# Outcome of the XXL meeting

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# *An XXL extragalactic survey: prospects for the XMM next decade*

14-16 April 2008, Paris

- Bring together scientists interested in a ~100 deg2 extragalactic survey with XMM
- Workshop : 57 participants
- Presentations available at the workshop website:
  http://www.astro.ulg.ac.be/RPub/Colloques/XXL/index.html

# Goals of the meeting

- Evaluate the science cases for
  - Clusters
  - AGN
  - Galaxies
- Examine the technical issues
- Address the multi-λ and spectroscopic follow-up

detailed written contributions sent 3 months in advance ==> forum discussion

# Contents

- Review of the existing XMM surveys (serendipitous or not)
- Design your ideal XMM survey, assuming 10-20 Ms (clusters, AGN, galaxies)
- Session on the importance of good cluster mass determination for cosmology
- Presentation of 4 SZ instruments and planned surveys
- Input about SWIRE, Herschel, HSC, and spectro f-up
- A number of ‘interesting regions’ were ‘advertised’
- Presentation of the new Mosaic mode

# Summary of survey proposals

| | | | |
|---|---|---|---|
| Galaxies<br>*(Ptak)* | **100 deg2 25 ks** | Optical/NIR ~22 | Photo-z |
| AGN + Galaxies<br>*(Georgakakis)* | **200 deg2 5ks** | Optical down to SDSS<br>IR not necessary for AGN but helpful for galaxies | Spectro-z are very important (r=19.8) |
| AGN Science<br>(Alexander) | **20-50 deg2 50 ks** | IR and Submm | |
| AGN Science<br>*(Polletta)* | **10 deg2 50 ks**<br>in at least 3 regions | Optical, NIR, IR multi-band (Spitzer) | Spectro-z are very important |
| AGN LSS<br>*(Plionis, Garcet)* | **> 50 deg2 10ks**<br>in > ~ 10 deg2 regions | IR + Optical important for photo-z | Spectro-z 5deg2 with 2h VIMOS |
| Cluster LSS and Physics<br>*(Melin)* | **200 deg2 10 ks**<br>**50 deg2 40 ks** | Optical multi-band lensing quality in i<br>NIR | Photo-z useful<br>Spectro-z necessary for LSS |

# Main conclusions

**see details on the website**

- Having a contiguous and uniform survey is essential for :
  - LSS
  - Monitoring correctly selection effects and science *(cf Pacaud)*
  - Uniform multi-λ coverage *(photo-z and spectro-z)*

- A 50 deg2 with 40 ks is favoured over 200 deg with 10 ks (similar cosmological constraints)
  - better cluster masses
  - better spectral characterisation of AGN
  - will enable measurements of cluster scaling laws at ~ 3 keV out to z ~1
  - better insights onto the z > 1 cluster population
  - (very different from the eRosita surveys)

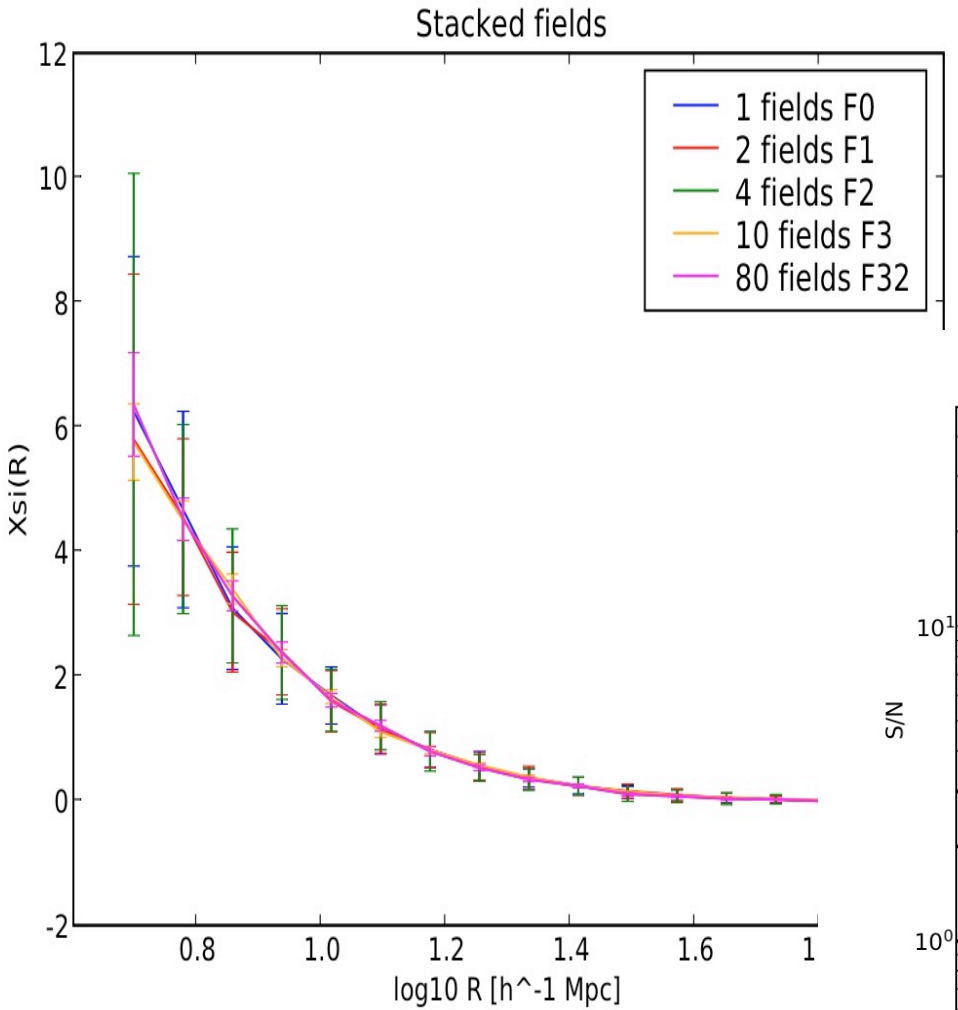
- At least 2 sky areas (maybe 4)

# Example of an application

- **Cosmology with clusters**
  - It is most important to connect the cosmological constraints from the early universe (CMB) with the local one (clusters)
  - CMB, SN and clusters do not depend on the same physical processes
  - A totally independent and self-sufficient measurement

# The cluster-cluster $\xi$

(using HVS)



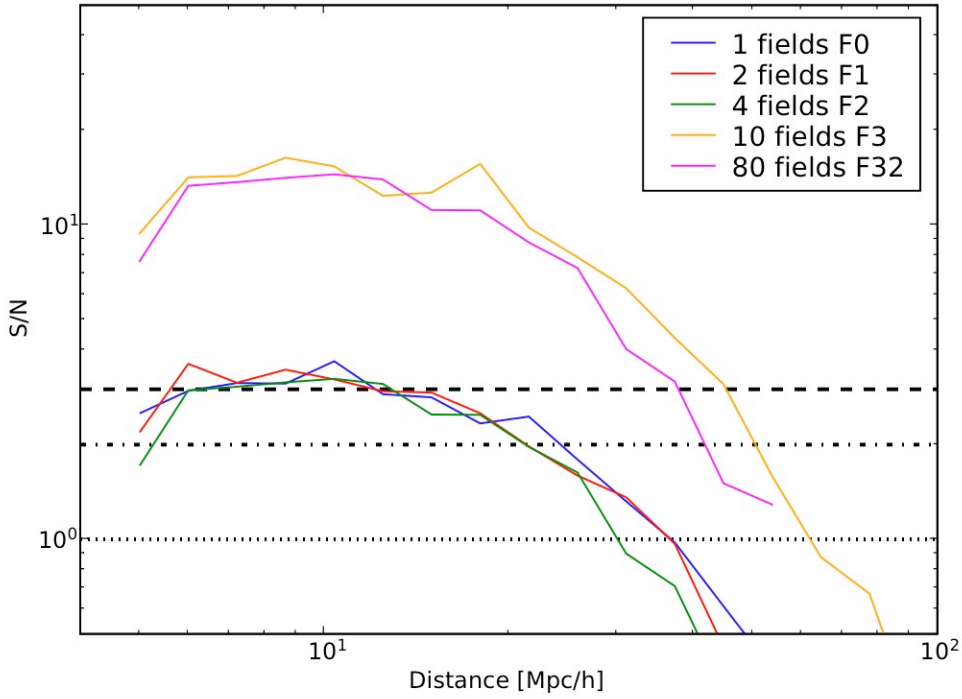

**50 deg2 = 1 x 50 deg2**

**50 deg2 = 2 x 25 deg2**

**50 deg2 = 4 x 12.5 deg2**

**1000 deg2 =10 x 100 deg2**

**1000 deg2 =80 x 12.5 deg2**



# Cosmological constraints from clusters

## Free parameters

$\sigma_8$, $\Omega_M$, $\Omega_\Lambda$, h

$\alpha$: “mass calibration” parameter

(M $\Rightarrow$ $\alpha$M in the selection function)

## Assumptions

XMM-LSS C1 selection function

[10ks XMM exposure, ~6 clusters/deg$^2$]

$\Gamma$=f($\Omega_M$,h) from Sugiyama (1995)

No assumption on flatness or h unless specified

## Observables

Cluster counts: **dN/dz**

Correlation function: $\xi$

**==>**

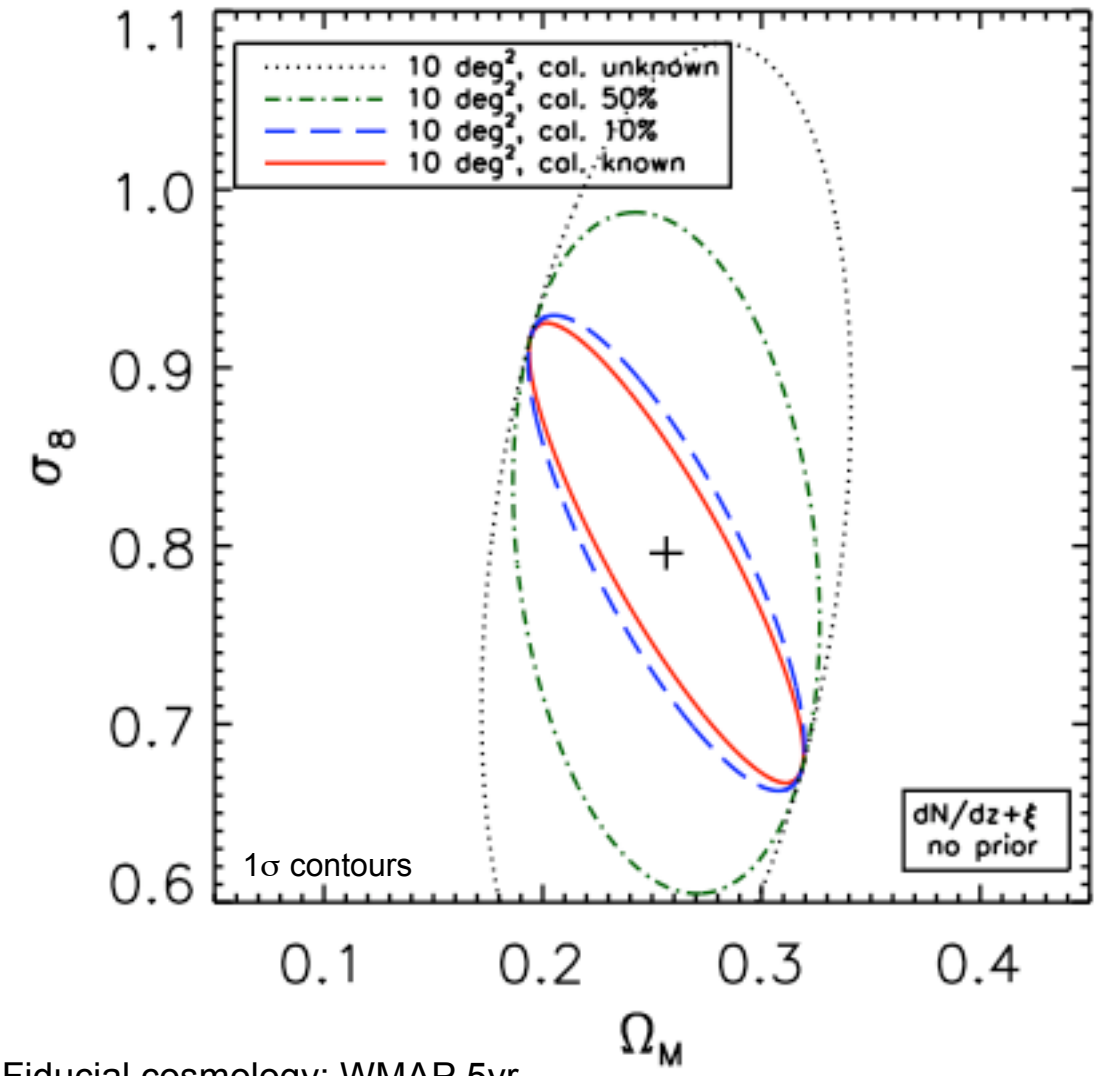
**Fischer analysis**

**Study the respective effect of:**

**-number of clusters = area size**

**- cluster mass accuracy**

# The current XMM-LSS design [10 deg$^2$]

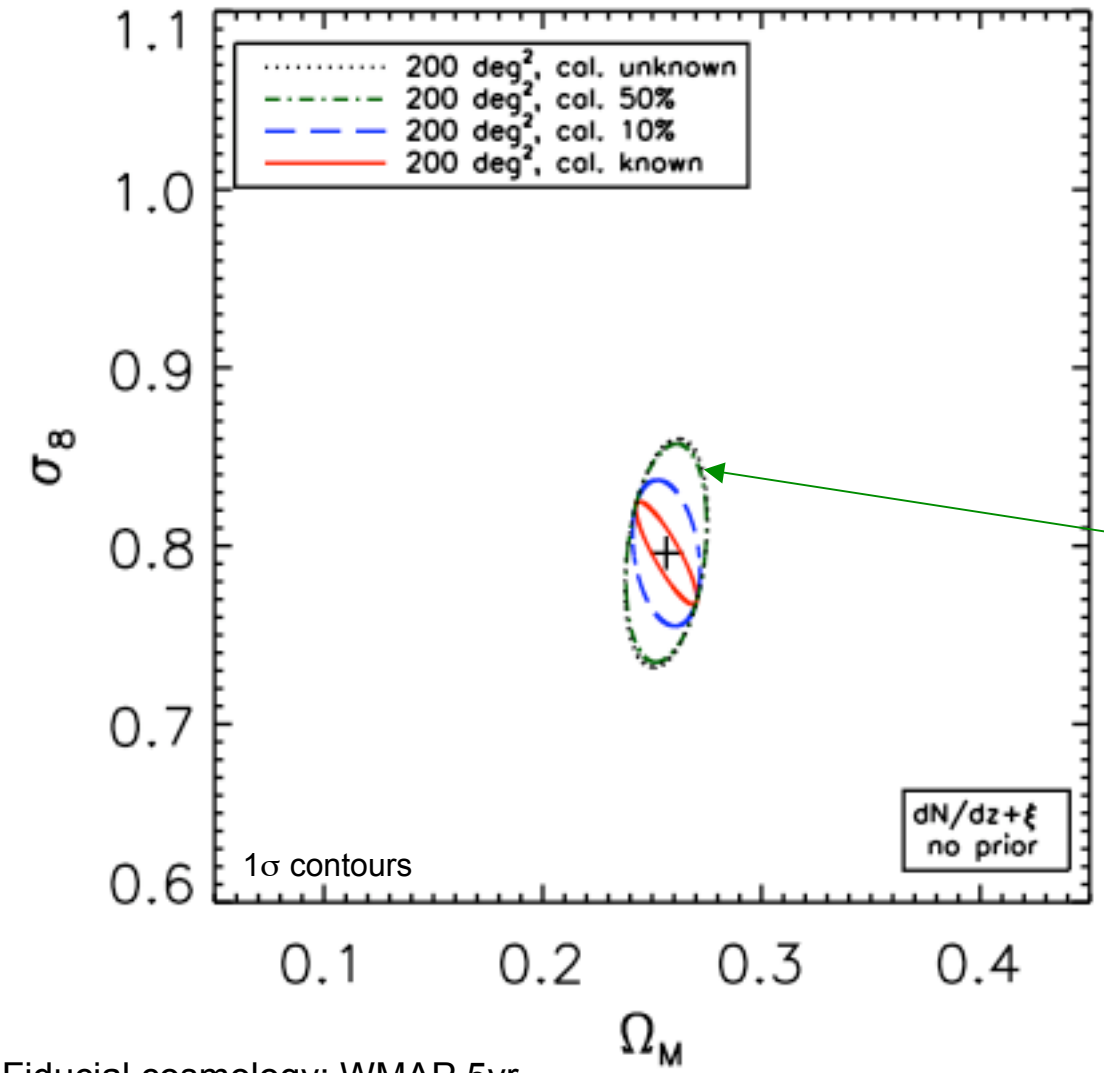



Cluster scaling laws **unknown** in XMM-LSS [10 deg$^2$]

Weak contraints on $\sigma_8$

Fiducial cosmology: WMAP 5yr

# Increasing the survey area by a factor of 20...



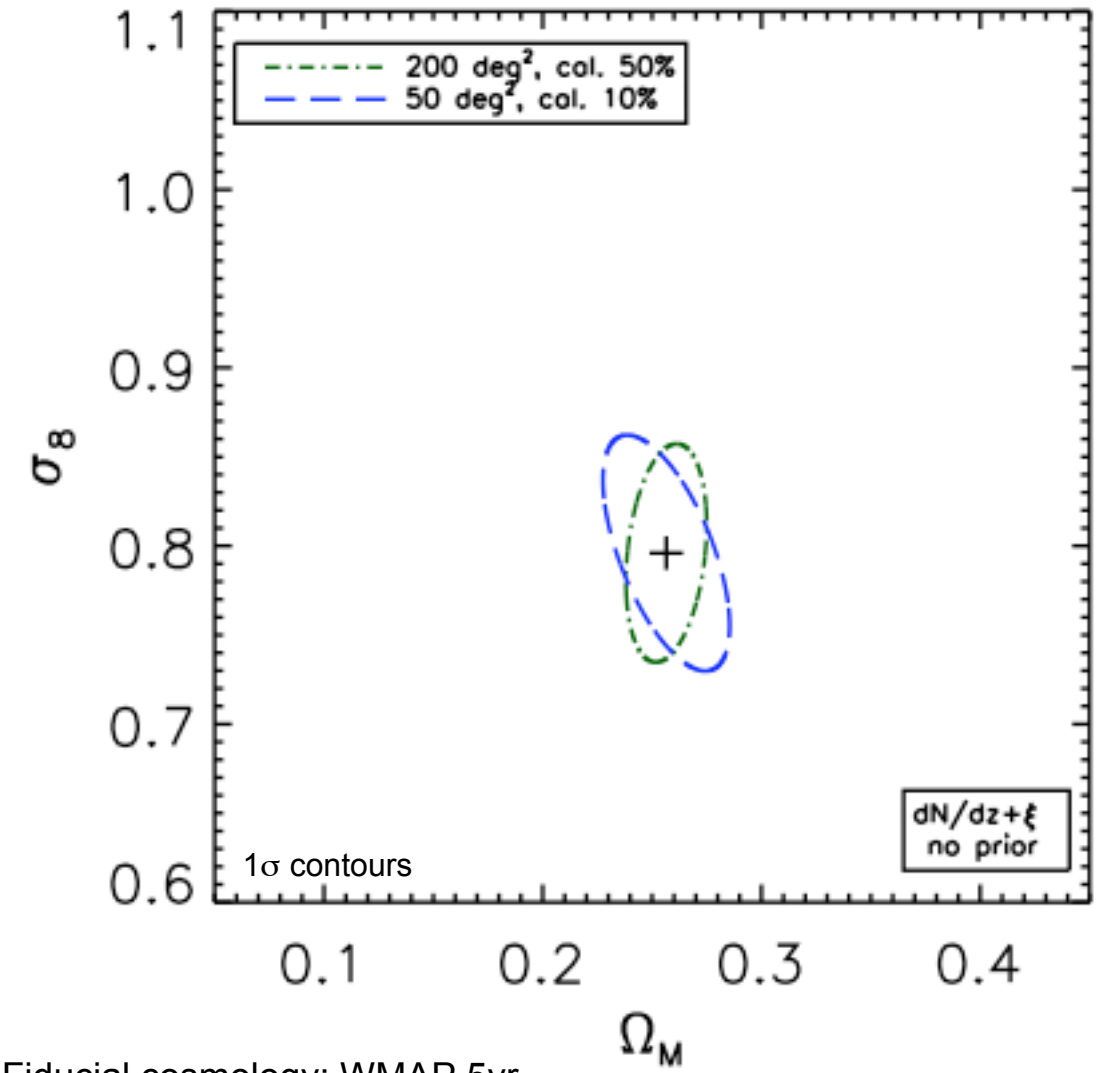

Fiducial cosmology: WMAP 5yr

Now, some constraints on $\sigma_8$ (5%)

cal. unknown ~ cal. 50%

"self-calibration" effect thanks to survey area

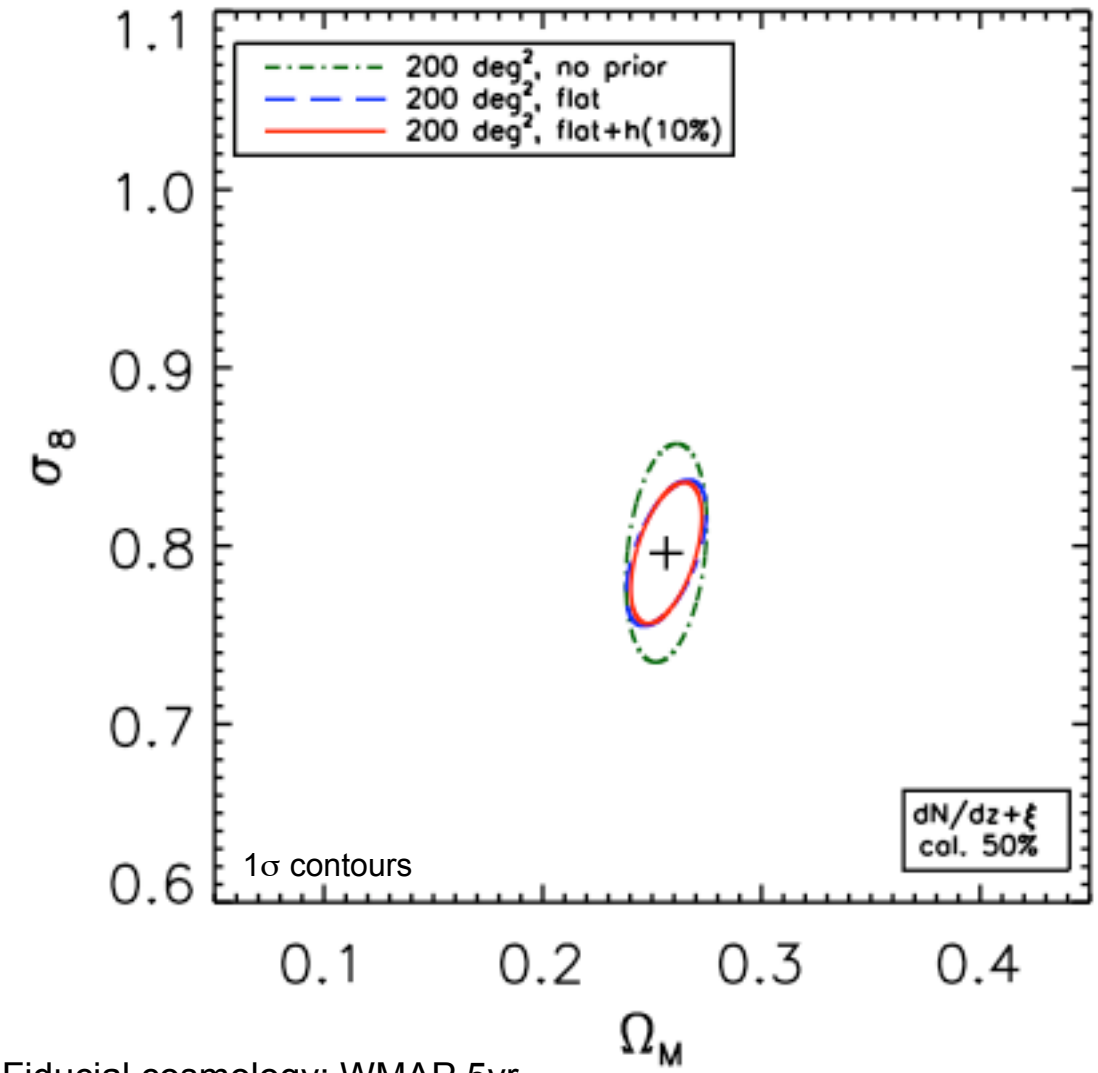
# Survey area: 200 deg$^2$ or 50 deg$^2$ ?




Very similar constraints on both $\sigma_8$ (~5%) and $\Omega_M$ (<10%)

Fiducial cosmology: WMAP 5yr

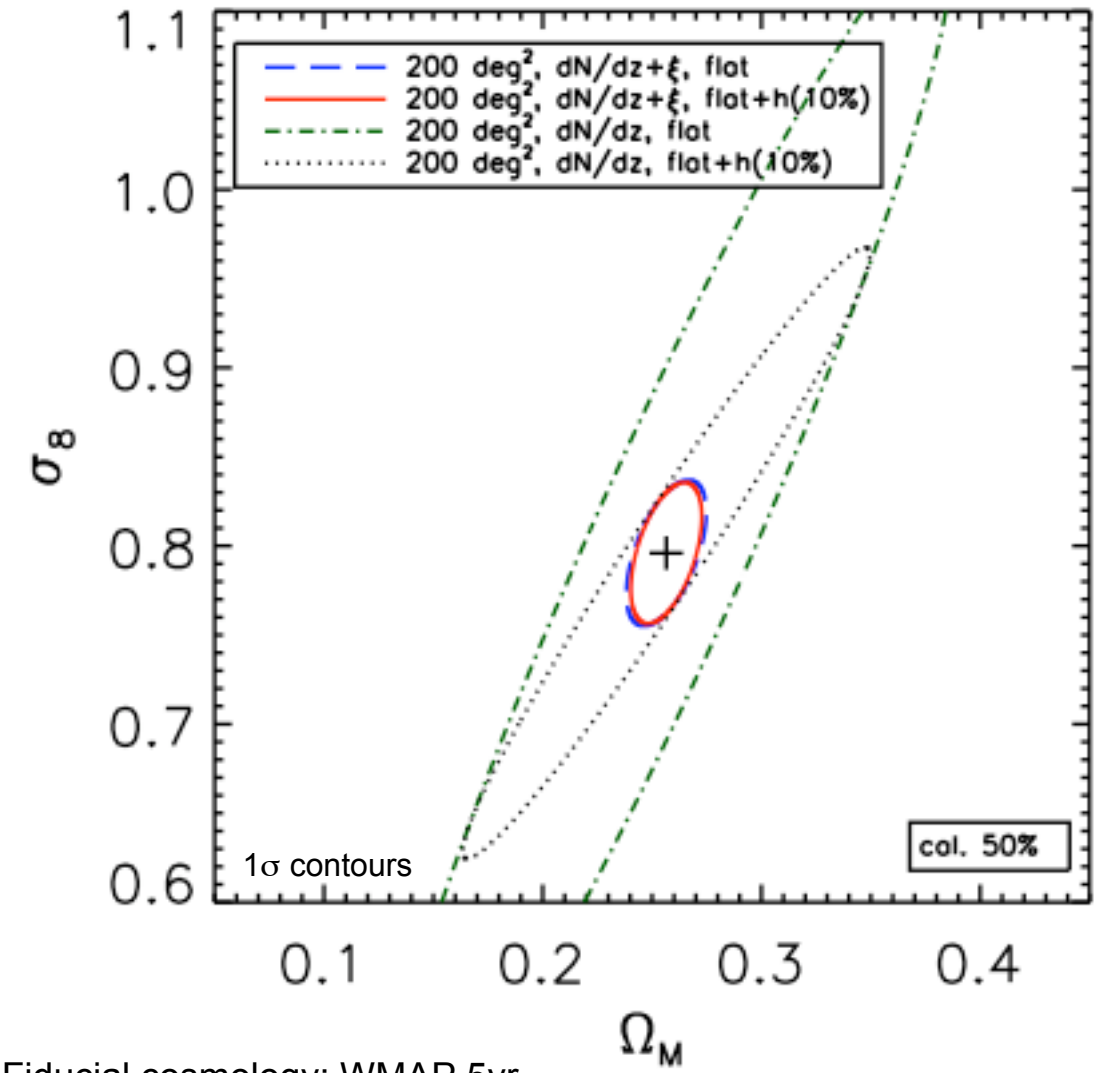
# And if we include weak priors…




Flat prior strengthens cosmological constraints

Fiducial cosmology: WMAP 5yr

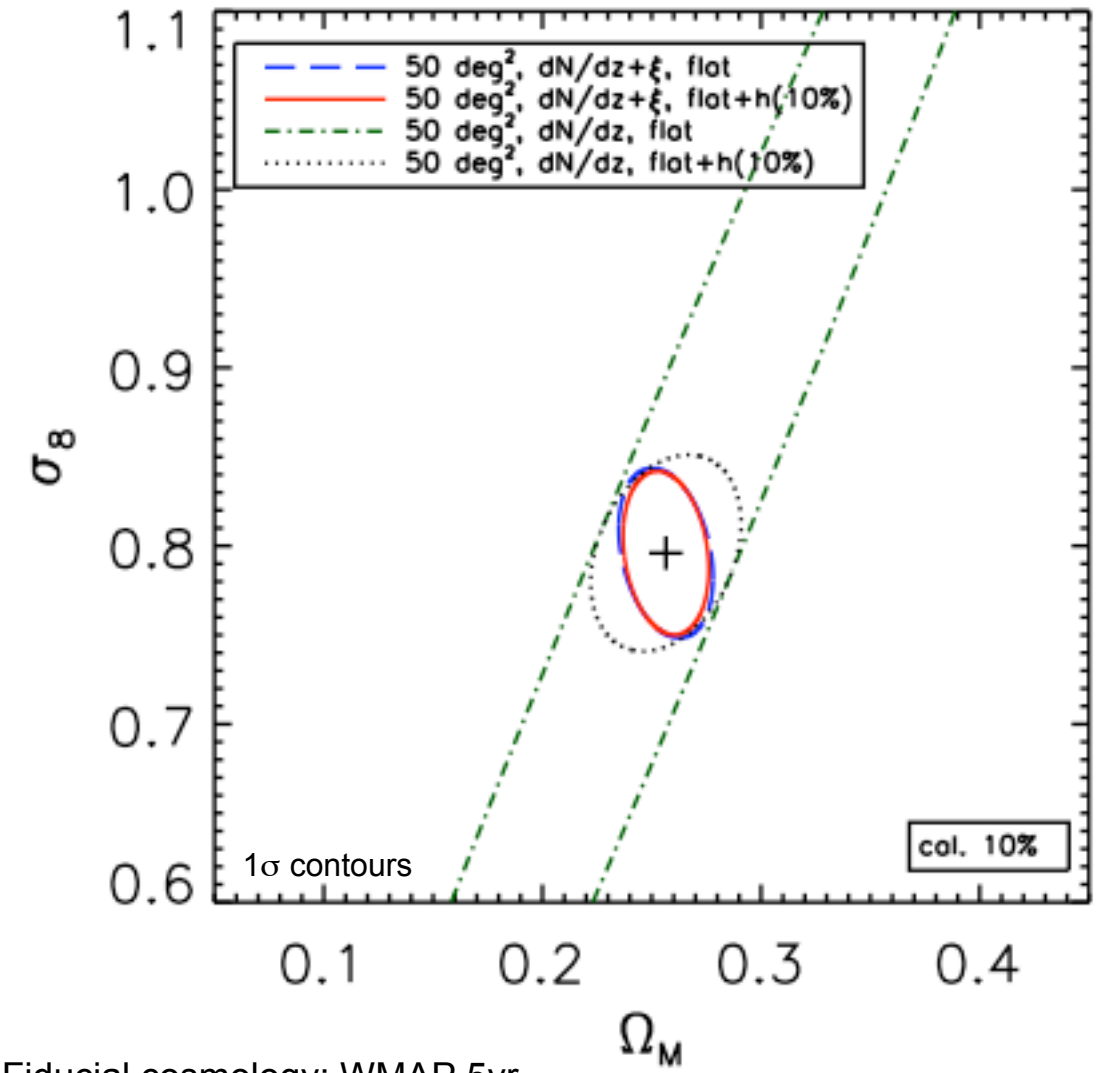
# Knowing the correlation function or not




Fiducial cosmology: WMAP 5yr

Correlation function is essential for a 200 deg$^2$ survey …

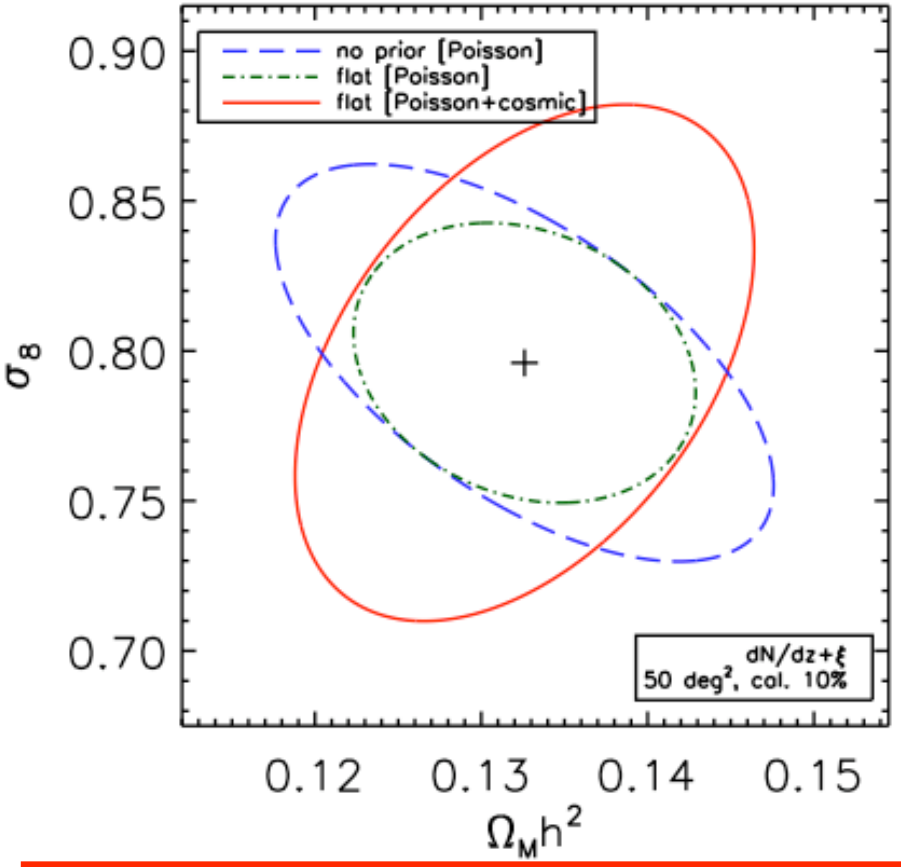
# Knowing the correlation function or not

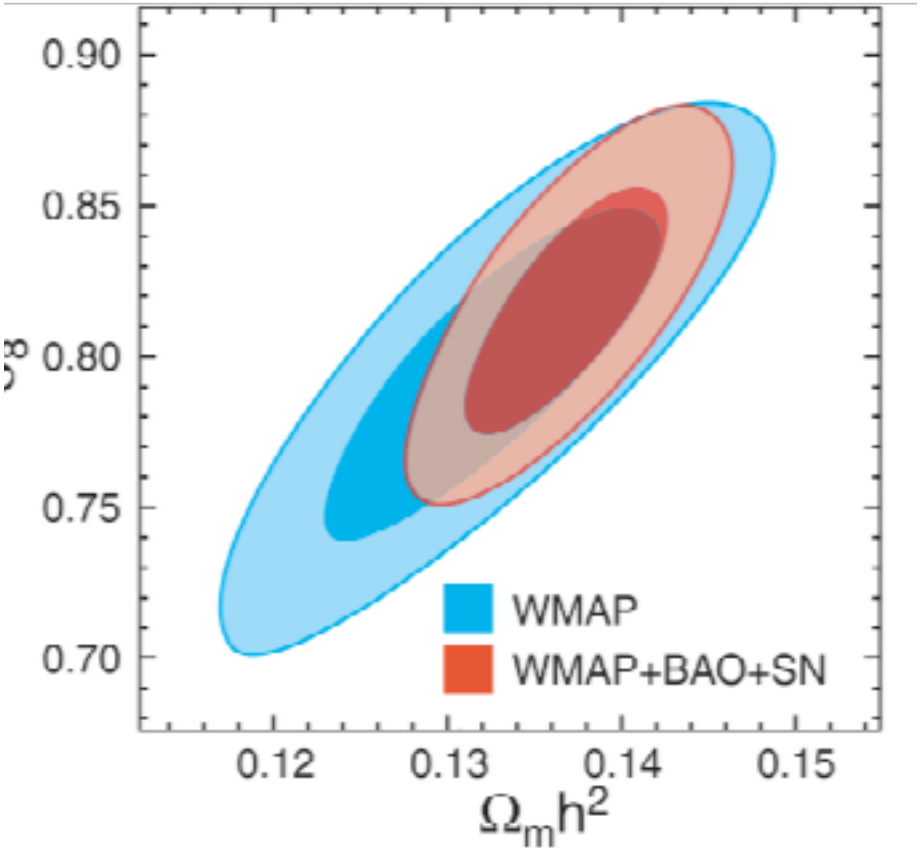



… and also
for a 50 deg$^2$ survey
if no prior assumed

Fiducial cosmology: WMAP 5yr

# Cosmological constraints from clusters




The green curve shows the expectation from a 50 deg2 **cluster survey alone** (C1 selection), assuming a flat universe. The cosmological constrains come from the combination of dn/dz and ξ with adequate cosmic variance and noise estimates. A 10% accuracy on cluster masses is assumed.

Similar accuracy is provided by WMAP5 alone

# Summary

- It is the good time to initiate such a **Treasury Survey**
  - very good knowledge of XMM capabilities now
  - XMM's health is good
  - New mosaic mode
  - No other such opportunity will be available for the next 10 years at least

- Follow-up is essential => associated surveys
  - Optical (weak lensing quality) - S-Z - IR(SWIRE)
  - ➔ **A reference comprehensive survey**

- Covering 50 deg2 with 20 ks requires ~ 9 Ms
  - 4 areas
  - Optimally achieved by two => four successive rasters of 10 ks (variability studies)
  - i.e. 4 x 20 days / year for 2 => 4 years *(new mosaic mode; P. Rodriguez)*

# Future

Anyone interested in contributing :

Contact XXL_Science@astro.ulg.ac.be

- select the areas
- working groups
- proposal writing

A treasury survey…

and not only for extragalactic astrophysics!