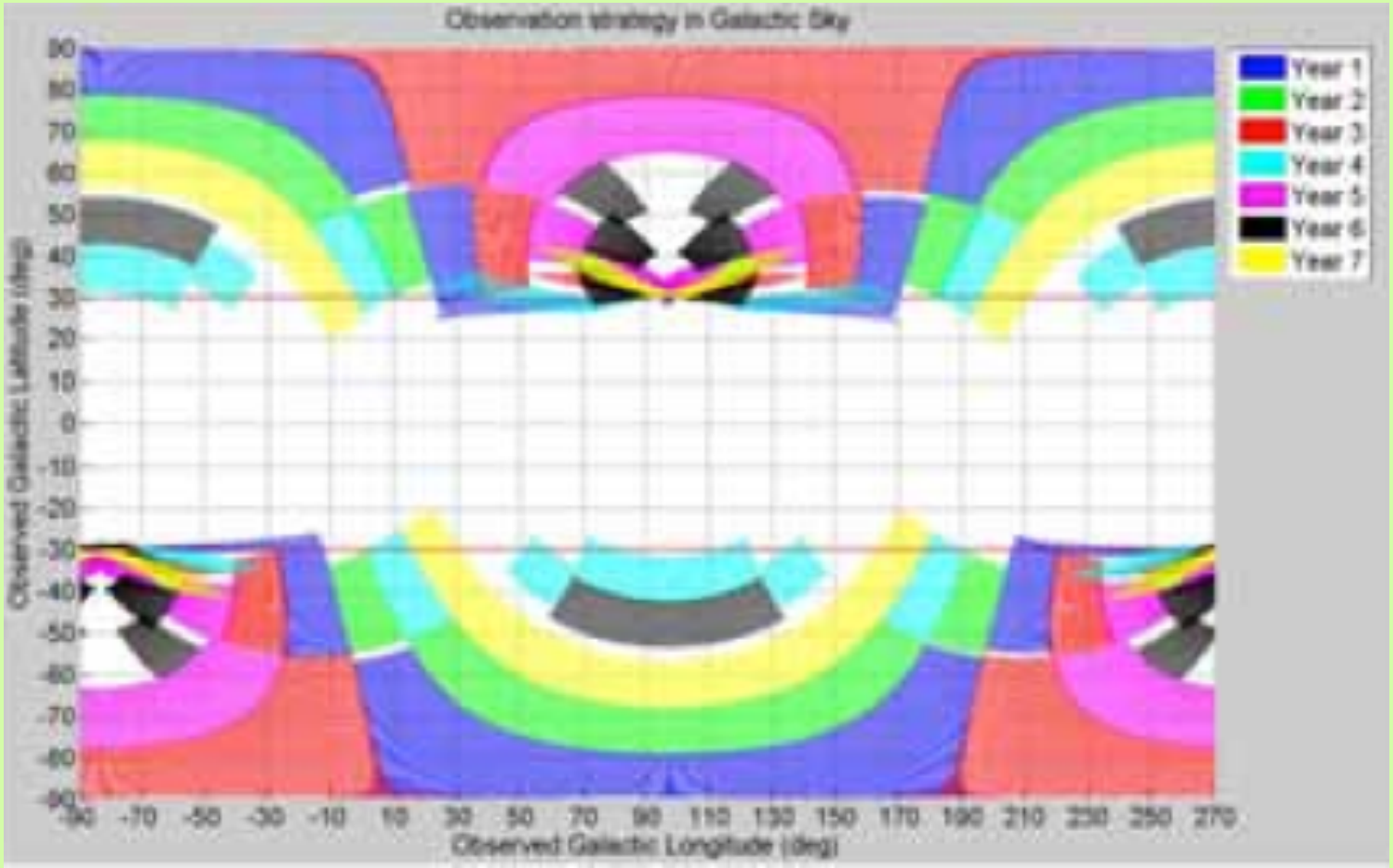
Euclid Legacy Science on Brown Dwarfs

Eduardo L. Martín (CAB) Independent Legacy Scientist in the Euclid Science Team appointed by ESA

Medium Class mission of the ESA Cosmic Vision 2015-2025



Euclid Independent Legacy Science Team on BDs

David Barrado y Navascués (CAB)
Hervé Bouy (CAB)
Nuria Huélamo (CAB)
Nicolás Lodieu (IAC)
Basmah Riaz (MPIA)
Johannes Sahlmann (ESA)
Enrique Solano (CAB & SVO)

CENTRO DE ASTROBIOLOGÍA
ASOCIADO AL NASA ASTROBIOLOGY INSTITUTE

CSIC

Euclid Wide Survey

15,000 sq. deg. (required)

VRI 24.5 mag. 10 sigma
0.1 arcsec / pix

YJH 24 mag. 5 sigma
0.3 arcsec / pix

NIR spectroscopy
1.2—1.8 microns
R=250

Euclid Deep Survey

40 sq. deg. (2 regions)

VRI 26.5 mag. 10 sigma
0.1 arcsec / pix

YJH 26 mag. 5 sigma
0.3 arcsec / pix

NIR spectroscopy
0.9—1.8 microns
R=250

Spacecraft & Payload

Launcher: Soyuz ST-2.1 B from Kourou

Launch window: 2020

Orbit: Large Sun-Earth Lagrange point

Lifetime: 7 years

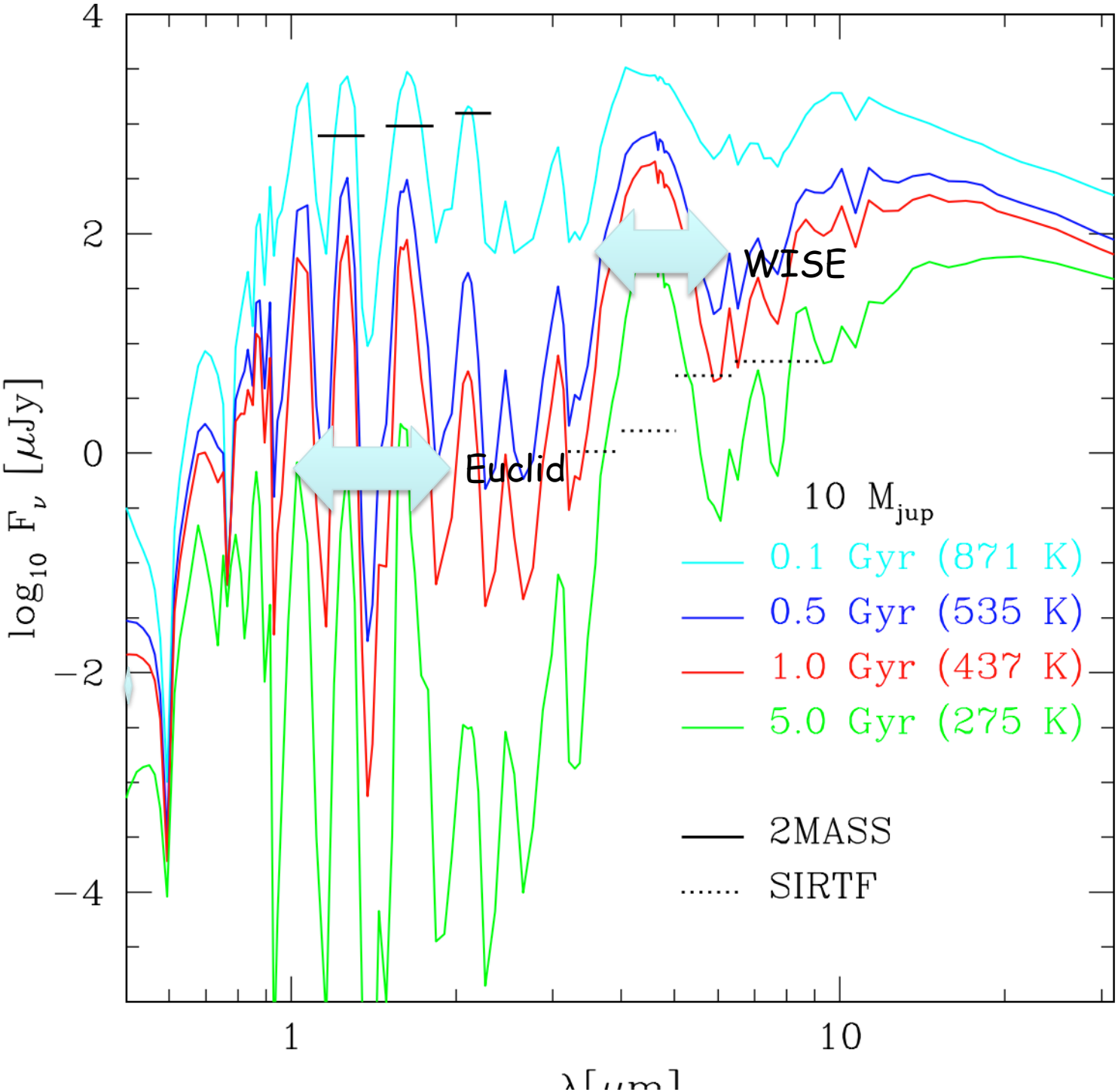
Maximum science data rate: 850 Gbit/day

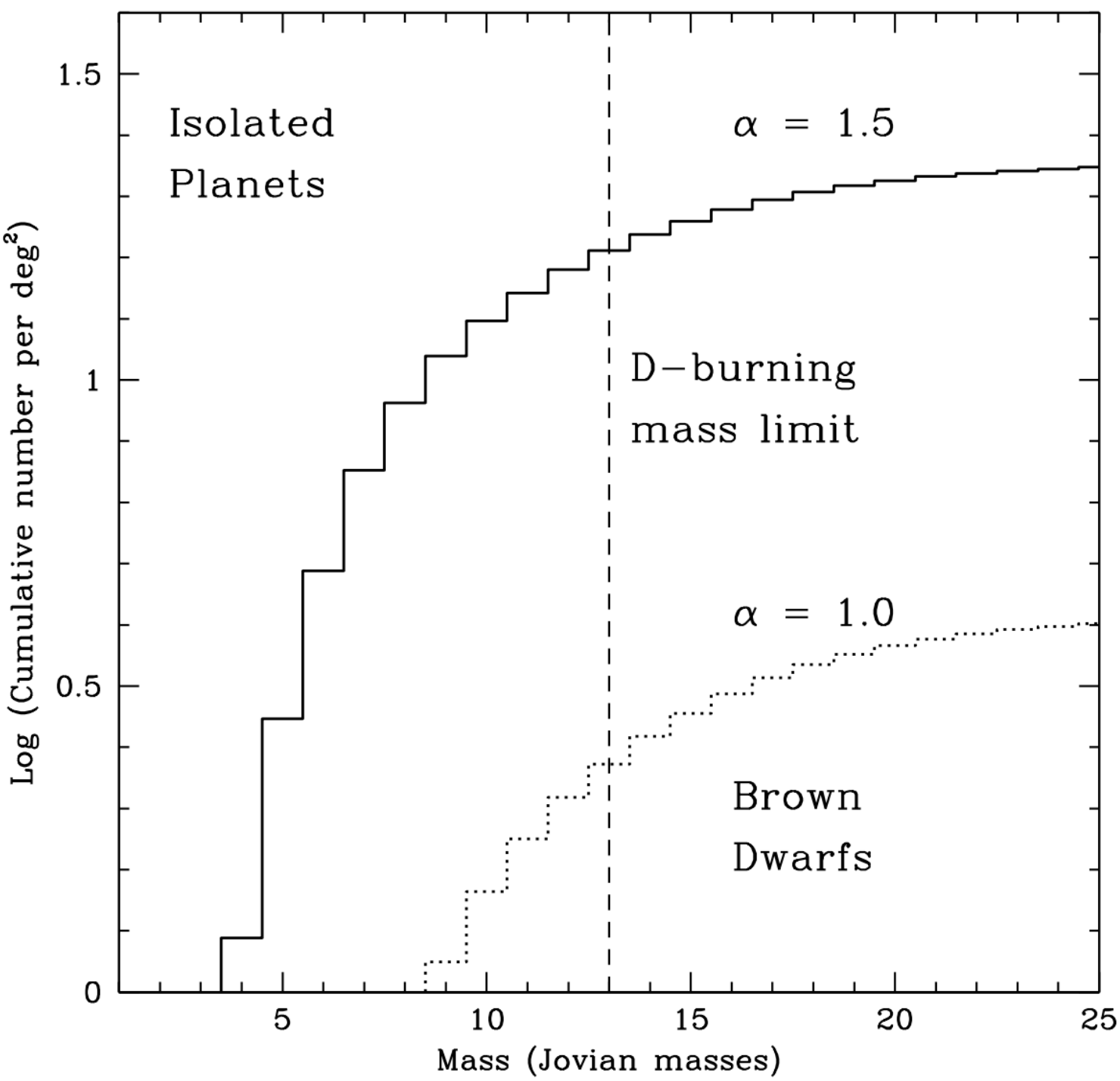
Telescope: 1.2 m Korsch, f=24.5 m

FOV: 0.787x0.709 sq. deg.

Detectors: 36 x 4k x 4k CCD, 16 2k x 2k HgCdTe

Martín
et al.
2001 PASP



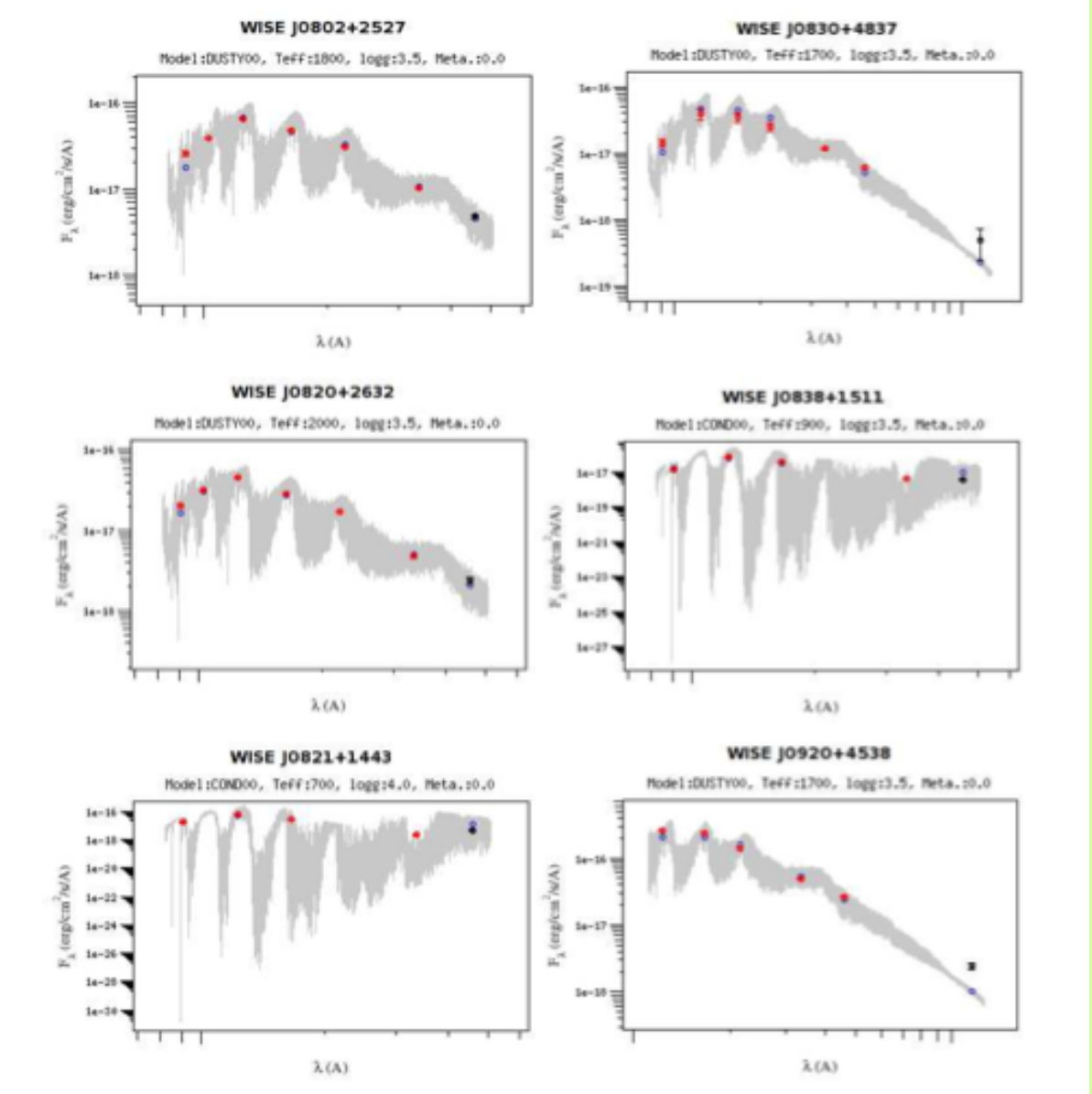

Isolated
Planets
α = 1.5
D−burning
mass limit
α = 1.0
Brown
Dwarfs
Log (Cumulative number per deg²)
Mass (Jovian masses)
0
0.5
1
1.5
5
10
15
20
25

Ultracool subdwarf surface density

Ultracool subdwarfs 5500 times less numerous their solar metallicity counterparts (N. Lodieu et al. 2012, A&A, 542, A105).

Less than 30 L subdwarfs known to date, in contrast with > 1000 ultracool dwarfs known. Less than 10 are ultra-subdwarfs (m/H<-1.5).

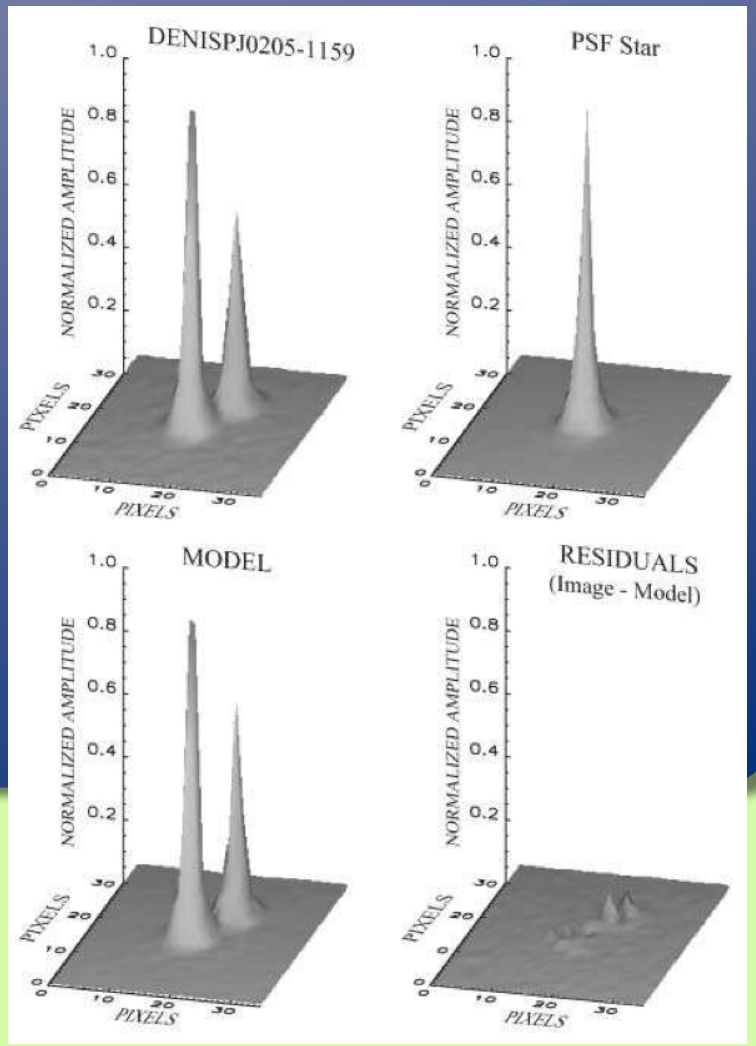
BD identification with VO



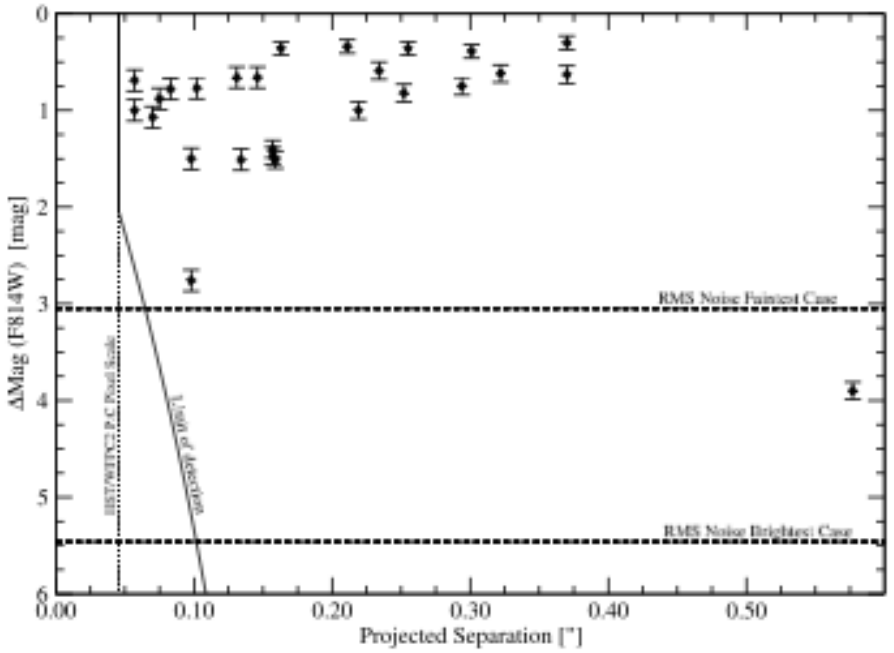
M. Aberasturi et al. 2011, A&A, 534, L7

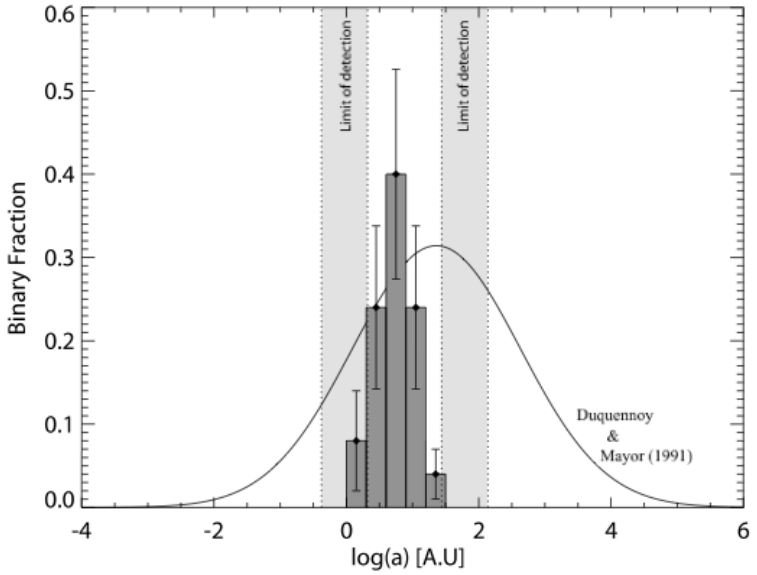
Ultracool binaries

- HST/WFPC2-PC imaging of 134 late and L dwarfs (H. Bouy et al. 2003, AJ, 126, 1526).
- FWHM=0”.110 for F814W filter
- Scale 0.0455 arcsec/pix
- Diffraction limit 0”.086
- 8 PSF reference stars
- Binary detection threshold 0”.06
- 0”.0005 error in separation
- 0.3 deg error in PA for sep.<0”.15
- 0.07 mag. error in relative phot.



Ultracool binaries (II)





Ultracool dwarf astrometry

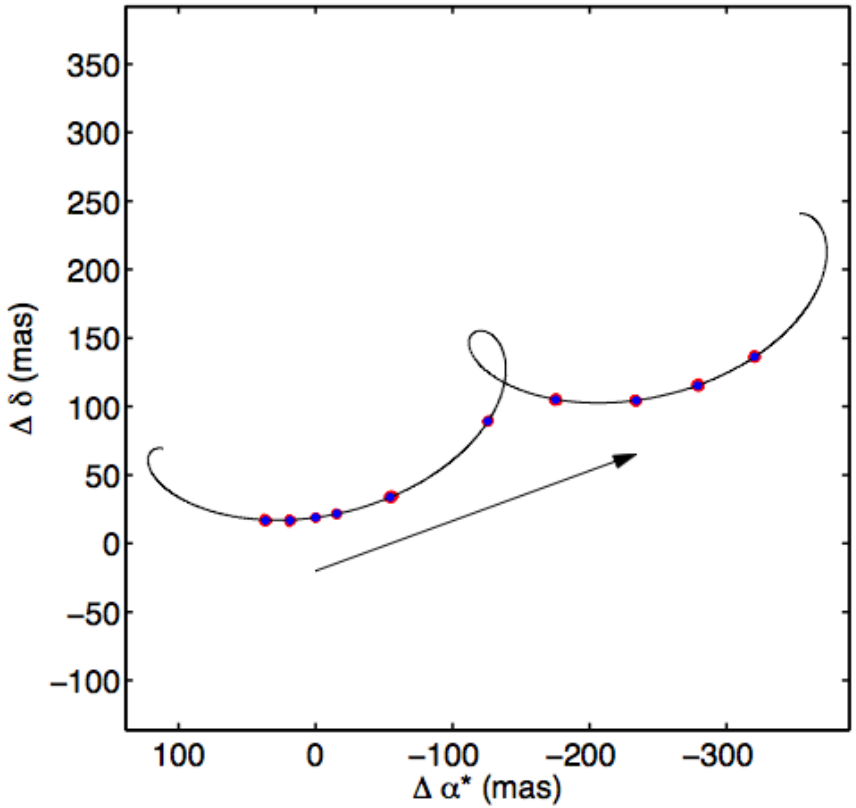
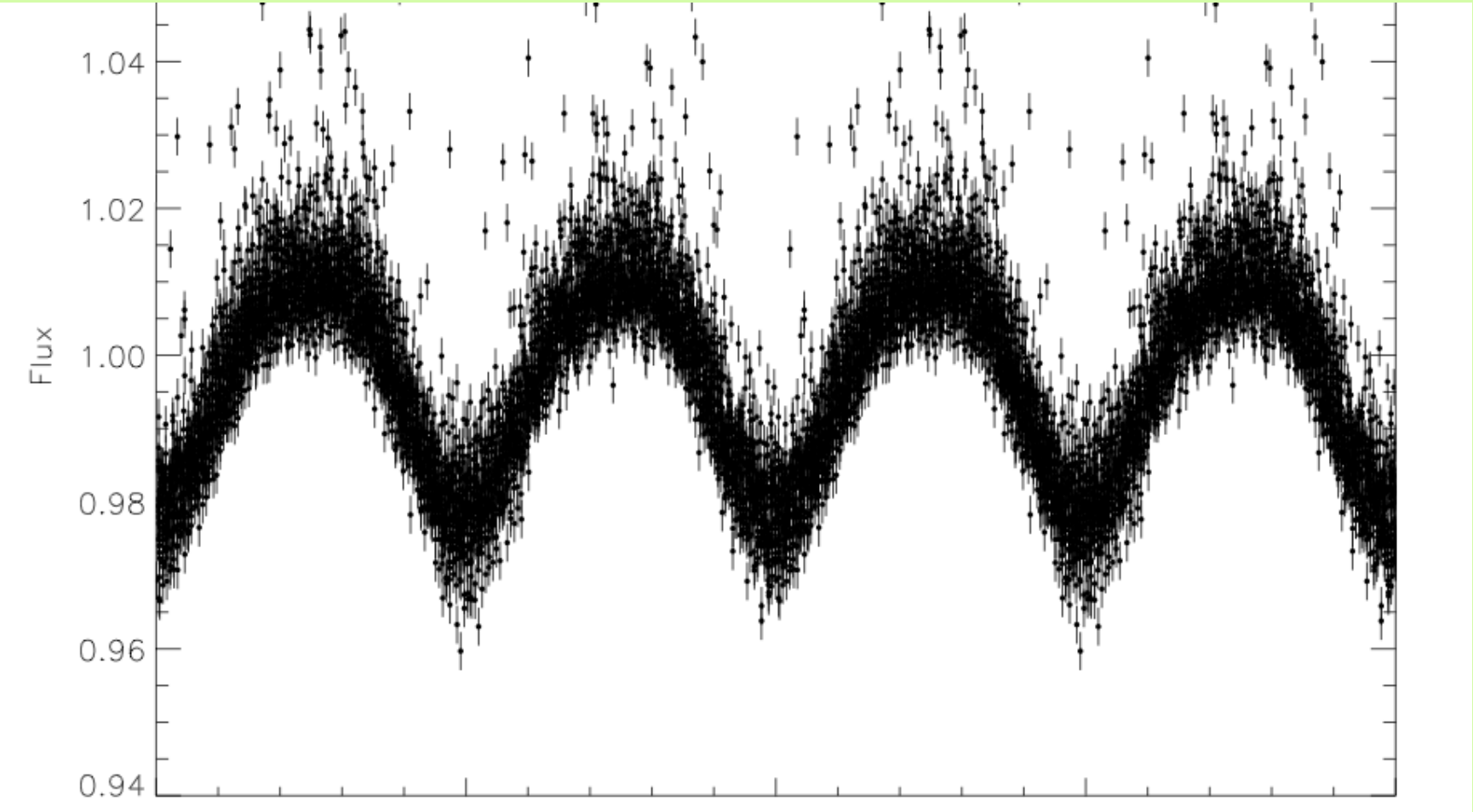


Figure 1: FORS2 astrometric measurements over 500 days (red and blue symbols) and the best fit model motion of an ultra-cool dwarf without detected companion, showing parallactic and proper motion. North is up and east is left. The residual dispersion about this standard astrometric model is 140 μas and the parallax precision is 0.1 %

J. Sahlmann et al. 2014, A&A (VLT/FORS data).

Ultracool dwarf variability



Martín et al. 2013 A&A (Kepler data)

Expected Euclid Legacy

Discovery of room temperature planetary mass objects

High precision astrometry, optical/NIR photometry and NIR spectra for about 1 million ultracool dwarfs

Semimajor axis and mass ratio for about 100,000 resolved ultracool binaries

Parallaxes, proper motions & variability for about 3,000 ultracool dwarfs

Discovery of rare ultracool subdwarfs, such as extreme Pop II or even Pop III brown dwarfs