Cosmography With Galaxy Clusters: Shedding Light on Dark Energy

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Accelerated Expansion and Dark Energy

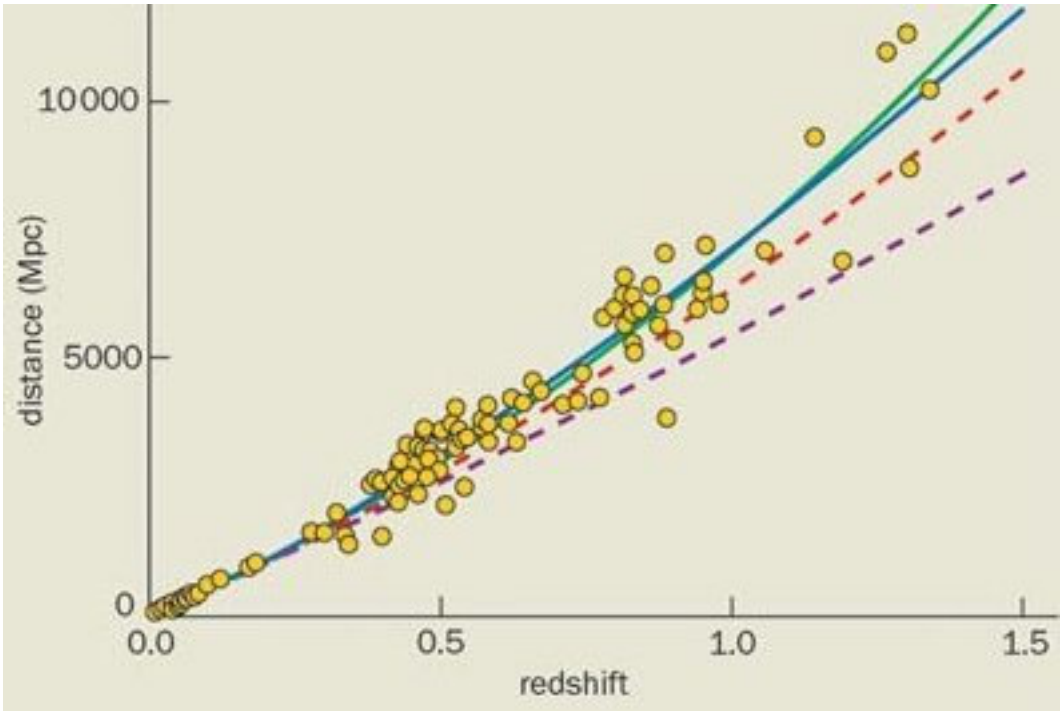
Einstein equations
$G_{\mu\nu} = 8\pi G\, T_{\mu\nu}$

1st Friedmann equation
$\ddot{a} = -4\pi G/3\,(\rho+3p)a$

$\ddot{a} > 0$ implies $p < -\rho/3$

2nd Friedmann equation
$\dot{a}^2 = 8\pi G/3\,\rho\, a^2 - k$

DE's equation of state
$p(\rho) = ?$

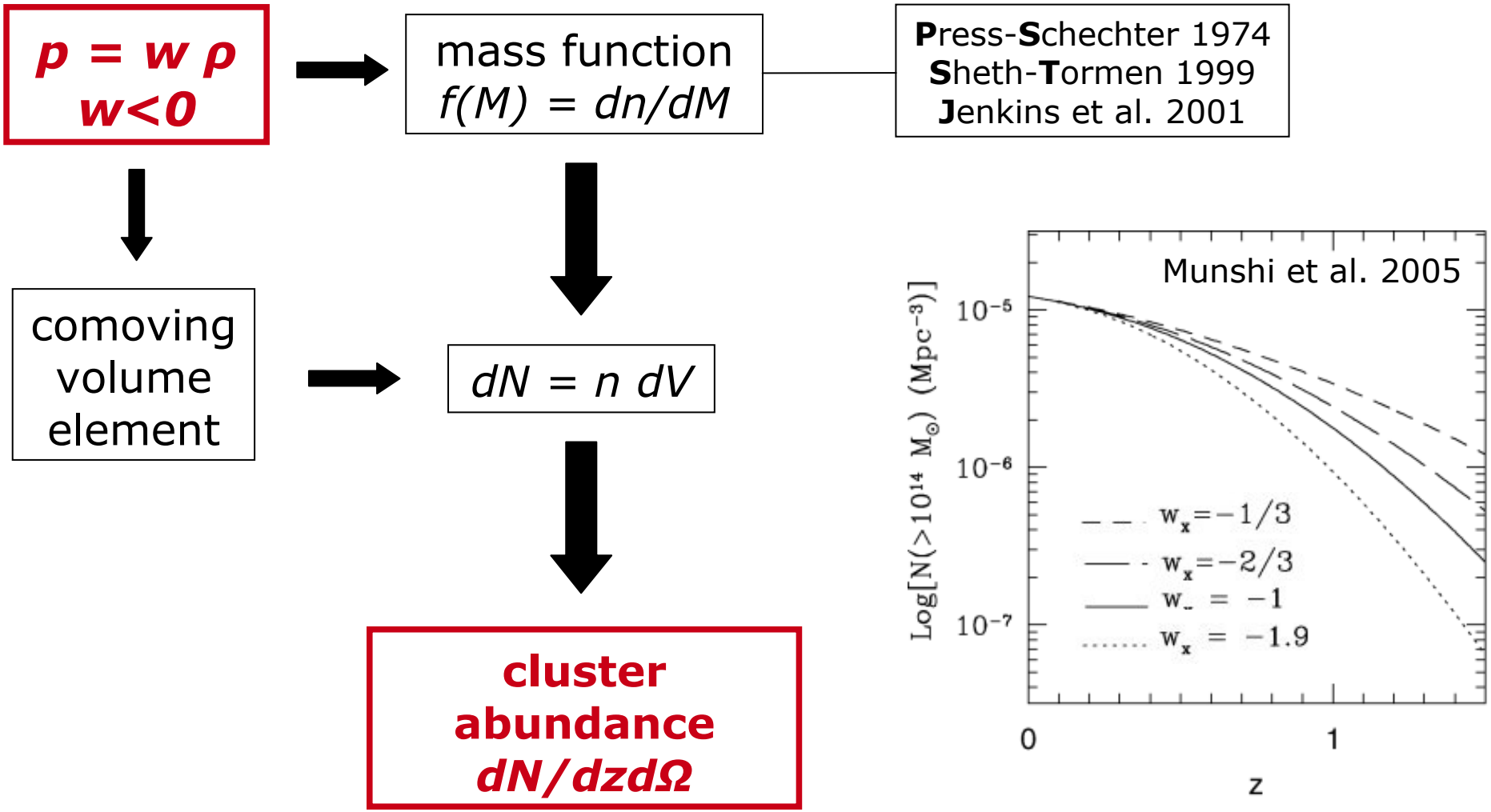


benchmark model

$\Omega_m = 0.3$
$\Omega_\Lambda = 0.7$
$p = -\rho$

SNe experiments
Spergel et al. 1998
Riess et al. 1998

Cluster Abundance Probes DE's Equation of State



effect of w >> difference between PS, ST, J

KIDS/Vesuvio@VST

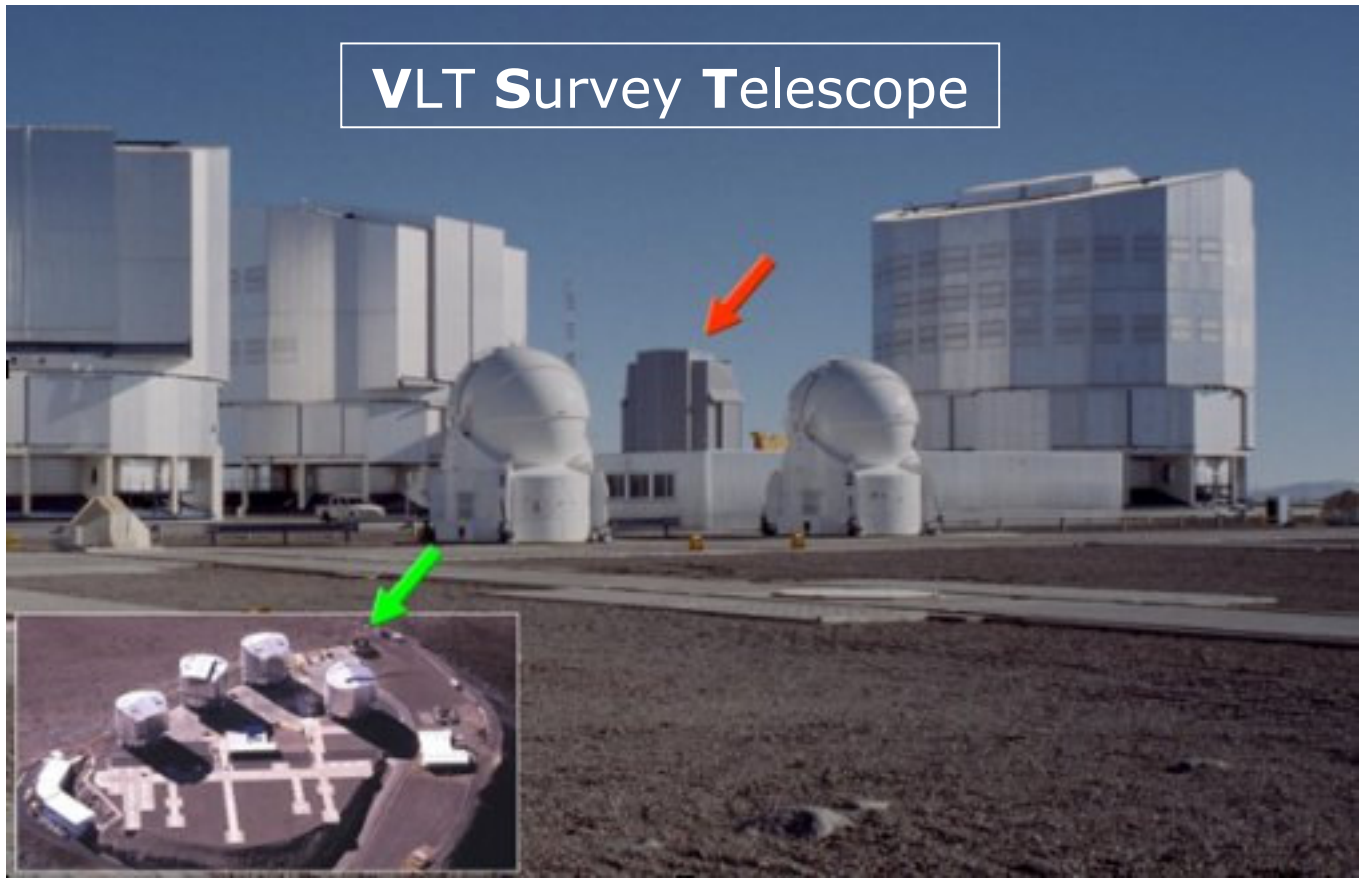
Kilo-**D**egree **S**urvey

VST **E**xploration of **SU**perclusters, **V**oids and **I**ntermediate **O**bjects

sky area:
1500 sq deg

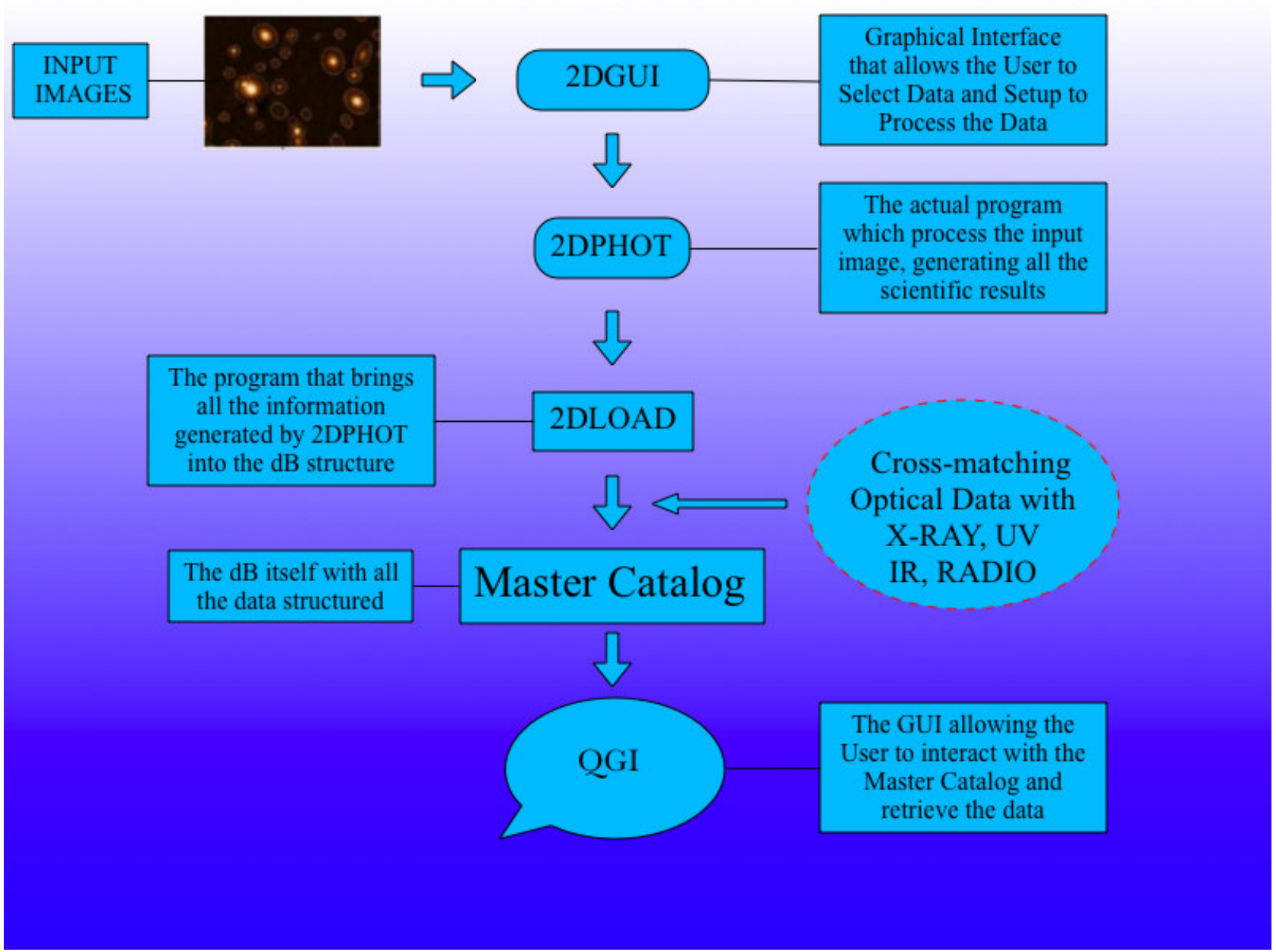
bands:
u' g' r' i' z'

depth:
r' ~ 24.4
i' ~ 23.4
(z ~ 1.5)



INAF/OAC
Leiden Observatory

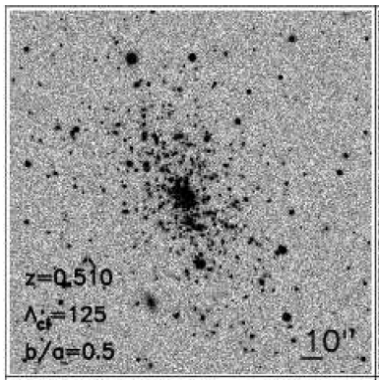
2DPHOT



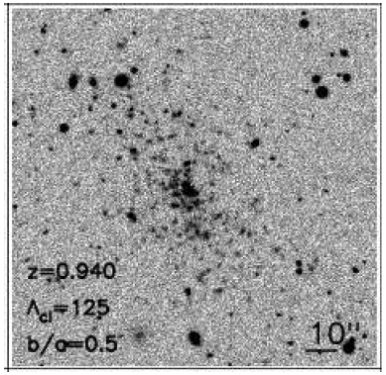
La Barbera et al. 2005

Cluster Identification With 2DPHOT

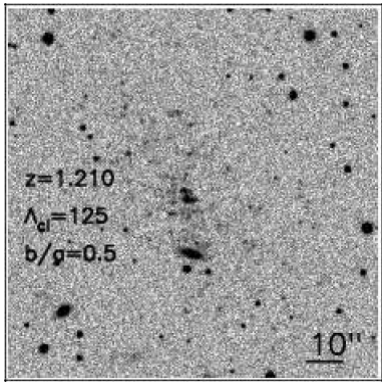
$M = 10^{15}$ solar masses



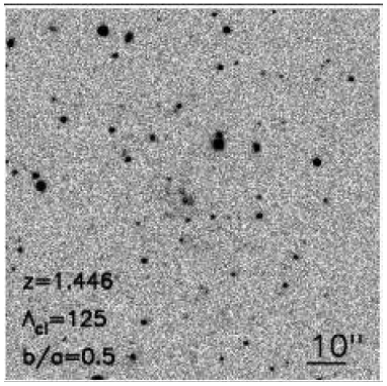
$z = 0.5$



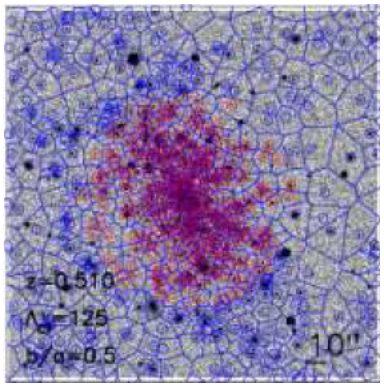
$z = 0.9$

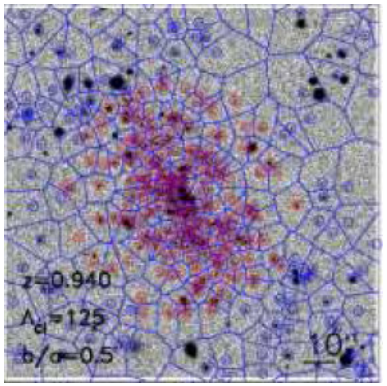


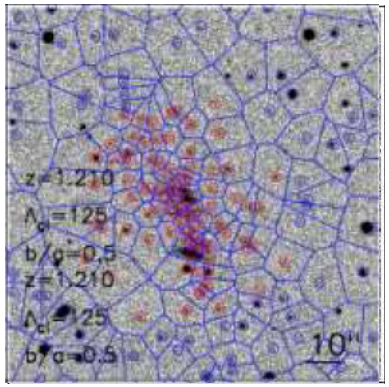
$z = 1.2$

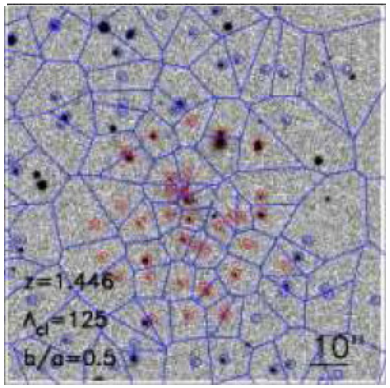


$z = 1.5$



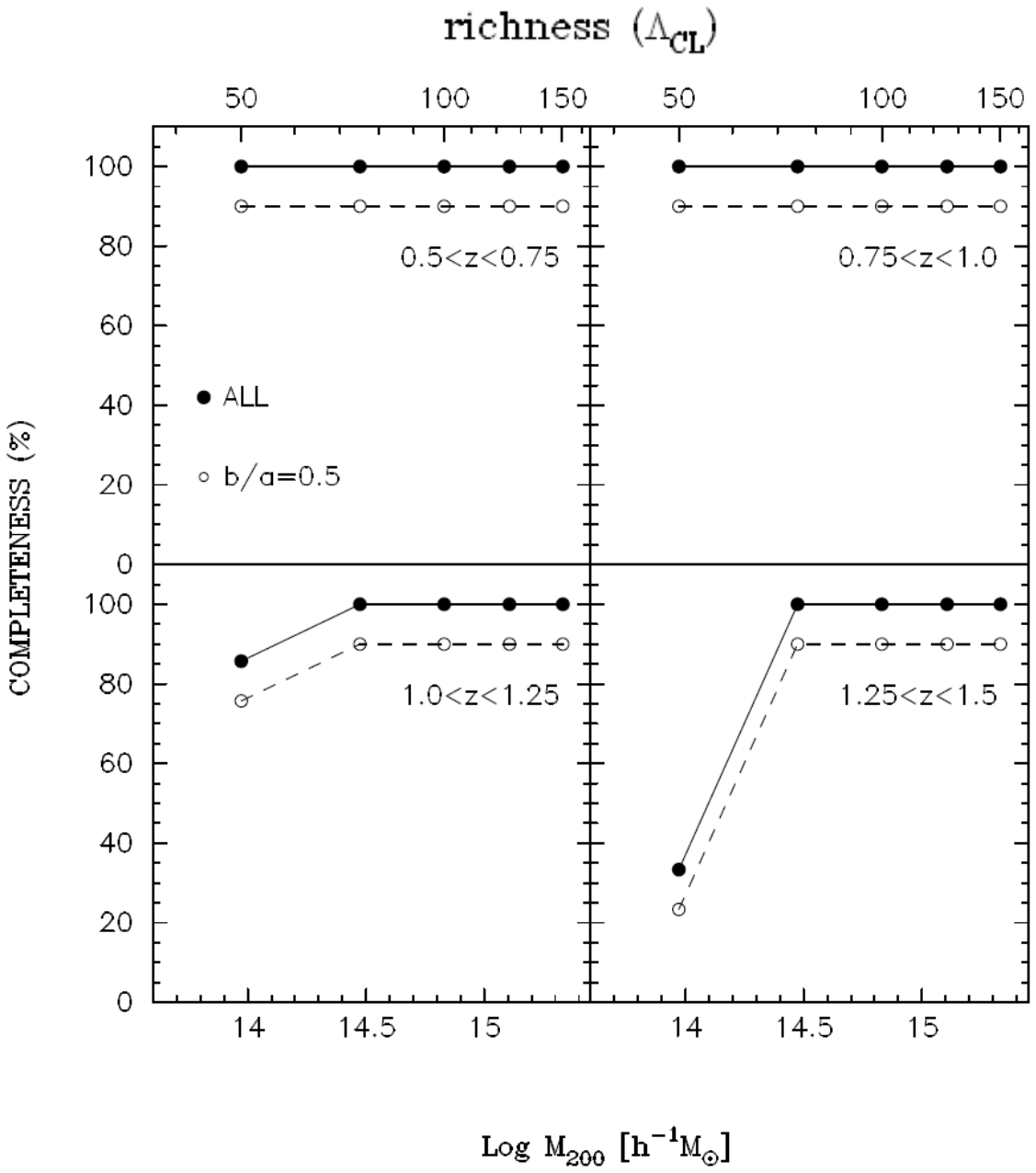






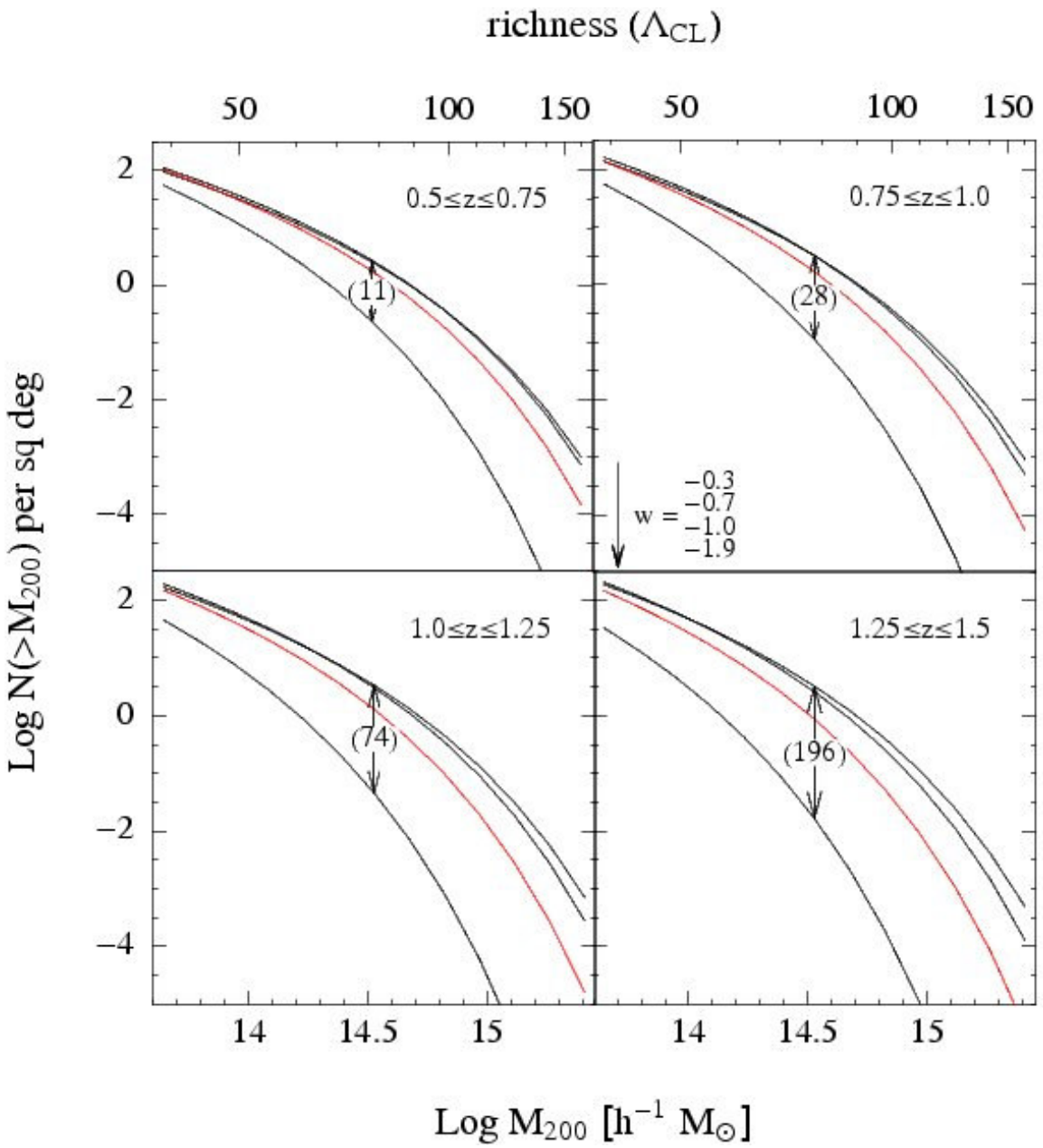
Voronoi Tesselation Method (Ramella et al. 2001)

Cluster Completeness Function



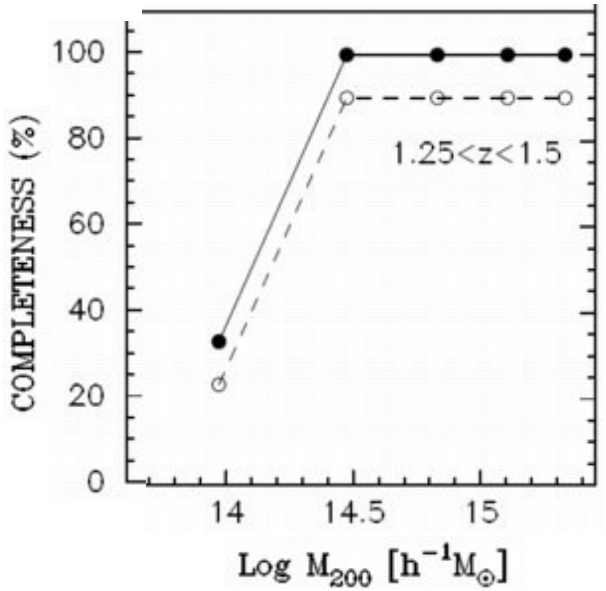
de Carvalho et al. 2007

Number of Clusters per sq deg



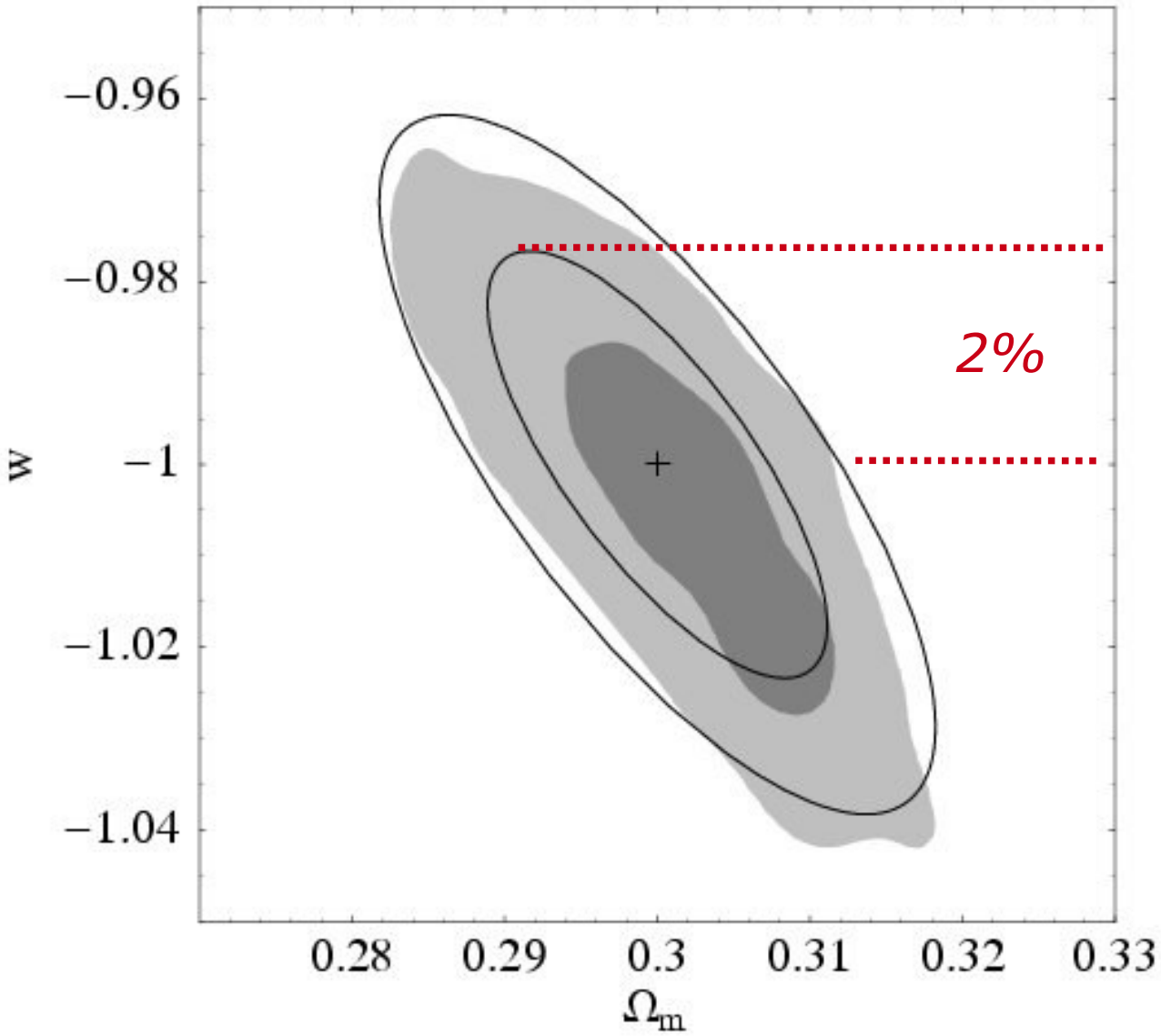
KIDS/Vesuvio

1500 sq deg
z~1.5



de Carvalho et al. 2007

Constraints on *w*: forecasts



Fisher **M**atrix
Monte **C**arlo Simulation

fiducial model: **ΛCDM**

fixed parameters:
$\sigma_8 = 1.0$
$h = 0.72$
$\Omega_x = 1 - \Omega_m$

ST mass function

redshift range:
0.5 ≤ z ≤ 1.5

mass threshold:
***$10^{14.5}$* solar masses**

Soares-Santos et al. 2007

Summary & Conclusions

- **cluster abundance** is a powerful tool to constrain theories of **DE**
- **KIDS/VESUVIO**, covers **1500 sq deg** on the sky with depth up to **z~1.5**
- applying **2DPHOT** on simulated images we find that **KIDS** would allow measurements of galaxy clusters more massive than $10^{14.5}h^{-1}$*solar masses* up to *z~1.5*, with a completeness of *100%*
- constraints on cosmological parameters are predicted from **FM** and **MC simulations**
- **cluster abundance** obtained from **KIDS** data using **2DPHOT** will establish strong constraints on **DE**'s equation of state: $-0.98 \leq w \leq -1.02$, with 1σ confidence level