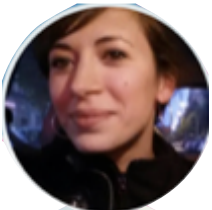# Retrieving cosmological information from Diffuse hot gas in CMB small scales

Marian Douspis
마리엉 두스피

Laura Salvati (IAS), Adélie Gorce (McGill), Hideki Tanimura (IPMU), N. Aghanim (IAS)

"Retrieving cosmological information from small-scale CMB foregrounds I. The thermal Sunyaev Zel'dovich effect", *Douspis, Salvati, Gorce, Aghanim, A&A 2022, arXiv:2109.03272*
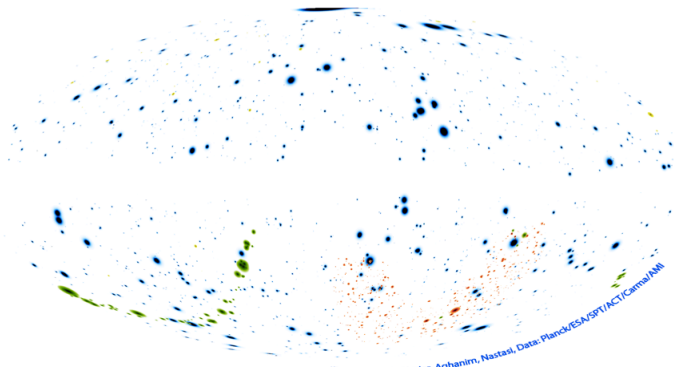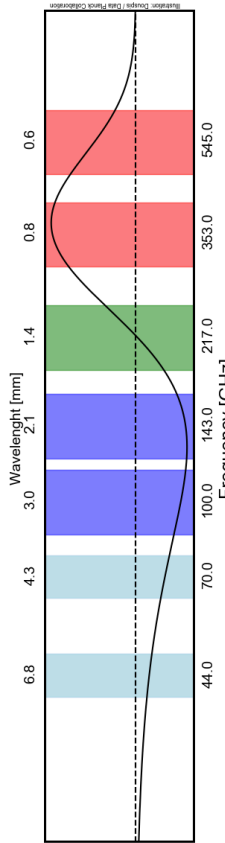
"Retrieving cosmological information from small-scale CMB foregrounds II. The kinetic Sunyaev Zel'dovich effect", *Gorce, Douspis, Salvati, A&A 2022, arXiv:2202.08698*
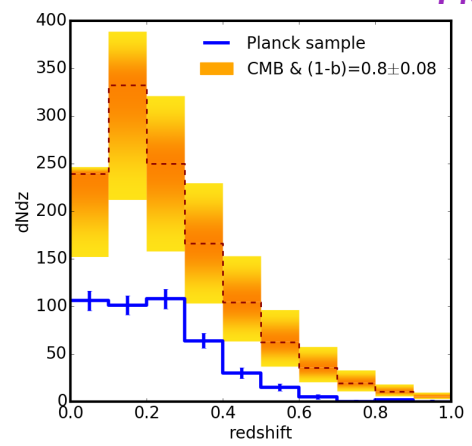
"Constraining cosmology with a new all-sky Compton parameter map from the Planck PR4 data", *Tanimura, Douspis, Aghanim, Salvati, MNRAS 2021, arXiv:2110.08880*

Better Accuracy and robusTness for Mass Assessment of Neutrinos

IAS
Institut d'Astrophysique Spatiale
Orsay

European Research Council
Established by the European Commission
erc

anr
agence nationale
de la recherche

tSZ EFFECT: HOT BARYON TRACER & COSMO PROBE
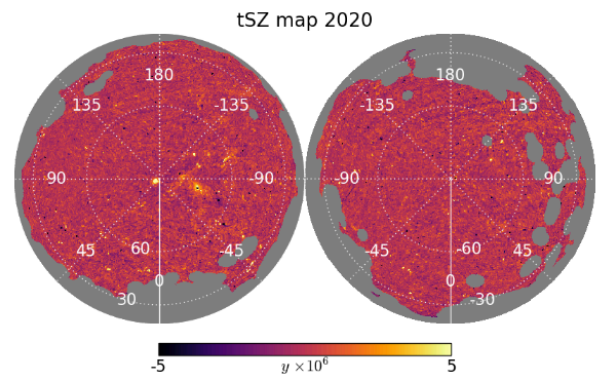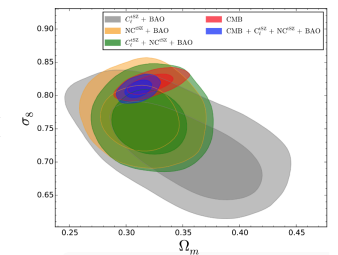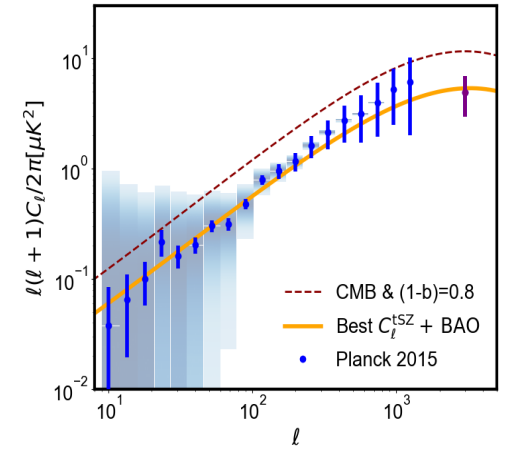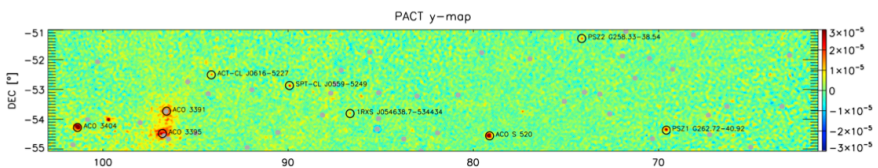
- tSZ is hidden among many other signals

- tSZ not negligible at small scales as Primordial CMB damped

Planck/Large scales

SPT/small scales
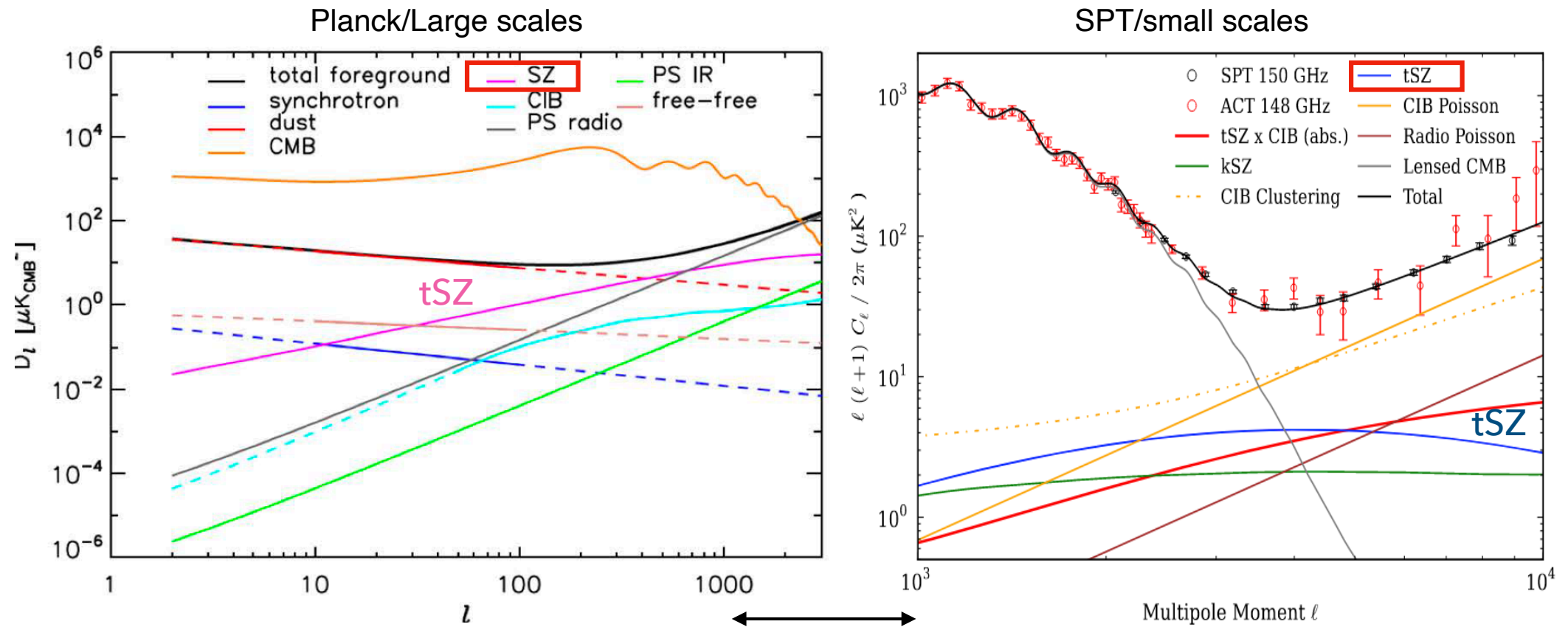
Planck coll. 2013

Addison et al. 2012

- Can we exploit the full cosmological information of extragalactic components (CMB, tSZ, kSZ, …) in CMB analyses ?
- Yes by using coherent modelling and analysis !

Douspis et al 2006

Replace in SPT analysis

Reionisation

Cosmology

$$C_\ell^{obs} = C_\ell^{CMB}(\Theta, xe = tanh) + A^{tSZ} C_\ell^{temp-t} + A^{kSZ} C_\ell^{temp-k} + \ldots.$$

By

$$C_\ell^{obs} = C_\ell^{CMB}(\Theta, xe = asym) + C_\ell^{tSZ}(\Theta) + C_\ell^{kSZ}(\Theta, xe = asym) + \ldots.$$

BUILDING AN SZ EMULATOR

- Training Random forest with random values of 8 params on 10 l-values of the Cls (l=10 to l=11000) [scikit-learn]

- Training 15000 models (test on 20%)

- RF Score of 96%
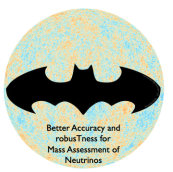
- Comparison Halo model vs RF
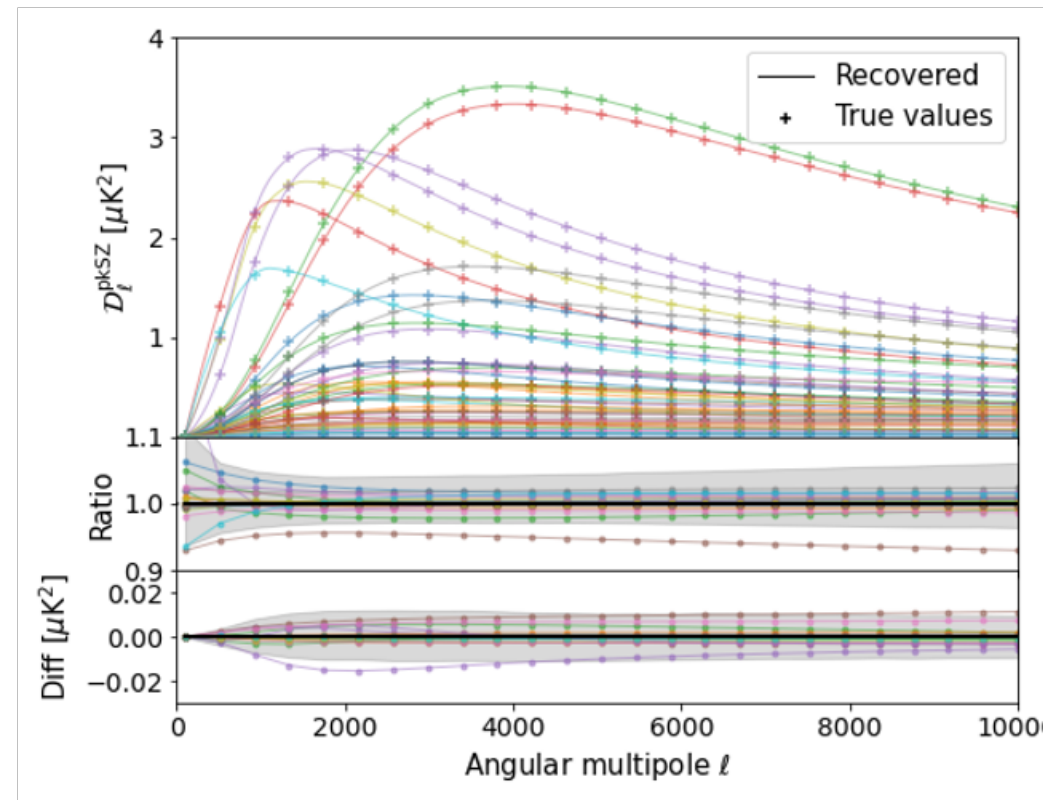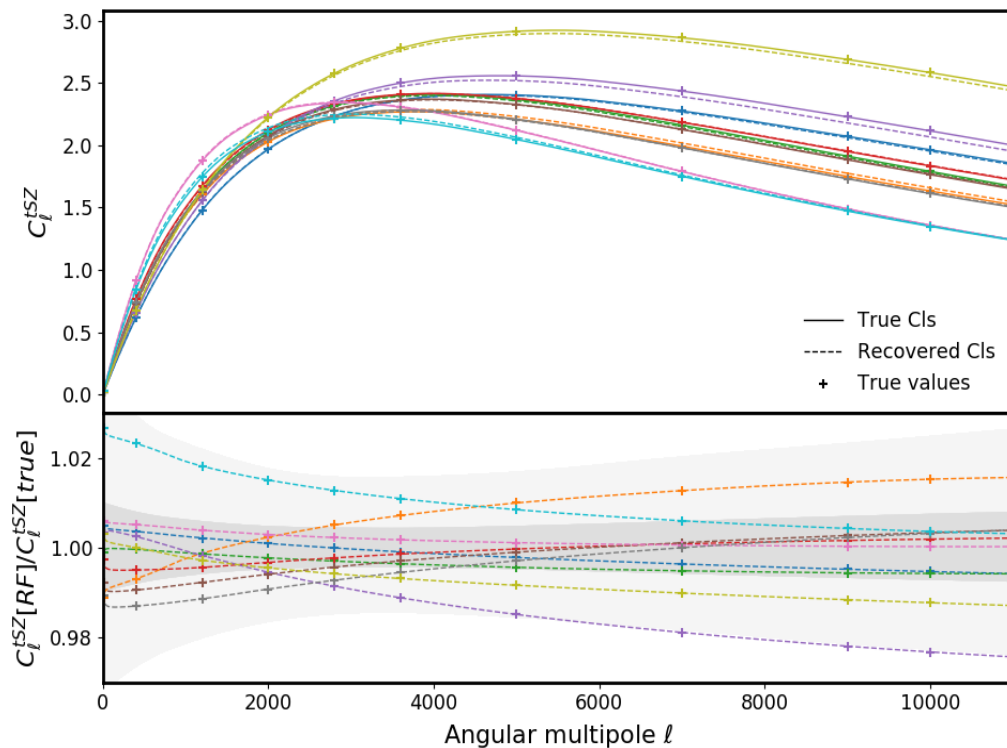
± 2% while observation errors are ~20%

100 times faster to compute

- Effect of cosmological information of tSZ

Ω_M
Ω_b
H_0
n_s
σ_8
A_{tSZ}
$Y*$
α
$(1-b)$

+ 6 foreg
+ 4 instrum

prior on $\Omega_b h^2$
prior on n_s
prior on α
prior on $Y*$

Legend:
- SPT (tSZ template) — grey
- SPT (tSZ RF) — blue
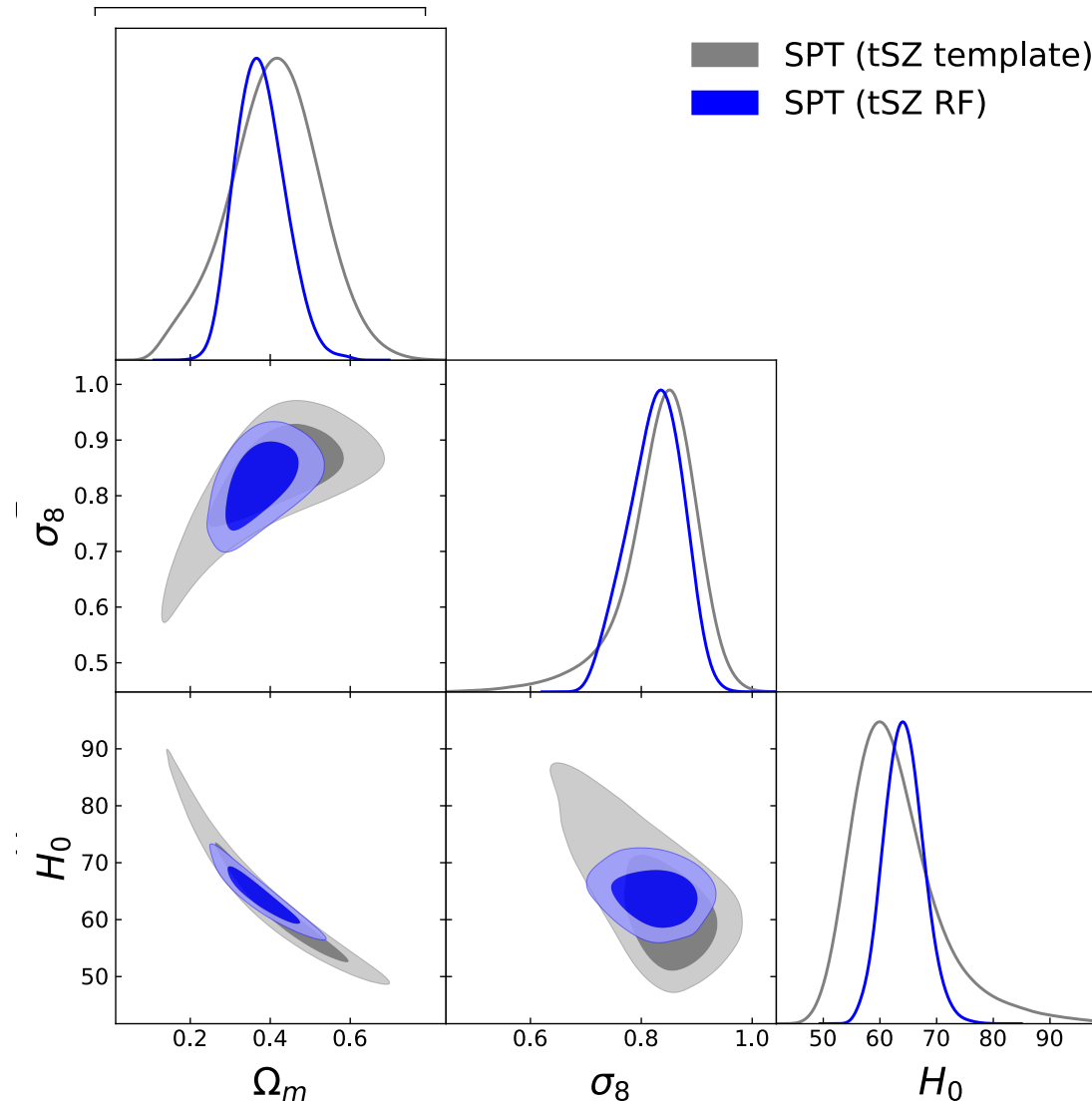
Compatibility of results

Better χ^2 with free cosmological parameters:

	Fixed Cosmo Template	Free Cosmo Template	Free Cosmo RF(Θ)
	236	216	215
	dof	~dof-3	~dof-3

Stronger constraints on $(\Omega_M,\ \sigma_8)$

Douspis et al. 2022

⦿ Hot gas + reionisation

Ω_M
Ω_b
H_0
n_s
σ_8
A_{tSZ}
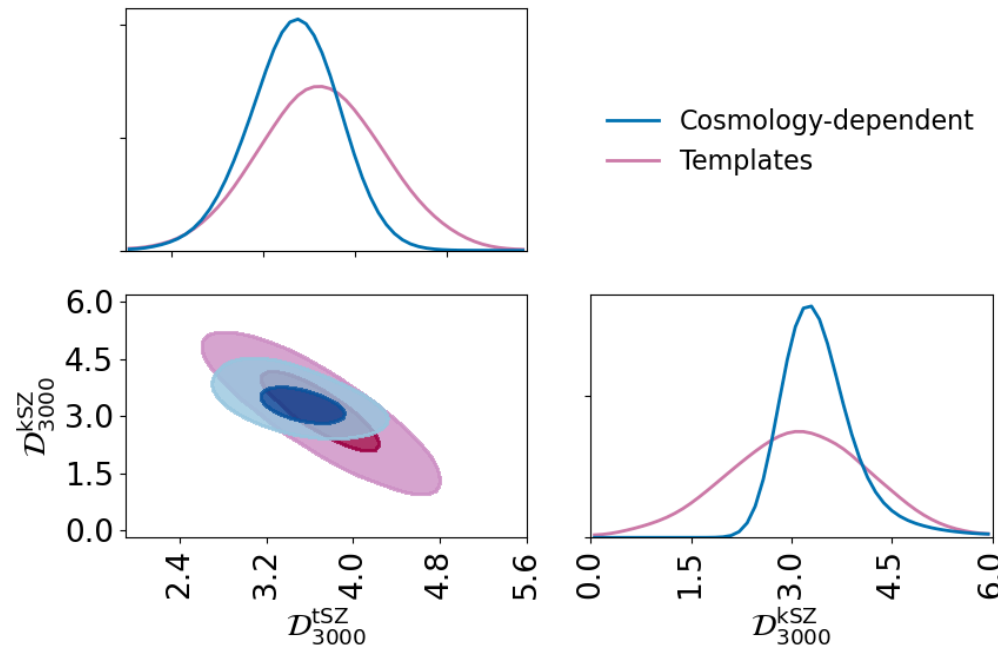$Y*$
α
$(1-b)$

+ 4 reio params
+ 6 foreg
+ 4 instrum

prior on $\Omega_b h^2$
prior on n_s
prior on α
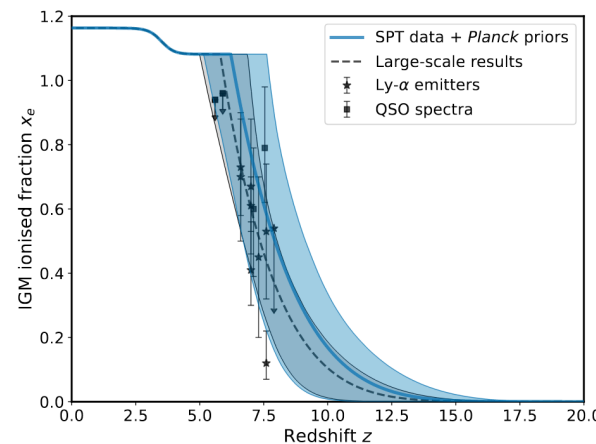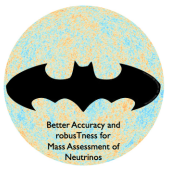prior on $Y*$

Adding cosmological information breaks degeneracy of tSZ with kSZ

May bring additional information on reionisation

Gorce et al. 2022

Conclusions-1

- First attempt to bring full information of high ell components (focusing on tSZ and kSZ)

- Moving from template to cosmology dependency brings consistent and stronger constraints

- Emulator 100 times faster, allows to make many tests: tSZ and kSZ, available with other products:

  - szdb.osups.universite-paris-saclay.fr

  - l3s.osups.universite-paris-saclay.fr

CONCLUSIONS-2

- Moving for a full all-ell cosmological analysis with coherent foregrounds extracting all cosmological information from CMB data (Paper III ongoing) including coherently SZ cluster number counts

- French ANR funding project "**BATMAN**" on *CMB constraints on neutrinos with acurrate reionisation history and gas physics*

$\Longrightarrow$ 3 postdoc positions opened now !!

https://inspirehep.net/jobs/2170877
https://inspirehep.net/jobs/2170876
https://inspirehep.net/jobs/2170871