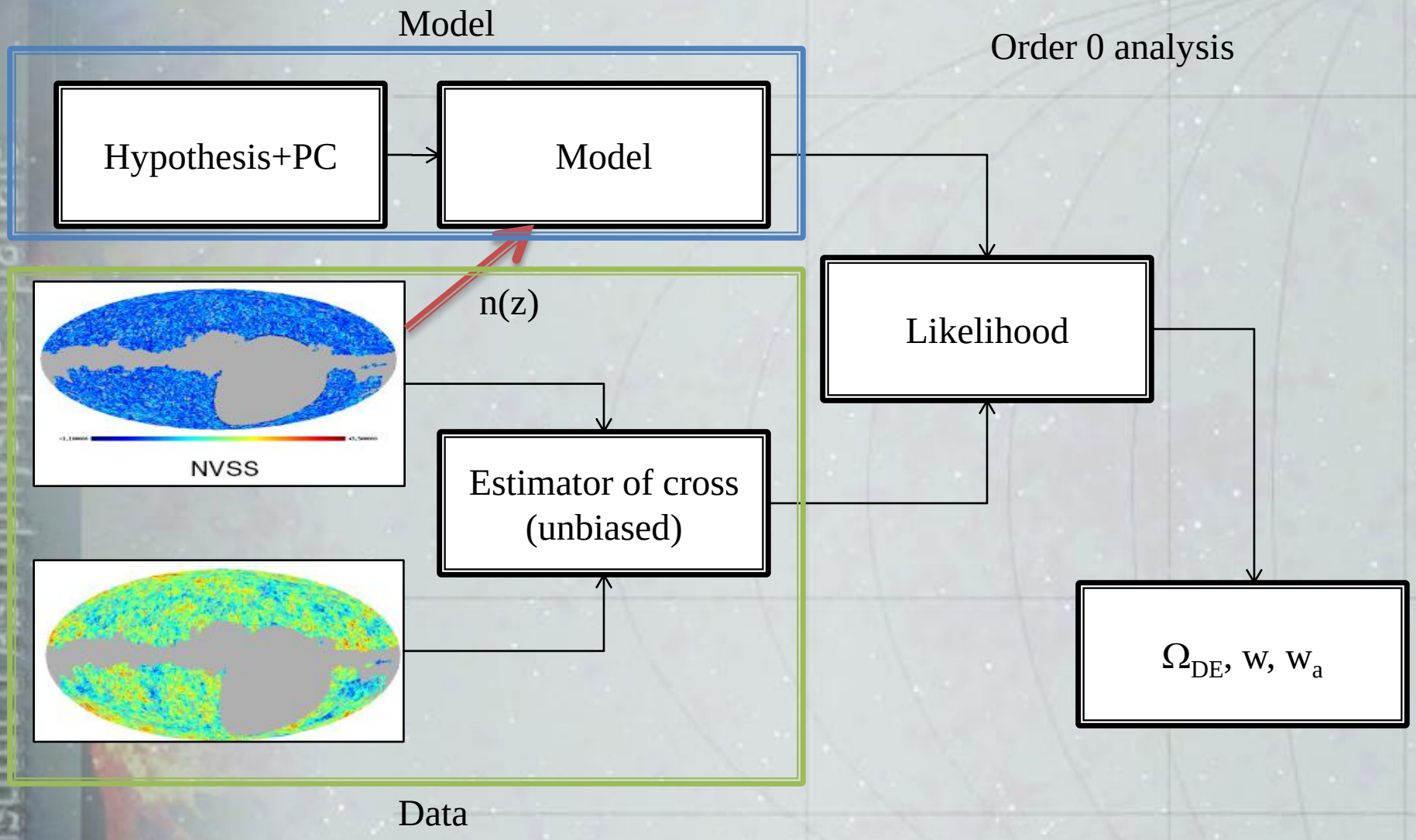
ISW - observations

MD
IAS

- Cross correlation of maps of ISW for cosmological parameter estimation
- Present status
- Optimisations

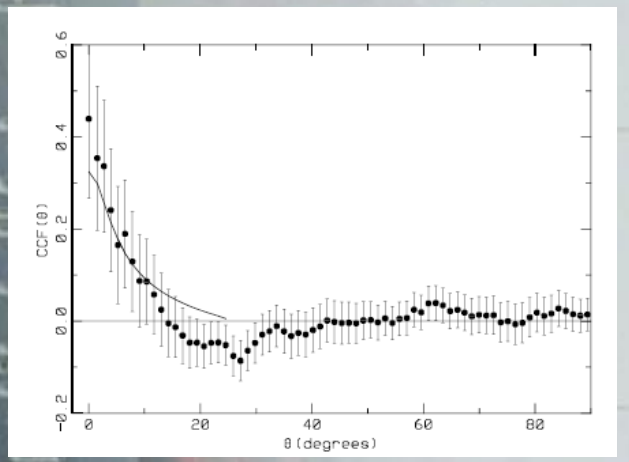
From Maps to P.C.

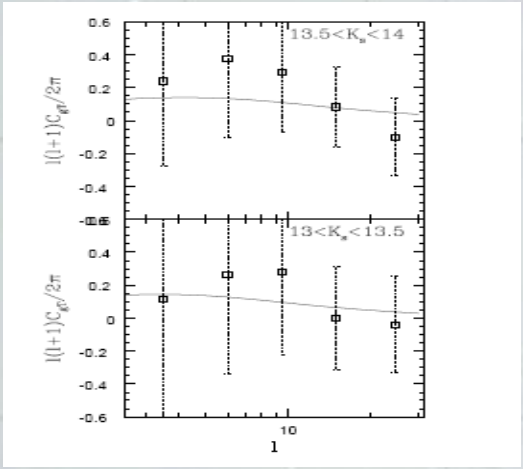


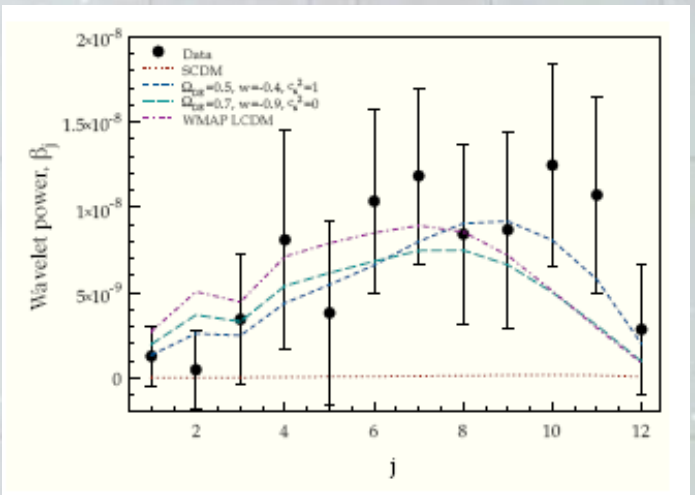
Estimator of cross

Several ways of doing the cross-correlation of 2 maps

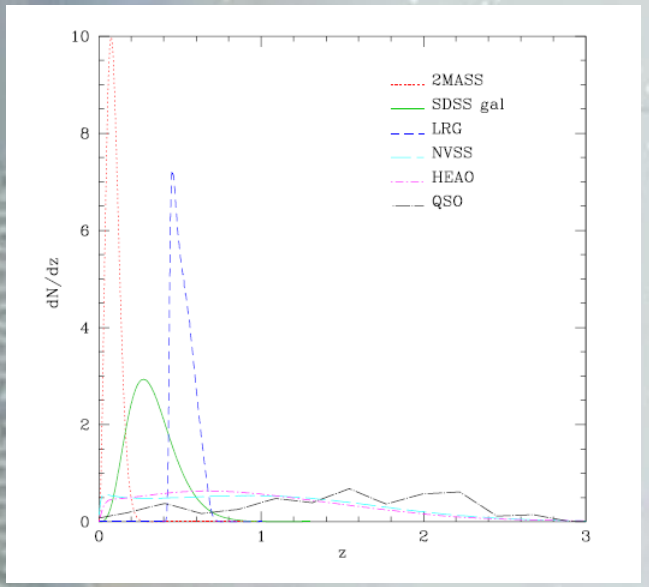
- Pixel space: correlation function $\xi(\theta)$
- Spherical harmonics space : angular P.S. C_ℓ
- Wavelets space (~SH) : eg. needlets

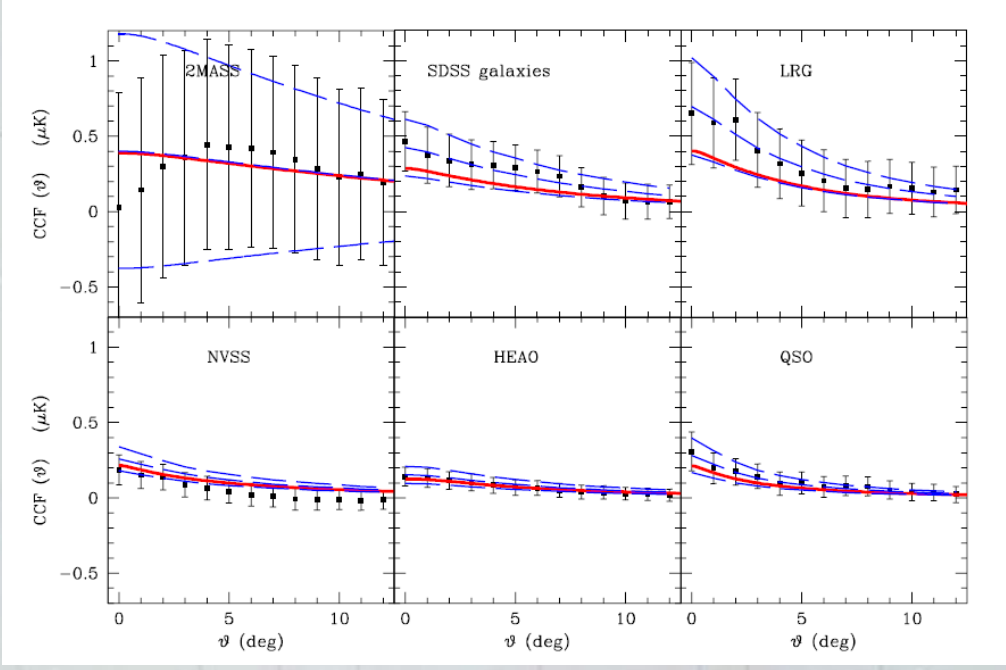






Current status

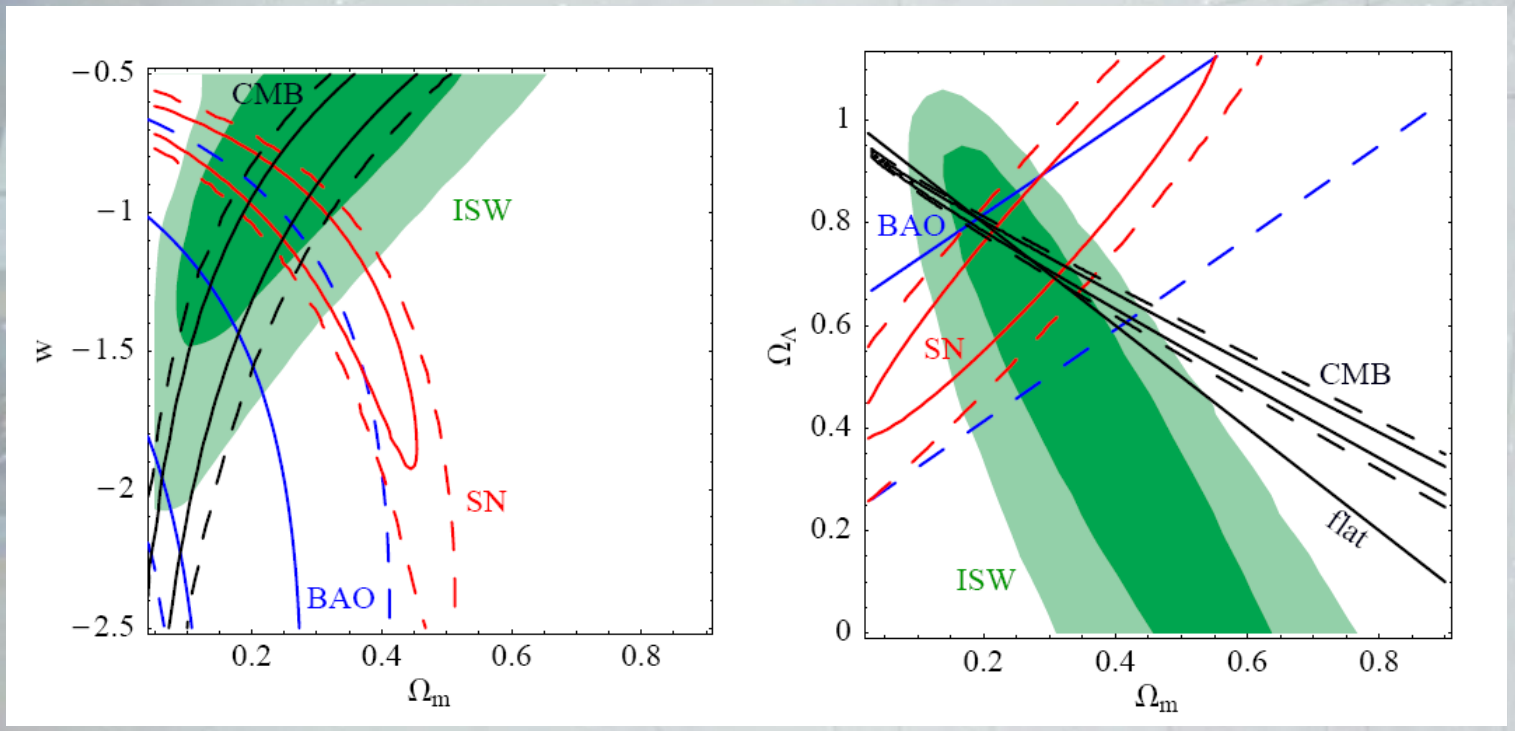




	5000 T-only Monte Carlos		5000 full Monte Carlos		JK - δ only		JK - δ and T	
catalogue	A	S/N	A	S/N	A	S/N	A	S/N
2MASS cut	1.22 ± 1.87	0.7σ	1.00 ± 1.96	0.5σ	0.66 ± 0.77	0.9σ	1.36 ± 1.10	1.2σ
SDSS	1.58 ± 0.70	2.2σ	1.48 ± 0.66	2.2σ	1.24 ± 0.42	3.0σ	1.59 ± 0.44	3.6σ
LRG	1.67 ± 0.76	2.2σ	1.73 ± 0.80	2.2σ	0.92 ± 0.50	1.8σ	1.22 ± 0.49	2.5σ
NVSS	1.12 ± 0.40	2.8σ	1.20 ± 0.37	3.3σ	0.68 ± 0.29	2.4σ	0.83 ± 0.27	3.1σ
HEAO	1.10 ± 0.41	2.7σ	1.22 ± 0.45	2.7σ	0.97 ± 0.26	3.7σ	1.00 ± 0.24	4.2σ
QSO	1.40 ± 0.53	2.6σ	1.33 ± 0.54	2.5σ	1.50 ± 0.58	2.6σ	1.33 ± 0.46	2.9σ
TOTAL	$\mathbf{1.02 \pm 0.23}$	$\mathbf{4.4\sigma}$	$\mathbf{1.24 \pm 0.27}$	$\mathbf{4.5\sigma}$	—	—	—	—

catalogue	f	χ^2_0	$\chi^2_{\rm bestfit}$	$\chi^2_{\Lambda\rm CDM}$
2MASS	9	5.4	5.2	5.2
SDSS	13	17	11	12
LRG	13	9.6	4.9	5.7
NVSS	13	17	6.0	6.3
HEAO	13	18	10	10
QSO	13	9.7	3.7	4.0
TOTAL	74	67	47	48

Constraints



weak but not useless !

Can we do better ?

CMB side

- cleaner maps
  - less foregrounds
  - component separation
- more frequency maps
  - ISW indpt of ν
- bigger fraction of sky

Tracer side

- more objects
- bigger fraction of sky
- different $\langle z \rangle$
- better understanding of n(z)

How to increase detection ?

Signal to noise analysis (in Spherical harmonics space)

$$\left(\frac{S}{N}\right)^2 = f_{sky}^c \sum_{l=l_{min}}^{l_{max}} (2l+1) \frac{\left[C_l^{ISW-G}\right]^2}{\left[C_l^{ISW-G}\right]^2 + \left(C_l^{ISW} + N_l^{ISW}\right)\left(C_l^{G} + N_l^{G}\right)}$$

$C_l^{ISW-G} \equiv C_l^{CMB}$

$N_l^{G} \equiv \frac{1}{N}$

Free parameters from surveys:

- **fraction of sky: f_{sky}**
- **median redshift : z_m**
- **nb of galaxies per arcmin²: $\overline{N}$**

1 bin in z considered n(z) total

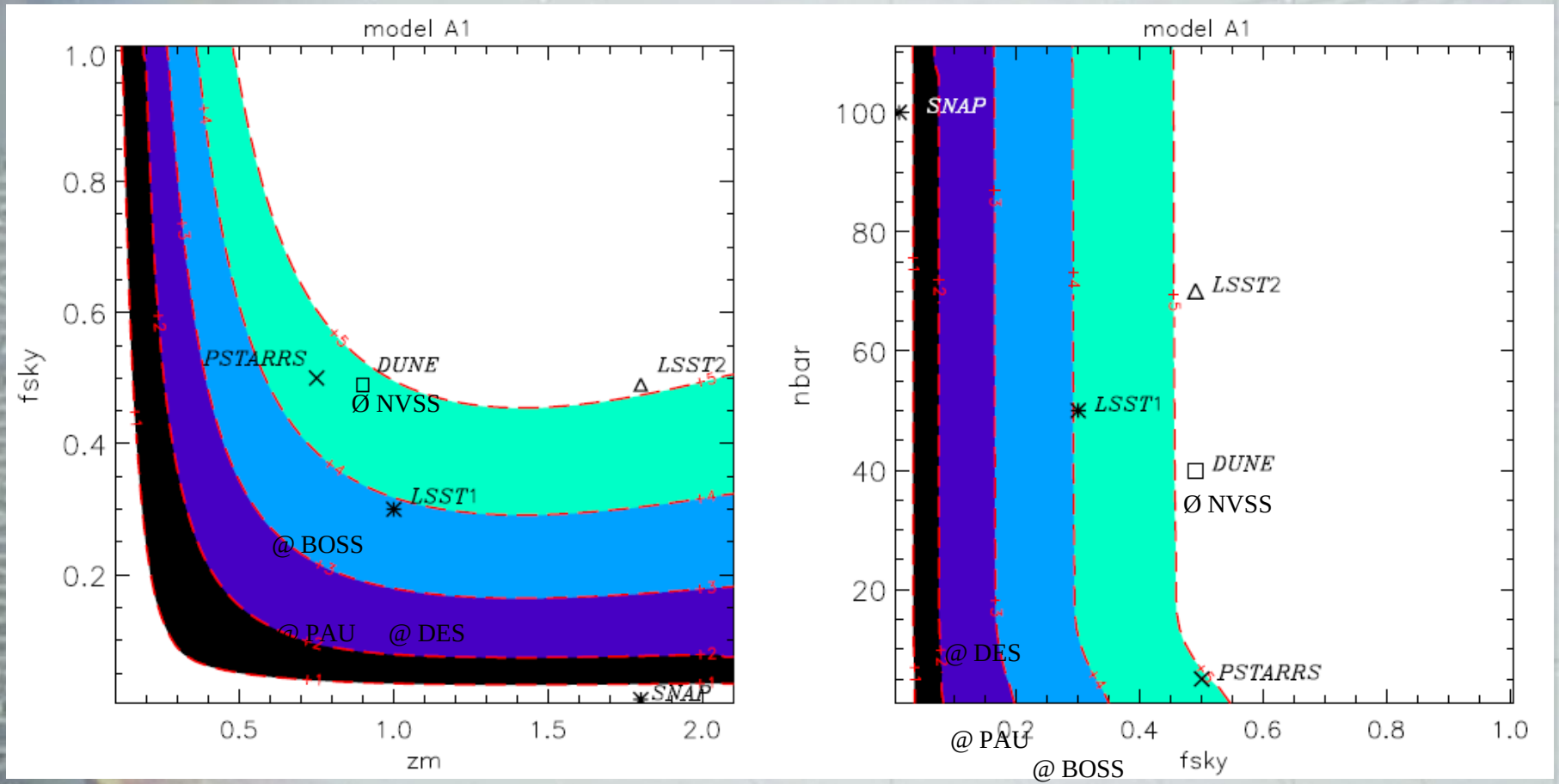
4 scenarios of DE

- Λ, $w=-1$
- $w=-0.9$
- $w=-0.9+0.1z/1+z$
- $w=-1.0 \rightarrow -0.2$ **kink**

Douspis, Castro, Aghanim, Caprini, A&A, 2008

Signal-to-Noise Analysis

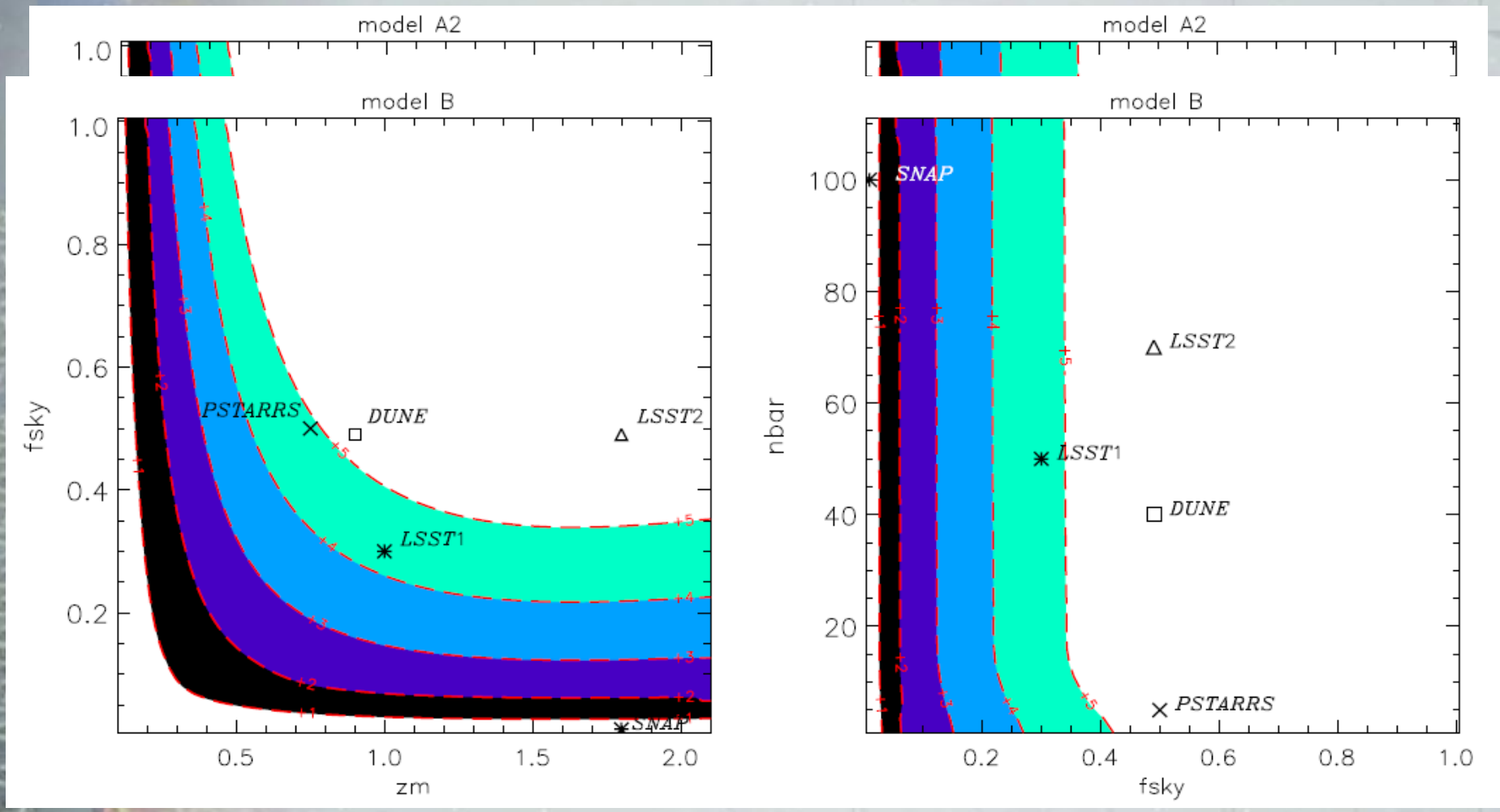
LCDM



$Z_m > 0.8$, f_{sky} as big as possible , nbar > 10/arcmin²

Douspis, Castro, Aghanim, Caprini, A&A, 2008

Signal-to-Noise Analysis

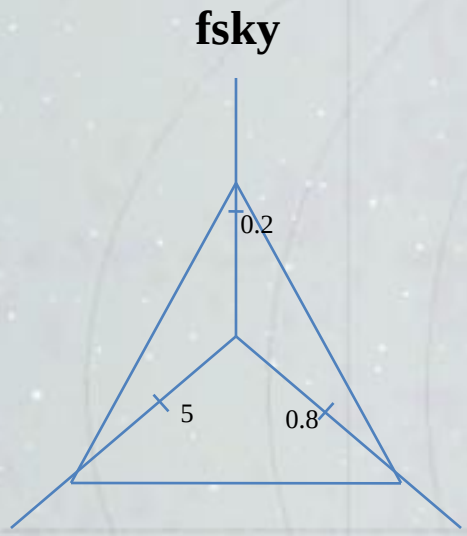


Z_m > 0.8 , f_{sky} as big as possible , nbar > 10/arcmin²

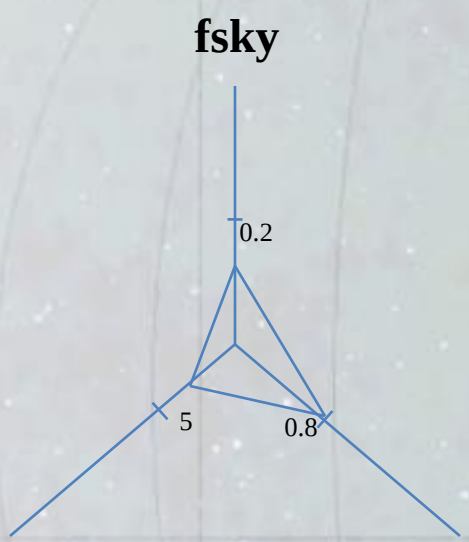
Douspis, Castro, Aghanim, Caprini, A&A, 2008

S/N

Euclid



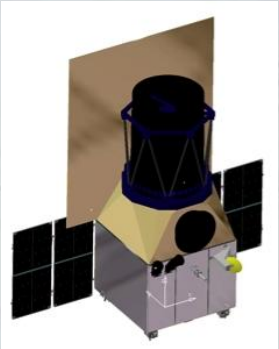
LSST 1



PAU

Contraints from ISW

Fisher Matrix analysis for DUNE & Planck (z_m=0.9, f_{sky}=0.5, nbar=40) :



$$F^{i,j} = f_{sky}^{c} \sum_{l} (2l+1) \frac{\partial C_l^{\mathrm{ISW-G}}}{\partial \Theta_i} \, cov^{-1}(l) \, \frac{\partial C_l^{\mathrm{ISW-G}}}{\partial \Theta_j}$$

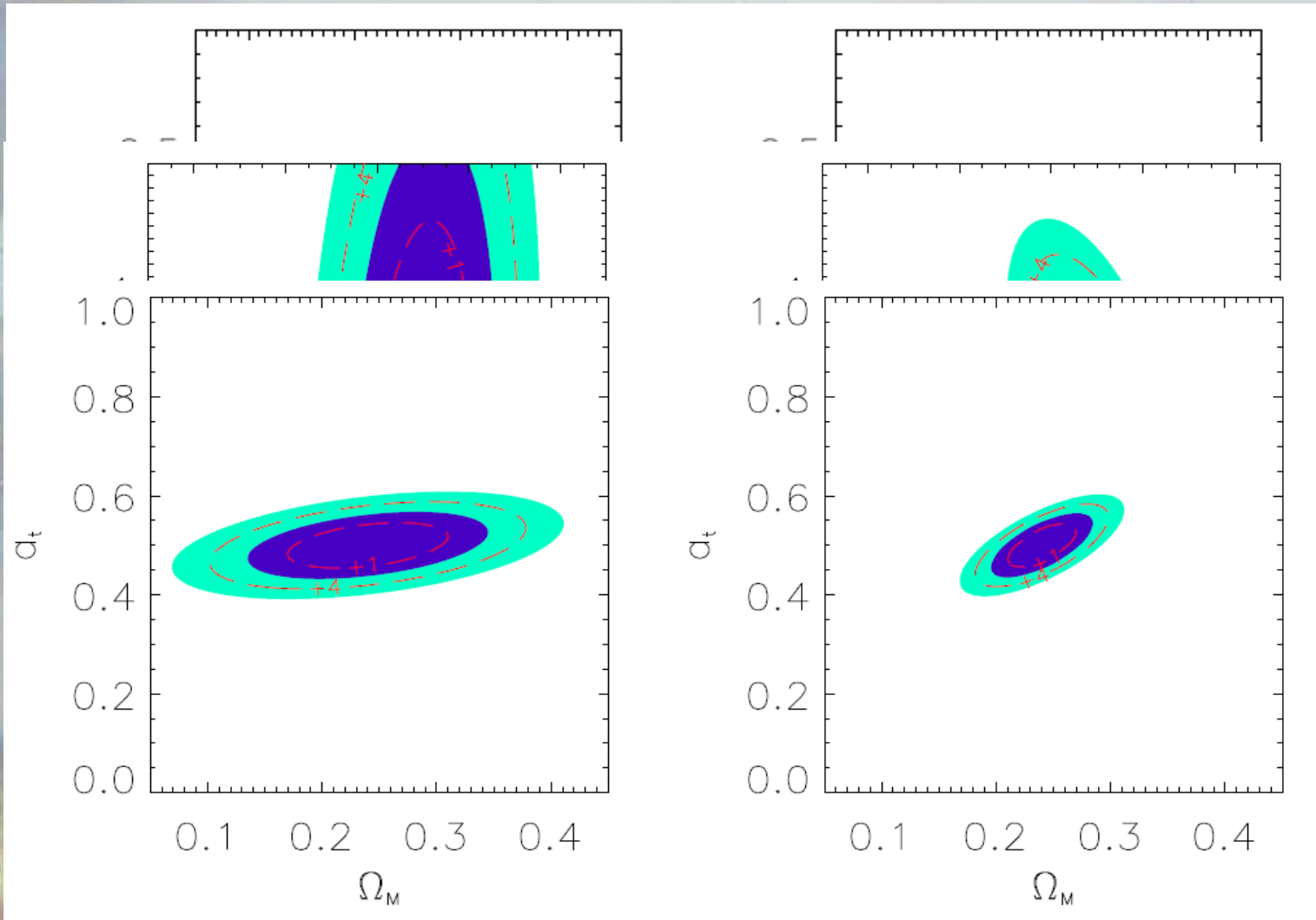
$$cov(l) = \left[C_l^{\mathrm{ISW-G}}\right]^2 + \left(C_l^{\mathrm{ISW}} + N_l^{\mathrm{CMB}}\right)\left(C_l^{\mathrm{G}} + N_l^{\mathrm{G}}\right)$$

$$\Theta = (H_0, \Omega_{\mathrm{b}}, \sigma_8, n_{\mathrm{s}}, \Omega_{\mathrm{DE}})$$

+ w or (w_0,w_a) or a_t

Douspis, Castro, Aghanim, Caprini, A&A, 2008

Fisher matrix analysis



CMB (T)

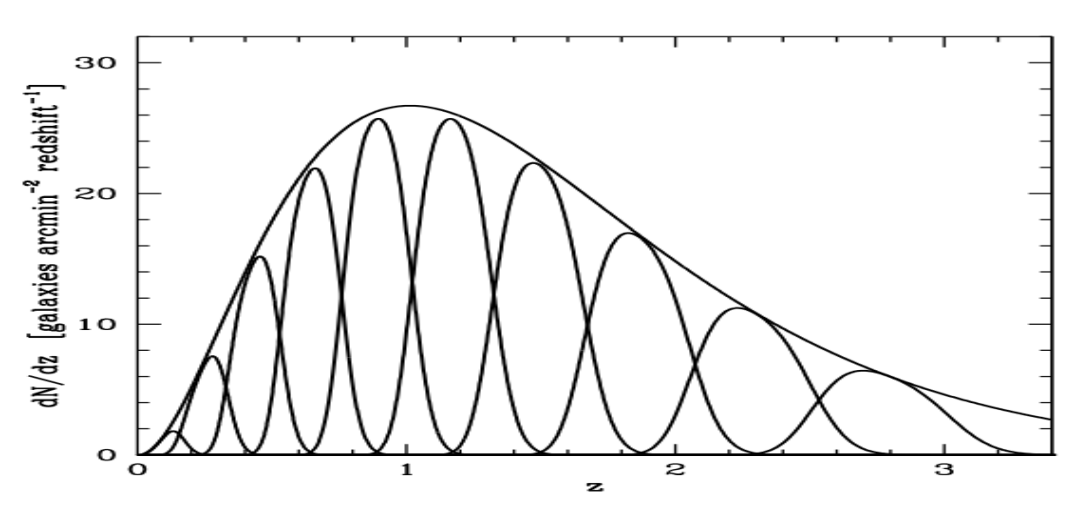
CMB (T) + ISW

Douspis, Castro, Aghanim, Caprini, A&A, 2008

Improvement Signal/Noise

Limitation: CMB

- **Cross-correlation @ different redshifts**
  - **Multiply surveys** *(Giannantonio et al 2008)*
  - **Divide survey: tomography**



$$\overline{N}_i \geq 10/arc\,\mathrm{min}^2$$

$$f_{sky} \geq 50$$

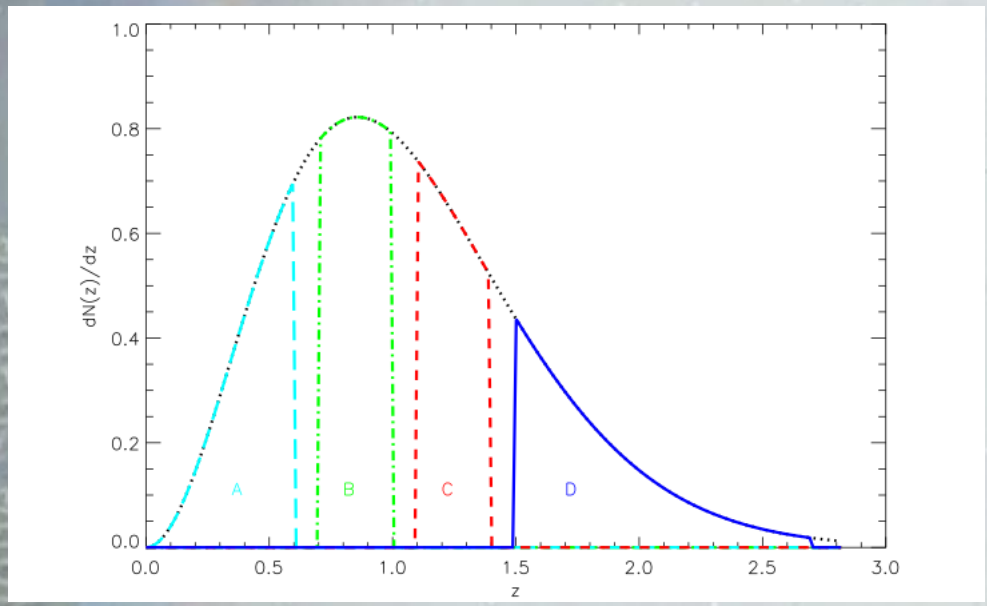
↓

Factor > 3 for DUNE

Then comes the problems of knowing $n_i(z)$, photometric z etc...

Tomography: with DUNE Survey

from Anais Rassat



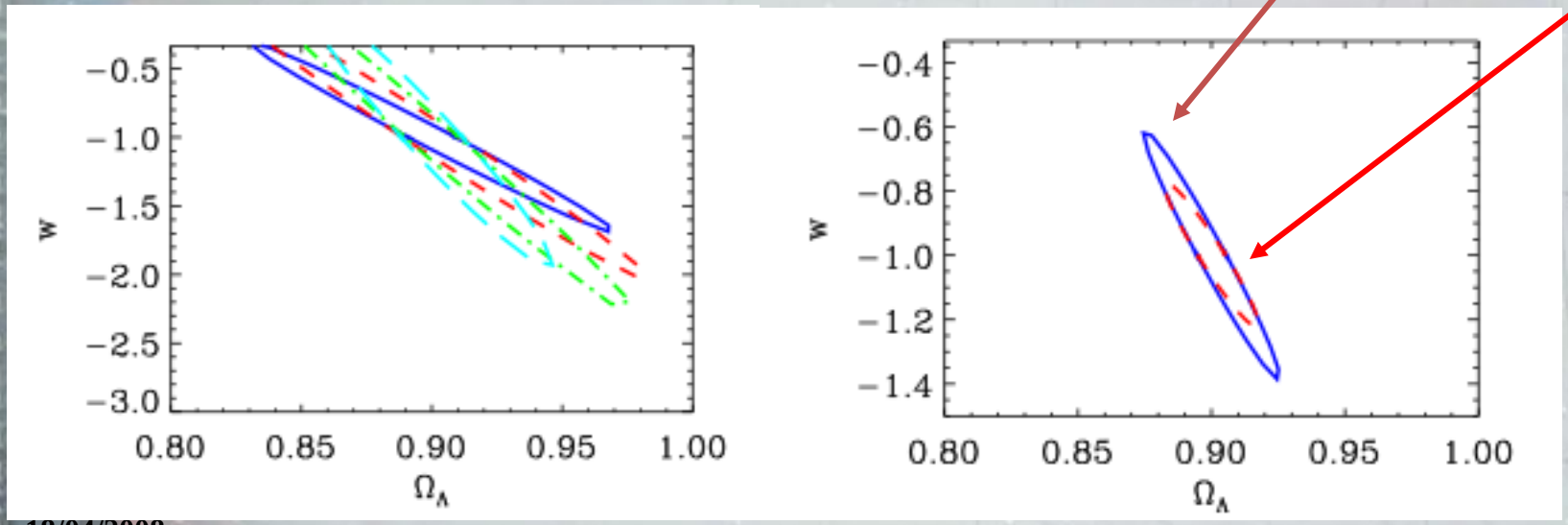
Consider separate redshift shells

Direction of degeneracy changes with redshift

Still need to include Cosmic Magnification

No tomography

Tomography



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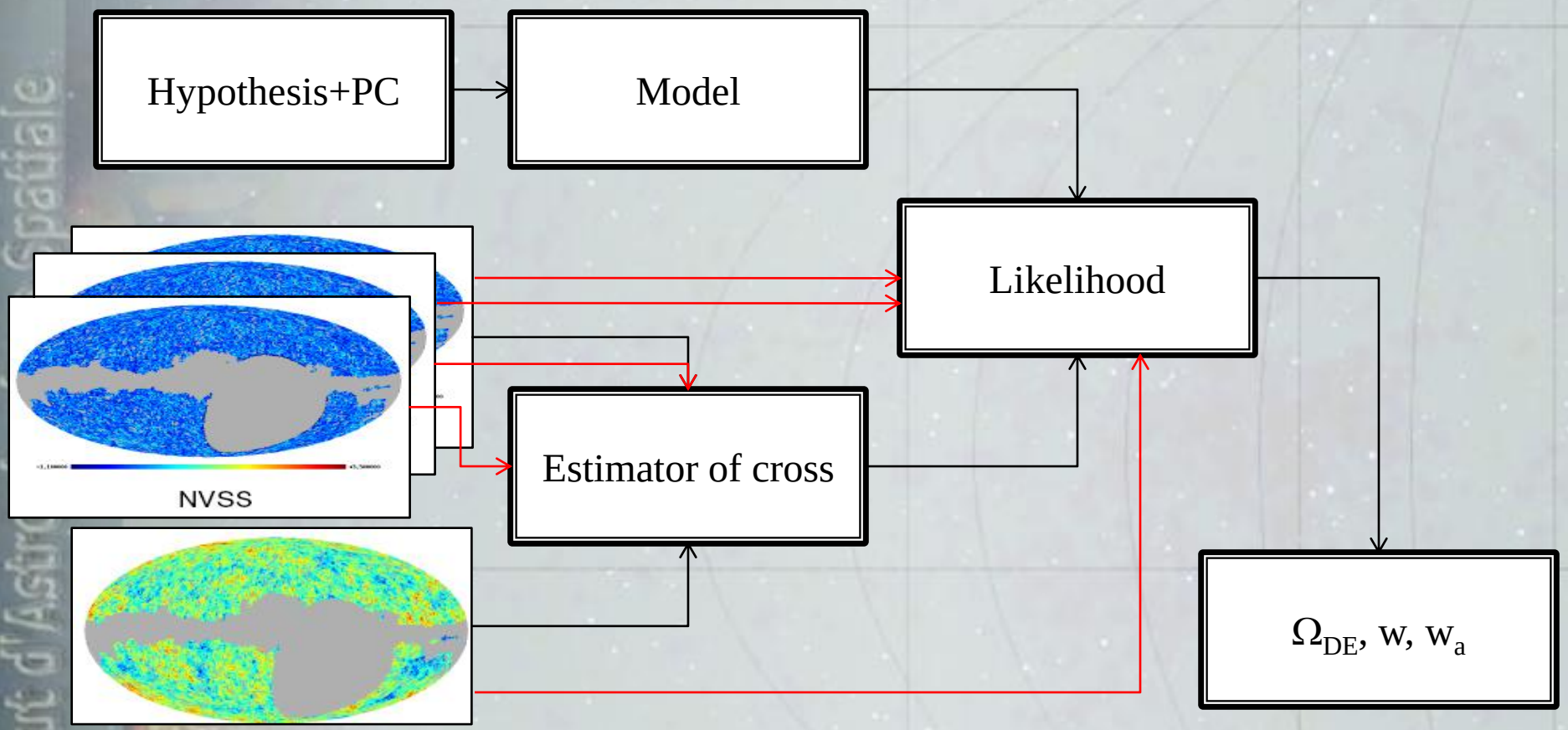

Conclusion

- low signal-to-noise probe
- complementary anyway
- beginning: detection time
- Improvements will come from tracer surveys mainly
- part of a global analysis (CMB+survey)