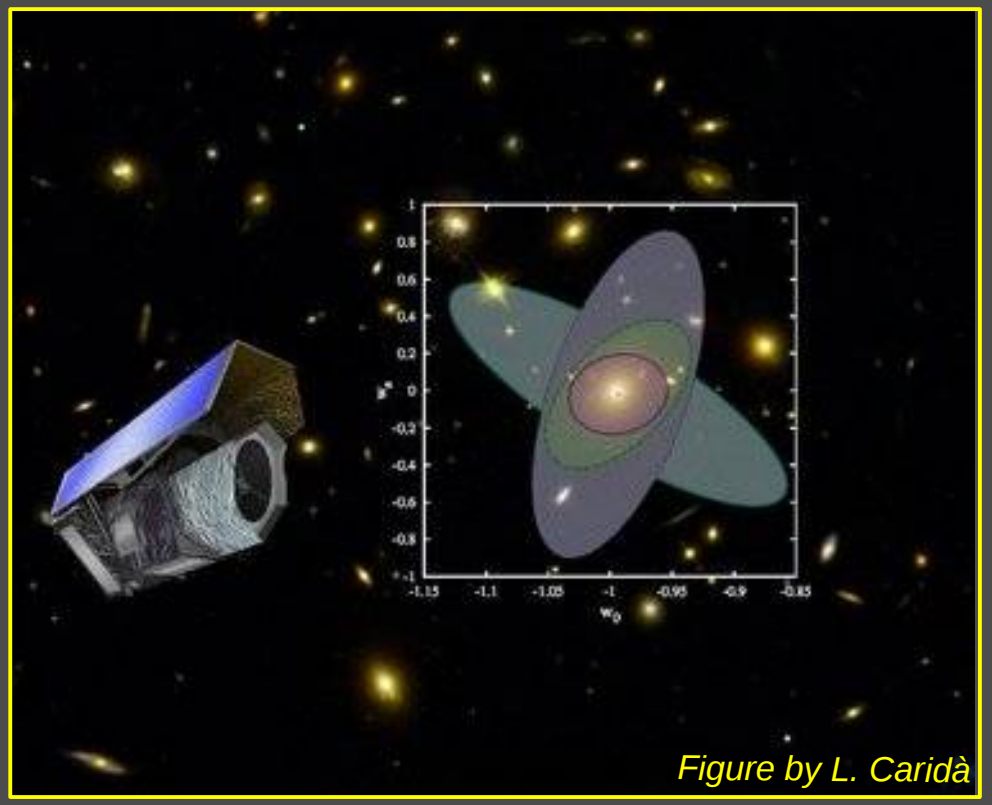
Clusters of Galaxies with Euclid



A. Biviano (INAF-OATS)

largely based on Sartoris, AB, Fedeli et al. 2016

Euclid: ESA medium class A&A mission,
selected Oct 2011, to be launched in 2020

1.2 m telescope, 2 instruments:
NISP (Photometer and Spectrograph) and VIS (imager)

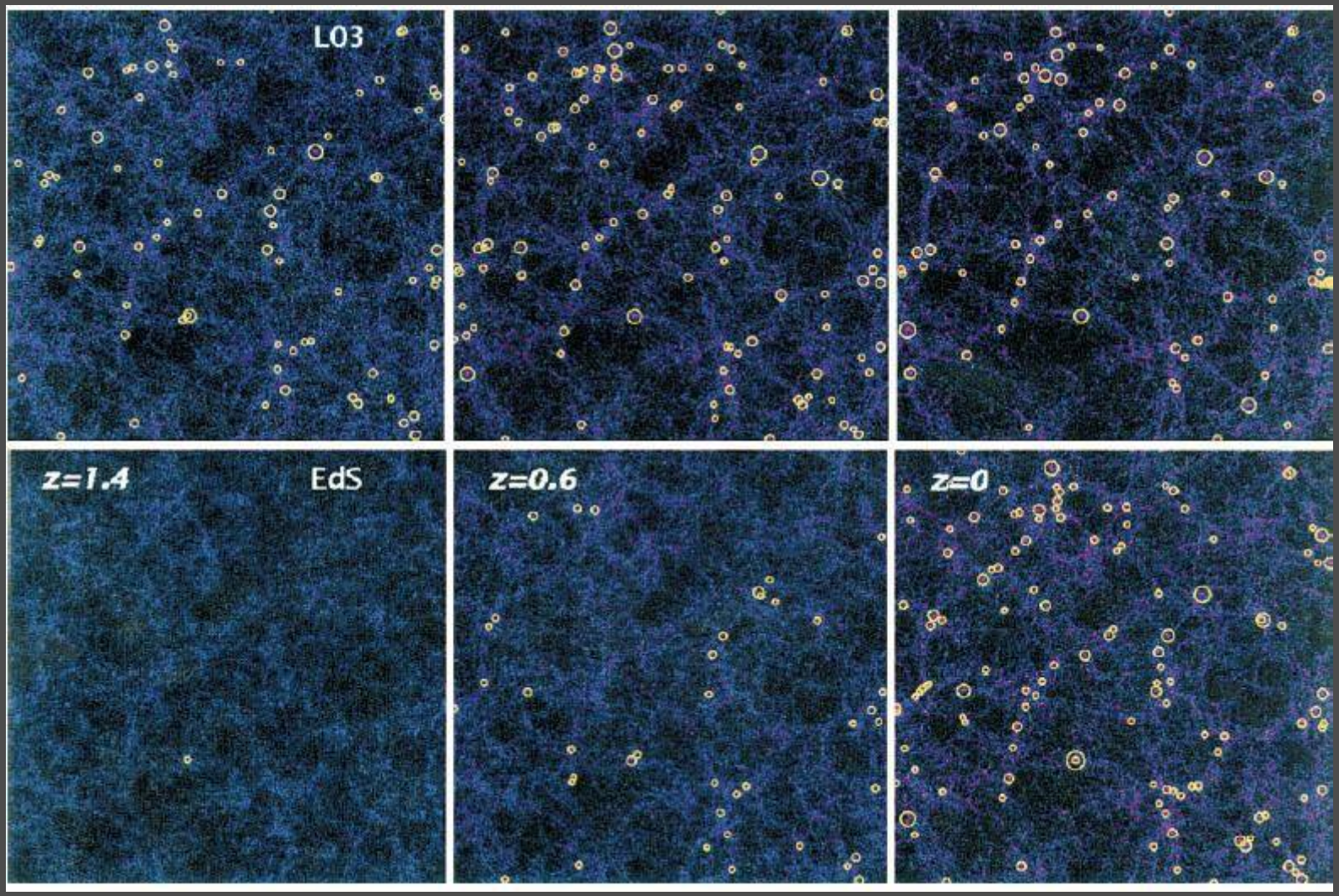
Surveys: 15000 deg^2 wide (H_{AB}=24.0) + 40 deg^2 deep (2 mag deeper)

Location: L2; duration: 6.25 years

Main aim: understand the nature of Dark Energy by two probes,
Weak Lensing and Galaxy Clustering (BAOs)

...Clusters of Galaxies are “additional cosmological probes” for Euclid.

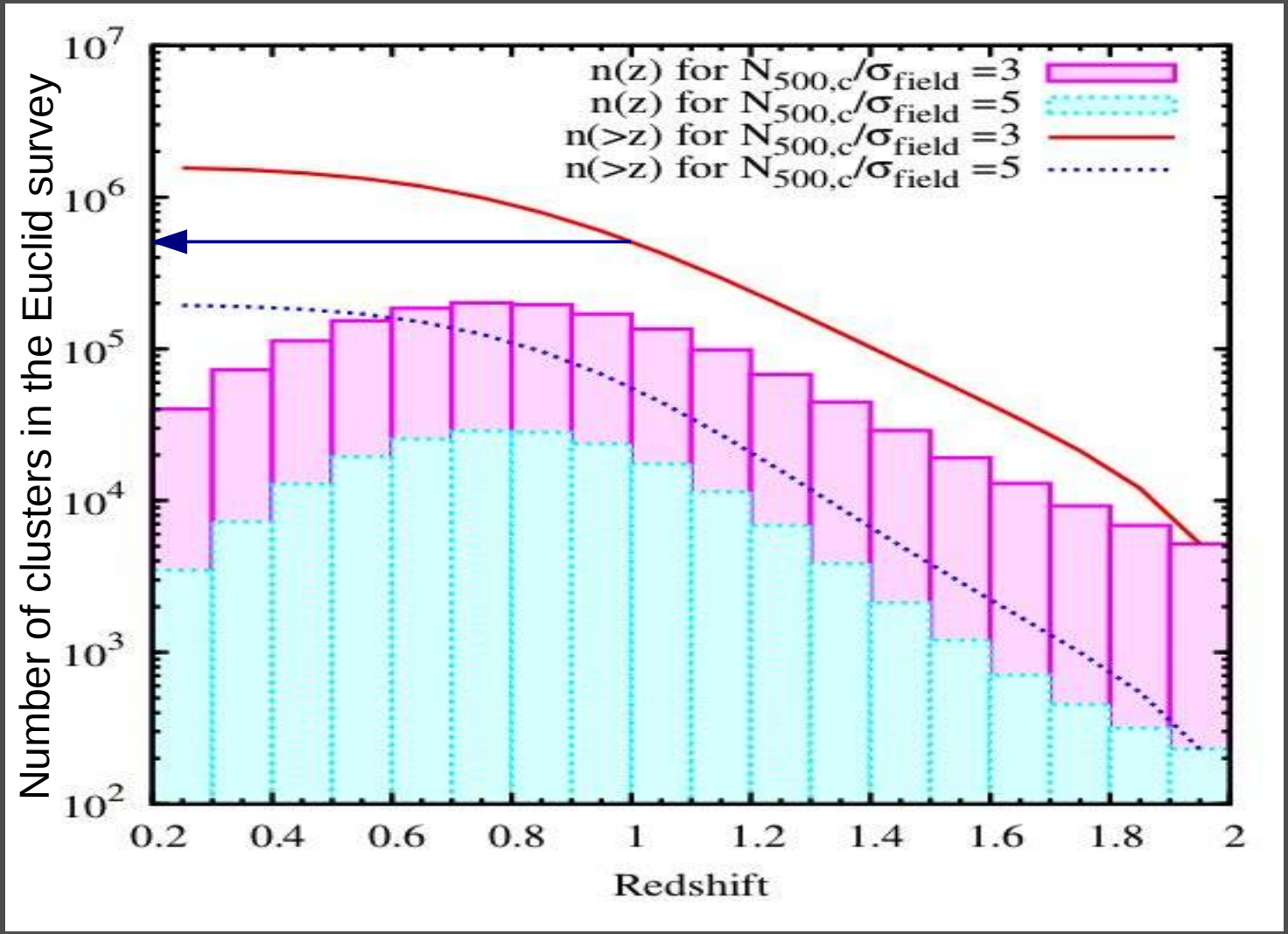
The number counts and spatial distribution of clusters of galaxies have a strong dependence on a number of cosmological parameters



Clusters in different cosmologies (yellow circles; Borgani+Guzzo 2001)

We know few dozens clusters at z>1, and virtually none at z>2.

Euclid will change this picture drastically:



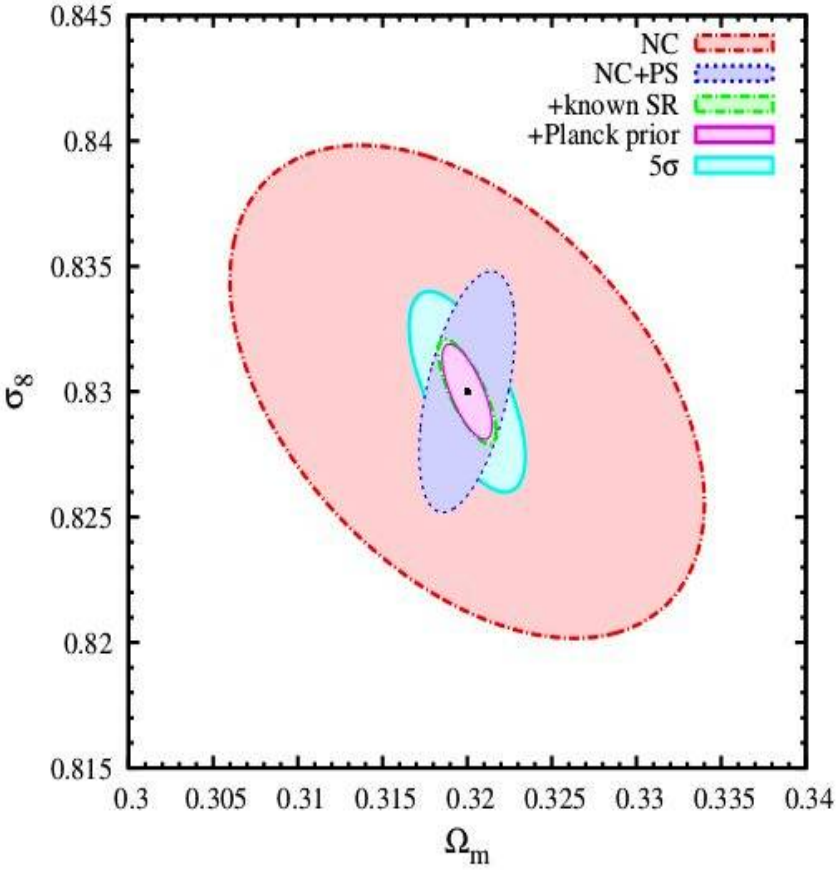
from Sartoris+16

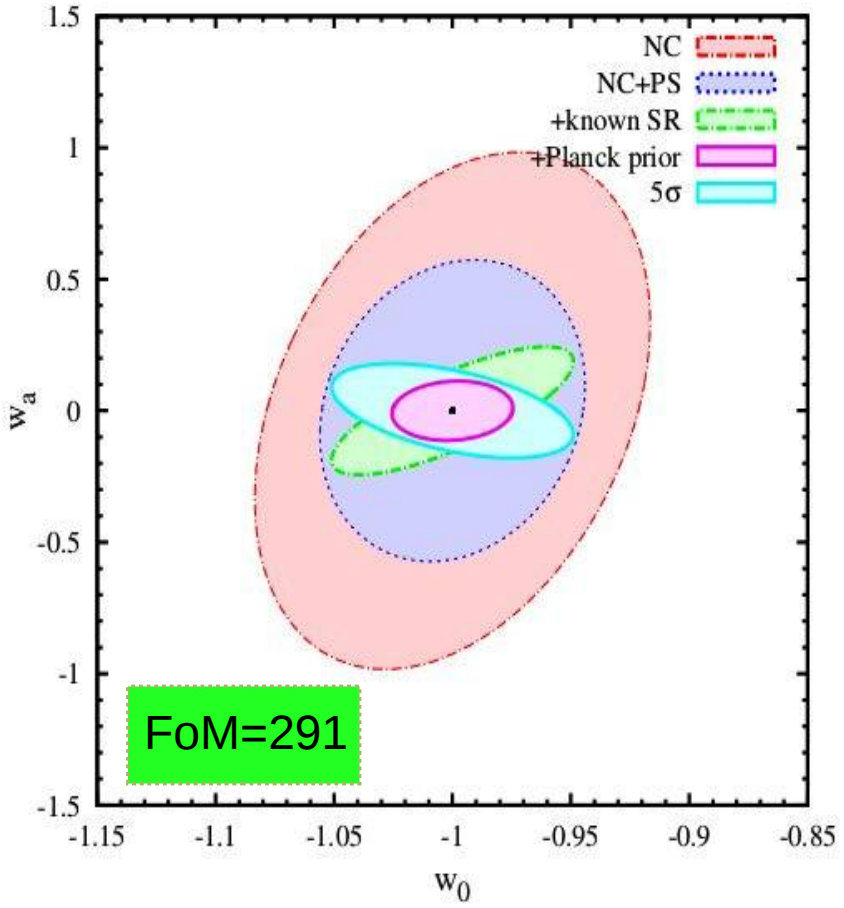
~5 10^5 clusters detected with s/n>3 at z>1

~2 10^3 clusters detected with s/n>3 at z>2

Number Counts + Power Spectrum cosmological constraints from Euclid clusters:

from Sartoris+16



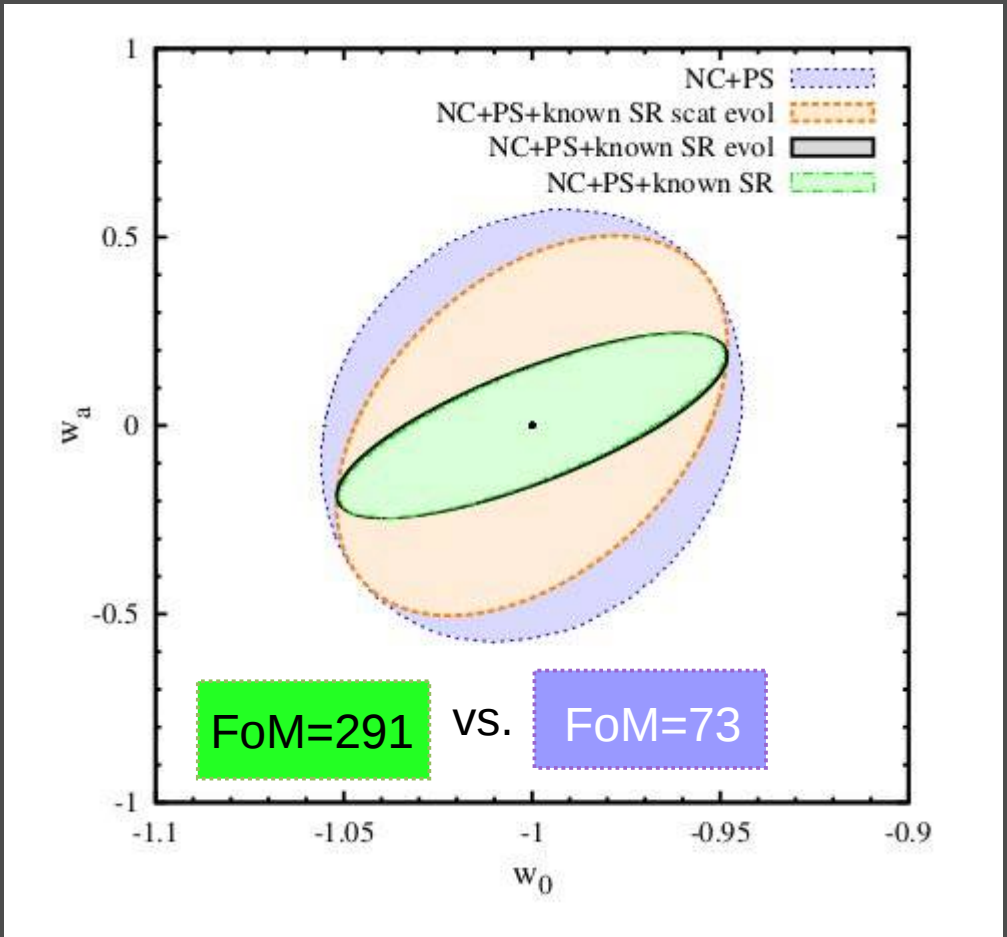


$N_{500,c}/\sigma_{\rm field} \geqslant 3$ *Euclid* photometric cluster selection

Parameter arrays:		Eqs. 16 & 28				Eqs. 22 & 28	Eqs. 20 & 28	Eqs. 26 & 28
Constraints:	FoM	Δw_0	Δw_a	$\Delta\Omega_m$	$\Delta\sigma_8$	$\Delta\gamma$	Δf_{NL}	$\Delta\Omega_\nu$
NC+PS	73	0.037	0.38	0.0019	0.0032	0.023	6.67	0.0015
NC+PS+known SR	291	0.034	0.16	0.0011	0.0014	0.020	6.58	0.0013
NC+PS+known SR+Planck	802	0.017	0.074	0.0010	0.0012	0.015	4.93	0.0012

Number Counts + Power Spectrum cosmological constraints from Euclid clusters:

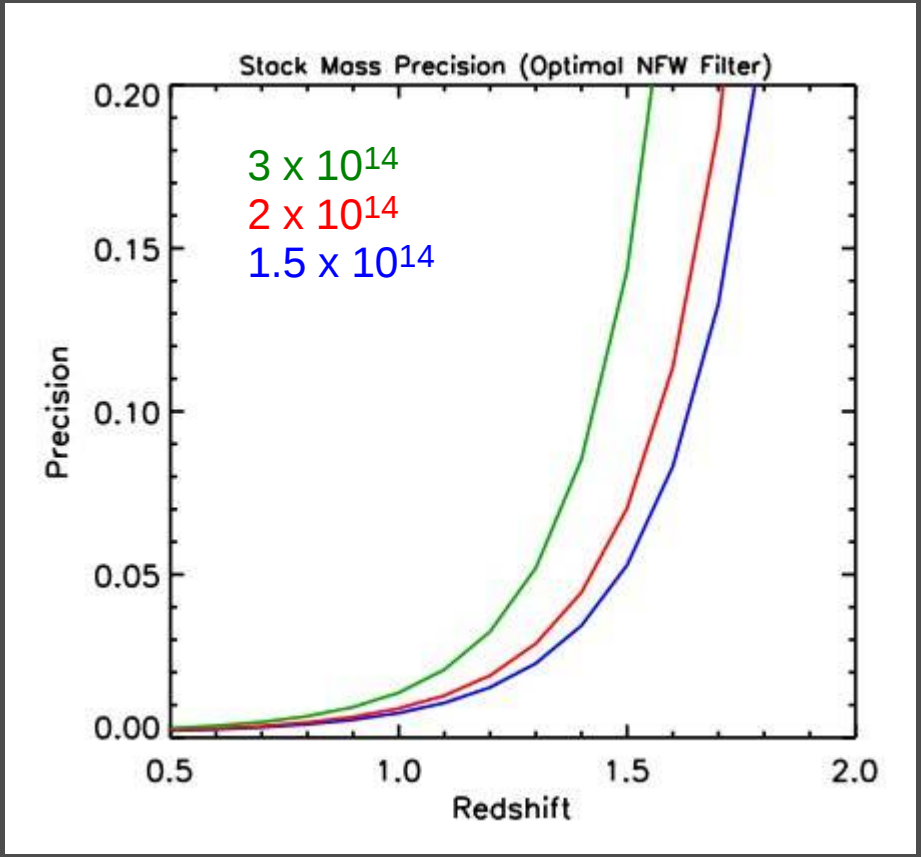
from Sartoris+16



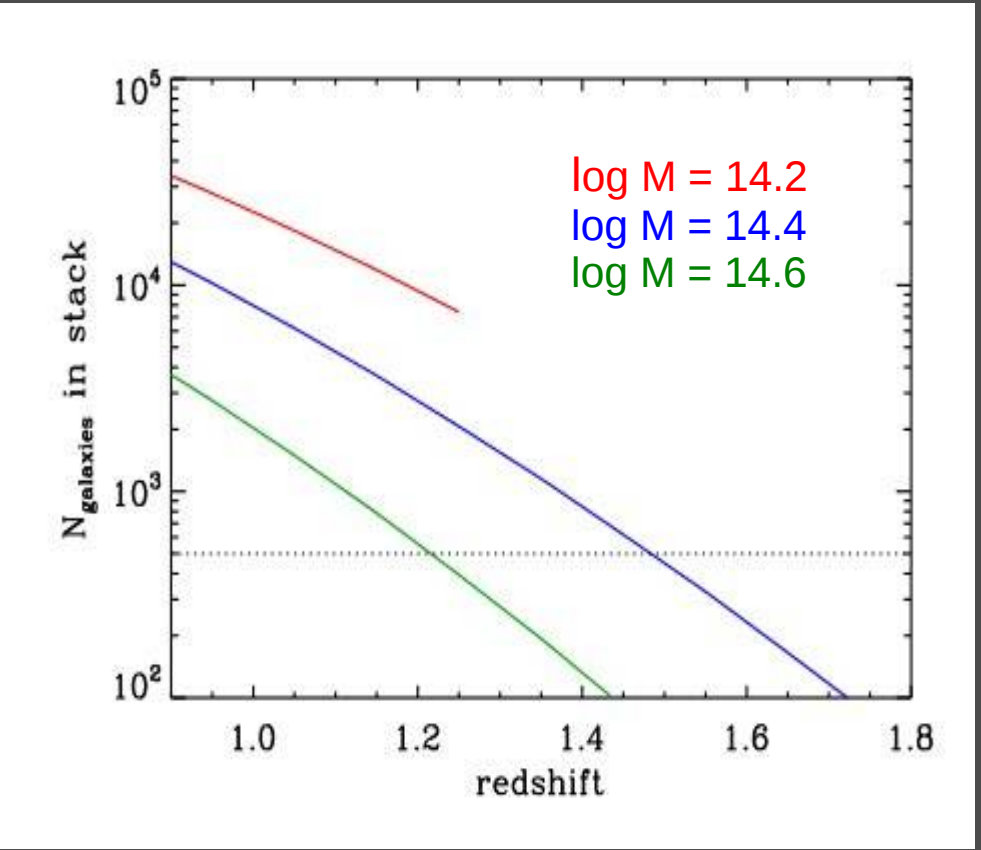
Knowledge of the Scaling Relation relating the cluster mass to a given observable, and in particular of the evolution of the scatter and bias of the SR with redshift, **is very important!**

The Scaling Relation and its evolution can be calibrated internally with Euclid, by correlating the observed richnesses (or optical luminosities or stellar masses) with masses from Weak Lensing or velocity distributions, through stacking

from Sartoris+16



Expected precision on <M> in bins of Δlog M = 0.2 and Δz = 0.1



Number of galaxies with z in stack

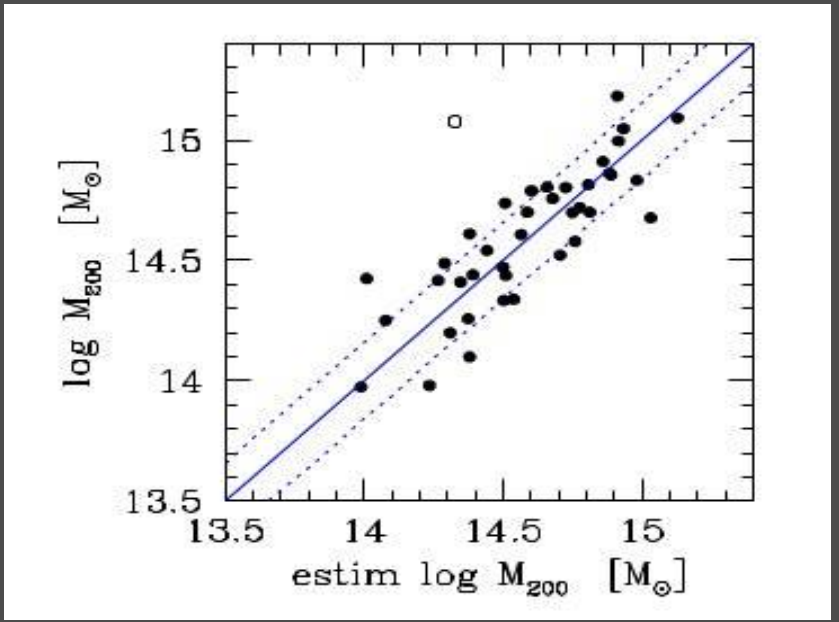
Sinergy with current and forthcoming surveys/facilities:

CLASH & CLASH-VLT (z~0.4):

- understand the uncertainties and systematics in the estimate of masses from gravitational lensing (see Massimo's talk) and the velocity distribution of galaxies (e.g. AB+13; Balestra+16);

- establish the lowest-scatter mass proxy based on the cluster luminosity, total stellar mass (Annunziatella+15) or richness (Andreon 15)

from Andreon 15:
richness-predicted mass vs. mass from kinematics (Rines+12);
scatter=0.16 ±0.02 dex



Sinergy with current and forthcoming surveys/facilities:

KMOS & MOONS (z>1):

- spectroscopic follow-up of some z~2 Euclid clusters: study the velocity distribution of galaxies and their spectral characteristics

ALMA:

- follow-up of massive star-forming galaxies in z~2 Euclid clusters

(see Stefano A's talk on cluster galaxies evolution)

Sinergy with current and forthcoming surveys/facilities:

eROSITA & ATHENA (see Stefano B's talk on behalf of Silvano):

- calibrate the observable-mass relation using masses from X-ray luminosities and temperatures for eROSITA clusters (z<1)

- study the intra-cluster medium metallicity evolution with ATHENA by following-up Euclid clusters up to z~2, the presumed epoch of intense star-formation for cluster galaxies

LOFAR & SKA (see Rossella's talk):

- At high z more and more clusters are expected to be undergoing major mergers: look for radio-halos in high-z Euclid clusters

Conclusions

1) Italy is well represented in the Euclid Consortium in particular for clusters of galaxies:

L. Moscardini co-lead of the Science Working Group

AB co-lead of the work package for the implementation of algorithms for cluster detection and characterization

35 out of 144 members of “Euclid Clusters” are Italian
(and the fraction is higher among active members: 19 out of 44)

Conclusions

2) Italy is NOT well represented in other cosmological surveys, such as DES, KiDS, LSST

This may hamper the readiness of the scientific exploitation of Euclid data

3) Italy is not participating to the next generation of Sunyaev-Zel'dovich surveys

This will reduce our synergetic capabilities of exploitation of high-z Euclid cluster data


SAY, EUCLID,
HOW DO WE GET
TO THE specola?