# Subaru weak lensing cluster survey

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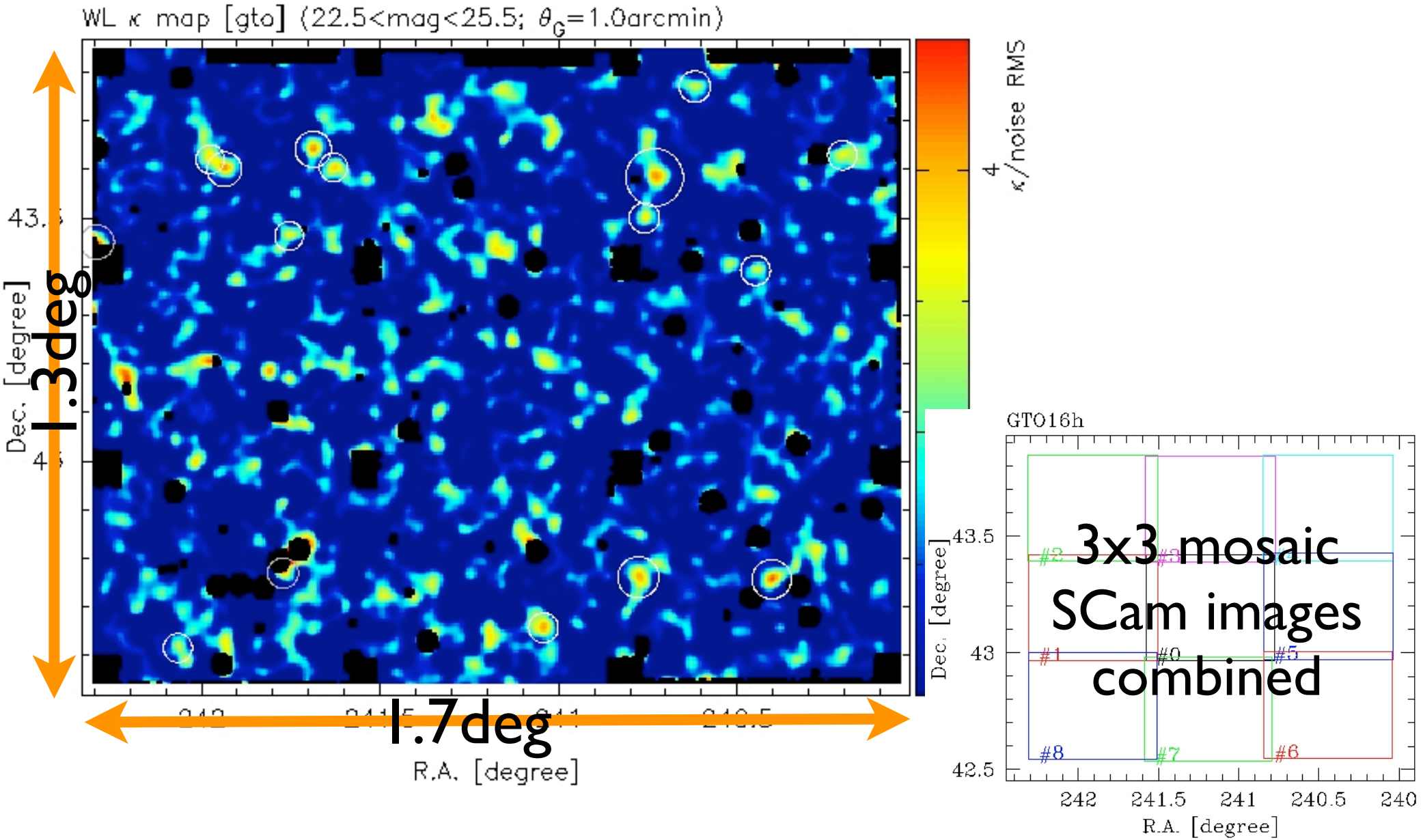
Outline
1. Overview of Subaru WL survey
2. CDM predictions of WL clusters
3. Spectroscopic follow-up of WL clusters
4. Summary

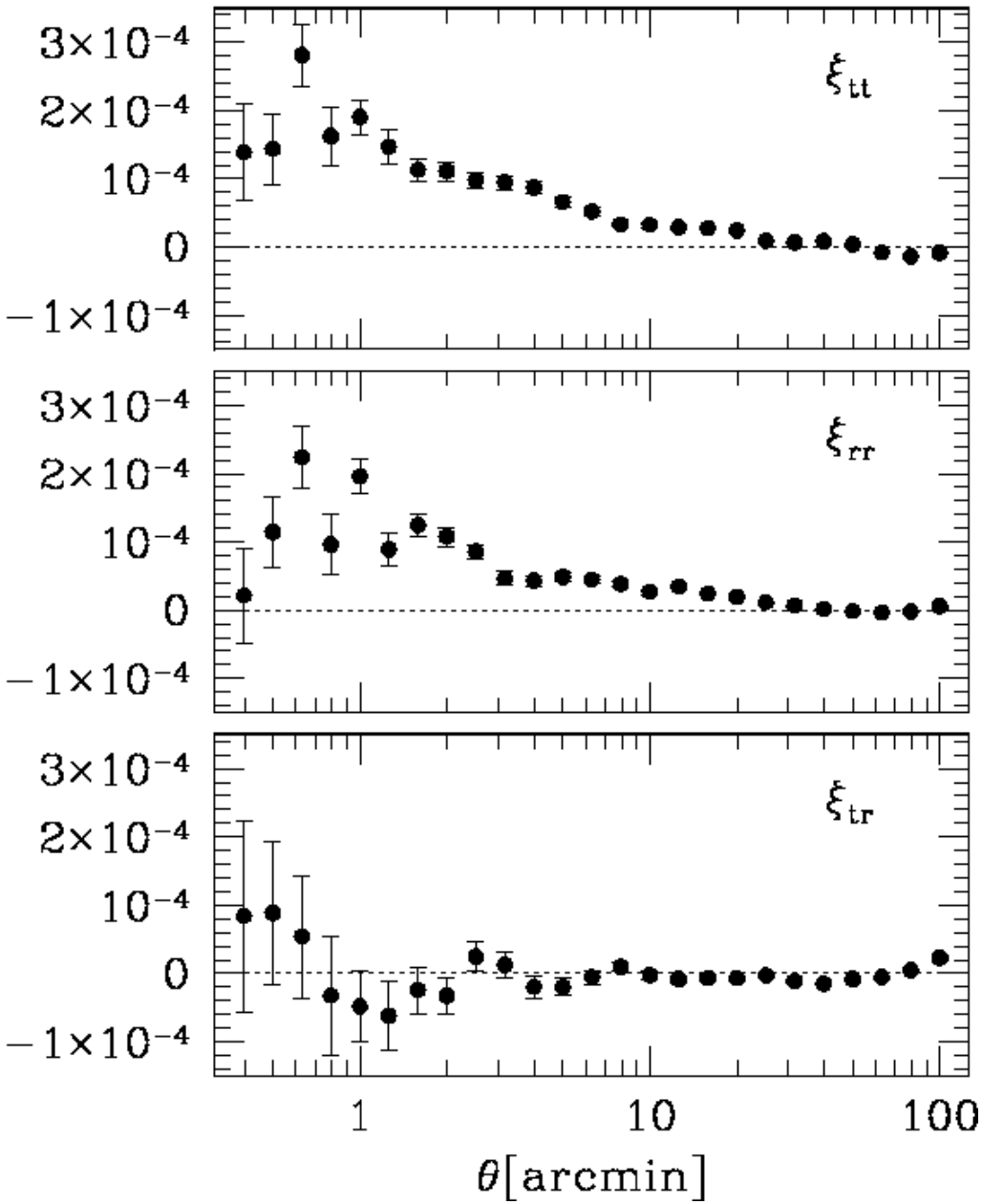
XXIIIrd IAP Colloquium
"From giant arcs to CMB lensing: 20 years of gravitational distortion"
2007/7/2

SupCam GTO program
PI: S. Miyazaki

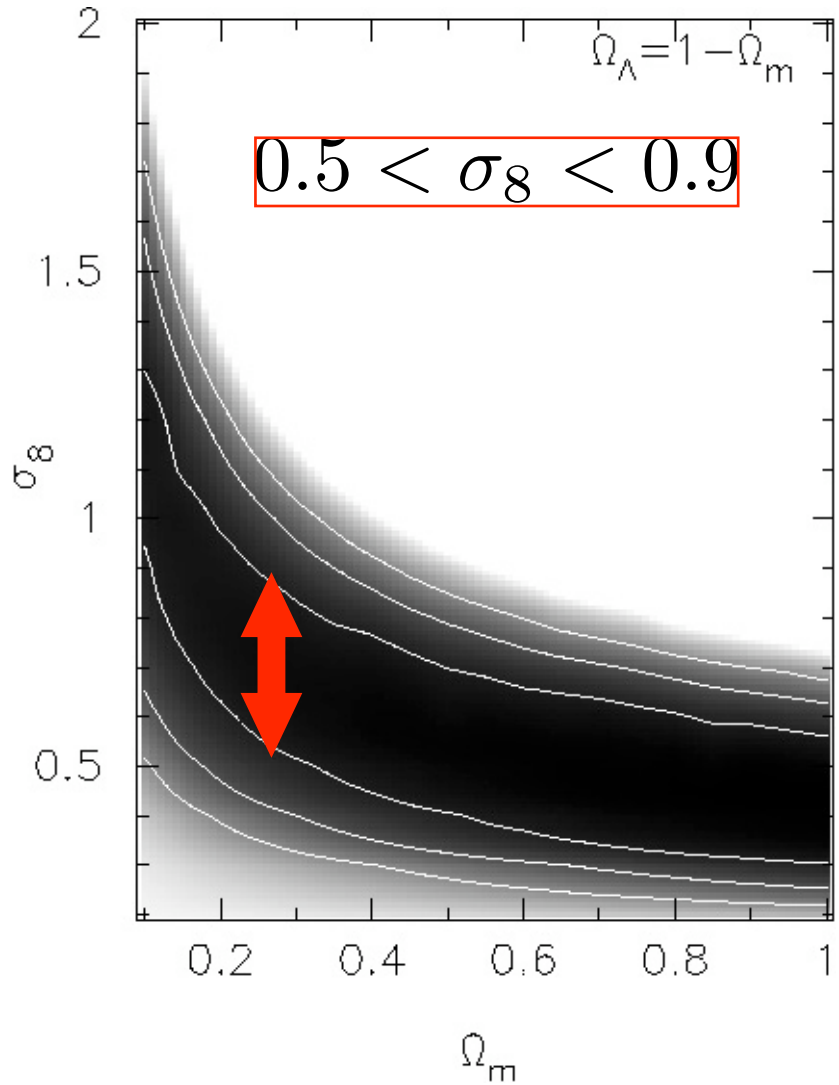
# Subaru WL survey started with 2sq deg in1999



# Subaru WL survey in 2sq deg field
# (1) Cosmic shear correlation



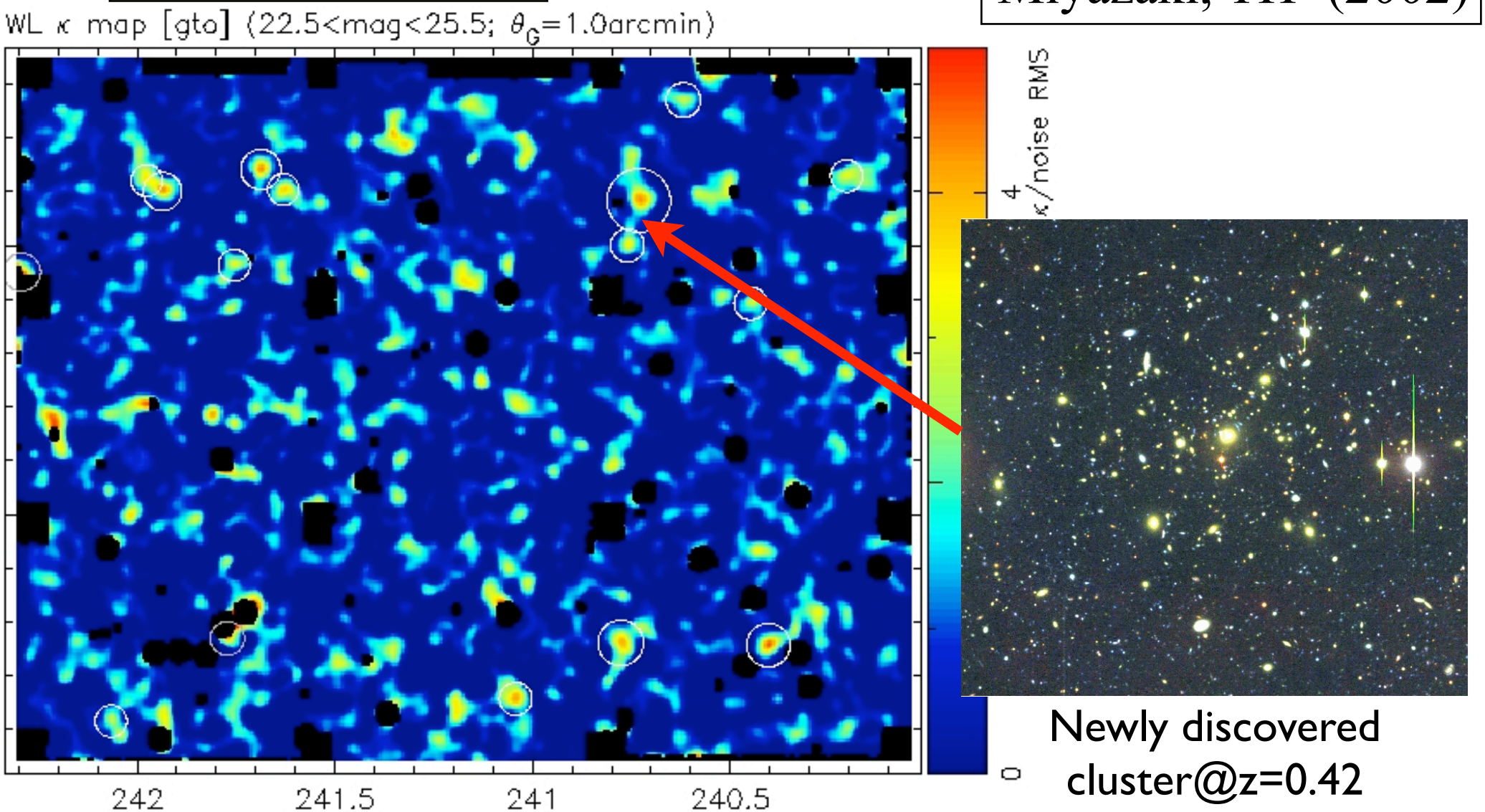

TH+(2003)



# Subaru WL survey in 2sq deg field
# (2) Cluster search

10 clusters/2sq deg

Miyazaki, TH+(2002)






Newly discovered
cluster@z=0.42

# Subaru WL survey -Current status-

- S. Miyazaki, TH, R. Ellis, R. Massey, A. Refergier
- 14 fields, 1-3 sq deg each => 21sq deg in total
- 30min exp. in R => Rlim~26 => ng~35/sq arcmin
- Spec. follow-up of 35 cluster candidates
- (PI: M. Takada) B-, V-, I-band over ~10sq deg

# Subaru WL survey -Scientific goals-

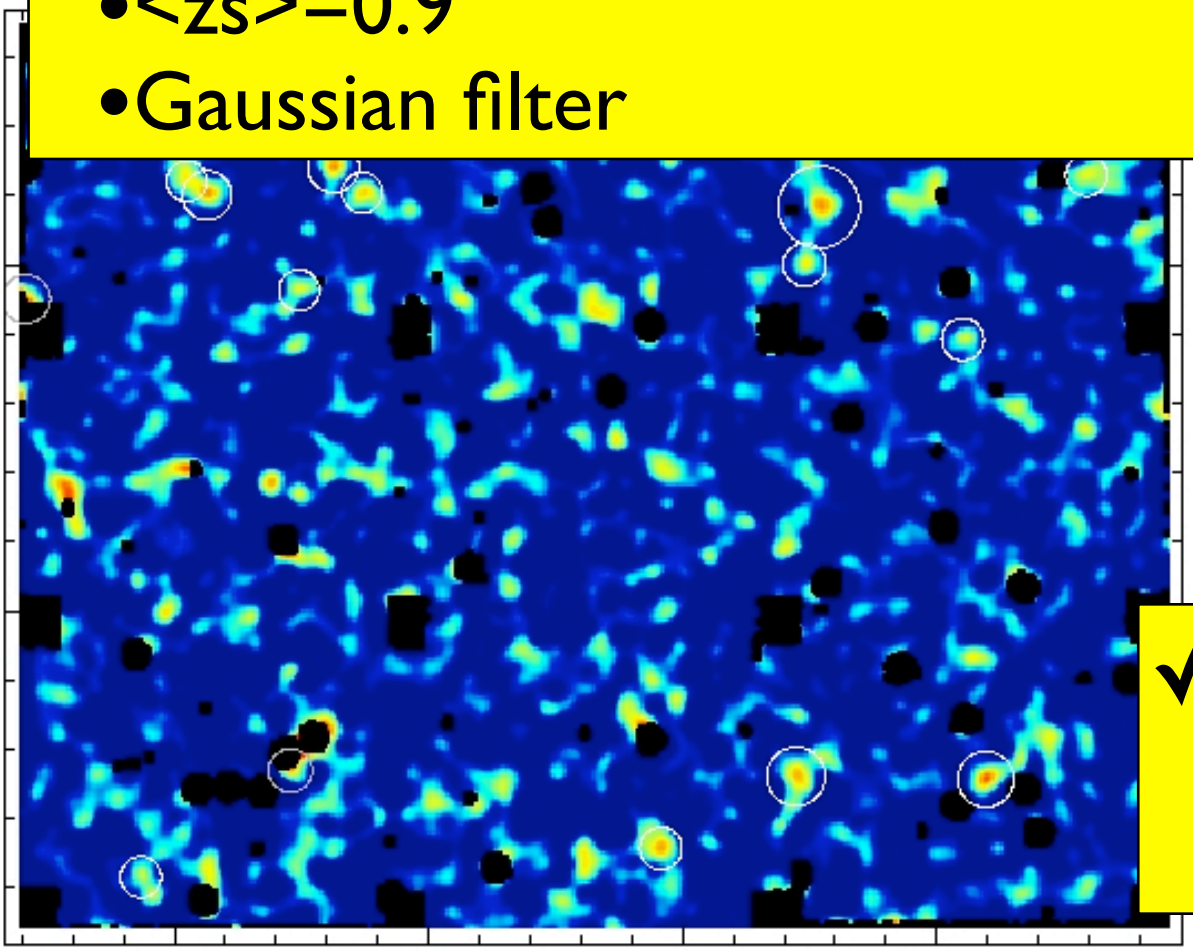
✓Cosmic shear correlation functions
  ➡Cosmological parameters
✓Searching for galaxy clusters
  ➡Providing "Mass selected" cluster catalog
    ➡Cluster scaling relations
    ➡Cosmological params from cluster counts

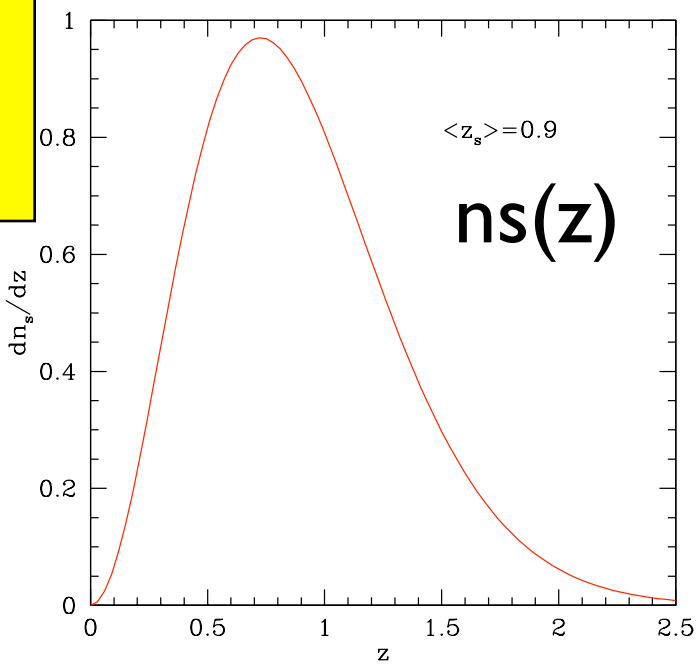
# Models

TH, Takada, Yoshida (2004)

## S/N of WL cluster detection

✓WL signal = peak height in kappa map
- Lambda CDM
- NFW profile => kappa/shear profile
- <zs>=0.9
- Gaussian filter

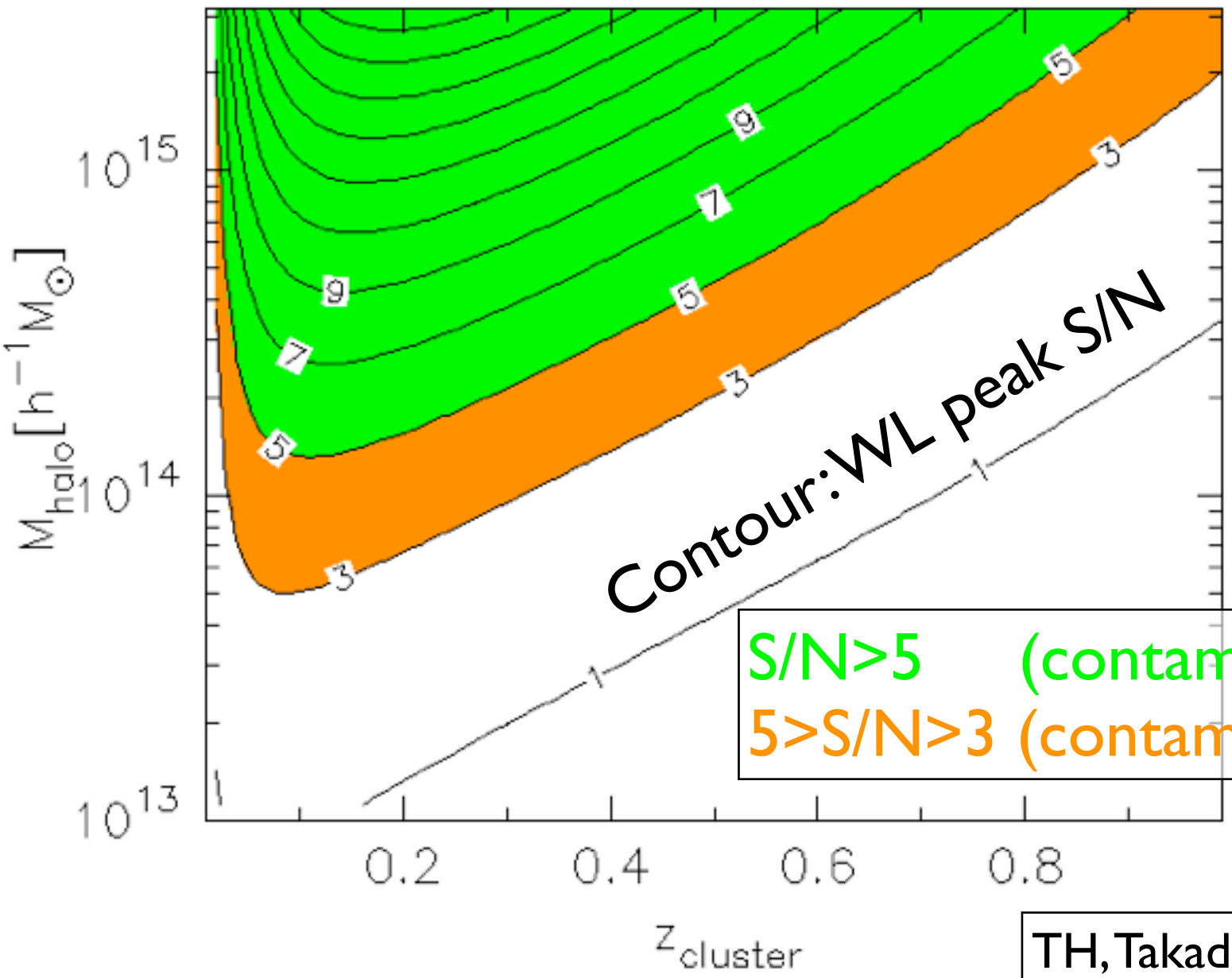





✓RMS noise in kappa map
- ng=35/arcmin^2
- RMS of e =0.4

# Detectability of clusters

$0.1 < z < 0.7, M > 10^{14} \times M_{\odot}$

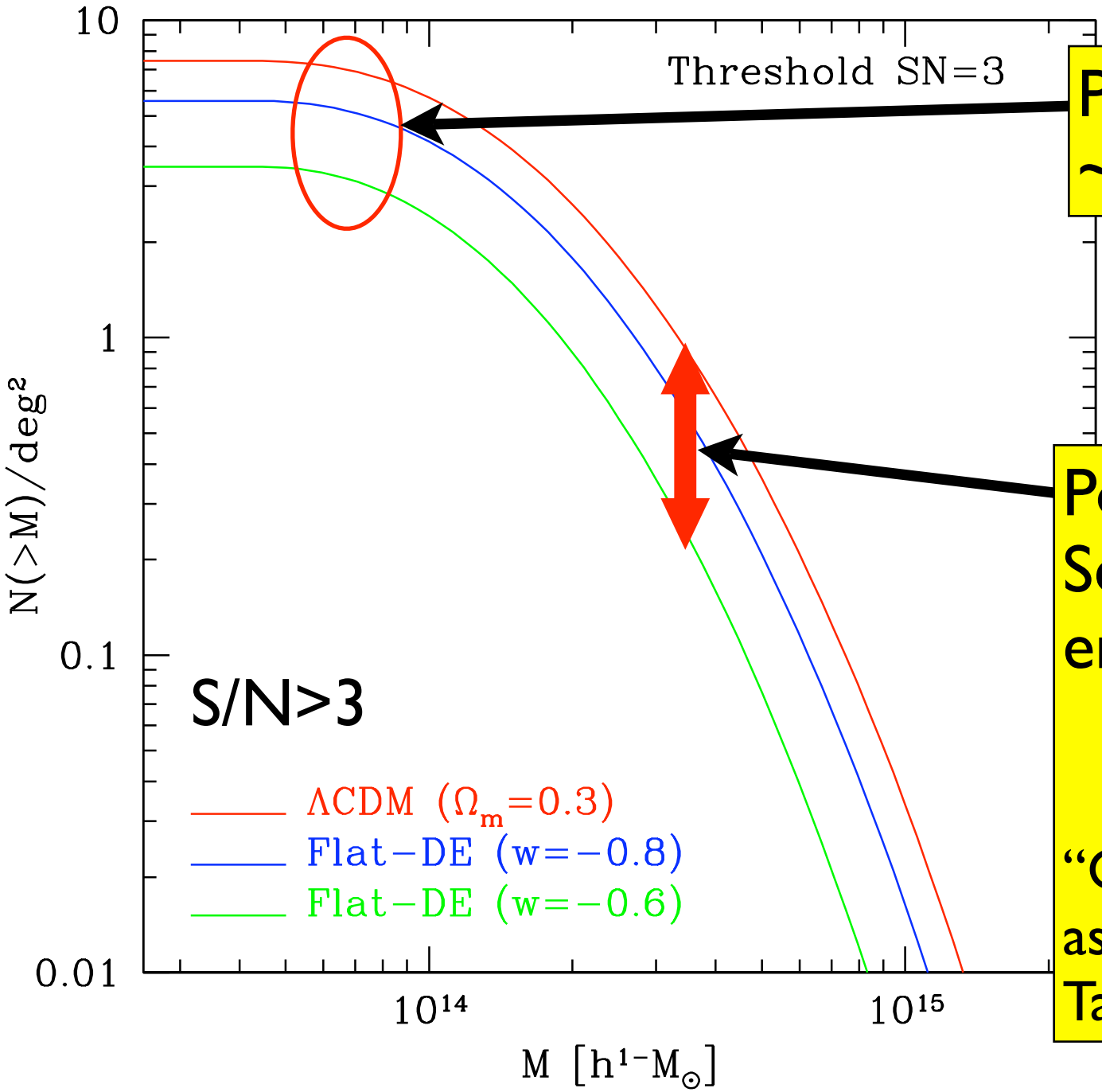



S/N>5 (contamination <10%)

5>S/N>3 (contamination >10%)

TH, Takada, Yoshida (2004)

# Expected cluster counts




Point-2:
~5clusters/1 sq deg

Point-1:
Sensitive to the dark energy param "w"

$$N \propto w^{-1.5}$$

"Counts is as powerful as cosmic shear"
Takada&Bridle 2007

# Cluster counts from Subaru WL survey

100 “mass selected” cluster candidates in 18sq deg

~5/1sq deg

Miyazaki, TH+(2007)

# Spec. follow-up -Aims-

1. WL cluster confirmation by galaxy concentration
2. determine redshifts
   - ➡ Cluster WL mass
     - ➡ cluster scaling relations
     - ➡ selection function of WL cluster search
3. estimate dynamical mass from the velocity disp.
   - ➡ WL mass VS dynamical mass
4. investigate influences of LOS projection
   - ➡ statistical properties of kappa peaks

# Spec. follow-up -Targets-

Target selection:

- Weak lensing peak S/N
- visibility

✳include low-SN (SN>2.5) candidates to test the sensitivity to low-mass (or high-z) clusters

# Spec. follow-up by FOCAS

FOCAS: Multi-slit spectrograph on Subaru

- FoV~7'~the virial radius of clusters
- ~30 slits/MOS mask
- 30-60min exposure => R<21mag = R*+1-2

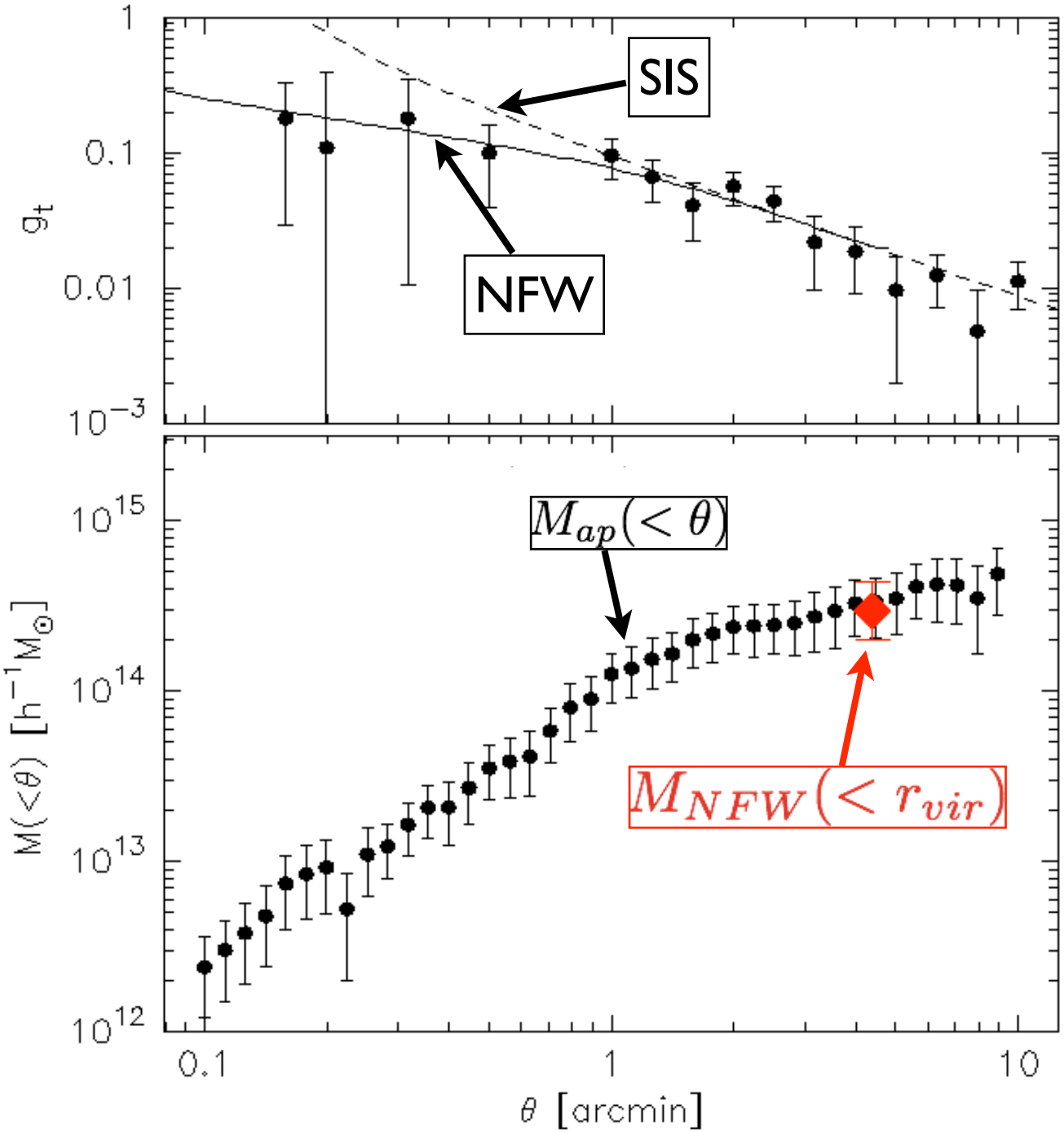
Plot here
Wait for publication

# Spec. follow-up -Summary-

Table here
Wait for publication

High WL peaks mostly come from real clusters

# Weak lensing mass estimation




Findings:
(1) NFW gives better fit than SIS

(2) The virial mass from NFW fit to the shear profile agrees well with the aperture mass (the latter does not rely on any assumption).

TH, Miyazaki+in prep.

# Cluster mass-velocity disp. relation

$$M_{vir} = 3.2 \times 10^{14} (\sigma_v / 1000 km/s)^3$$

Plot here
Wait for publication

TH, Miyazaki+in prep.

# WL vs dynamical mass estimators

Plot here
Wait for publication

Findings:
(1) $\sigma_{SIS}$ roughly agree with $\sigma_v$

(2) No apparent difference between Xray selected (Abel or MS) and WL selected (similar trend, similar scatter).

TH, Miyazaki+in prep.

# Summary

✓Weak lensing survey is practical and efficient to search for massive clusters

- •5clusters/1sq deg
- •20clusters/night (SuprimeCam)

✓WL cluster counts is a sensitive probe of DE param: $N \propto w^{1.5}$

✓Spec. follow-up reveals:

- •high success rate (high WL signal ~ real cluster)
- •not very small chance of cluster superposition (3/35~0.08)
- •not very small probability of WL signals by LOS projections of small systems

✓WL shear profile and WL aperture mass are consistent with NFW model

- ➡observational support of NFW model

✓WL selected and Xray selected clusters are similar from the dynamical point of view (agreement between $\sigma_v$ and $\sigma_{SIS}$)