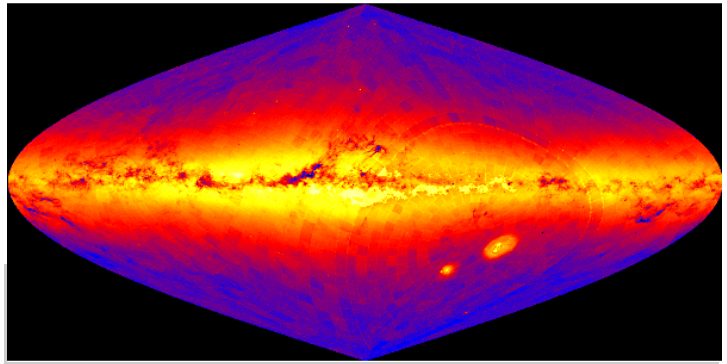
Detecting and classifying faint neighbours of the sun

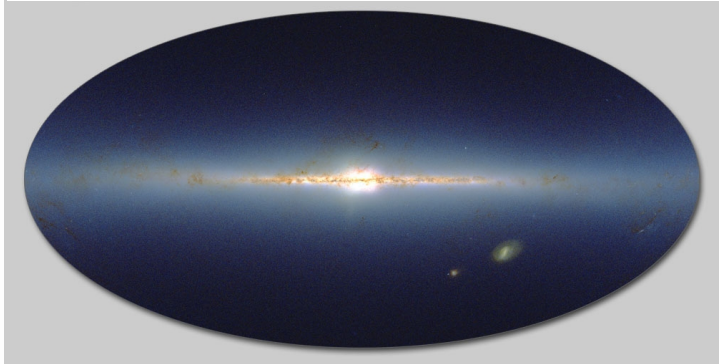
using multi-epoch & multi-colour sky surveys

R.-D. Scholz (AIP)

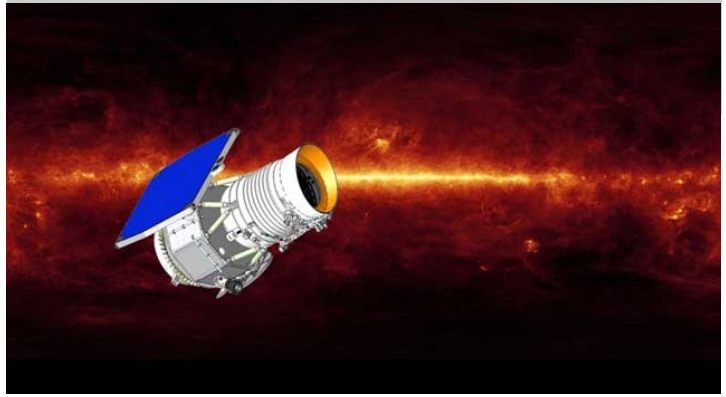
DSS (optical)

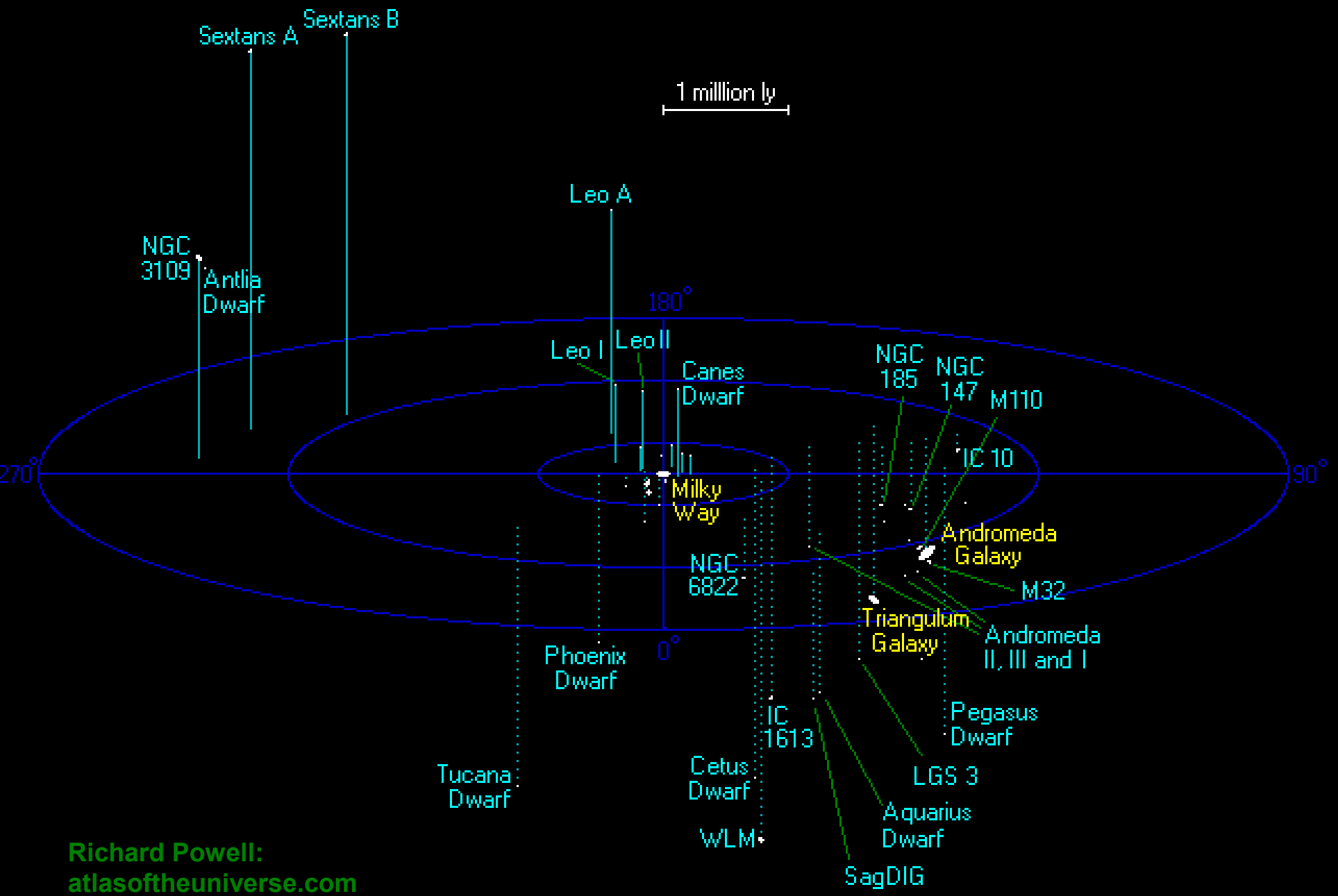


2MASS (near-infrared)



WISE (mid-infrared)

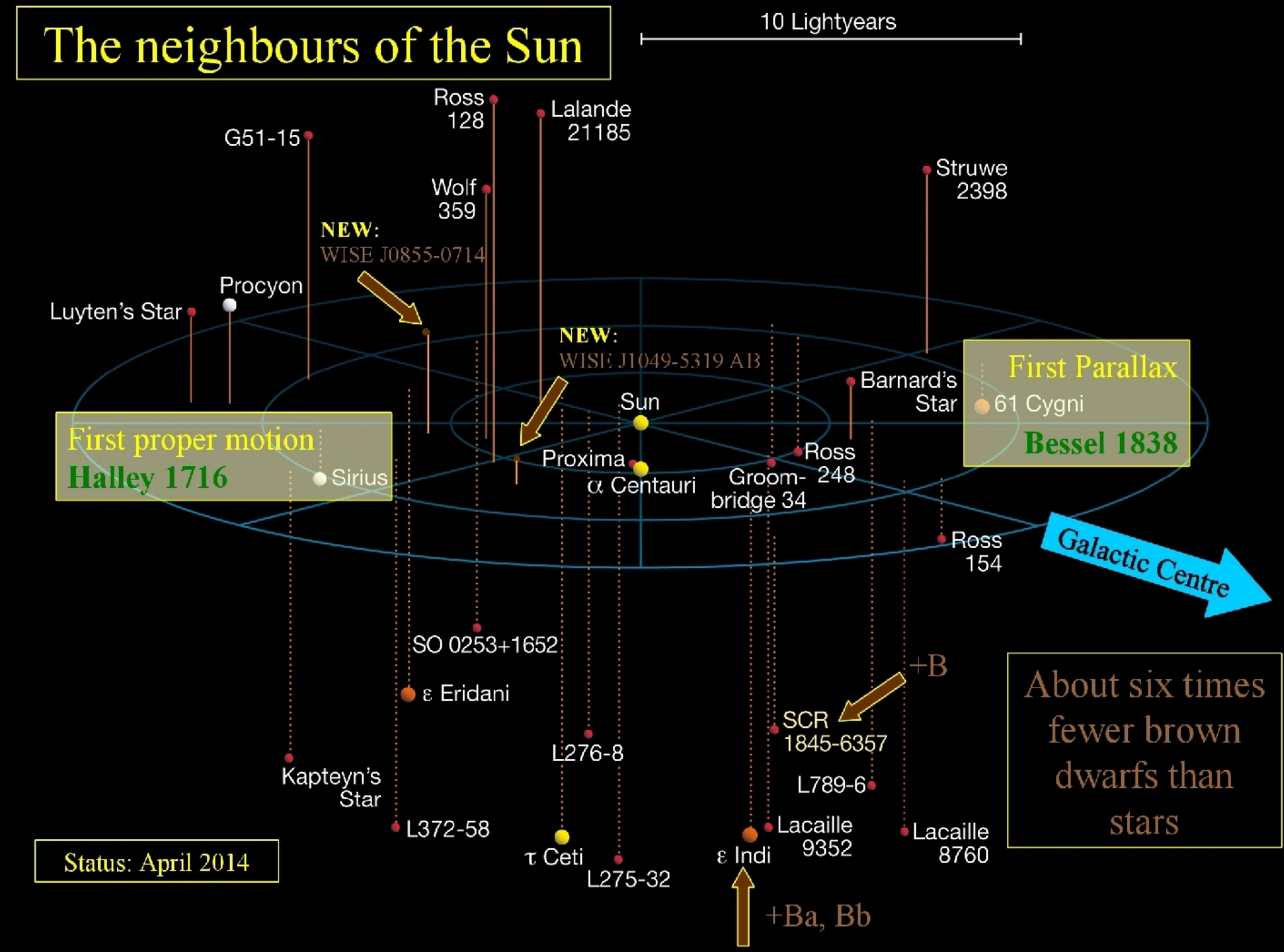




MW and The Local Volume at Large

Richard Powell:
atlasoftheuniverse.com

r powell



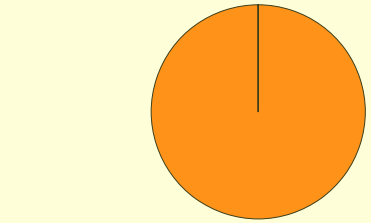
The immediate Solar neighbourhood

=

very local volume

adapted from images of Richard Powell

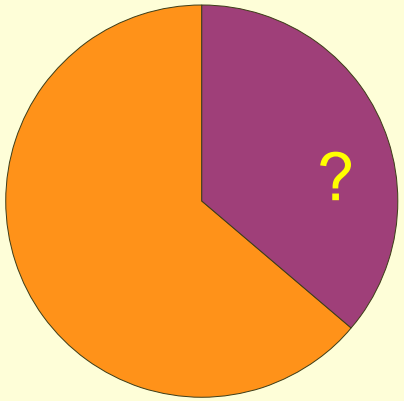
Missing neighbours / Progress of last years



Missing stellar neighbours:

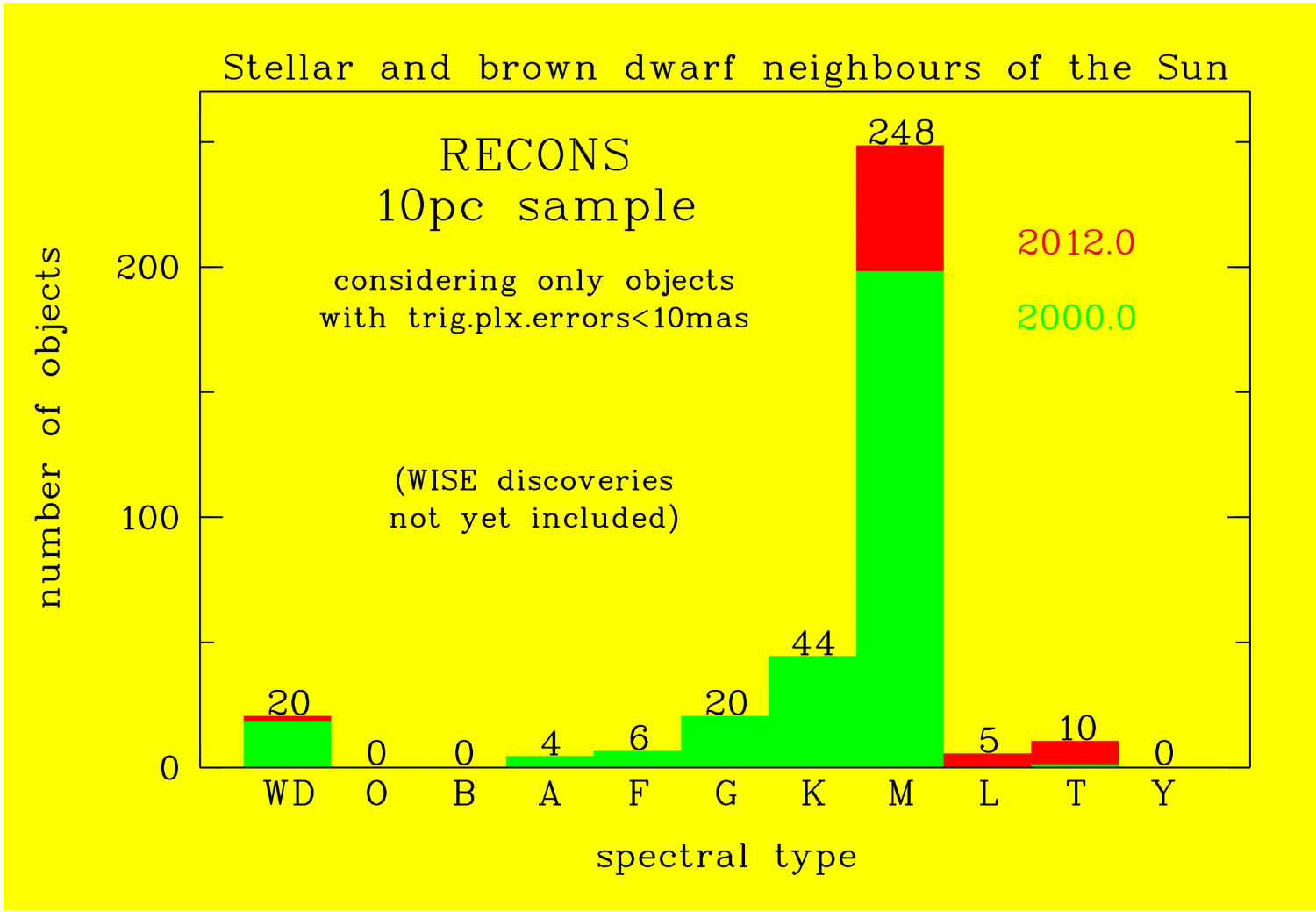
If 5pc sample (44 systems) is complete,

then



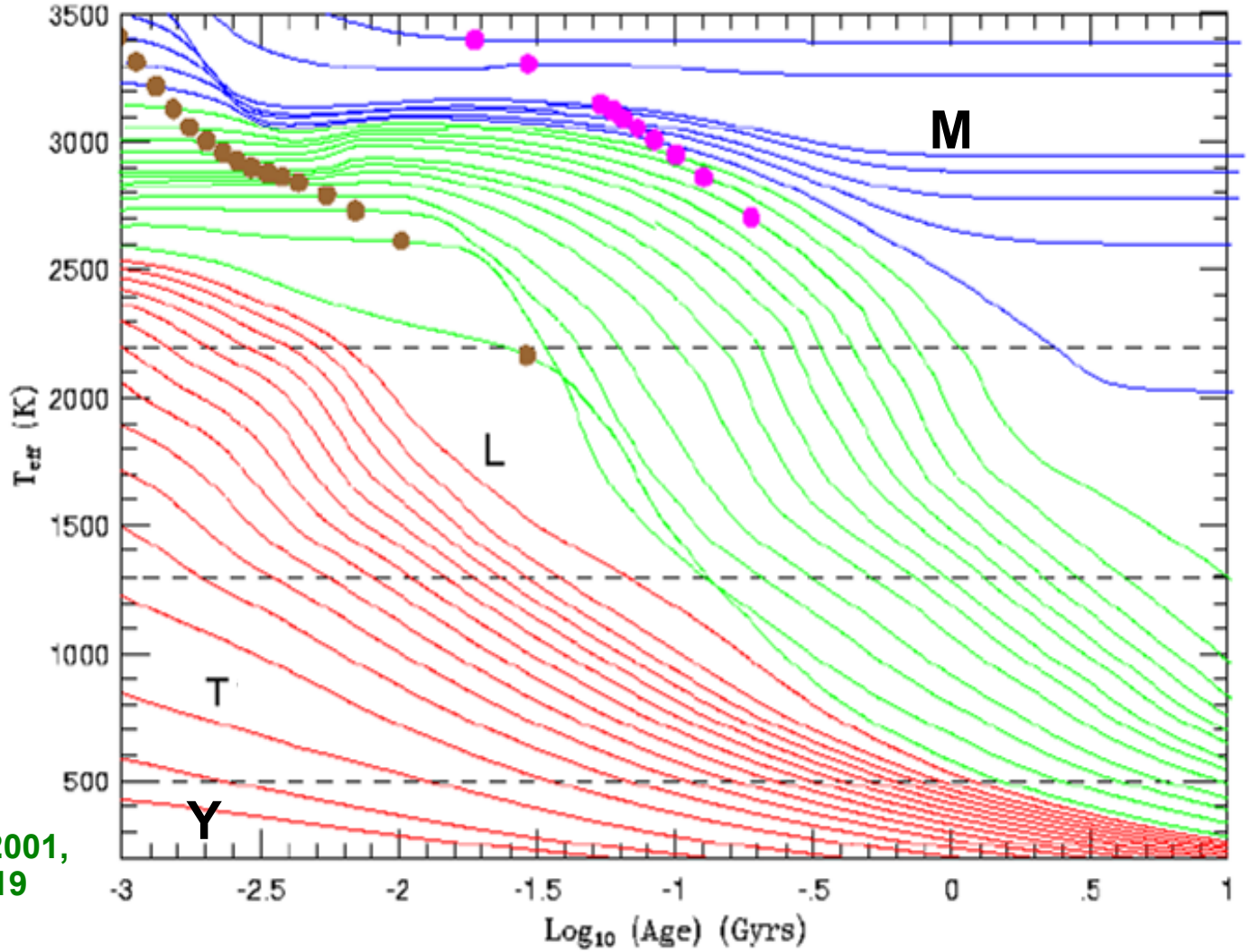
the 10 pc sample (229 systems) is only 64% complete (130 systems are missing)!

Henry et al. 1997, AJ, 113, 142



Research Consortium on Nearby Stars (RECONS): recons.org

Evolution of T_{eff} with age of low-mass stars, BDs, planets



low-mass stars
Types: M, L

brown dwarfs
Types: M, L, T, Y

planets
Types: M, L, T, Y,...

Burrows et al. 2001, RvMP, 73, 719

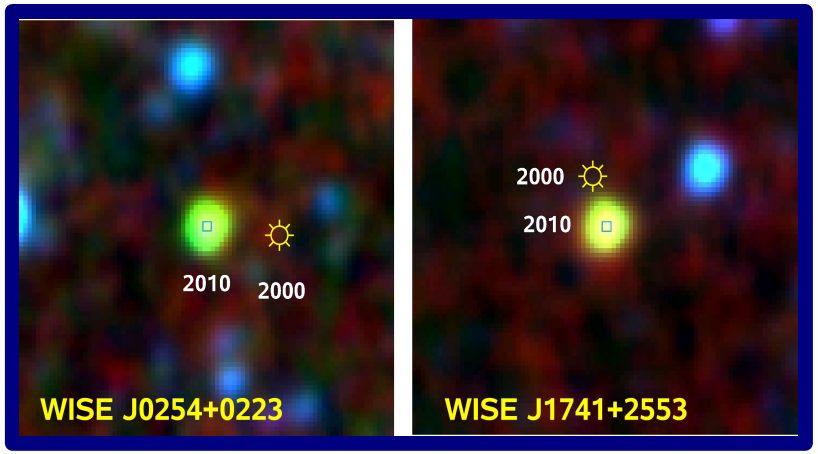
Combined colour / proper motion search

(e.g. in Scholz, Bihain, Schnurr & Storm, 2011, A&A, 532, L5)

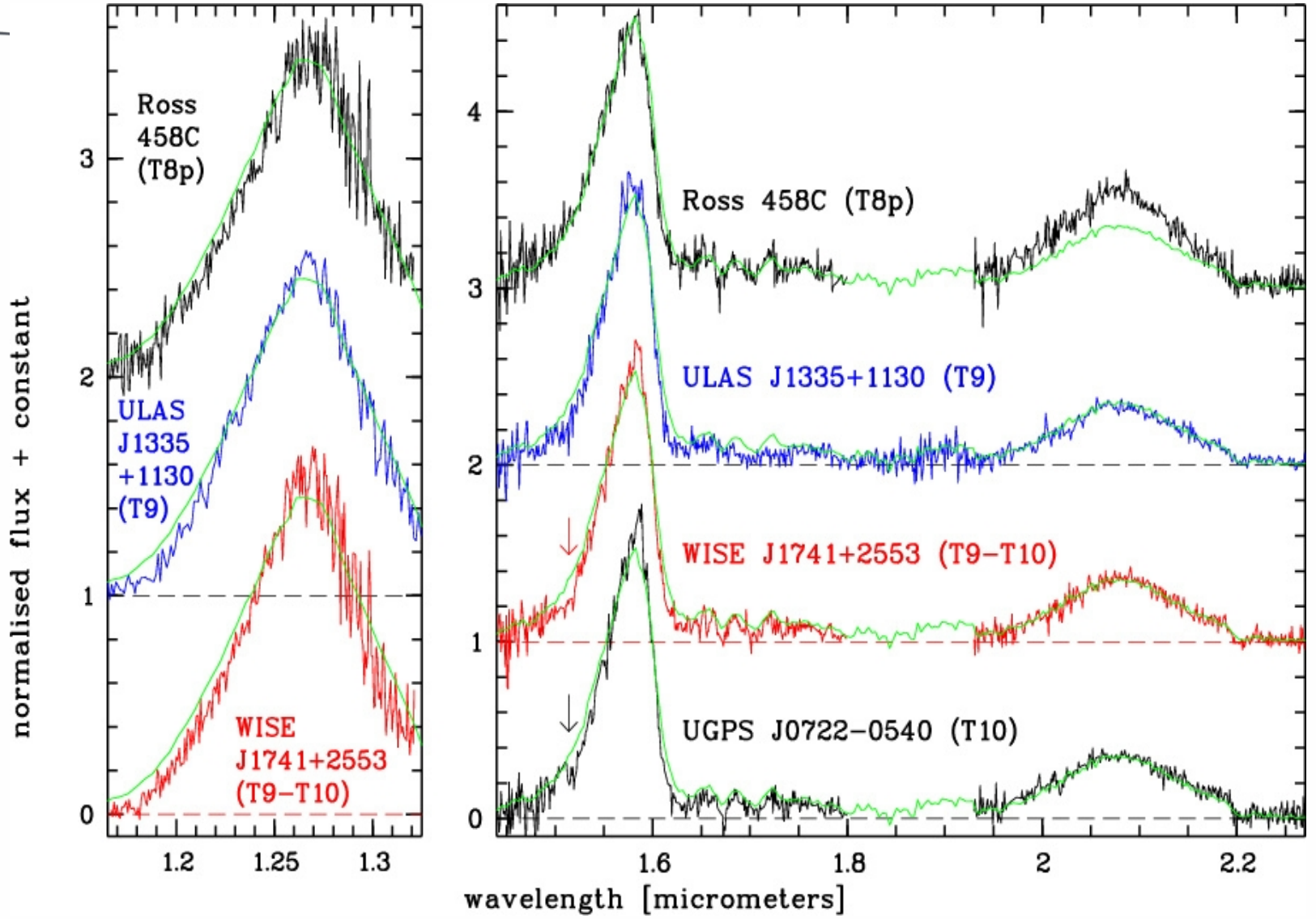
- ♣ *w1-w2* > 2 (>T5) and *w2-w3* < 2.5 (to exclude extragalactic objects)
- ♠ Only bright sources (*w2* < 13) (may be still seen in 2MASS/SDSS)
- ♥ Only point sources at |*b*|>10° (to avoid artefacts and reddening)
- ♦ no 2MASS counterpart within 3 arcsec (→ μ > 0.3 arcsec/yr)

▼

98 candidates, incl. four known and two new late-T dwarfs:
(with very large proper motions of ≈2.5 and ≈1.5 arcsec/yr, respectively, and both with photometric distances of ≈5 pc)



LUCIFER @ LBT follow-up observations



Green:
T8 template

Blue:
T9 template

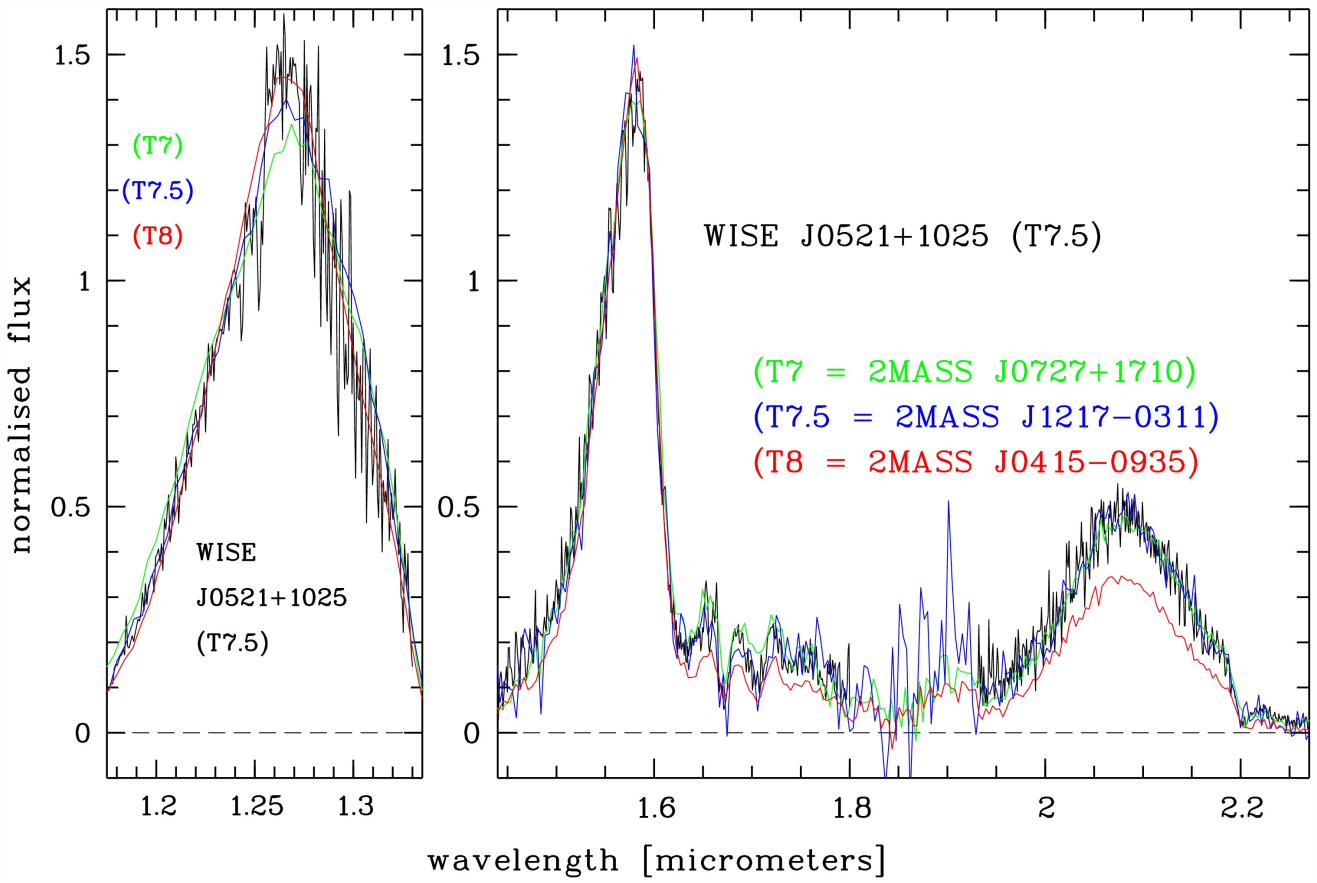
Red:
our target

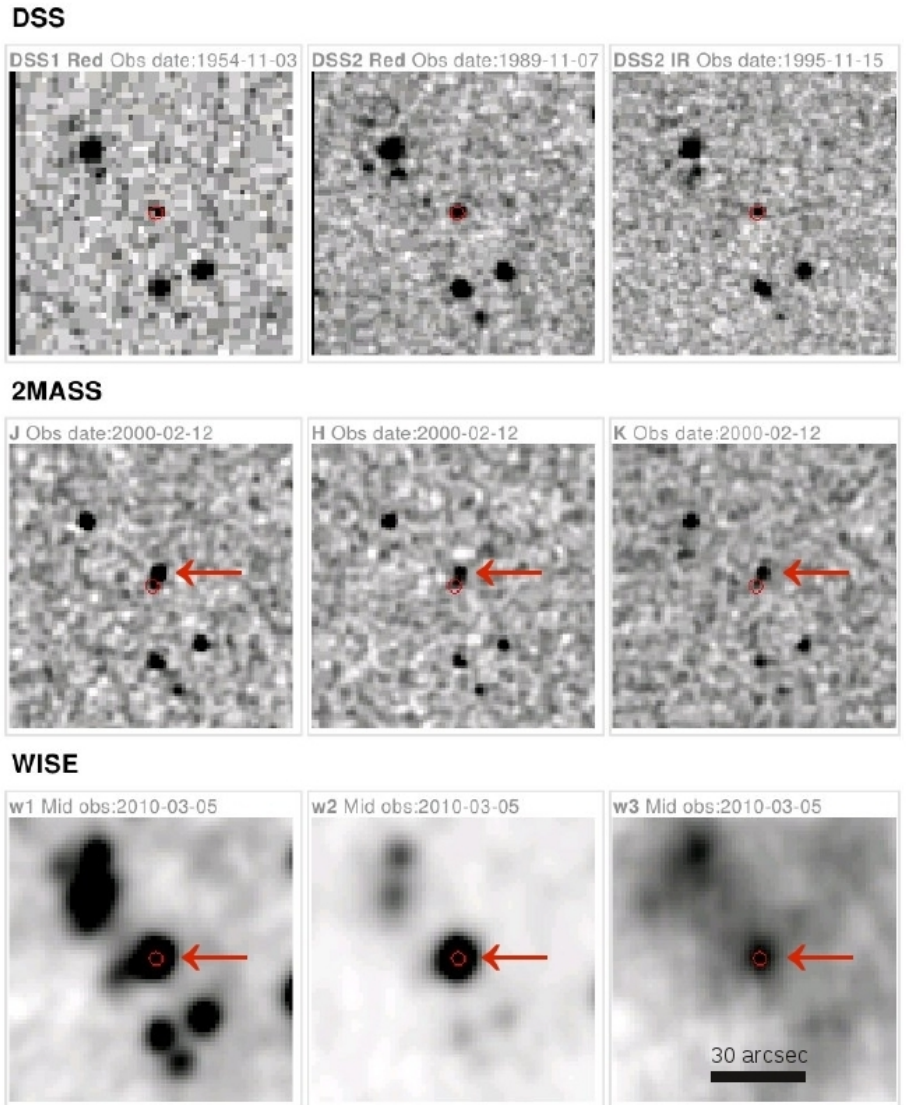
Black:
comparison objects
also observed with LBT

Scholz, Bihain, Schnurr & Storm, 2011, A&A, 532, L5

A previously overlooked T7.5 dwarf

LUCIFER@LBT low-resolution classification spectroscopy





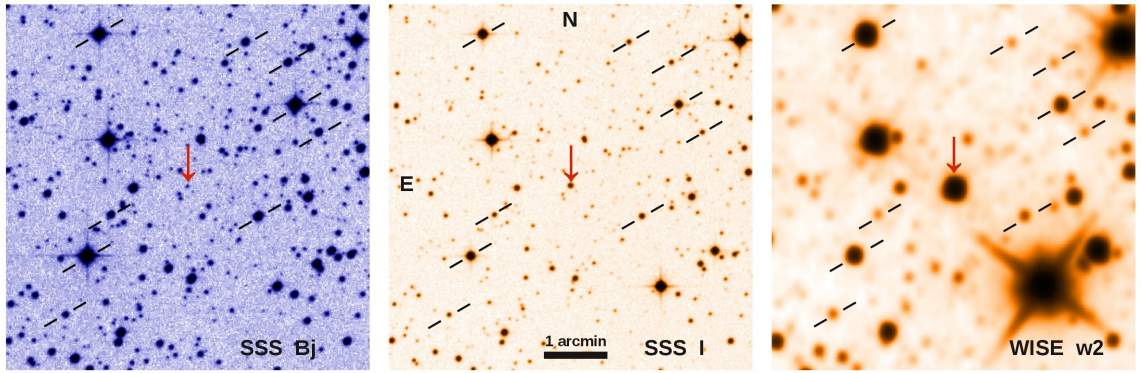
$\mu \approx 470$ mas/yr

d_{spec} = 5.0±1.3 pc, nearest known T dwarf in the northern sky

Bihain, Scholz, Storm & Schnurr, 2013, A&A, 557, A43

Bright M9 dwarf hiding in the Galactic plane

optical (blue+red) mid-infrared



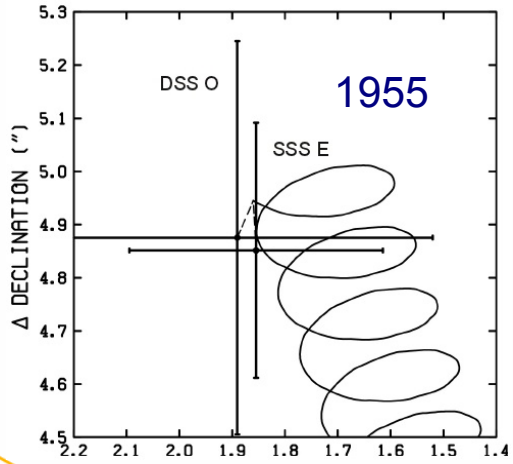
Follow-up by

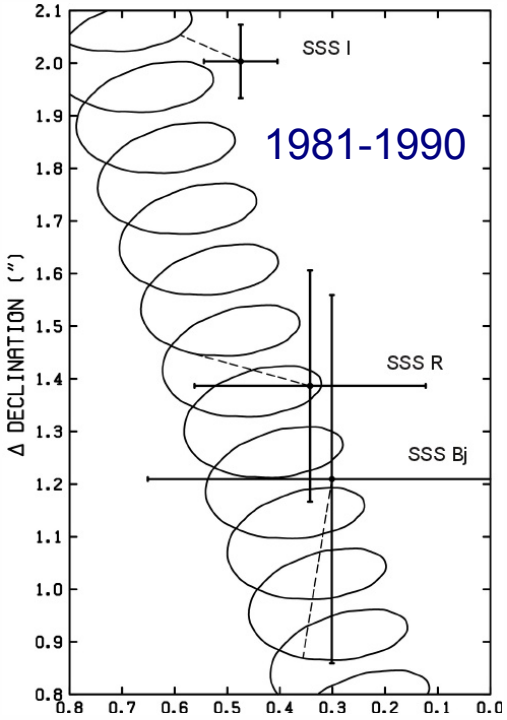
Burgasser et al., 2014, arXiv:1410.4288
(M9.5+T5 binary @ 6.0±1.0 pc)

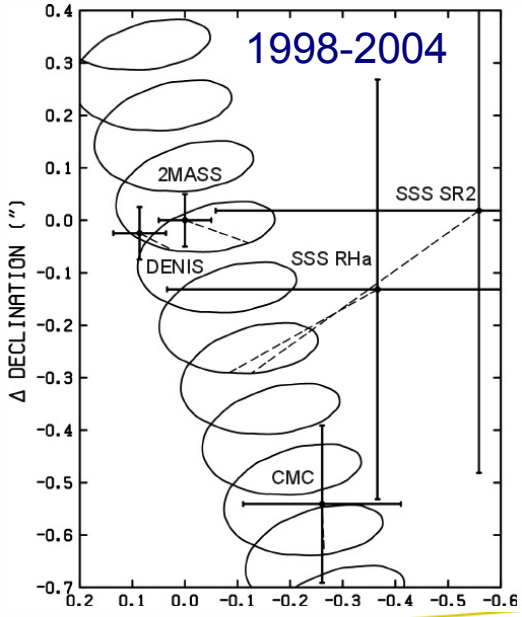
Ivanov et al., 2014, arXiv1410:6792
(L0 @ 6.1±1.0 pc, no indication of binarity)

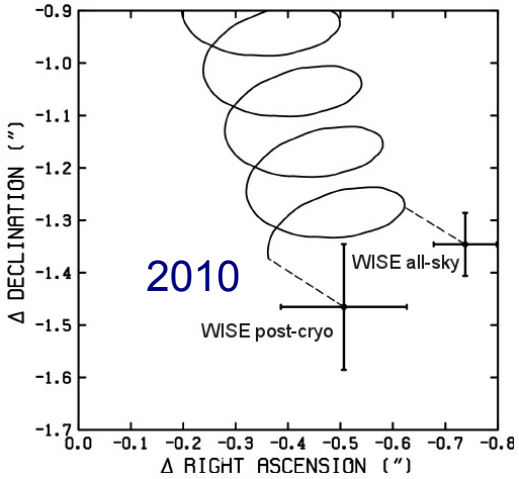
$\mu \approx 120$ mas/yr
$d_{trig} = 7.0 \pm 1.9$ pc

Scholz, 2014, A&A, 561, A113









Summary

(1) WISE: 5-6 times more stars than BDs (see also **Kirkpatrick et al. 2012, ApJ, 753, 156**)

(2) Most BDs are relatively old and cooled down to temperatures of T- and Y-types

(3) More Y-type BDs similar to WISE J0855-0714 (**Luhman 2014, 786, L18**) are expected

(4) There are several benchmark binary systems among the nearest MLTY dwarfs