Winter conferences: cosmology

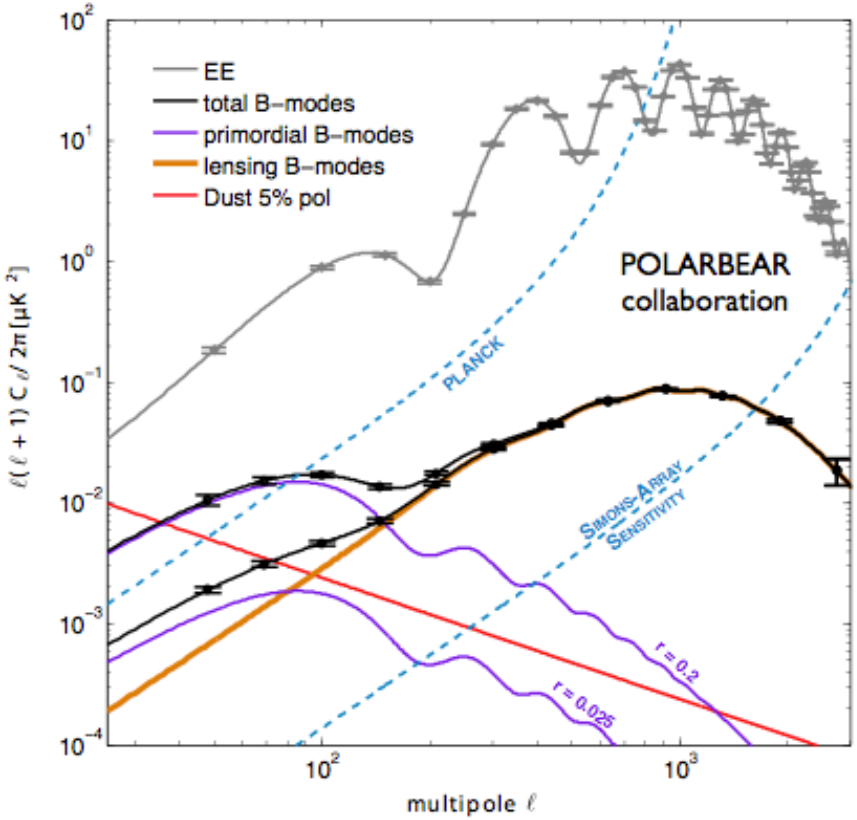
- CMB
- clusters
- dark energy
- dark matter

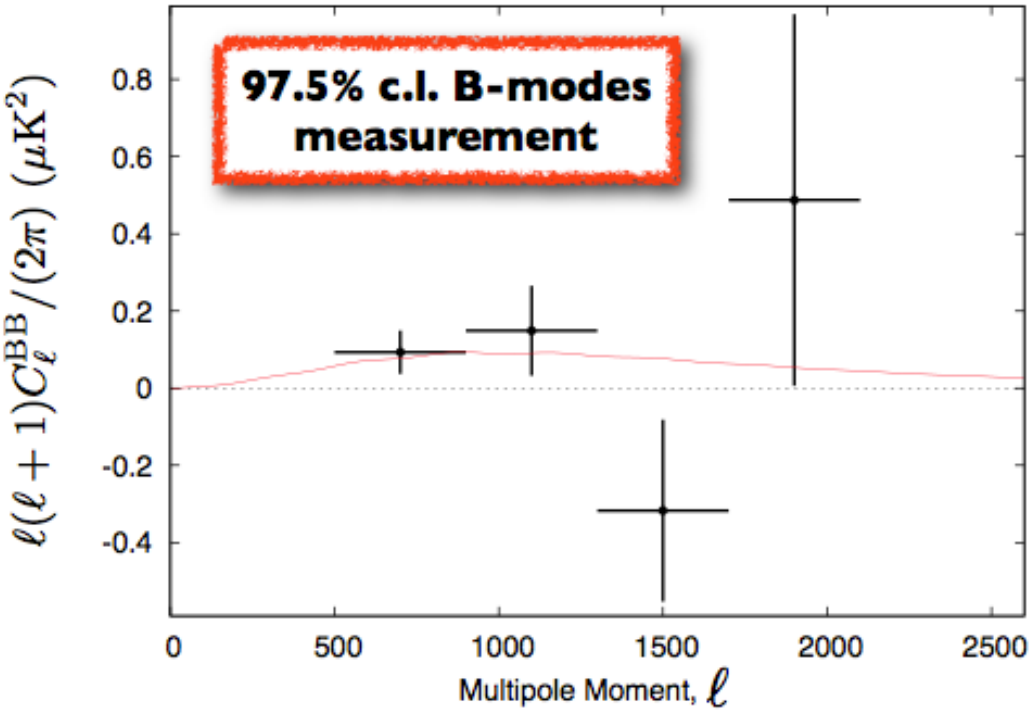
CMB

PolarBear: lensed B modes

- lensed B modes l > 500: 4.2 σ with 1274 detectors
- 2014: 7600 detectors
- 2018: Simon array, 22 800 detectors

Giulio Fabbian

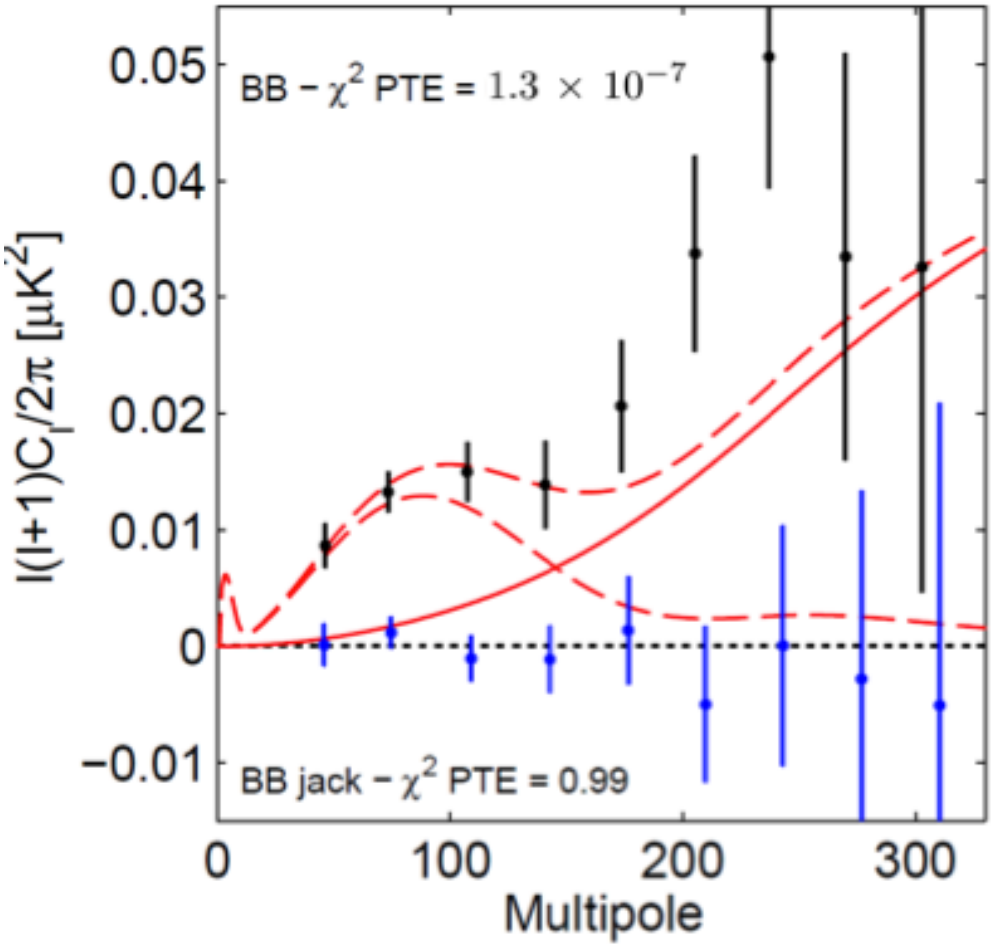


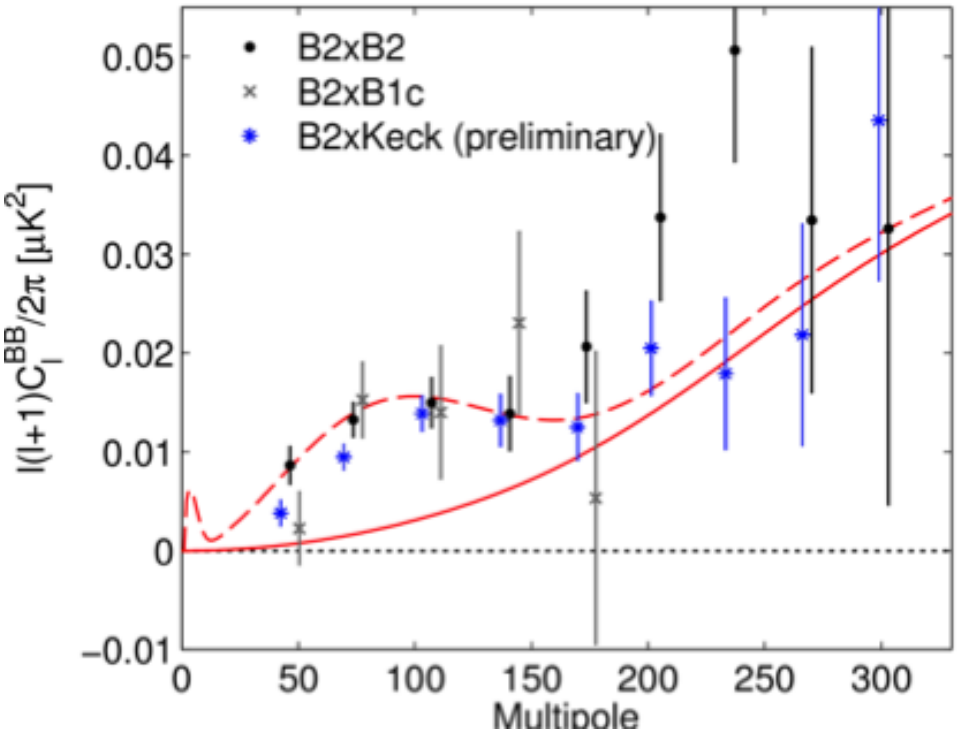


BICEP2: primordial B modes

- primordial B modes observed $r = 0.20^{+0.07}_{-0.05}$ (r=0 ruled out at 7σ)
- confirmed in cross correlation with BICEP1 (3σ) and Keck array (3σ)
- removing polarized dust $r = 0.16^{+0.06}_{-0.05}$ (r=0 ruled out at 6σ)

Clem Pryke





Confirmation of BICEP2 ?

- Keck array within a few months
- Planck should be able to confirm at l = 10 and / or l = 80
- SPTPol (South Pole) has data over the same sky patch
  but they did not make any comment about primordial B modes
- PolarBear with the 7600 detectors in 2014 ?
- EBEX balloon has flight for 11 days, enough ?
  if funded EBEX6K would flight in 2017, results 1 or 2 years latter
- Qubic, not yet fully funded
- ACTPol (Atacama) is late relative to SPTPol,
  advACT will see it but when ?

CMB anomalies

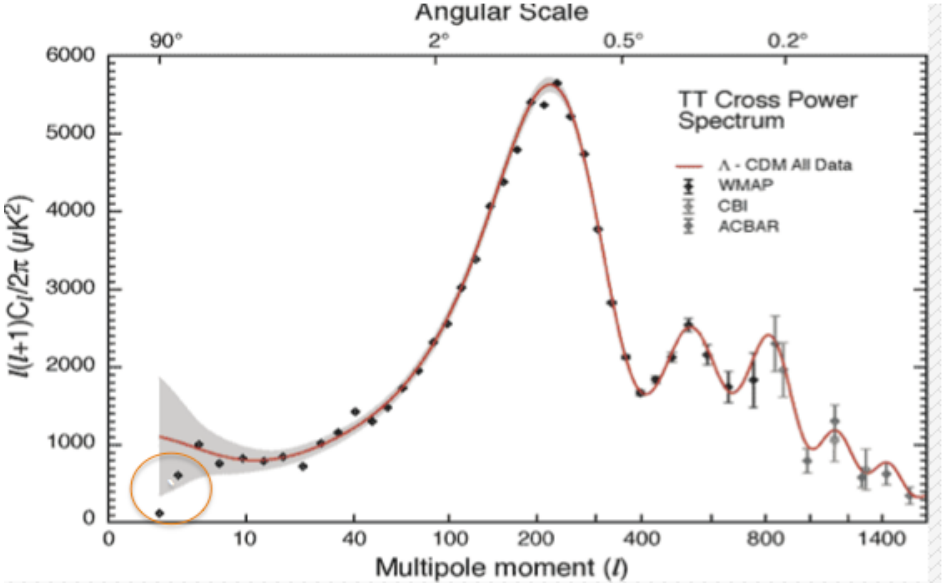
- low quadrupole power
- dipole, quadrupole, octopole alignment
- cold spot
- lack of correlation at $\theta > 60$ deg
- odd-even multipole asymmetry

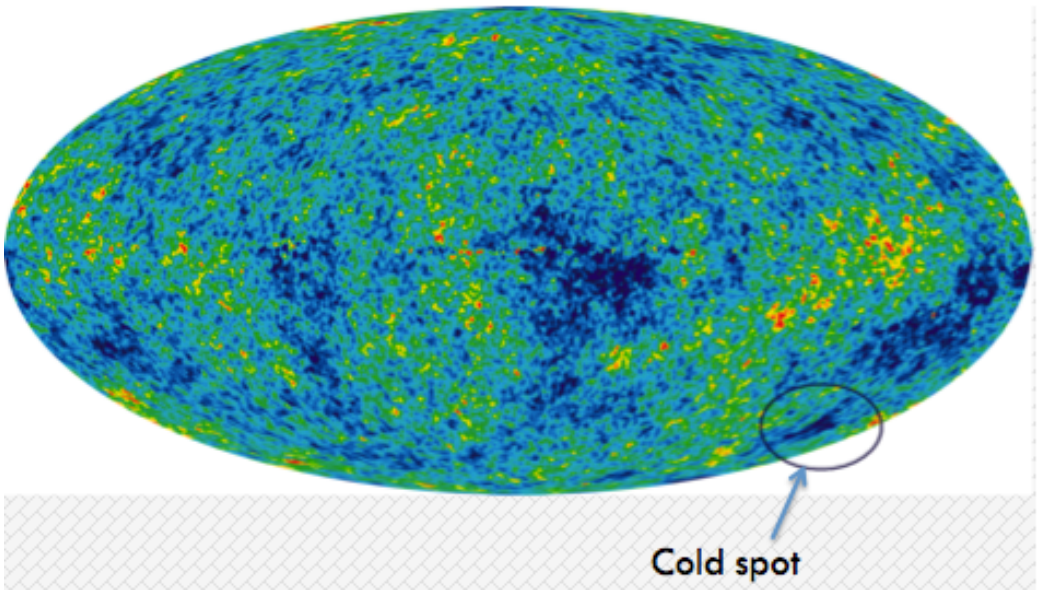
all at 3 - 4 σ

globally too many σ ?

but look else where effect ?

Schwarz, Fantaye, Santos

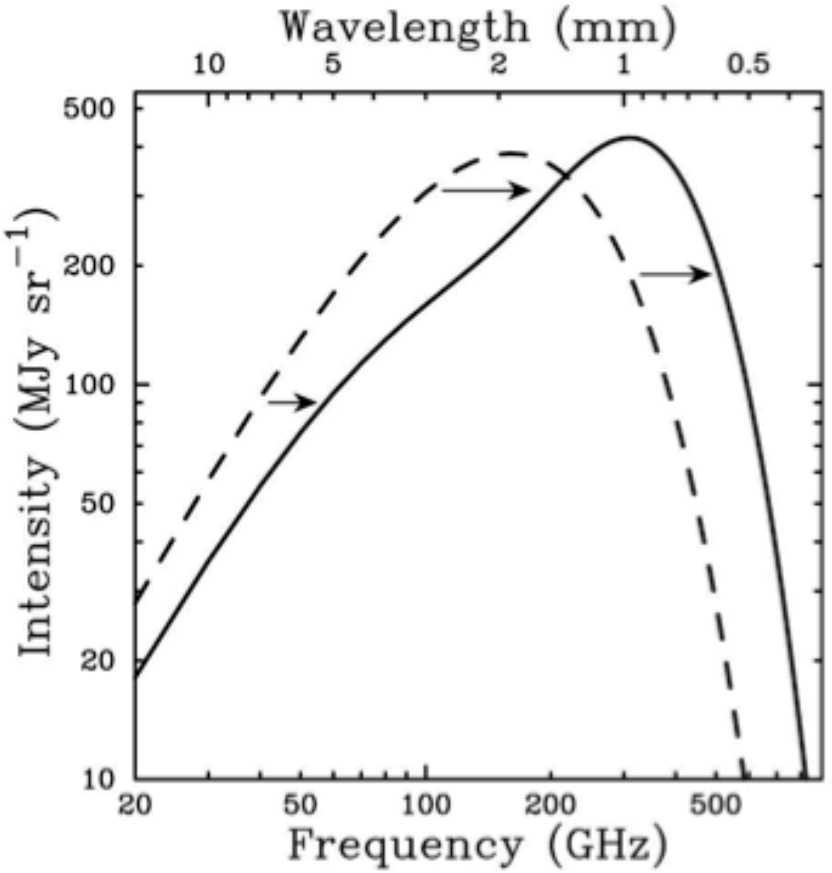


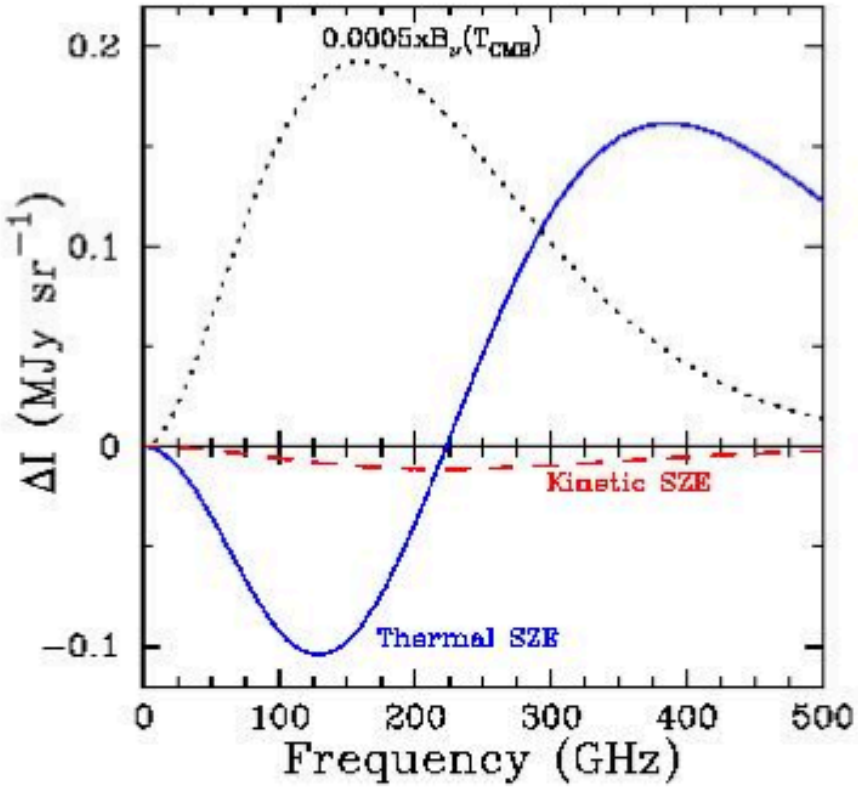


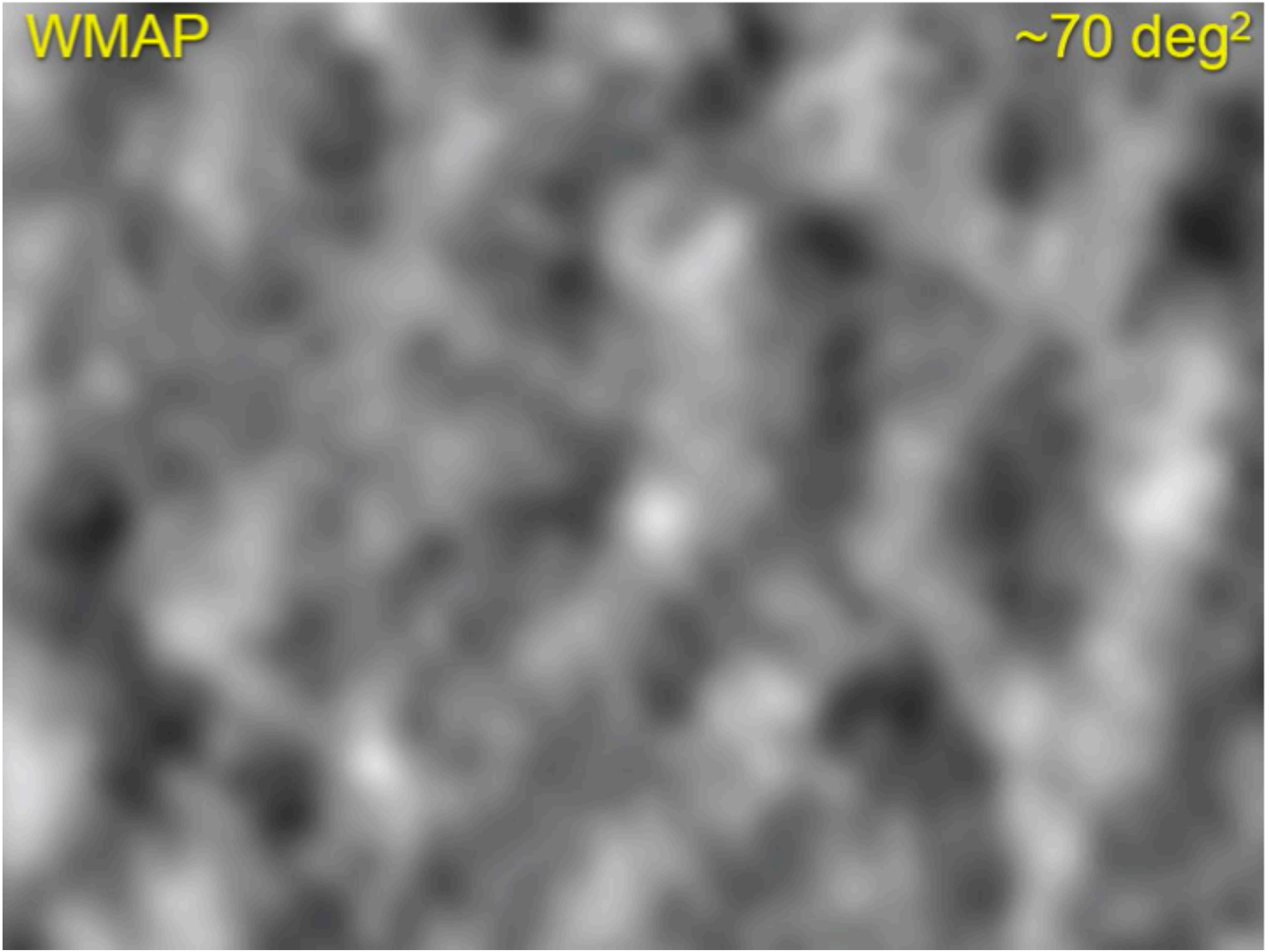
Clusters

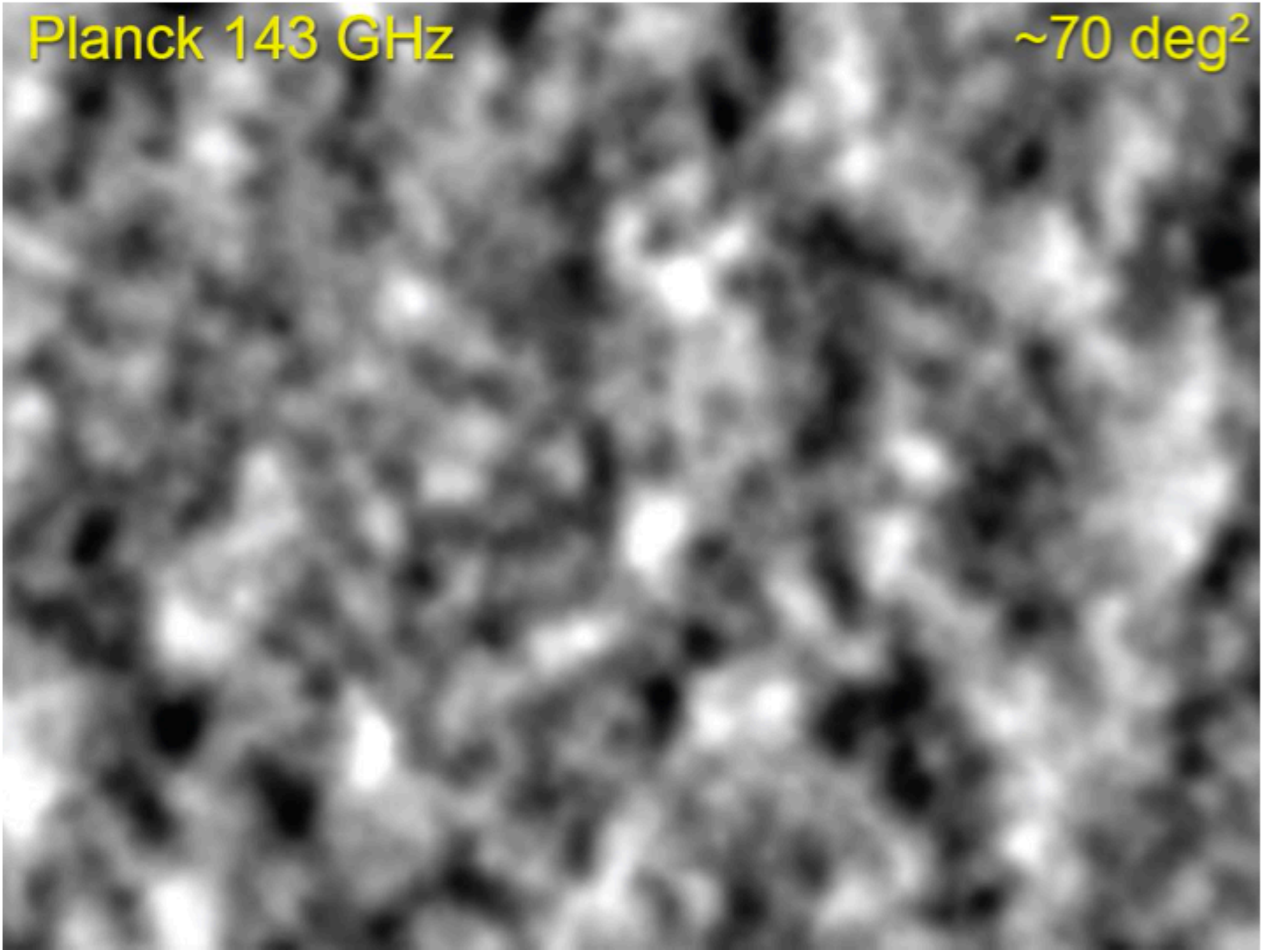
Sunyaev Zeldovich effect (SZ)

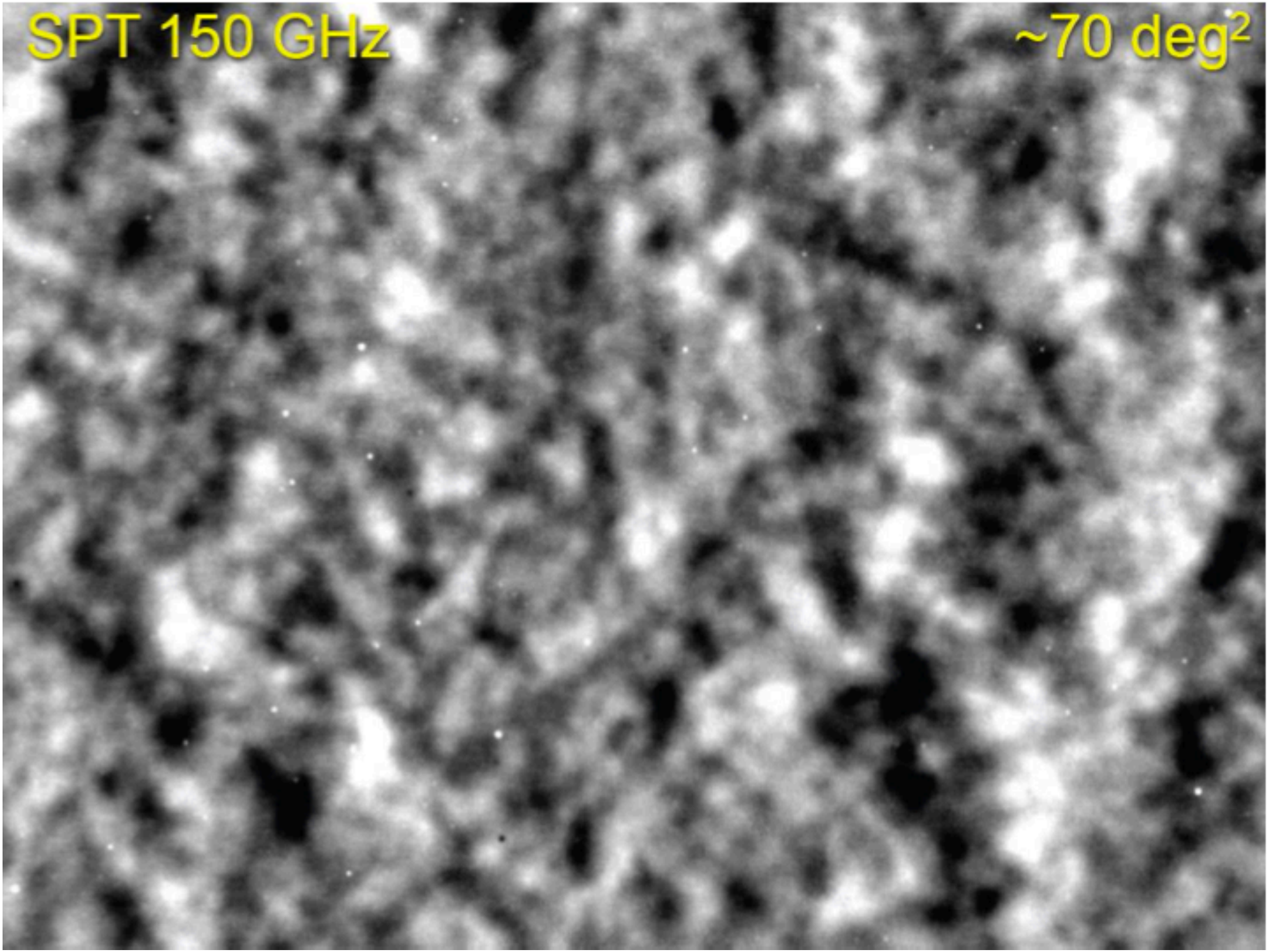
- CMB photons are warmed up by Compton scattering on electrons

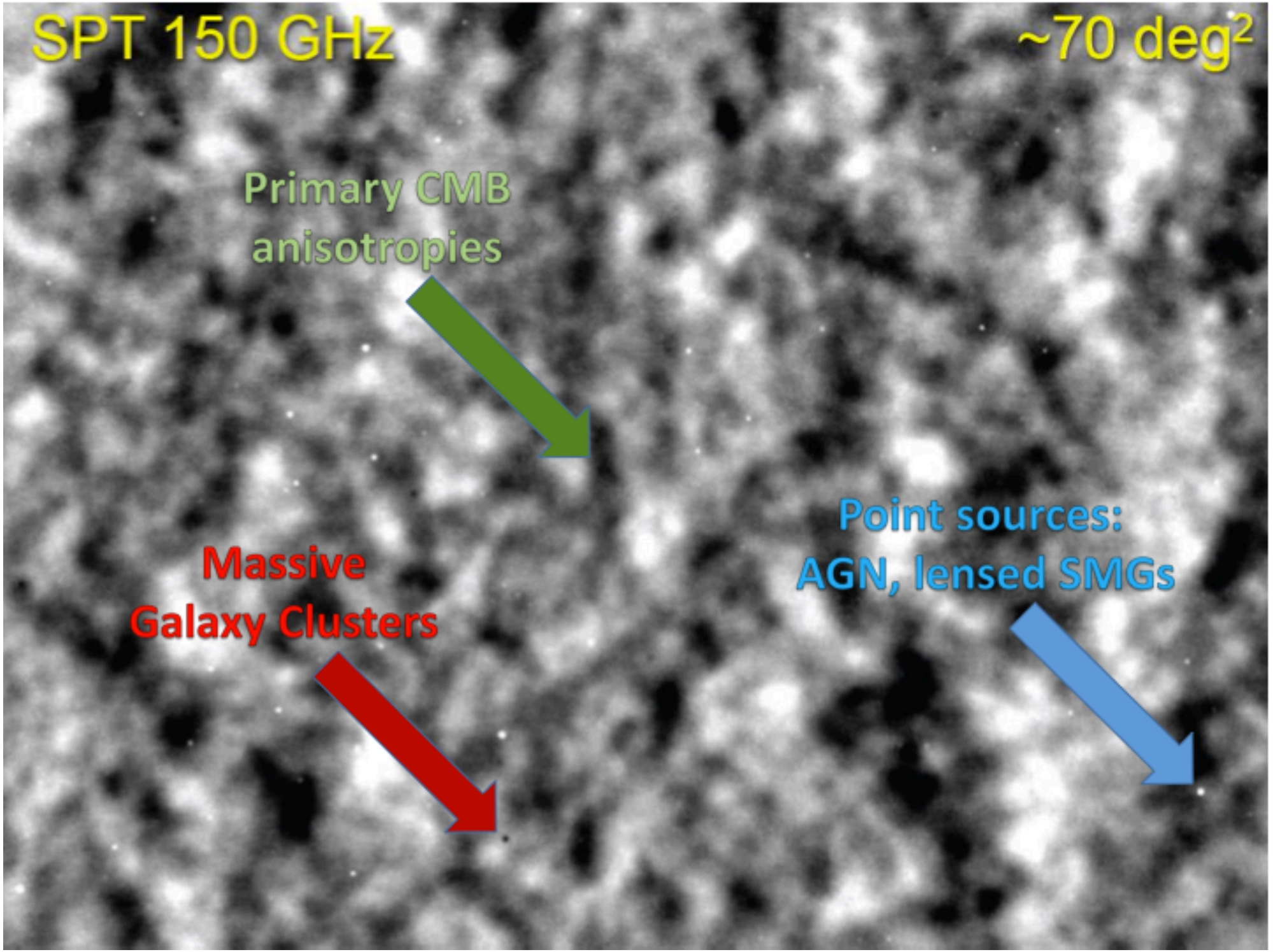





WMAP
~70 deg²


Planck 143 GHz
~70 deg²

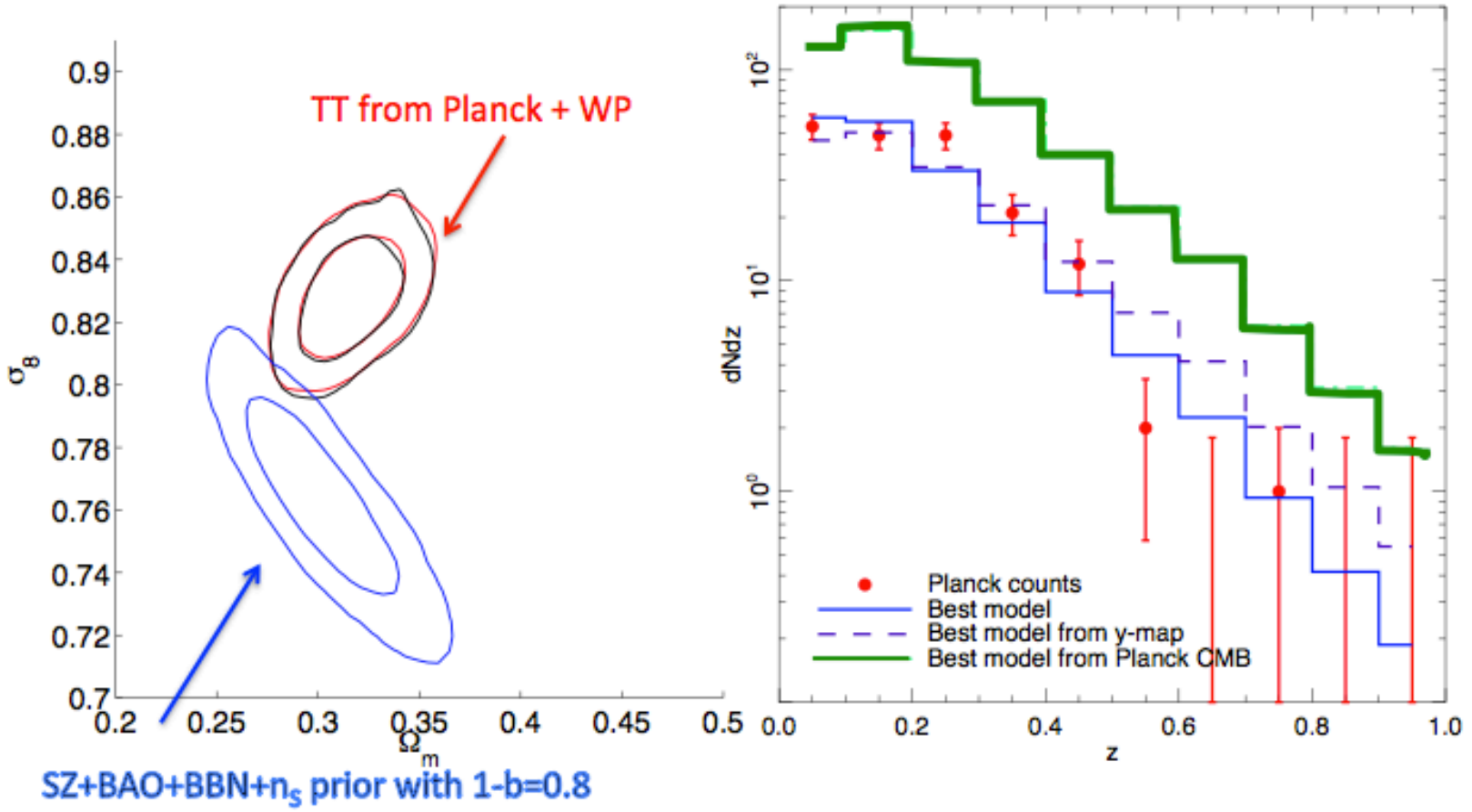

SPT 150 GHz
~70 deg²


SPT 150 GHz
~70 deg²
Primary CMB anisotropies
Massive Galaxy Clusters
Point sources: AGN, lensed SMGs

tension clusters / CMB

- too few clusters / CMB prediction
- The cluster mass measured in X ray is biased : (1-b) M
- best value 1-b = 0.8, reasonable range [0.7- 1] to fit CMB data needs 1-b = 0 .59 +- 0.05

Anna Bonaldi
Tijmen de Haan



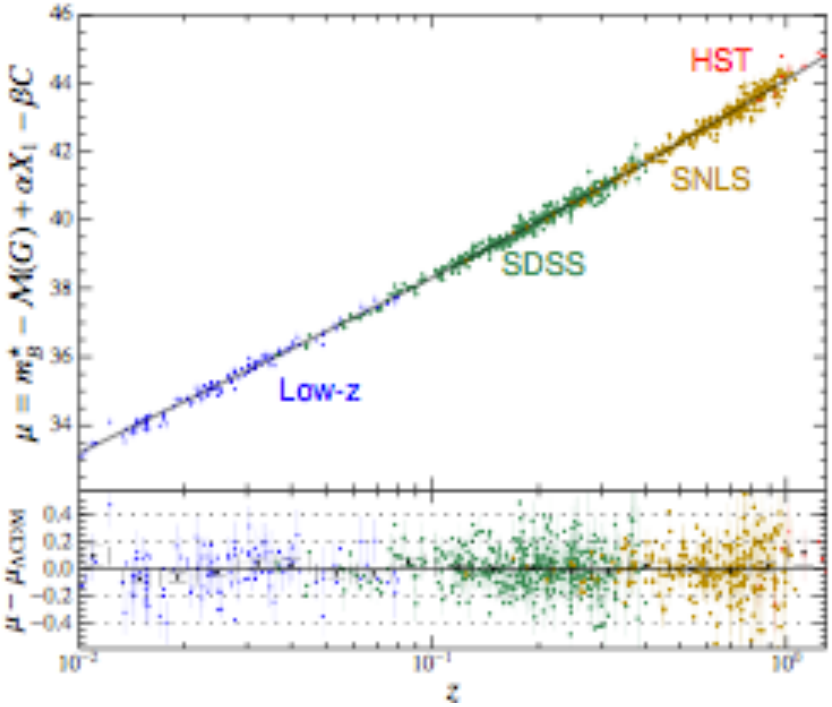
Dark energy

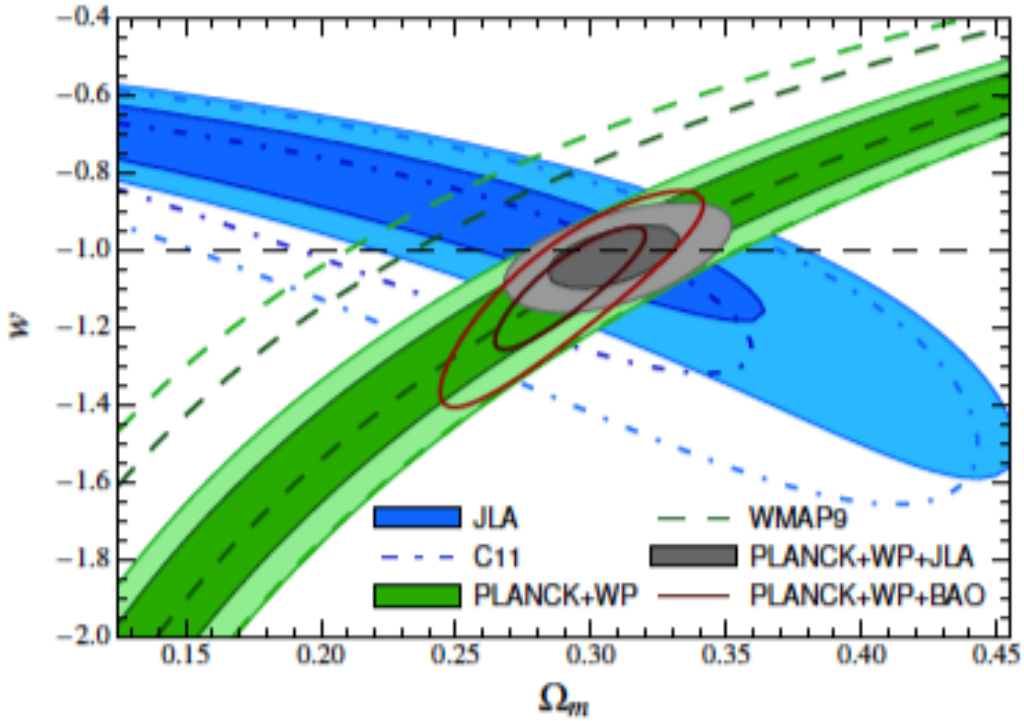
Supernovae

- JLA analysis : SDSS + SNLS

Marc Betoule

- Plank + SN : DE equation of state w = P / ρ = -1.018 +- 0.057

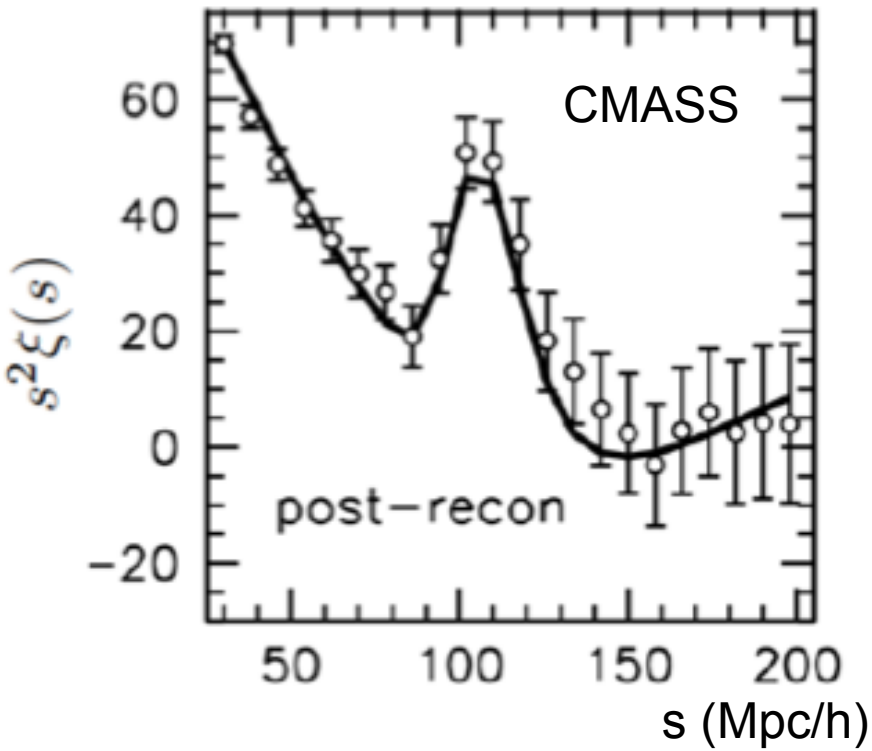


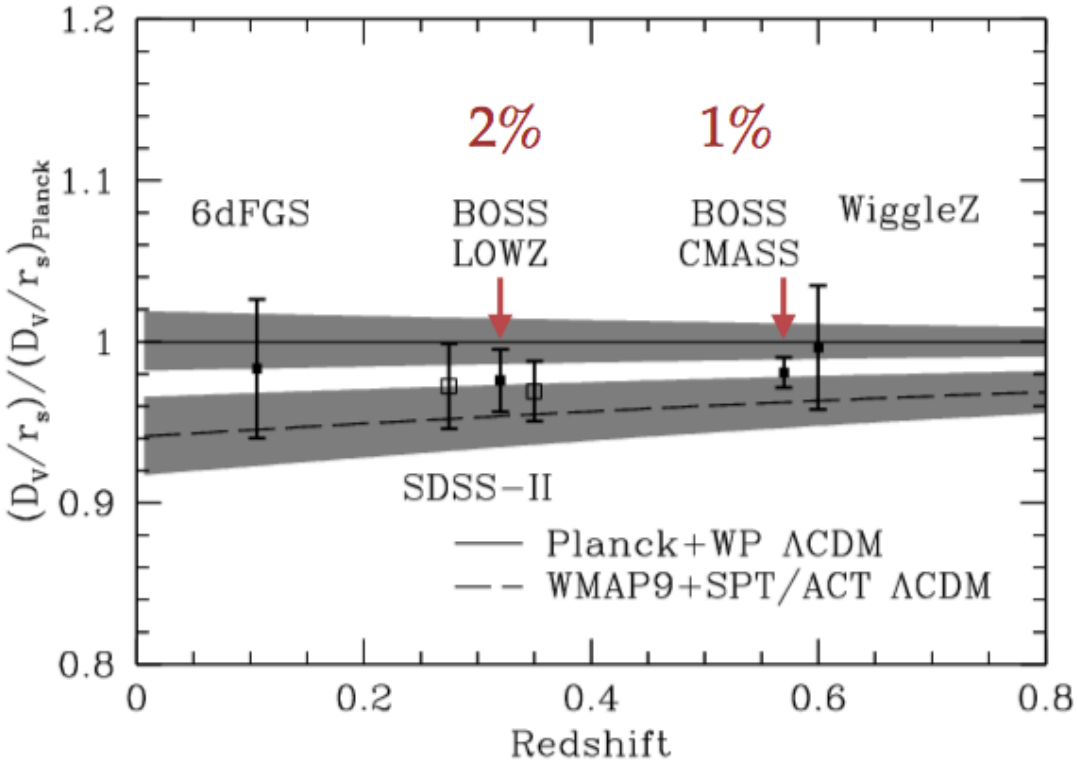


BOSS galaxy clustering

Marc Manera

- DR11 = 90% of nominal BOSS data
- CMASS (z=0.57) + Lowz(z=0.32)
- 7 σ detection of BAO for CMASS alone





BOSS Redshift-Space Distortions (RSD)

Florian Beutler

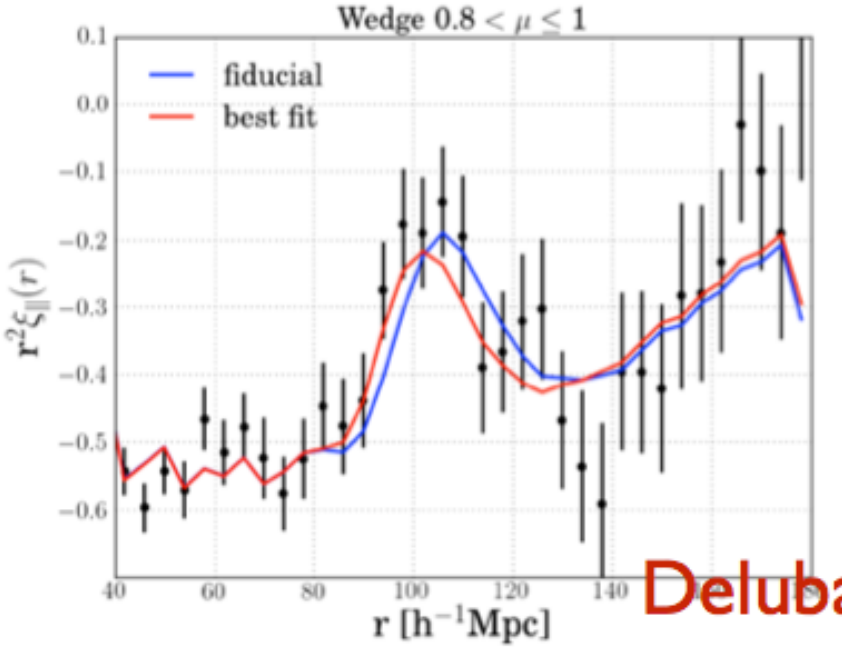
- radial position measured from z
- acceleration towards dense regions
- RSD amplifies power in radial direction -> anisotropy in P(**k**)
- SN and BAO are purely geometrical probes
- RSD dynamical probe -> test GR
- measures f σ_8 where growth rate f = $\Omega_m^{0.55}$ in GR

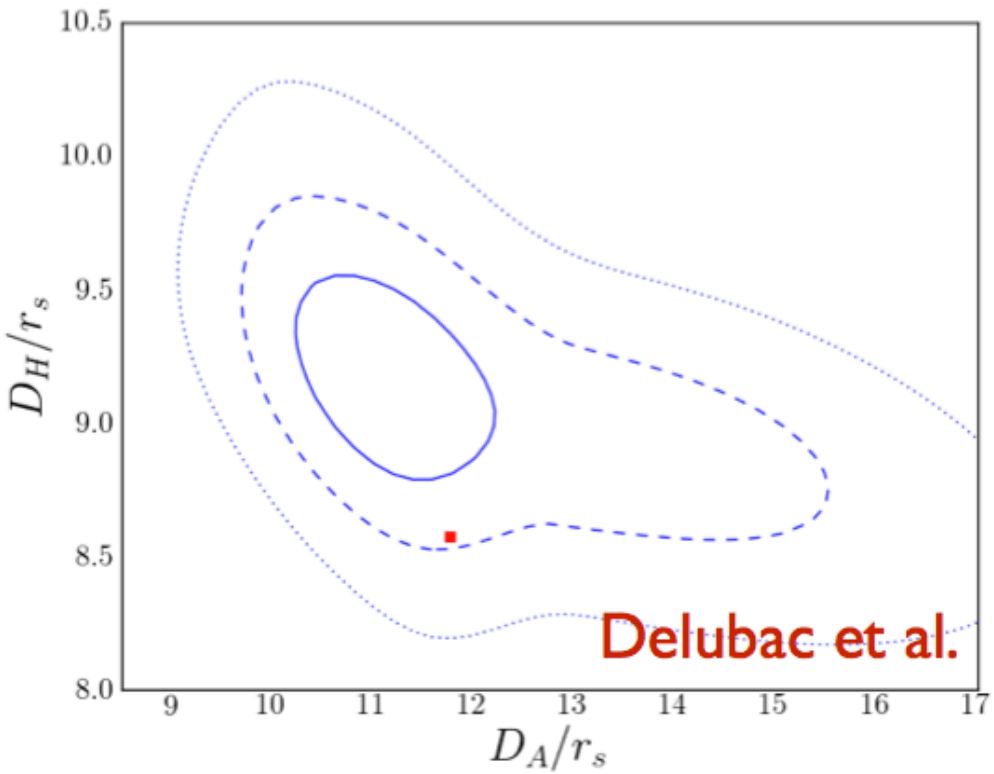
- wrong fiducial cosmology ("Alcock Paszinki" effect) also generates anisotropies
- for a monotonous P(k), RSD degenerate with AP
- BAO peak breaks the degeneracy
- combining with Plank : 2 σ tension with GR

  related to tension in the value of σ_8

BOSS Lyman α forest

- Timothée Delubac





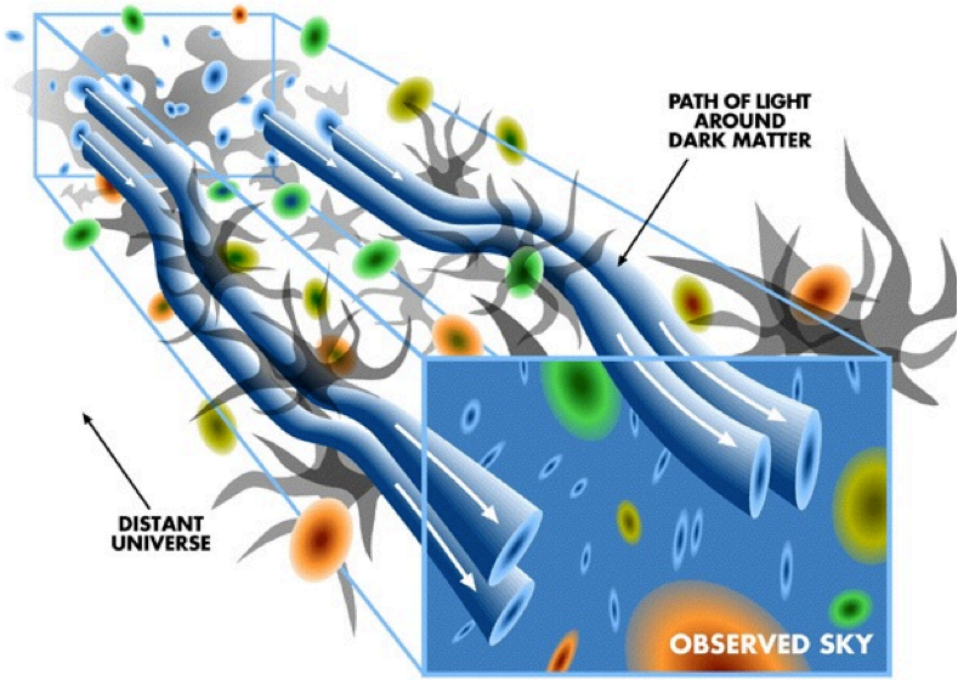
$$H(z = 2.34) = (222.3 \pm 5.9\,\mathrm{km\,s^{-1}\,Mpc^{-1}}) \times (r_d/147.36\,\mathrm{Mpc})$$

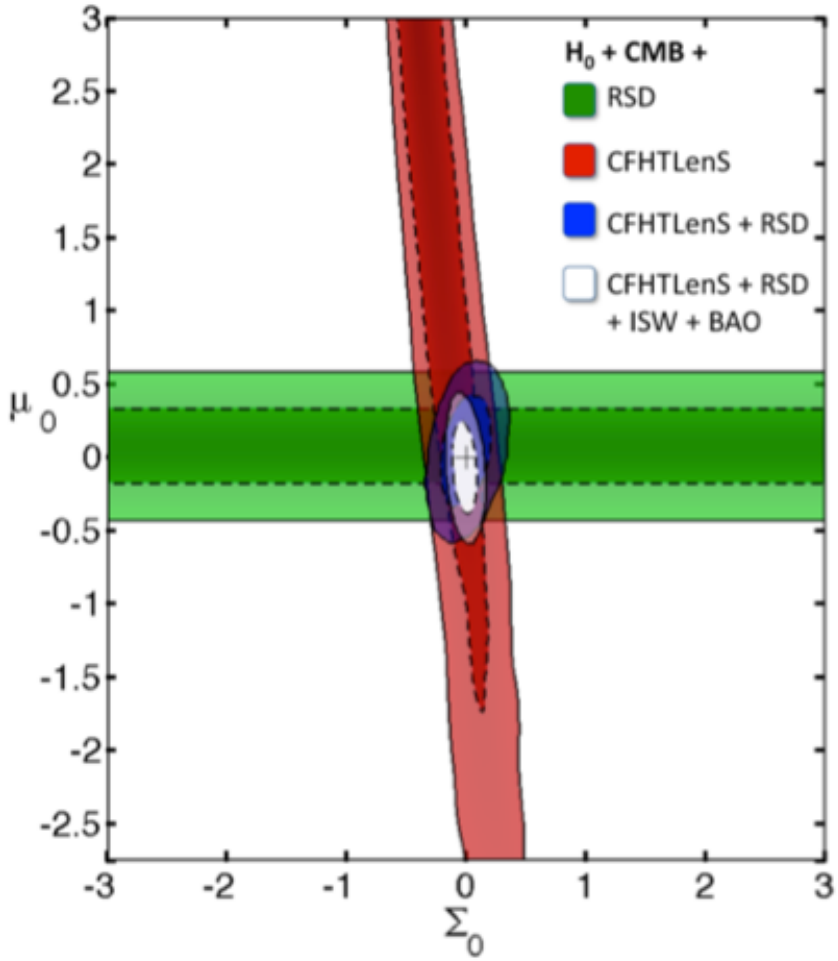
$$D_A(z = 2.34) = (1635 \pm 87\,\mathrm{Mpc}) \times (r_d/147.36\,\mathrm{Mpc}),$$

CFHT lens

- look at distortion of background galaxy by foreground matter

Hendrik Hildebrandt





- tests of GR

Tensions CMB vs LSS

Adam Moss

- number of SZ clusters, clustering in galaxy lensing, $f\sigma_8$ measured in RSD, all smaller by ~3σ than predicted by Planck or WMAP
- possible explanations include
  - massive neutrinos $\Sigma m_\nu \sim 0.3$ eV ~ 4.5 σ
  - sterile neutrinos
  - wrong τ from WMAP polarized low ℓ

Dark matter

NEWS: Nuclear Emulsion Wimps Search

Natalia di Marco (LNGS) + Napoli, Bari, Nagoya

- R&D for directional search (earth revolution gives seasonal modulation of direction)

low pressure gas target -> mm track length but small detector mass

- use solid target to obtain good sensitivity

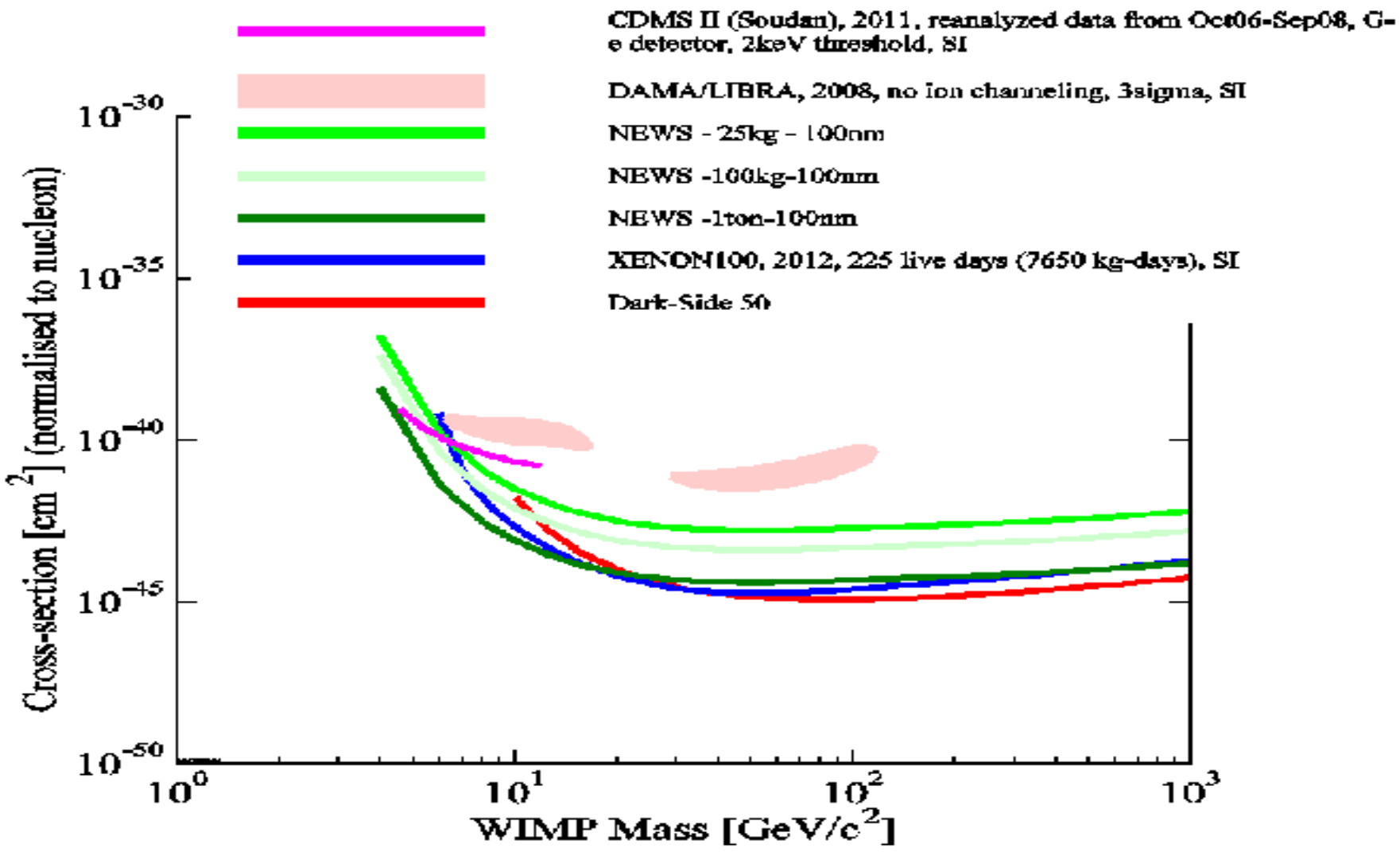
then recoil track < 300 nm for 150 GeV WIMP

- nuclear emulsion acting both as target and detector

NIT (nano imaging tracker) 20 nm crystals

1) factor 2 film expansion by chemical treatment
2) scanning with optical microscope
3) scanning of selected regions with X ray microscope -> 17° resolution

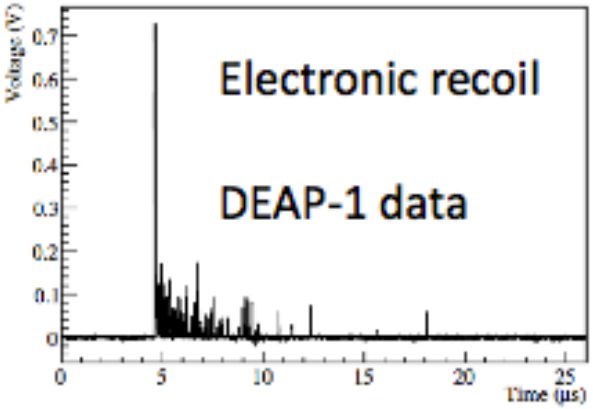
NEWS: Nuclear Emulsion Wimps Search

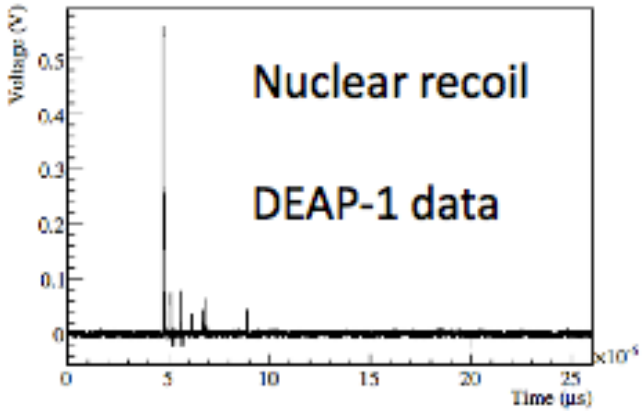


DEAP-3600 principle

- Dark matter Experiment using Argon Pulse-shape discrimination
- 3600 kg of liquid Ar at SNOLAB, Ontario,
- Ar excited states singlet (7ns) and triplet (1.5 μs)

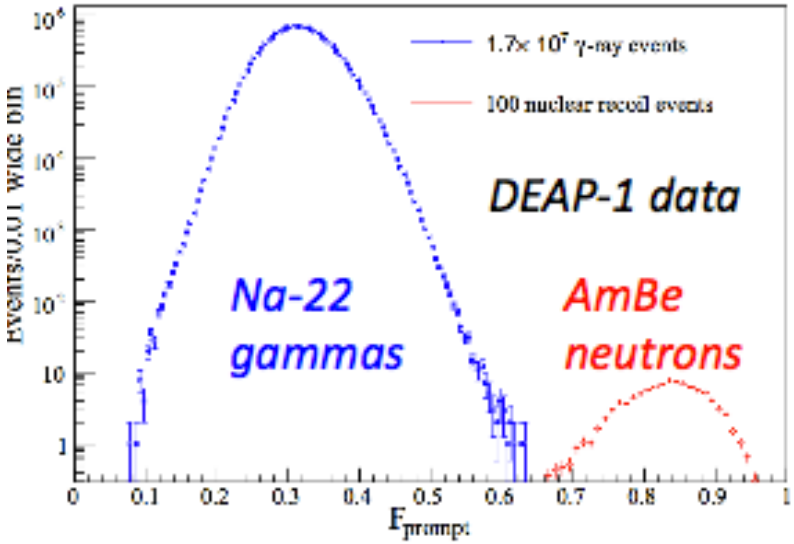
Joseph Walding





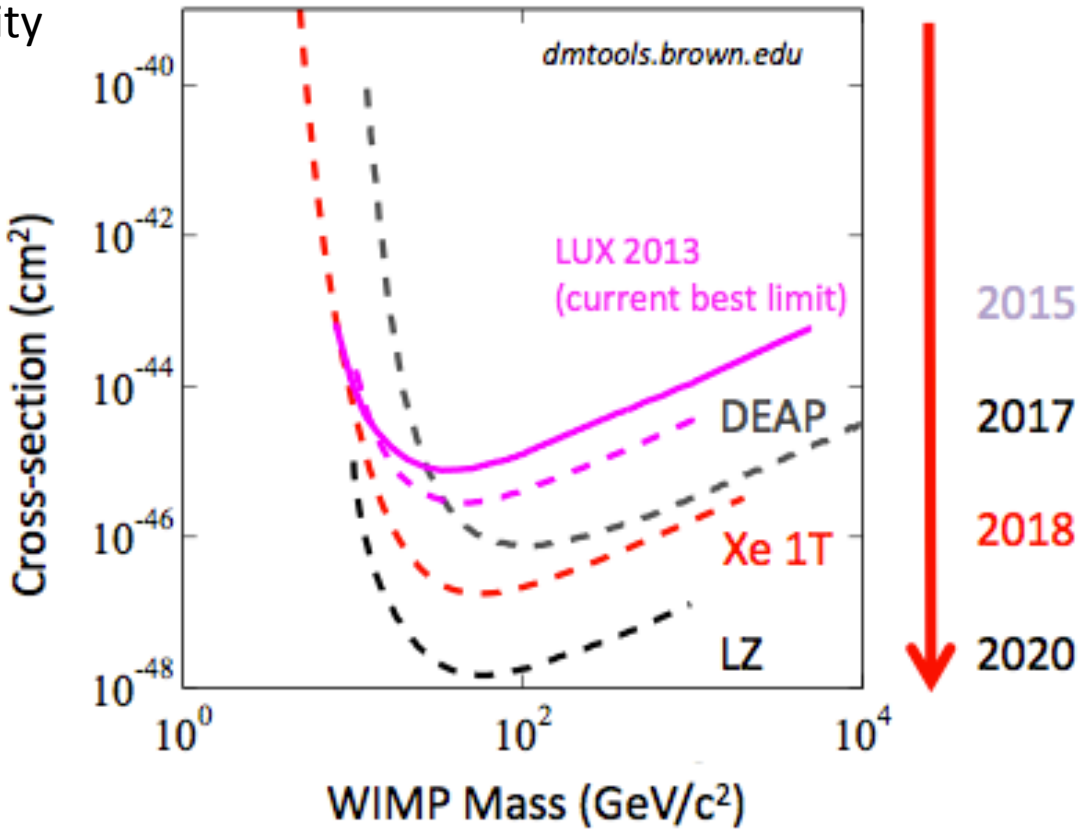
prompt window [-50,150ns]

$F_{prompt} = E_{prompt} / E_{total}$



DEAP-3600 sensitivity

- extrapolation from DEAP-1 results
- begin physics run Oct 2014
- first results early 2015
- 1 year to exceed LUX final sensitivity
- 3 years: full sensitivity

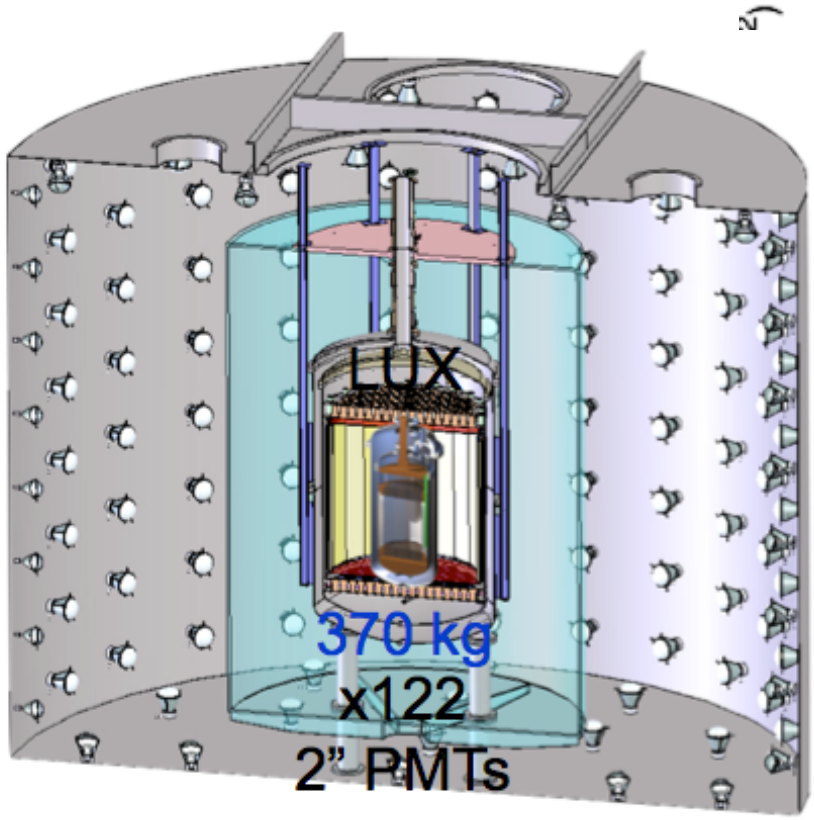


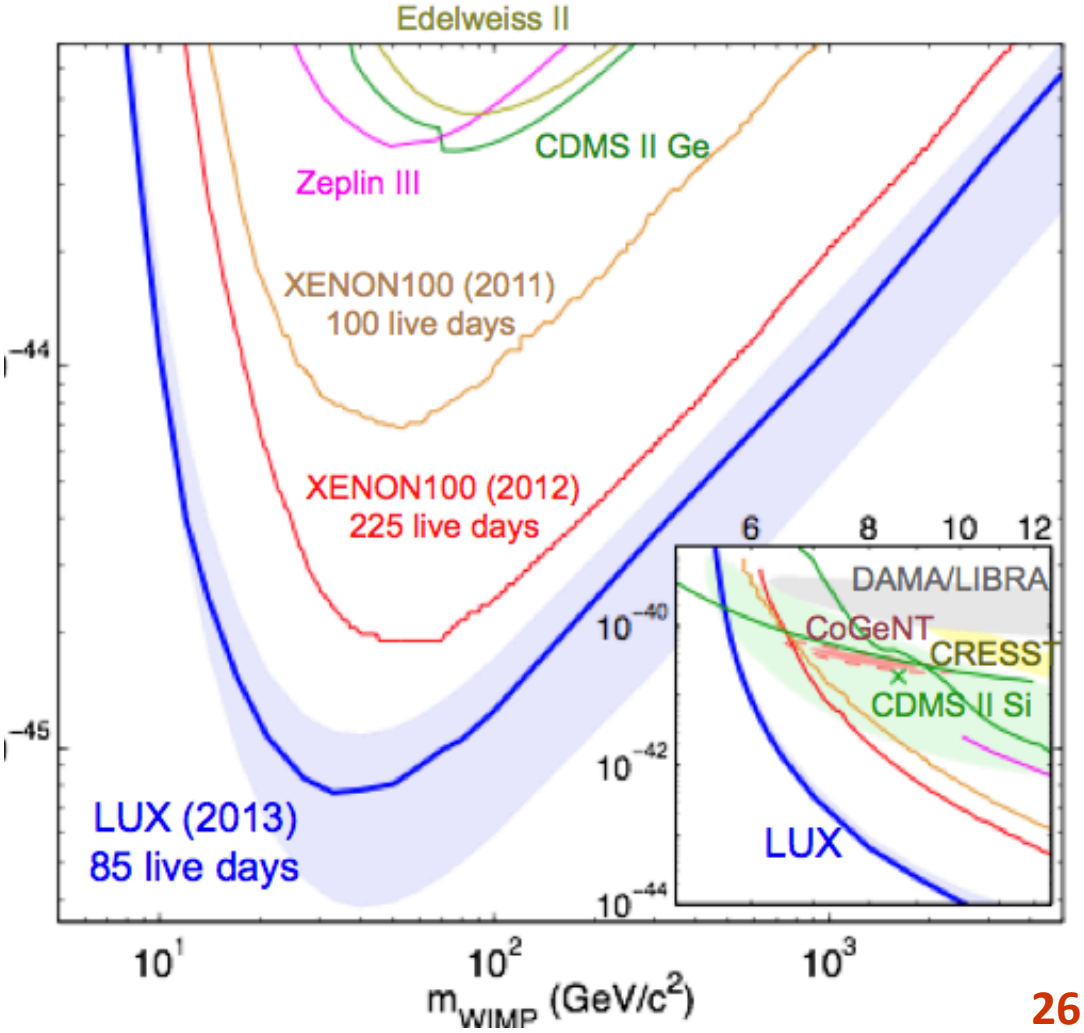
LUX

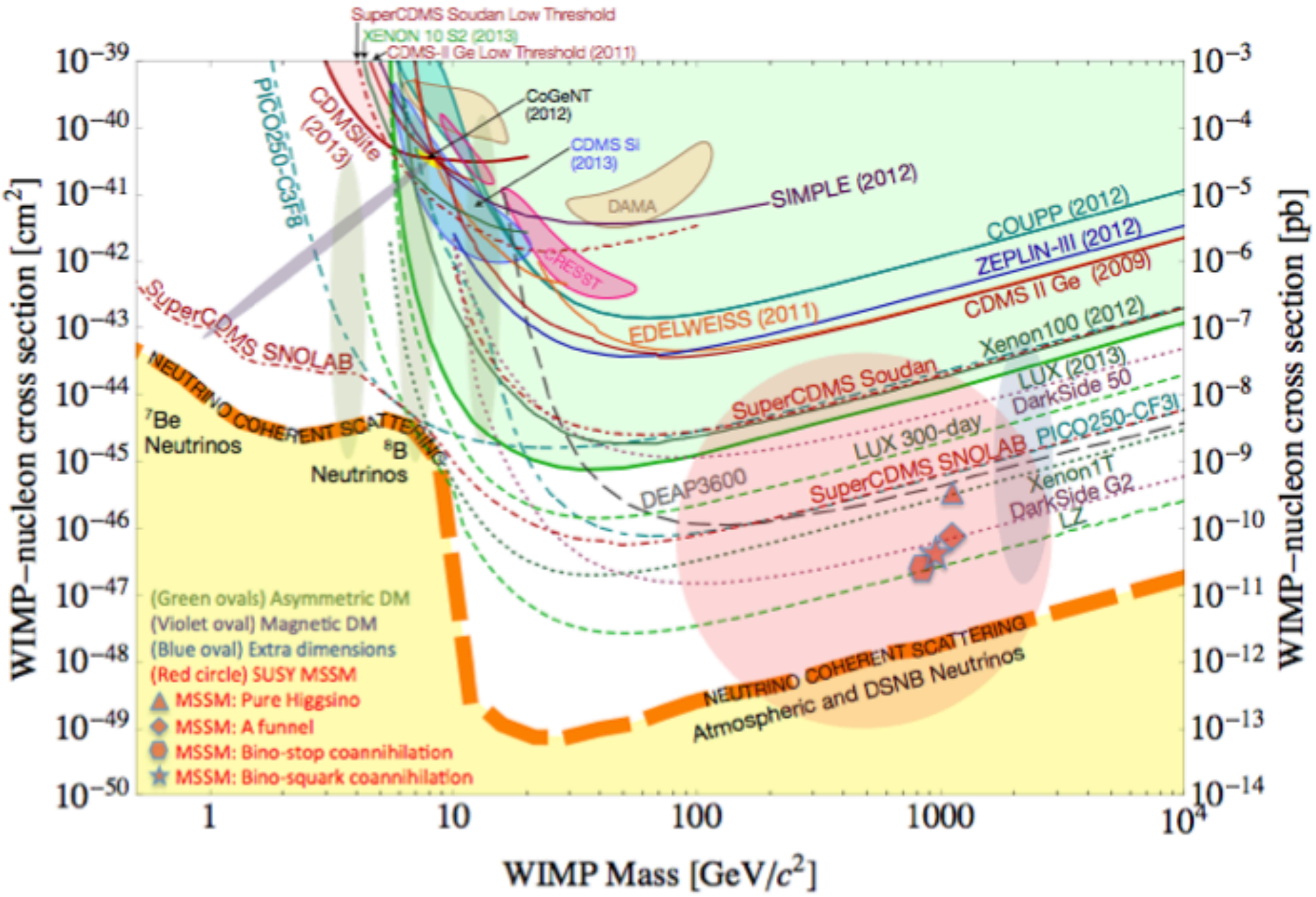
- 1/3 ton liquid xenon TPC
- with 85 days: best current results
- seminar on Friday

Carlos Hernandez Faham

LZ = 7 tons, 482 3” PMTs



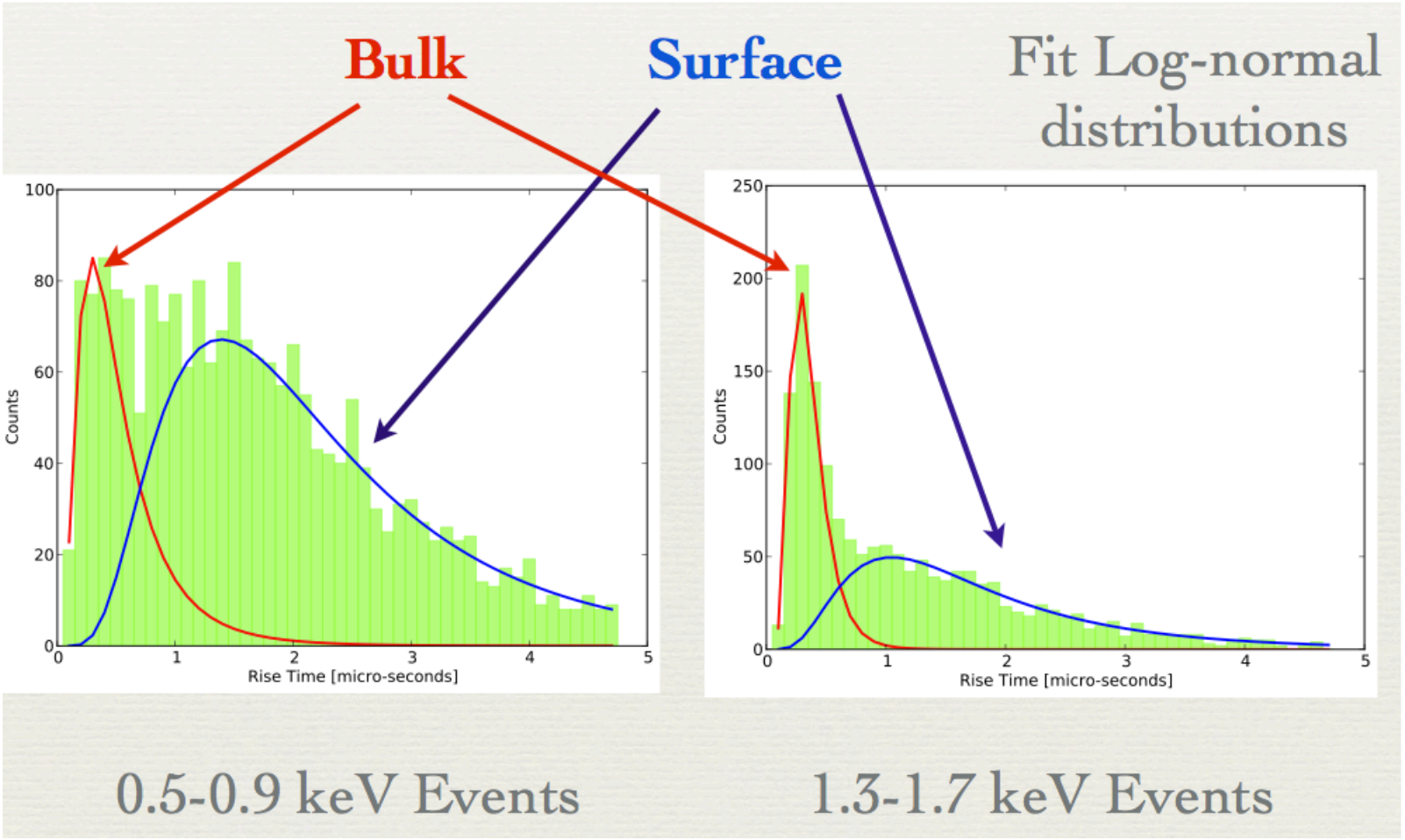



SuperCDMS Soudan Low Threshold
XENON 10 S2 (2013)
CDMS-II Ge Low Threshold (2011)
CoGeNT (2012)
CDMSlite (2013)
CDMS Si (2013)
DAMA
SIMPLE (2012)
CRESST
COUPP (2012)
ZEPLIN-III (2012)
CDMS II Ge (2009)
EDELWEISS (2011)
Xenon100 (2012)
SuperCDMS Soudan
LUX (2013)
DarkSide 50
LUX 300-day
PICO250-CF3I
SuperCDMS SNOLAB
DEAP3600
Xenon1T
DarkSide G2
LZ
PICO250-C3F8
SuperCDMS SNOLAB
NEUTRINO COHERENT SCATTERING
7Be Neutrinos
8B Neutrinos
(Green ovals) Asymmetric DM
(Violet oval) Magnetic DM
(Blue oval) Extra dimensions
(Red circle) SUSY MSSM
MSSM: Pure Higgsino
MSSM: A funnel
MSSM: Bino-stop coannihilation
MSSM: Bino-squark coannihilation
NEUTRINO COHERENT SCATTERING
Atmospheric and DSNB Neutrinos
WIMP–nucleon cross section [cm²]
WIMP–nucleon cross section [pb]
WIMP Mass [GeV/c²]
10⁻³⁹
10⁻⁴⁰
10⁻⁴¹
10⁻⁴²
10⁻⁴³
10⁻⁴⁴
10⁻⁴⁵
10⁻⁴⁶
10⁻⁴⁷
10⁻⁴⁸
10⁻⁴⁹
10⁻⁵⁰
10⁻³
10⁻⁴
10⁻⁵
10⁻⁶
10⁻⁷
10⁻⁸
10⁻⁹
10⁻¹⁰
10⁻¹¹
10⁻¹²
10⁻¹³
10⁻¹⁴
1
10
100
1000
10⁴

independent analysis of CoGeNT

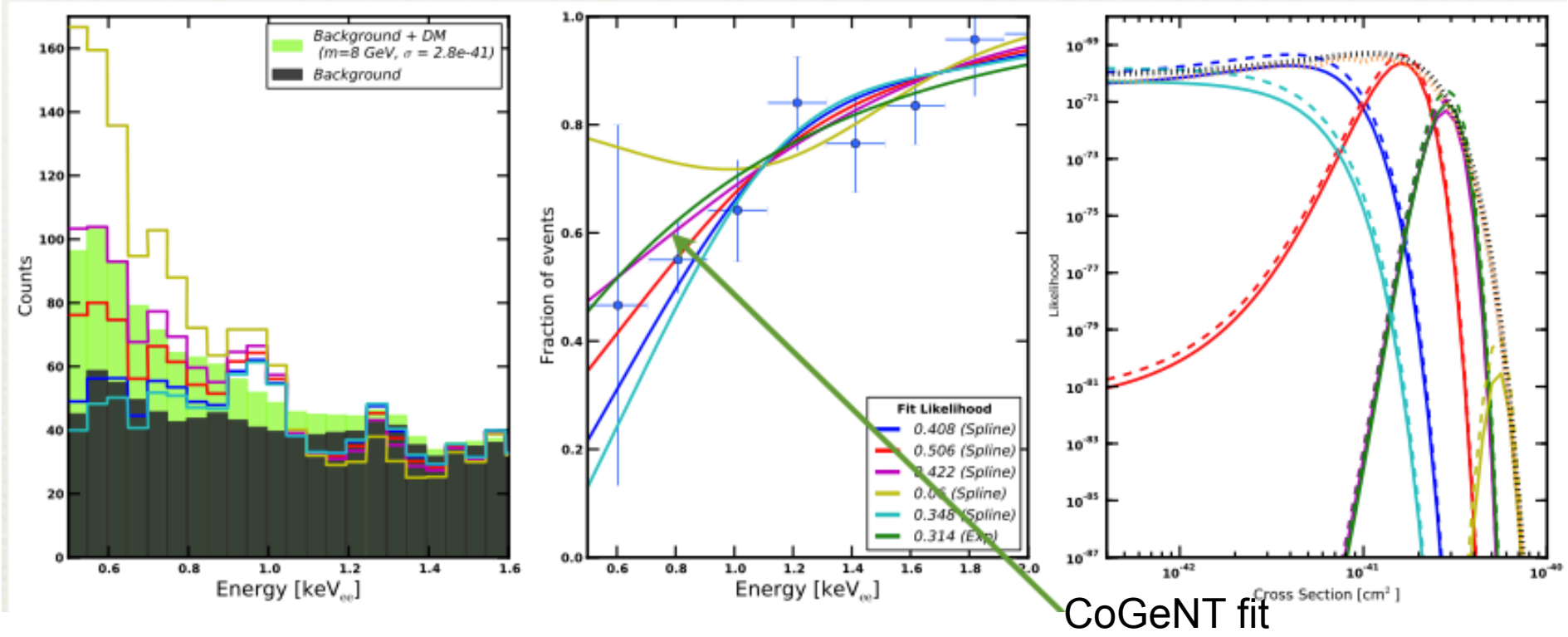
- result very sensitive to event fraction: bulk / (bulk + surface)

Jonathan Davis

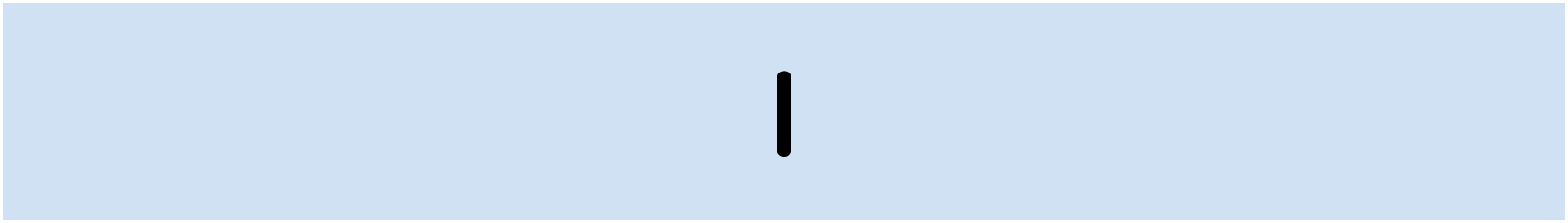


independent analysis of CoGeNT

- result very sensitive to : bulk events / (bulk + surface)



- the blue fits result in no DM signal
- marginalizing over the choice of the fit -> no significant signal



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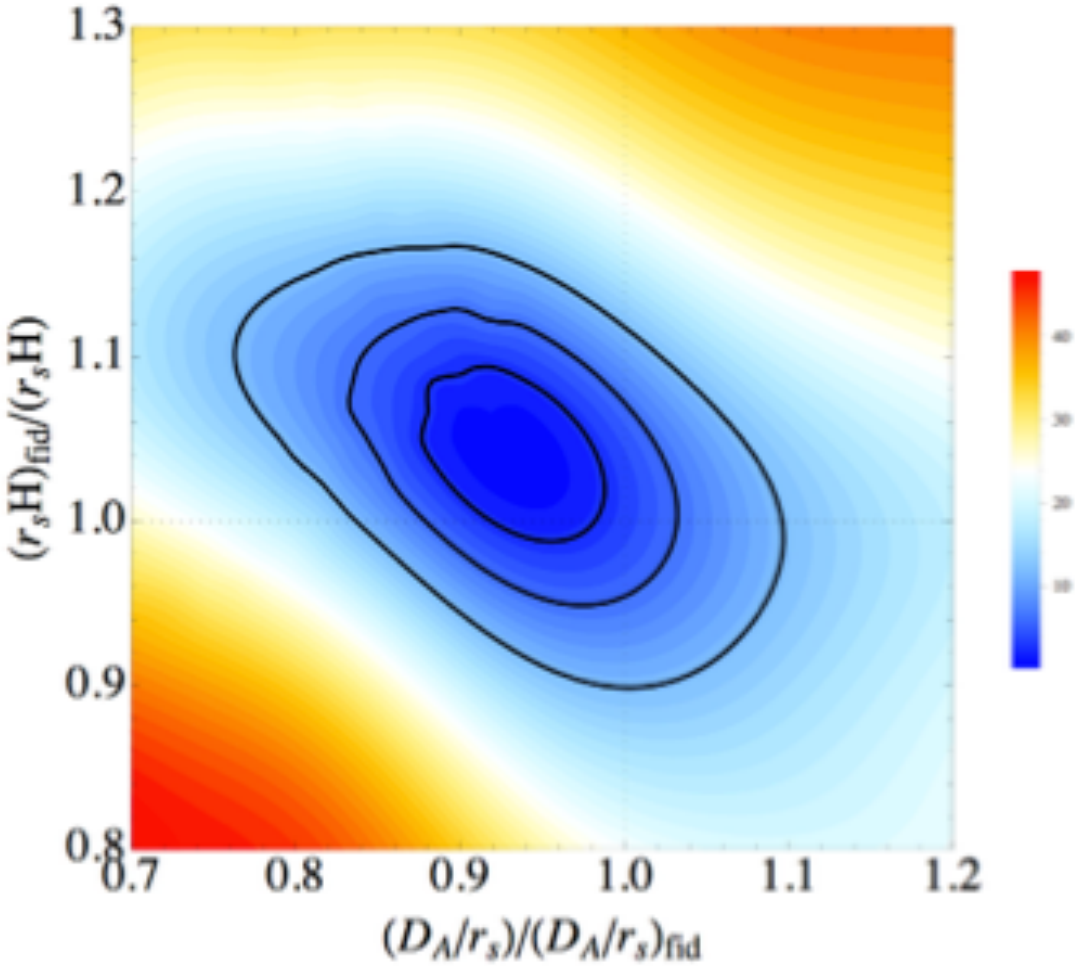
Lyman α forest – Quasar

- cross correlation between Lyman α forest and Quasars (Font-Ribera et al.)
- sensitivity close to Lyman α auto-correlation