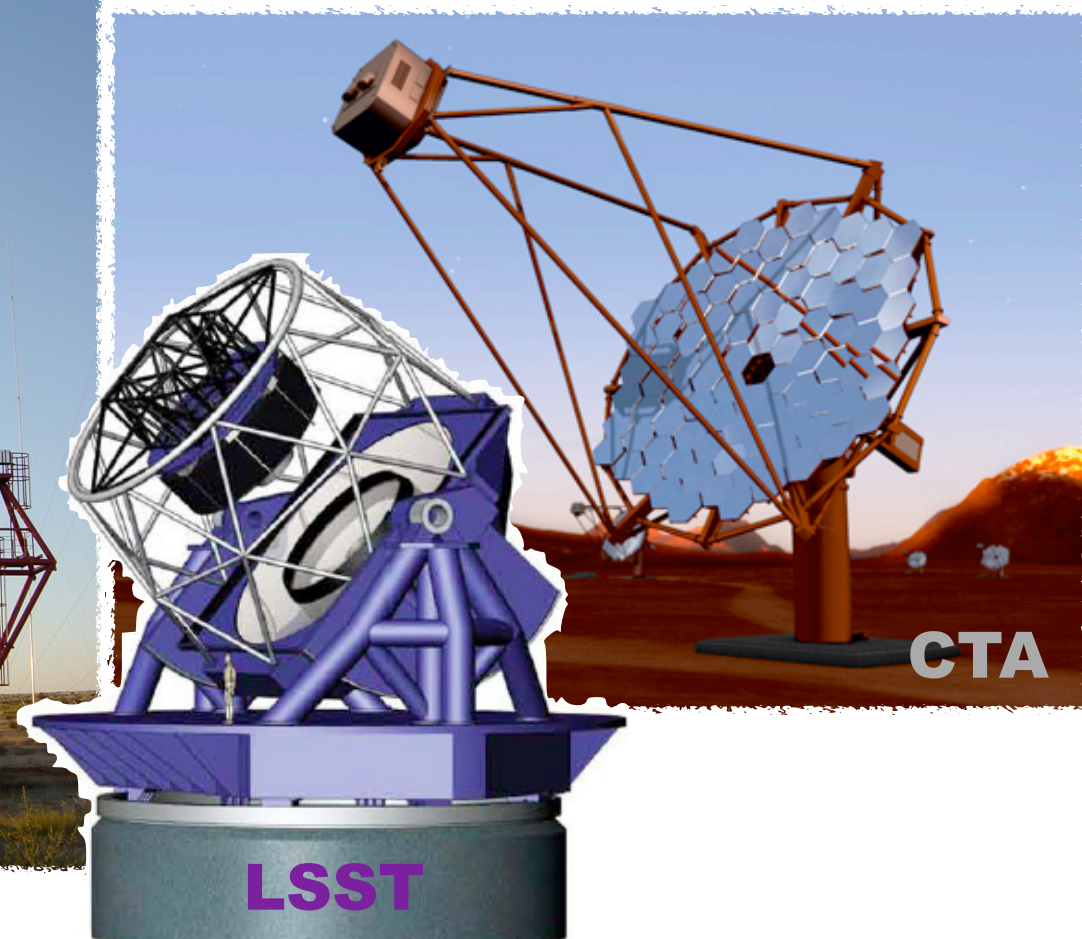
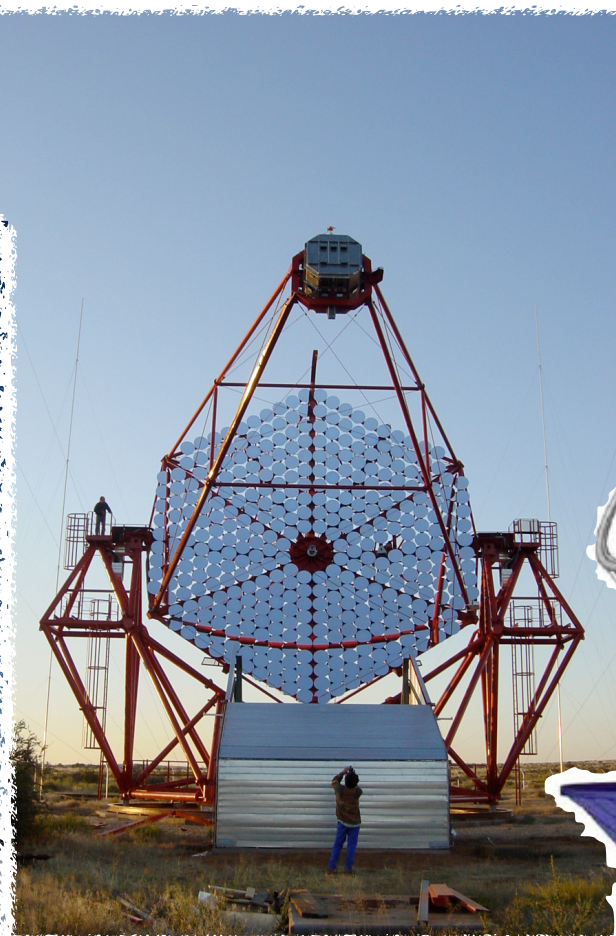
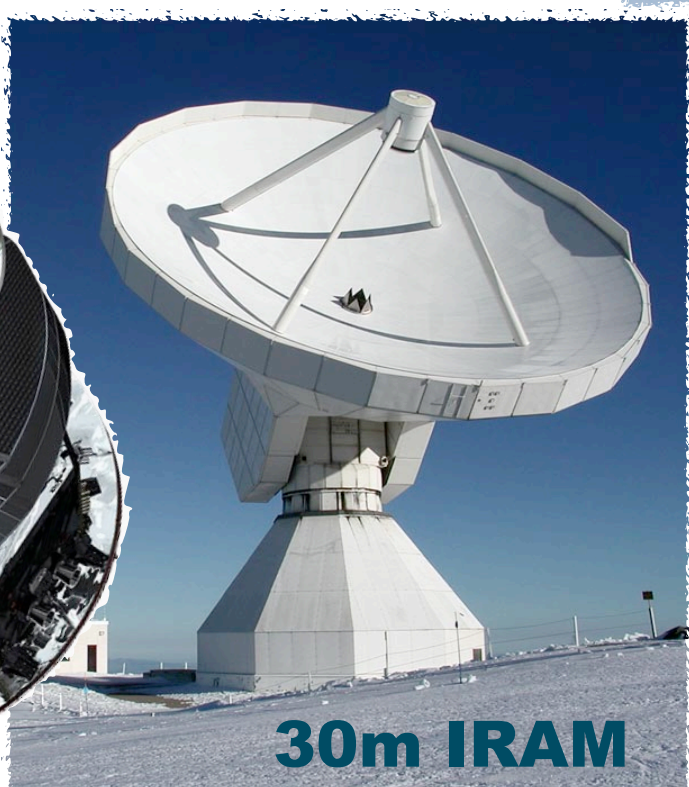
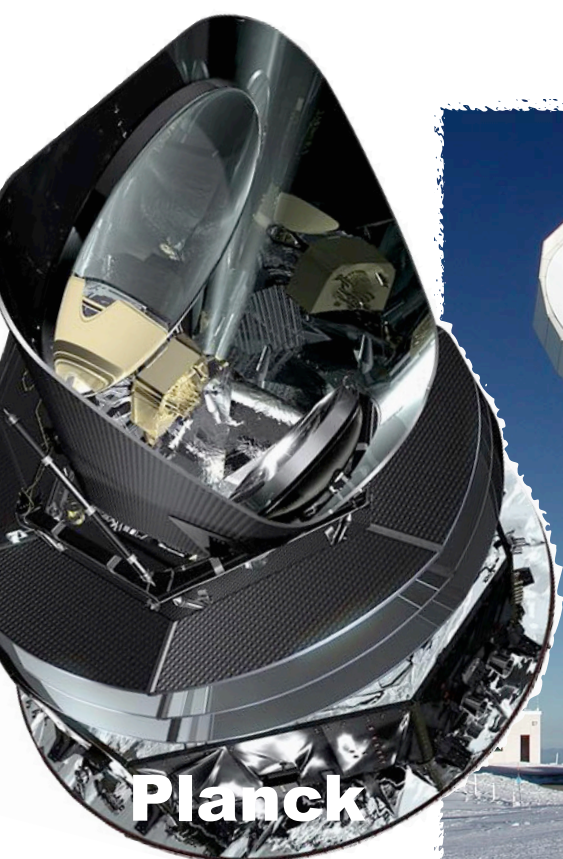


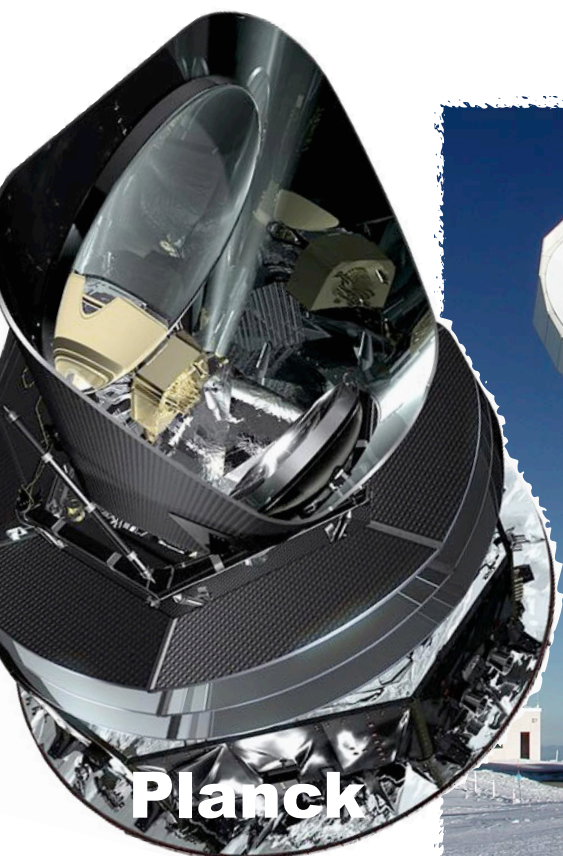
- the sky freely provides the particules : “the Universe is our lab”
- access to huge energy phenomena, large scale gravitation
- LAPP, LAPTh, LPSC, LSM largely implied



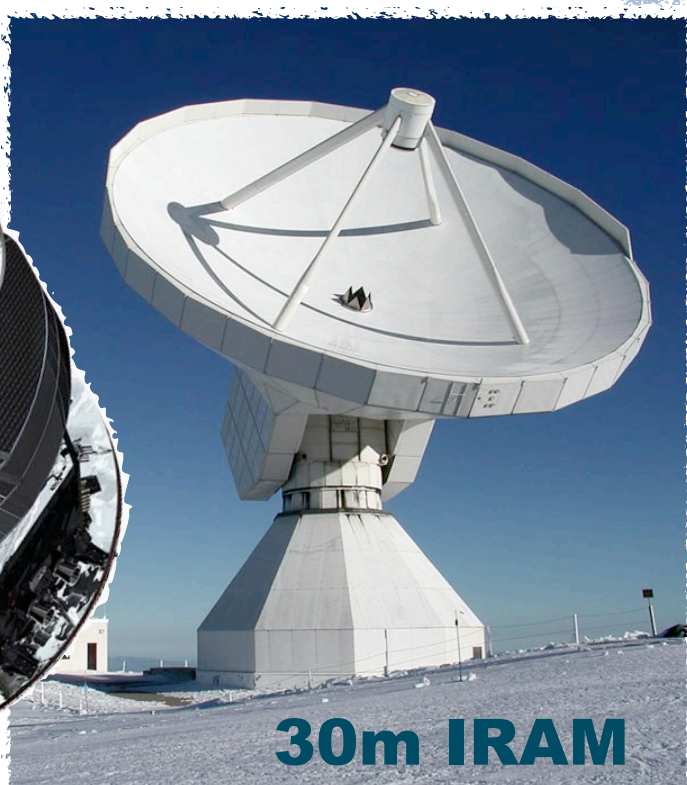
CTA

Summary

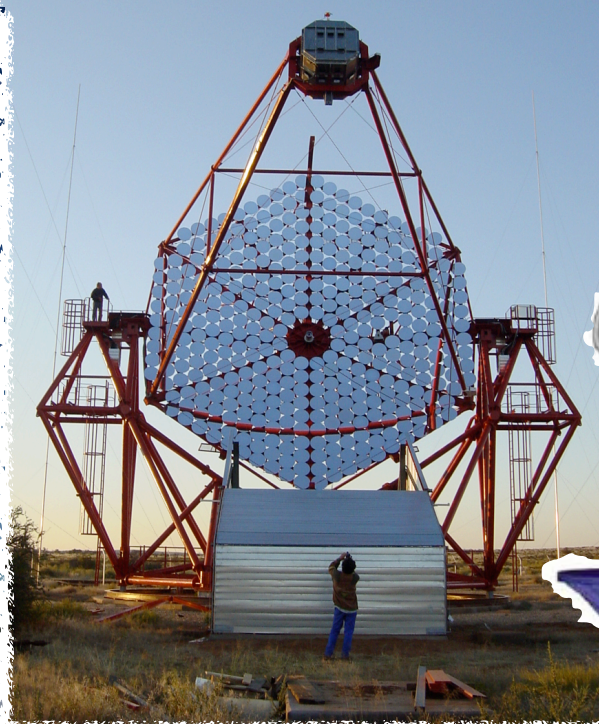
- **News from the Earth:** instrumental realizations in 2015
Some pictures of the LSM, MIMAC, NIKA2, LSST, VIRGO
- **News from the sky:** data analysis in 2015.
Some highlights from MIMAC, Edelweiss, AMS, HESS, Planck, NIKA, LSST, LQC (see Y. Genolini talk for pheno@LAPth)
- **News for the future:** MIMAC, LSST, CTA, VIRGO



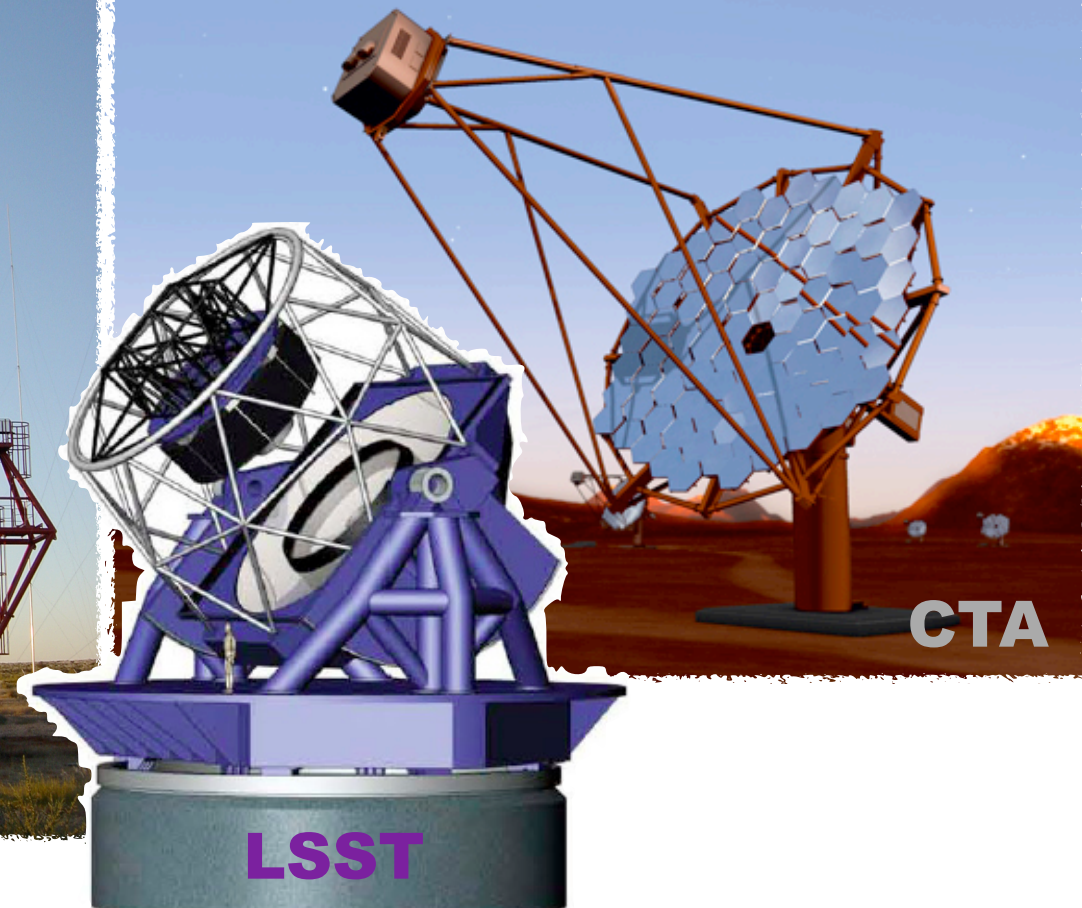
Planck



30m IRAM

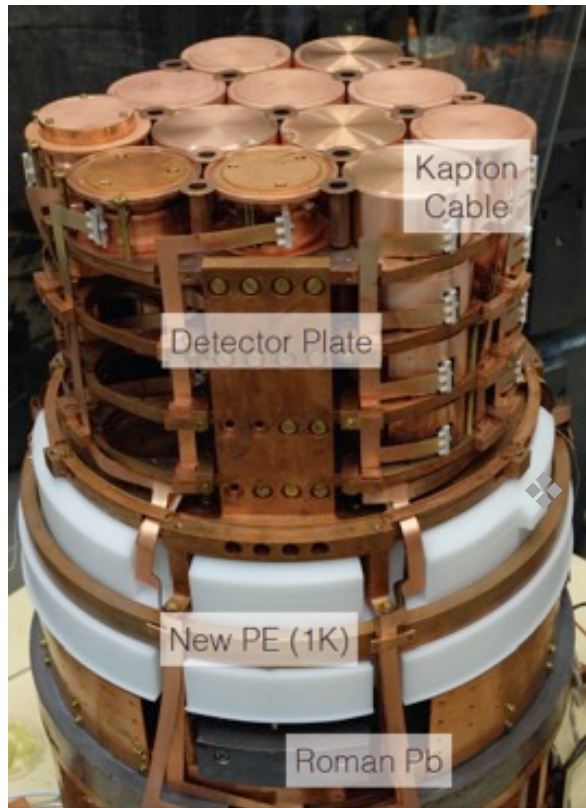


HESS

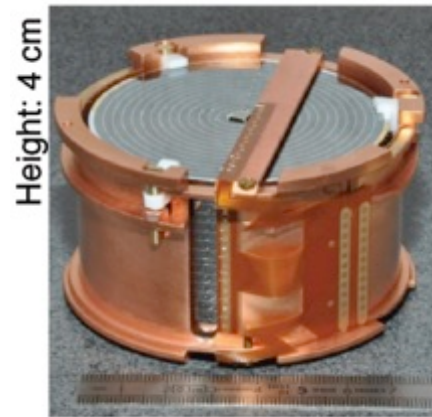


LSST

CTA



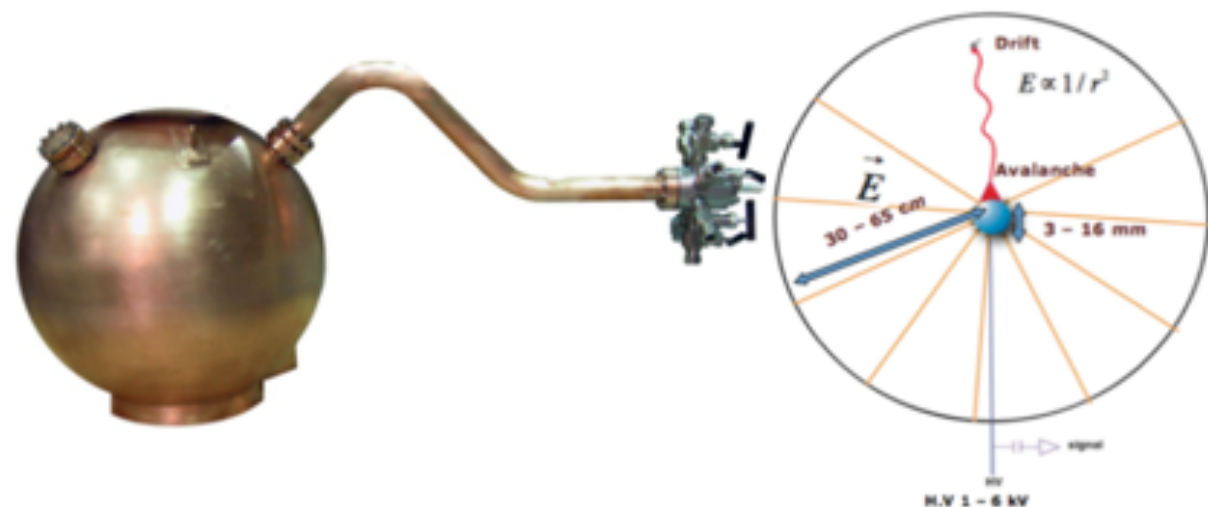
EDELWEISS
III



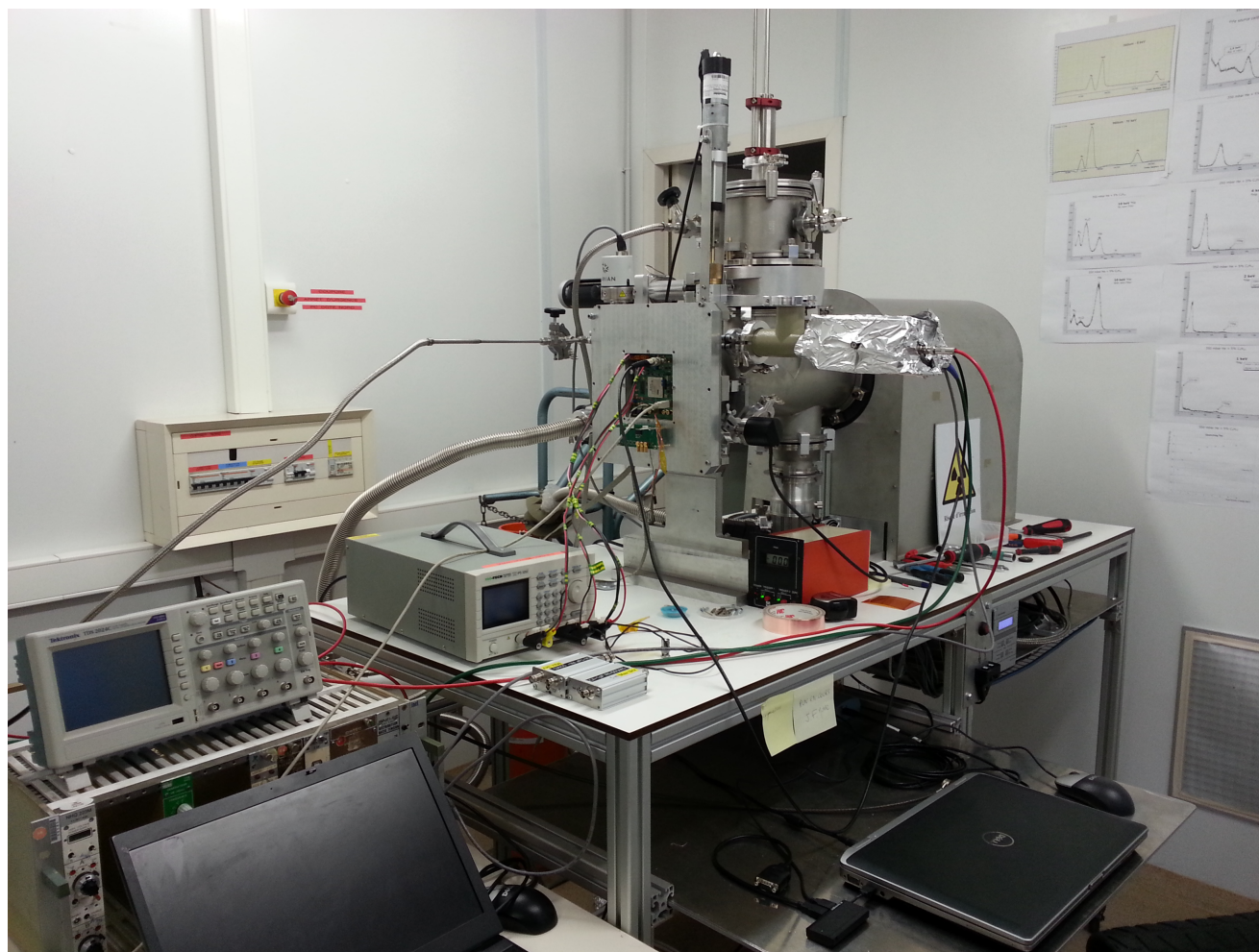
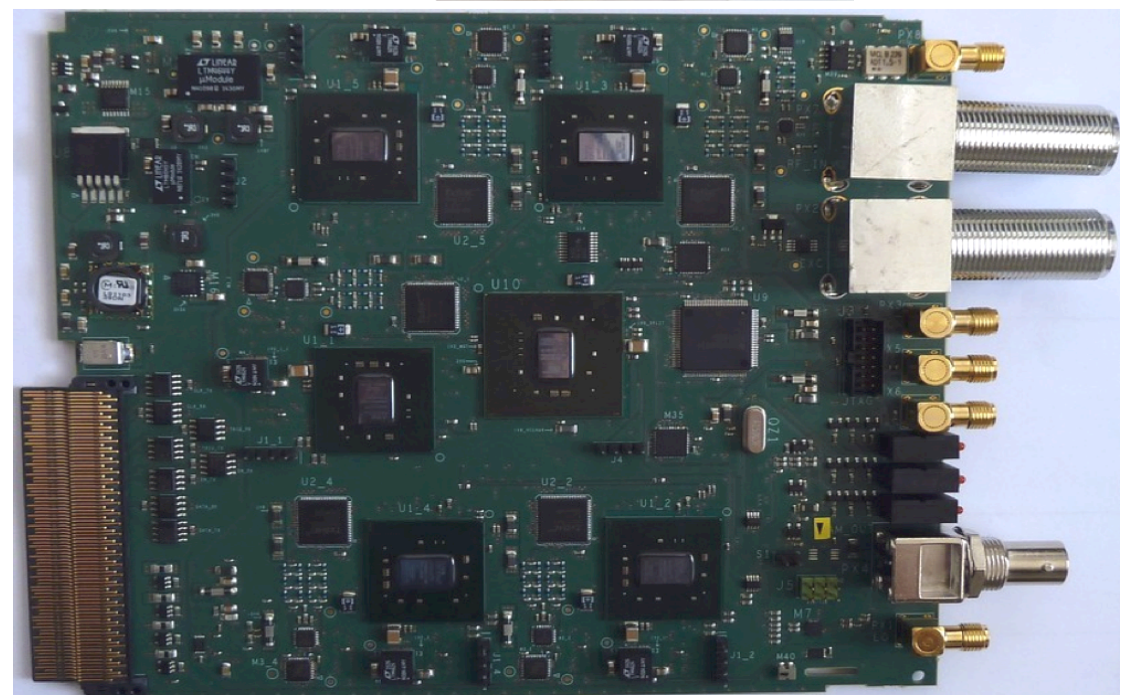
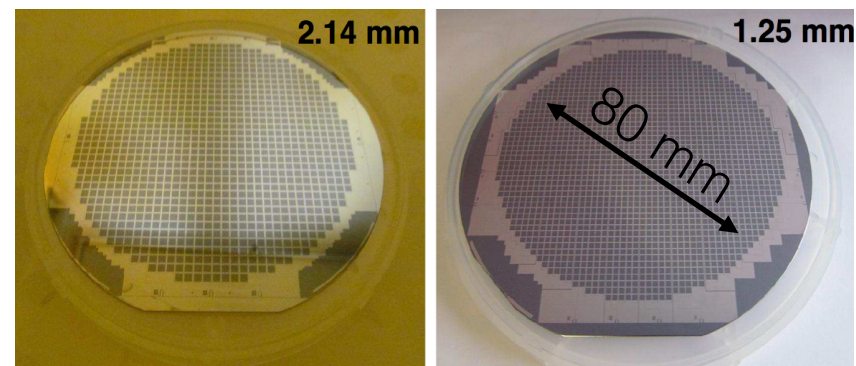
Diameter: 7 cm

- ❖ Recherche de Matière noire avec bolomètre
- ❖ Mesure chaleur + ionisation
- ❖ Résultats préliminaires avec 582 kg.jour

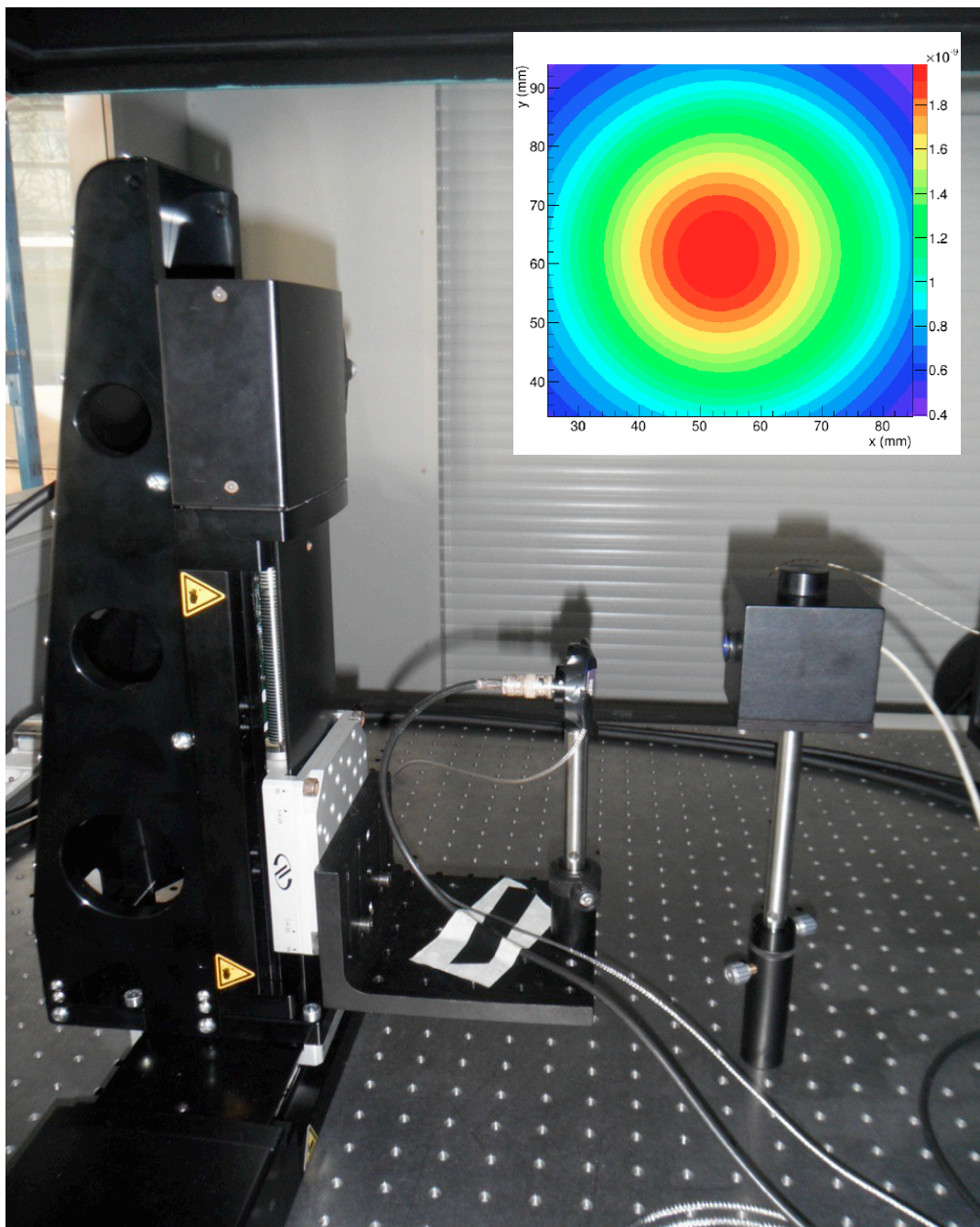
- ❖ Sphère SEDINE/NEWS (Irfu – **LSM**)
- ❖ Support LAPP pour mécanique blindage
- ❖ Recherche de matière noire à basse masse
- ❖ Amélioration du bruit de fond en cours
- ❖ ANR News obtenue en 2015 (Irfu-LSM-LPSC-Queen's (Canada))



- ❖ Successfully combined COMIMAC ion/electron beam line with a pixelized **MIMAC**-anode @Grenoble, for 3D track studies



- ❖ NIKA2 instrument: 3 KIDS matrices of ~ 1000 px each. Electronics @ LPSC
- ❖ installed and available for the astronomers @ IRAM 30m



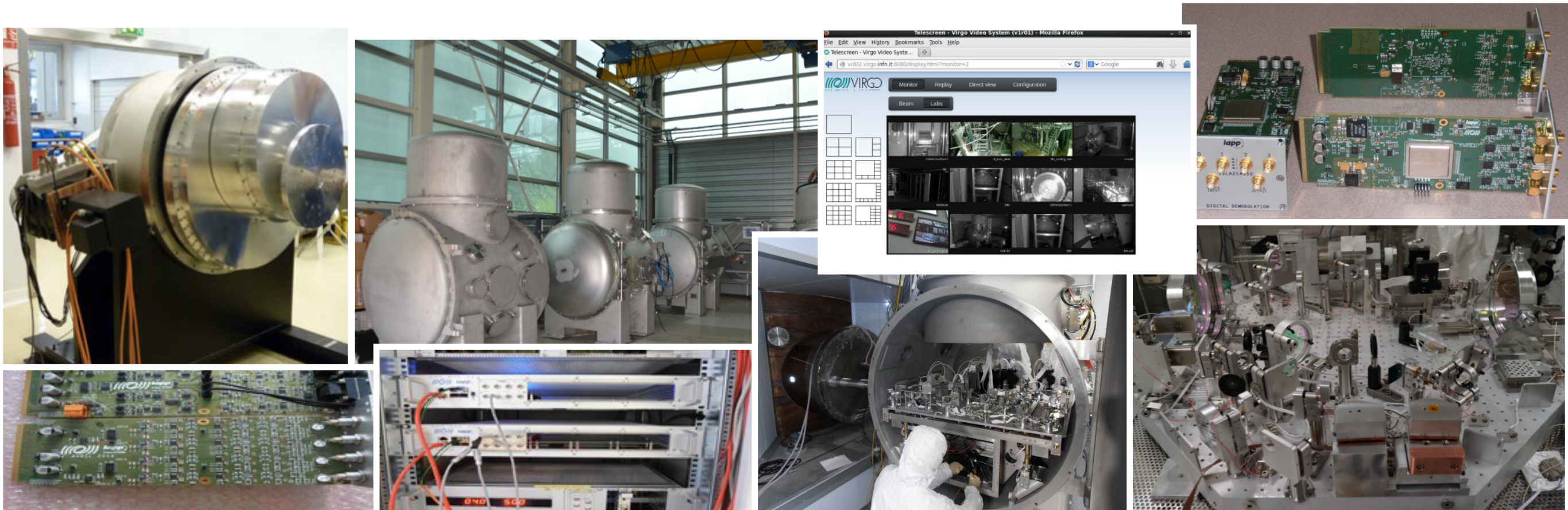
- ❖ Finalization of the Camera calibration optical bench for **LSST** (large beam) @ **LPSC**

- ❖ Filters loader for **LSST** @ **LPSC**



Detectors coming online, with increased detection prospects for gravitational waves

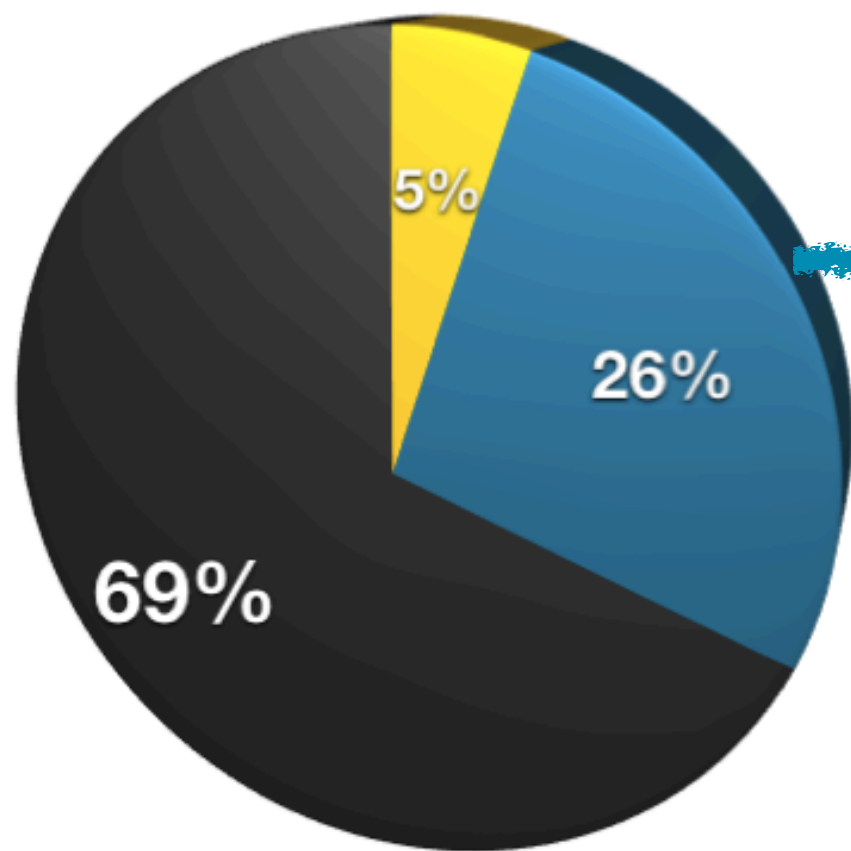
- Advanced LIGO up and running
- Advanced **Virgo** in final stages of installation with strong contribution from **LAPP**



Dark matter puzzle

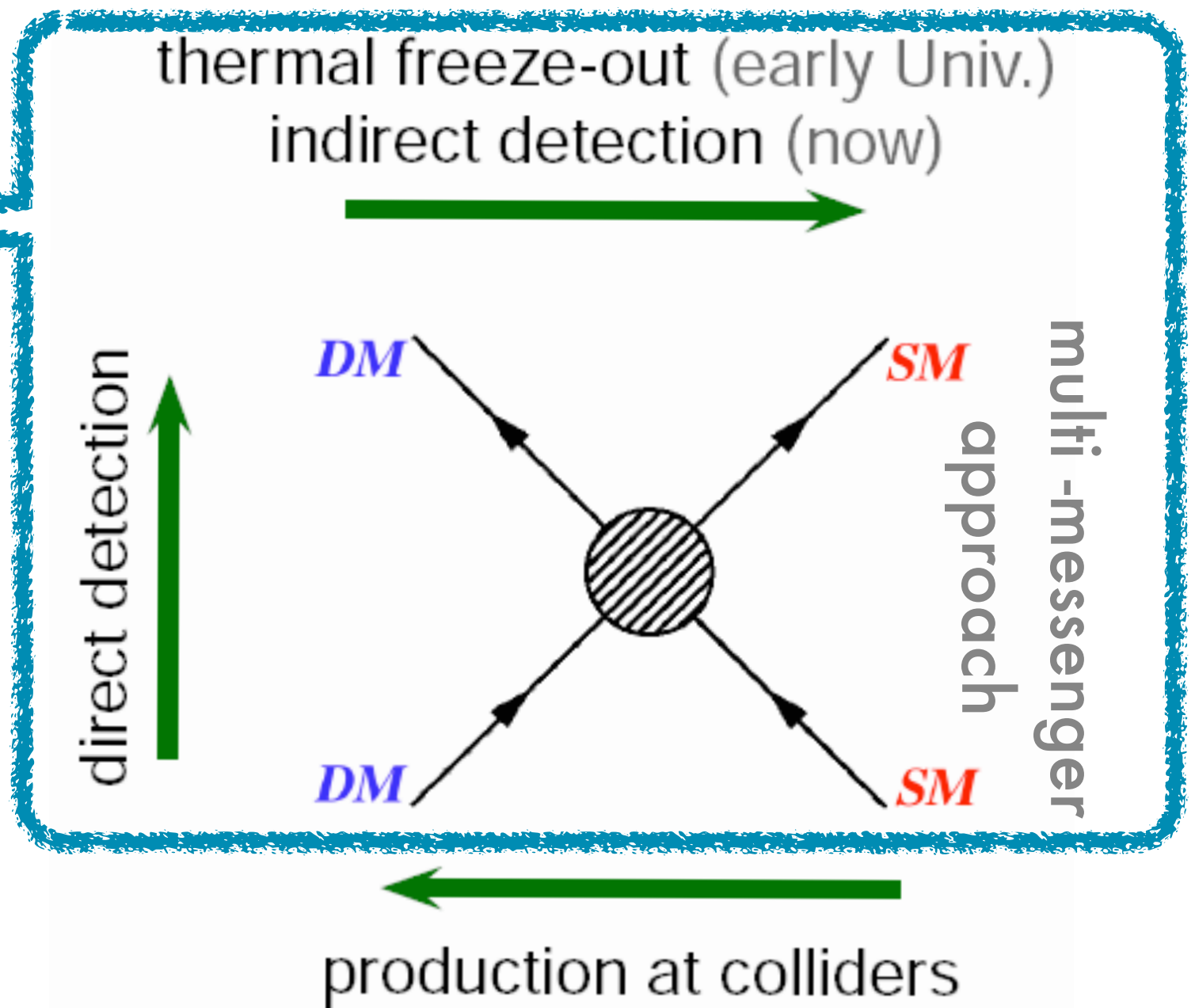
The dark matter problem is common to all projects

(except Virgo)

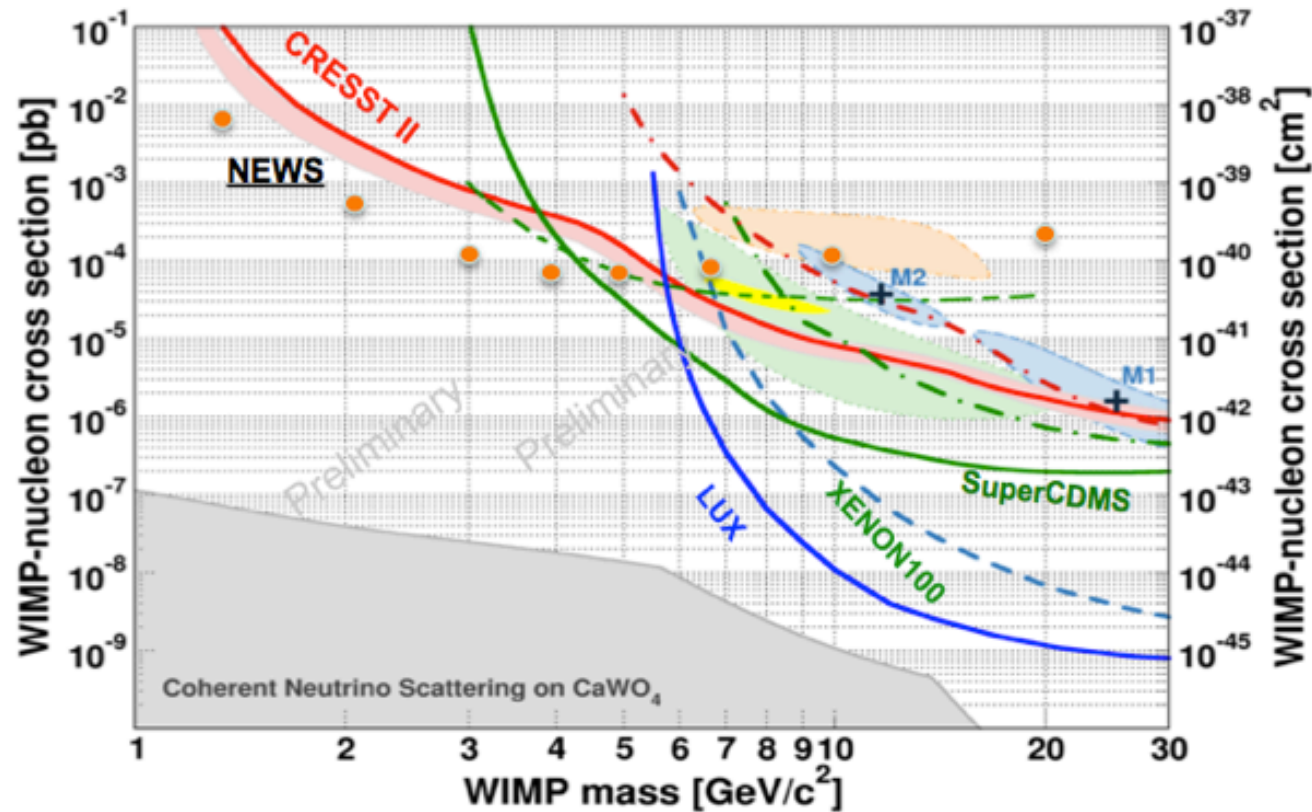


- matière ordinaire
- matière noire
- énergie noire

[Planck 2015]

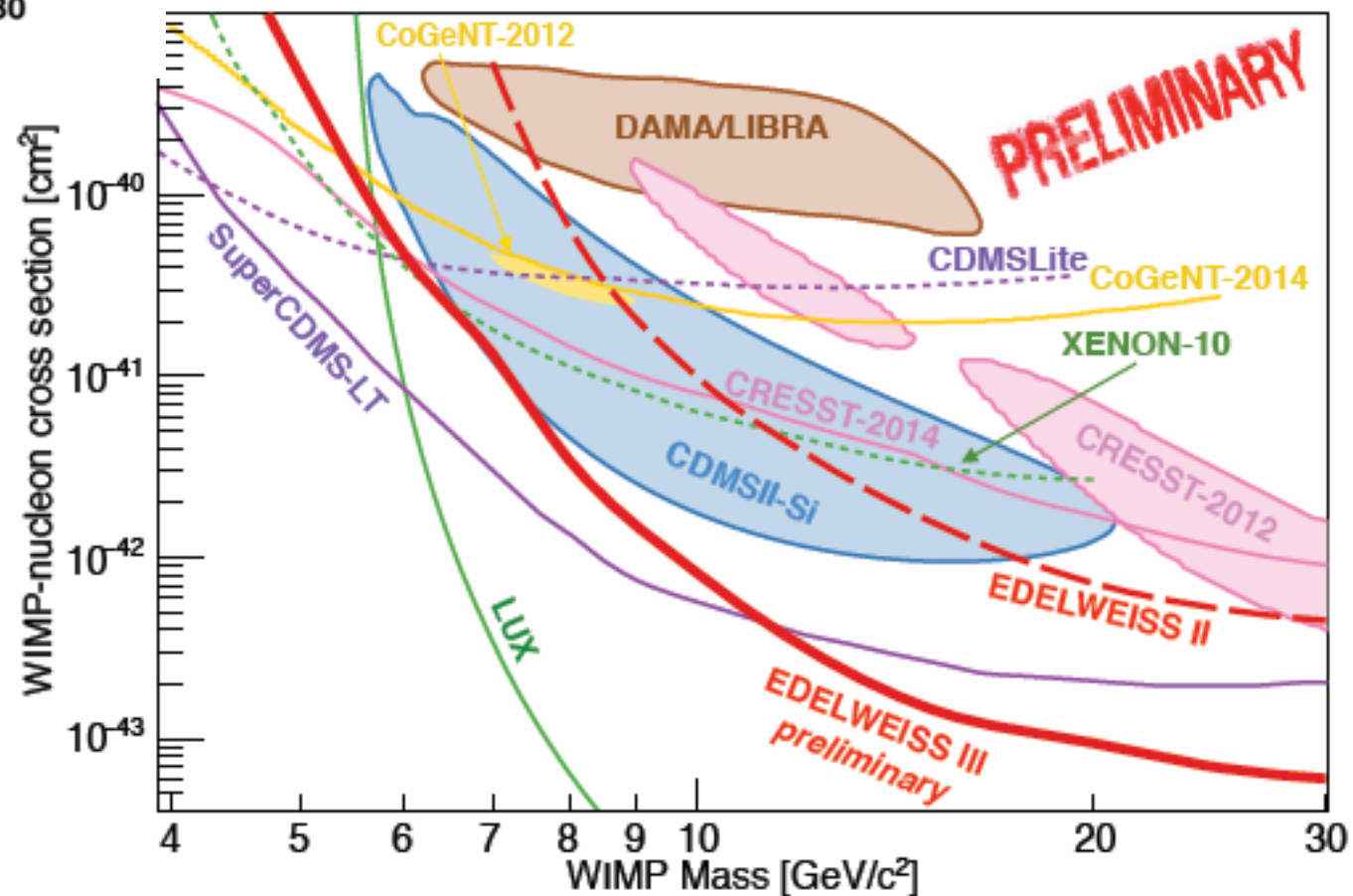


DM direct detection

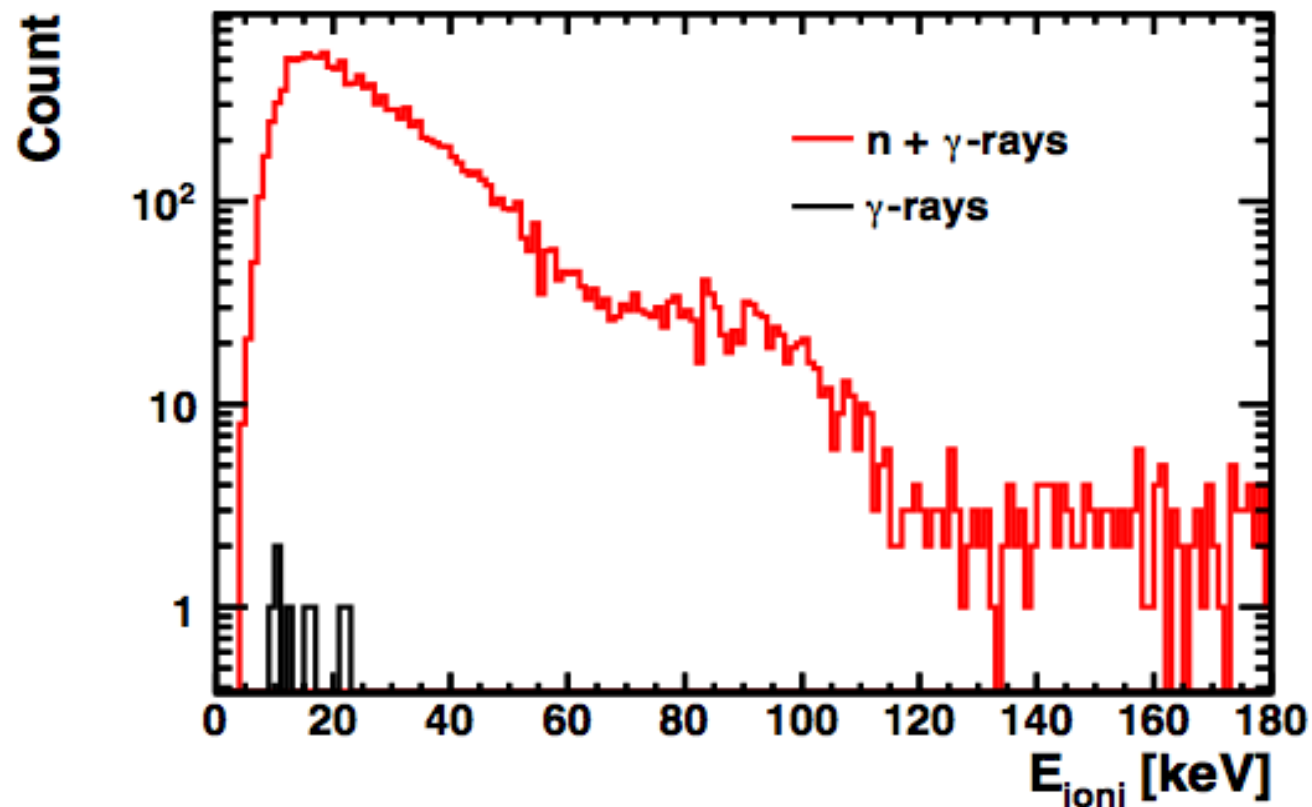
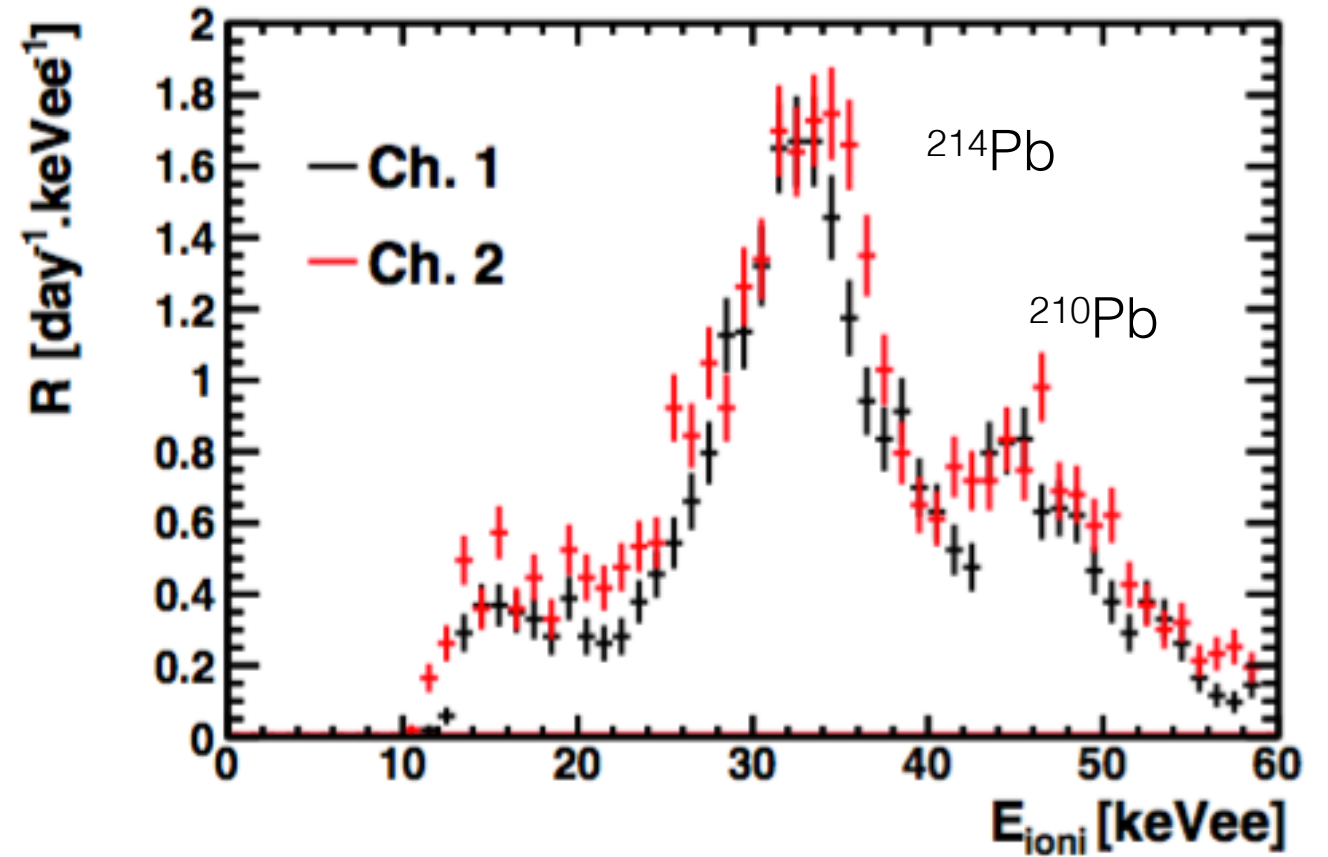


❖ NEWS for the lower mass WIMP (simulation)

❖ Preliminary limits from Edelweiss III: ~ one order of magnitude better than Edelweiss II



❖ First Measurement of 3D tracks of Rn progeny @Modane
Ionization released by the recoils of ^{214}Pb and ^{210}Pb when the alpha particle is absorbed by a surface.
Q. Riffard et al. arXiv:1504.05865.

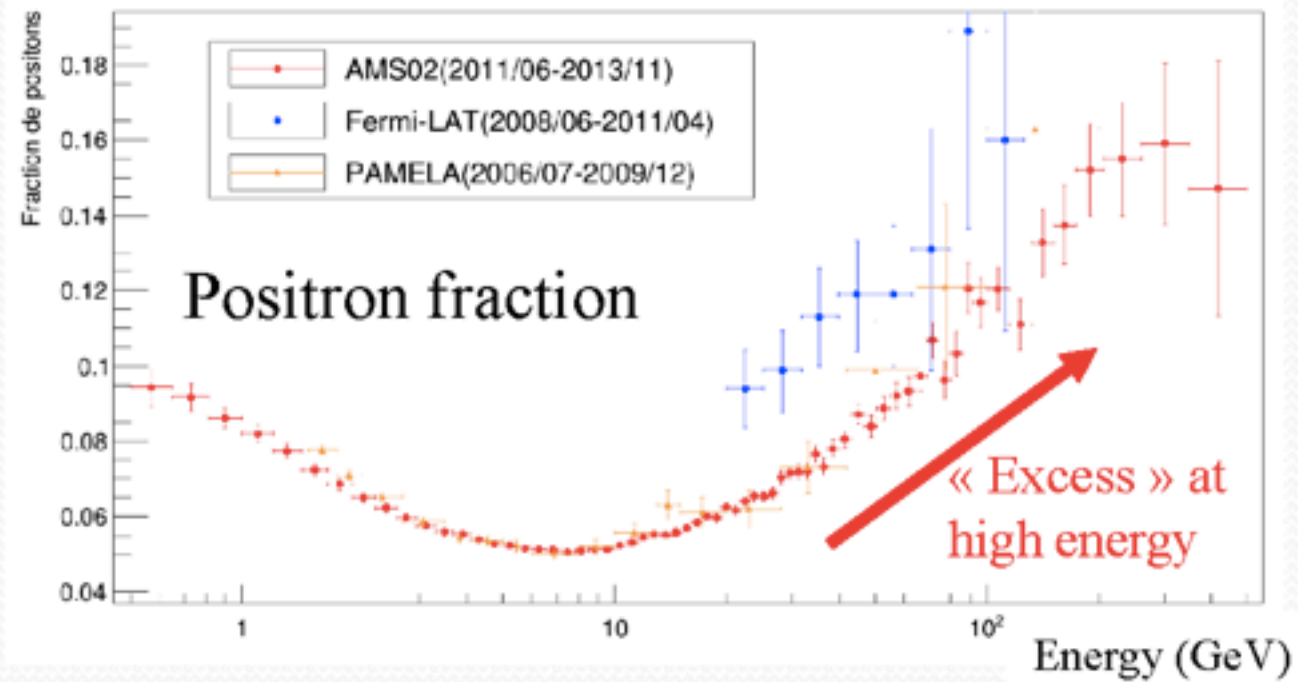


Powerful discrimination between e- and recoils with BDT using @Cadarache neutrons
Q. Riffard et al. in prep.

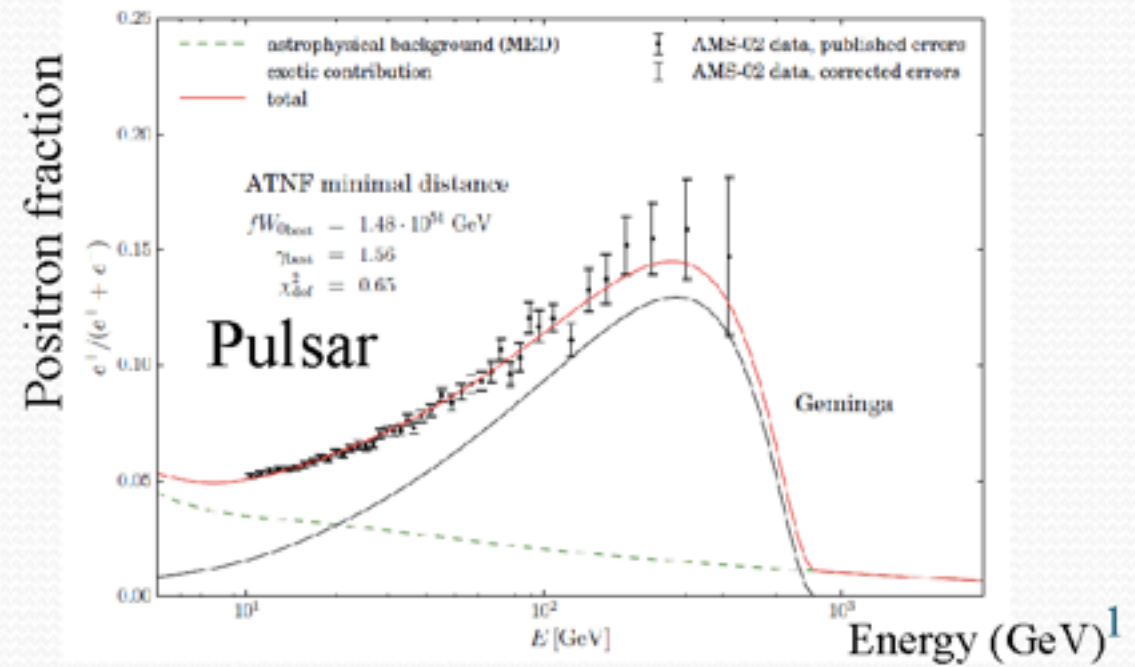
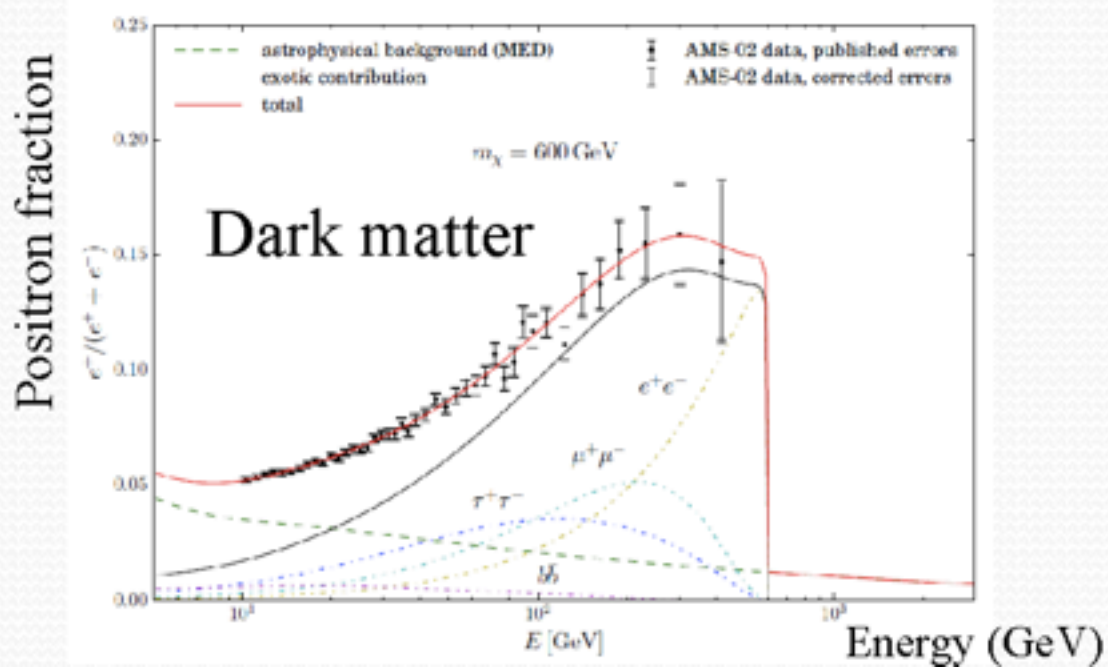
positrons with AMS

- LAPP team is working on electron and positron fluxes, and positron fraction
 - Three theses defended or about to be defended
- These measurements show that a new source of positrons is needed in our Galaxy
 - Dark matter?
 - Pulsars?
- LAPP and LAPTh collaboration published an interpretation of the rise of the positron fraction in term of dark matter and pulsars
 - CRAC : Cosmic Ray Alpine Collaboration
 - Astronomy&Astrophysics 575, A67 (2015)

PRL 113, 121101 (2014)
PRL 113, 121102 (2014)
PRL 113, 221102 (2014)

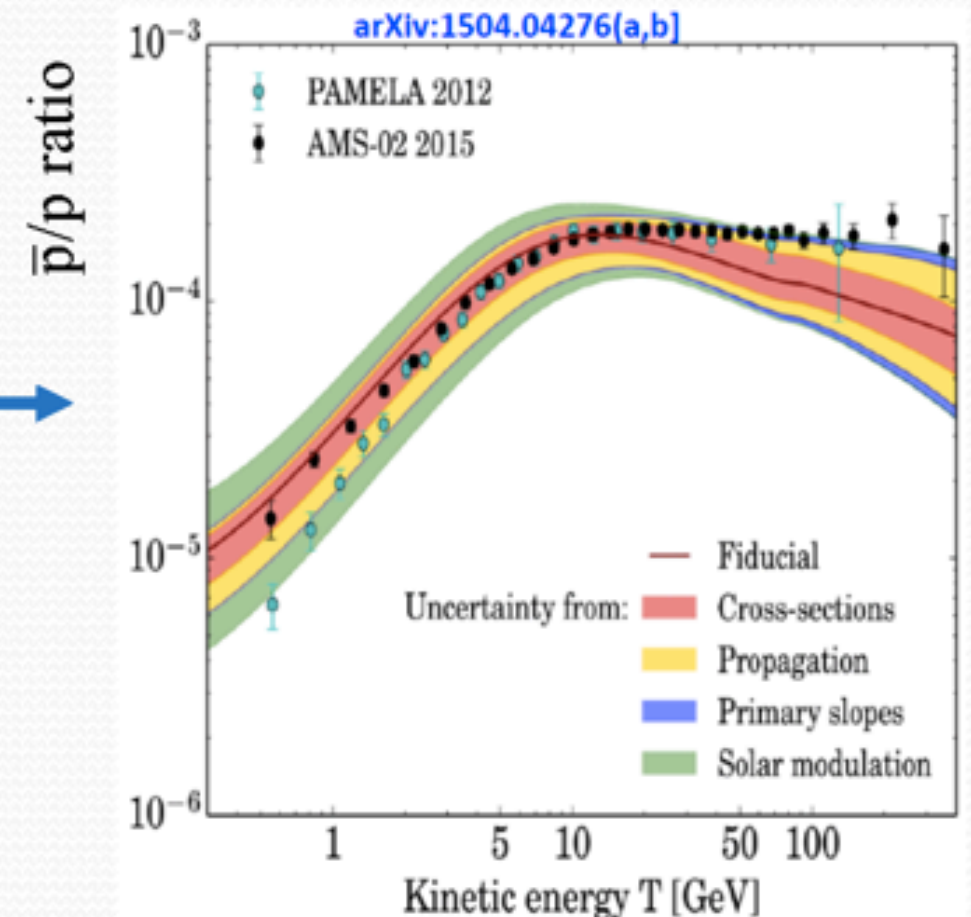
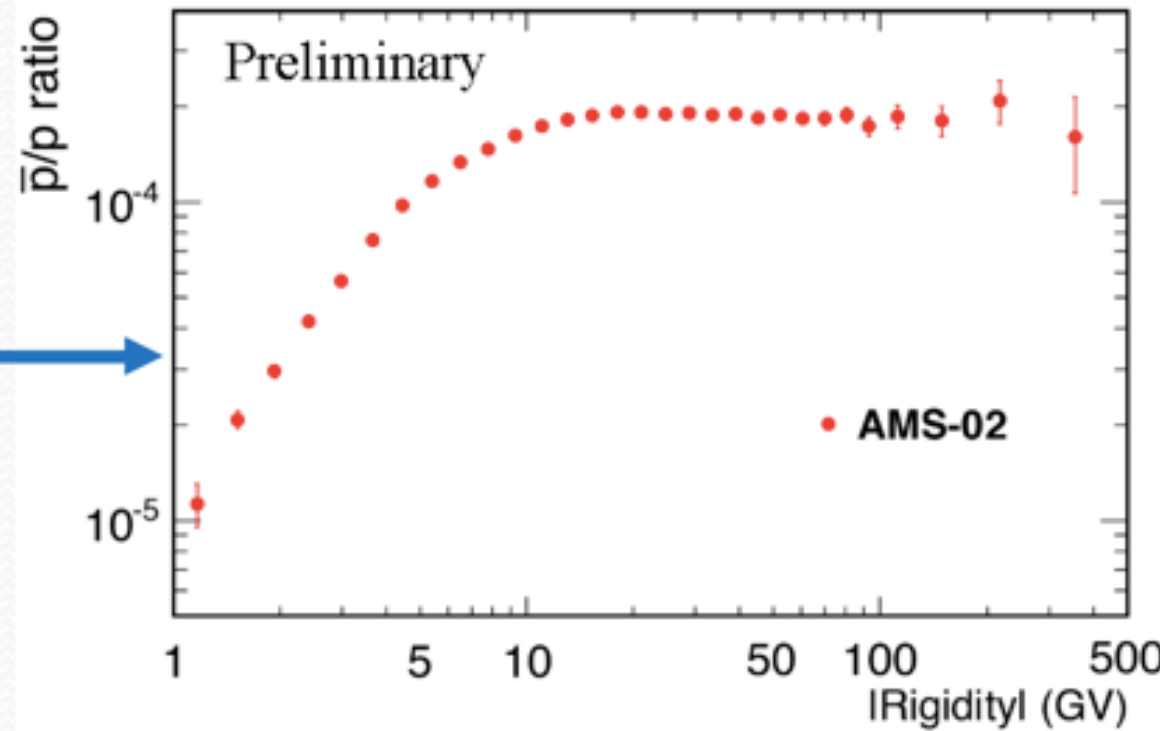


70 10⁹ cosmic rays detected since 2011 !



antiprotons with AMS

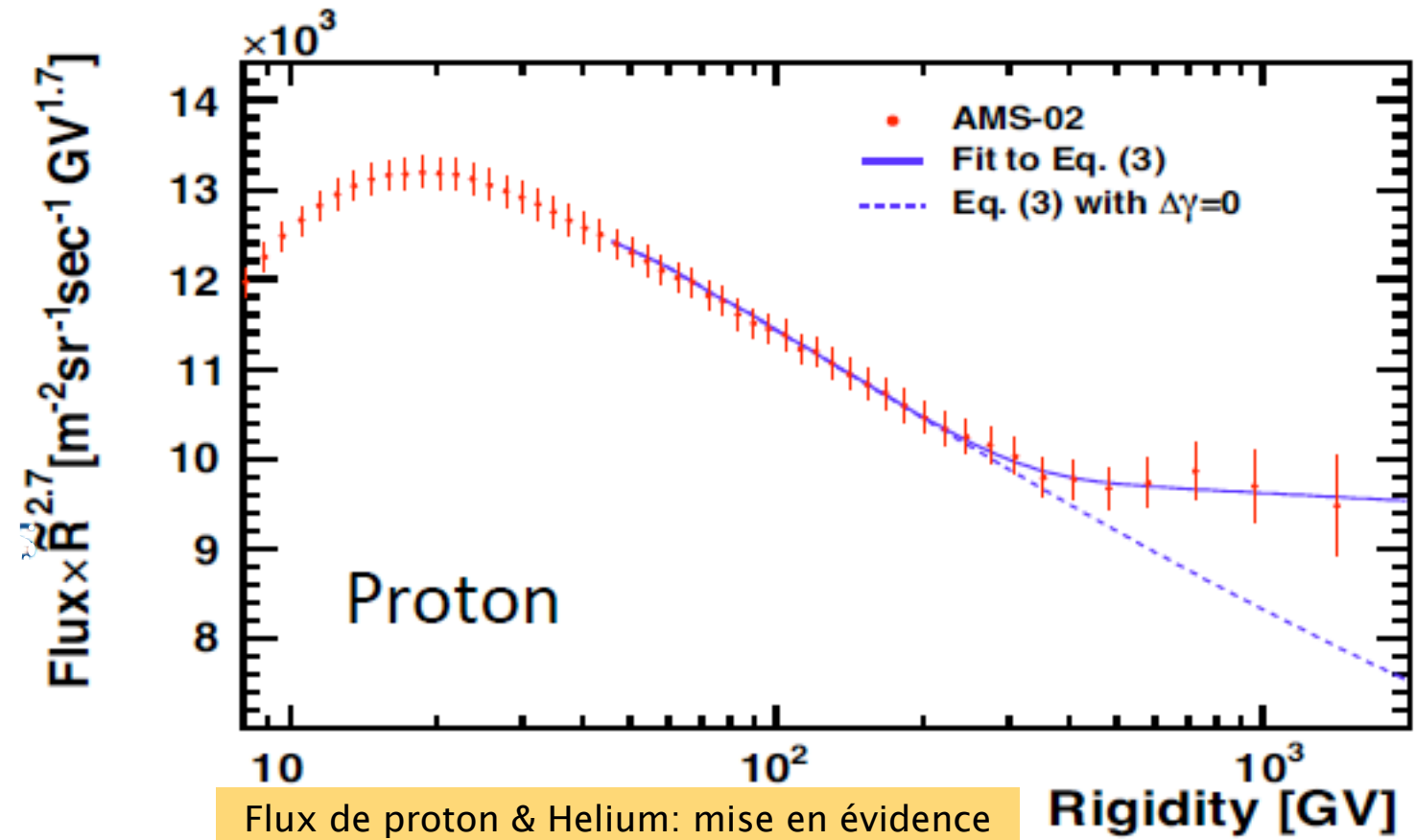
- LAPP team is also working on antiprotons to protons ratio
 - One thesis and one postdoc
- Preliminary results shown in April
- Is this compatible with secondary antiprotons? Is dark matter needed to explain \bar{p}/p ratio?
 - Pulsars do not produce antiprotons
- \bar{p}/p could be explained without dark matter component (for now)
- AMS will publish soon the final result on \bar{p}/p ...



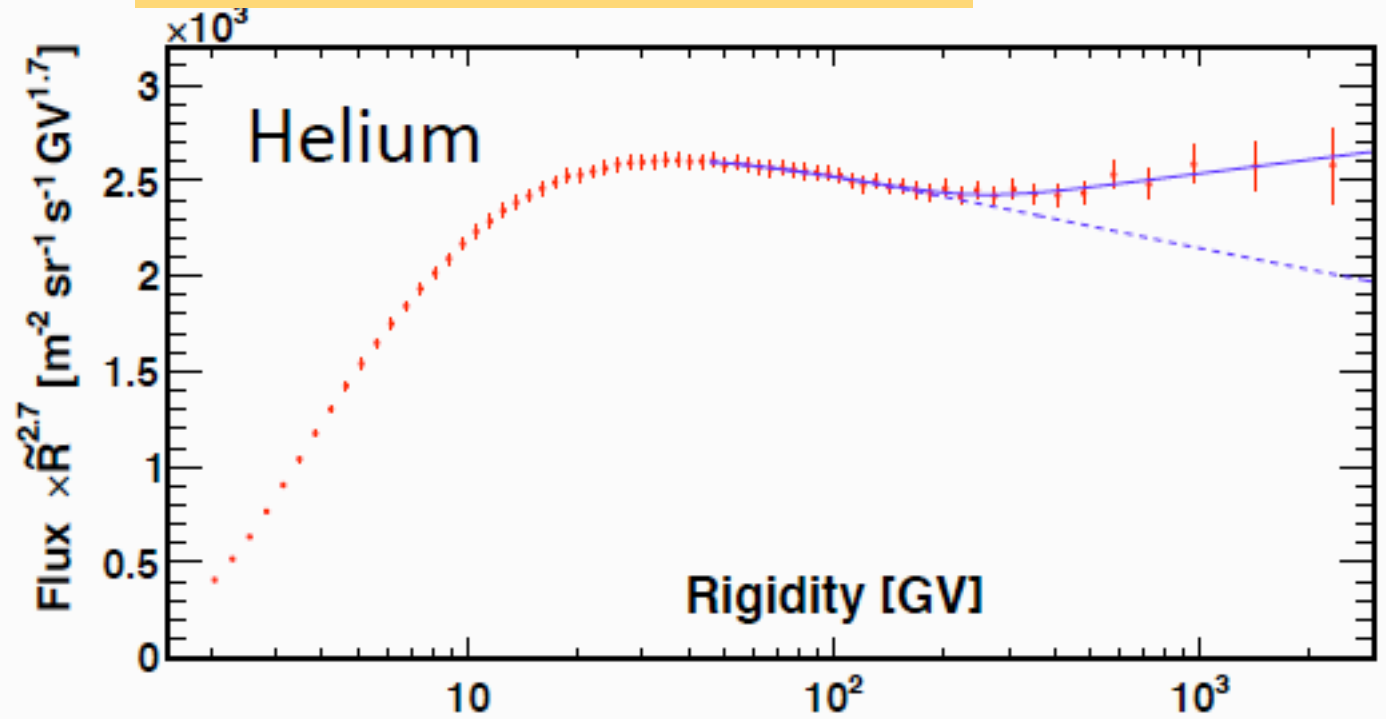
❖ Precise measurements of the proton & Helium fluxes (important rôle of LPSC in the publication) :

Similar hardening of the spectra for both species is shown @ 300 GV.

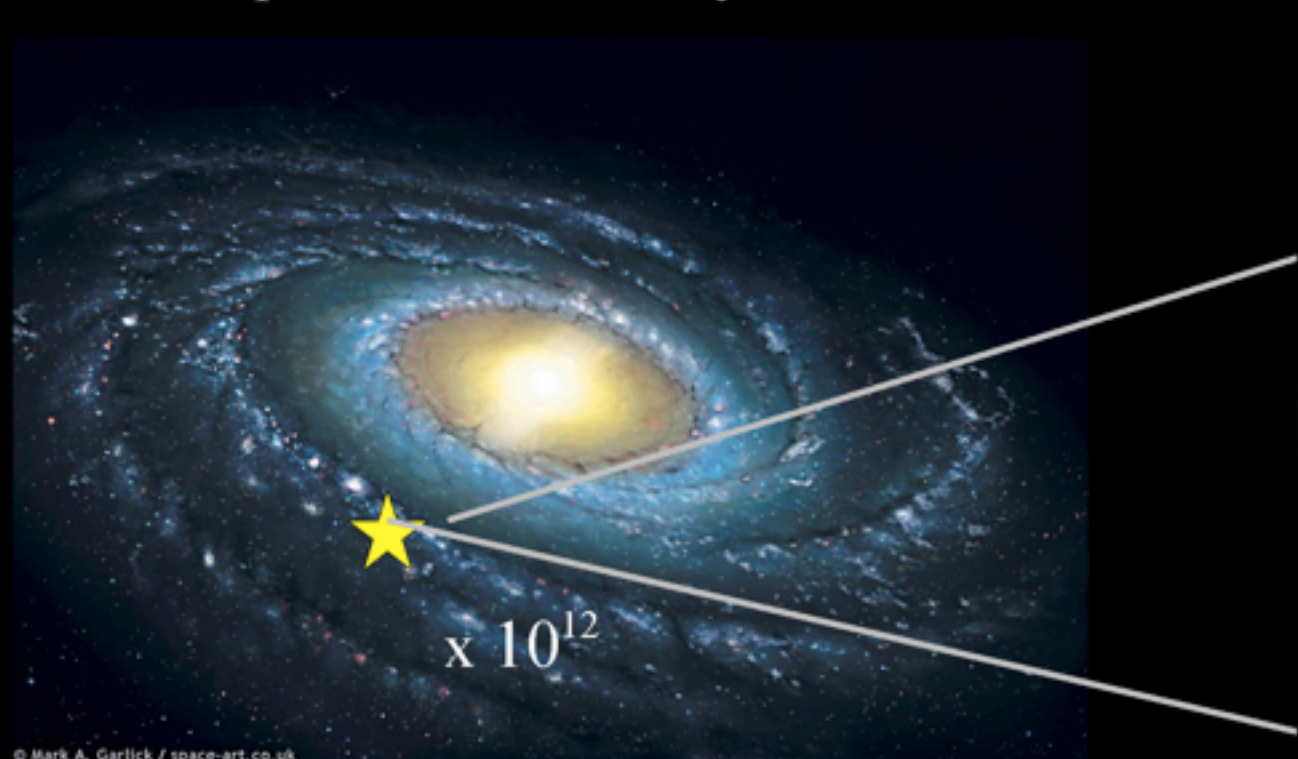
❖ Many results presented in conferences AMS-days & ICRC15



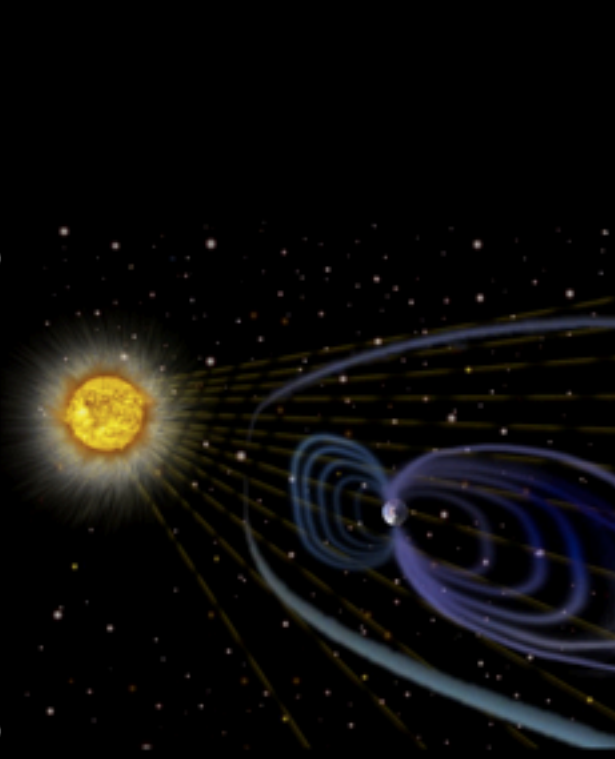
Flux de proton & Helium: mise en évidence d'un durcissement du spectre à 300GV



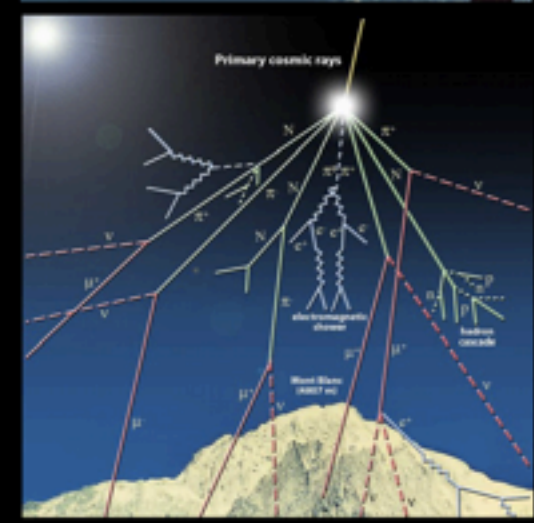
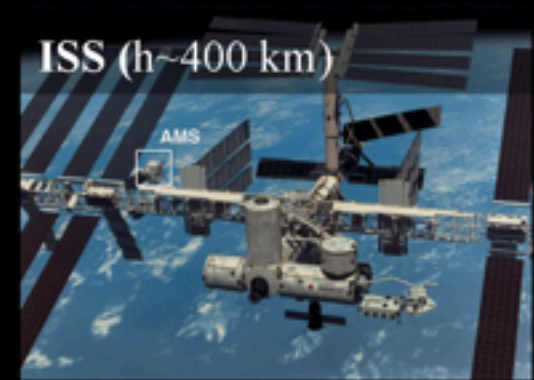
1. Transport in the Galaxy



2. Solar modulation



3. Detection



AMS-02 data interpretation

- Origin of the proton/helium anomaly
- Two-halo scenario for propagation
- Impact of nuclear uncertainties on transport
- ...

Solar modulation and AMS-02 data

- Neutron monitors for modulation time series
- New interstellar flux determination

Tomassetti & Donato, ApJL 803, 15 (2015)
 Tomassetti, ApJL 815, 1 (2015)
 Tomassetti, PRD 92, 063001 (2015)
 Tomassetti, PRD 92, 081301 (2015)
 Tomassetti, PRC 92, 045808 (2015)

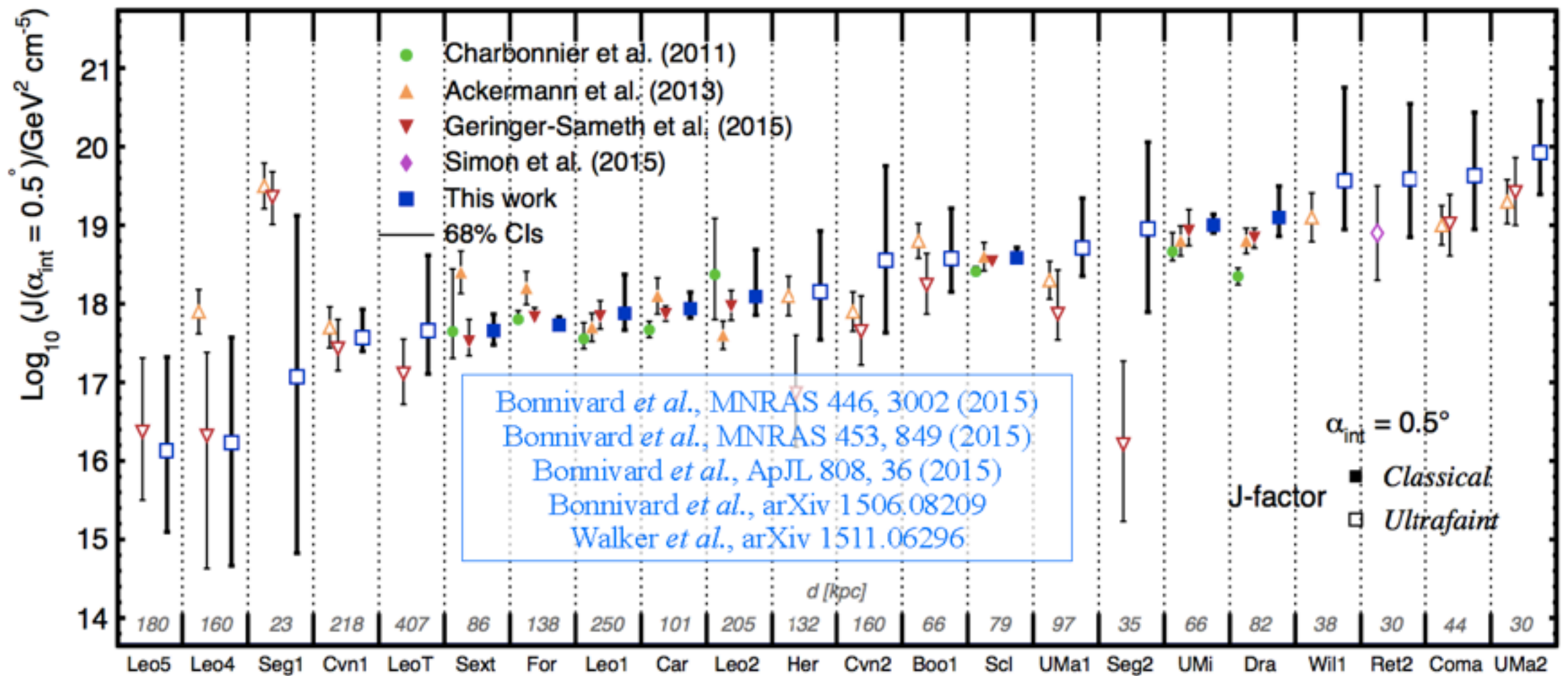
Maurin, Derome, Ghelfi *et al.*, AdSpR 55, 363 (2015)
 Ghelfi *et al.*, arXiv 1511.08650

DM indirect detection

→ Dwarf spheroidal galaxies orbiting the Milky Way among the best targets for Fermi-LAT, H.E.S.S., etc.

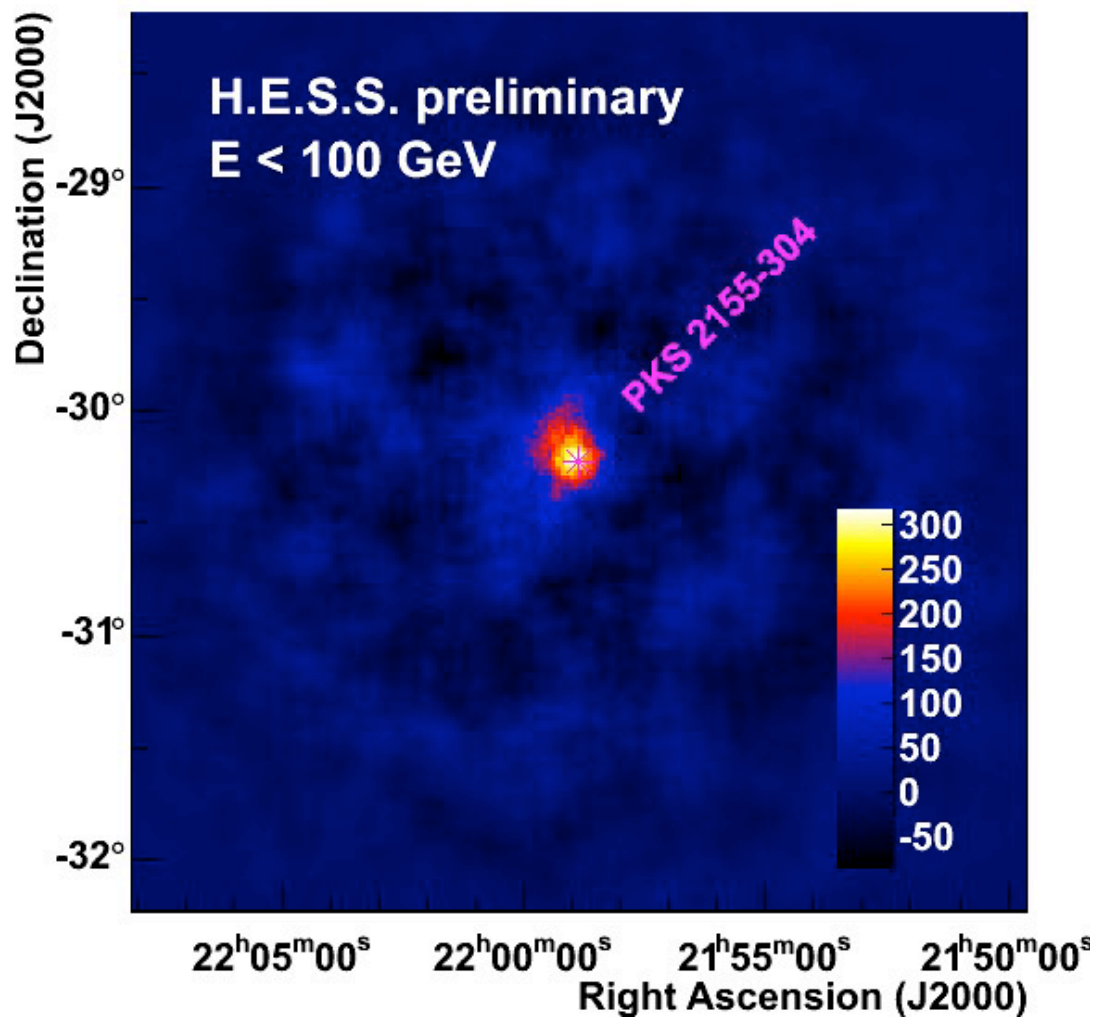
1. New ranking of the best targets (J-factor)

(which parameterises the expected gamma-ray flux, independently of the choice of DM particle model)



2. Public code to calculate J-factor from many targets (dSphs, galaxy cluster, ...)

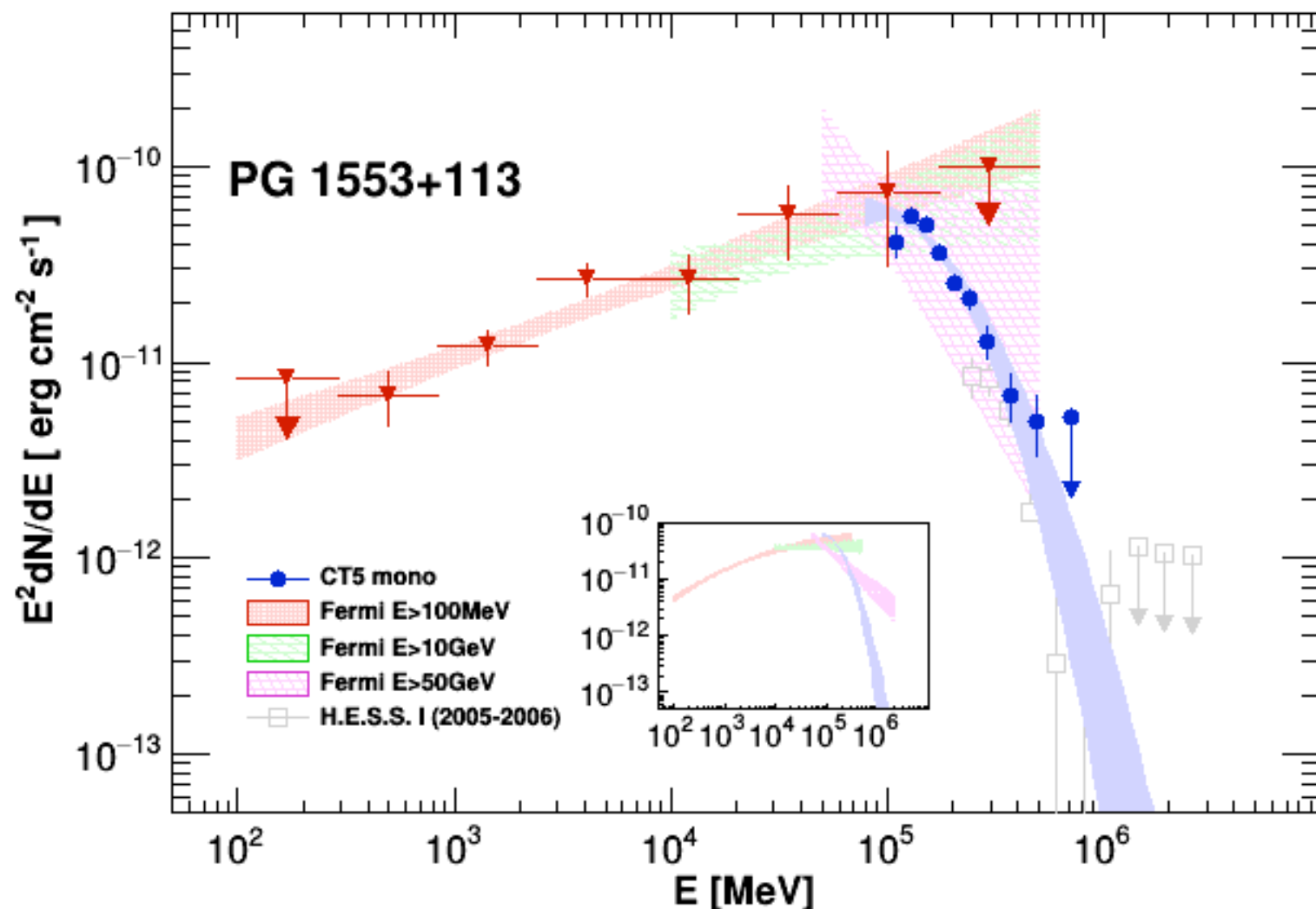
<http://lpsc.in2p3.fr/clumpy/>
 Bonnivard et al., CPC (accepted)

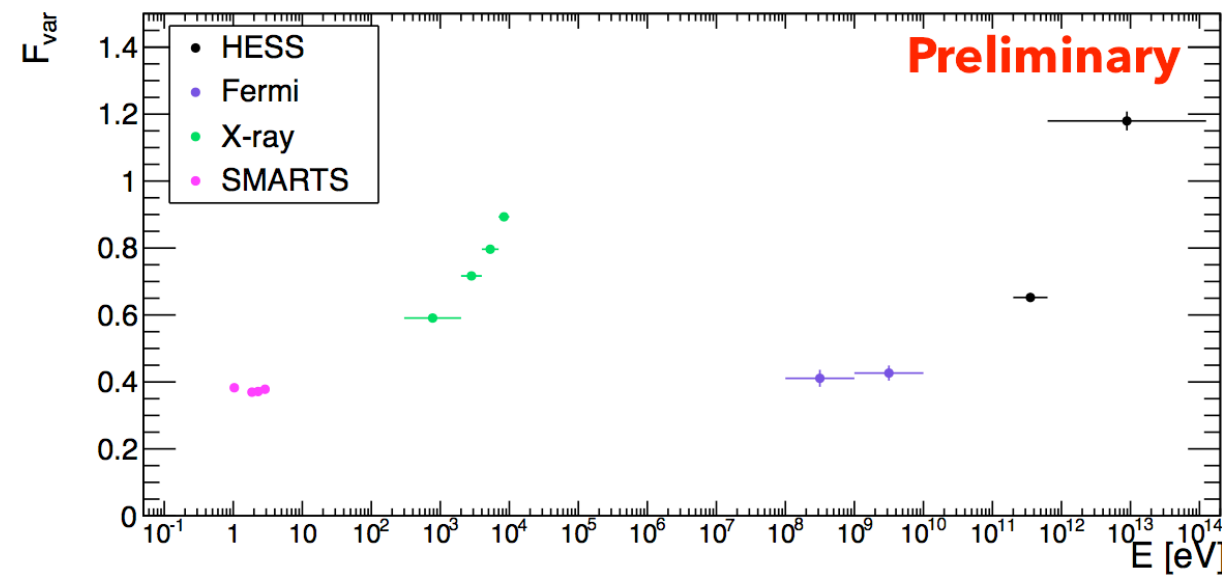
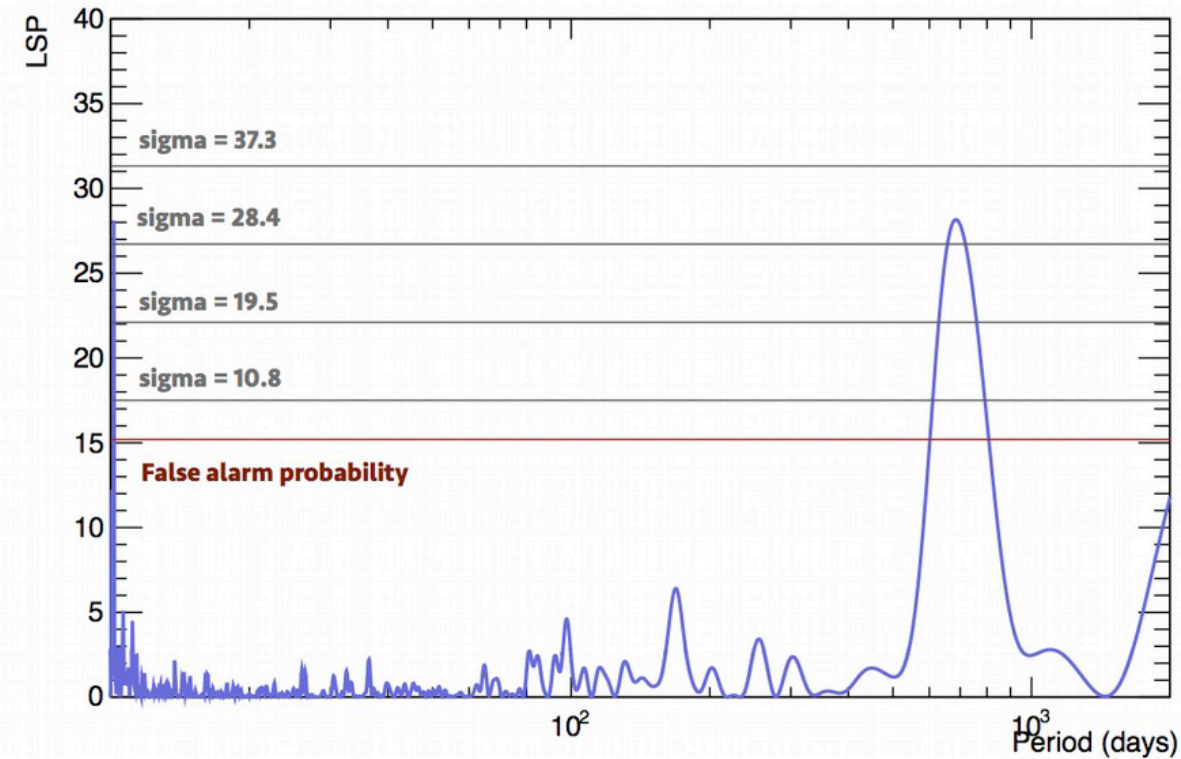
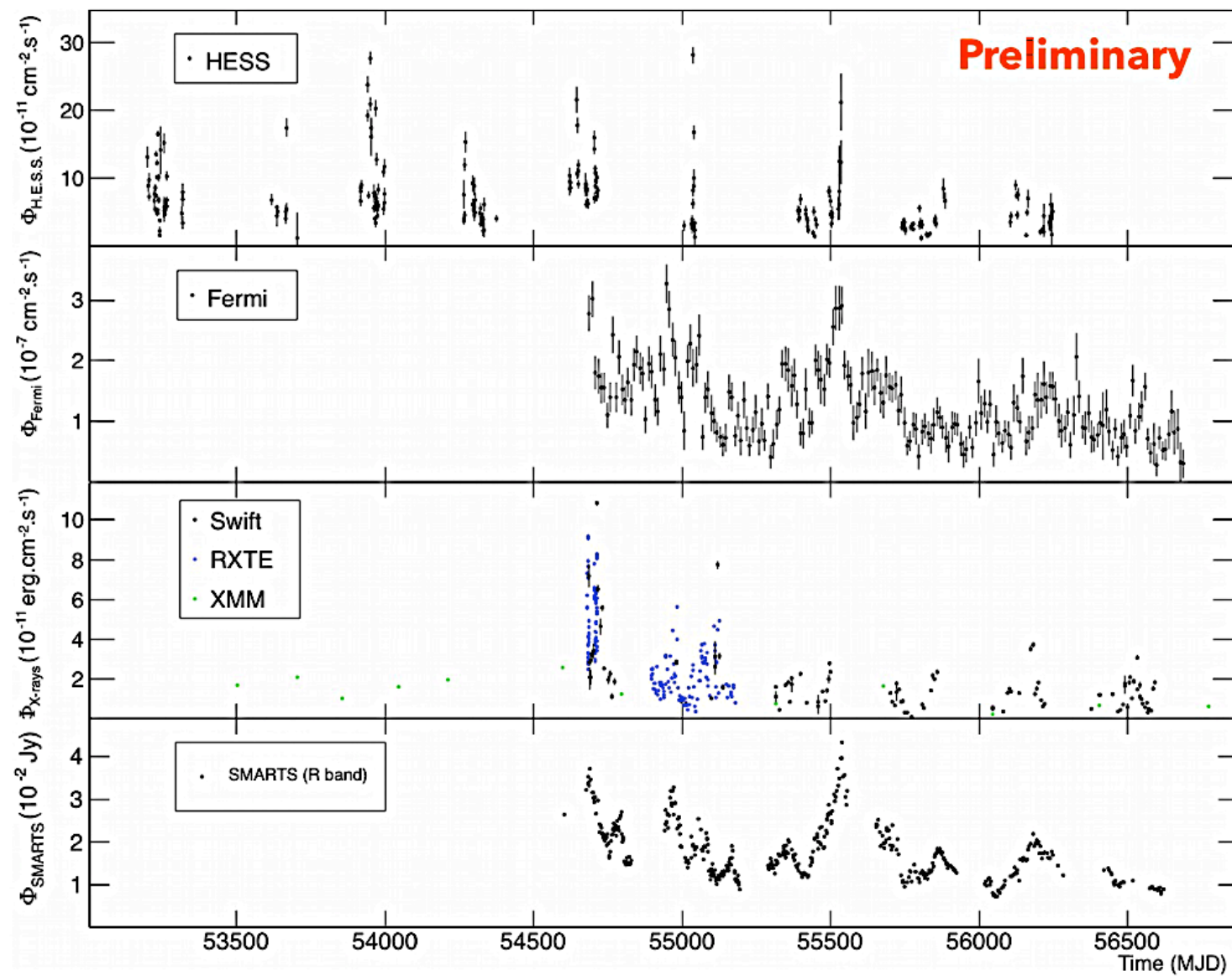


The labex opened an activity in the extragalactic field

- ❖ Active Galactic Nuclei with HESS and HESS phase II
- ❖ Extragalactic background → cosmology

- ❖ Detection at E < 100 GeV
- ❖ ● Probe spectral turn-over
- ❖ ● Variability on year time-scale





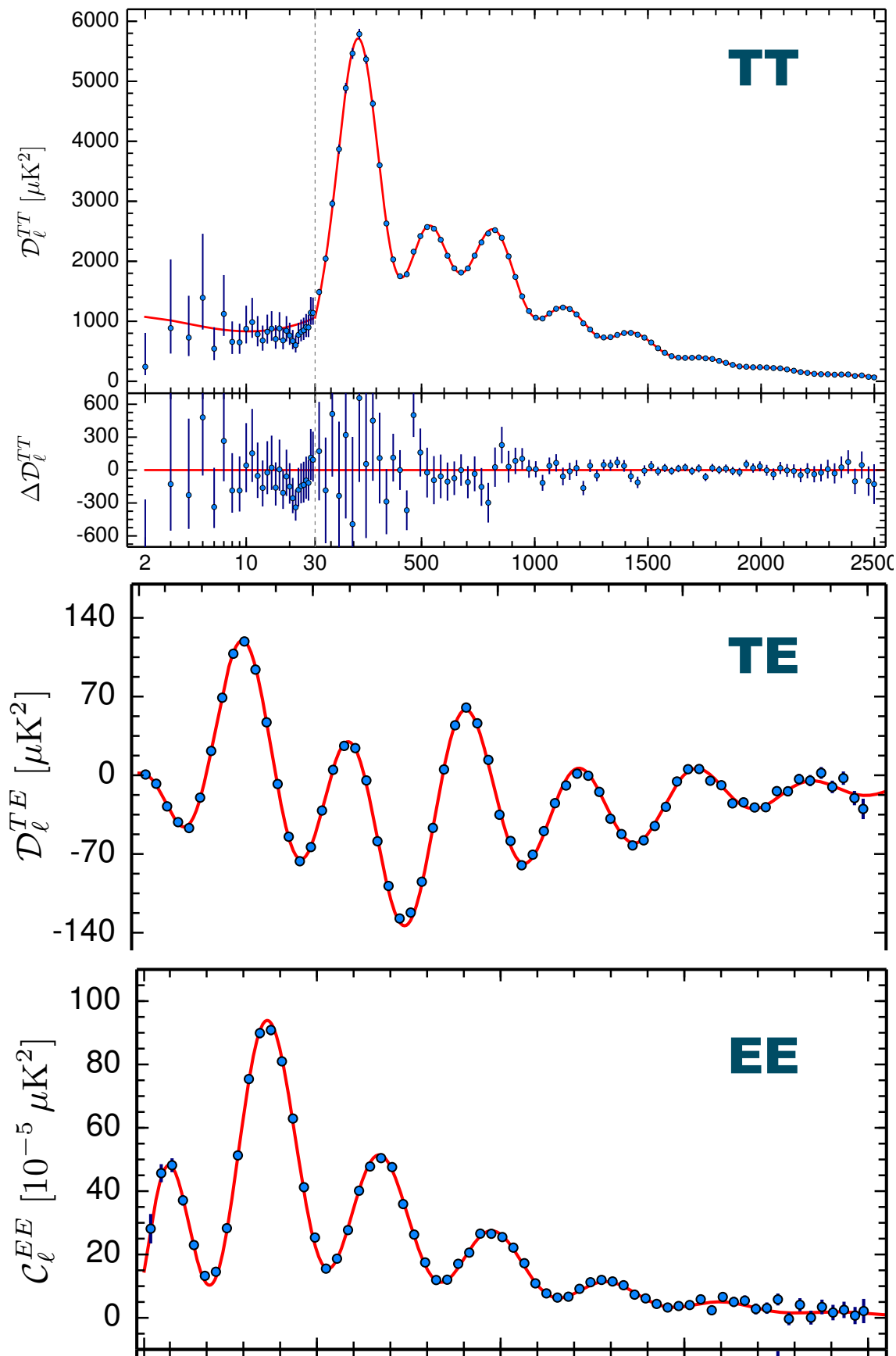
10 years of data with HESS

* Energy dependent variability

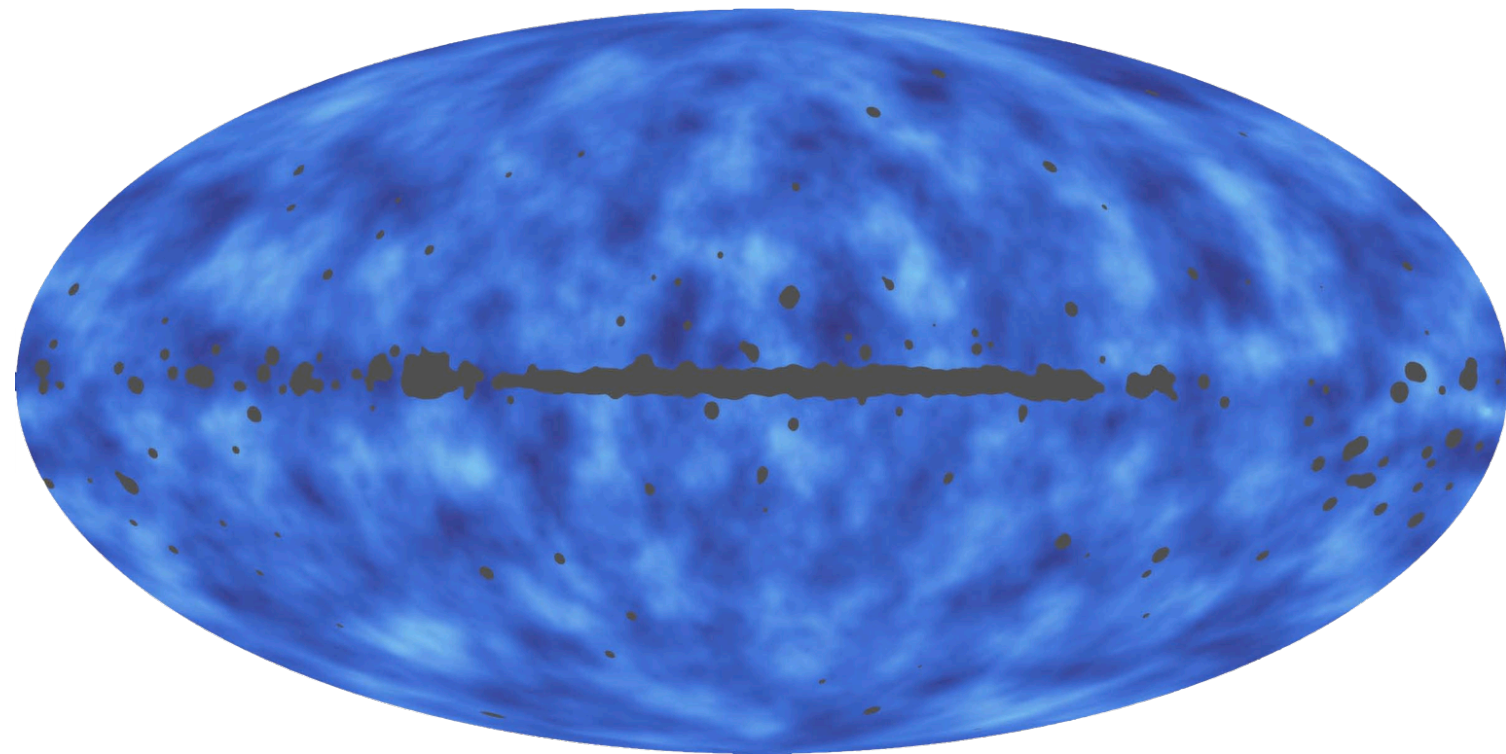
** Periodicity

PhD thesis of Jill Chevalier

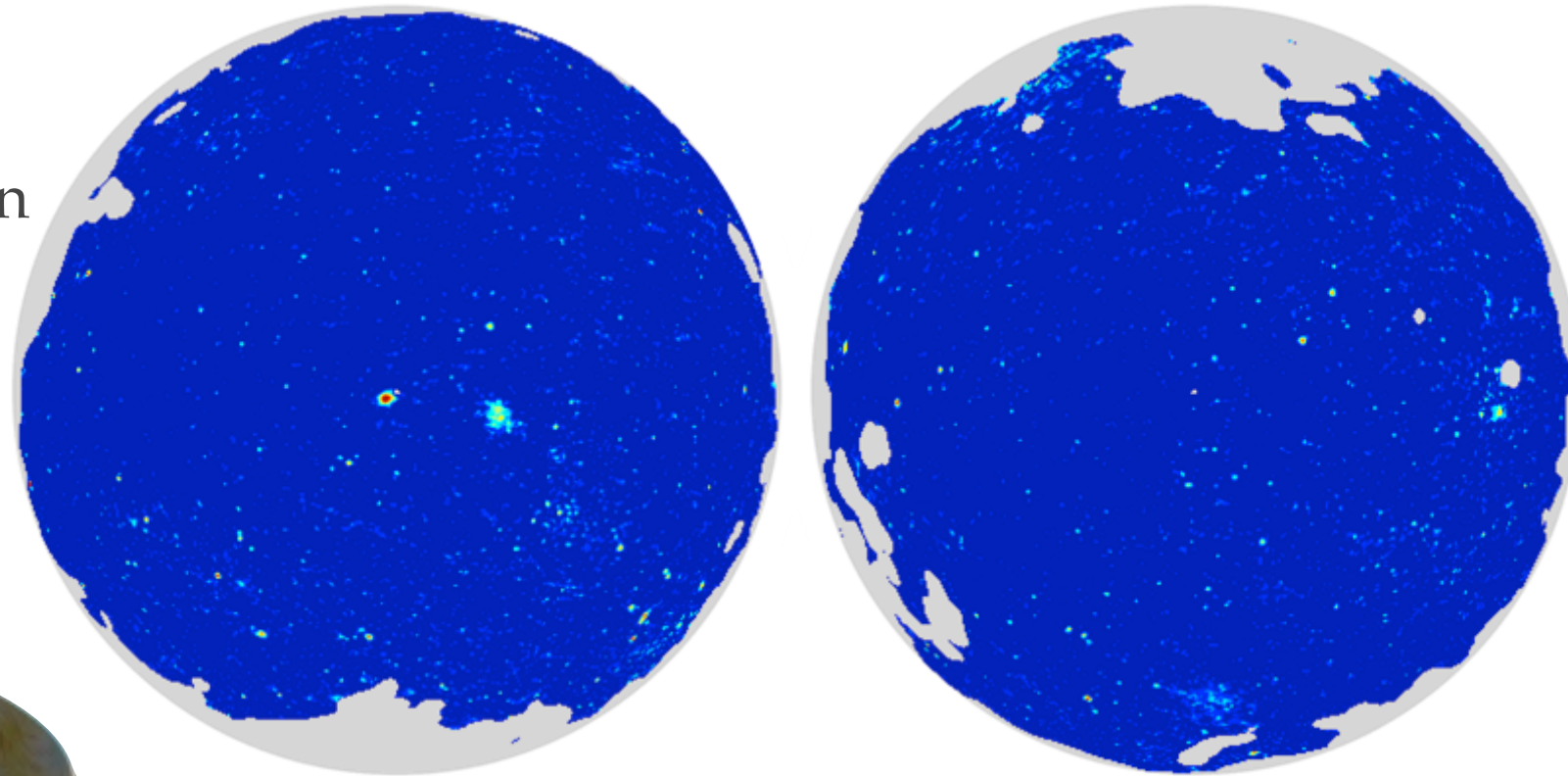
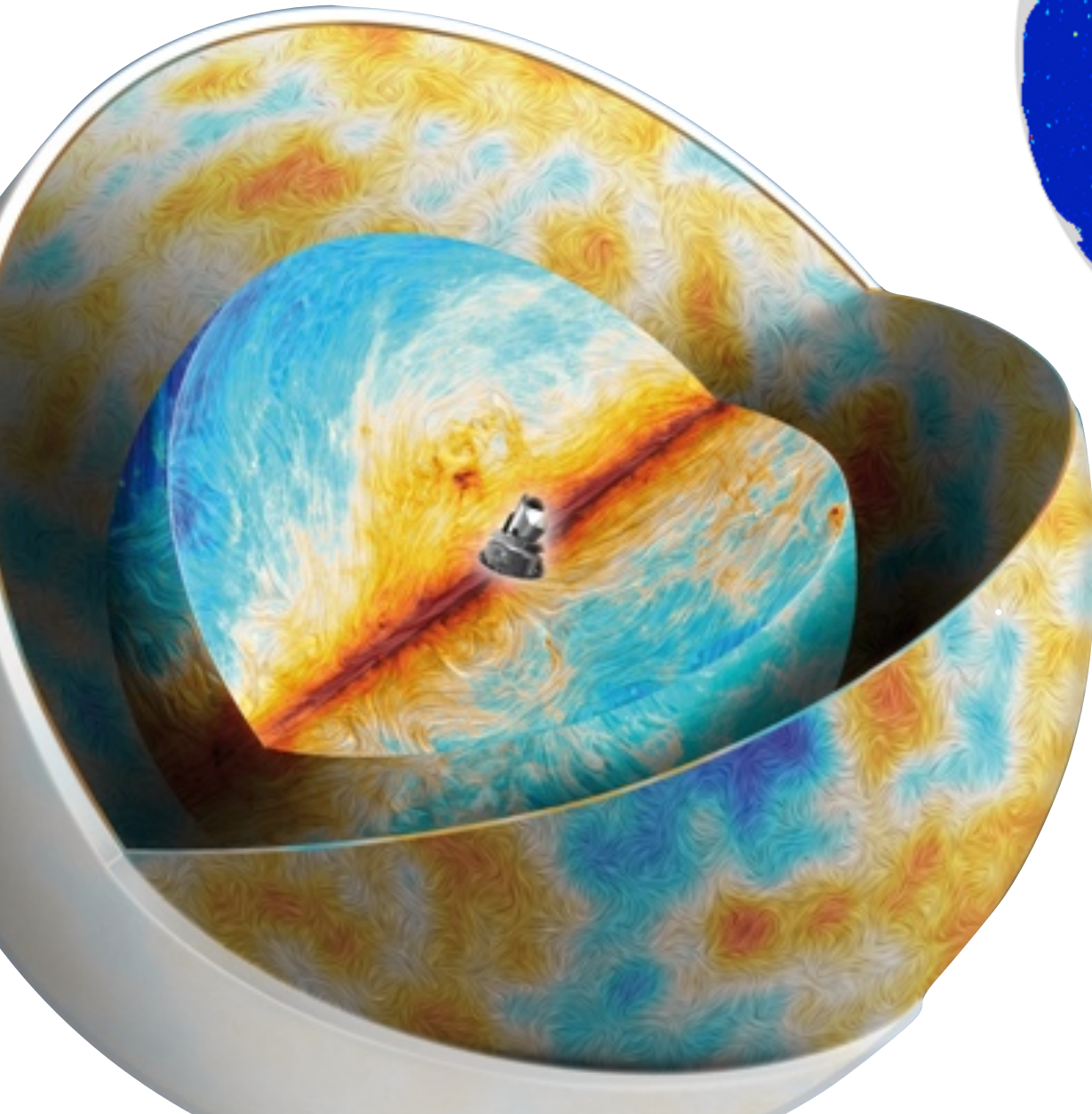
** Periodicity Collaboration with Pasquale S. (LAPTh)



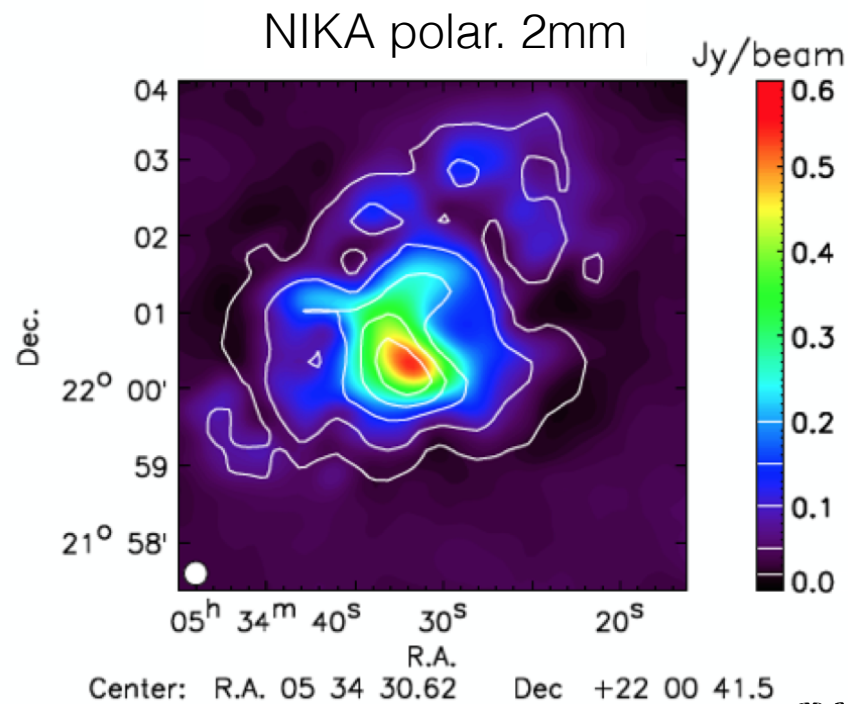
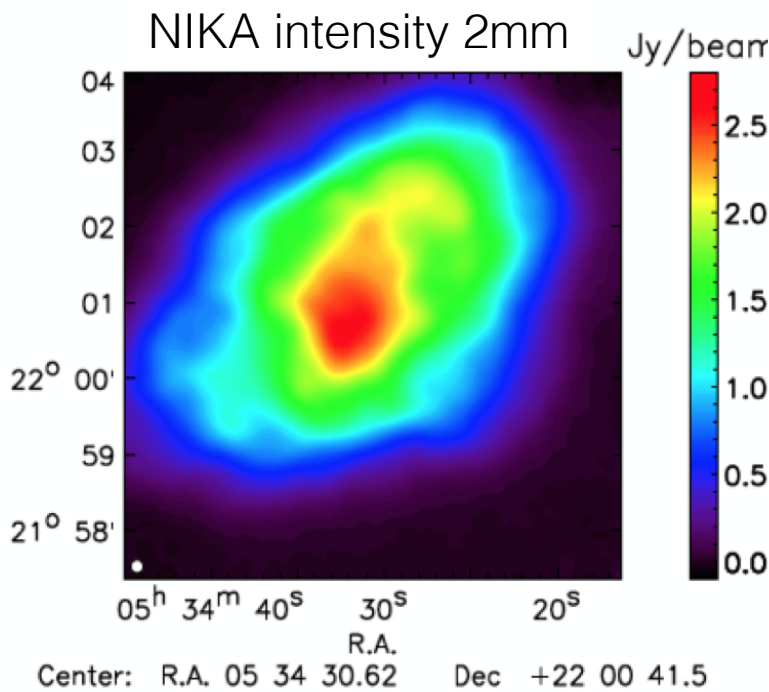
- Data analysis on time ordered data & maps @ LPSC. Systematics dominated data
- Data available (temperature & polarization, full mission, per frequency & per component). Lensing is crucial.
- No evidence of any deviation from the Λ CDM model (curvature, neutrino, Gaussianity, primordial spectrum shape ...)



- Planck / BICEP / KECK common analysis: no evidence of primordial gravitational waves signal
- Galactic dust polarized emission larger than foreseen, everywhere



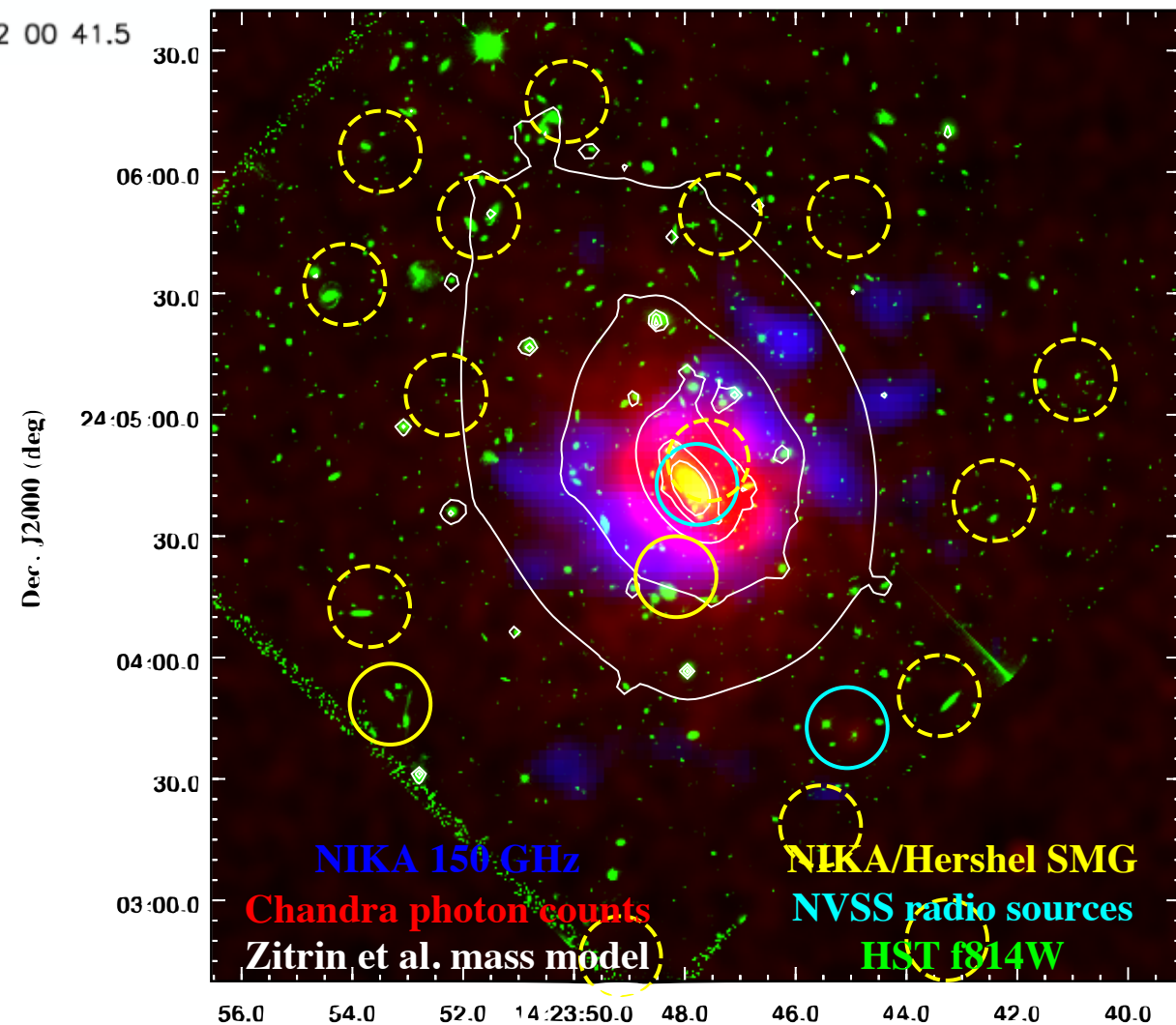
- CMB interacts with hot gaz of galaxy clusters (SZ effect)
- catalog of 1653 sources + y-map of the diffuse emission

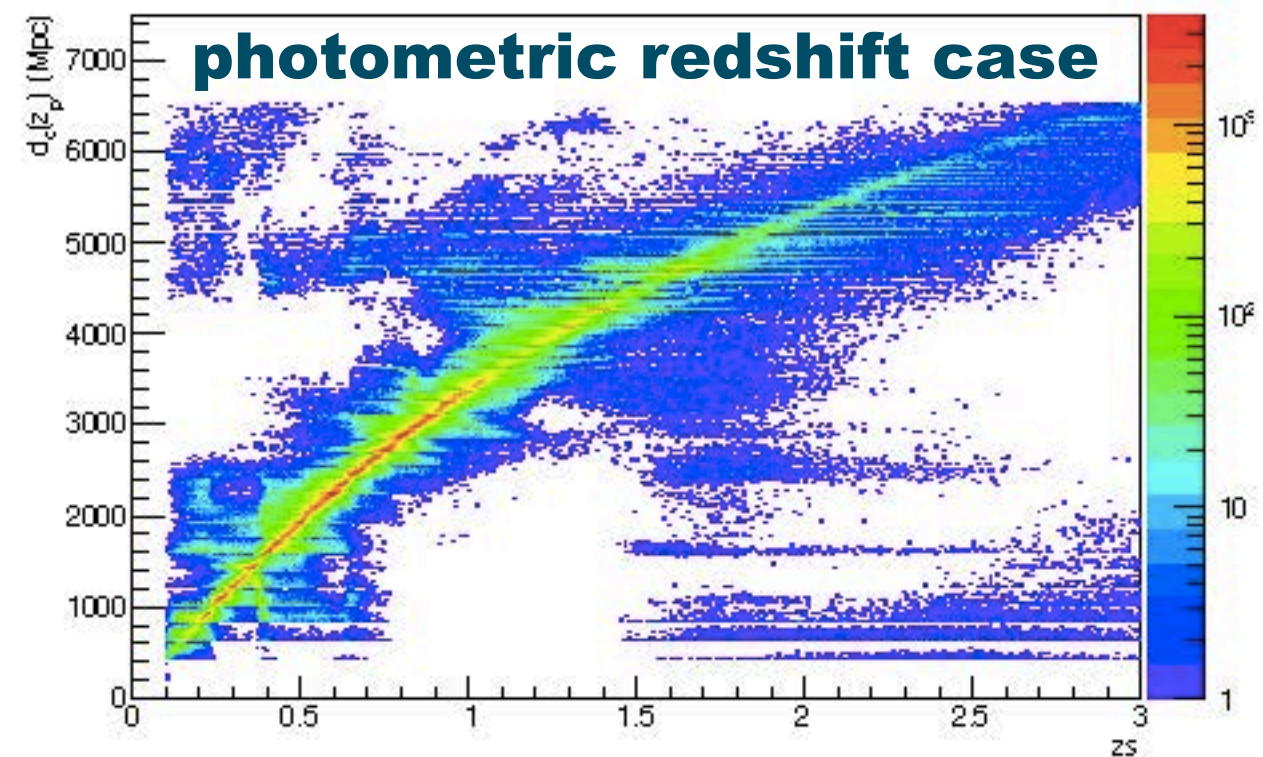
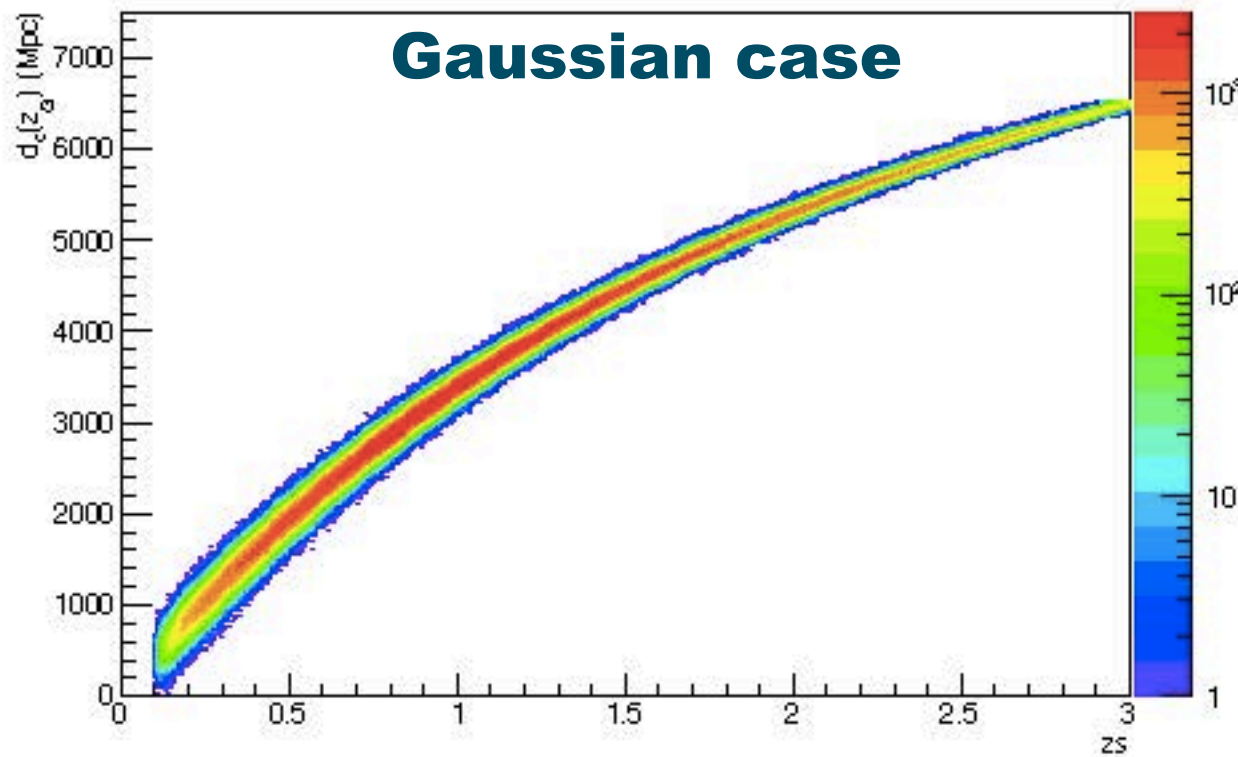


State-of-art polarisation obs. of the Crab Nebula

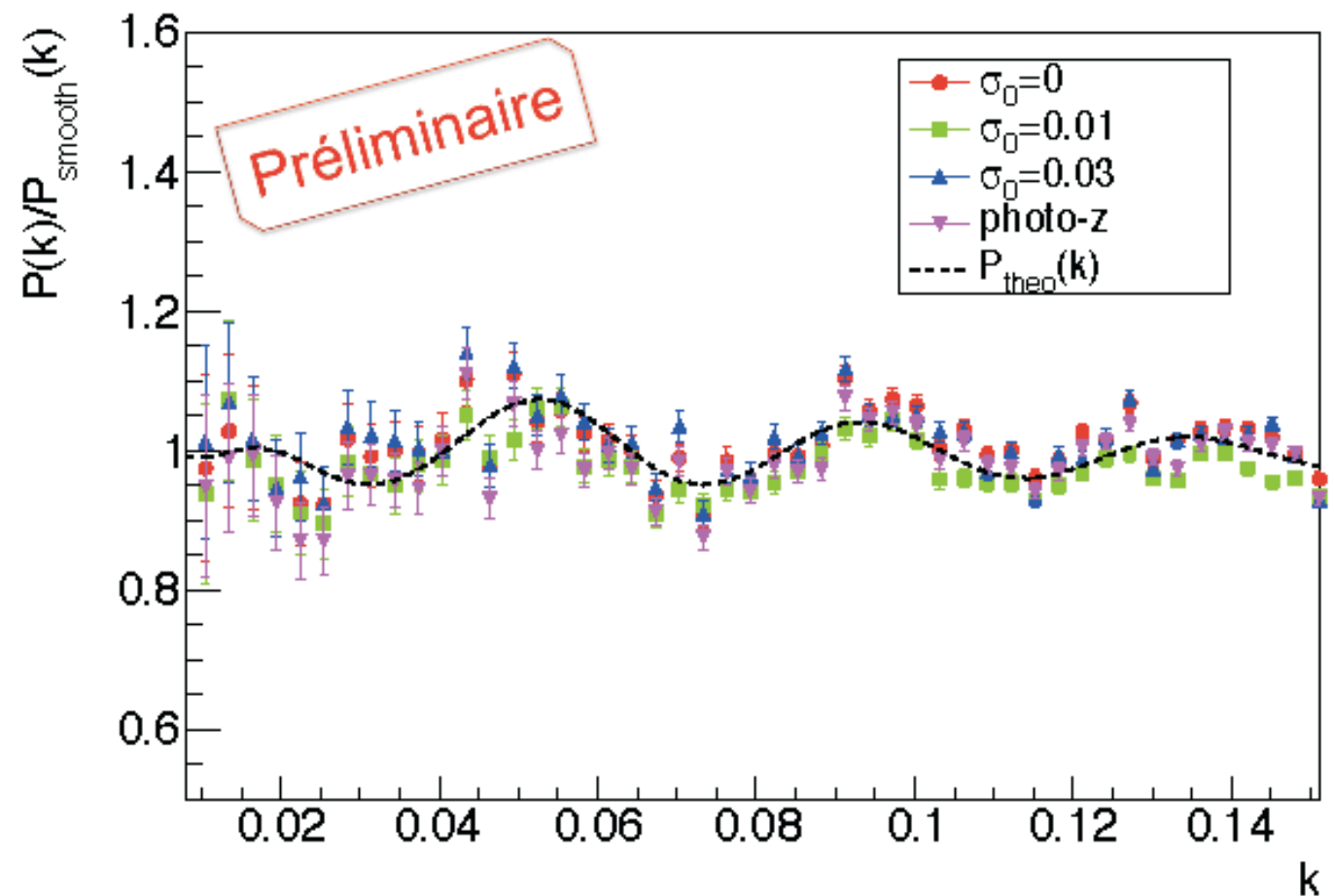
LPSC responsible for readout electronics, first data analysis pipeline and polarisation performance characterisation.

- SZ is a powerful tool to constrain n_e, T . Cosmology with cluster counts (mass calibration)
- High-resolution images of Planck clusters
- 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)



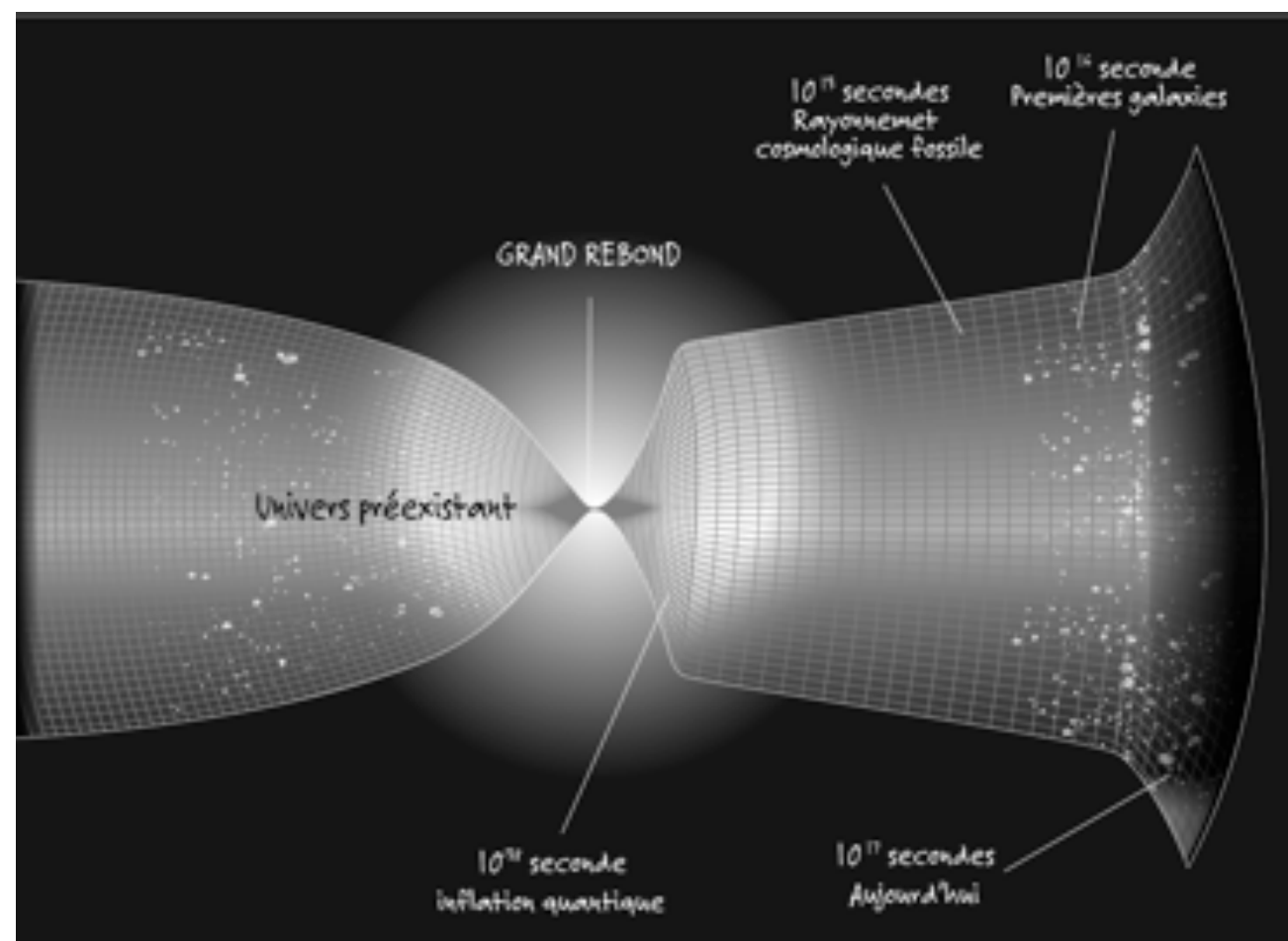


- Cosmology with LSST: accurate photometric redshifts are mandatory
- Method checked on a billion of simulated galaxies: the BAO scale is well recovered. (*A. Choyer PhD thesis*)



Loop Quantum Cosmology

- Study of primordial cosmological perturbations (scalar & tensor) in the case of an “euclidian phase” at very high density.
- Computation of the CMB spectrum - $C(l)$ – taking into account algebra deformation of the general relativity due to quantum gravity.
- Phenomenological study of black holes in rebond (or Planck stars).
Individual emission & integrated signal.



L. Linsefors & A. Barrau, **Phys.Lett.** **B748** (2015) 295-300

B. Bolliet, J. Grain, C. Stal, L. Linsefors, and A. Barrau, **Phys.Rev.** **D91** (2015) 8, 084035

A. Barrau, X. Cao, K. Noui, and A. Perez, in press for **Phys.Rev.** **D** (2015)

A. Ashtekar & A. Barrau, **Class.Quant.Grav.** **32** (2015) 23, 234001

S. Schander, A. Barrau, B. Bolliet, L. Linsefors, and J. Grain arXiv: 1508.06786

B. Bolliet, A. Barrau, J. Grain, and S. Schander, [arXiv:1510.08766](https://arxiv.org/abs/1510.08766)



MIMAC in China

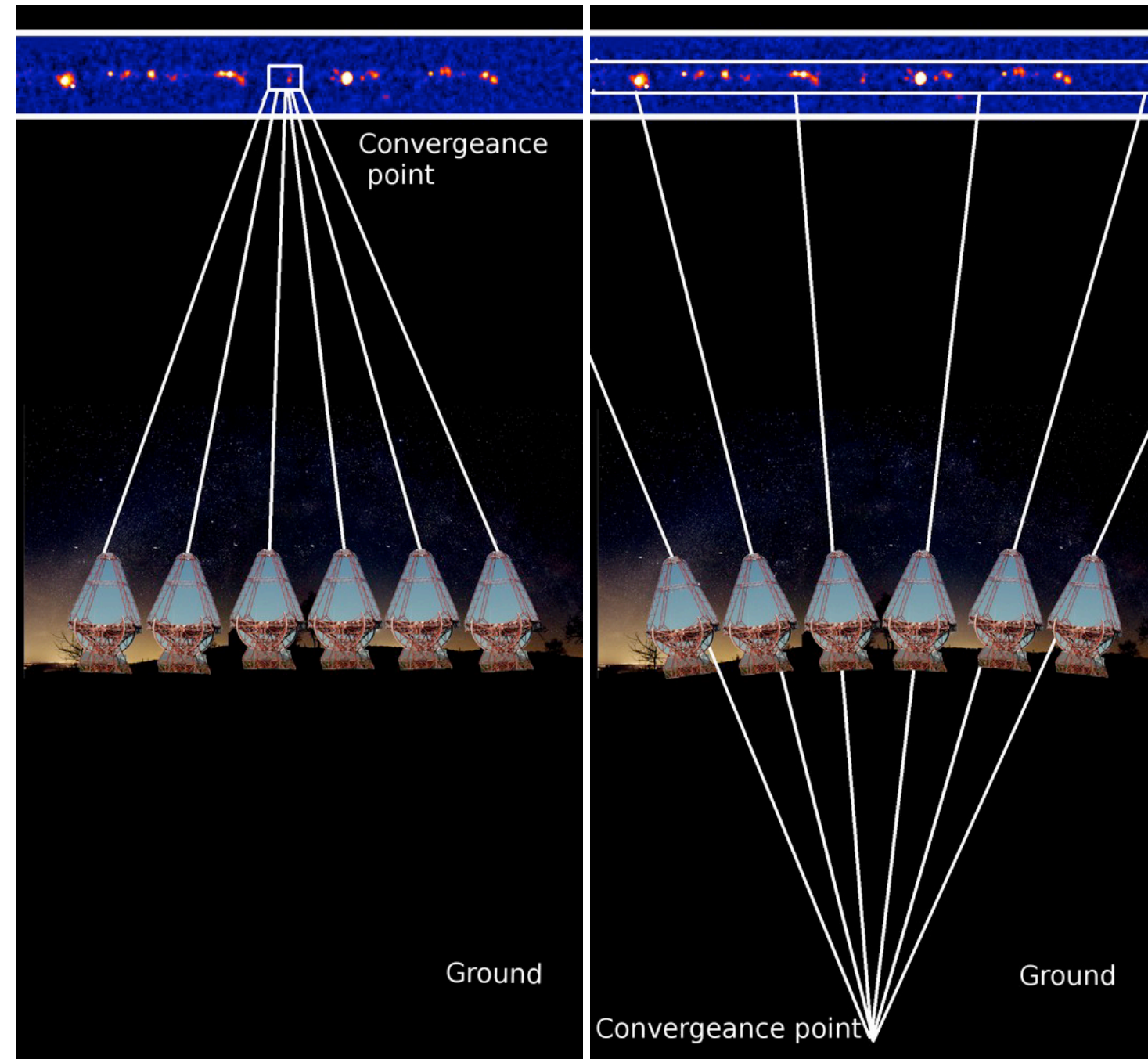
- Collaboration with China (Tsinghua (Beijing)) :MOU signed 15/11
- MIMAC-LowBackground 1 m³ (ANR-2016?)

- AMS

- Flux noyaux du lithium à oxygène, identification isotopique, dépendance temporelle

Cosmology

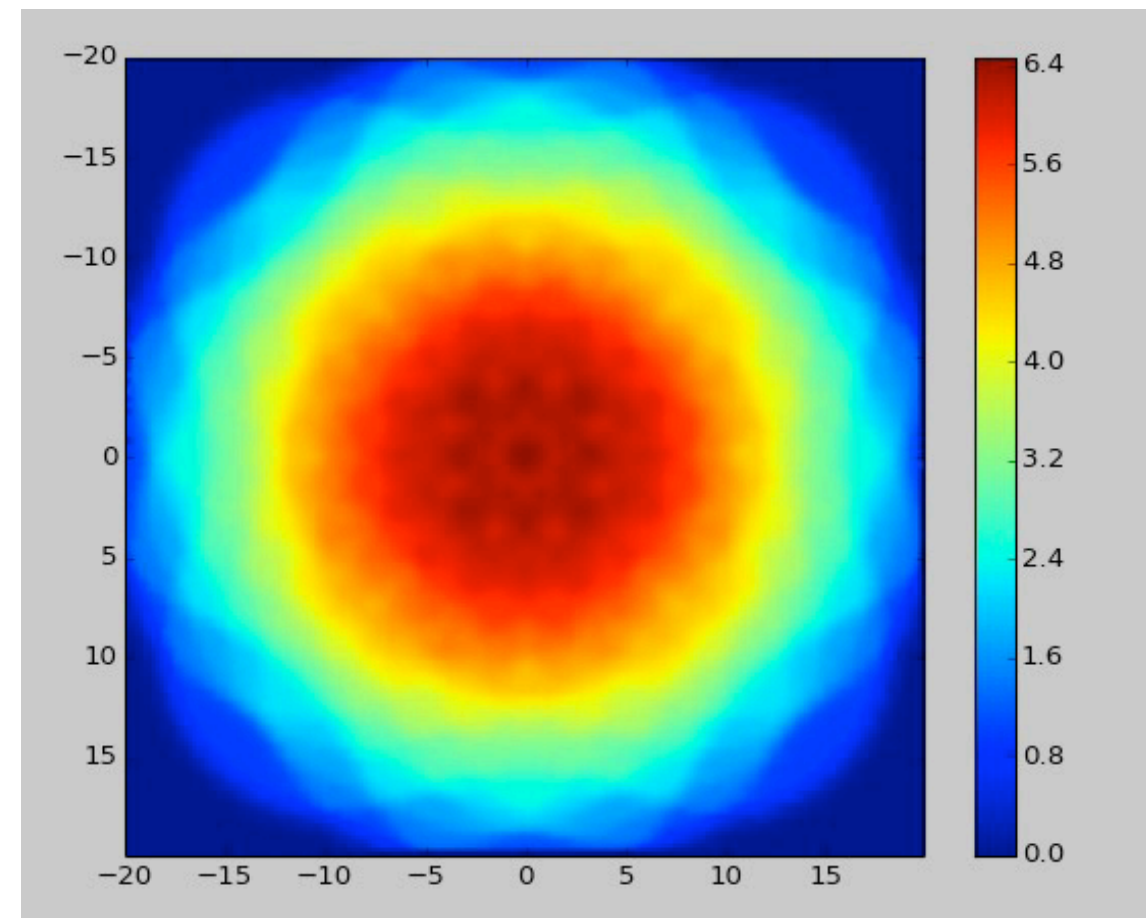
- NIKA2 ready for science
- LLST CCOB large beam to deliver, thin beam to design
- A new era for LSST in Enigmass: Dominique Boutigny, who will be the LSST-France PI, come back in February 2016. Should be the catalizer for a new group @ LAPP.



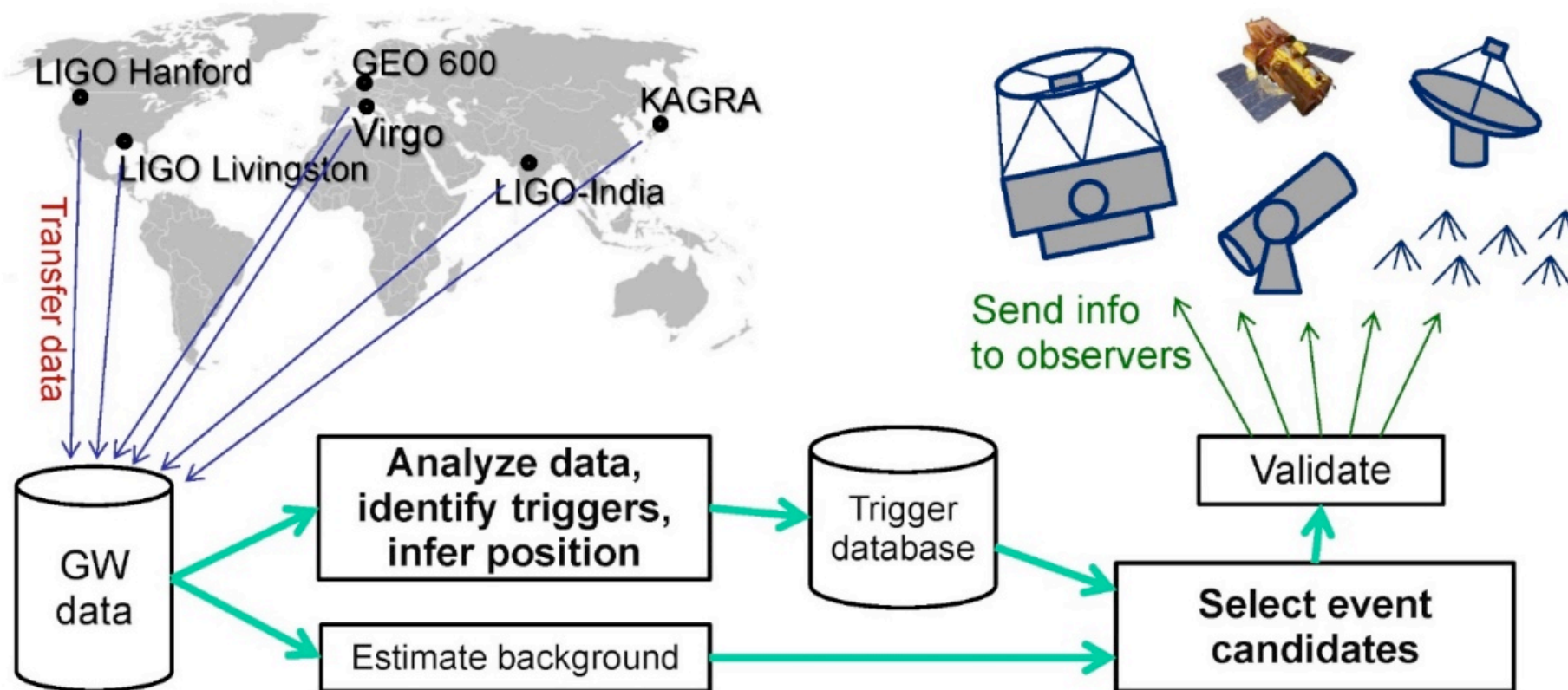
Telescope convergeant point is under the ground not in the sky

-->

This gives a larger field of view



- Sep 2015 – Jan 2016
 - Two LIGO detectors
 - Sensitivity surpassing first generation detectors
- Joint data analysis



Swift: NASA E/PO, Sonoma State U., Aurore Simonnet

- Advanced Virgo will join for O2 run in 2016