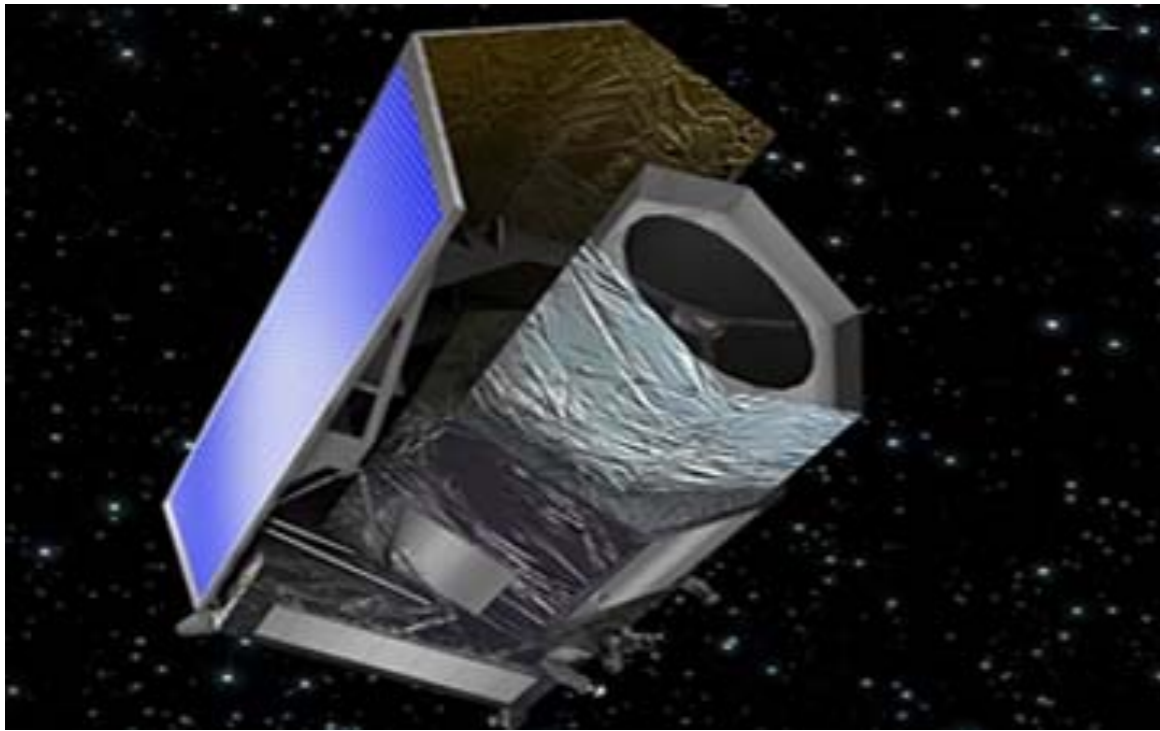


# The Universe is our lab

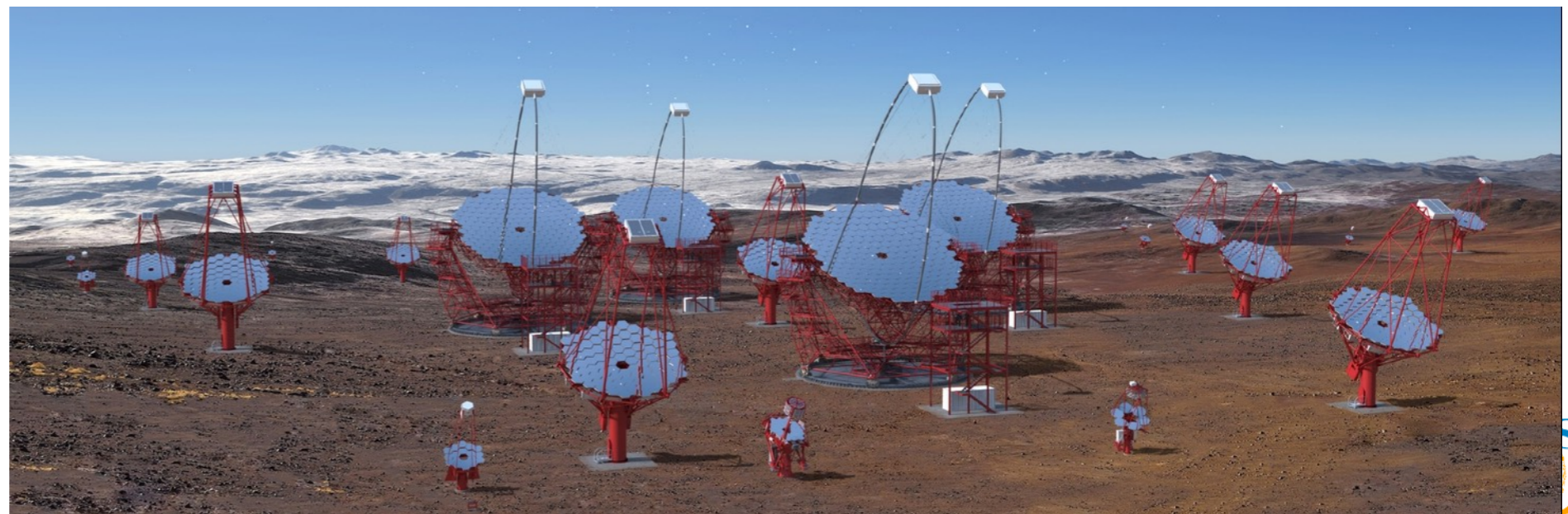


**Euclid** will map 15 000 deg<sup>2</sup> from space to “see” the dark matter distribution and constrain the DE equation of state.



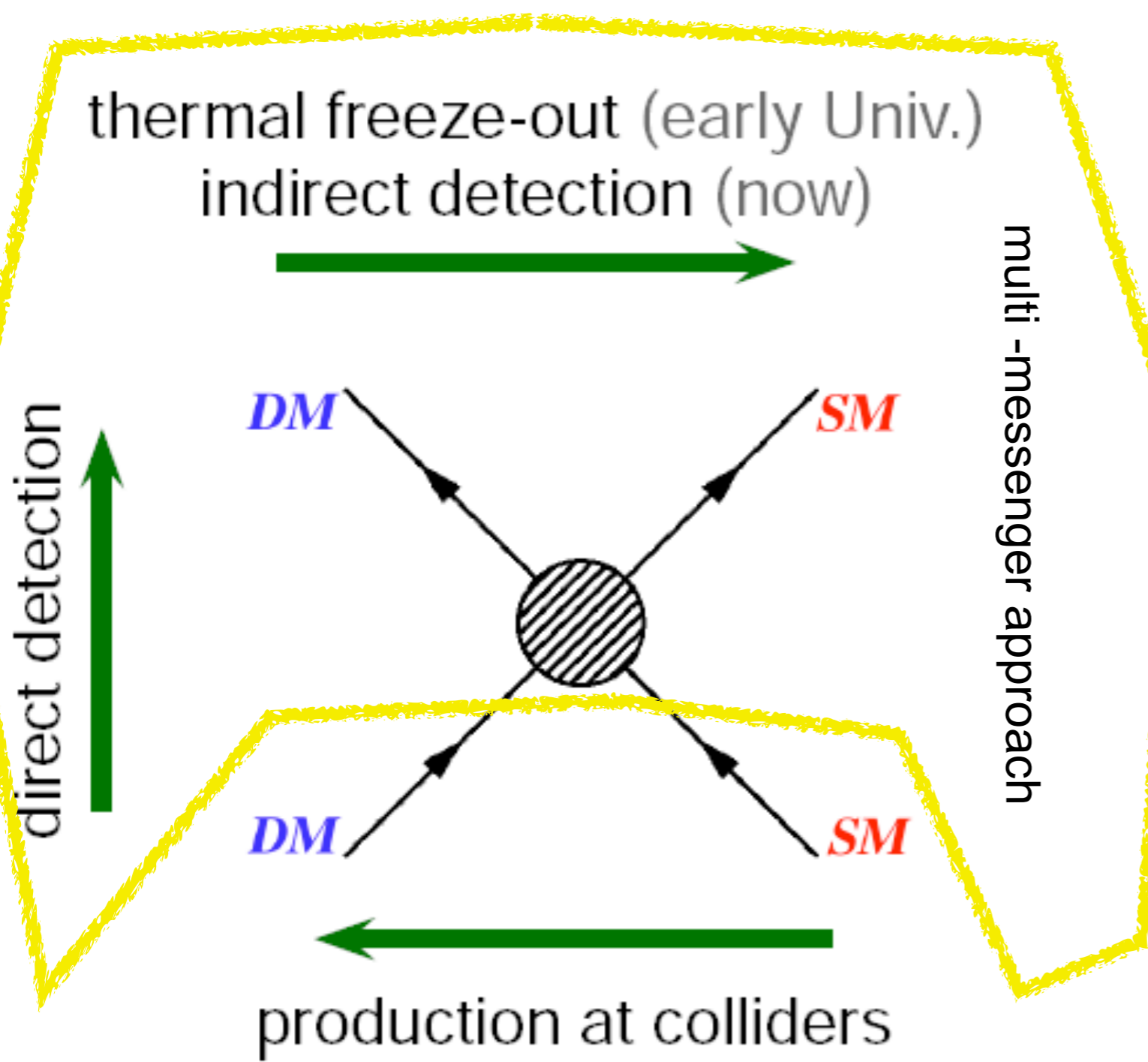
**AdVIRGO** is a gravitational wave detector in Italy, which started operating in 2017. It is a massive Michelson laser interferometer made of two orthogonal arms, each three kilometers long.

**CTA** 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.

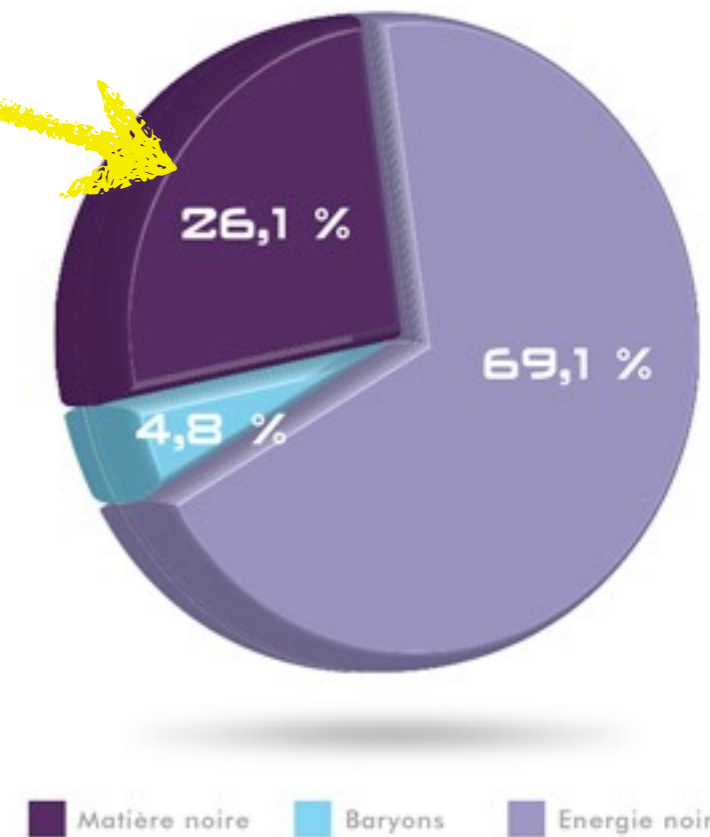


# Dark matter

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



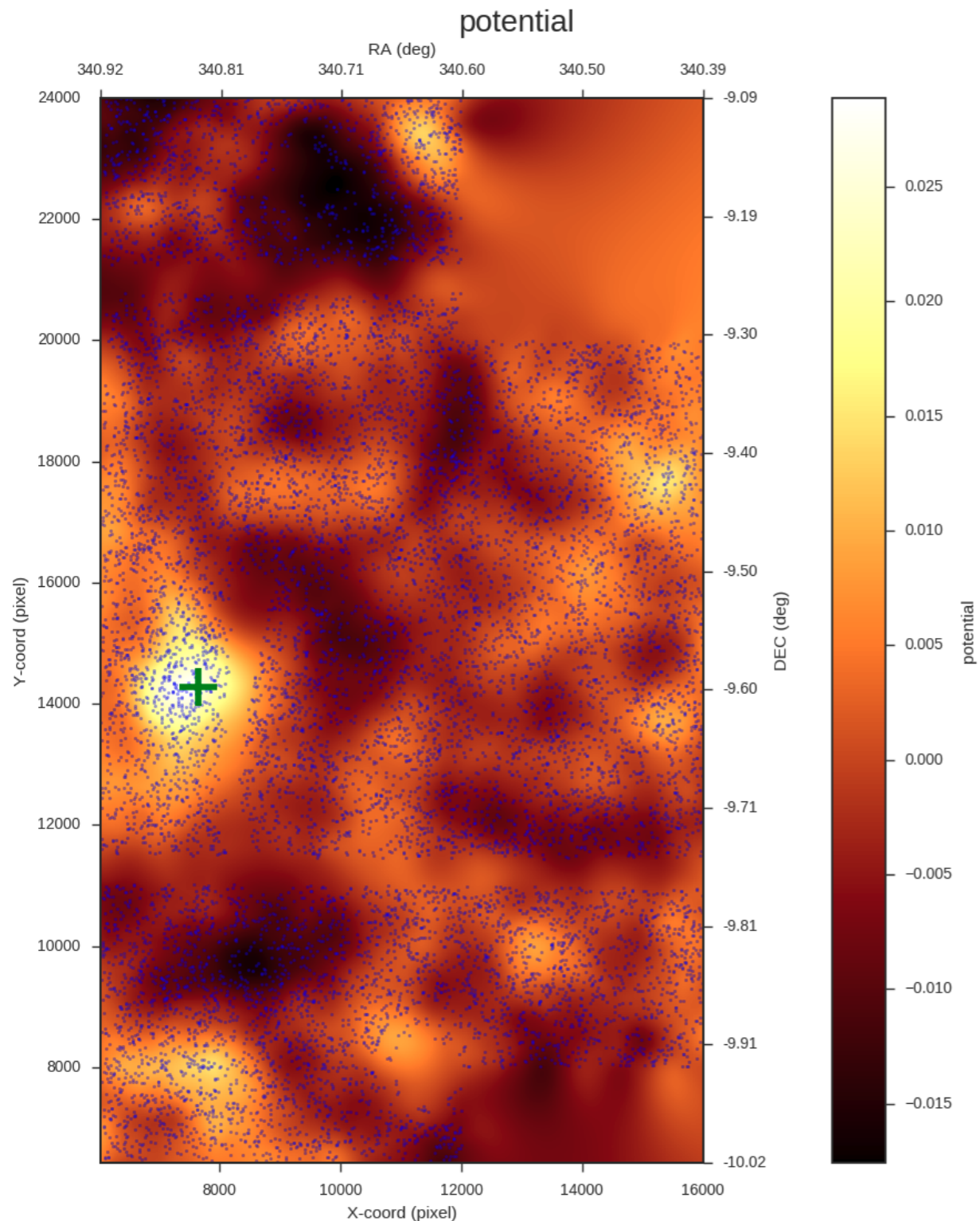
## CMB + BAO



[Planck 2015]

# Dark matter: where is it ?

MACSJ2243.3-0935



**lensing & LSS** with LSST (LAPP, LPSC)

**clusters of galaxies** with NIKA2, KISS, Euclid, LSST (LPSC)

Reconstruction of the matter gravitational potential using the shear

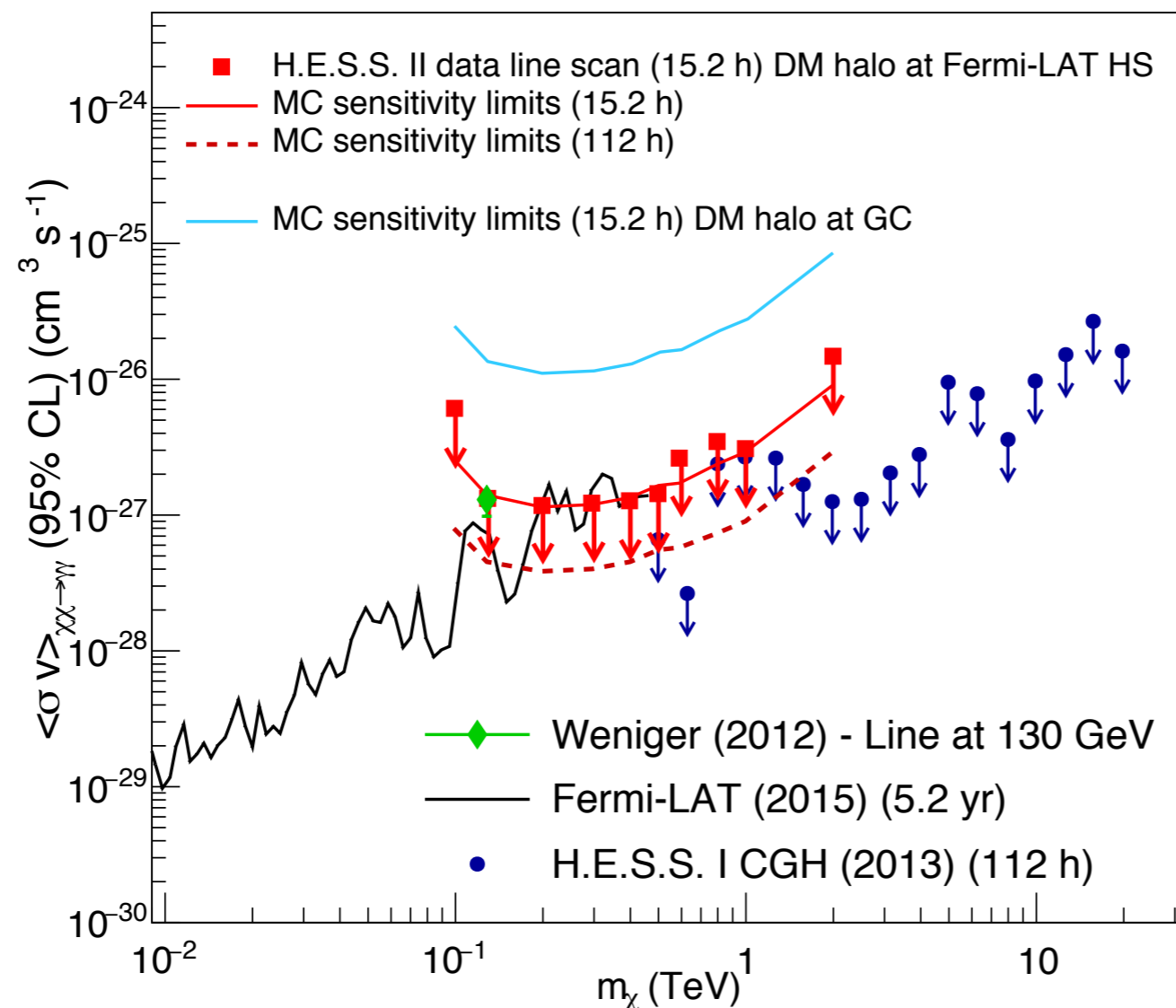
Work using CFHT data processed with the LSST stack (LAPP, LPSC)

# Dark matter: what is it ?

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

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

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



astro-ph 1609.08091

$\langle\sigma v\rangle$  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

# Extreme state of the matter

new!

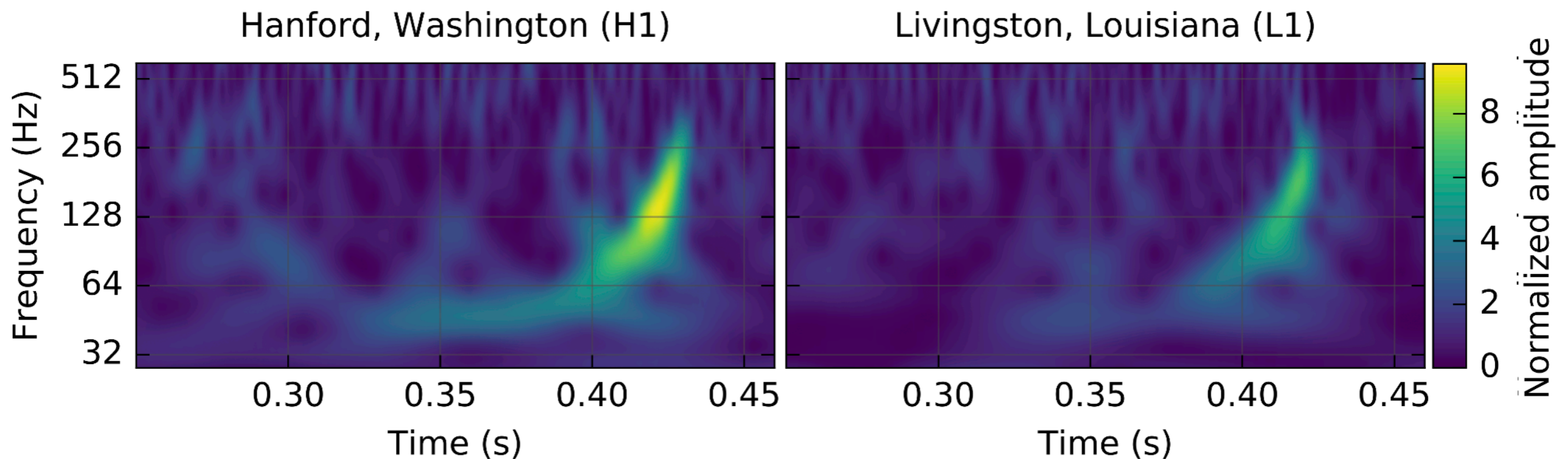
Active Galactic Nuclei with **CTA** (LAPP)

Black holes and neutron stars with **AdVirgo** (then ET)

Origin of the cosmic-rays with **Auger** & **CTA** (LPSC, LAPP)

Inflation with CMB **E4** (LPSC, LAPTh)

**Loop quantum cosmology** (LPSC)



# Synthesis of astro/cosmo activities

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

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

*it is only a scheme !*

# What's ending ?

- Planck (2016)
- AMS (detector still at work but teams move on to other subjects in 2018/2019)
- HESS/HESSII (probably ~ 2019)

# What's in progress ?

- SZ observations with NIKA then with NIKA2 from ~ 2010 up to ~ 2022 + KISS in Spain starting in ~ 2018
- MIMAC @ LSM and MIMAC Cygnus @ LSM 1 m<sup>3</sup> + China 1 m<sup>3</sup>
- phenomenology on quantum gravity & cosmology
- phenomenology on dark matter (& RC ?)



# Which new data ?

- AugerPrime (upgrade of Auger detectors, new in ENIGMASS next generation)
- CTA (successor of HESS/HESSII + team from AMS/LAPP; observations in ~ 2018/19 but already in construction, tests, simulations ...)
- LSST (survey will start in 2022 but already in construction, tests, simulations ...; new team now in LAPP)
- Euclid (observations in 2021 but already in tests, simulations ...)

# What will be new but we don't know what (yet)

- Einstein Telescope (next generation after AdVirgo, underground detector, 3 arms of 10 kms, but place, exact design, money etc to define & find)
- E4 (CMB after Planck to detect primordial B-modes; the CORE satellite project discarded: what to do now ? French/European meetings & groups have to draw a strategy using ground-based telescopes & balloon in the framework of the US S4 effort, participations to other space experiments for the next 15 years).