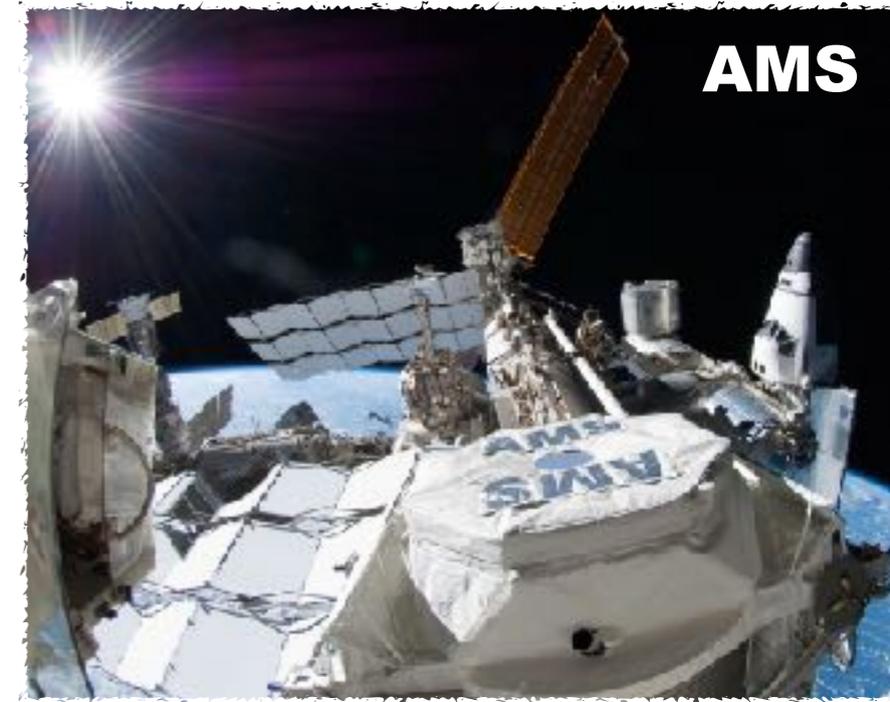




Planck

- the sky freely provides the particules :
“the Universe is our lab”
- access to huge energy phenomena,
large scale gravitation
- LAPP, LAPTh, LPSC, LSM largely
implied



AMS



NIKA2 @ 30m IRAM



Virgo

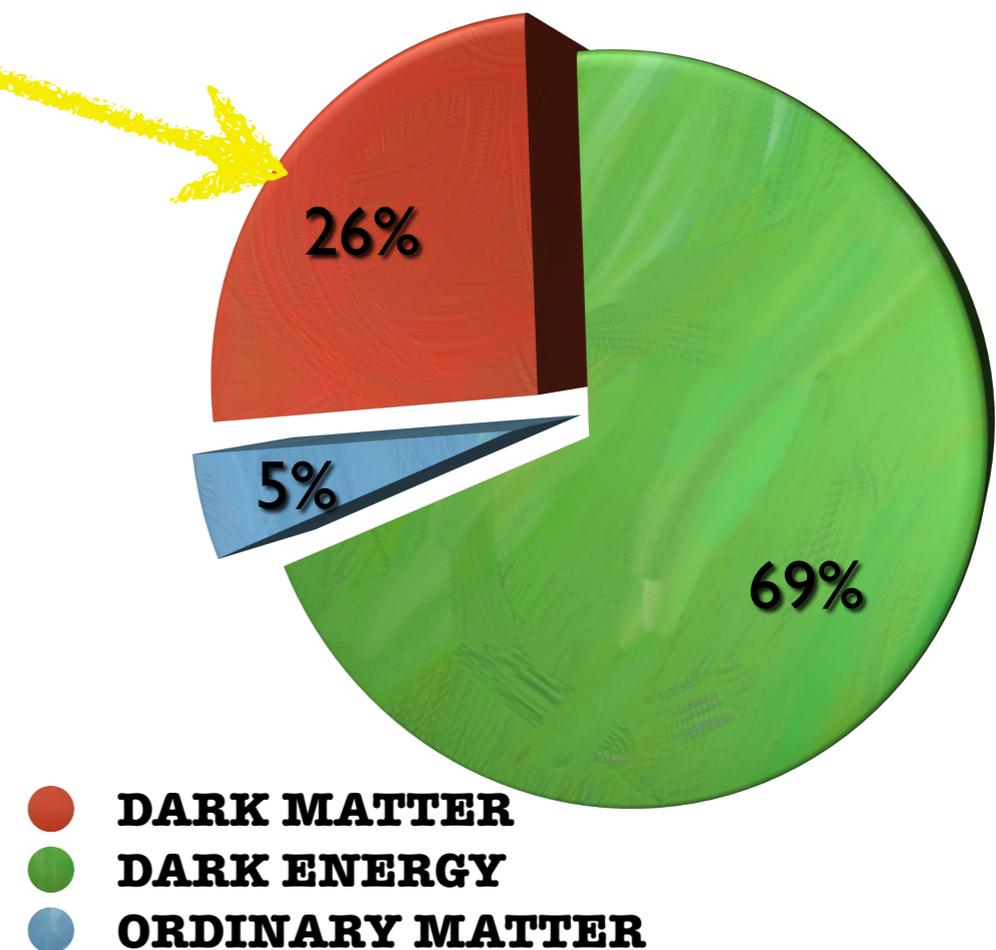


HESS

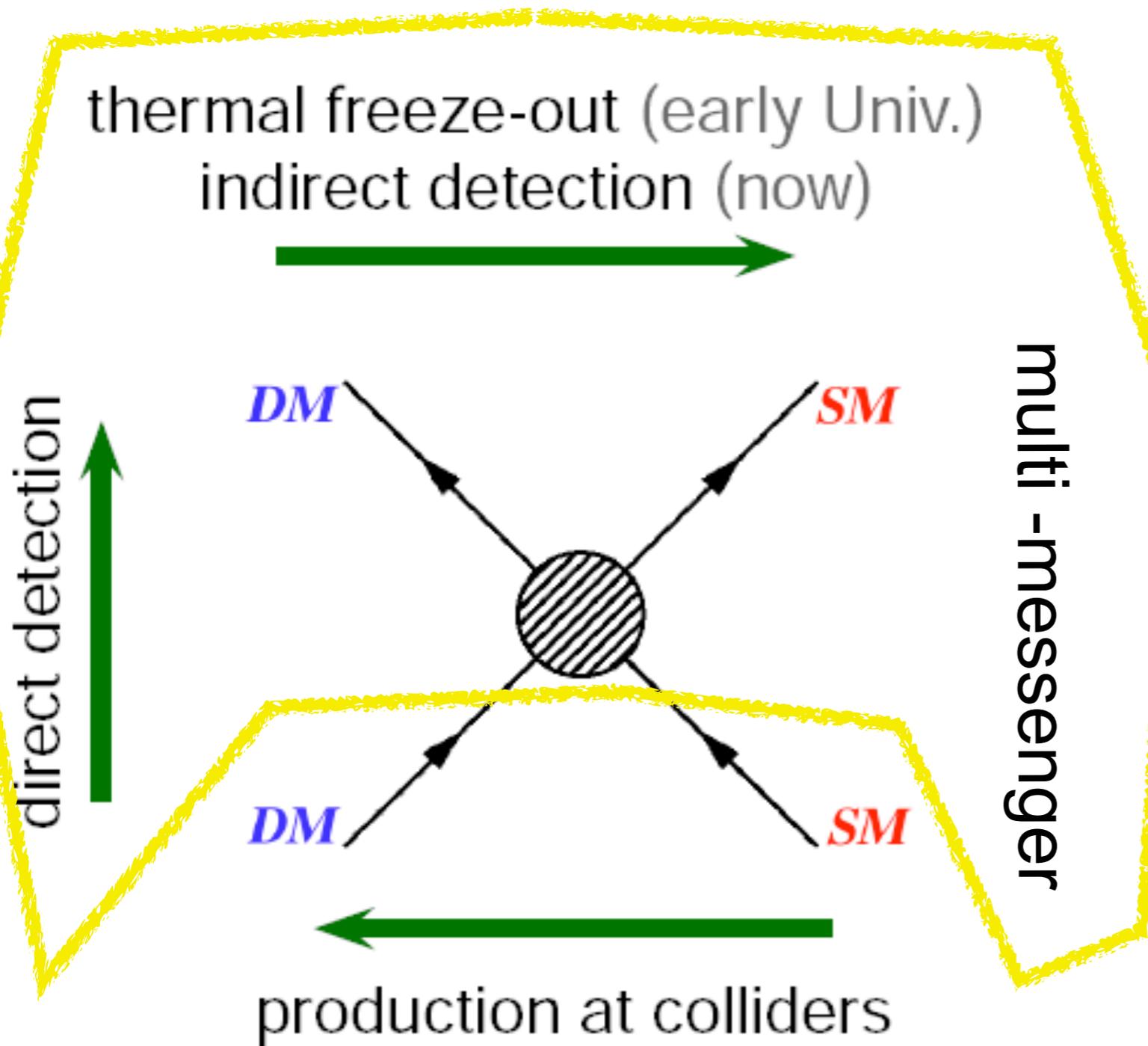
Dark matter

All Enigmass experiments have something to say about the puzzling DM problem.

Plank Collaboration (2016)

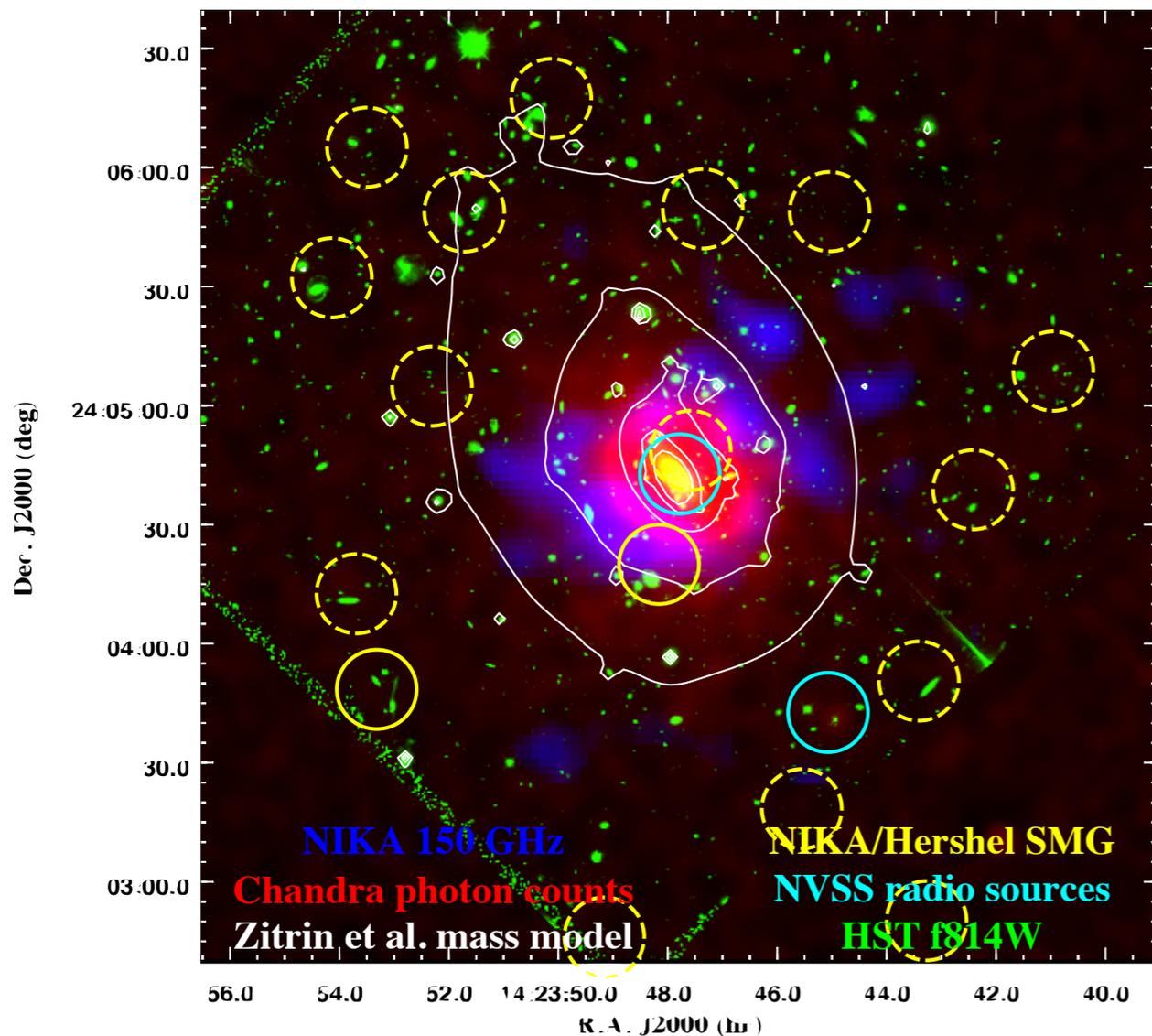


CMB + BAO



Dark matter: where is it ?

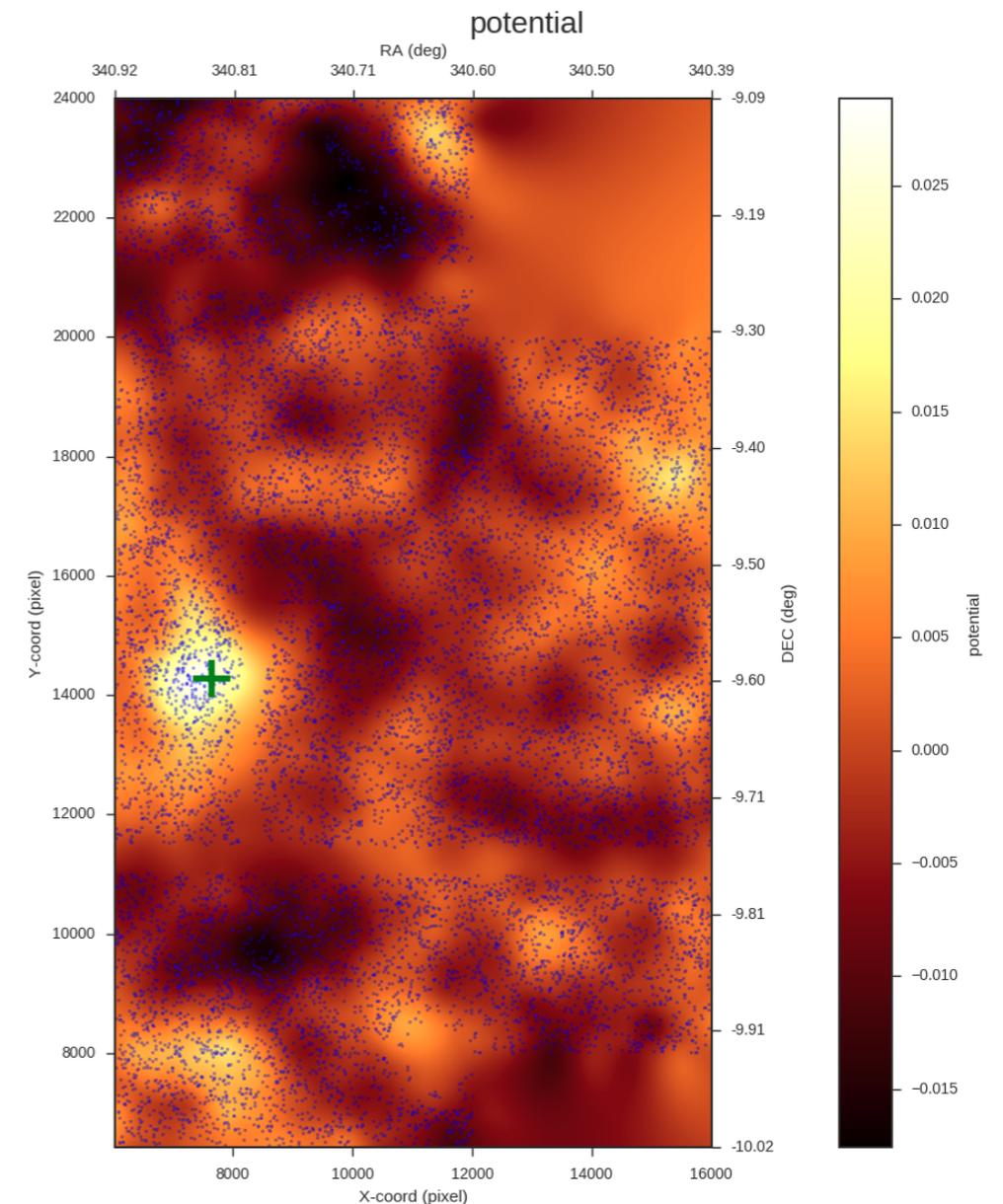
clusters of galaxies with Planck,
NIKA, NIKA2, KISS, Euclid (LPSC)
+LSST (LAPP, LPSC)



Joint reconstruction of the intracluster medium electronic pressure and density by combining NIKA, Planck, XMM-Newton and Chandra data [Adam et al. arXiv:1510.06674](https://arxiv.org/abs/1510.06674)

lensing & LSS with LSST (LAPP, LPSC)

MACSJ2243.3-0935

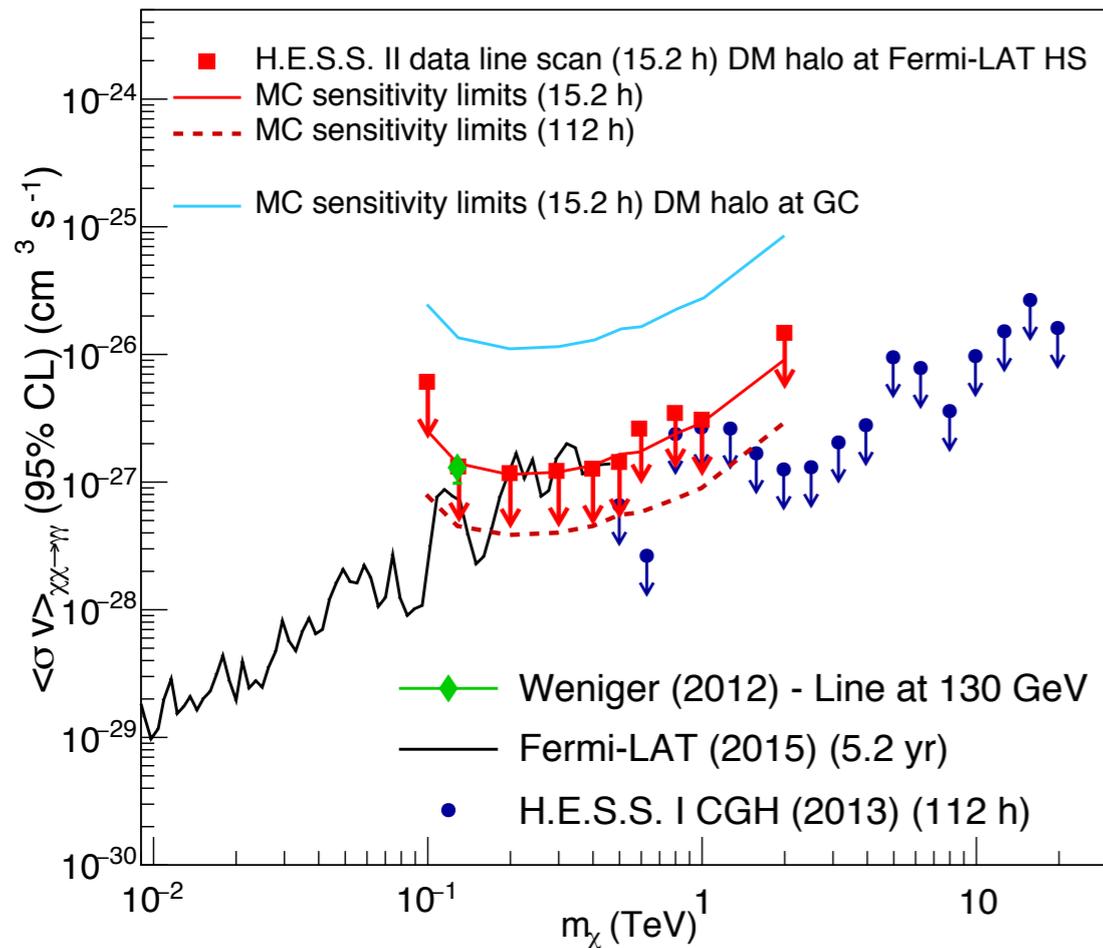


Reconstruction of the matter gravitational potential using the shear. Work using CFHT data processed with the LSST stack (LAPP, LPSC)

Dark matter: what is it ?

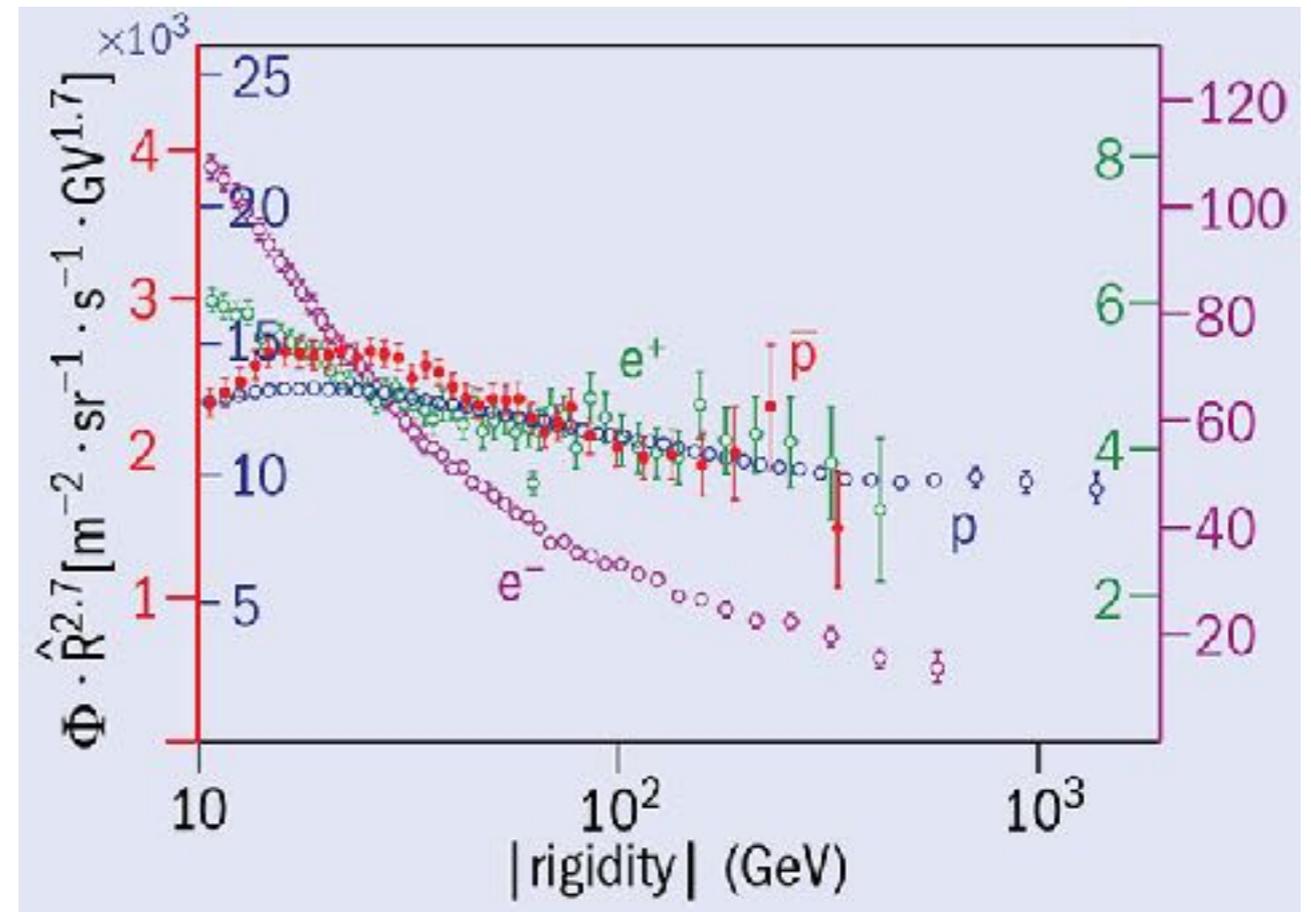
indirect detection with photons with **HESS**
then with **CTA** (LAPP)

gamma and cosmic-rays background
understanding (LAPP/LAPTh/LPSC)



$\langle\sigma v\rangle$ limit at 95% CL for the line scan between 100 GeV and 2 TeV using H.E.S.S. and H.E.S.S.II data + CLUMPY package. astro-ph 1609.08091

AMS measurements of electron, positron, proton and antiproton



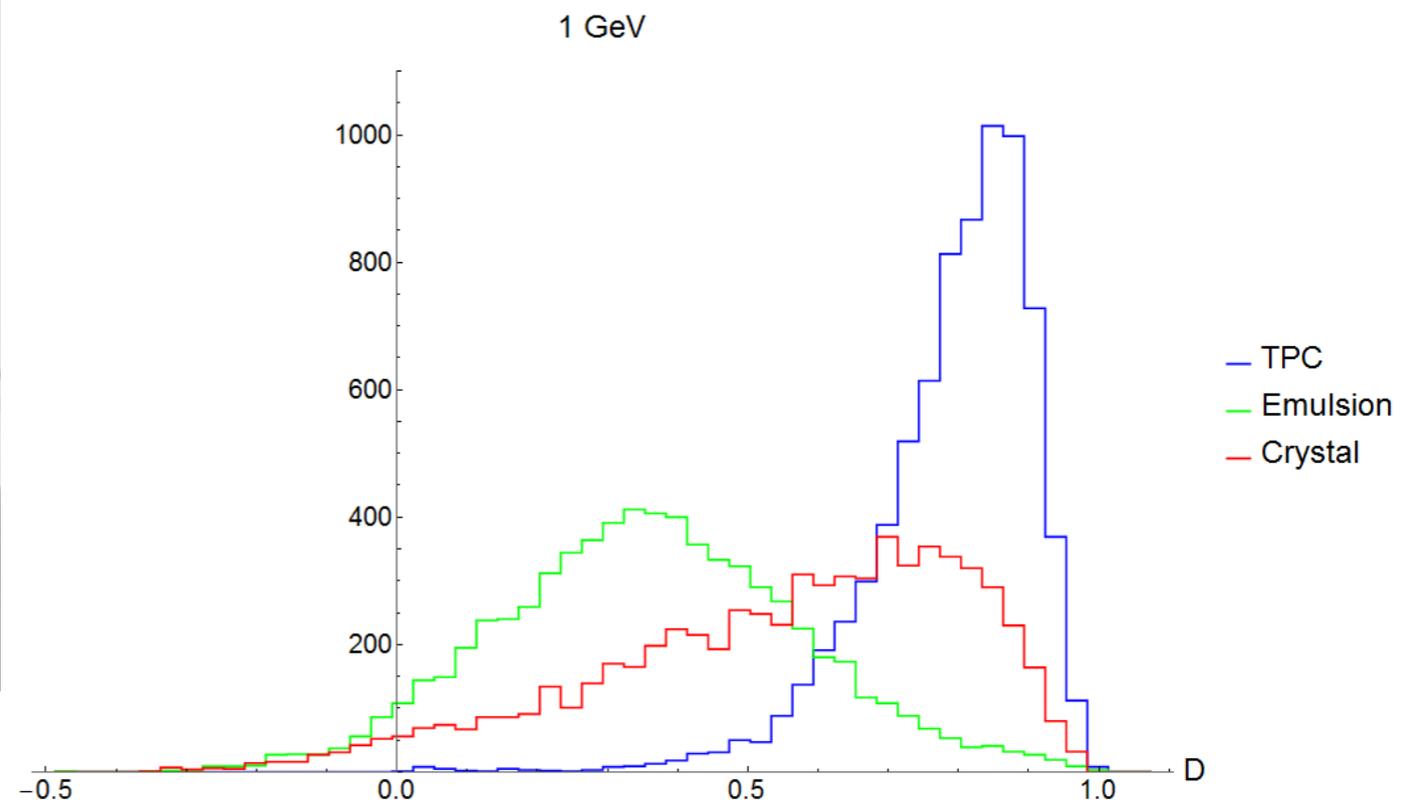
The measured fluxes of elementary particles multiplied by $|R|^{2.7}$. The fluxes show different behaviour at low rigidities, while at $|R|$ above ~ 60 GV the functional behaviour of the antiproton, proton and positron fluxes are nearly identical and distinctly different from the electron flux.

Dark matter: what is it ?



R&D Instrumental development installed in Modane
Possibility to have the full detector in China

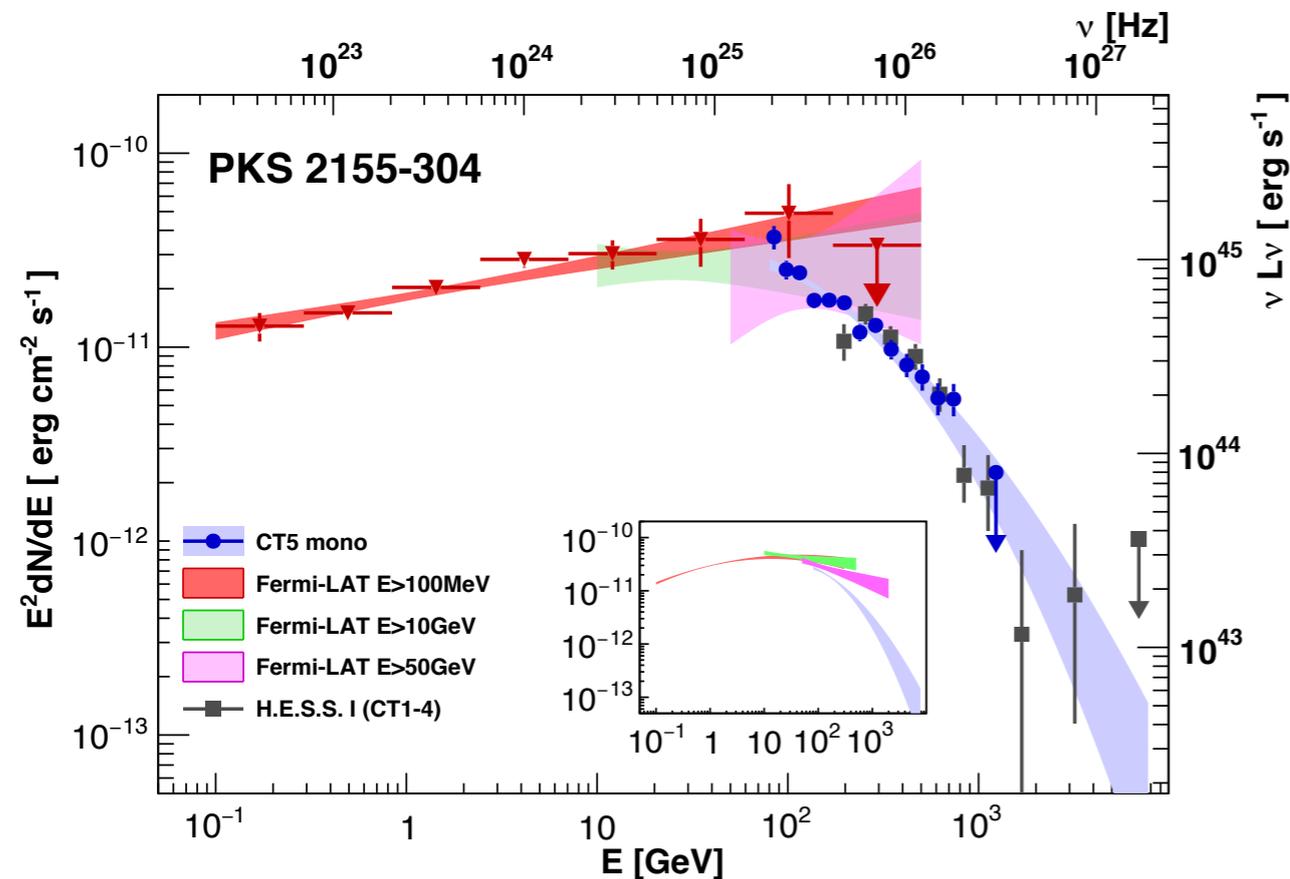
direct detection with MIMAC/Cygnus
(LPSC / LSM) $1m^3$, toward $50m^3$



Comparison of the **directionality** D for the 3 strategies: gaseous TPC in blue, crystal in red, emulsion in green for a WIMP of $1 \text{ GeV}/c^2$. Simulations of the recoils in the different detector materials lead to higher D values for a gaseous TPC (id for 10, 100, 100 GeV WIMP).
astro-ph 1607.08157

Extreme state of the matter

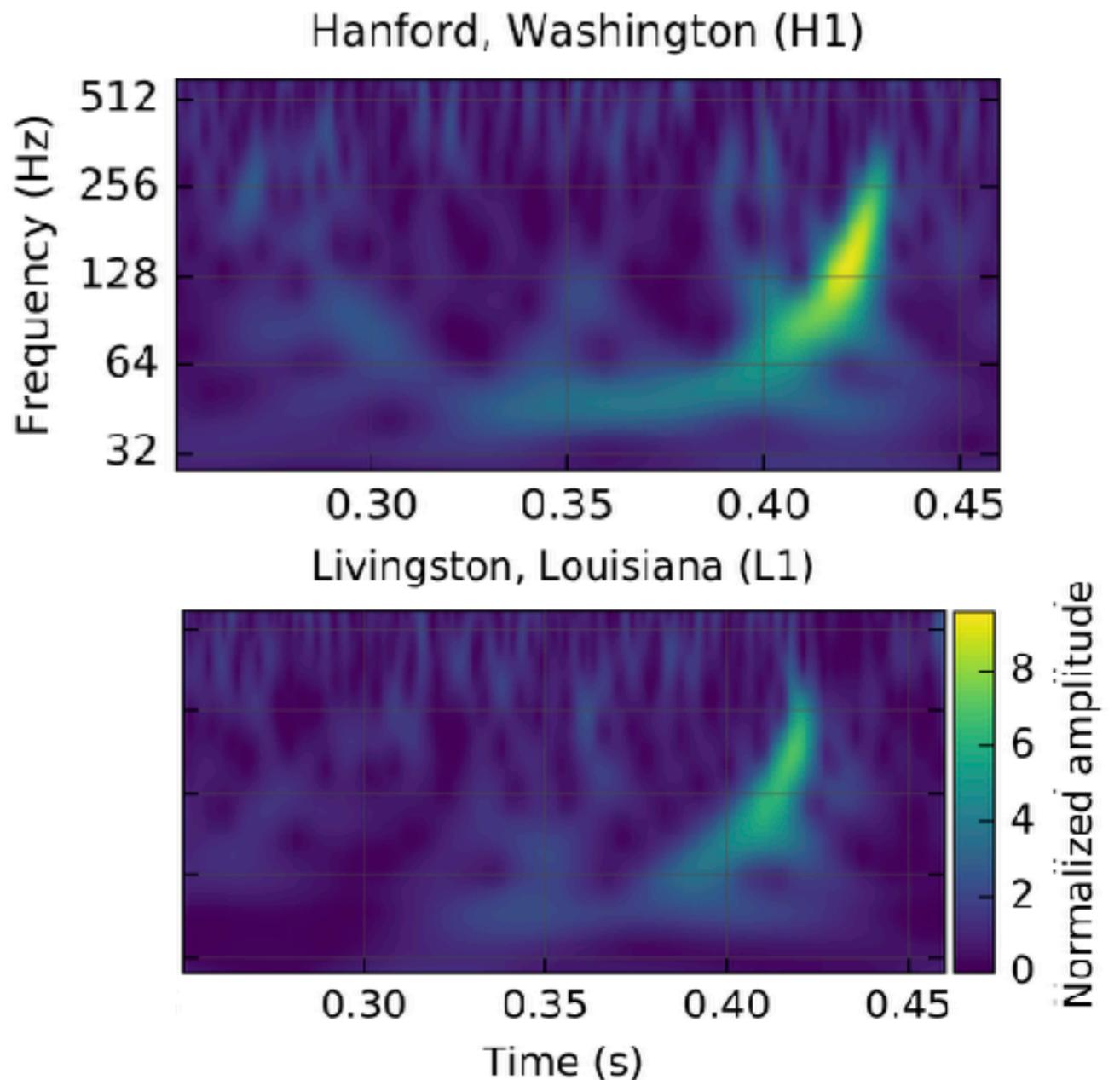
Active Galactic Nuclei with **CTA** (LAPP)



The energy spectrum of PKS 2155–304 obtained from the H.E.S.S. II mono analysis in comparison with the contemporaneous Fermi-LAT data with an energy threshold of 0.1, 10 and 50 GeV and contemporaneous CT1–4 data. In all cases the confidence bands represent the 1 σ region. The right-hand y-axis shows the equivalent isotropic luminosity (not corrected for beaming or EBL absorption).

astro-ph/1612.01511

Black holes and neutron stars with **AdVirgo**



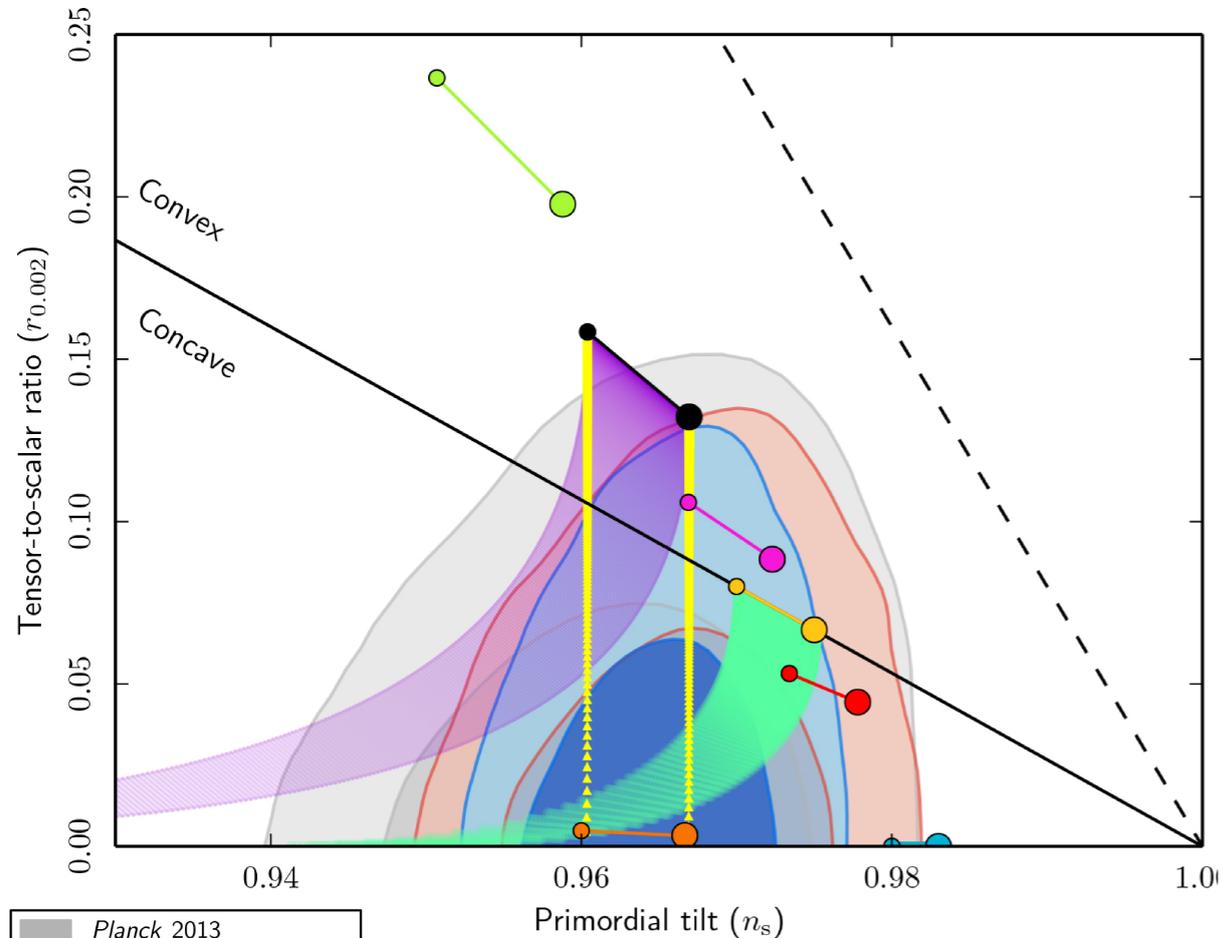
Virgo is now taking data (reduced sensitivity).

The LAPP Virgo team was involved in the data analysis of the events detected by the LIGO detectors.

The primordial Universe

Planck results

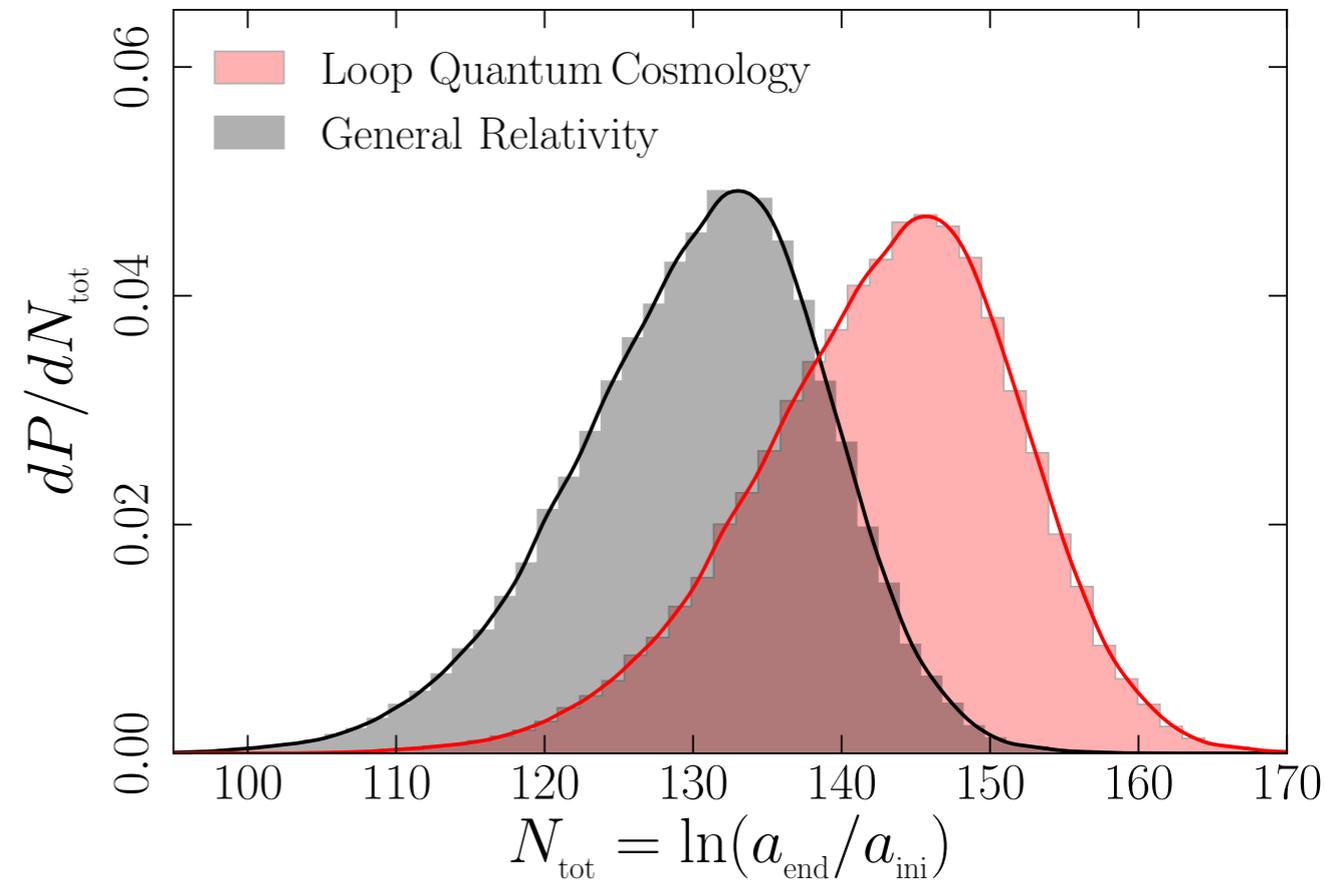
Inflation with CMB E4 (LPSC, LAPTh)



Marginalized joint 68% and 95% CL regions for n_s and r at $k = 0.002 \text{ Mpc}^{-1}$ from Planck compared to the theoretical predictions of selected inflationary models. aa25898-15

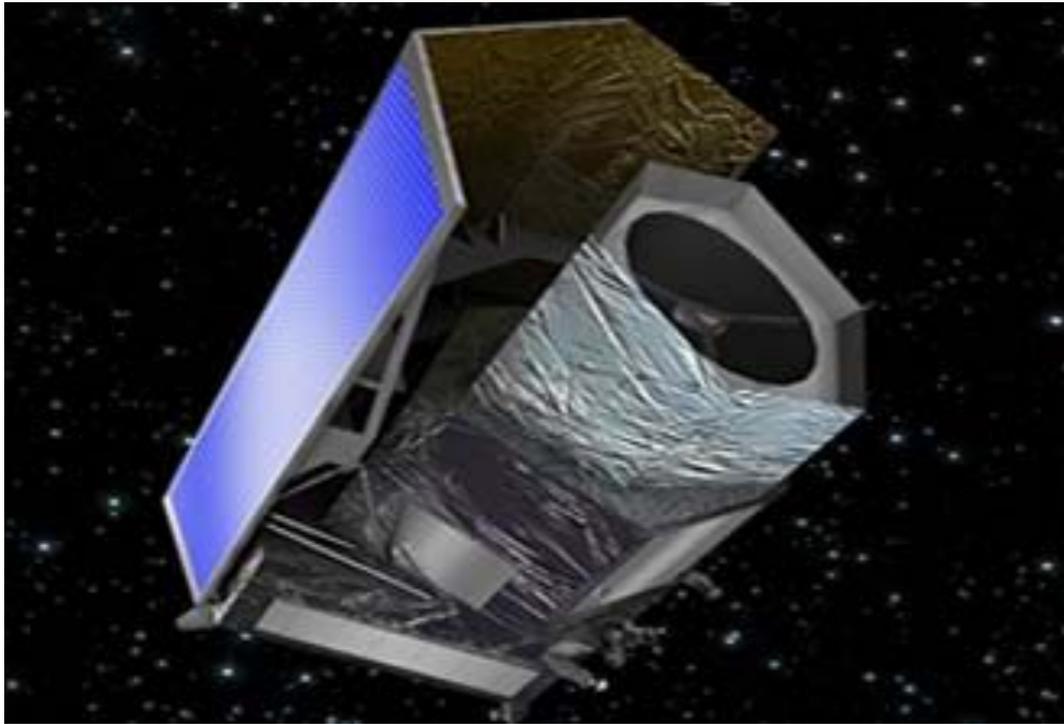
About 1/3 of inflation models discarded.

Loop quantum cosmology (LPSC)



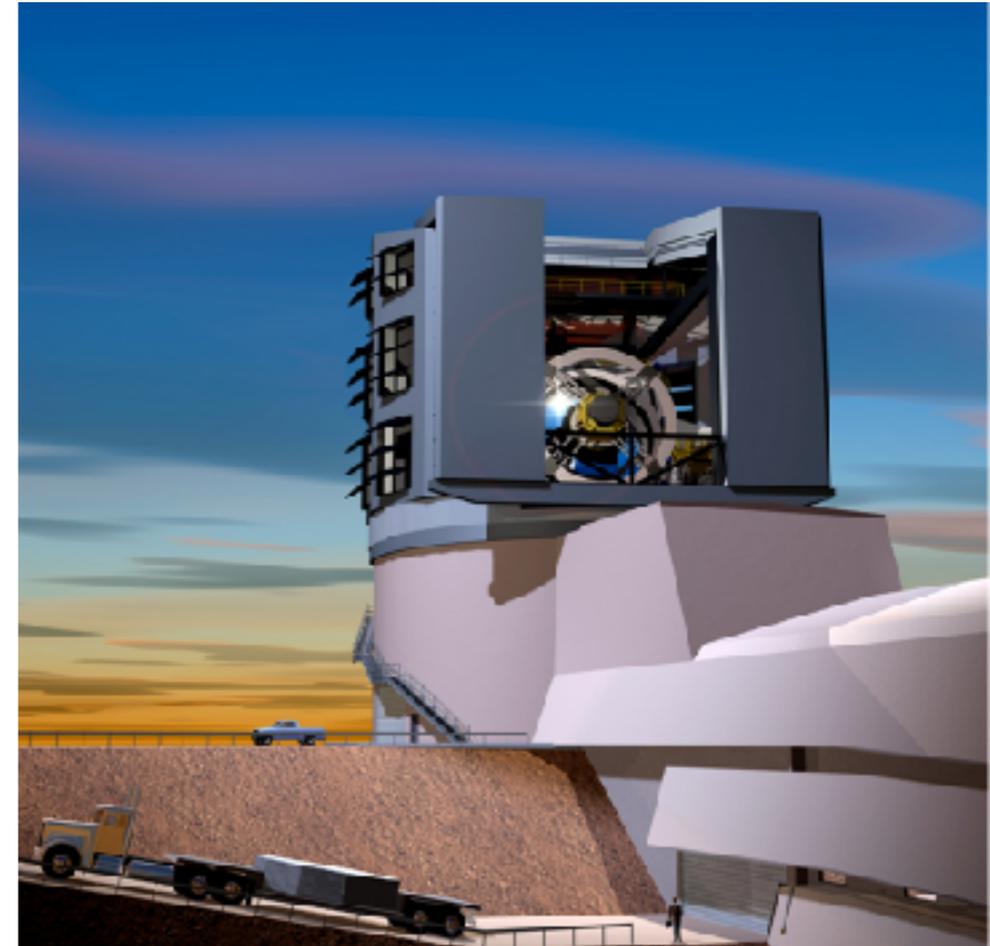
Probability distribution of the number of inflationary e-folds. The black histograms corresponds to a 'GR' like dynamics (using the standard Friedmann equation throughout the evolution). The red histogram is the prediction of loop quantum cosmology. arXiv:1701.02282

Almost ready new instruments

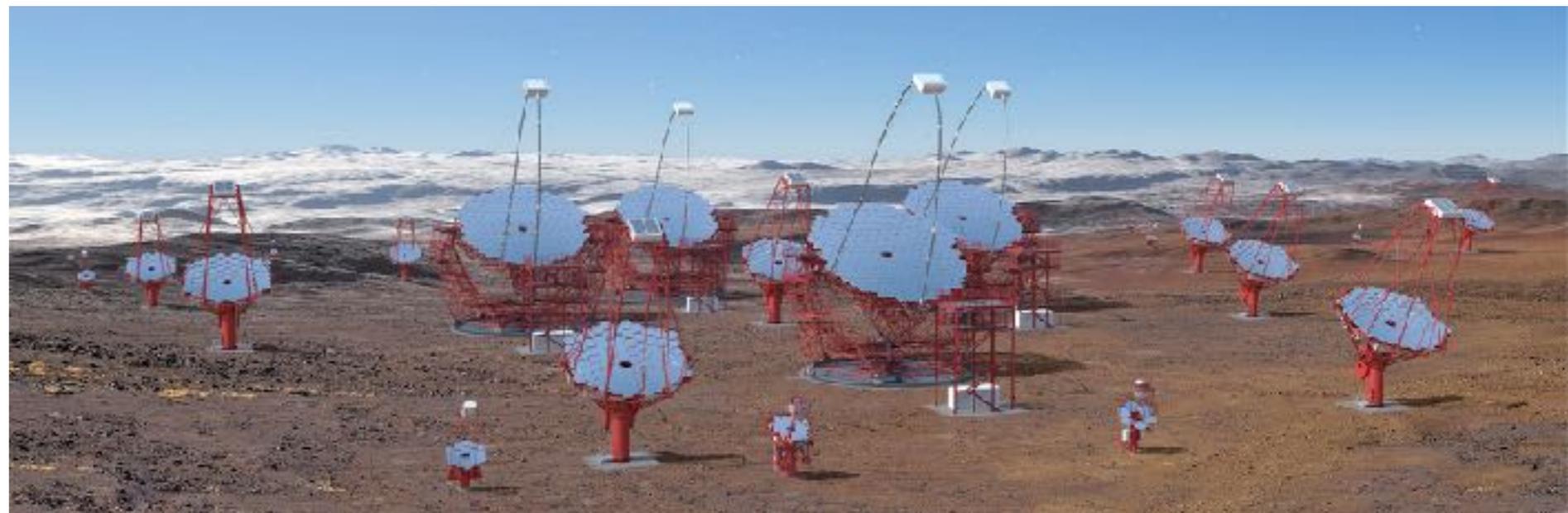


The **Euclid** satellite will map 15 000 deg² from space to “see” the dark matter distribution and constrain the DE equation of state.

The **Large Synoptic Survey Telescope** will map the whole visible sky during 10 years billions of stars and billions of galaxies with the biggest camera ever built.



The **Cherenkov Telescope Array** will be one order of mag. more sensitive, have an extended energy range, a better angular resolution and an improved capability to detect transient sources.

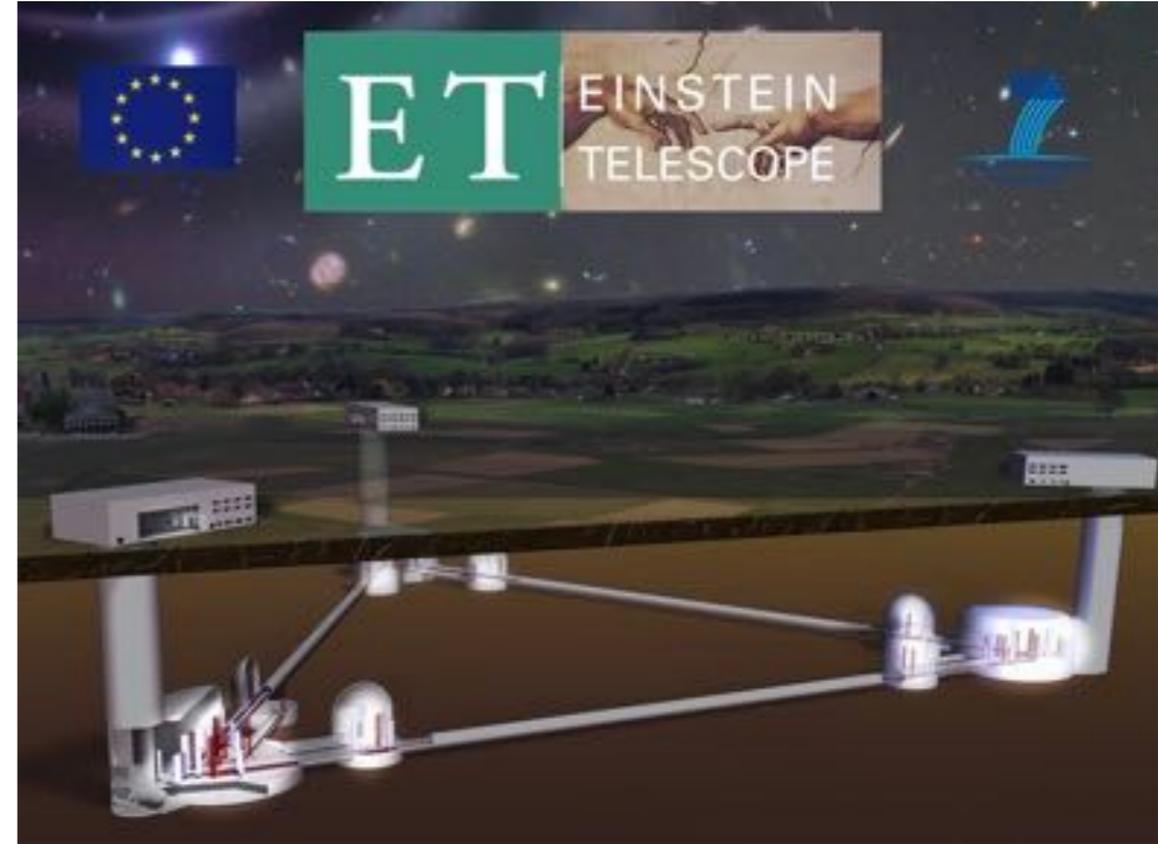


New or TBD in the EUR



Observatoire Pierre Auger detects showers produced by ultra-high energy cosmic particles. The network is currently improved by muon scintillators.

Contribution to study of the **Extreme state of the matter**



The **Einstein Telescope** is an FP7 funded design effort for a European third generation gravitational wave observatory, consisting of 3 underground interferometers with an arm length of each 10km.

E4: the European contribution to detect B-modes of the CMB from the ground. Design study (H2020 proposition), in the context of the Stage IV, led by the US.



Synthesis of astro/cosmo activities towards the EUR

	2012	2019	2029
CMB	Planck	NIKA / NIKA2	<i>E4</i>
galaxy survey	LSST	Euclid & LSST	
cosmic rays	AMS	Auger/Auger-Prime	
gamma photons	HESS/HESSII	CTA	
DM direct detection	MIMAC	MIMAC-Cygnus	
gravitational waves	Virgo	AdVirgo	<i>Einstein telescope</i>
<i>phenomenology</i>	dark matter & cosmic rays		
“	quantum gravity & cosmology		

yellow = 1 ENIGMASS lab
 green = 2 ENIGMASS labs
 blue = 1 ENIGMASS lab+ IPAG

it is only a scheme !