Euclid science

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http://www.euclid-ec.org/

Euclid consortium

The Euclid Consortium includes 250 institutions in 16 countries (with ~1,300 active members, 98 in US).

Three Euclid-US Science Teams led by R. Chary (Caltech), A. Kashlinsky (GSFC) and J. Rhodes (JPL).

The EC has the responsibility of the scientific instruments, the production of the data and of leading the scientific exploitation of the mission until completion.

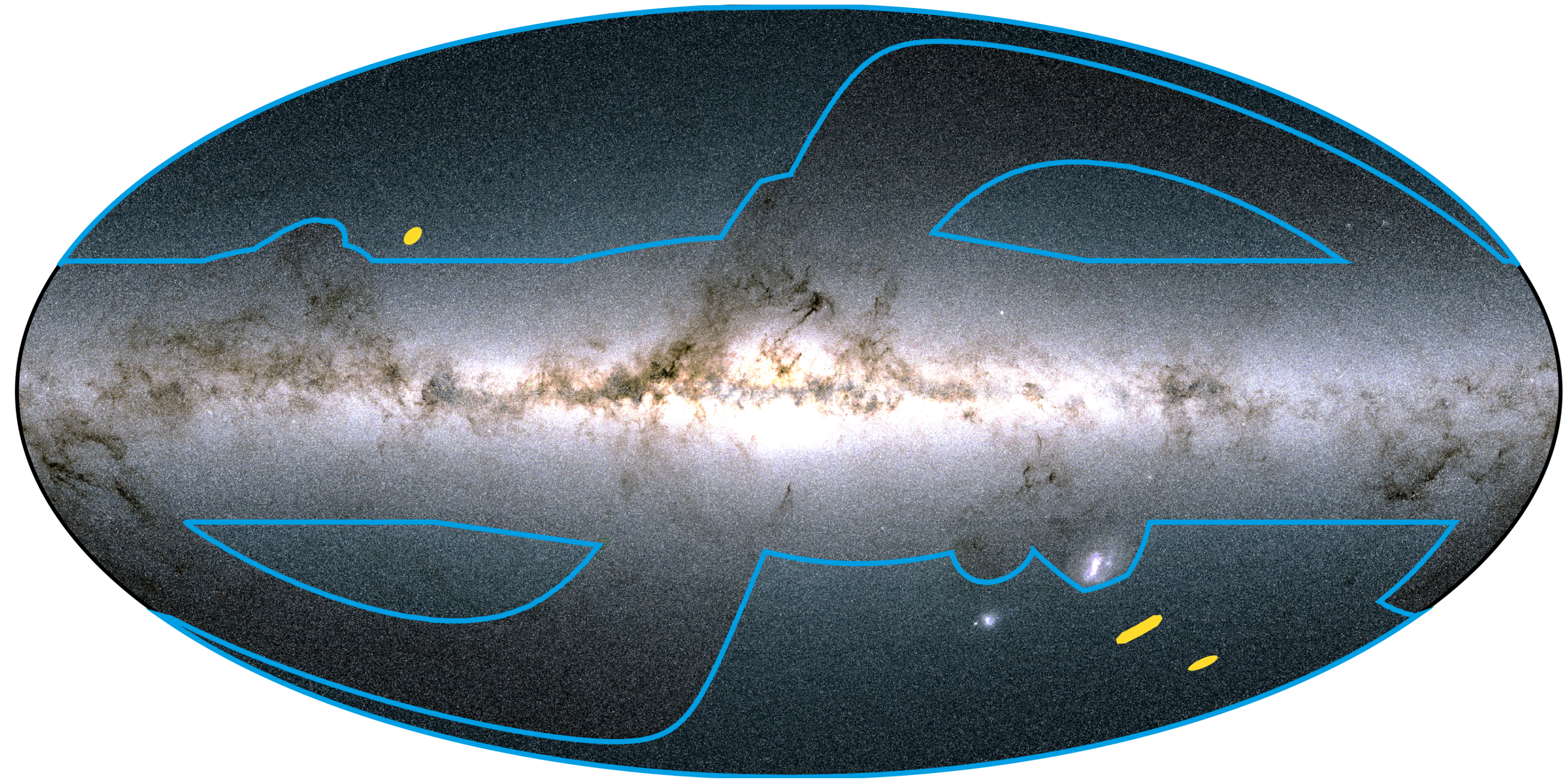
Euclid Surveys

All-sky map based on data from ESA's Gaia mission (Copyright image: ESA/Gaia/DPAC)

The Euclid Wide Survey and the Euclid Deep Survey [Mollweide Galactic]

Euclid Wide Survey : 15,000 deg.^{2}

Euclid Deep Fields : North=10 deg.^{2}, Fornax=10 deg.^{2}, South=20 deg.^{2}



Euclid's primary science objective is to understand the source of the accelerated expansion of the Universe.
This goal will be reached by measuring:

- the growth of cosmic structures using gravitational lensing effects on galaxies (Weak Lensing)
- the expansion rate of the Universe using Baryonic acoustic observations.

	Area	**Imaging**	**Spectroscopy**
Wide	15,000 deg^2	VIS, Y, J, H	1.25 -1.8μm
		VIS = 24.5 (10σ) NISP = 24 (5σ)	2x10^{-16} c.g.s.
Deep	40 deg^2 (20+10+10)	VIS, Y, J, H	0.92 -1.3μm 1.25 -1.8μm
		VIS = 26.5 (10σ) NISP = 26 (5σ)	5x10^{-17} c.g.s.

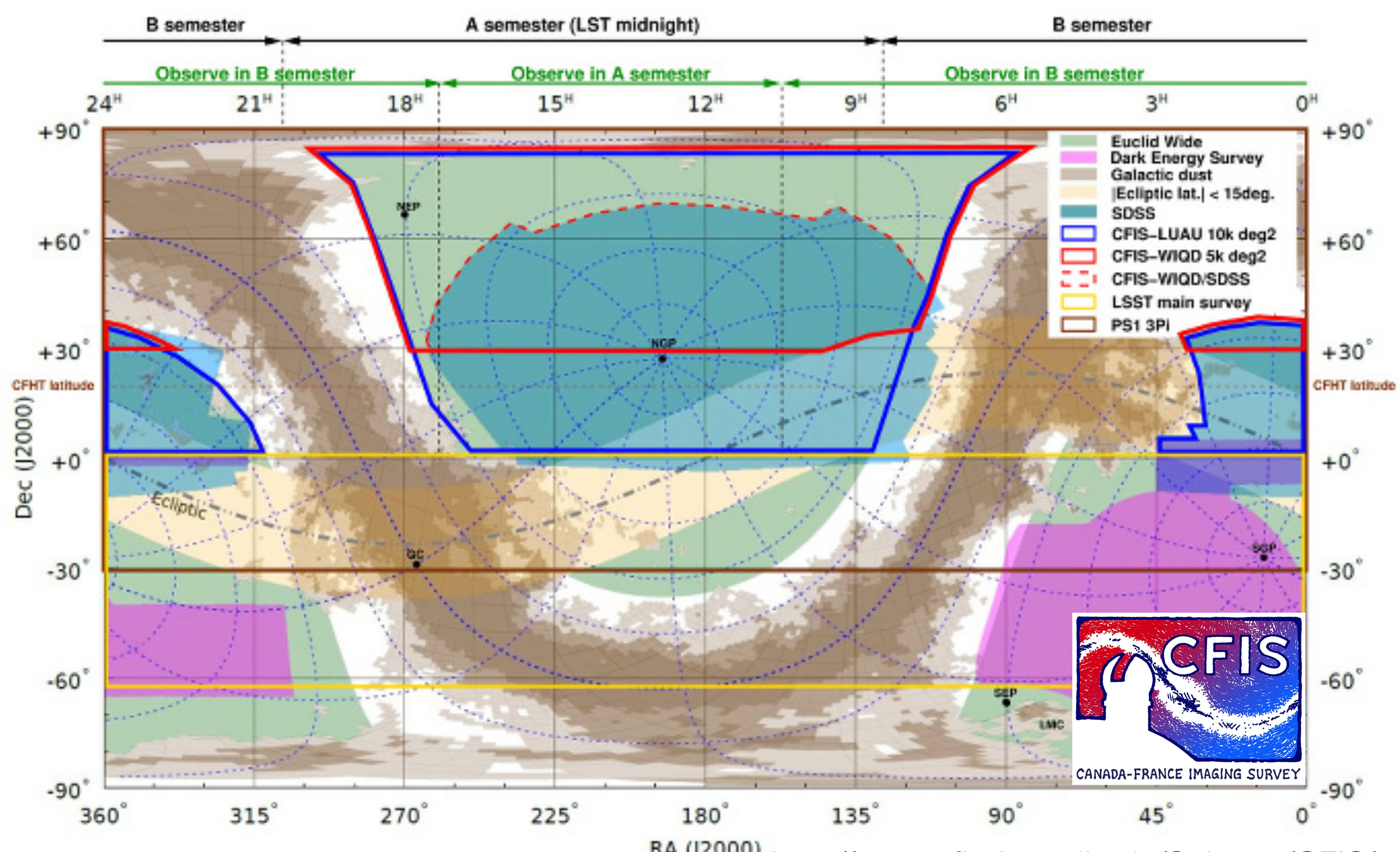
Euclid Complementary Observations: wide

Euclid weak lensing cosmology relies on the acquisition of external optical datasets to derive accurate photometric redshifts and source colors

WIDE imaging

- CFIS@CFHT (u=23.6 and r=24.1 over 10,000 and 5,000 deg^2)
- PanSTARRS PS1/2 (i, z over 5,000deg^2)
- JEDIS-G@Javalambre (g=24.7 over 5,000deg^2)
- DES (g,r,i,z over 4,500deg^2)
- LSST main survey @ the Rubin Observatory (u, g, r, i, z over 7,000deg^2)

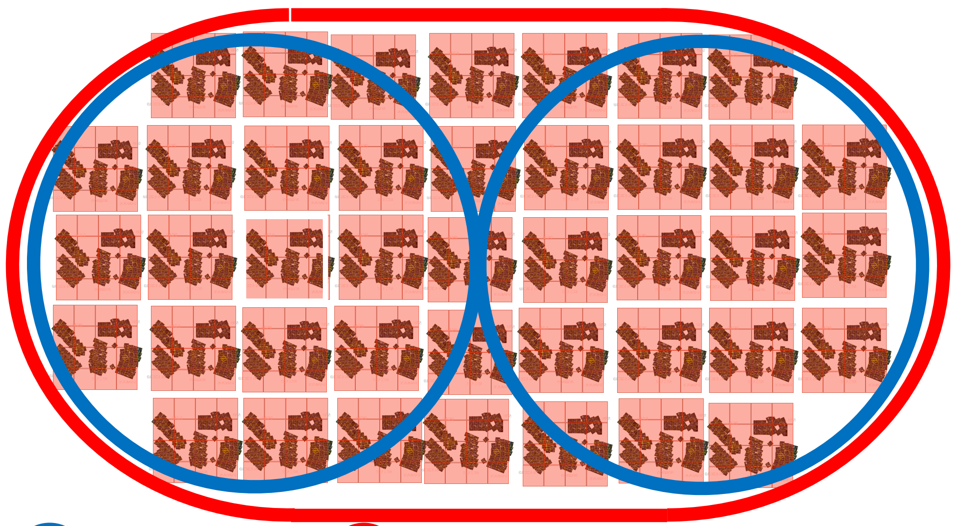
- South (1,000deg^2) and North (3,000deg^2) extensions (not confirmed, decision expected late 2020, early 2021)



http://www.cfht.hawaii.edu/Science/CFIS/

Euclid Complementary Observations: deep

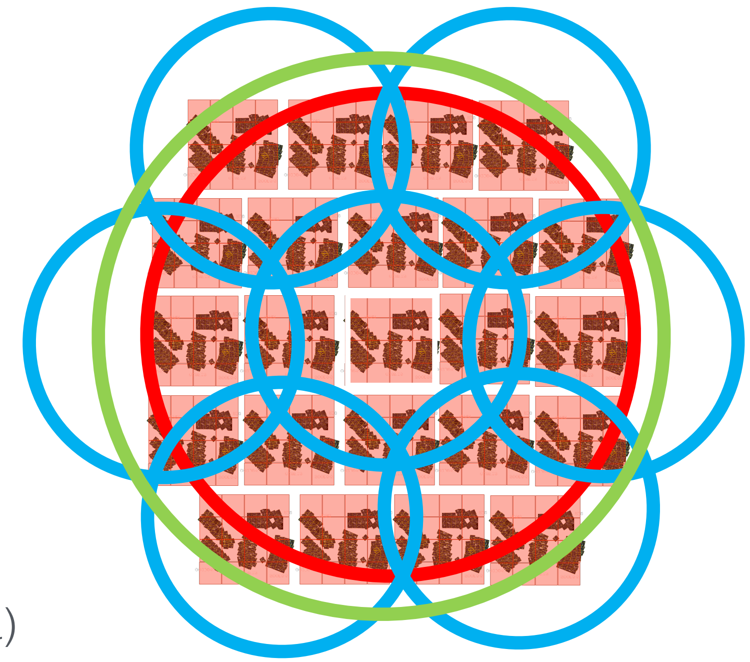
Euclid Deep Field South(20 deg²)



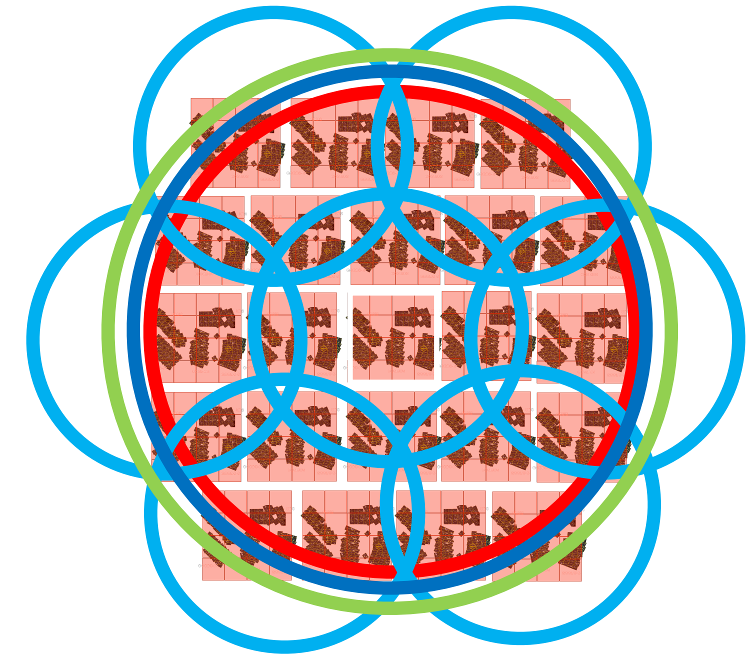
Vera Rubin IRAC (EDFS: 687h, PI: Scarlata)

https://dawn.ipac.caltech.edu/

North Ecliptic Pole (10 deg²)



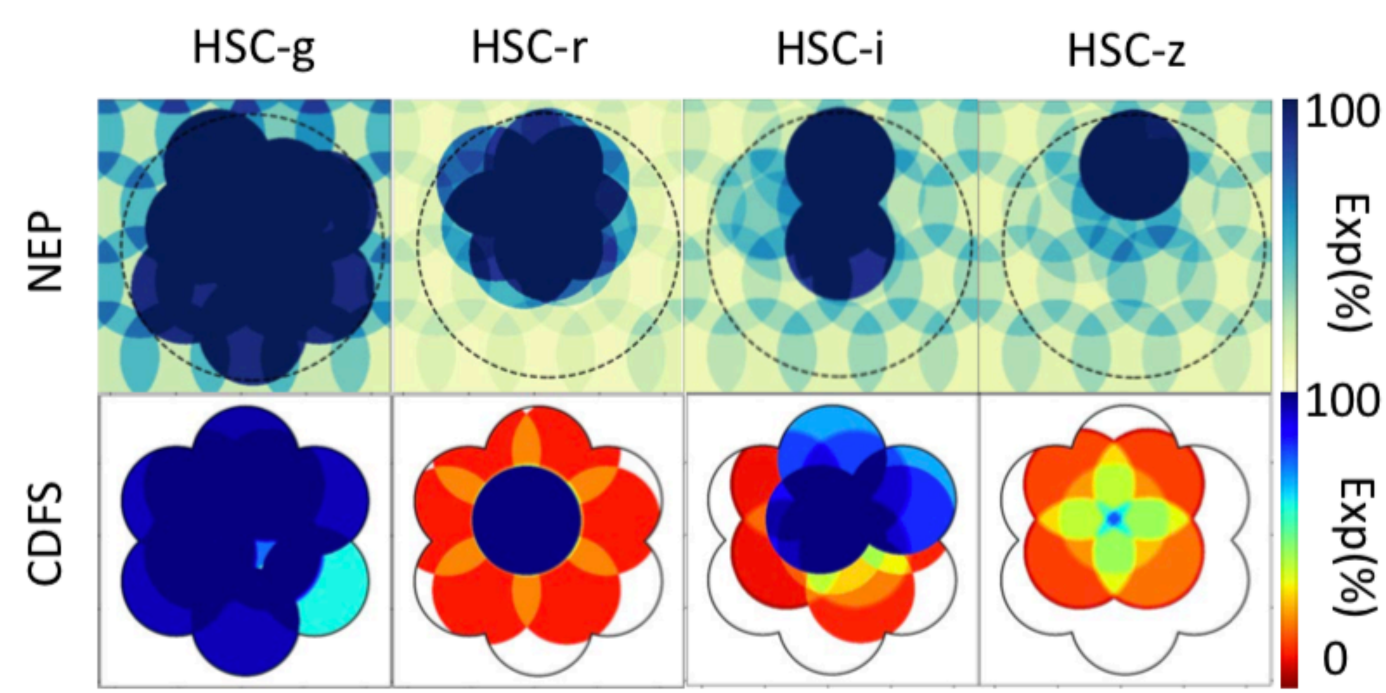
Chandra Deep Field South (10 deg²)



Subaru/HSC (H20: 30n, PI: Sanders) Spitzer IRAC (SLS: 6000h, PI: Capak) LMT/Toltec (Planned)

Link to Deep Fields

- Subaru EDFN and EDFS: part of the Hawaii-2-O survey (D. Sanders, PI)
- LSST will cover EDFS-Fornax
- Proposal to cover the EDFS with Rubin. Field shape optimal for Rubin followup.



Euclid Science Working Groups

- Cosmological Theory
- Cosmological simulations
- Weak lensing
- Galaxy Clustering
- CMB Cross-correlations
- Extra-solar planets (proposal)
- Milky Way and Resolved Stellar Pops
- Local Universe
- Galaxies and AGN evolution
- Primeval Universe
- Clusters of Galaxies
- Supernovae and transients
- Strong lensing

Euclid science

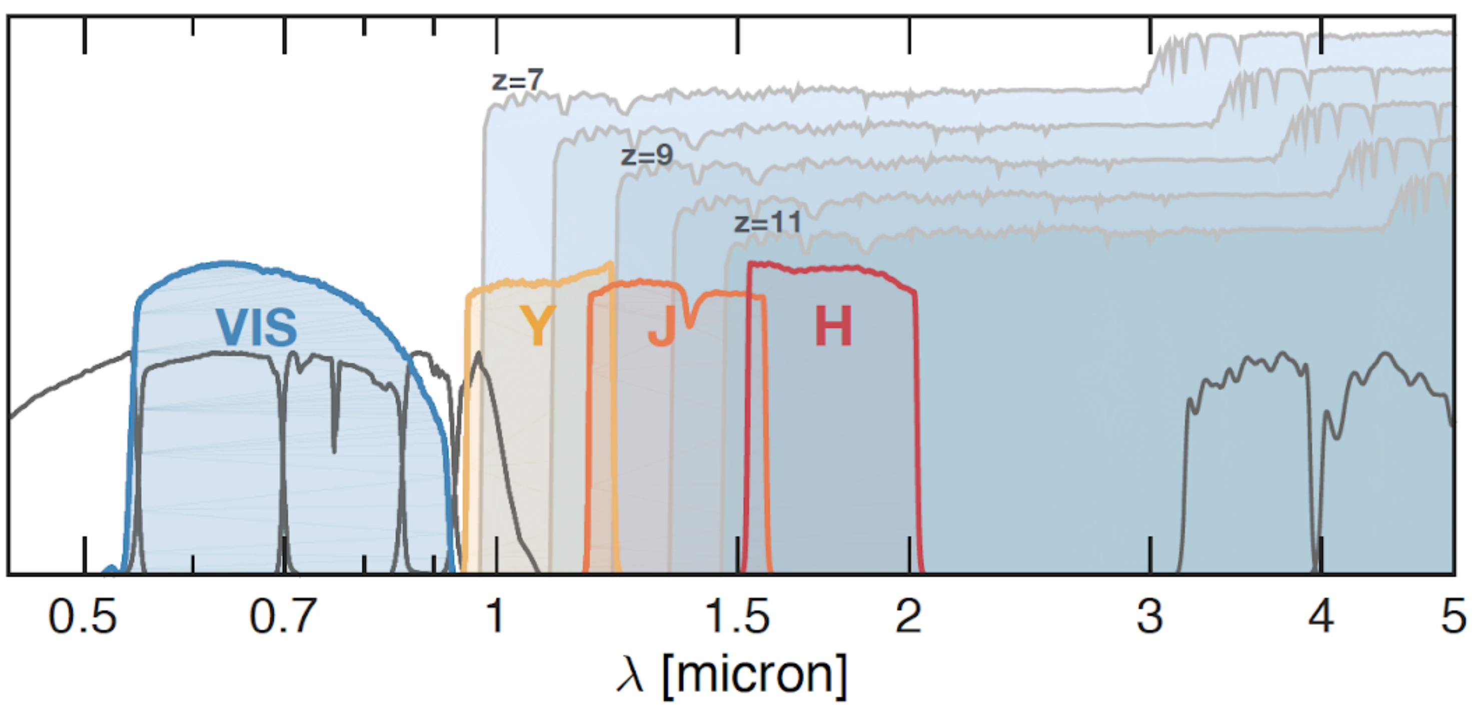
Legacy of Euclid data:

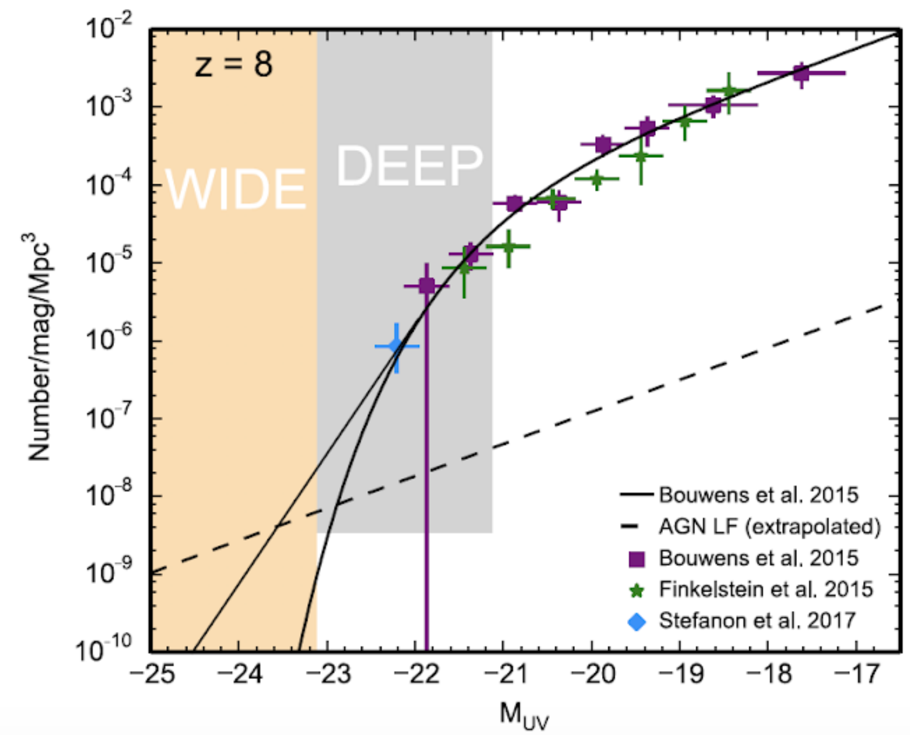
- **Very large samples:** Distribution functions
- **Exquisite imaging**: Morphological studies, mergers, strong galaxy lenses, etc
- **Weak Lensing**: Galaxy evolution as a function of halo properties, galaxy alignment
- **Very large volume**: Rare sources, probing the extremes
- **Spectroscopy**: physical parameters, environment

Euclid science: the reionization epoch

Credit: Bowler & Oesch

At z>6 the Lyman Break shifts into the IR and Euclid will identify hundreds of galaxies brighter than H~26 in the deep fields, constraining the bright end of the galaxy LF.

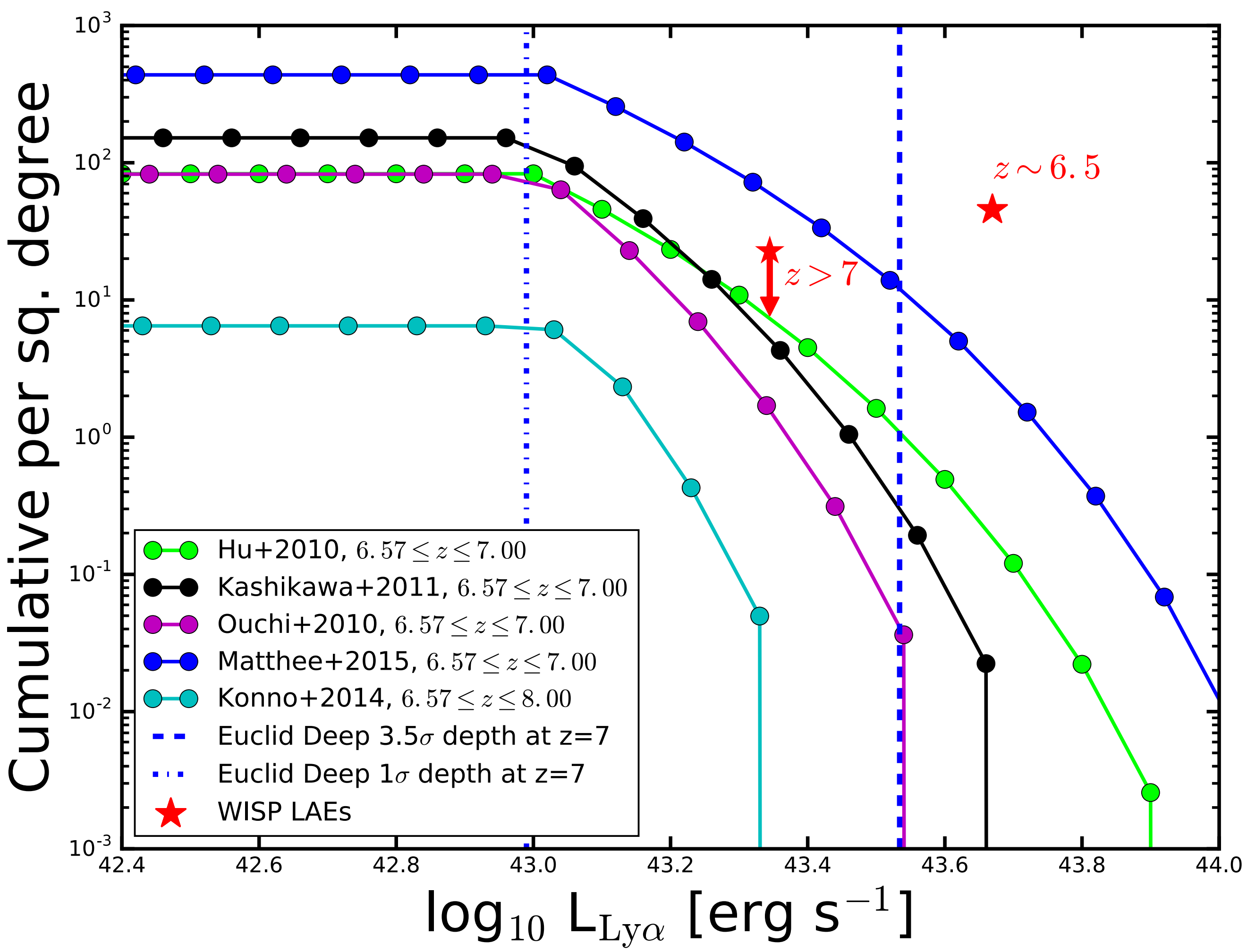




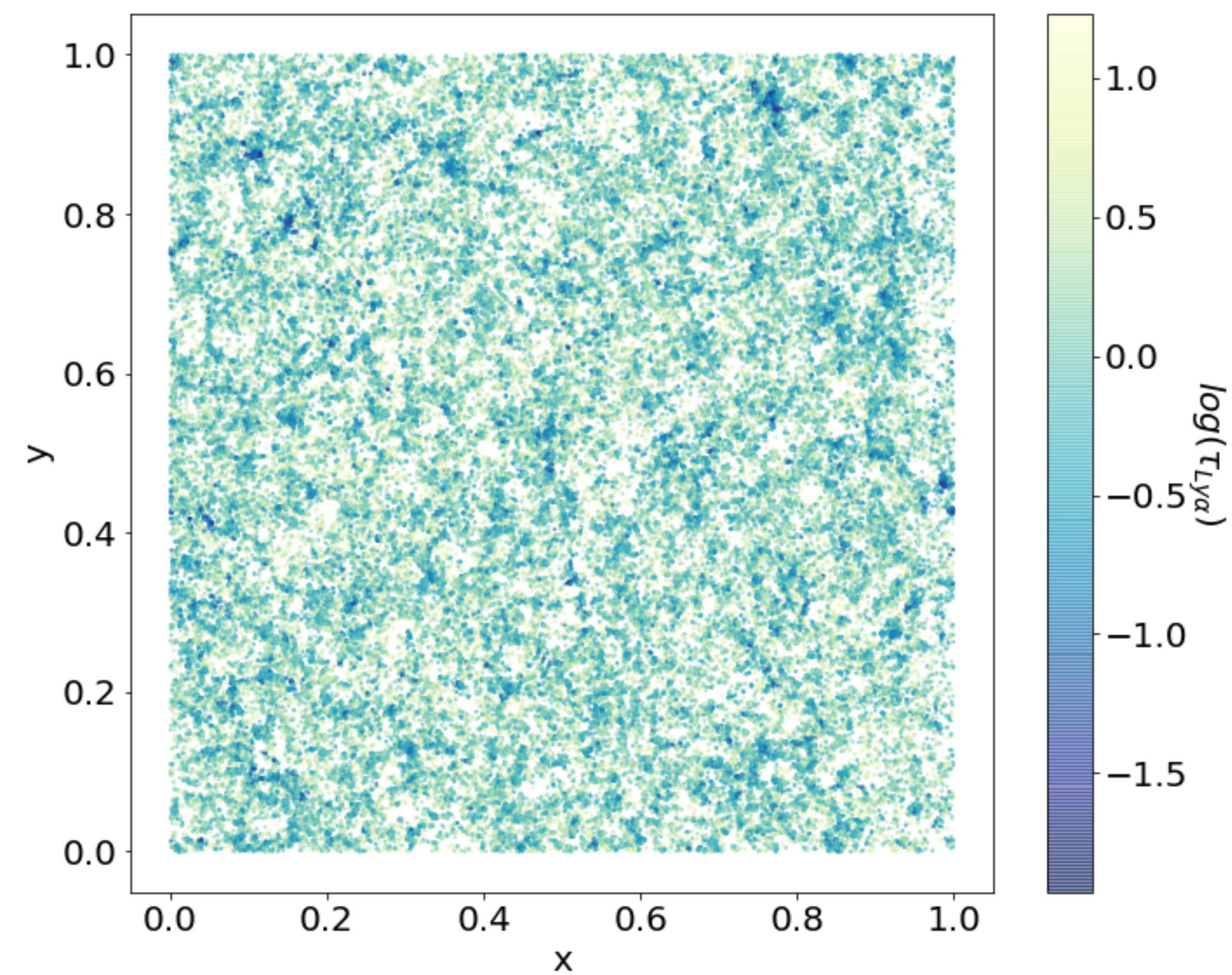
- Bright end of LF provides strongest constraints on galaxy formation models
- Bright galaxies J<25.5 allow spectroscopy for LAE/ LBG clustering studies (McQuinn et al 2007)
- Stellar population studies: UV slope, HeII 1640 (metallicity, IMF)

Euclid science: the high-z universe

Euclid will identify up to a few hundreds Lyα emitters @ z>6.5 in the Blue Grism to study the reionization



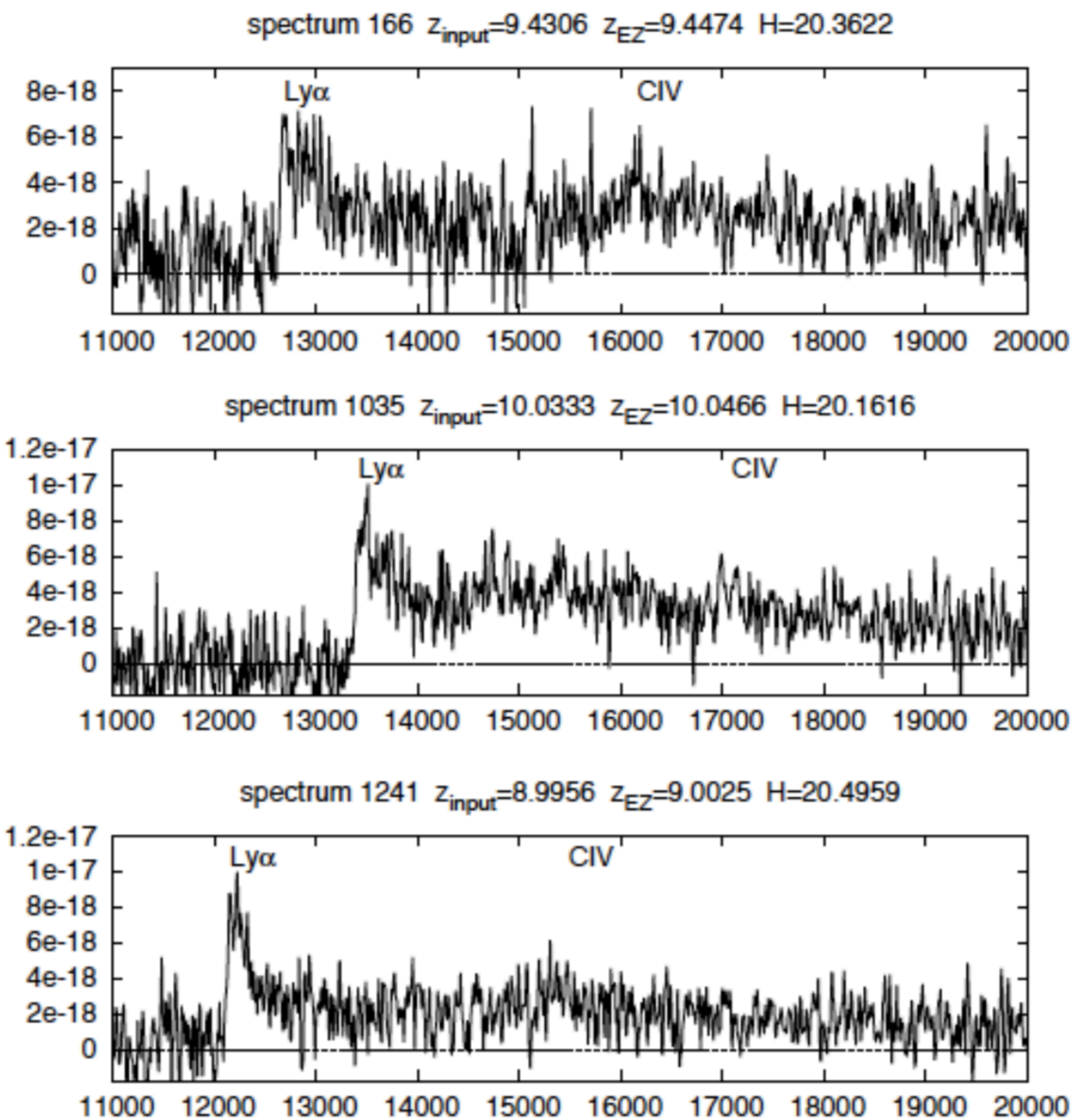
Bagley et al. (2018)



Bruton et al. (in prep)

Euclid science: the high-z QSOs

Large number of QSOs @z>7 in the wide survey, with Euclid data only.



Roche et al. (2011)

Redshift range	*Euclid* optical	
	$k = -0.72$	$k = -0.92$
$7.0 < z < 7.5$	87 (41)	51 (24)
$7.5 < z < 8.0$	20 (13)	9 (6)
$8.0 < z < 8.5$	11 (11)	4 (4)
$8.5 < z < 9.0$	6 (6)	2 (2)
Total	124 (71)	66 (36)

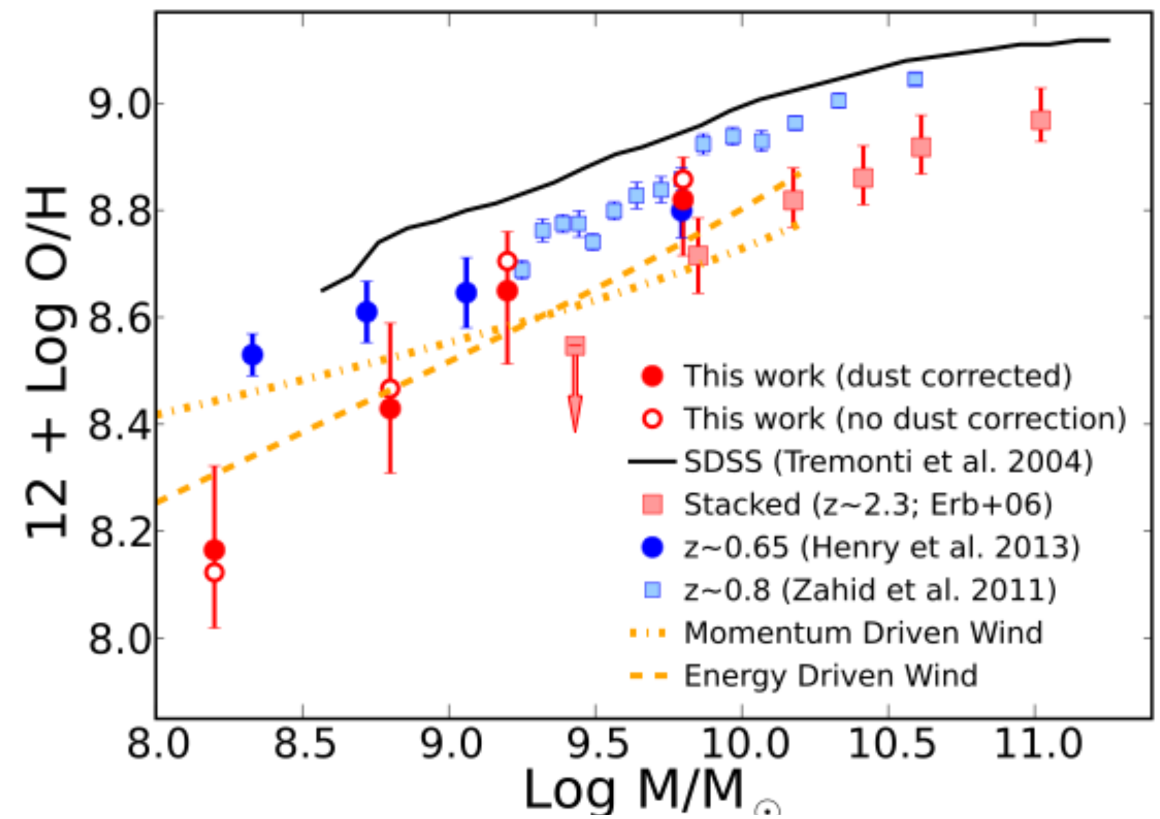
Barnett et al. (2019)

Euclid will get spectra of the brightest objets.
Follow-up of fainter QSOs will require ground- based NIR spectrographs on large telescopes.

The first Euclid quasars at z > 7.5 should be found in DR1

Euclid science: the intermediate-z universe

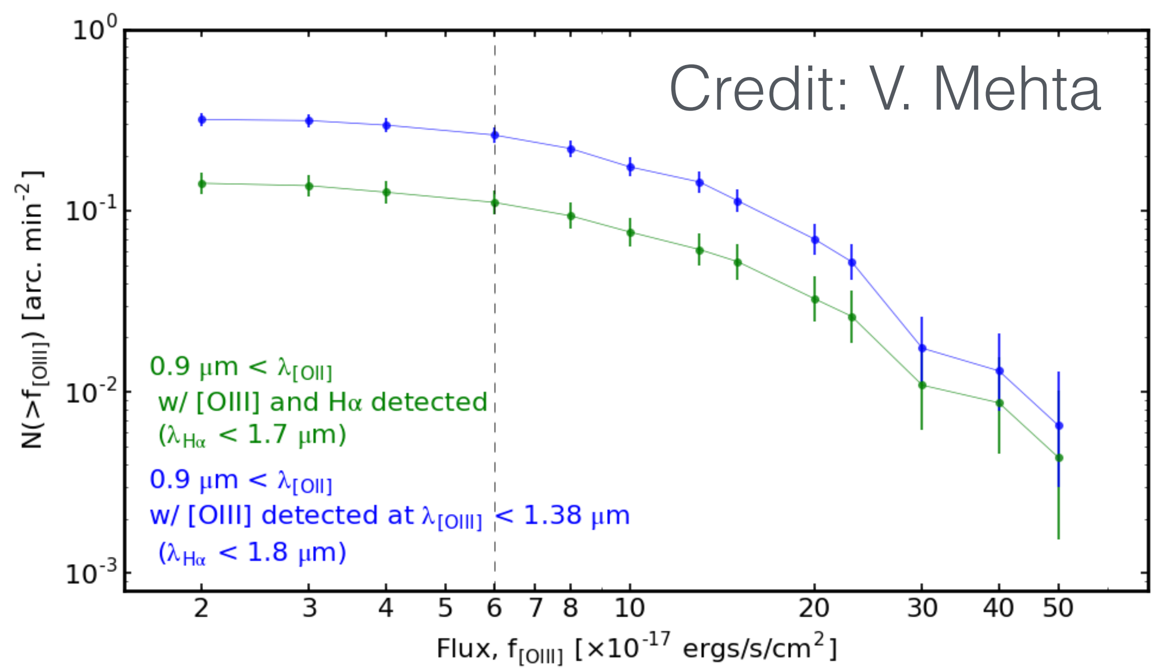
Henry et al. (2015)



Euclid spectra can be used to derive

— Multi-dimentional distribution of physical parameters:

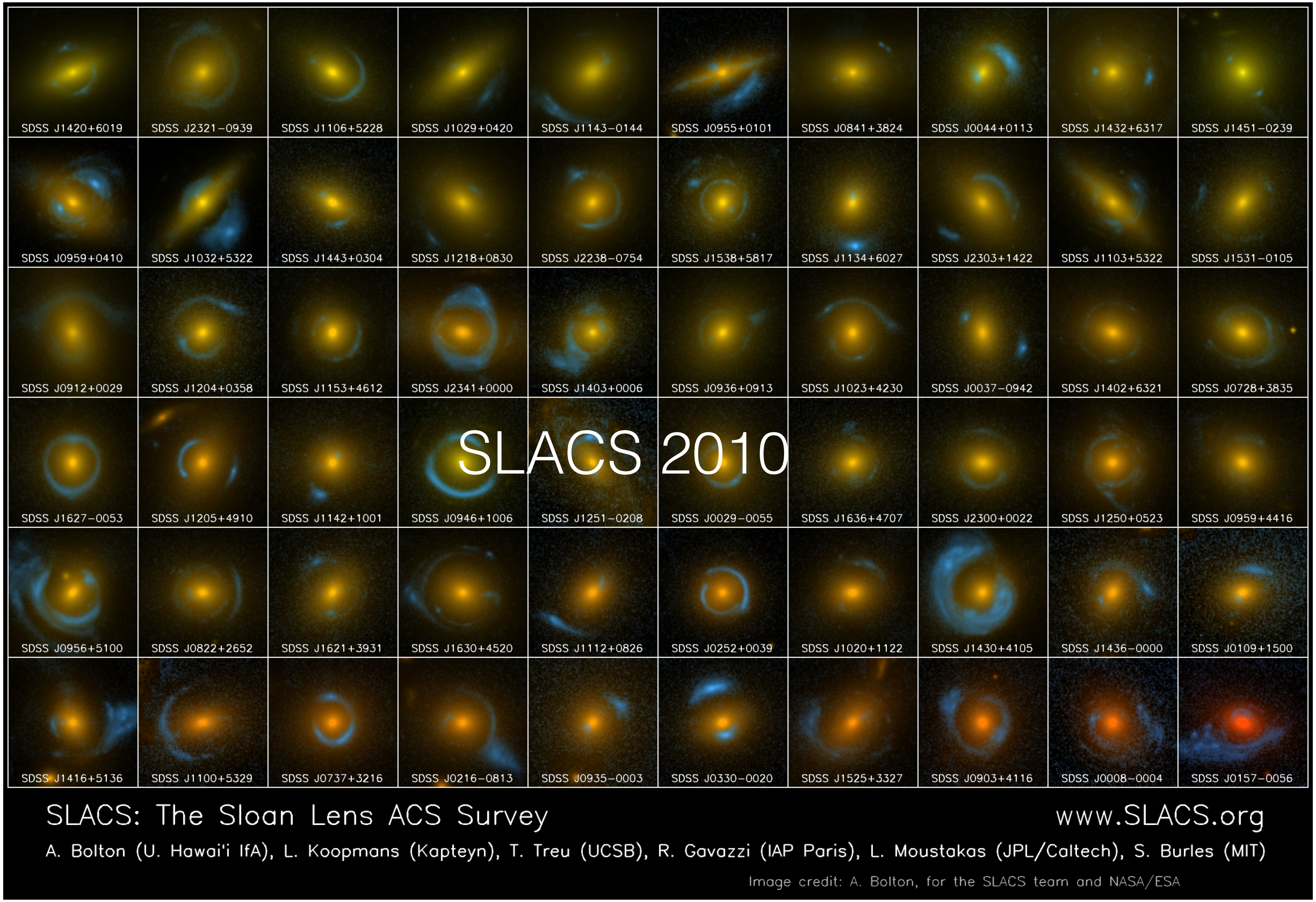
- SFR (Hα)
- Dust attenuation (Hα/Hβ)
- gas metallicity ([O/H])
- ionization parameter (O32, S32)
- SFHs (Hα EW)



900 galaxies per sq. degree with all diagnostic emission lines required for metallicity measurement

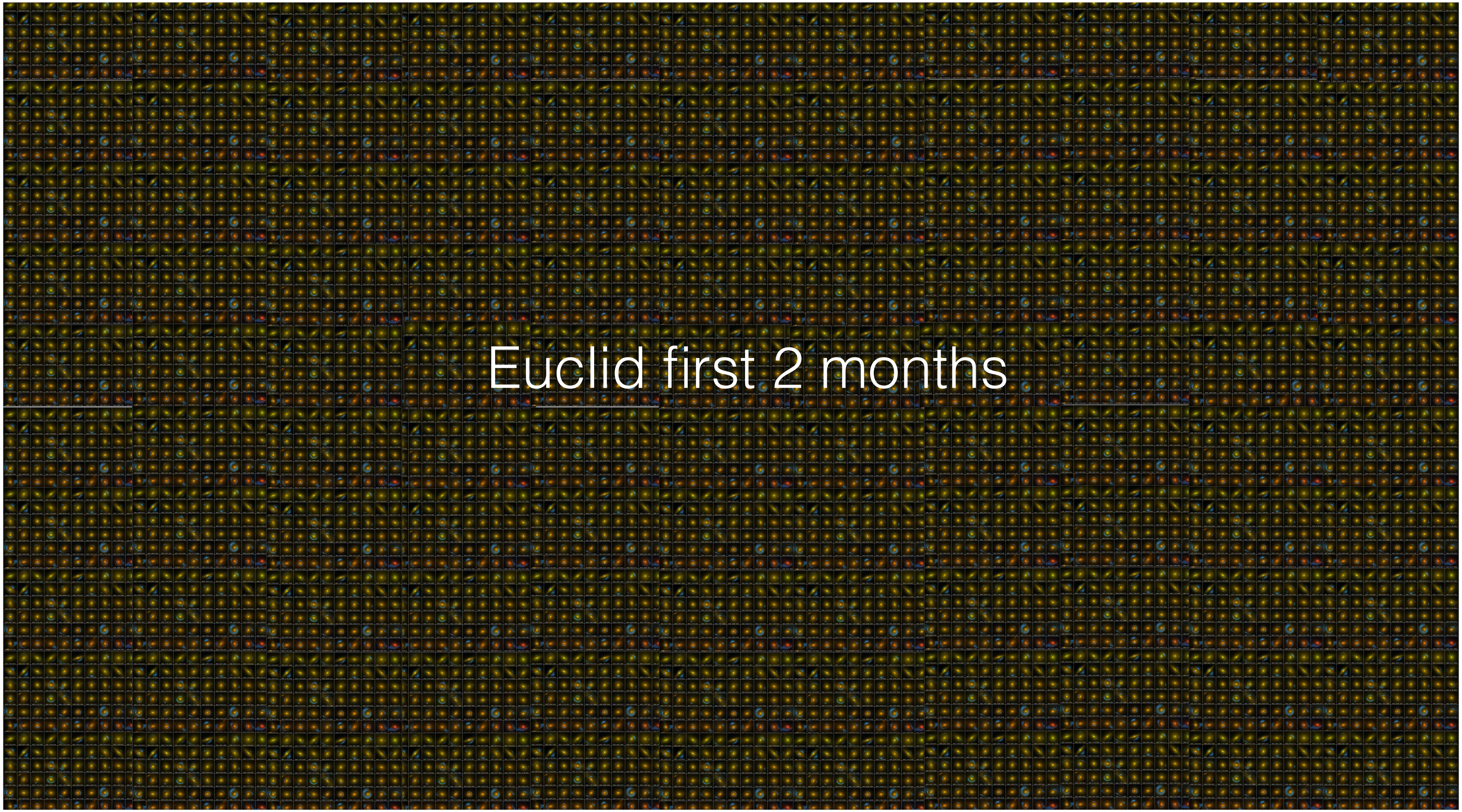
Strong Lensing

Credit: L. Koopmans



Strong Lensing

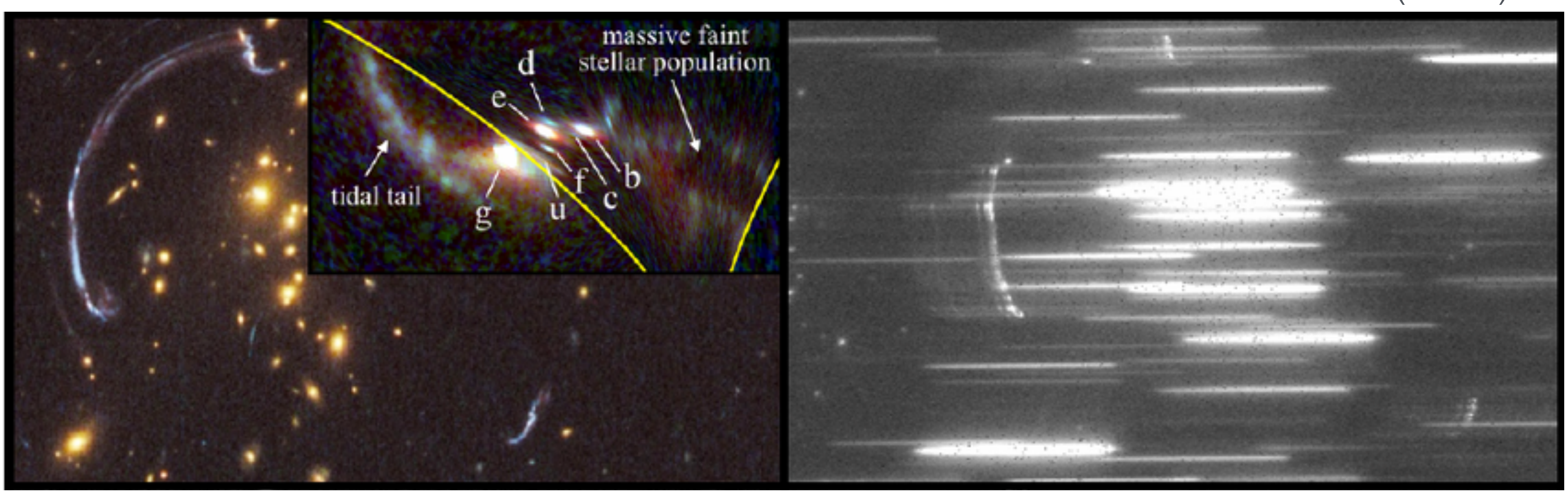
Credit: L. Koopmans



Strong Lensing: science

- Total-mass density profiles of galaxies in the inner several effective radii
- The stellar and dark matter mass fraction in the inner regions of galaxies.
- Resolved emission line studies
- …

Withaker et al. (2014)

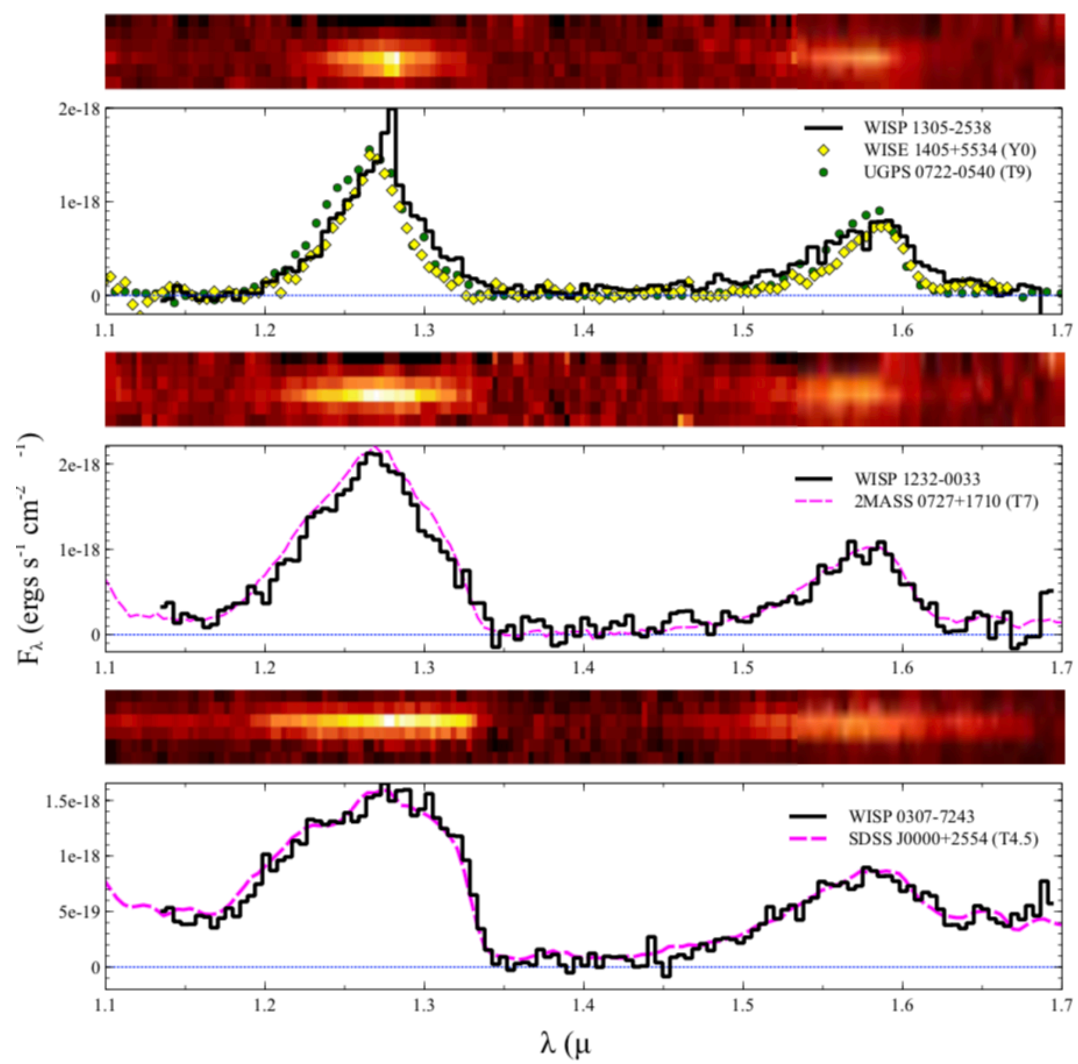


Euclid science: our Milky Way

Distributions of galactic compact dwarfs depend on the Galaxy's star formation history and stellar mass function.

Euclid will identify ~900 Brown Dwarfs brighter than H~18 in Euclid wide.

Spectra can be used to assign spectroscopic type.



Spectral type **T9.5/Y0**
Distance **≲ 60±9 pc**

Spectral type **T7**
Distance **≈ 270±60 pc**

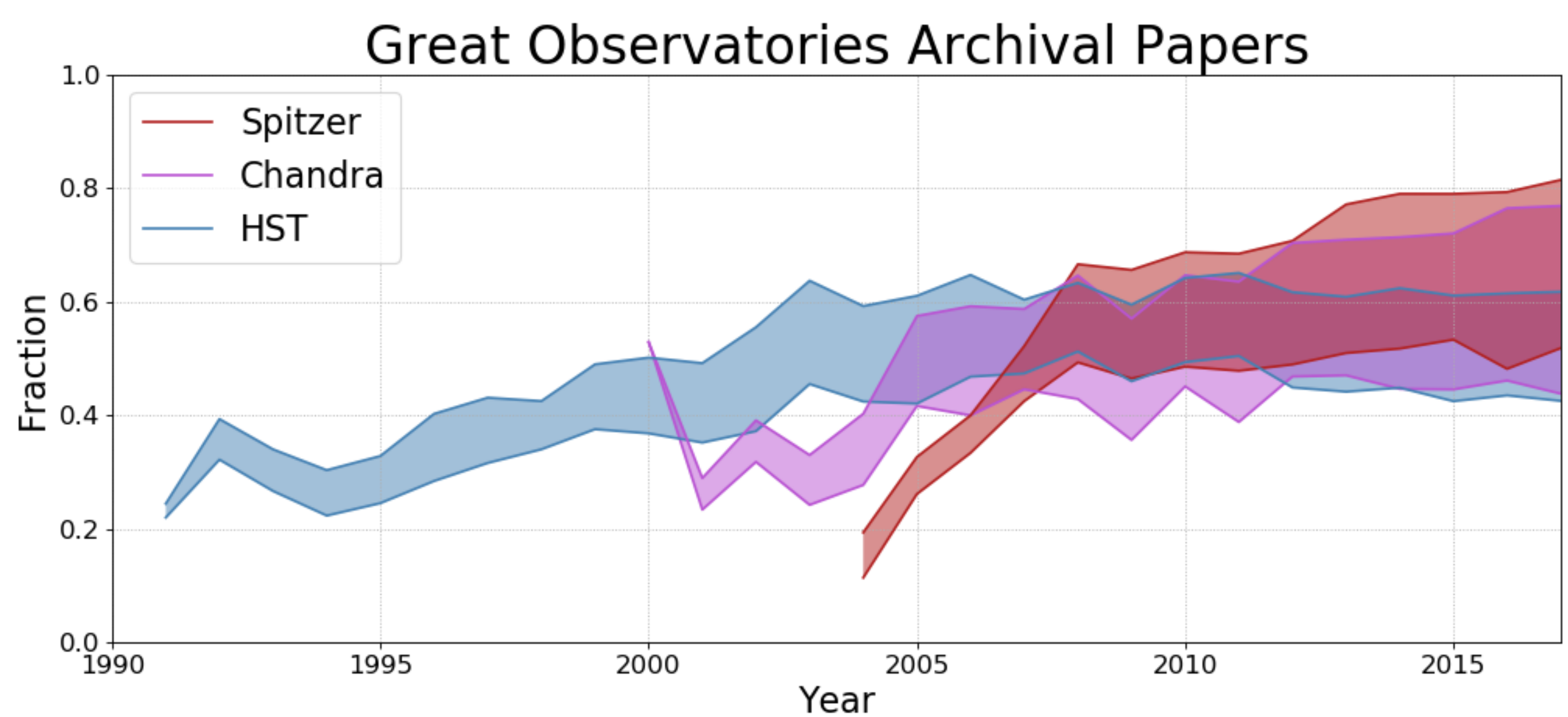
Spectral type **T4.5**
Distance **≈ 400±60 pc**

Masters et al. (2013)

Euclid science: Conclusions

What	Euclid
Galaxies at 1<z<3 with good mass	$\sim 2 \times 10^8$
Massive galaxies (1<z<3) w/ spectra	$\sim$few x 10^3
Hα emitters/metal abundance in z~2-3	$\sim 4 \times 10^7/10^4$
Galaxies in massive clusters at z>1	$\sim 2 \times 10^4$
Type 2 AGN (0.7<z<2)	$\sim 10^4$
Dwarf galaxies	$\sim 10^5$
Teff ~400K Y dwarfs	$\sim$few 10^2
Strongly lensed galaxy-scale lenses	~300,000
z > 8 QSOs	~10

- Euclid's NIR imaging and spectroscopy will make Euclid the reference survey of the extragalactic sky for years to come.
- Euclid's data will allow to address scientific questions from the solar system to the most distant galaxies.
- Archival science can double the number of papers from the mission.

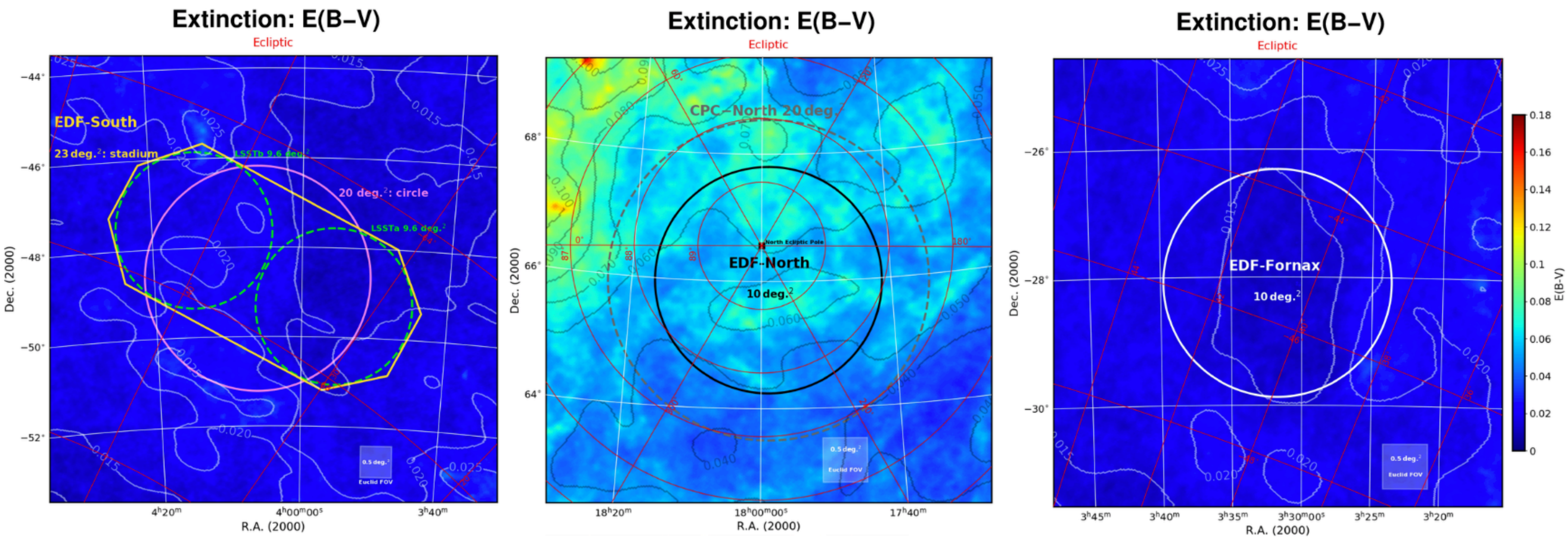


References

For more information visit:
http://www.euclid-ec.org/

Euclid Definition Study Report, Laureijs et al. 2011, arXiv:1110.3193

Euclid deep fields



https://www.cosmos.esa.int/web/euclid/euclid-survey