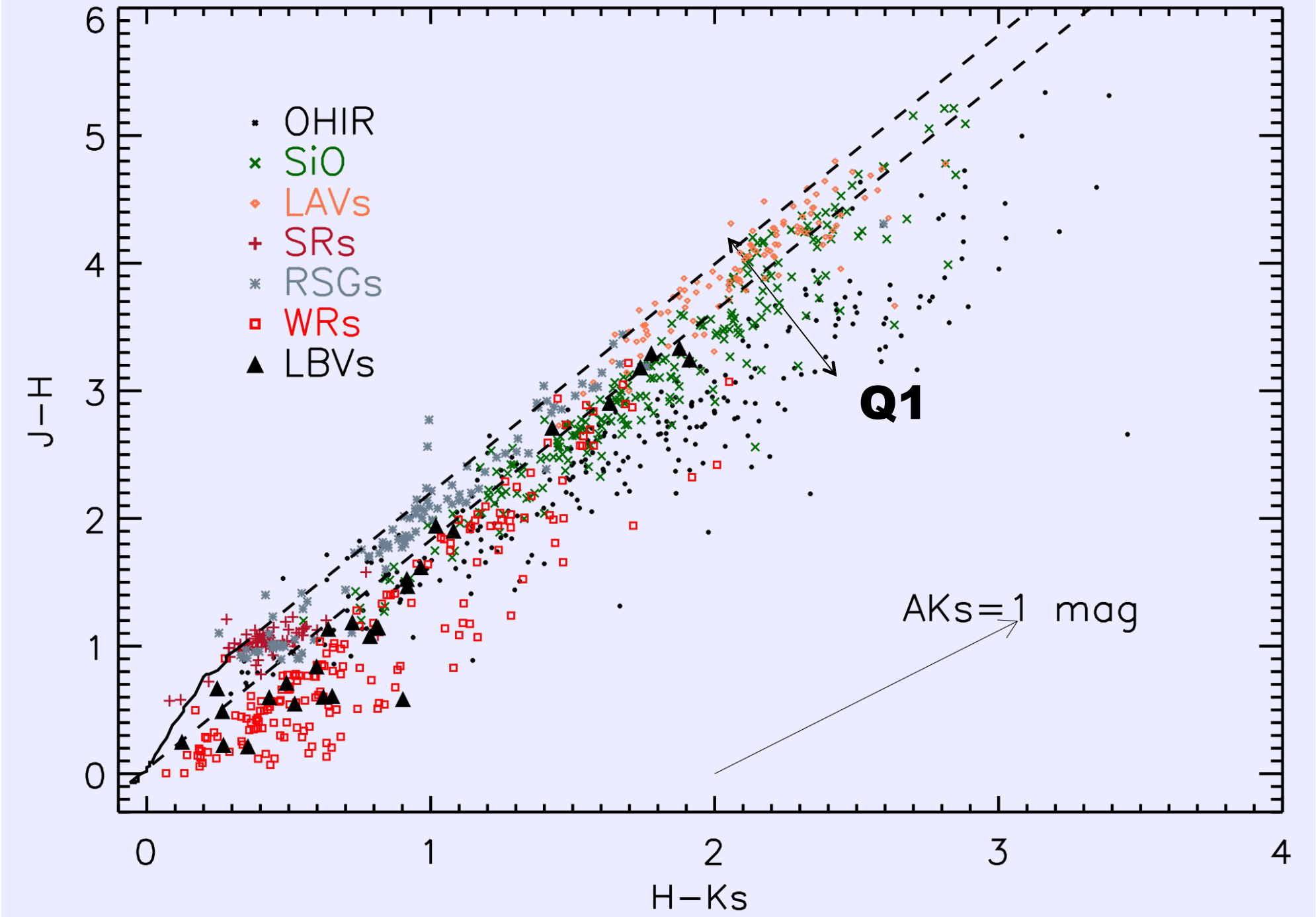
226 WR stars (van der Hucht 2001) 3000 WR + …

A dozen confirmed LBVs (Clark et al. 2005)

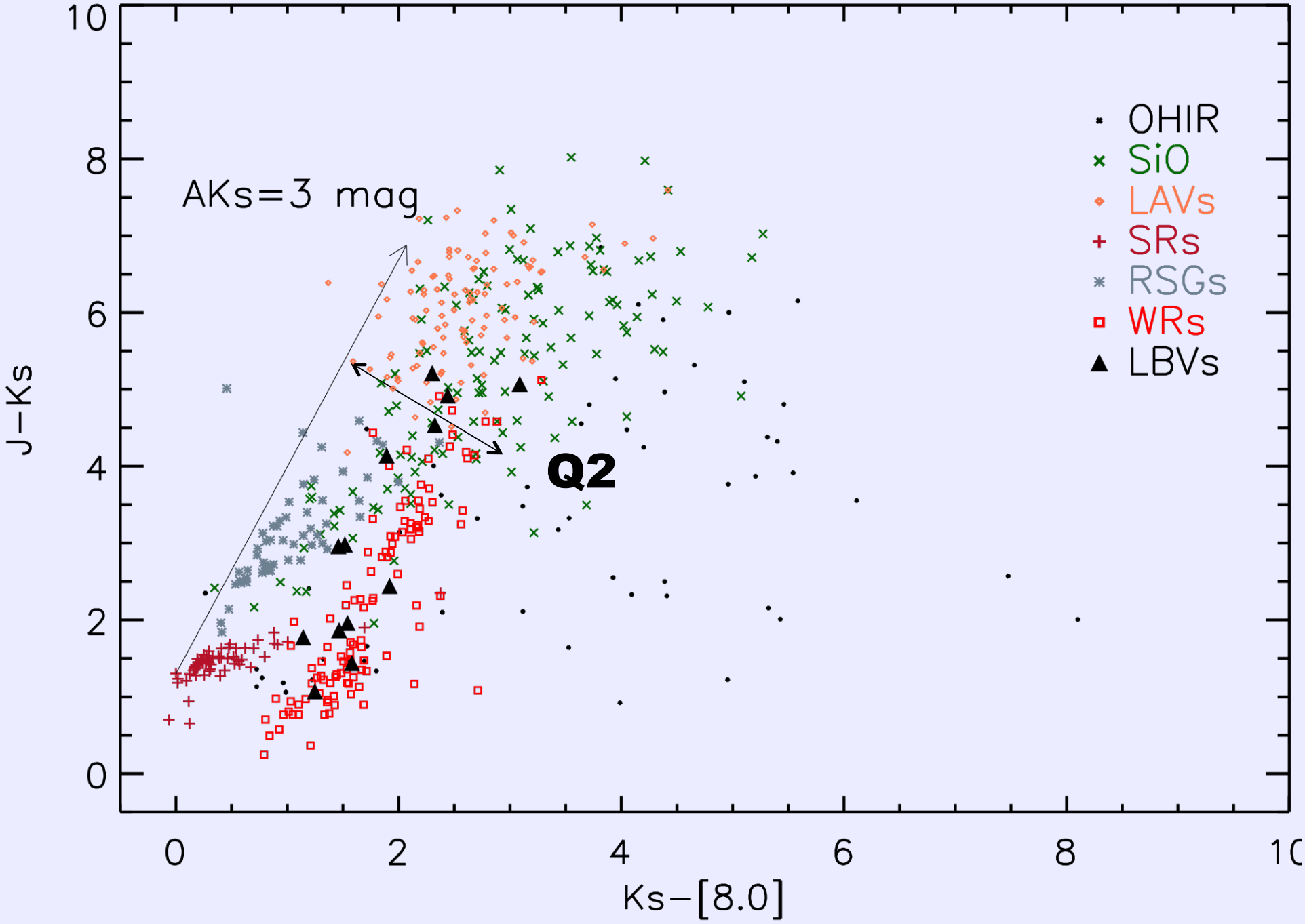
Several thousands of AGBs have been detected via their maser emission, or photometric pulsation properties (e.g. Alard et al. 2001; Glass et al. 2001; Habing et al. 2006; Messineo et al. 2002; Sevenster 2002; Deguchi et al. 2004, and references therein).
(9 millions Miras).

Predictions by Gehrz 1989

Messineo, M., Menten, K., Churchwell, E., & Habing H. et al A&A, submitted



Messineo, M., Menten, K., Churchwell, E., & Habing H. et al A&A, submitted



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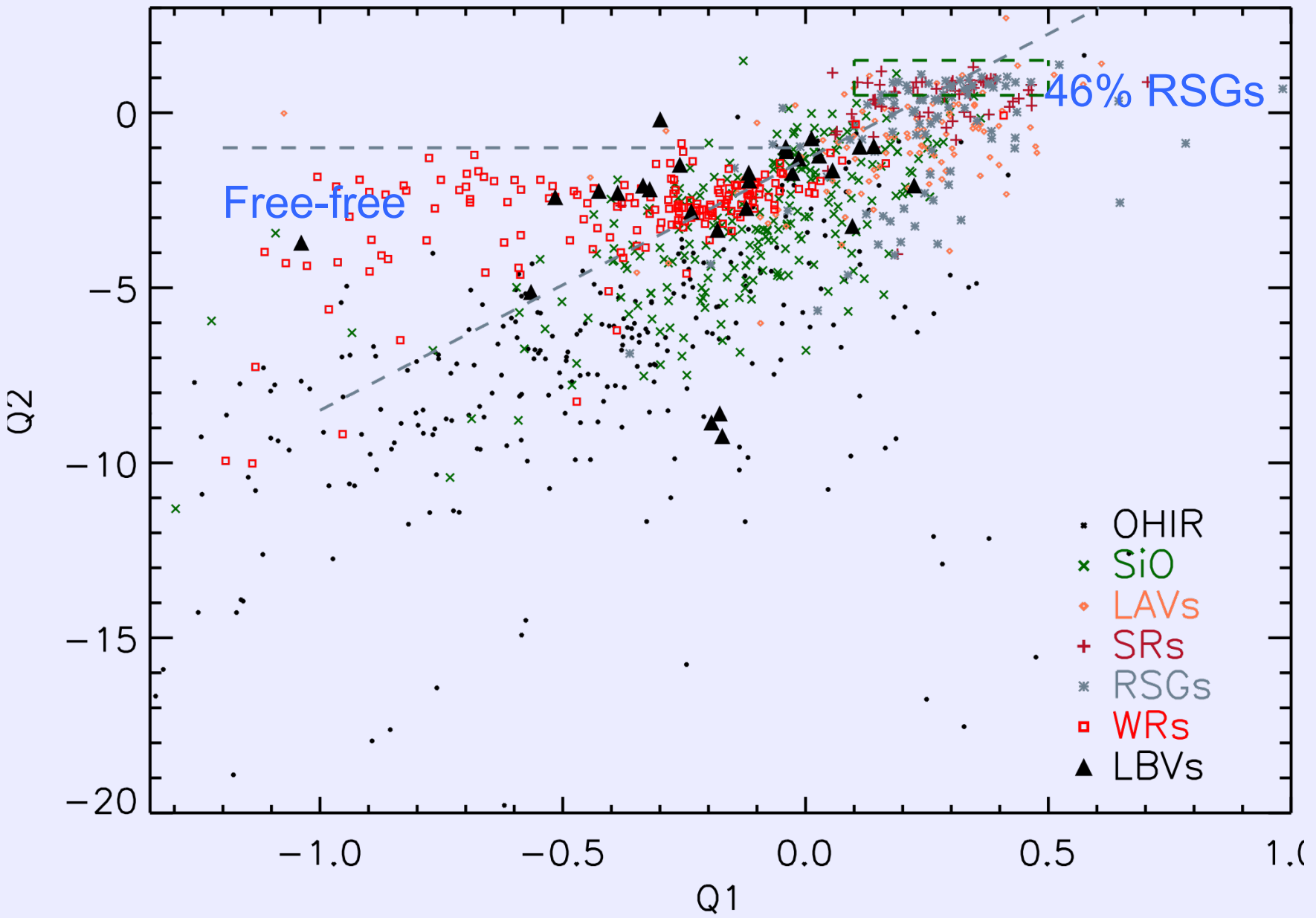
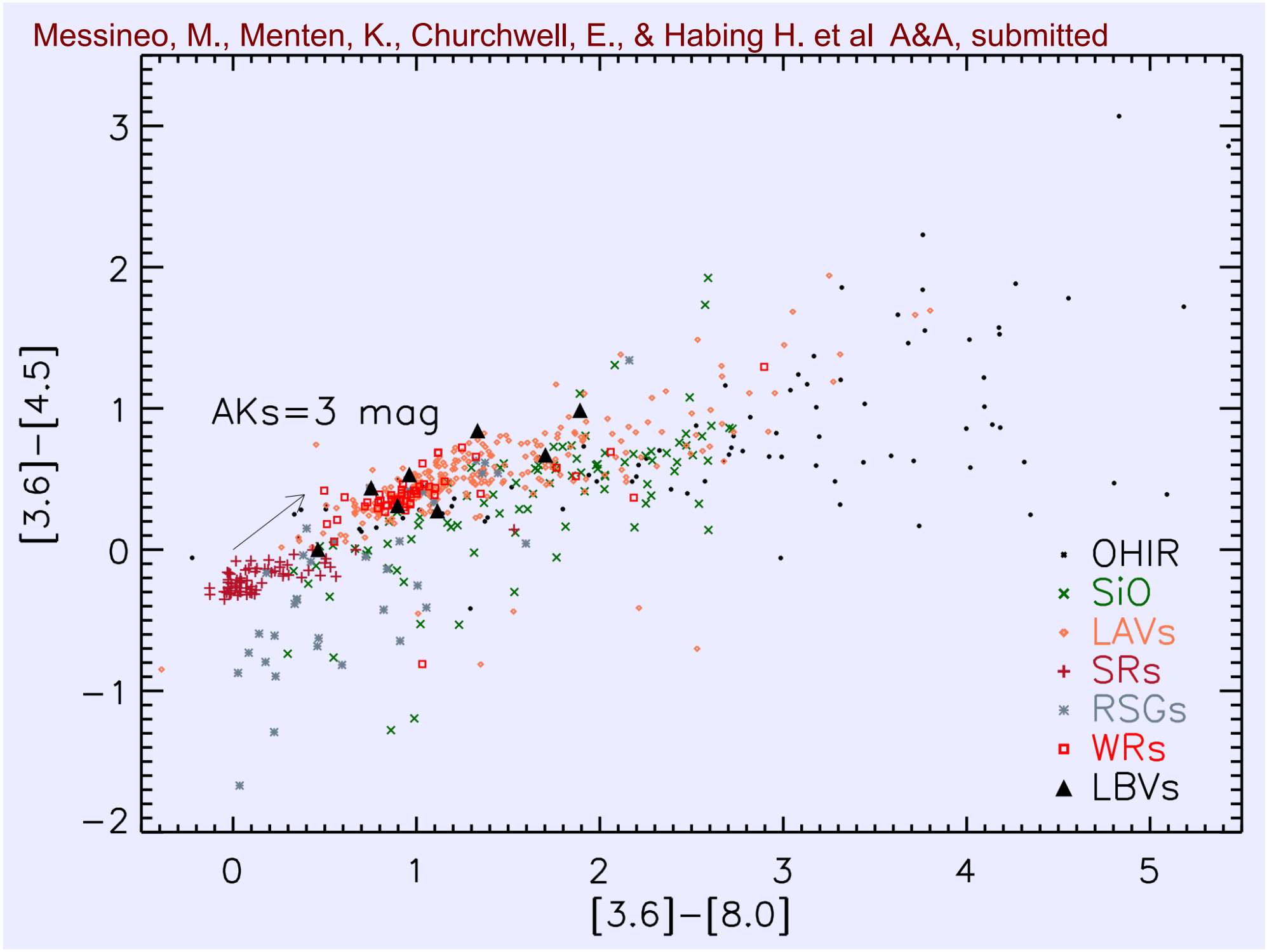
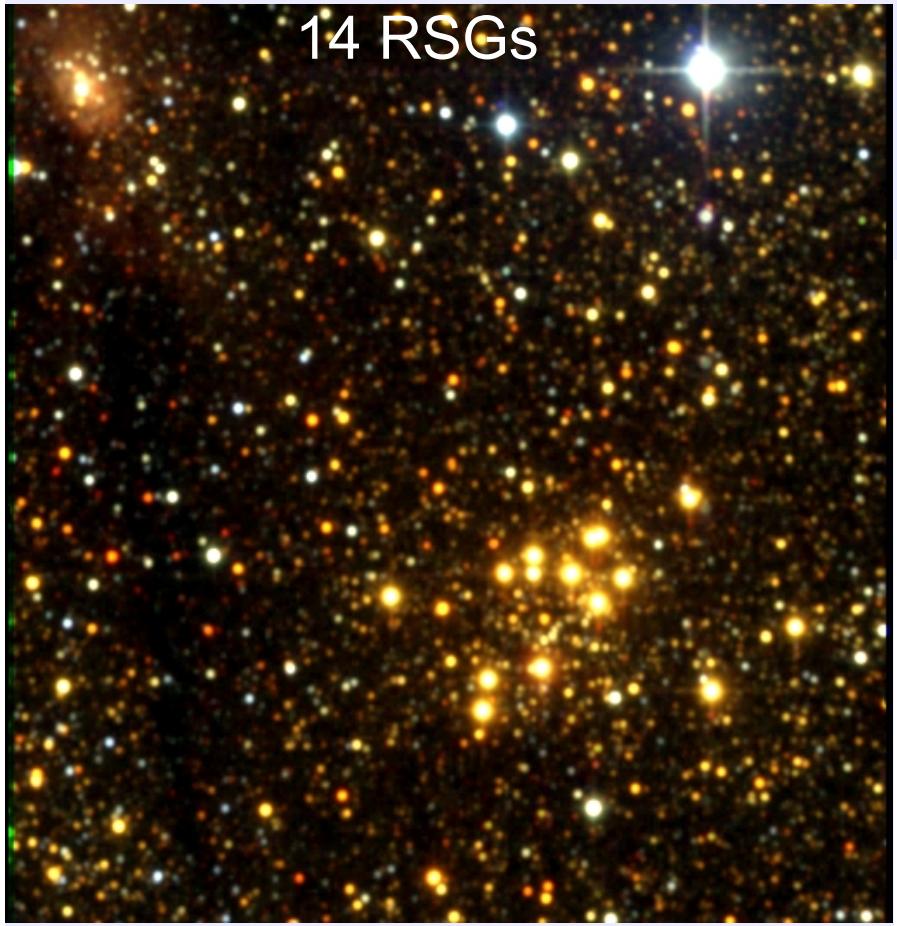


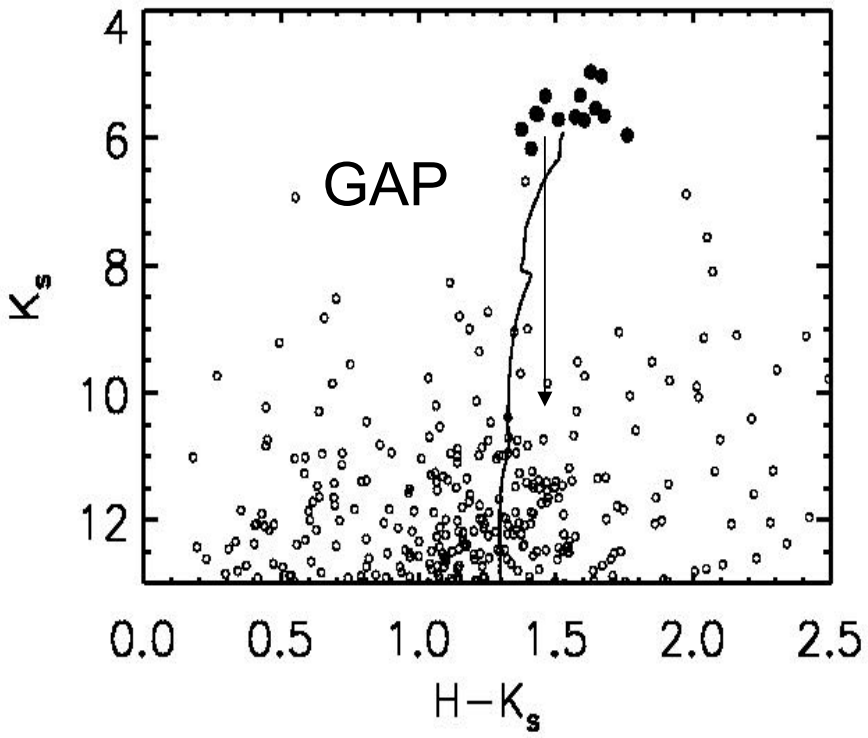

Messineo, M., Menten, K., Churchwell, E., & Habing H. et al A&A, submitted
AKs=3 mag
[3.6]−[4.5]
[3.6]−[8.0]
OHIR
SiO
LAVs
SRs
RSGs
WRs
LBVs

Detectability depends on Cluster mass



RSGC1, Figer et al. (2006)

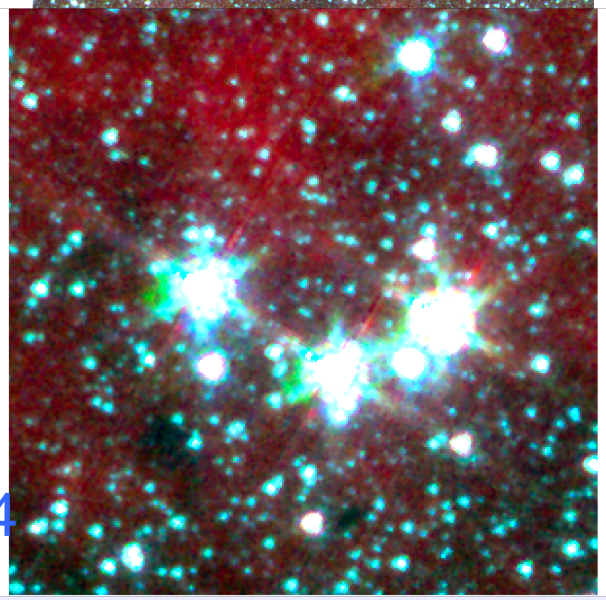
14 RSGs make a cluster.



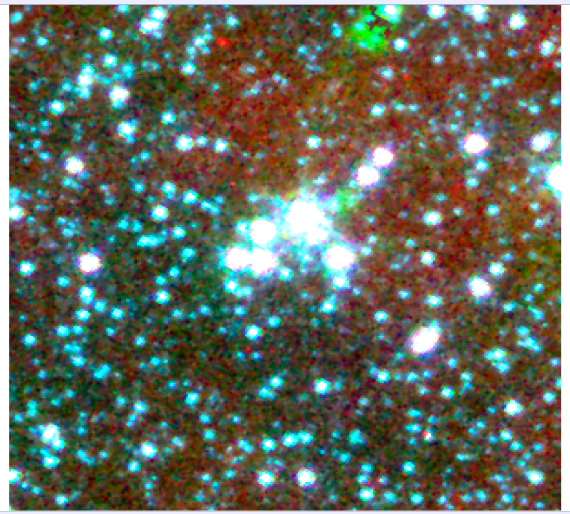
Candidate stellar clusters

AIUK 59

VIUK 14



VIUK 10



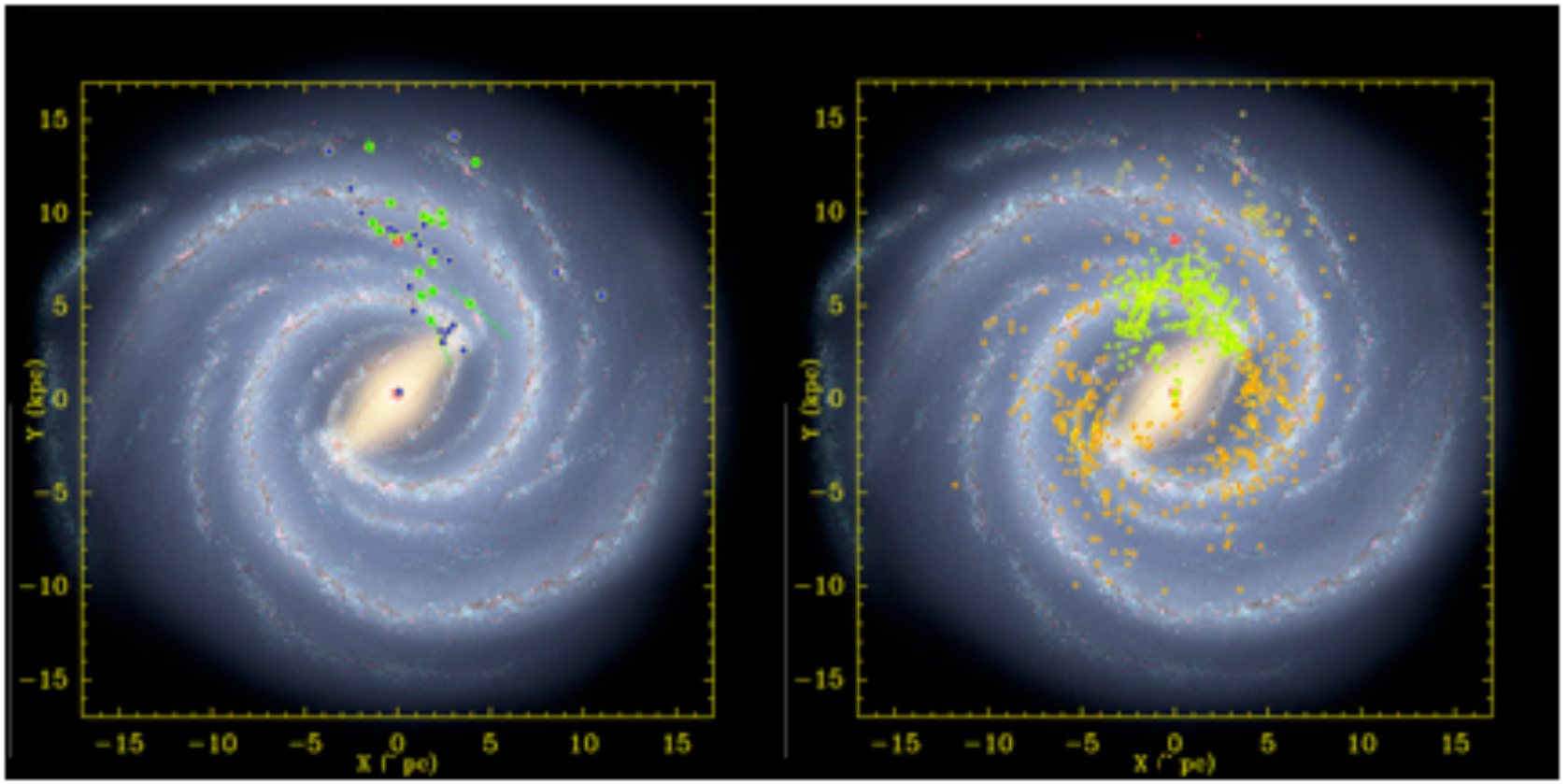
Ivanov, V. et al. IAUS, 266, 203

Messineo, M., Zhu, Q., Ivanov, V., et al. in preparation

Parallactic distances of all known maser sources using VLBI observations will be soon available: BESSEL survey

European side is financed by GLOSTAR: A Global View of Star Formation in the Milky Way (EU grant - Menten K.)

Brunthaler et al. 2011



Artistic view of the MW by NASA/JPL -- credit to Hurt (IPAC)

*Figure 1: **Left:** Positions of the Galactic Center (red asterisk), the Sun (red circle), and 18 Galactic sources (green) for*

An homogeneous re-calibration (distance, extinction)

Parallax measurements for 28 regions have already been published.

Cluster	HII region	Spectro-phot	Parallactic
GLIMPSE9	G23.01-0.41	$4.24^{+0.40}$	$4.59^{+0.38}$ Brunthaler al. (2009)
Cl 1813-178		$3.6^{+0.7}$	To come
Cyg OB2	Cygnus/ W75N	1.5	$1.32^{+0.11}$ Rygl et al. (2010)

Soon a recalibration the intrinsic properties of OB stars will be possible.

THANK YOU