Euclid

an ESA Medium Class Mission

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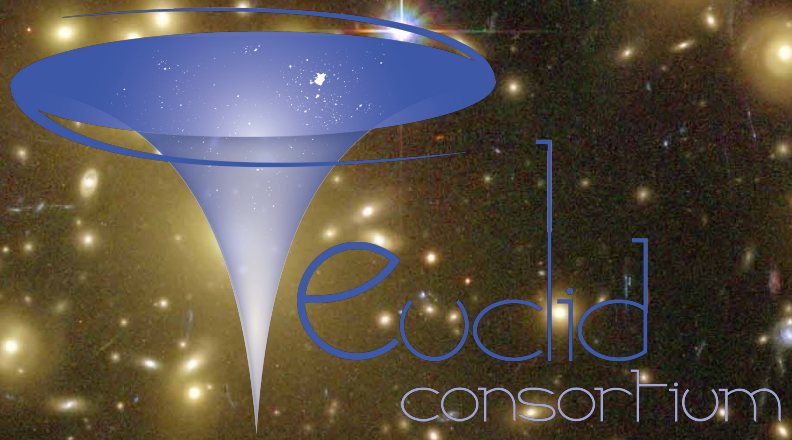
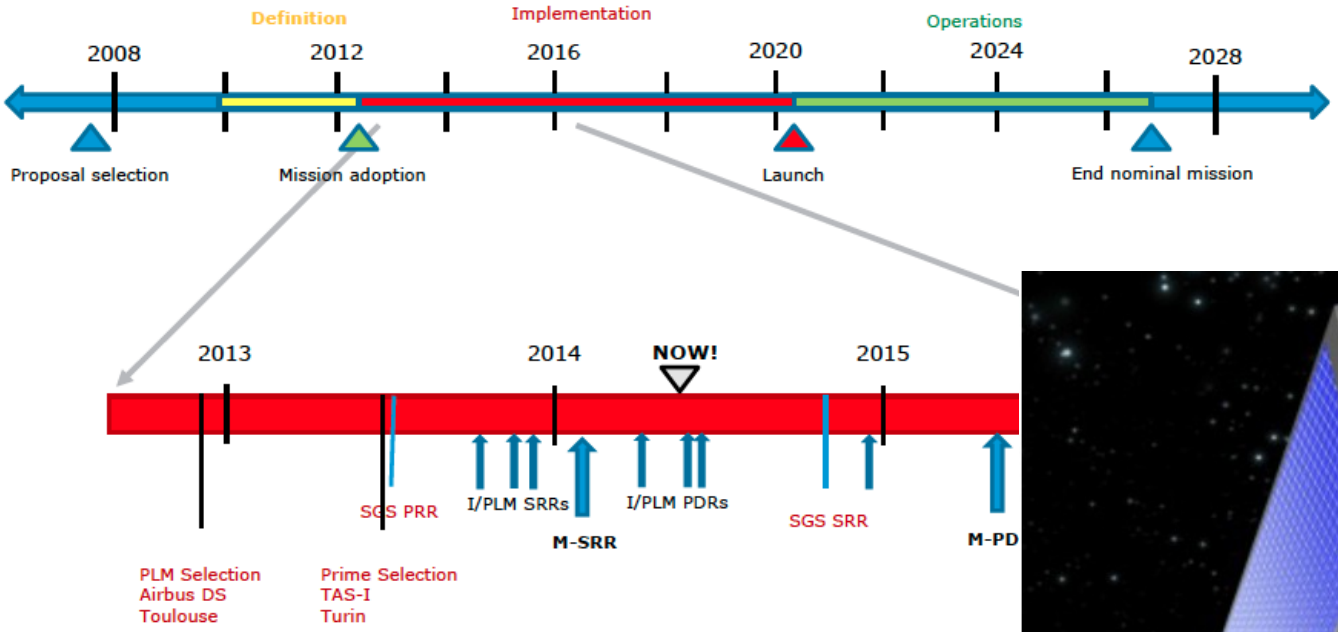


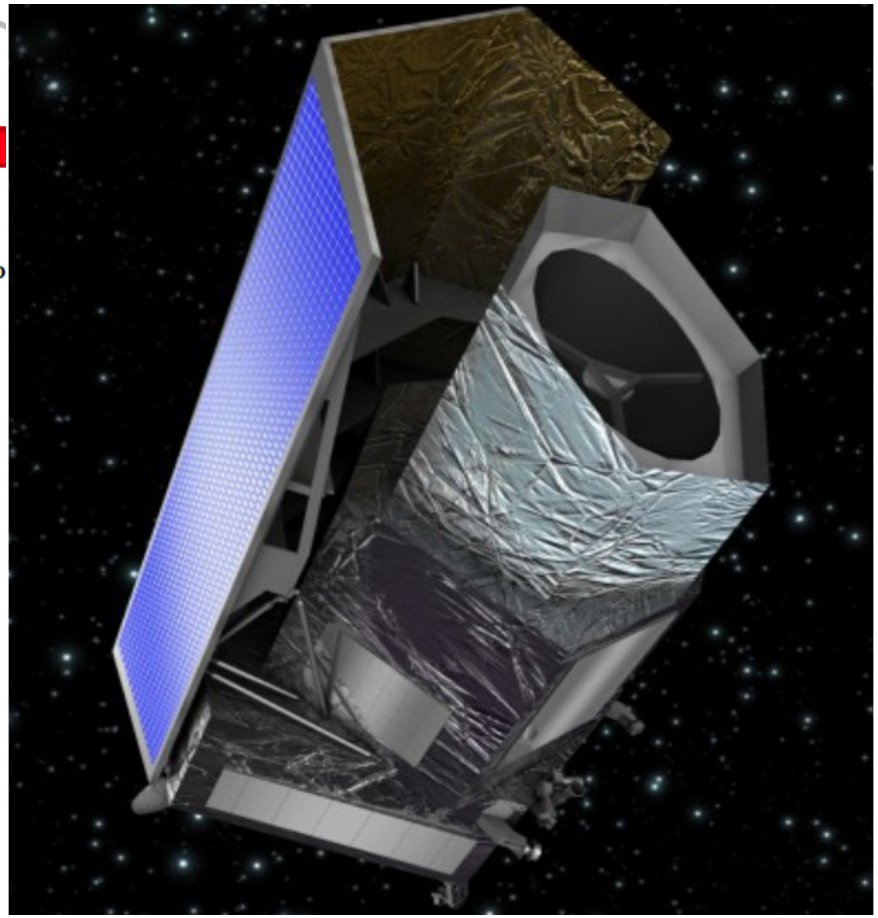
ING MOS Conference, La Palma

March 5th, 2015

Euclid timeline



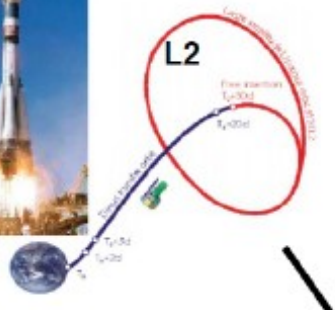
from R. Laureijs



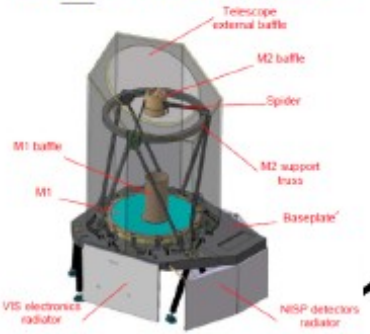
Euclid in one slide

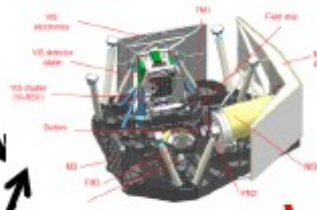
slide from Y. Mellier

Soyuz@Kourou
Q1 2020

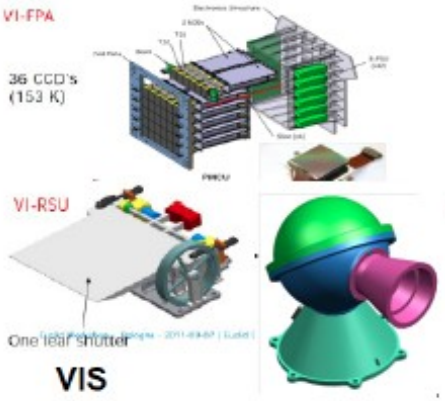


PLM+SVM: 2010-2019

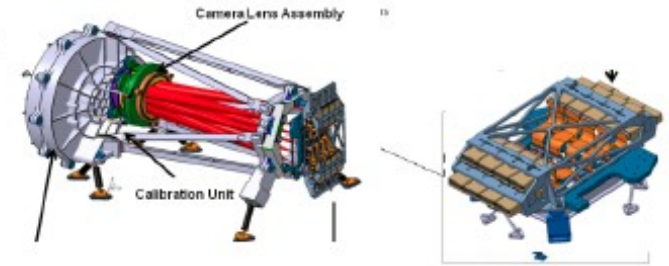




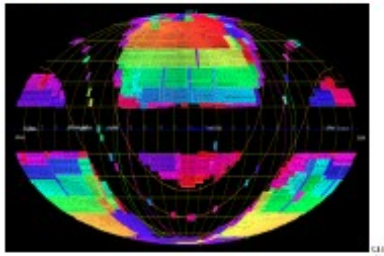
VIS imaging:
2010-2020
(VIS team)

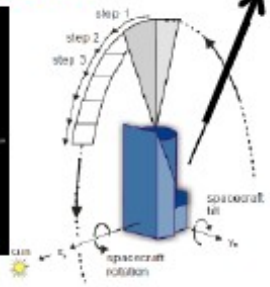


NIR spectro-imaging
2010-2020 (NISP team)



Surveys: 2010-2028 (Survey WG)

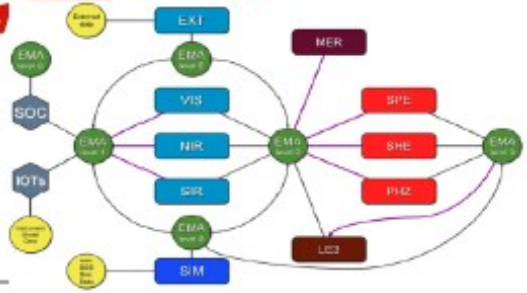




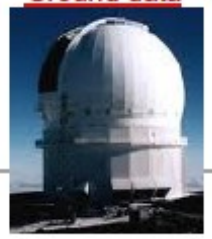
6 yrs - 15,000 deg²

- Commisionning – SV
- Euclid opération:
5.5 yrs:Euclid Wide+Deep
- +: SNIa, mu-lens, MW?

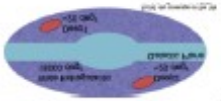
SGS: 2010-2028

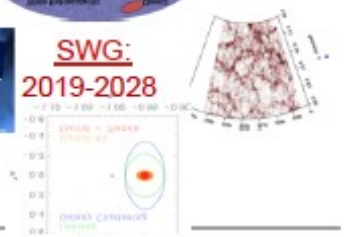


Ground data



SWG:
2019-2028





20-30 PB data processing (EC-SGS team) — Science analyses

Key numbers & probes

Ground based
Photometry and Spectroscopy (photo-z)

SURVEYS In ~6 years		
	Area (deg2)	Description
Wide Survey	**15,000 deg²**	Step and stare with 4 dither pointings per step.
Deep Survey	**40 deg²**	In at least 2 patches of > 10 deg² 2 magnitudes deeper than wide survey

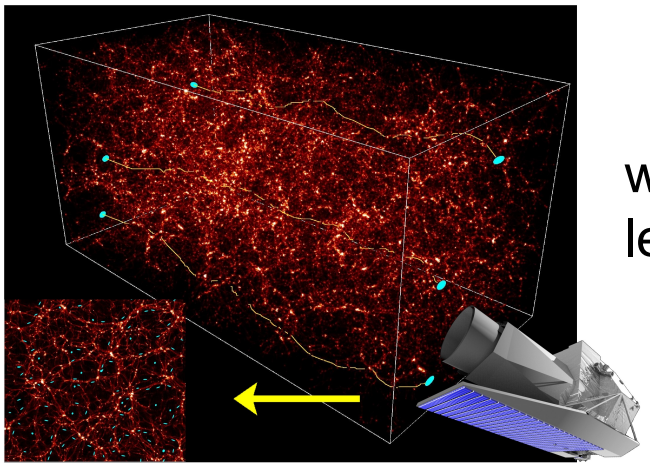
PAYLOAD					
Telescope	1.2 m Korsch, 3 mirror anastigmat, f=24.5 m				
Instrument	VIS	NISP			
Field-of-View	0.787×0.709 deg²	0.763×0.722 deg²			
Capability	Visual Imaging 0.1"/px	NIR Imaging Photometry			NIR Spectroscopy
Wavelength range	550– 900 nm	Y (920-1146nm),	J (1146-1372 nm)	H (1372-2000nm)	1100-2000 nm
Sensitivity	24.5 mag 10σ extended source	24 mag 5σ point source	24 mag 5σ point source	24 mag 5σ point source	3 10^{-16} erg cm-2 s-1 3.5σ unresolved line flux

Shapes + Photo-z of n = 1.5 x10⁹ galaxies

z of n=2.5x10⁷ galaxies

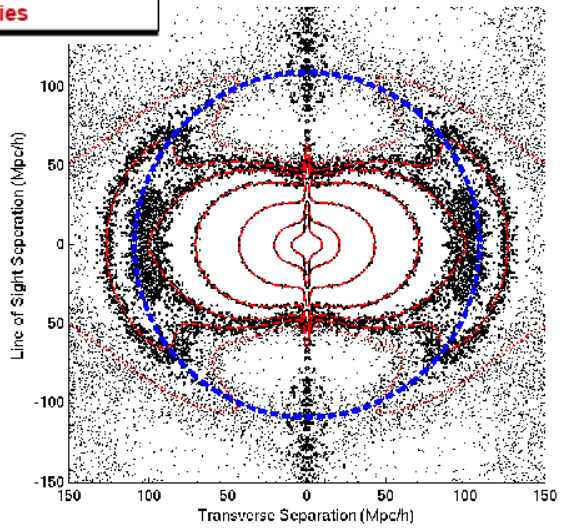
slide from
Y. Mellier

revised

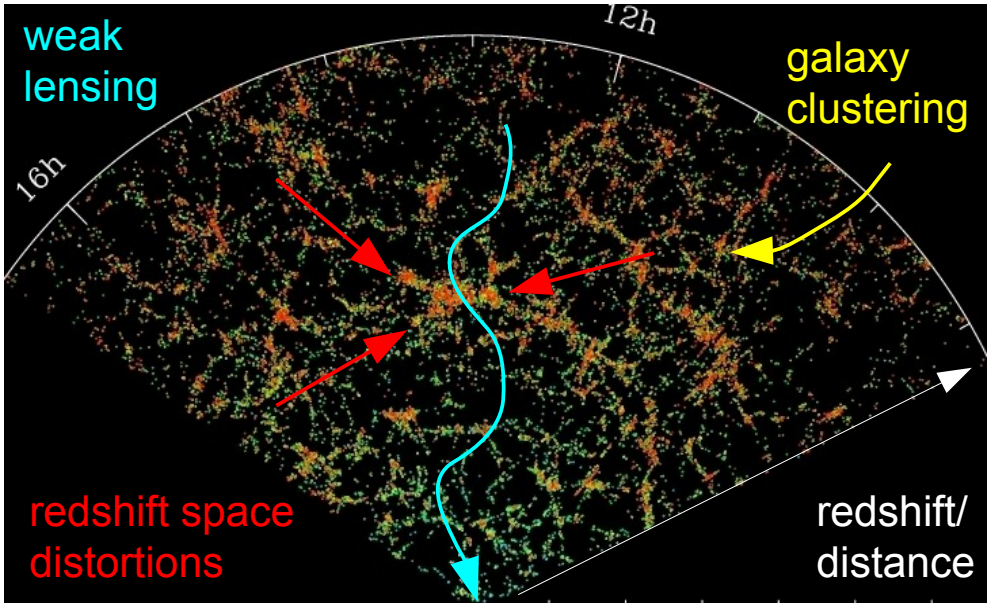


weak gravitational lensing

galaxy clustering



Synergy of probes

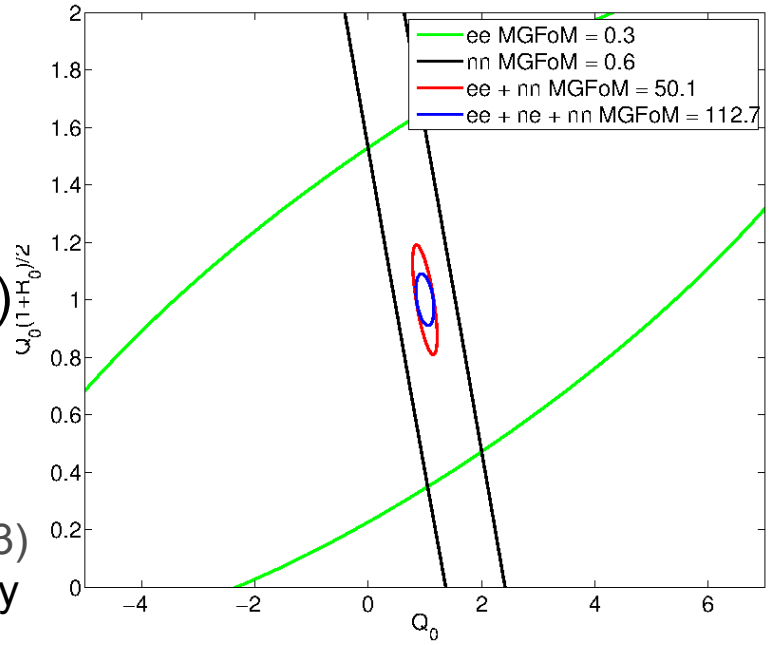


modified gravity parameters:

$$G_{eff} = G_{Newton} Q_0 a^3$$

$$\frac{\Phi}{\Psi} = R_0 a^3$$

- different sensitivities to cosmology
- different systematic effects
- include cross-correlations (same-sky surveys)
- add Euclid secondary probes:
  - CMB cross-correlations
  - galaxy cluster cosmology
  - strong lensing statistics



Kirk et al. (2013)
DES-like survey

Performance of Euclid

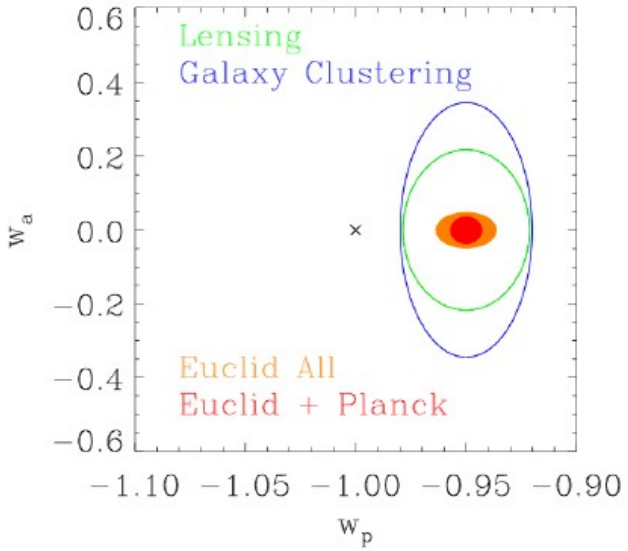
Laureijs et al. (2011)

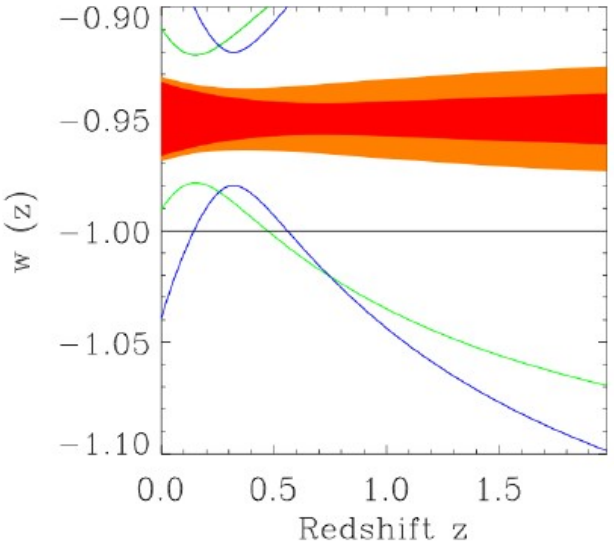
	Modified Gravity	Dark Matter	Initial Conditions	Dark Energy		
Parameter	γ	m_ν /eV	f_{NL}	w_p	w_a	**FoM** $= 1/(\Delta w_p \times \Delta w_a)$
Euclid primary (WL +GC)	0.010	0.027	5.5	0.015	0.150	430
Euclid All	0.009	0.020	2.0	0.013	0.048	1540
Euclid+Planck	0.007	0.019	2.0	0.007	0.035	4020 → **6000**

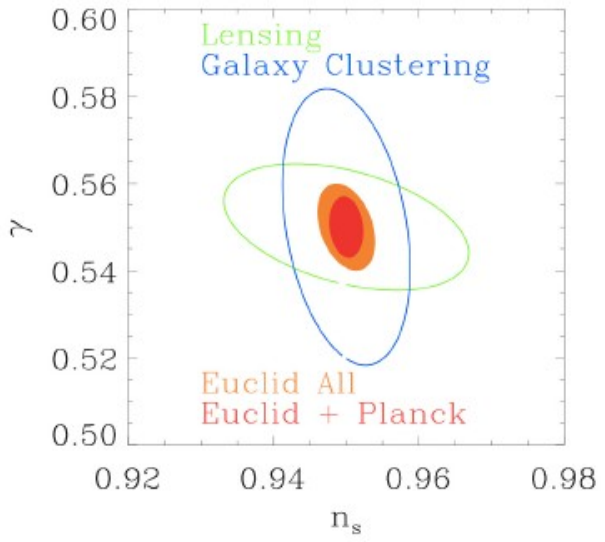
$$p_{DE} = w(z)\rho_{DE}c^2$$

$$w(z) = w_0 + w_a \frac{z}{1+z}$$

$$\frac{d\ln G}{d\ln a} \approx \Omega_M(a)^\gamma$$

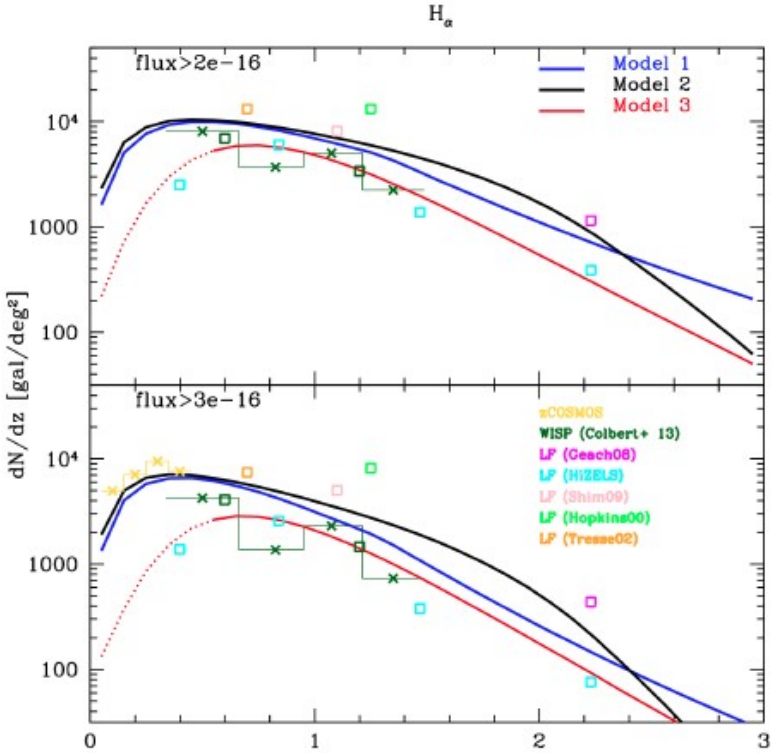






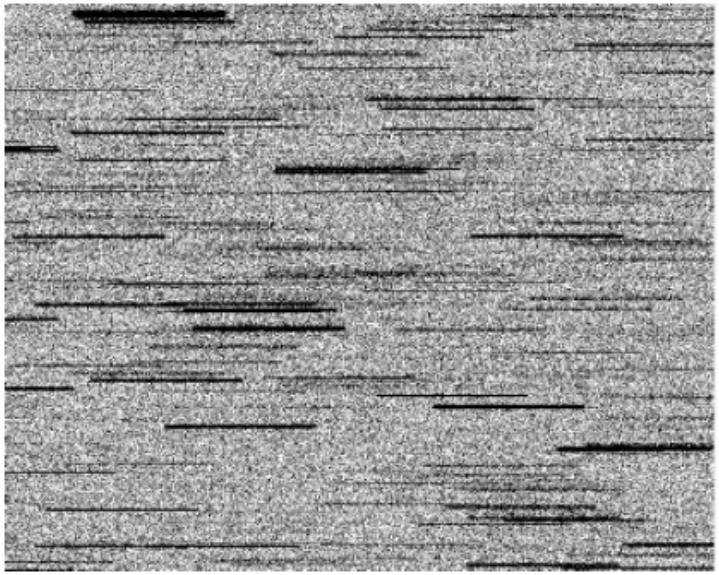
Challenges for clustering

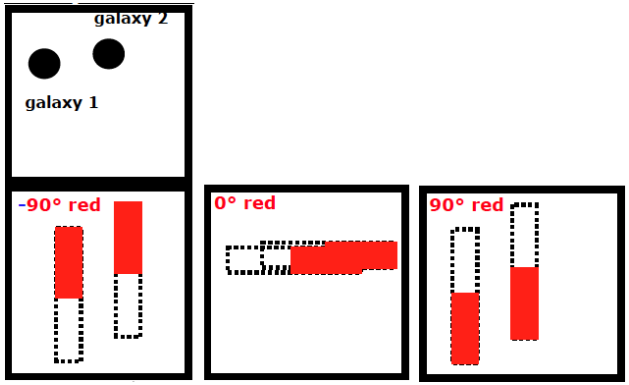
- untargeted observations with uncertain source numbers



from G. Guzzo

- slitless spectroscopy with significant confusion

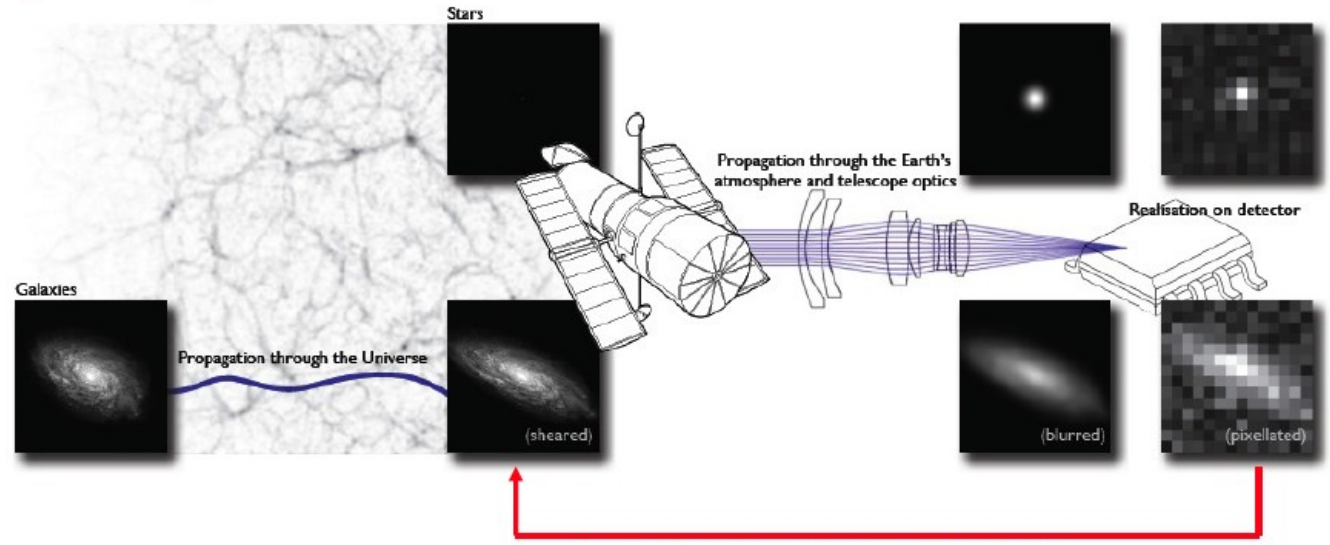




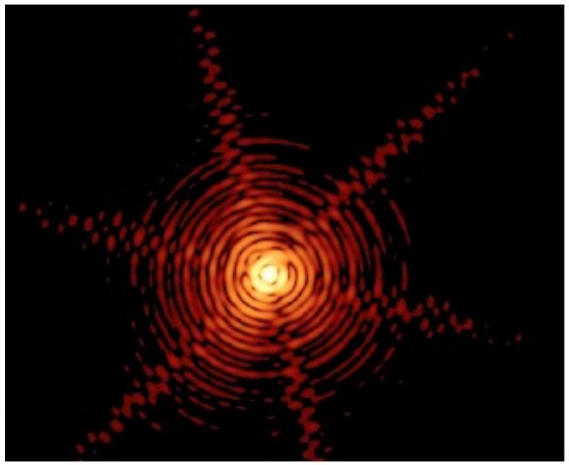
from O. LeFevre

Challenges for weak lensing

Figure from Kitching et al. 2012

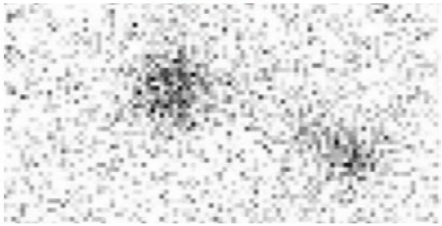


Euclid PSF



- low S/N shear estimation
- charge transfer inefficiency
- colour gradients

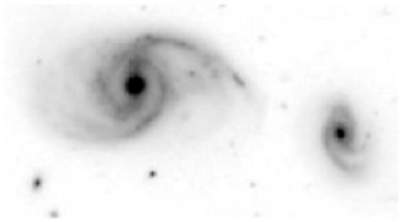
observed



from H. Hoekstra

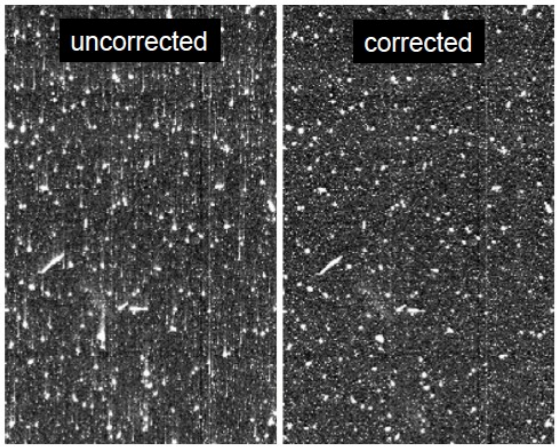
see Viola+14

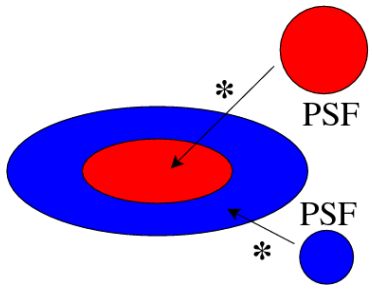
true



see Massey+13

from R. Massey





see Semboloni+13

Summary

- Euclid will map the full extragalactic sky from L2 in ~2021-2027
- primary probes: weak gravitational lensing & galaxy clustering
- high-res. optical imaging, NIR spectroscopy, NIR photometry
  + optical photometry from the ground

- unique capabilities for LSS weak lensing & medium-redshift clustering
- all measurements systematics-limited but Euclid probes synergetic and complementary to ground-based surveys
- expect excellent constraints on dark energy & dark matter properties as well as tests of Einstein gravity, galaxy formation & evolution, etc.

Euclid Definition Study Report (Red Book):
Laureijs et al. (2011), astro-ph/1110.3193
http://sci.esa.int/euclid/