UWISH2

The UKIRT Widefield Infrared Survey for H_2

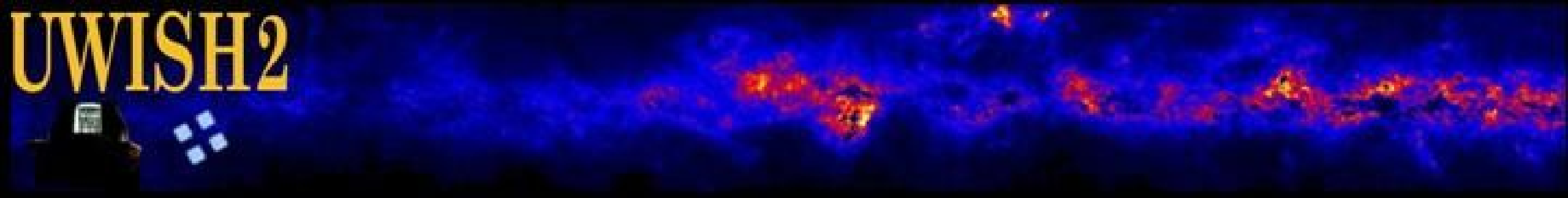
Dirk Froebrich

Chris Davis (Co-PI)

and the UWISH2 survey team

Centre for Astrophysics and Planetary Science (CAPS)

University of Kent



The UWISH2 Team

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R.-D. Scholz

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Outline

- Description of survey
- Survey Status
- Results so far:
  - Young Cluster Mercer 14
  - Variable Stars
  - others (PN, HPM stars, SNR)
  - + Georges Talk
- Future extensions?

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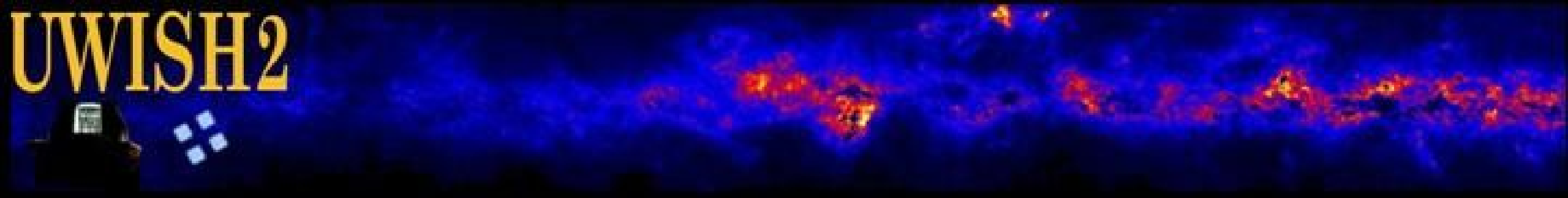

DESCRIPTION OF SURVEY

- Unbiased Survey of the Inner Galactic Plane in the H_2 1-0S(1) line at 2.122μm using WFCAM at UKIRT; sub-arcsec resolution; 720 sec/pixel
- Covers 150 square degrees ($10° < l < 65°$, $|b| \sim 1.3°$) - GLIMPSE-N
- Awarded 220 hrs spread across semesters 09B, 10A, 10B, 11A
- +5nights in 11A via access through the University of Hawaii (l=7°...10°)
- tiled as UKIDSS GPS

- Includes massive SF regions (e.g. W33, W51),
- SN remnants (e.g. W44, W49B),
- Galactic Clusters (e.g. M16, M17),
- nearby (<1kpc) GMCs

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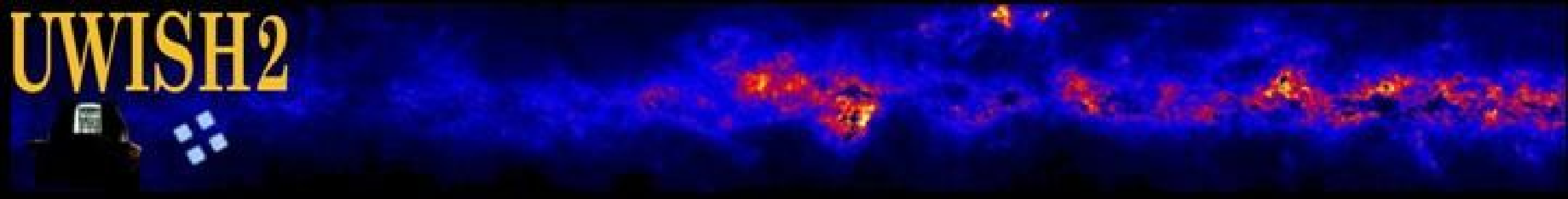

SCIENTIFIC OBJECTIVES (jets & outflows from YSOs)

- Characterise the dynamic component of star formation along a large fraction of the Galactic Plane in an unbiased manner.
- Determine the duration of the jet/outflow phase in YSO evolution (fraction of sources with jets/outflows).
- Determine the star formation efficiency along the Galactic Plane.
- How do jet/outflow properties (length, opening angle, power) relate to the source properties (mass, luminosity, age, accretion rates) and/or parental cloud (mass, structure) and/or mode of star formation (isolated/clustered)?

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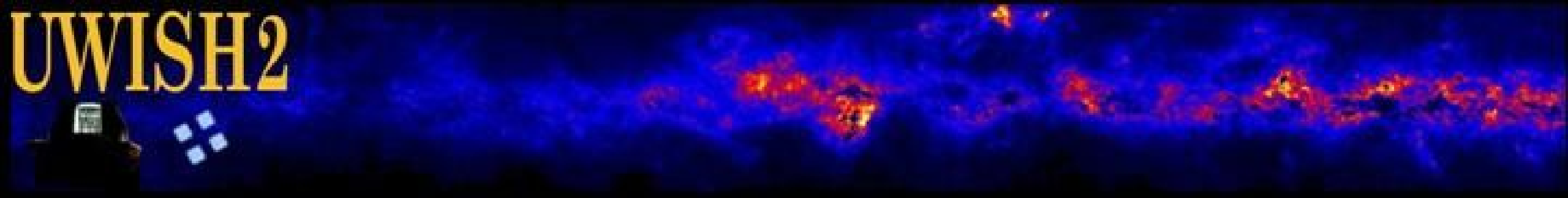

Further SCIENTIFIC OBJECTIVES

- Search for unknown planetary nebula/stellar clusters.
- Search for highly variable (flux, proper motion) stars.
- Investigate Spitzer EGOs.
- Investigate/search for Supernova remnants.
- ...anything else unusual

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Current Status

- 201 tiles are observed (89.7% of total)
- about 155 square degrees
- 33 tiles to do, 32hrs time left
- all but 2tiles in mid-plane done
- complete from l=7° to l=46°

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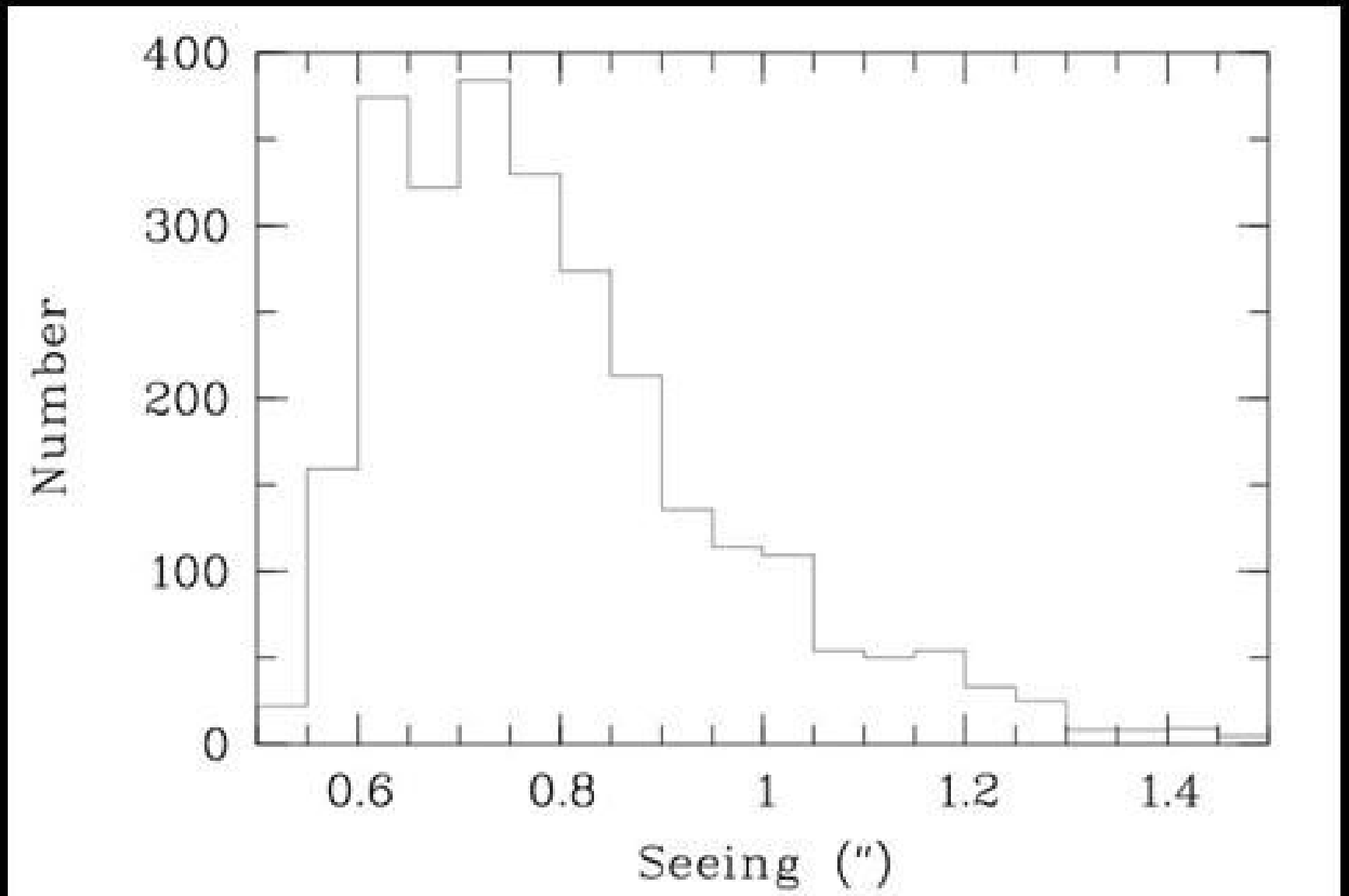
Current Status

- Median Seeing of 0.78", 87% of data have 1" or better seeing



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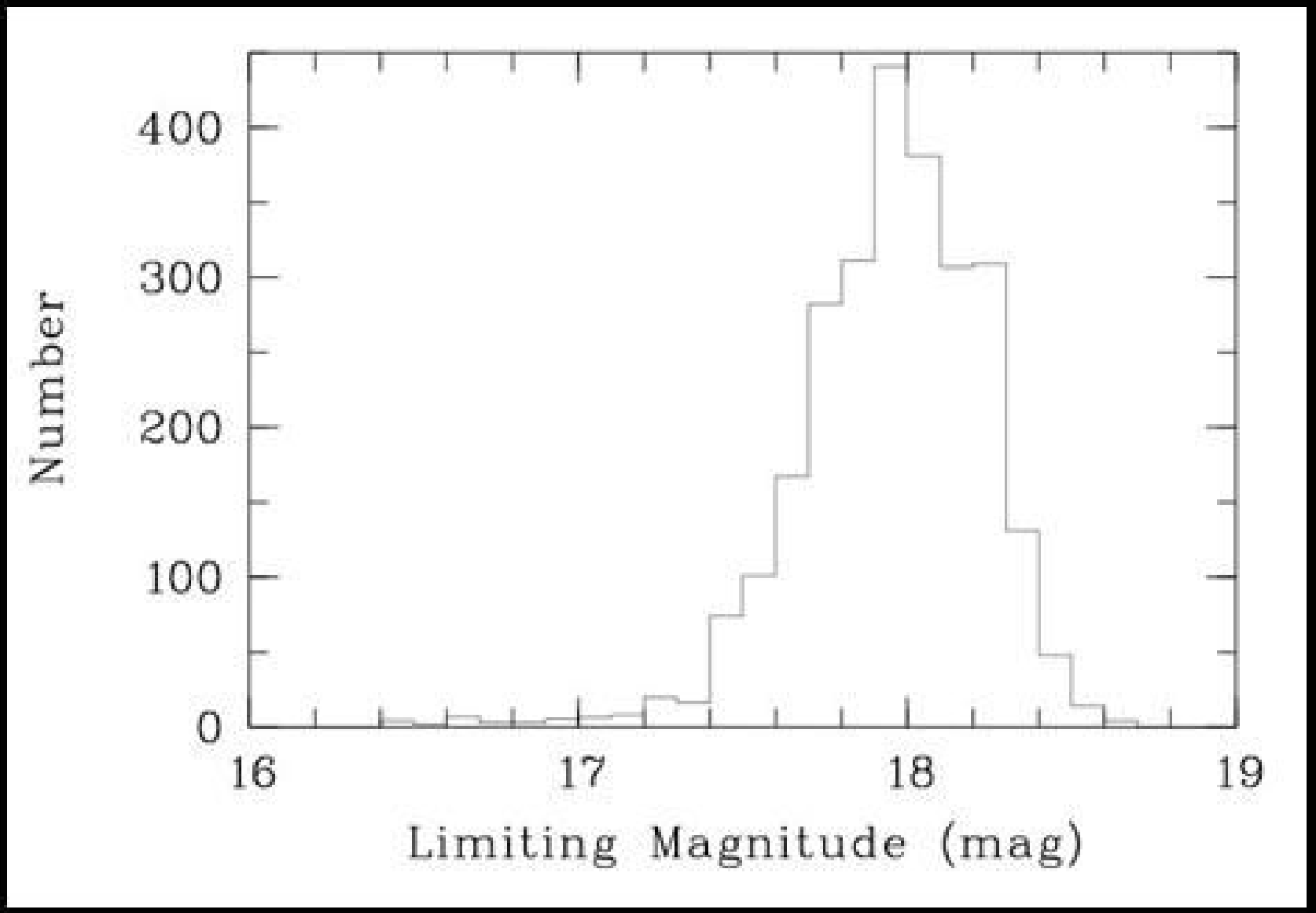
Current Status

- 5σ point source detection limits are about 18mag (comparable to GPS)



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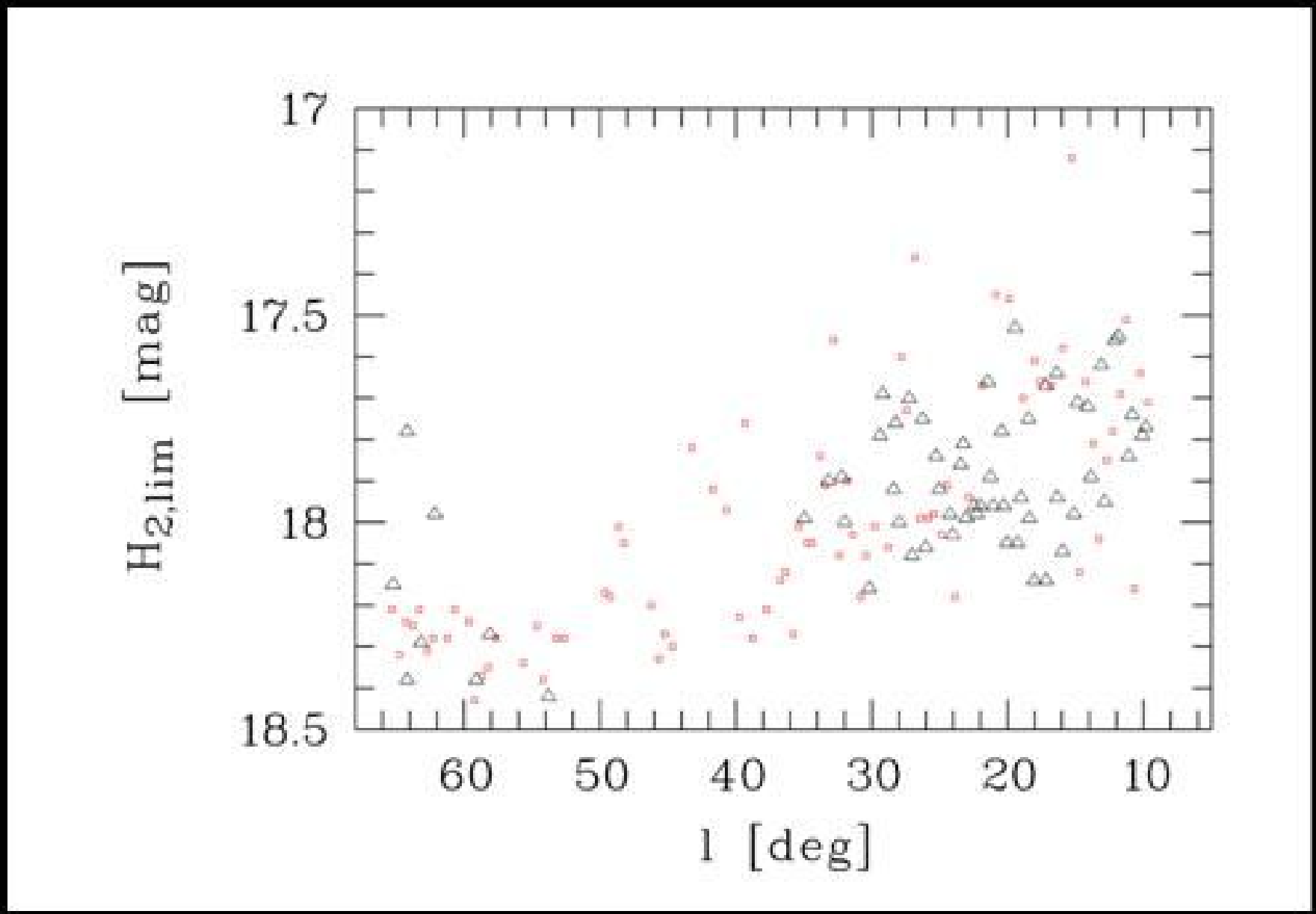
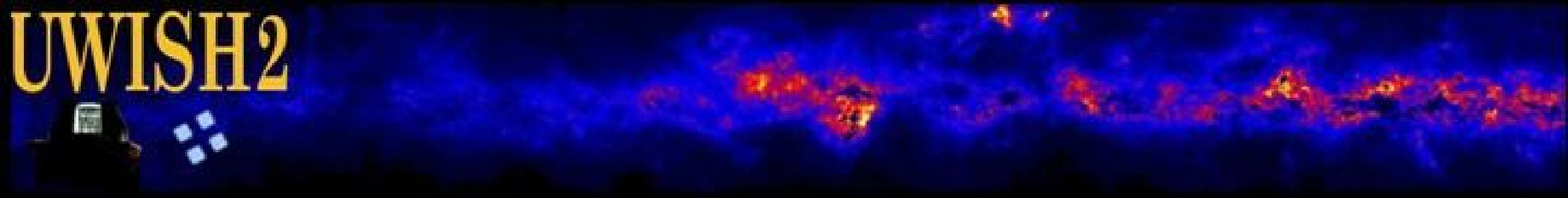


UWISH2



Current Status

- rms noise level of 3.4 x 10^{-19} W m^{-2} $arcsec^{-2}$ (unbinned – 0.2″ pixels)
- 3σ level of 1.7 x 10^{-19} W m^{-2} $arcsec^{-2}$ (at Spitzer resolution)
- 300 – 2000 times better for H_2 detection than Glimpse 4.5μm
- only at $A_K > 6$mag would Glimpse be better

- We should resolve H_2 features out to 4kpc (2″=0.04pc - see next talk),

hence a complete sample of outflows will be detected within this volume

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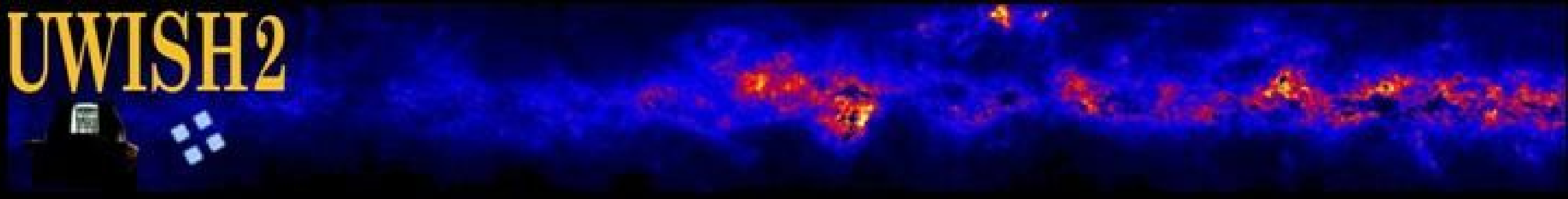
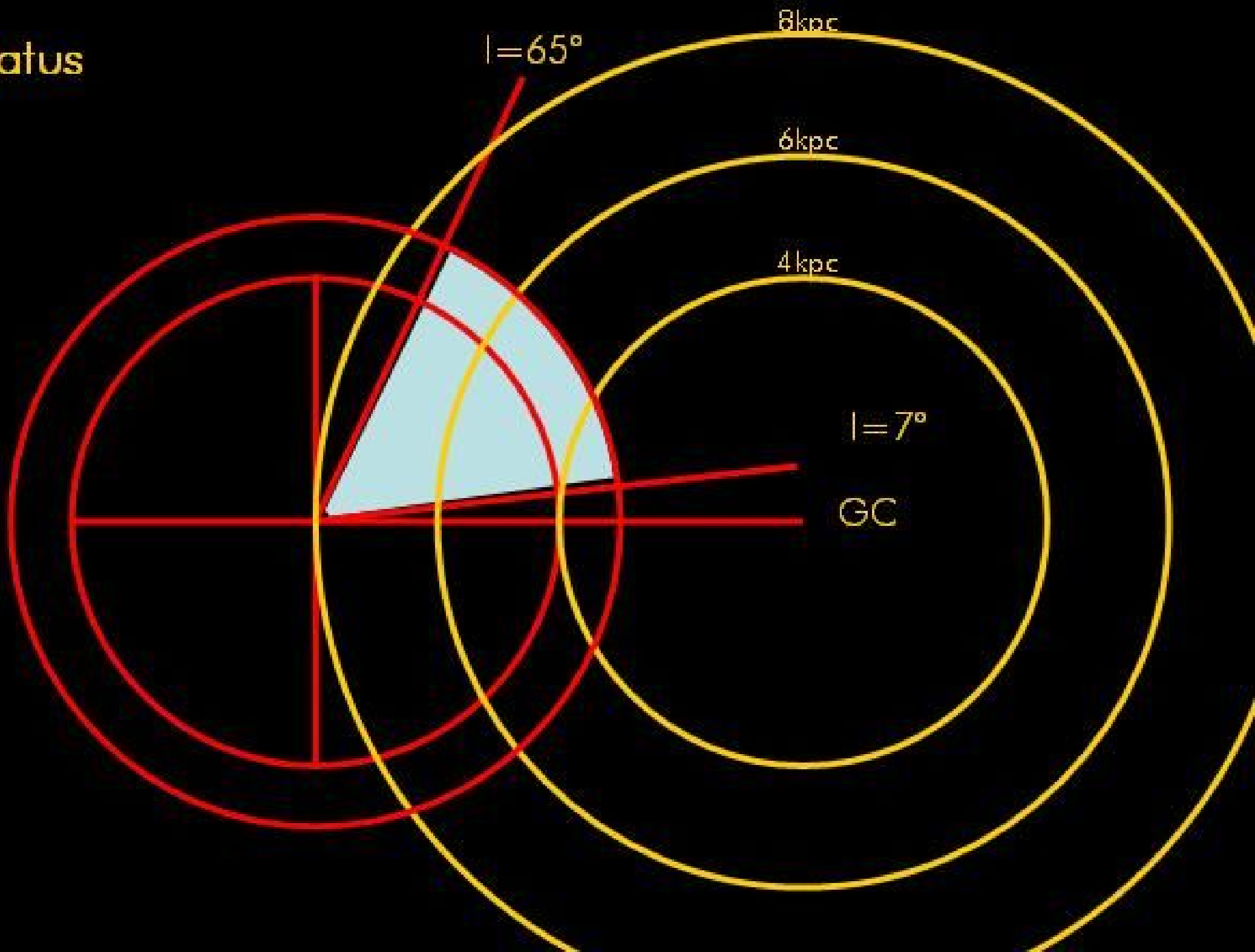


Current Status



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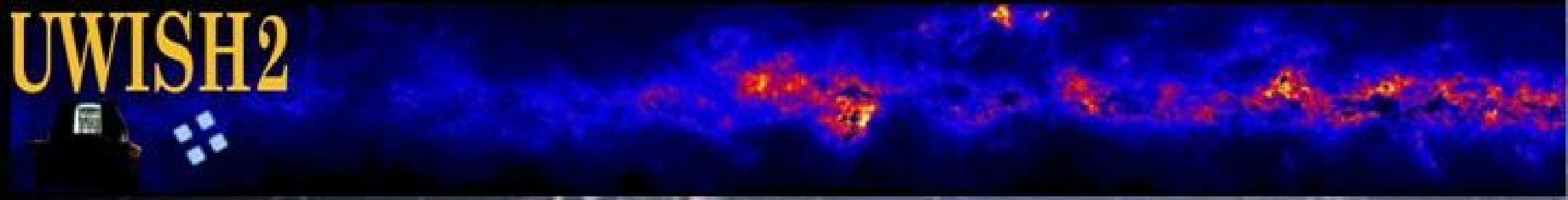

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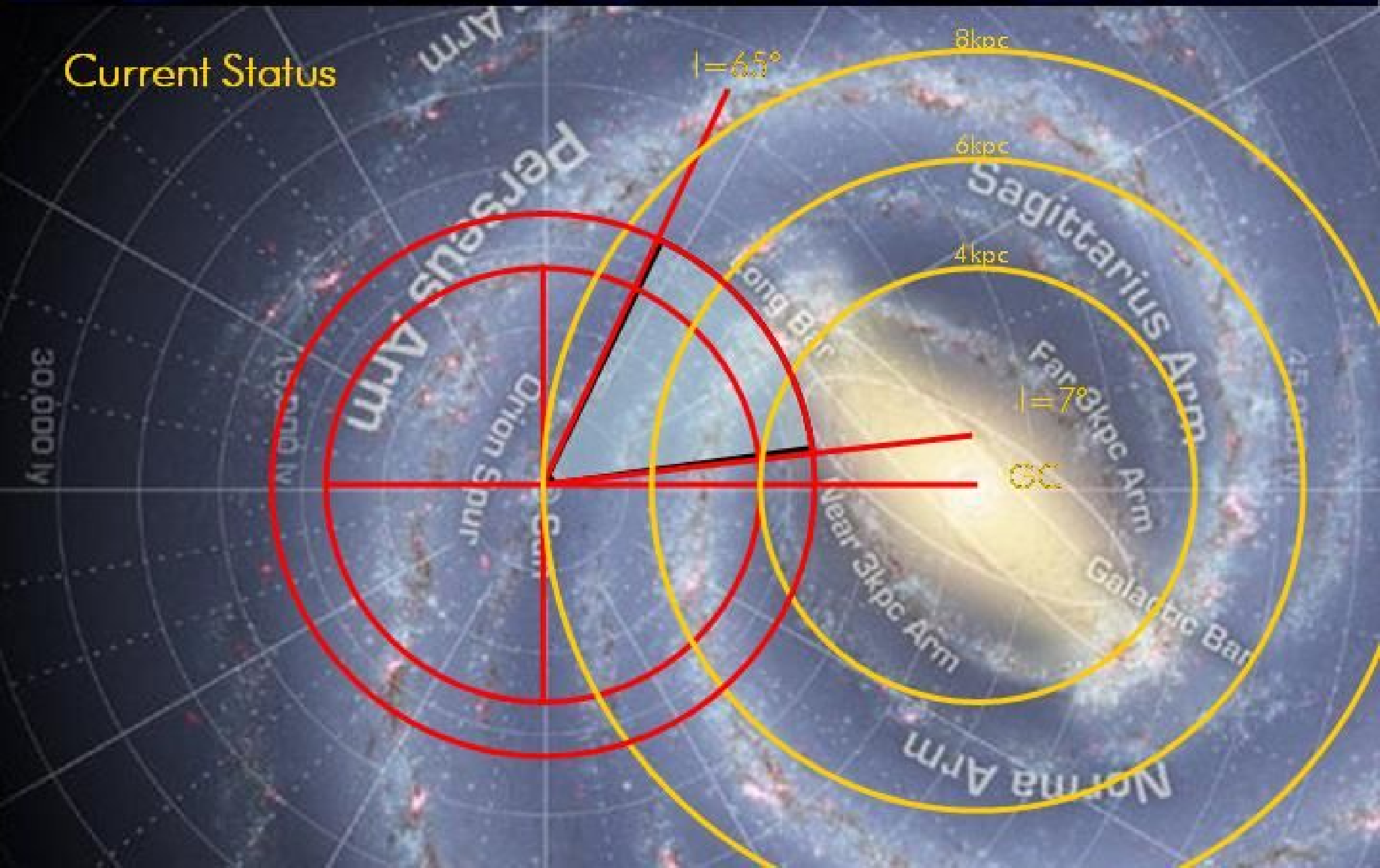
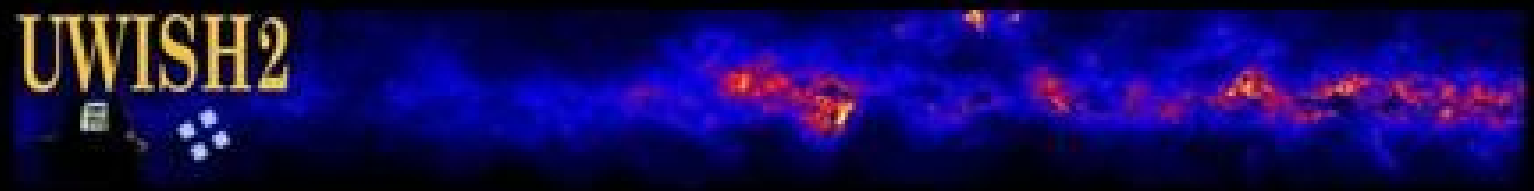


UWISH2 Website

http://astro.kent.ac.uk/uwish2/



UKIRT Widefield Infrared Survey for H2

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Internal Pages

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- *Projects*
- *Meetings*
- *Images*

Last update: 26/11/2010
Comments to: rf @ star.kent.ac.uk

We will image about 150 square degrees along the Galactic Plane ($10 < l < 65$; $-1 < b < +1$) with WFCAM at UKIRT. The observations will be taken with the narrow band filter centred on the molecular hydrogen 1-0 S(1) emission line at 2.122μm with an integration time of 720 sec per pixel.

Example of our 1st semester data. Colour image of the outflow from a massive star forming region (left) and an HII region around a massive star (right) in the filters J (blue), K (green) and H_2 (red). J and K data are taken from UKIDSS GPS.

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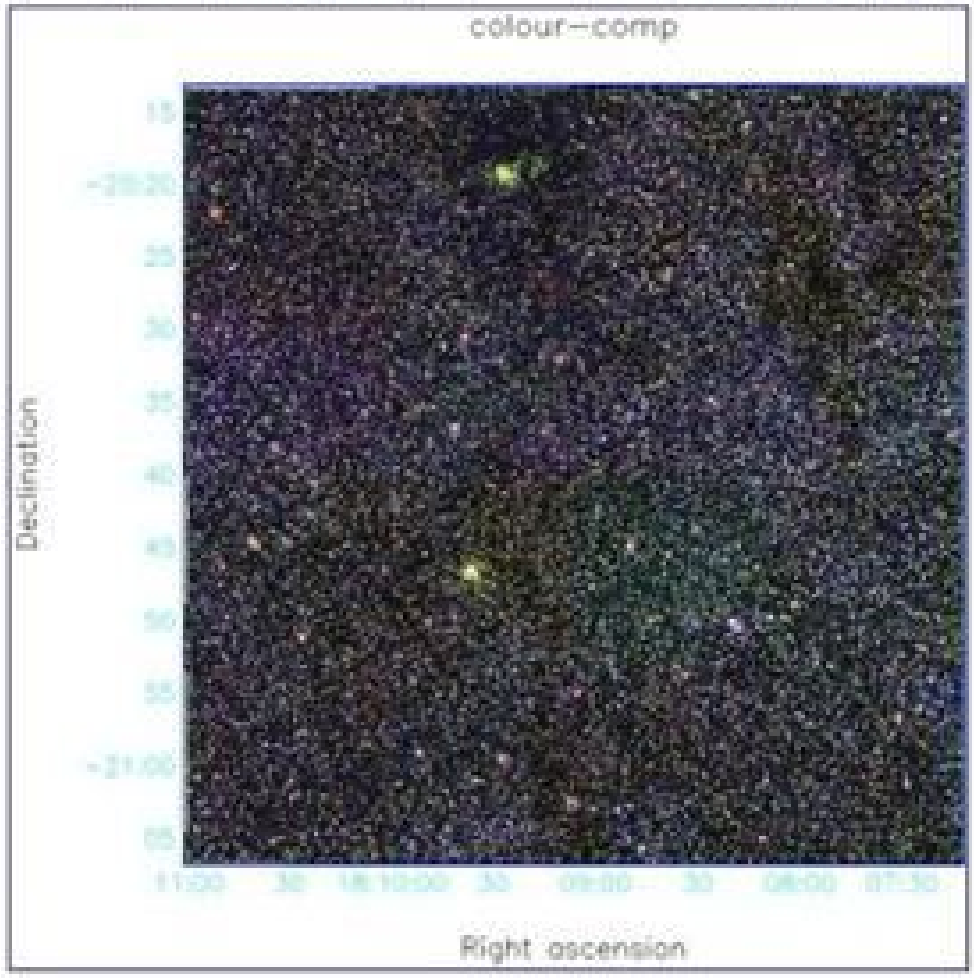
Last update: 24/02/2011
Comments to: df @ star.kent.ac.uk

Field of Tile H2_lm2_15: 71; w20090730_00309

[?] Low Res (Coords): [JHK] [JHH$_2$] [JKH$_2$] High Res: [JHK] [JHH$_2$] [JKH$_2$] [H$_2$] Maps: [A_V] [?]

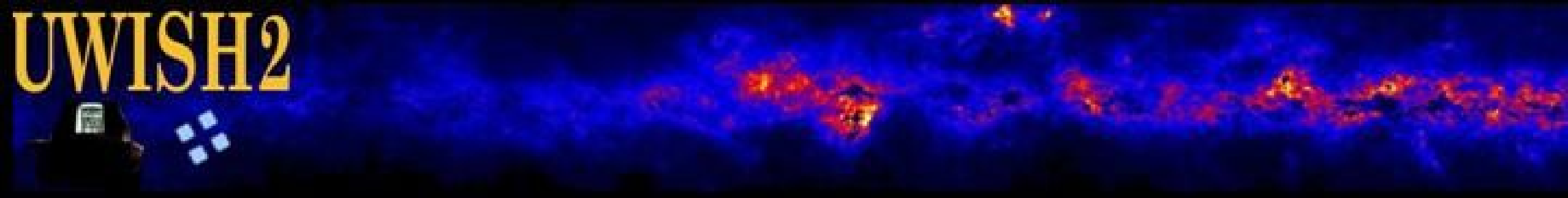


FITS Images:

H_2	K	H	J	H_2-K [?]
w20090730_00309	w20070509_02475	w20070509_02442	w20070509_02409	w x y z
w20090730_00321	w20070509_02483	w20070509_02450	w20070509_02417	w x y z
w20090730_00354	w20070509_02491	w20070509_02458	w20070509_02425	w x y z
w20090730_00366	w20070509_02499	w20070509_02466	w20070509_02433	w x y z

Source Tables/Graphs:

H_2	K	H	J	H-K vs J-H [?]	J-K vs K [?]	H_2-K vs K [?]
w20090730_00309	w20070509_02475	w20070509_02442	w20070509_02409	w x y z	w x y z	w x y z
w20090730_00321	w20070509_02483	w20070509_02450	w20070509_02417	w x y z	w x y z	w x y z



~40 people currently involved

To join us please email
Dirk Froebrich at df@star.kent.ac.uk

M17

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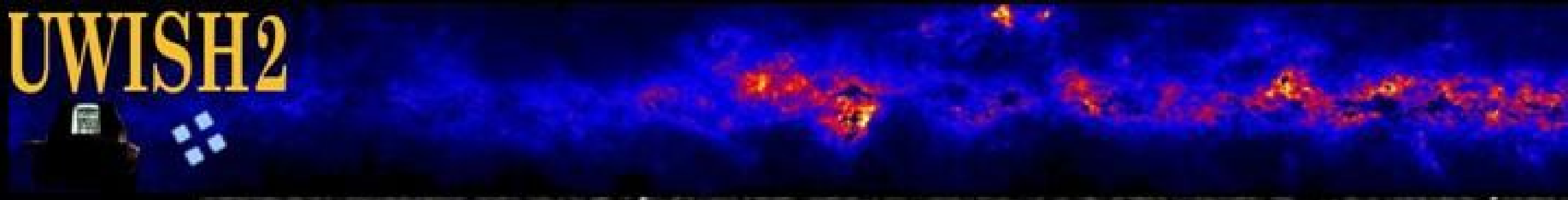
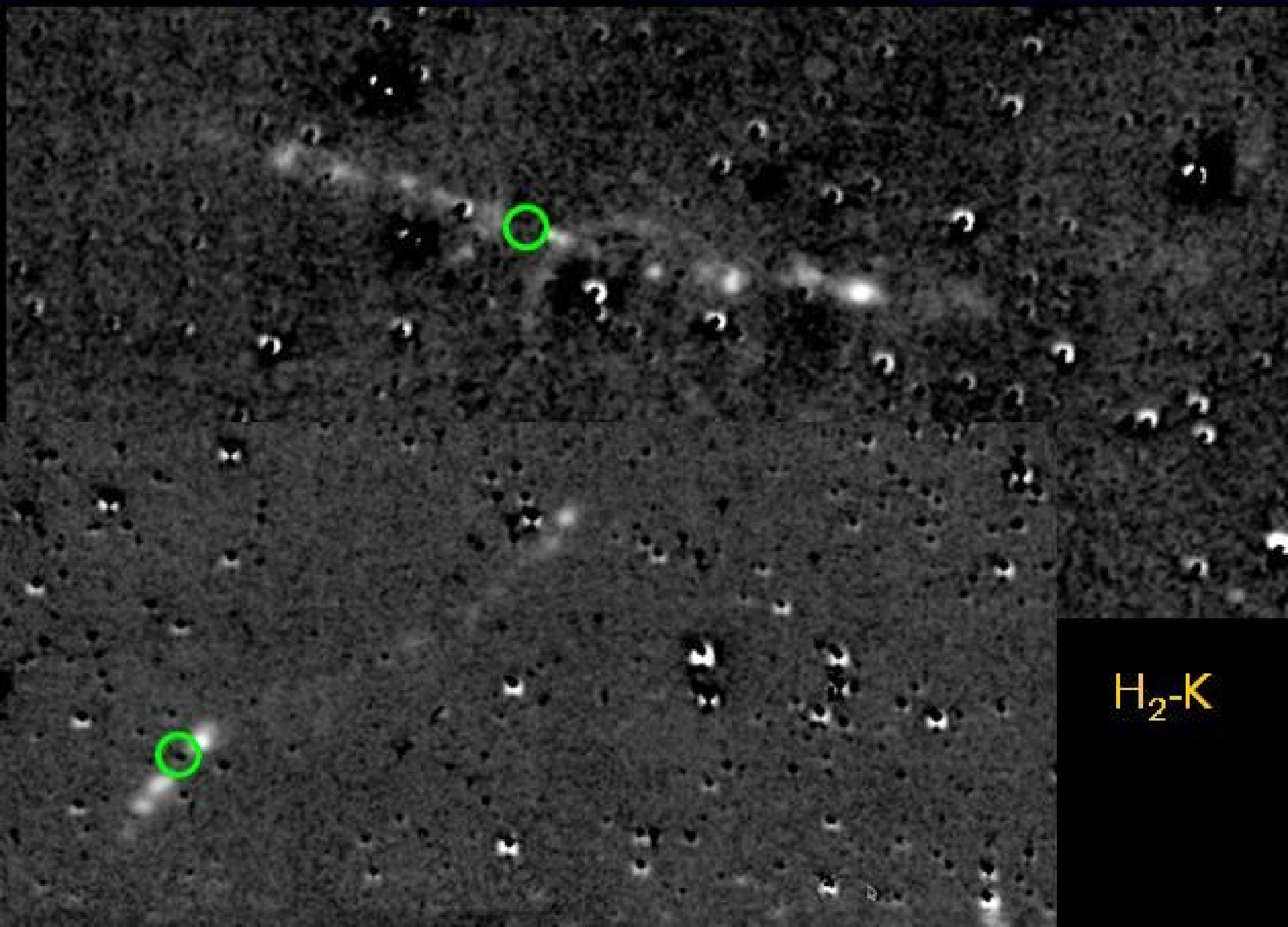


Some New Jets



H_2-K

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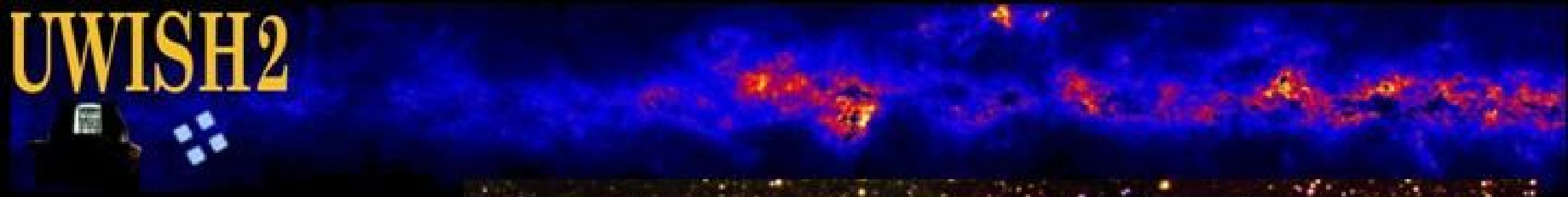
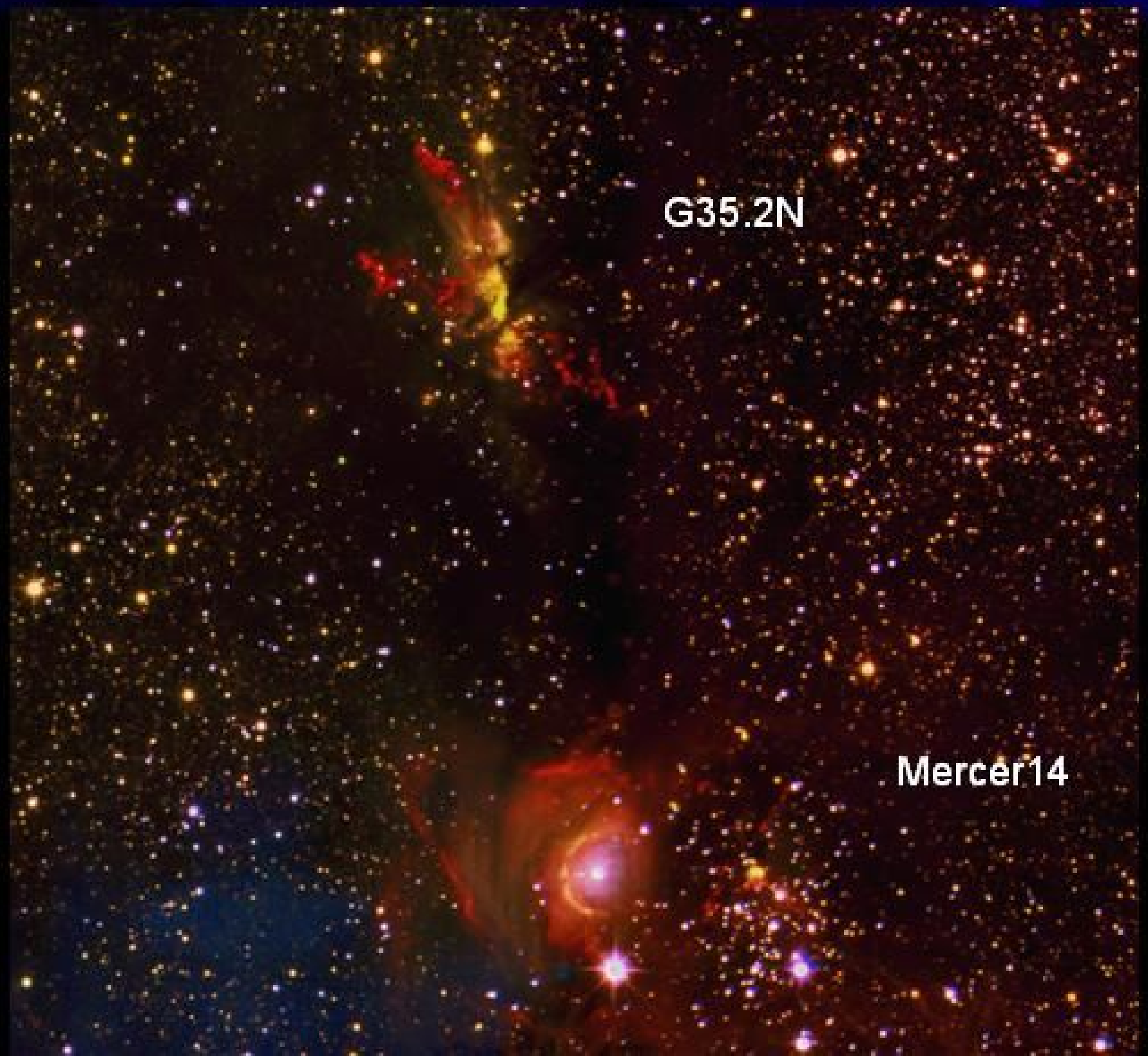


Massive SF-Region
G35.2N

Colour composite (JKH_2) image.

The image is about 5'x7' in size.



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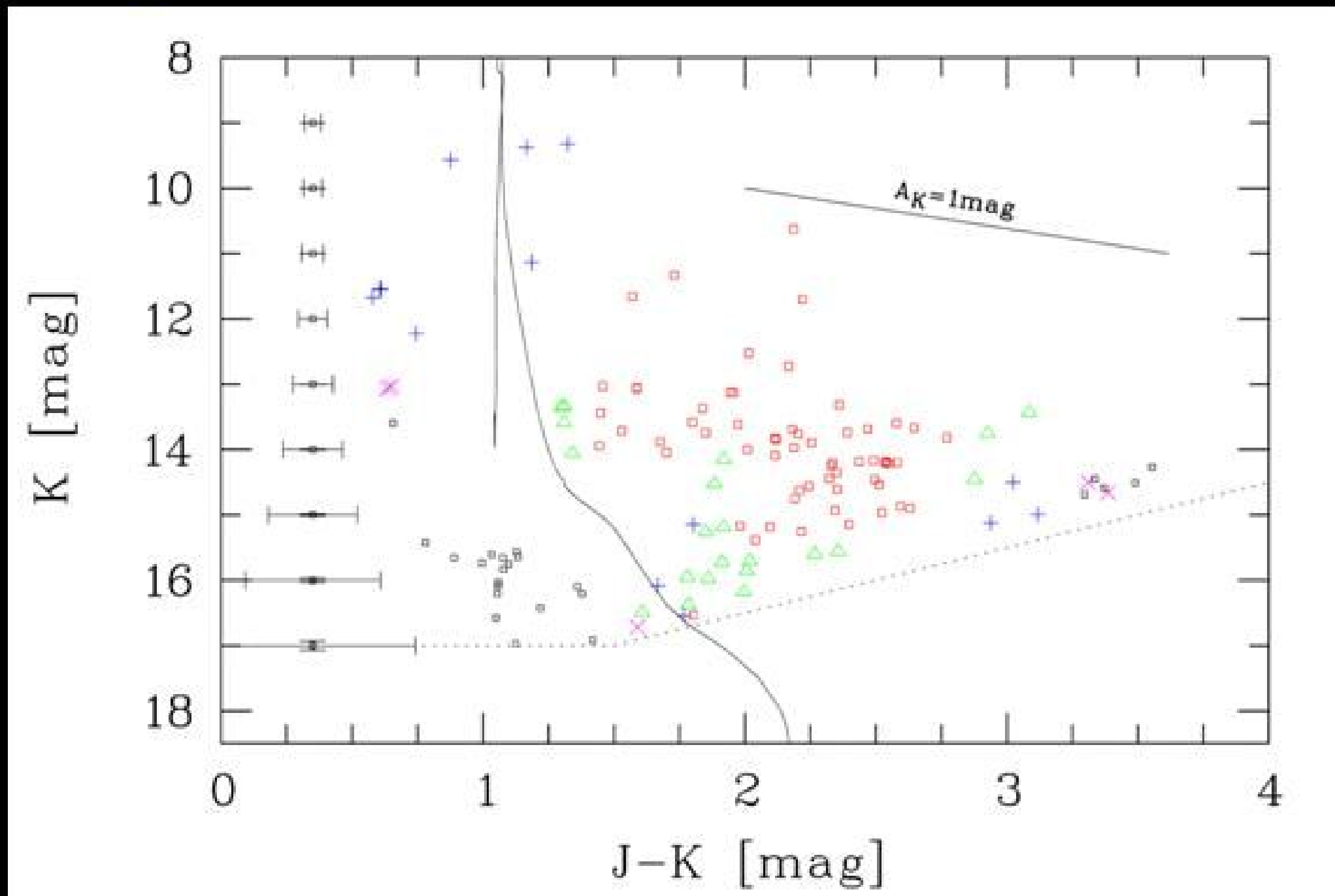
The Young Cluster Mercer14



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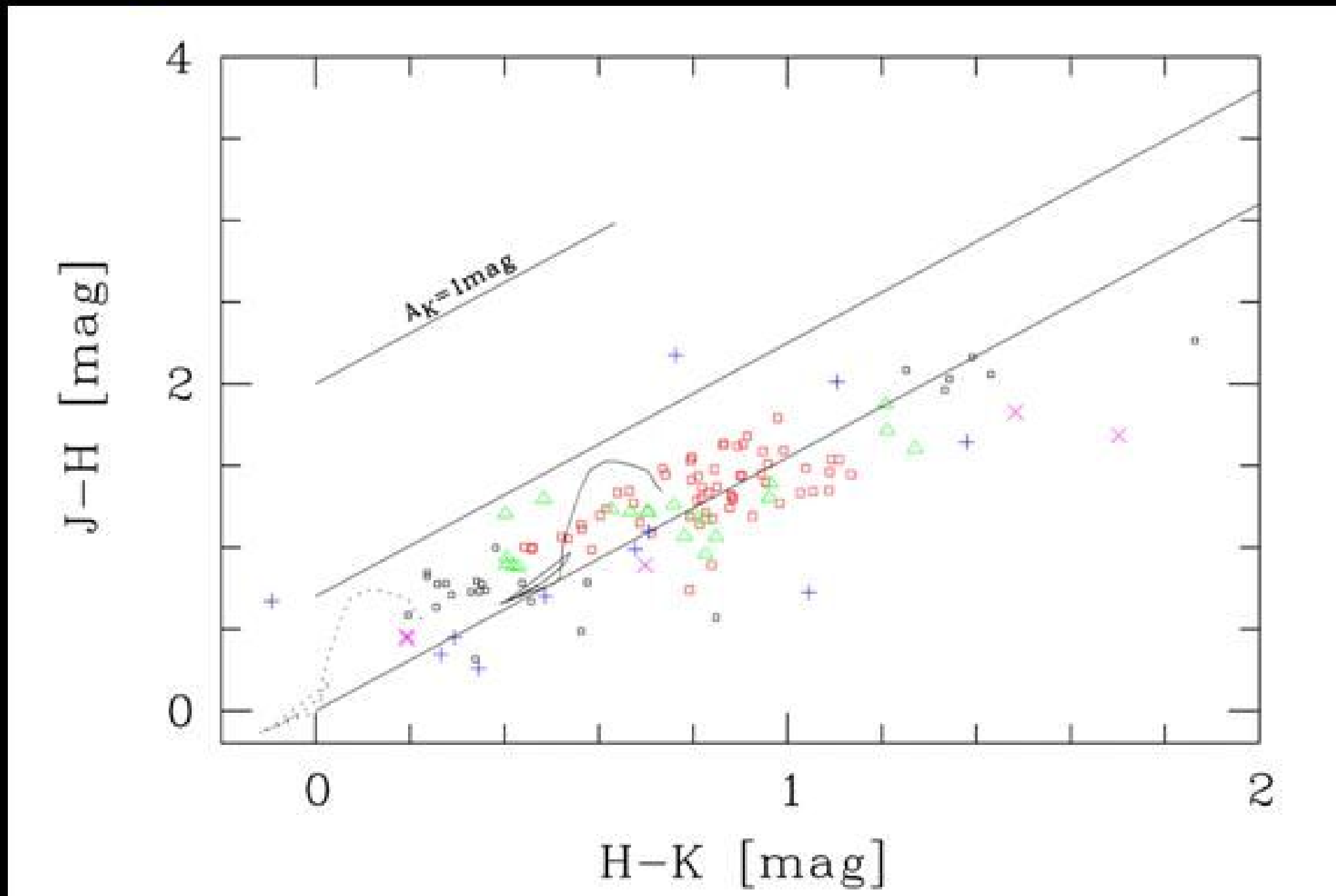

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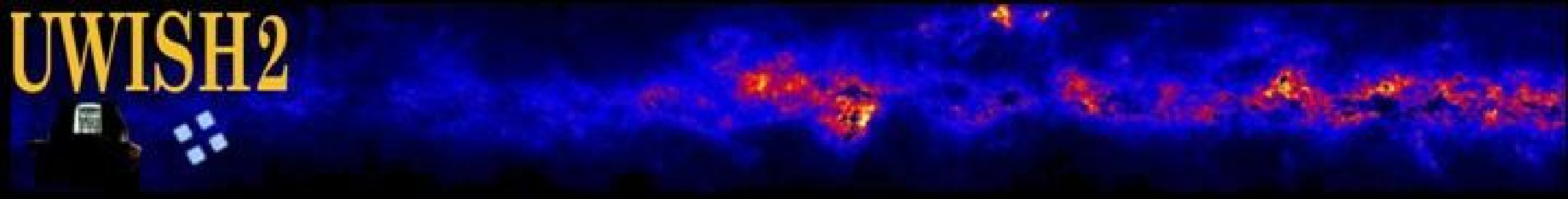
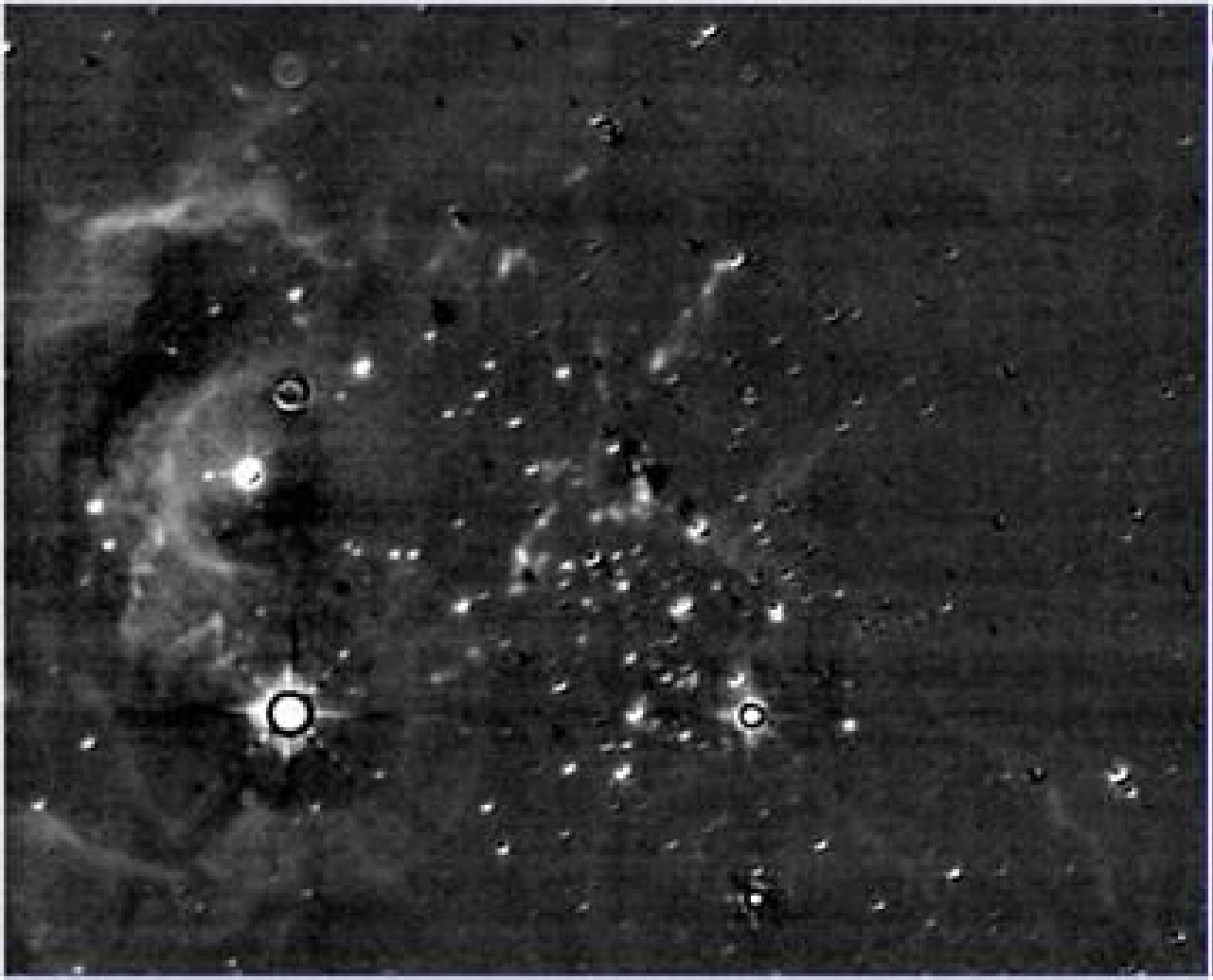


The Young Cluster Mercer14

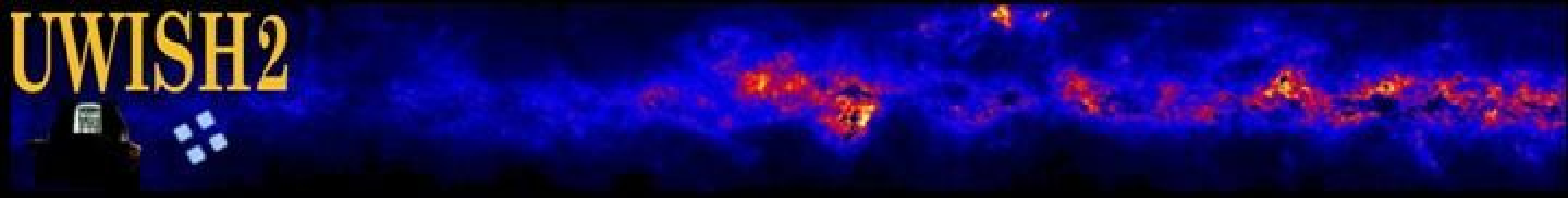
age<4Myrs; d=2.5kpc; A_K=0.8mag; M=500Mo

H_2-K



JHH_2

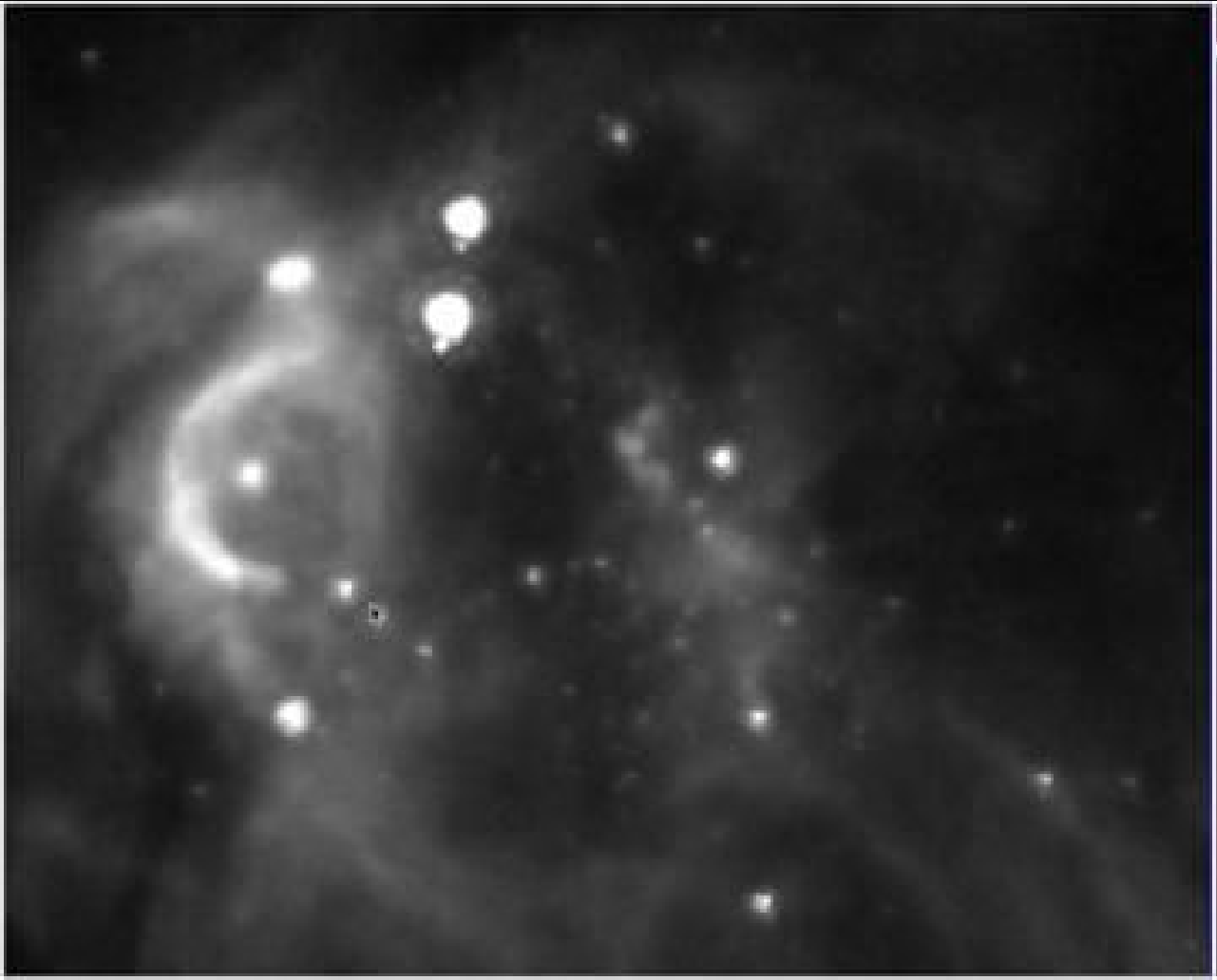
UWISH2



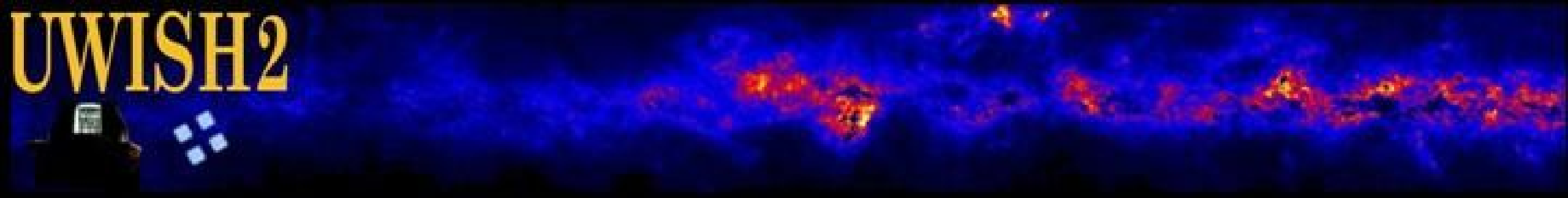
The Young Cluster Mercer14

age<4Myrs; d=2.5kpc; A_K=0.8mag; M=500Mo

IRAC3



JHH_2



VARIABLE STARS

Search methods:

H_2-K magnitudes in cross matched catalogues – unreliable so far

H_2-K difference images – time consuming but:

- finds variable saturated objects (bright, $m_{JHK} < 10$mag)
- finds extremely red objects
- finds HPM stars
- finds PN/outflows/SNRs

Colour images – only highly variable stars found, very red objects mimic variability

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VARIABLE STARS

JHK

UWISH2

VARIABLE STARS

JHH_2

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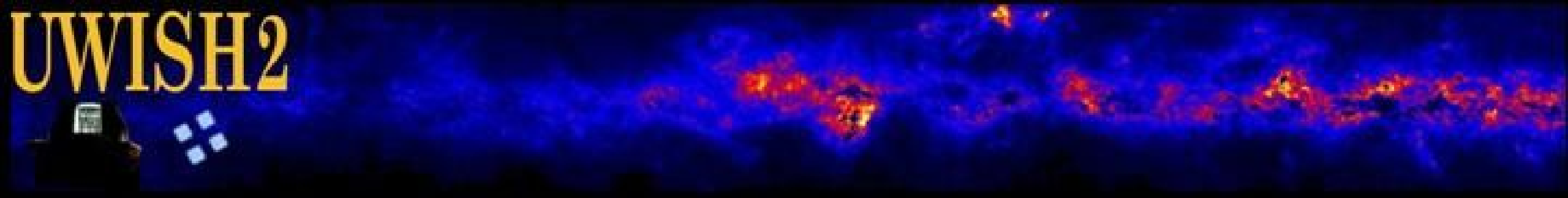


VARIABLE STARS

area searched: 12% of survey (22square degrees)

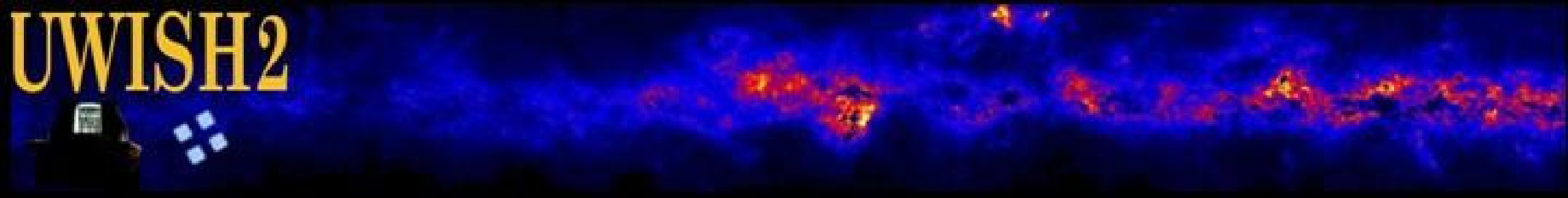
7500 candidate variable stars detected (~60.000 expected)

cross-id with GLIMPSE, 2MASS, DENIS, GPS, (UWISH2), (IPHAS), (WISE)

Good Glimpse detection in all bands: 45%

Good 2MASS detection in all bands: 50%

Good GPS detection in all bands: 21%



VARIABLE STARS

Glimpse sample:	2MASS sample:	GPS sample:
60% - Photospheres (giants)	89% - Photospheres	54% - Photospheres
10% - WTTS	3% - HAeBe	16% - HAeBe
22% - CTTS	7% - CTTS	18% - CTTS
8% - Protostars	1% - Protostars	11% - Protostars

UWISH2

VARIABLE STARS

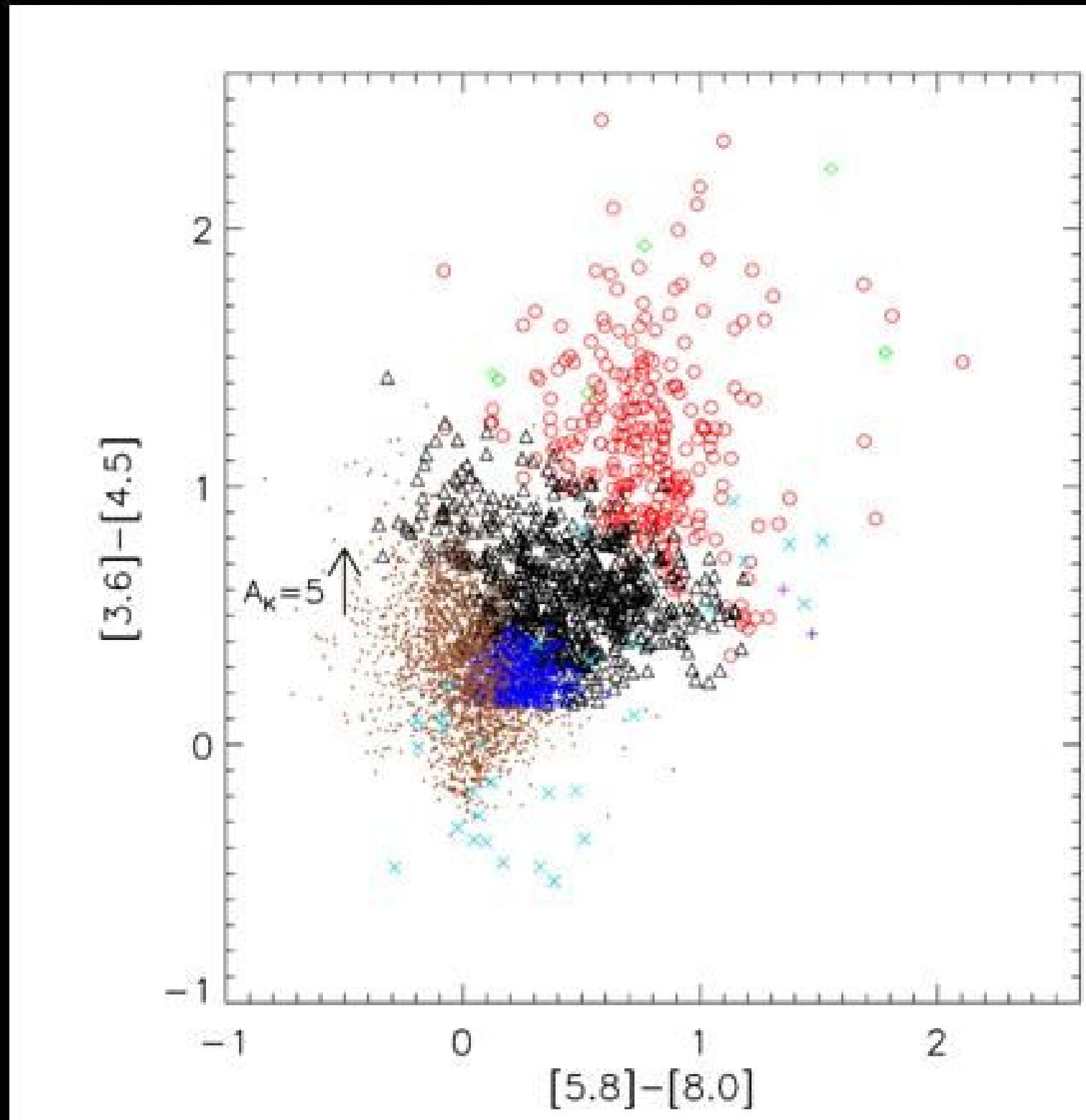
Glimpse sample:

60% - Photospheres (giants)

10% - WTTS

22% - CTTS

8% - Protostars



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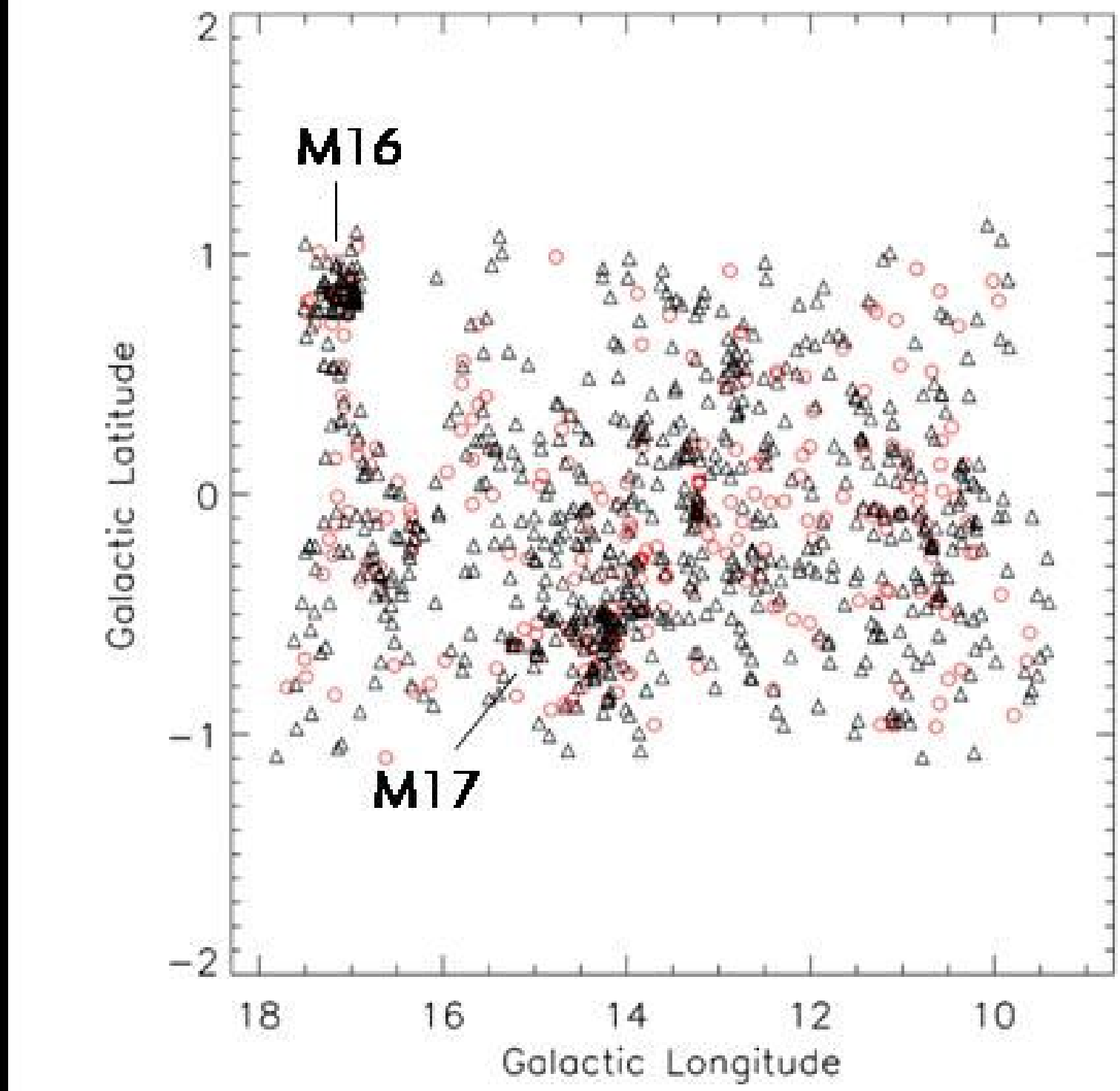

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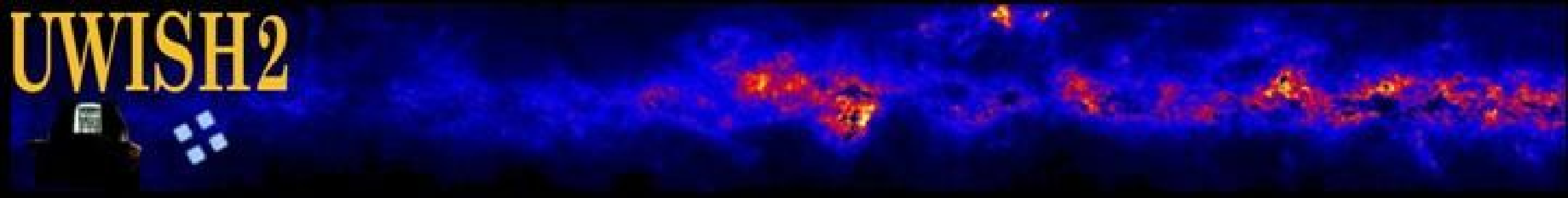

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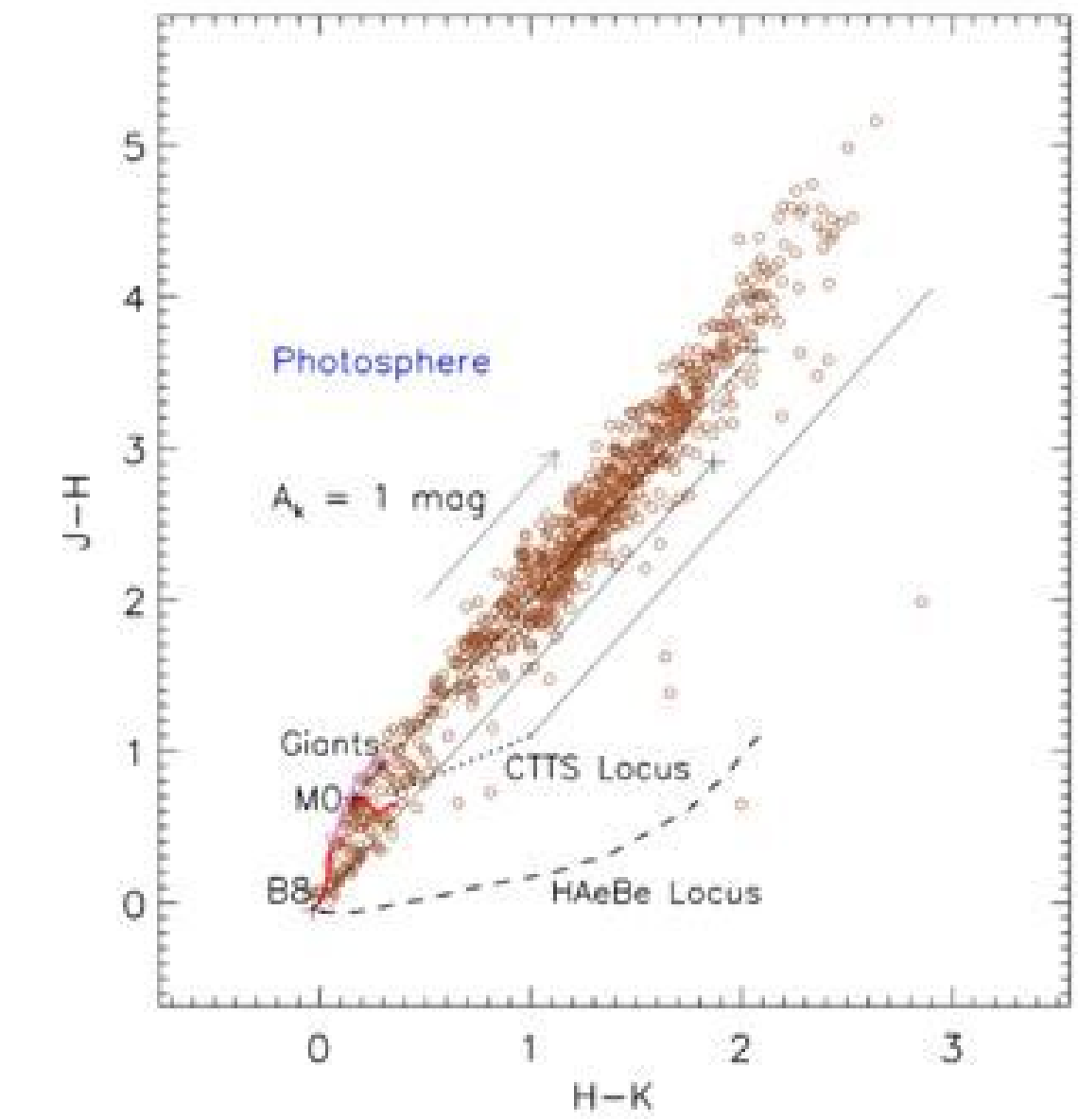

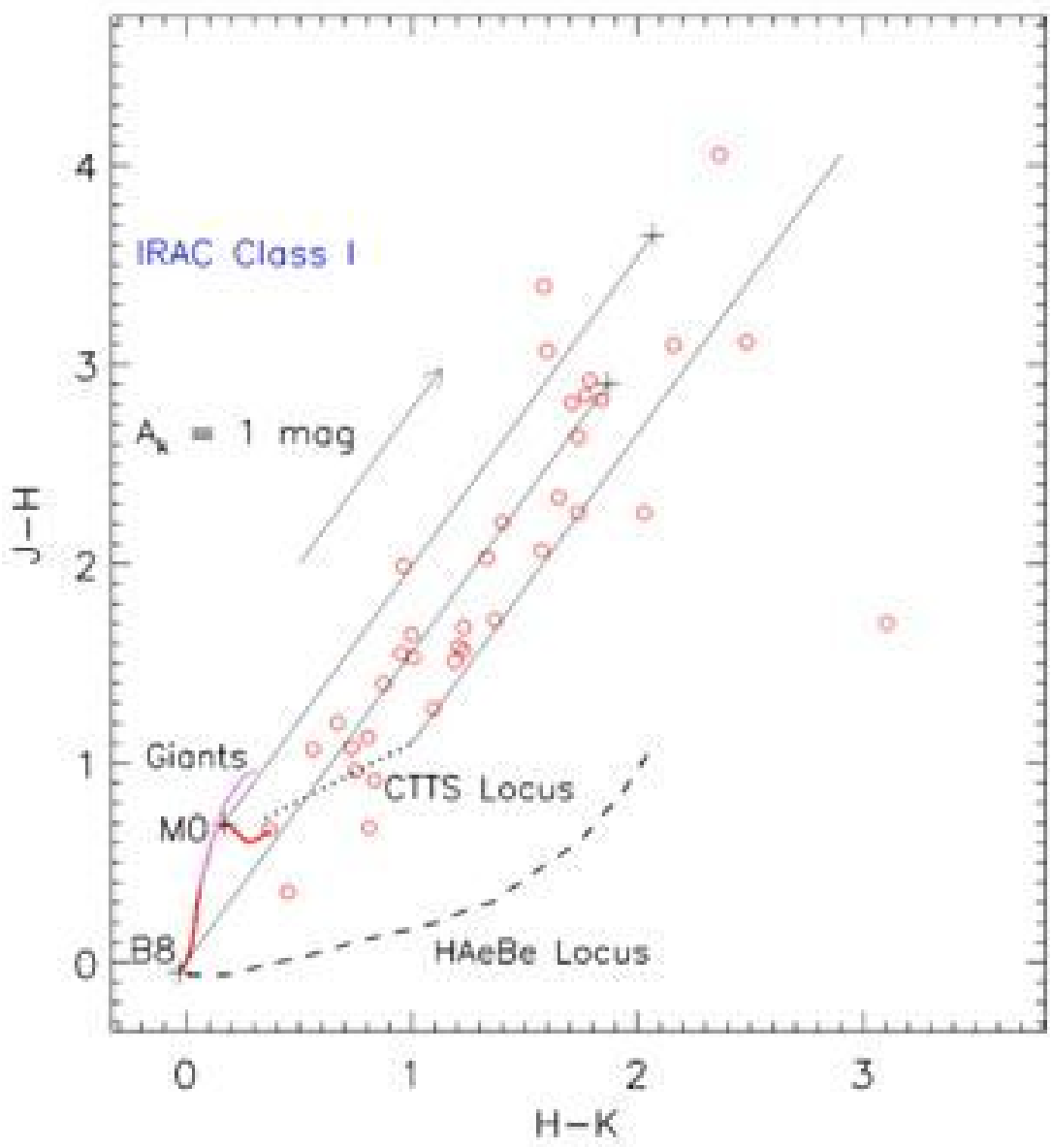

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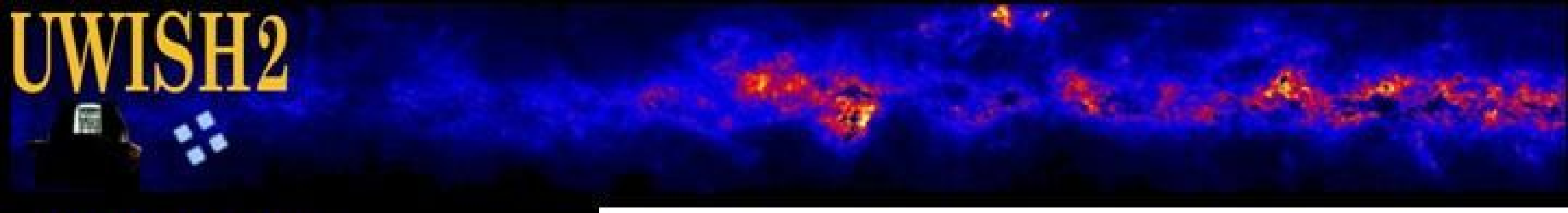


VARIABLE STARS

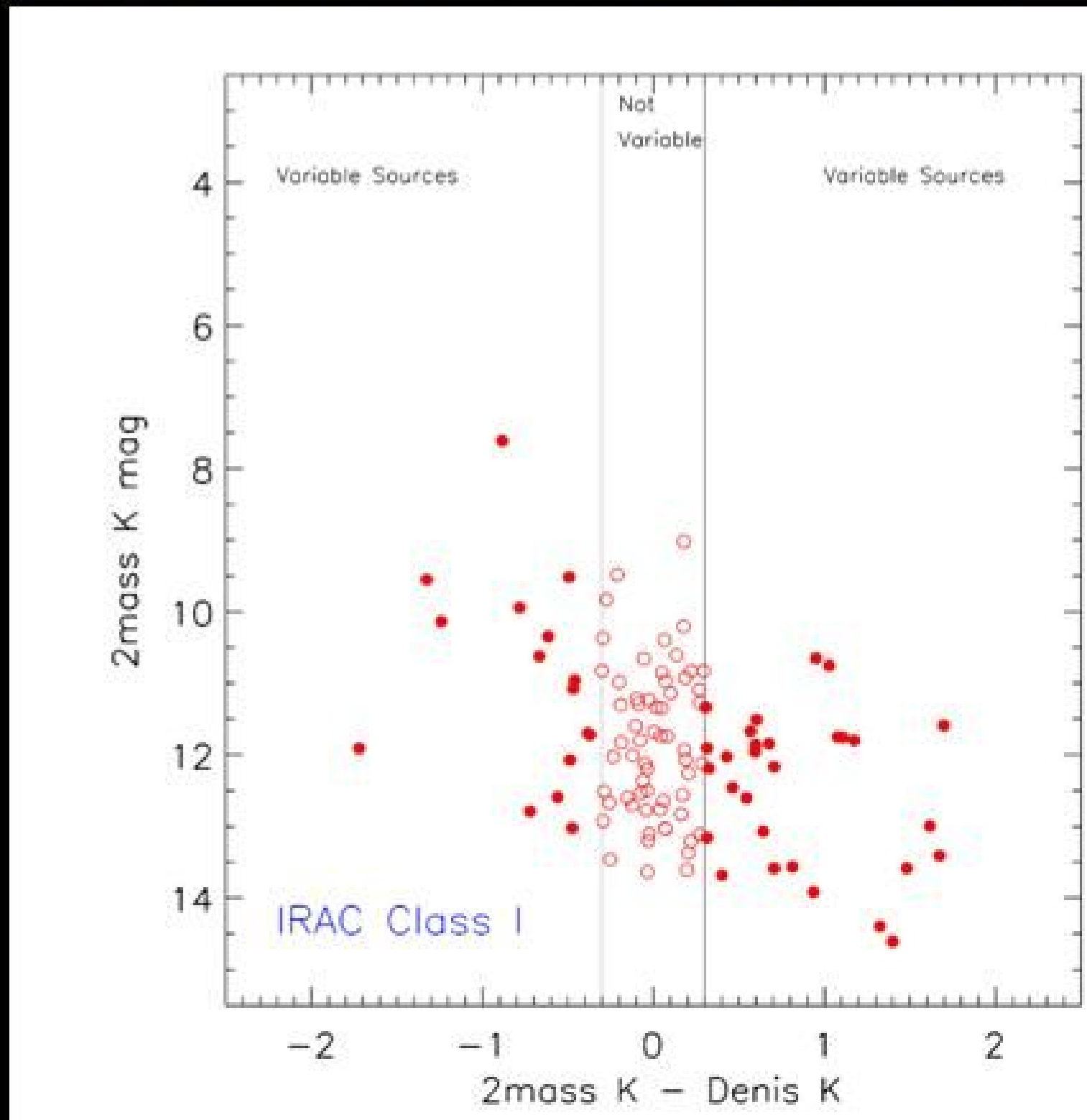
Glimpse sample + variability in K-band 2MASS & DENIS (65%):

13% of Photospheres (giants)

34% of WTTS

37% of CTTS

42% of Protostars



UWISH2

VARIABLE STARS

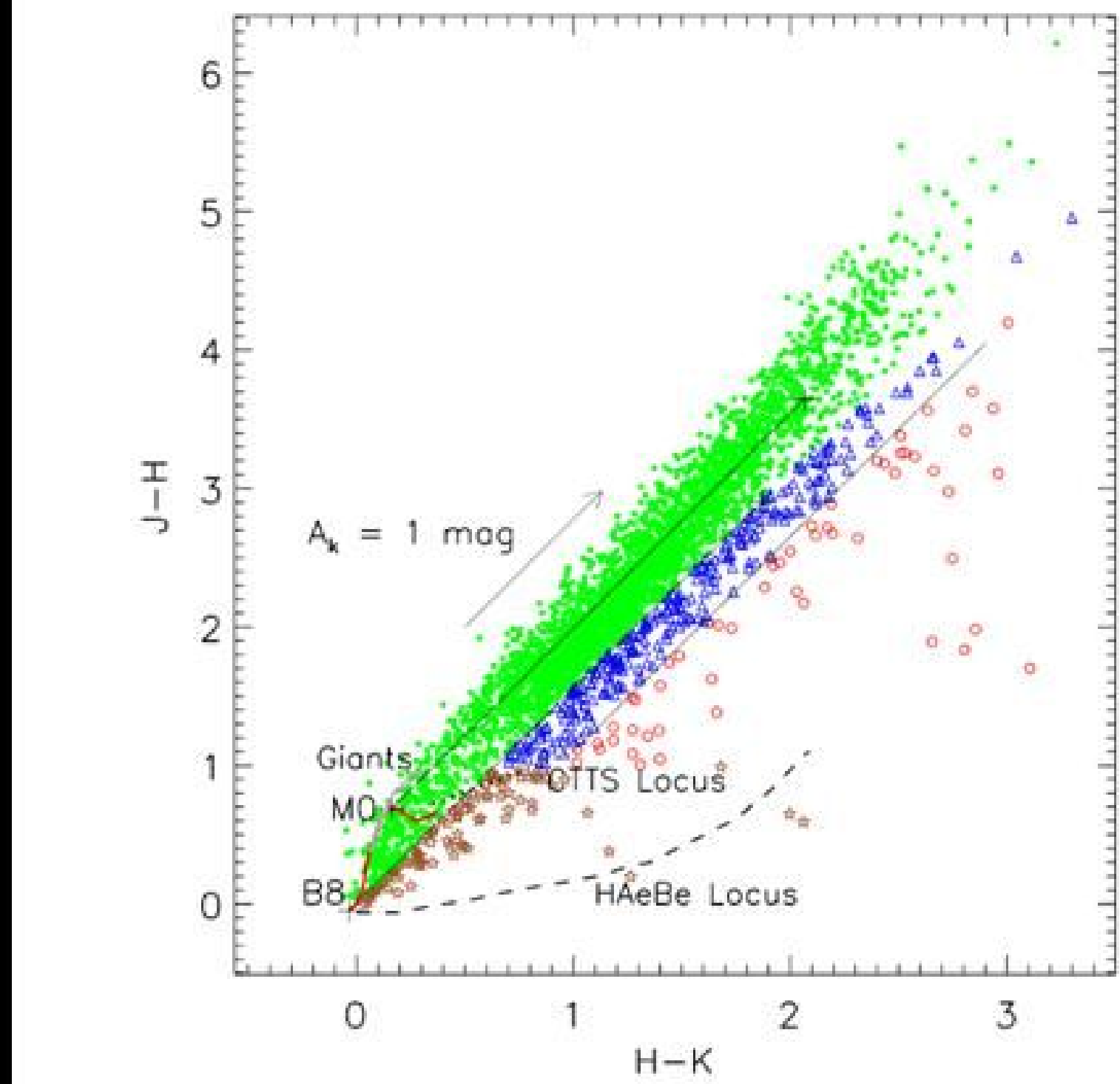
2MASS sample:

89% - Photospheres

3% - HAeBe

7% - CTTS

1% - Protostars



UWISH2

VARIABLE STARS

2MASS sample + variability in

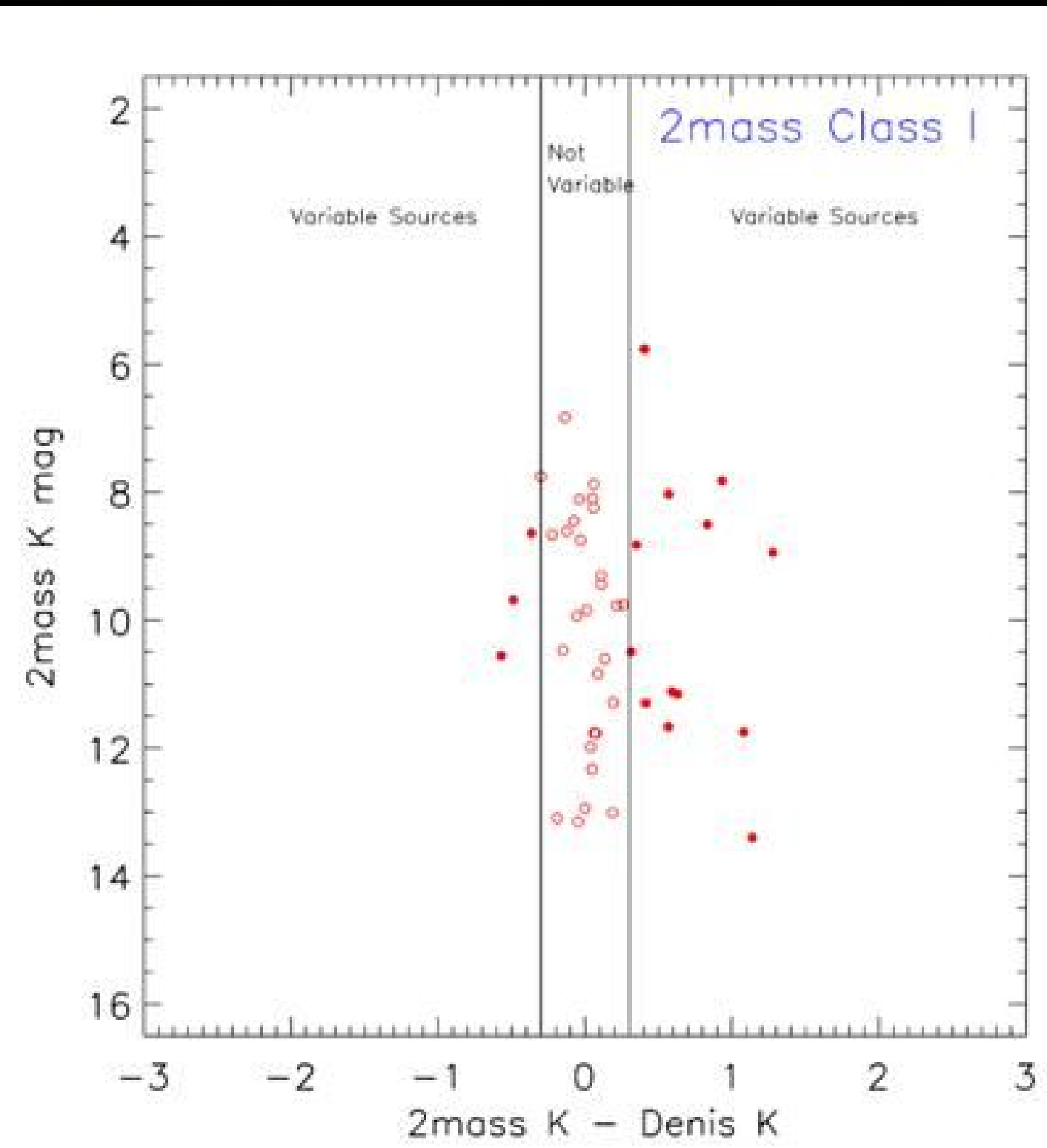
K-band 2MASS & DENIS:

32% of Photospheres

13% of HAeBe

41% of CTTS

36% of Protostars



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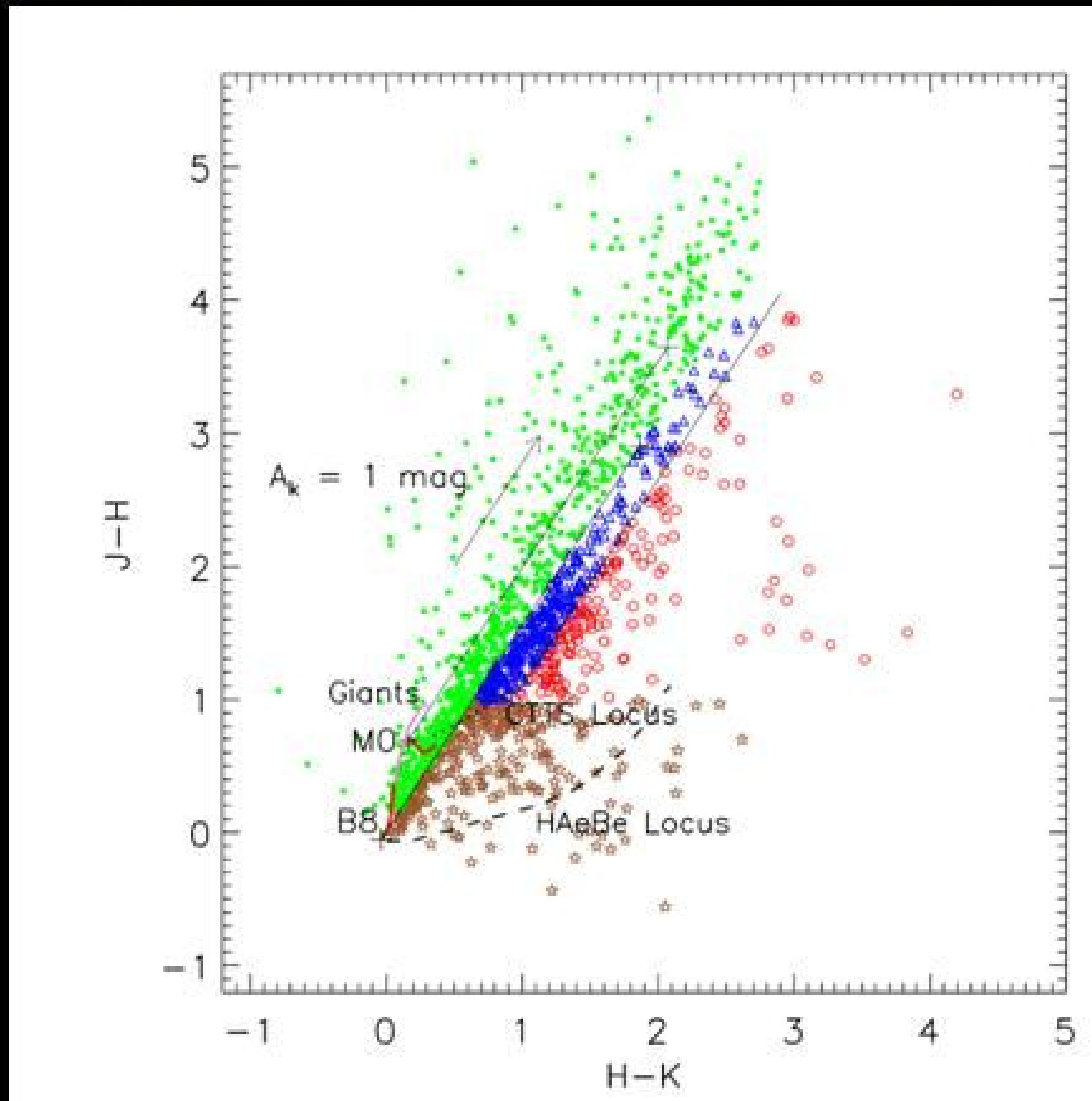
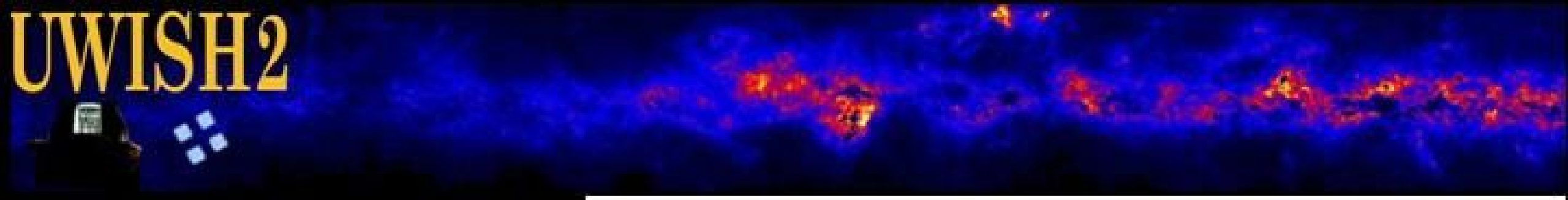
18% - CTTS

11% - Protostars



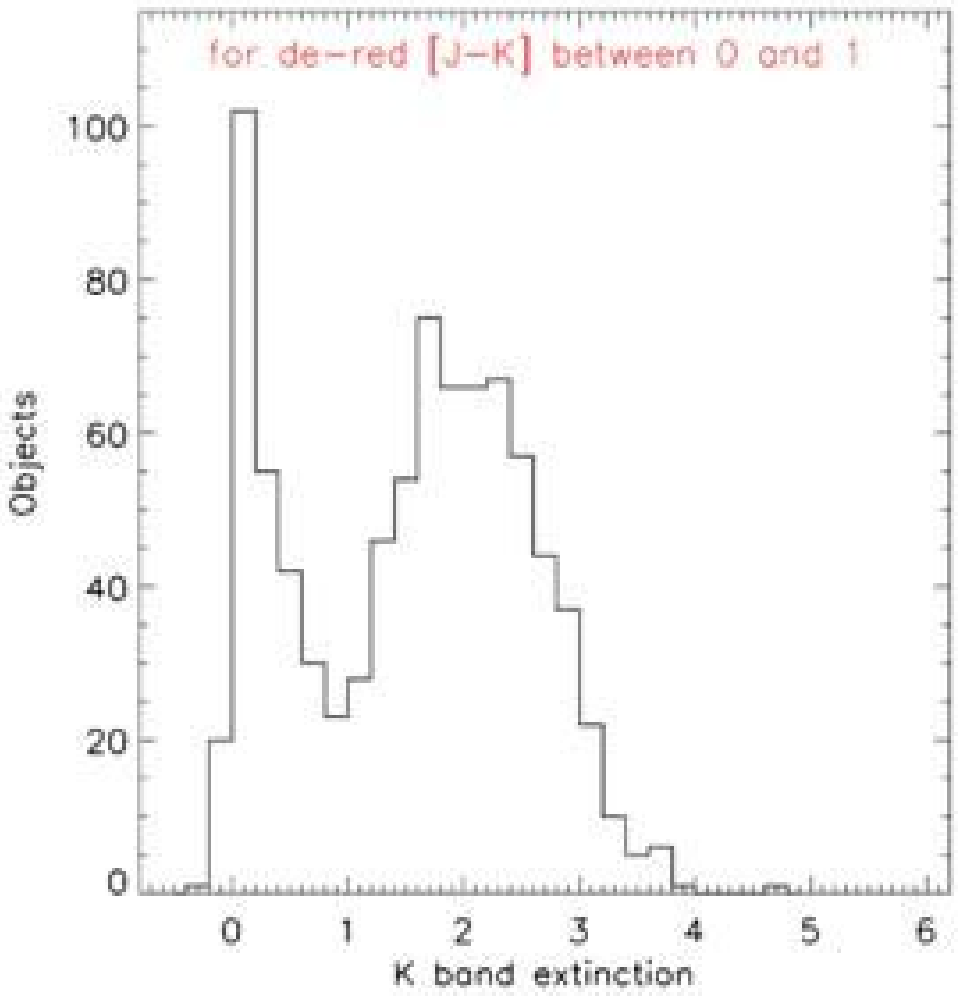
UWISH2

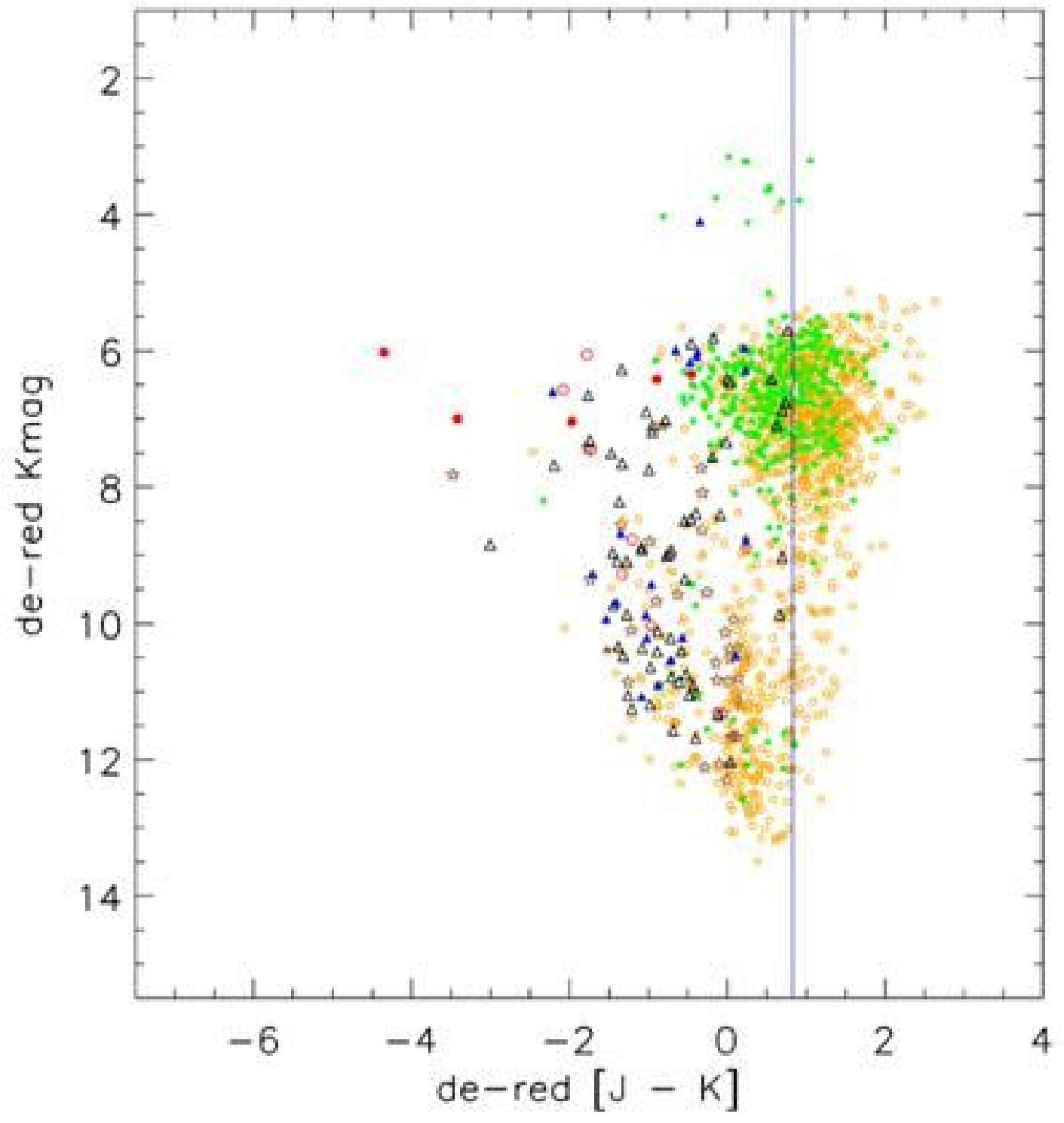


VARIABLE STARS

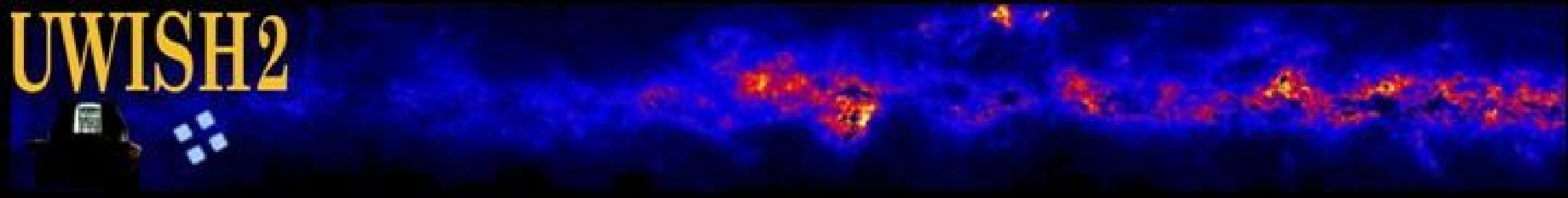
2MASS sample + 4.5μm IRAC:

dereddening based on [H-4.5]





UWISH2



VARIABLE STARS

There are

62 CTTS in Glimpse AND 2MASS sample

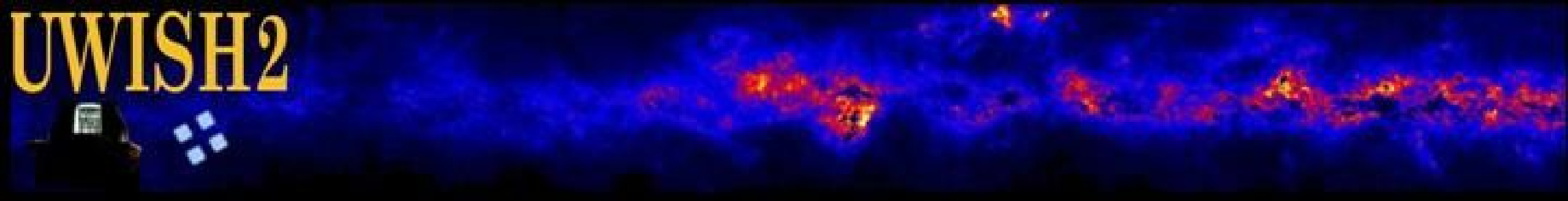
19 Protostars in Glimpse AND 2MASS sample

variability in K-band 2MASS & DENIS:

30% of CTTS

20% of Protostars

UWISH2

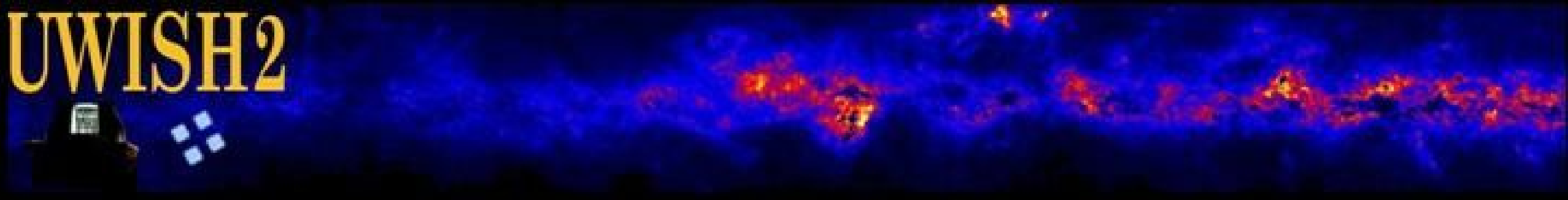


Planetary Nebulae

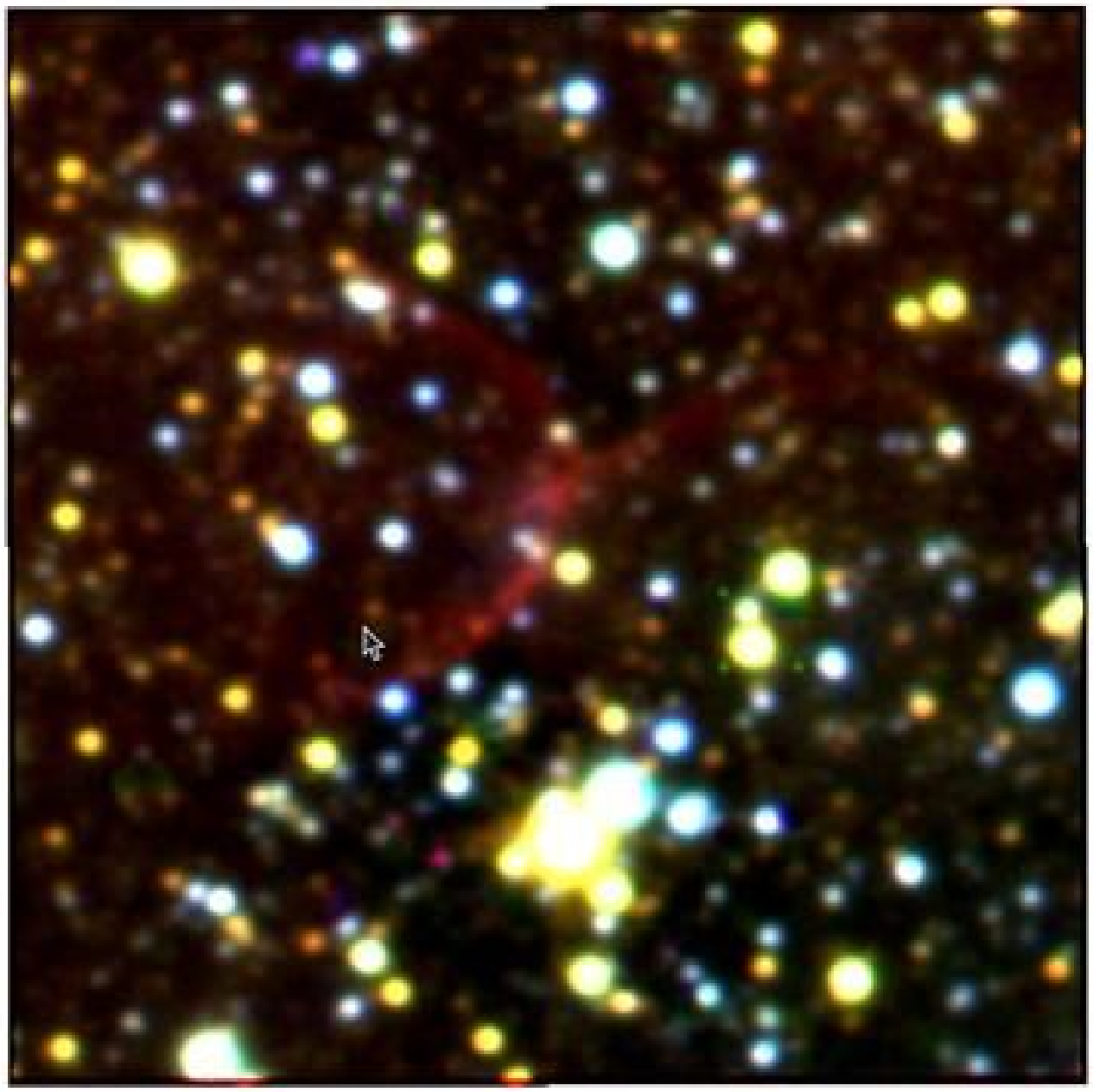
currently 46 new candidates
(60% of all PN seen in images!)

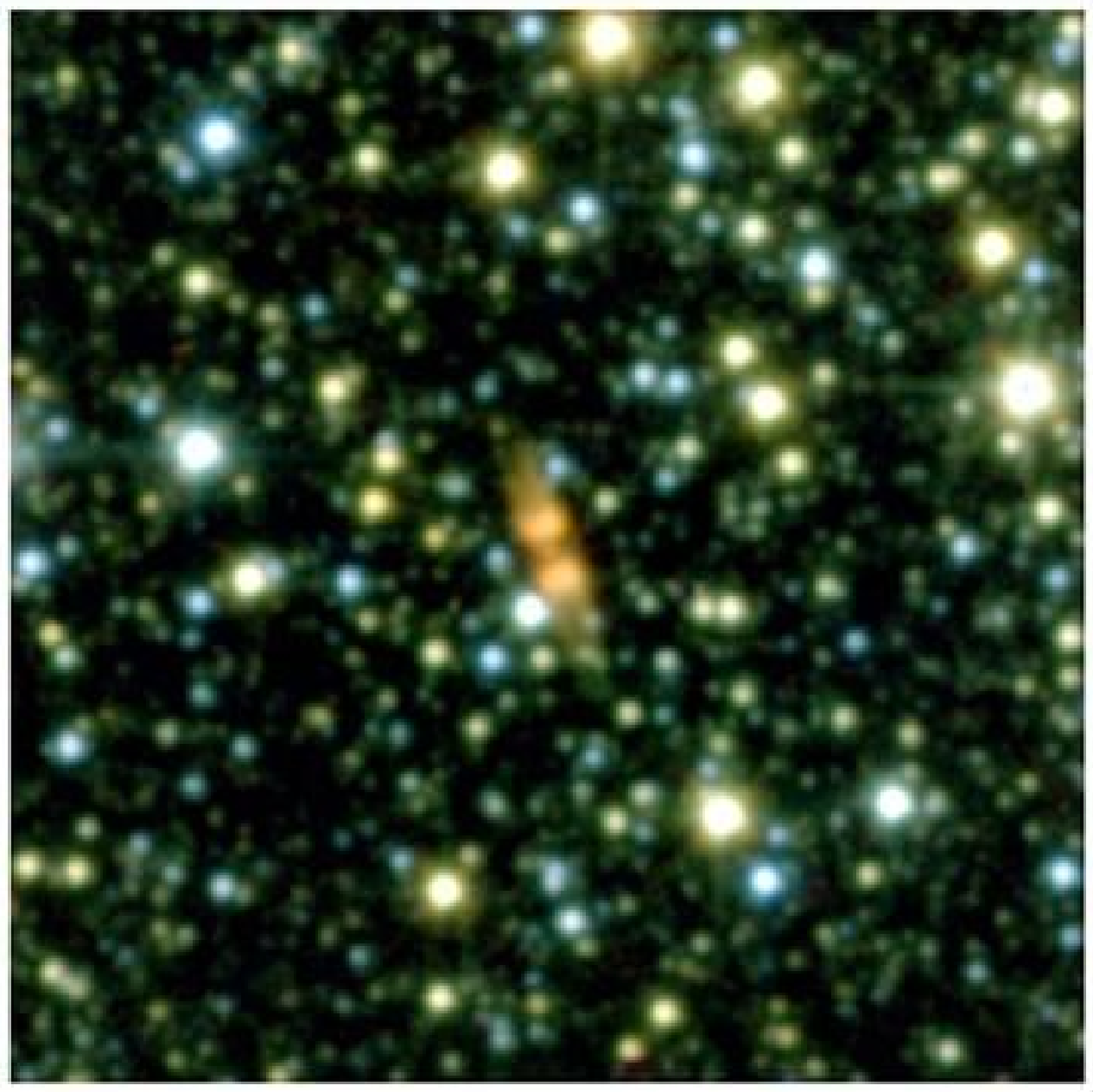
JKH_2 of three of the newly discovered planetary nebulae

UWISH2



Planetary Nebulae





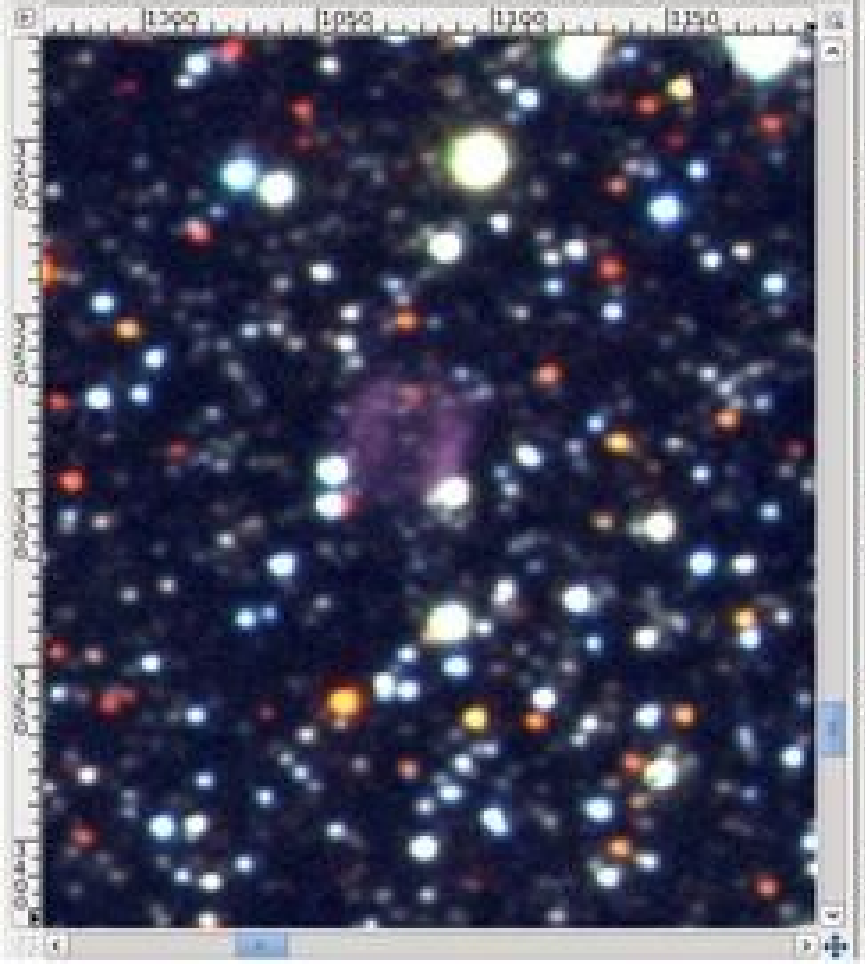
UWISH2

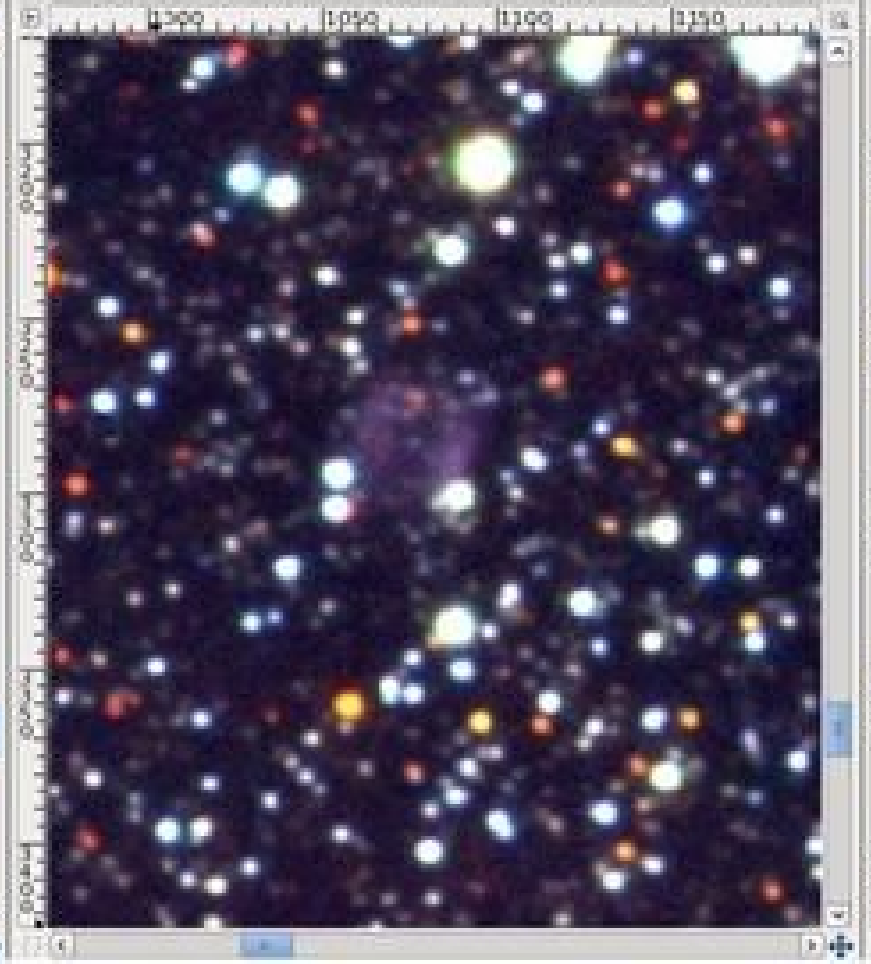
Odd Box

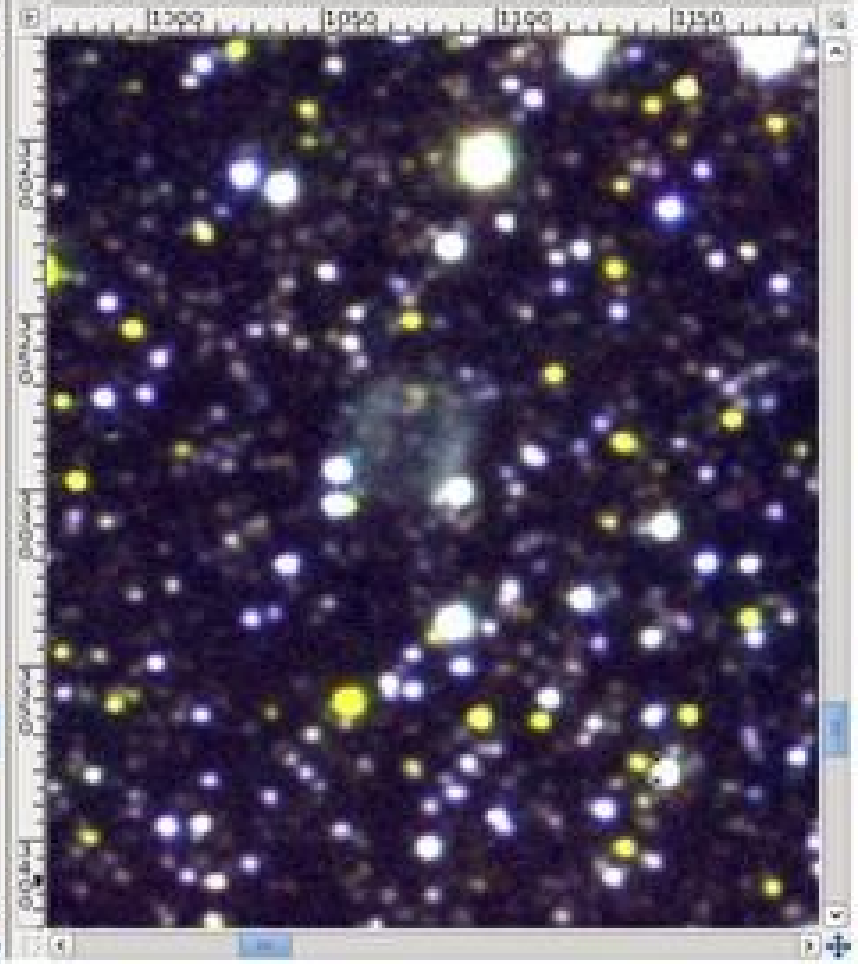
JHK

JHH_2

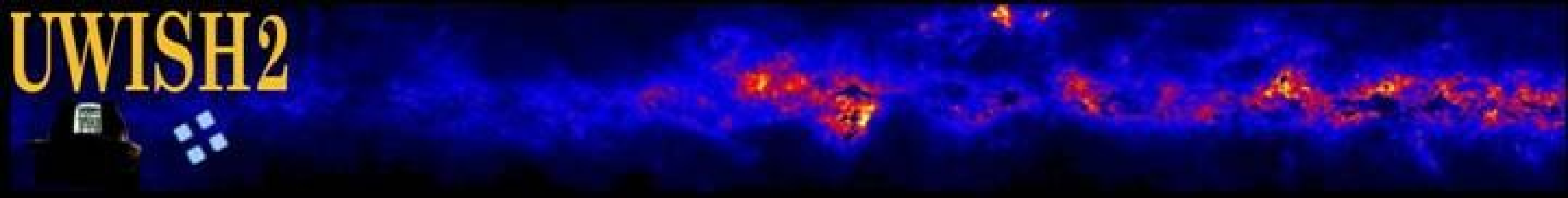
JKH_2



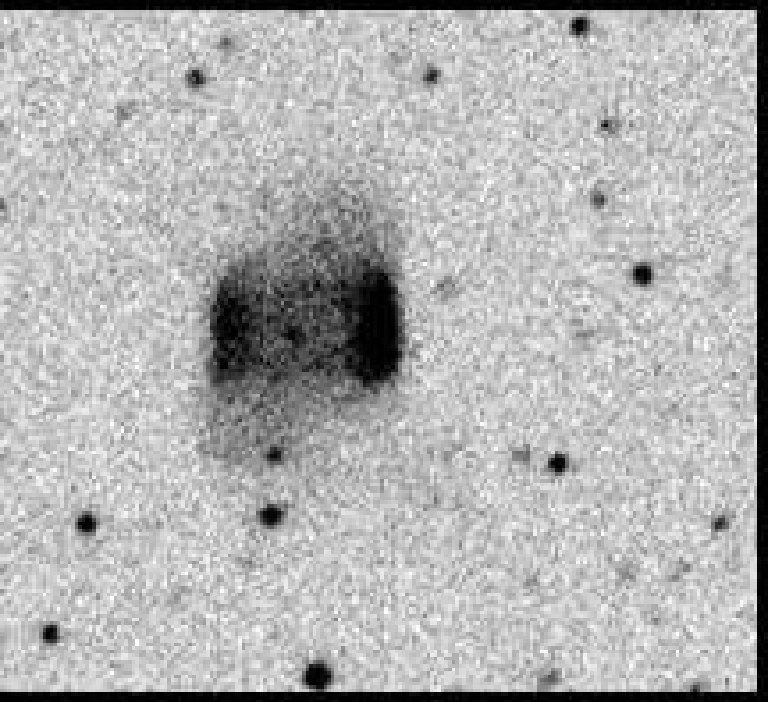




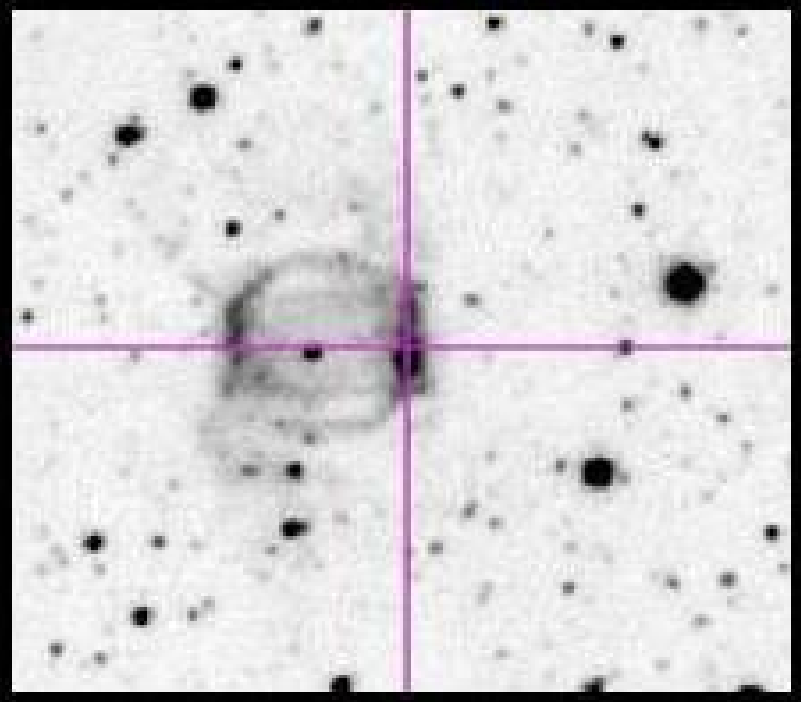
UWISH2



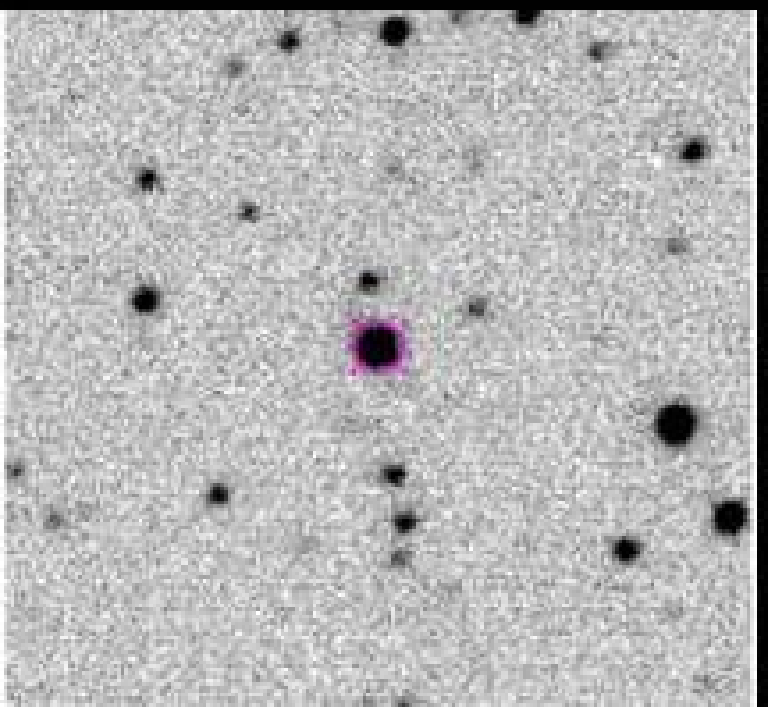
IPHAS Hα

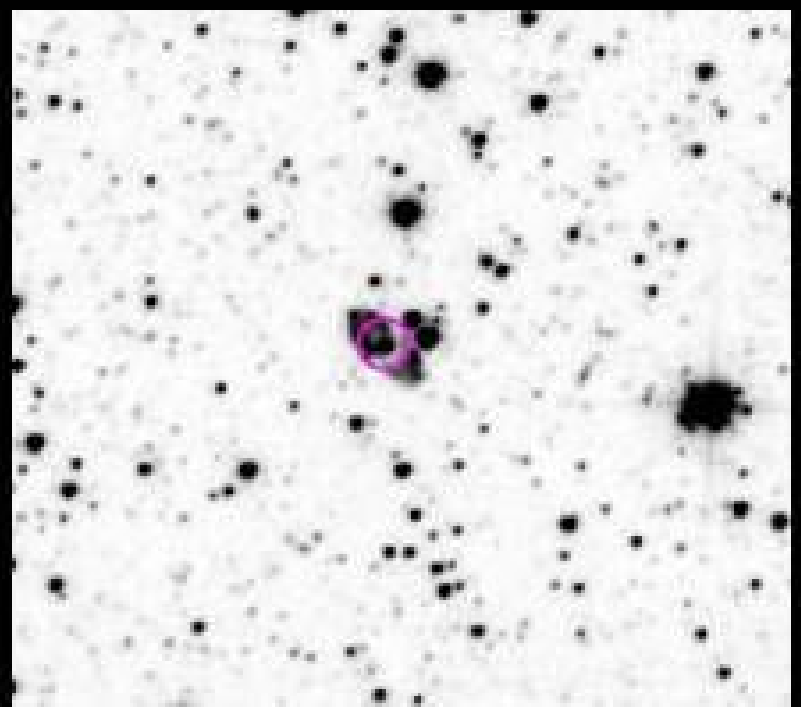


UWIS-H_2



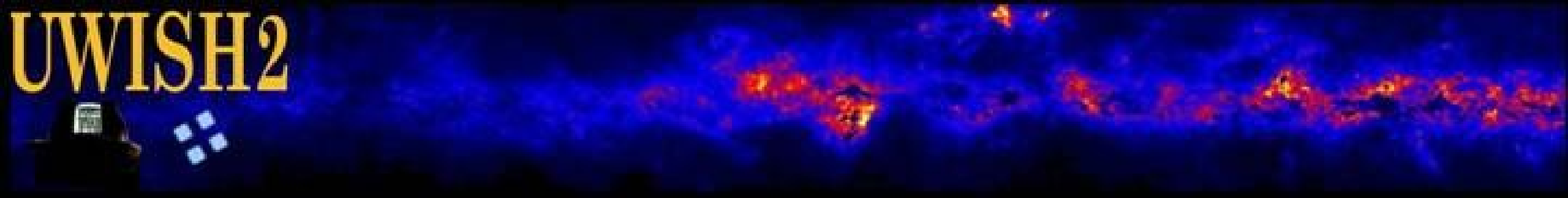
PN-like objects are generally visible in both filters, displaying similar morphology





Some objects are better resolved in H_2

UWISH2



IPHAS PN candidates in UWISH2

105 IPHAS PN candidates (Viironen et al. 2009) in UWISH2
50% analysed

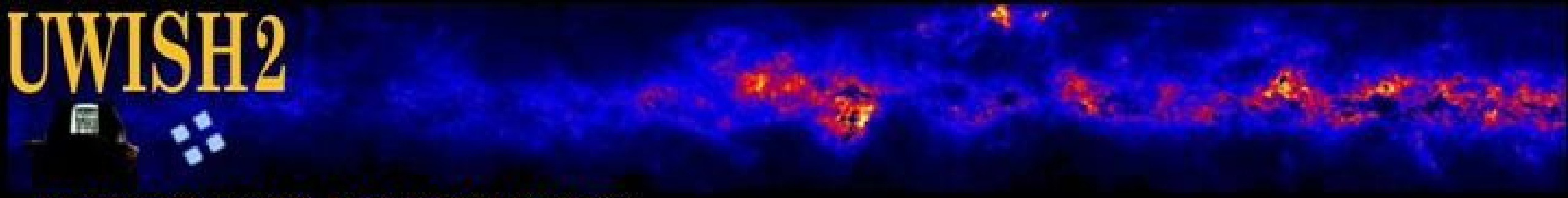
32% resolved in H**α**
32% resolved in H_2
26% resolved at **both** wavelengths

15% show clear PN-like structure visible in H**α**,
All of these are also resolved in H_2 (+2 more in H_2 only)

(ALL?) PN visible in H**α** also appear to excite H_2

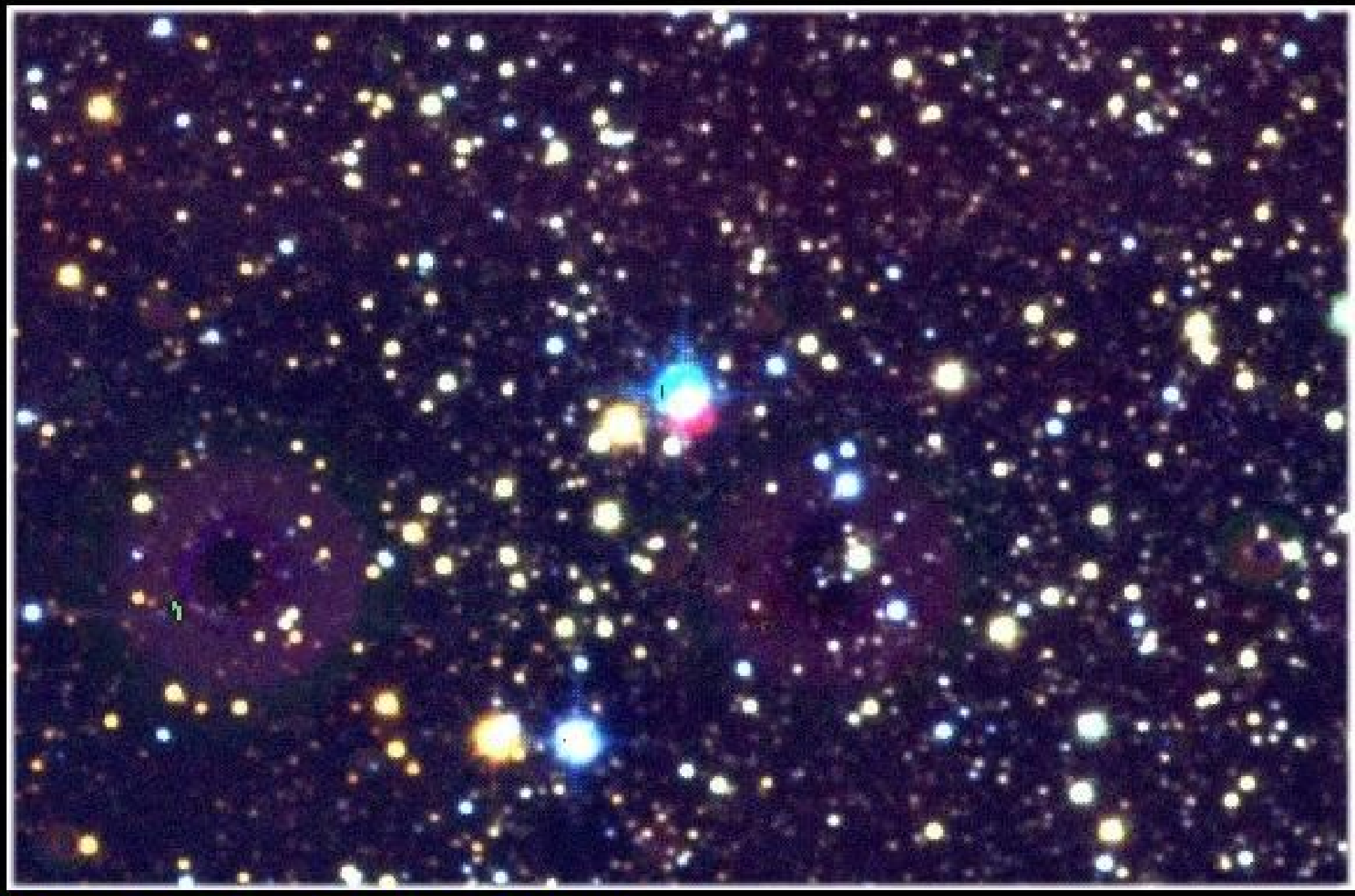
UWISH2 is an efficient PN detector in the Galactic Plane revealing optically obscured PN!

UWISH2



HIGH PROPER MOTION STARS

JHH_2

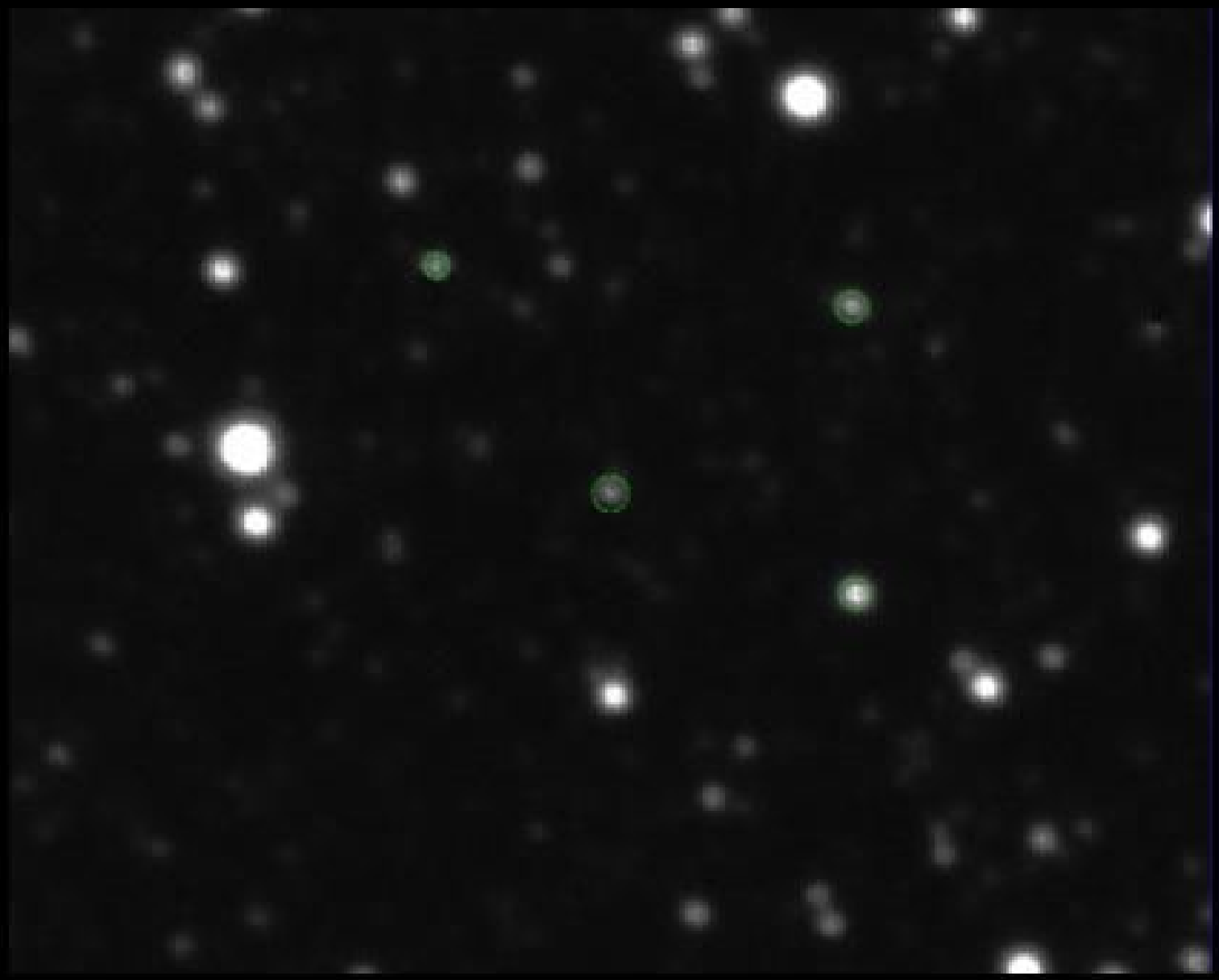


LP 690-83: 420mas, 0.7Mo, d=120pc, 230km/s

UWISH2

HIGH PROPER MOTION STARS

K vs H_2

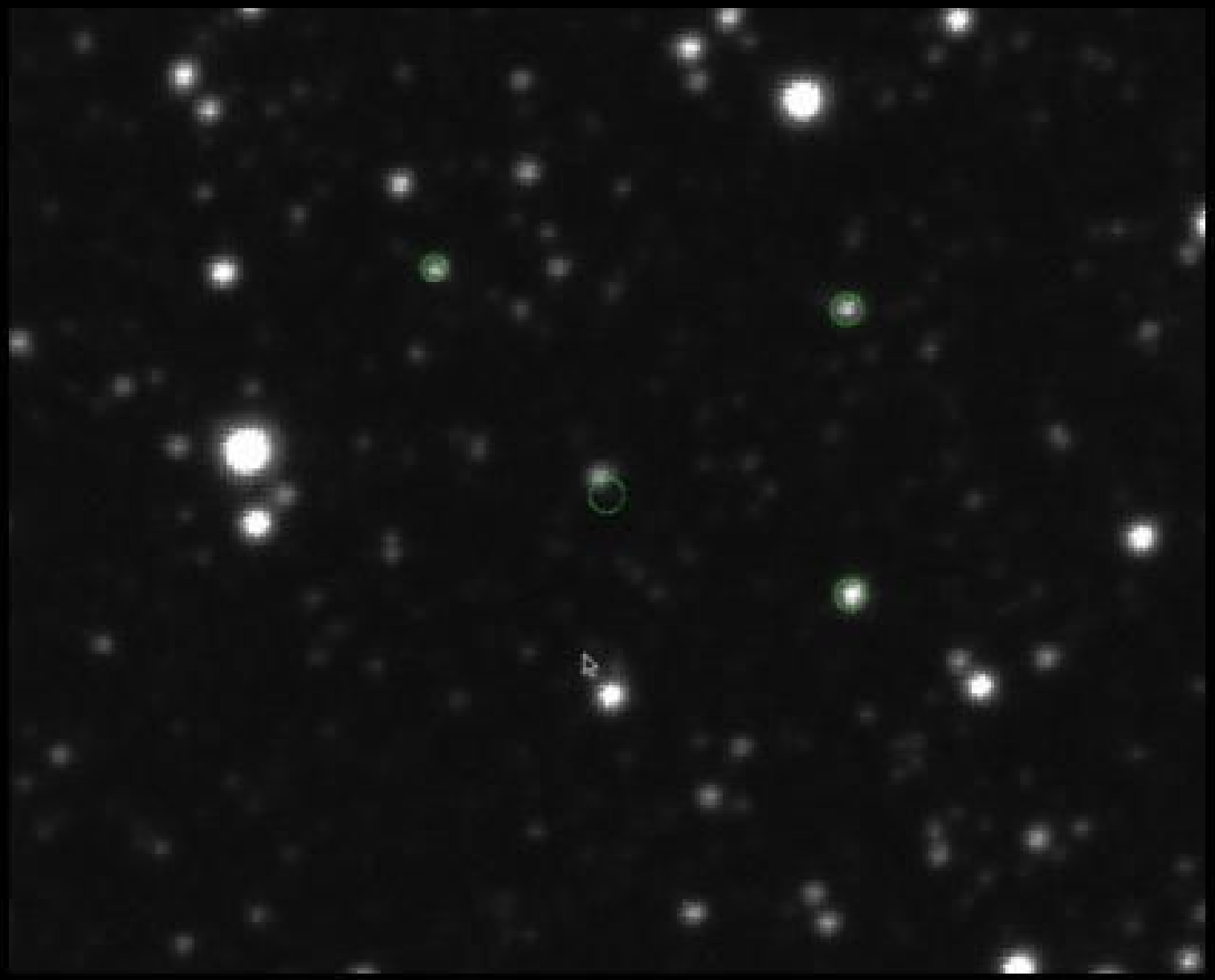


240mas, SpT=M6, d=80pc, 90km/s

UWISH2

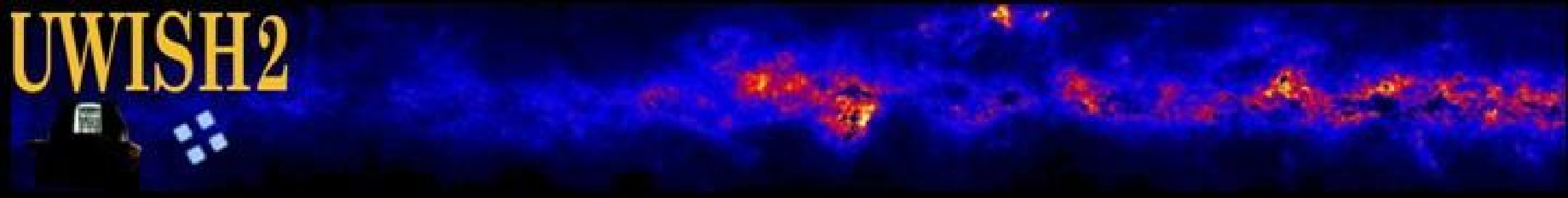
HIGH PROPER MOTION STARS

K vs H_2



240mas, SpT=M6, d=80pc, 90km/s

UWISH2



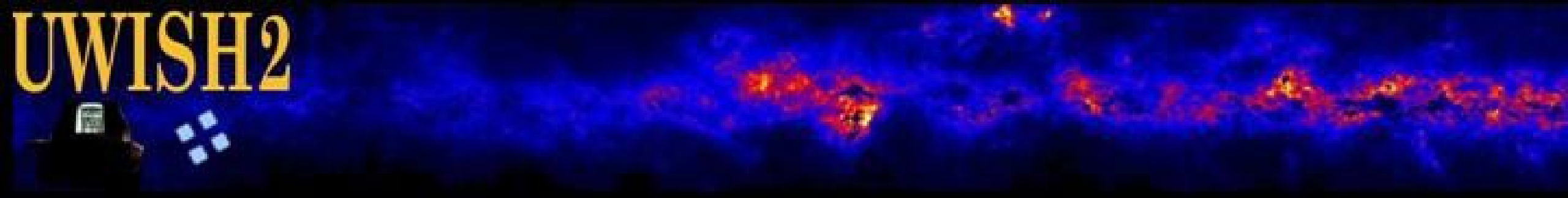
HIGH PROPER MOTION STARS

There are so far 77 unknown candidate HPM stars in about 12% of the entire survey area.

Many of these are L-dwarf candidates based on their NIR colours

Student project will look into comparison of search in H_2-K difference images and blinking the H_2 and K images

UWISH2



FUTURE?

- We will finish the survey this summer (3 more scheduled nights)
- If UKIRT stays open after 2012, we will expand the H_2 survey as part of UKIDSS++
- Image along the entire plane from l=-2deg to l=107deg with a width of 1.5deg
- Additional regions i.e. Serpens, CygnusX etc.
- 10% of entire field again in H_2 and Br-gamma
- 48 nights required
- A complementary VISTA survey is envisaged

Future?

Outer Arm

l=107°

l=65°

Perseus Arm

8kpc

6kpc

Sagittarius Arm

4kpc

Long Bar

Far 3kpc Arm

l=7°

GC

l=-2°

Near 3kpc Arm

Galactic Bar

Norma Arm

VISTA?