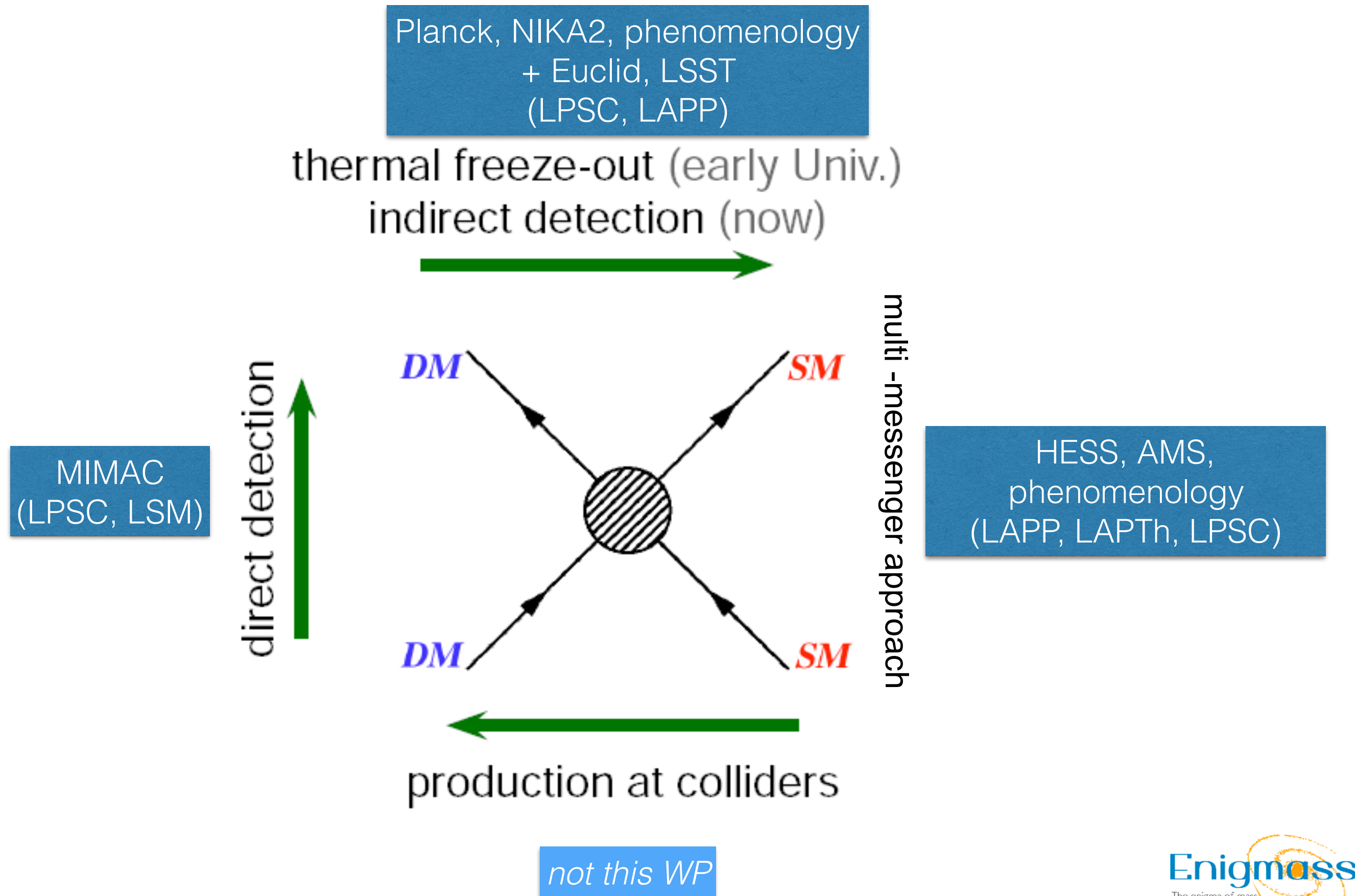
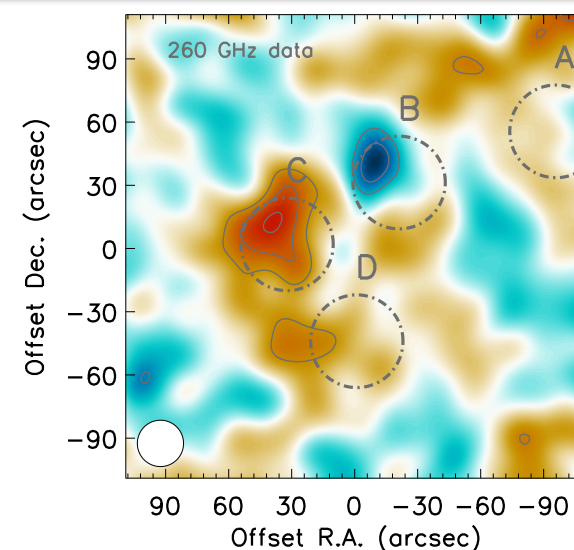
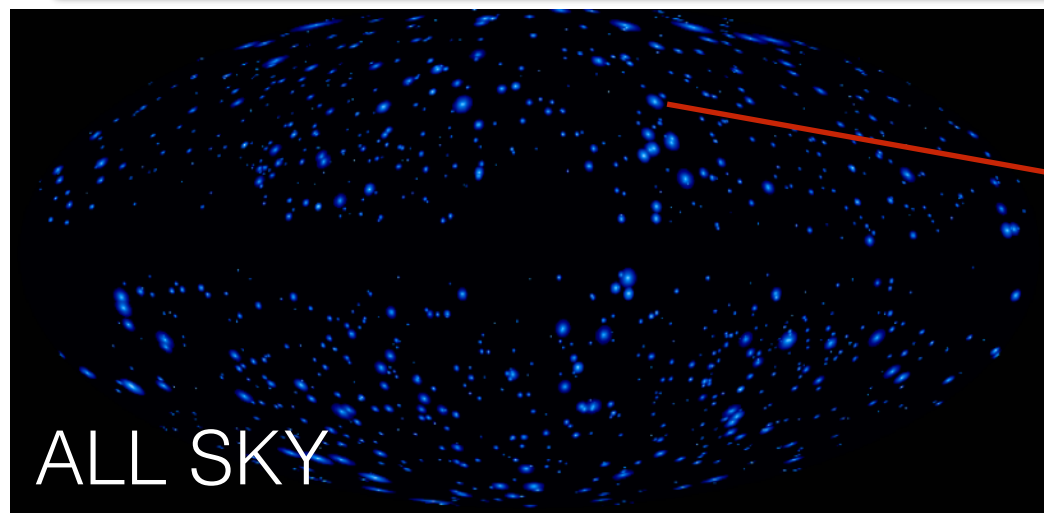


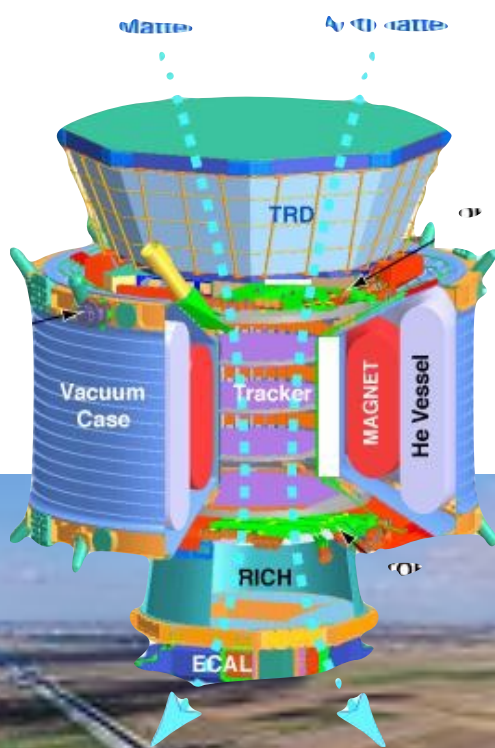
Astroparticles & cosmology: to tackle the Dark matter problem



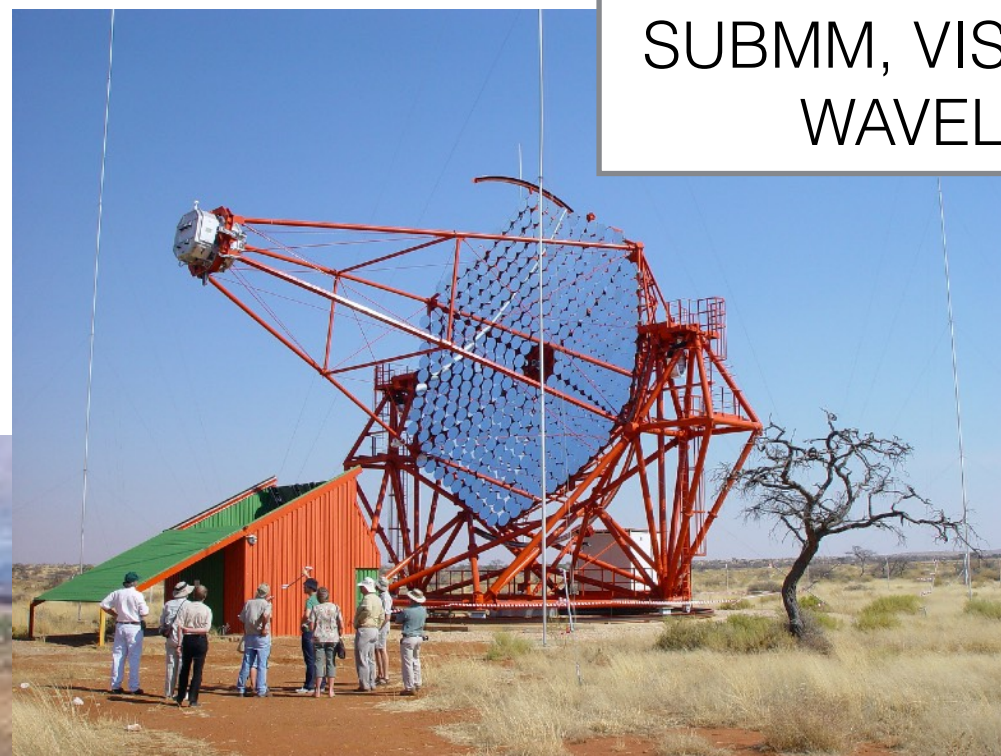
Multi-scales, multi-wavelengths, multi-messengers approach



DETAILED view
(see Florian's talk)



SUBMM, VISIBLE, GAMMA
WAVELENGTHS



COSMIC-RAYS,
PHOTONS &
GRAVITATIONAL WAVES
(see Quentin's talk)

Bilan 2016/2017

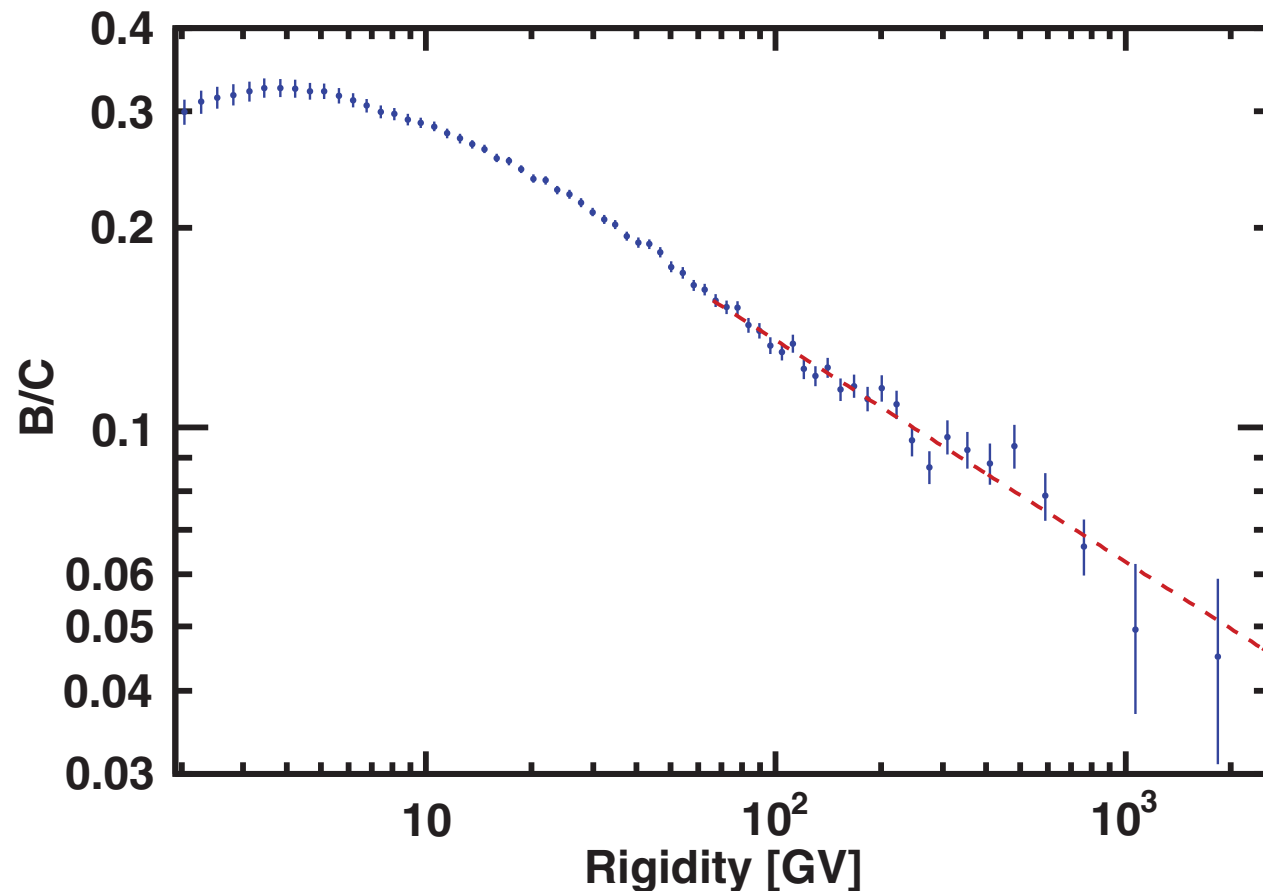
	publications 2016	publications 2017
AMS + CREAM	2	3
H.E.S.S.	9	12
MIMAC	1	1
NIKA2	3	4
Planck	51	5
Virgo	35	33
pheno BH&cosmo	5	6
pheno CR&DM	26	11

Just indicative - **probably not complete**

Note the very different collaboration sizes

Euclid & LSST in preparation (1 LSST publication in 2017 for DB)

Boron to Carbon Flux Ratio in Cosmic Rays from 1.9 GV to 2.6 TV with AMS

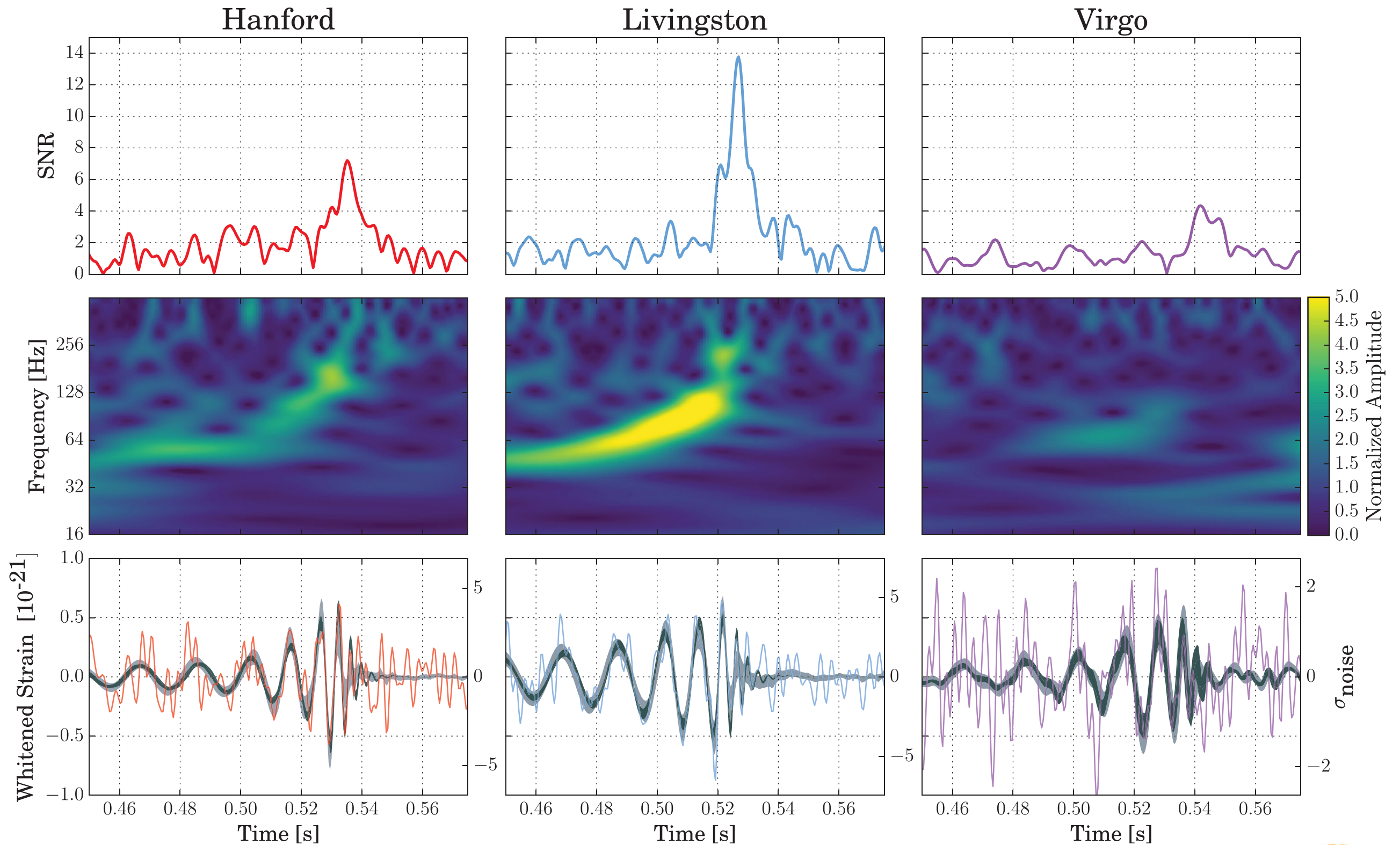


Knowledge of the rigidity dependence of the boron to carbon flux ratio (B/C) is important in understanding the propagation of cosmic rays.

The B/C ratio does not show any significant structures in contrast to many cosmic ray models that require such structures at high rigidities. Remarkably, above 65 GV, the B/C ratio is well described by a single power law, in good agreement with the Kolmogorov theory of turbulence which predicts $\Delta = -1/3$ asymptotically.

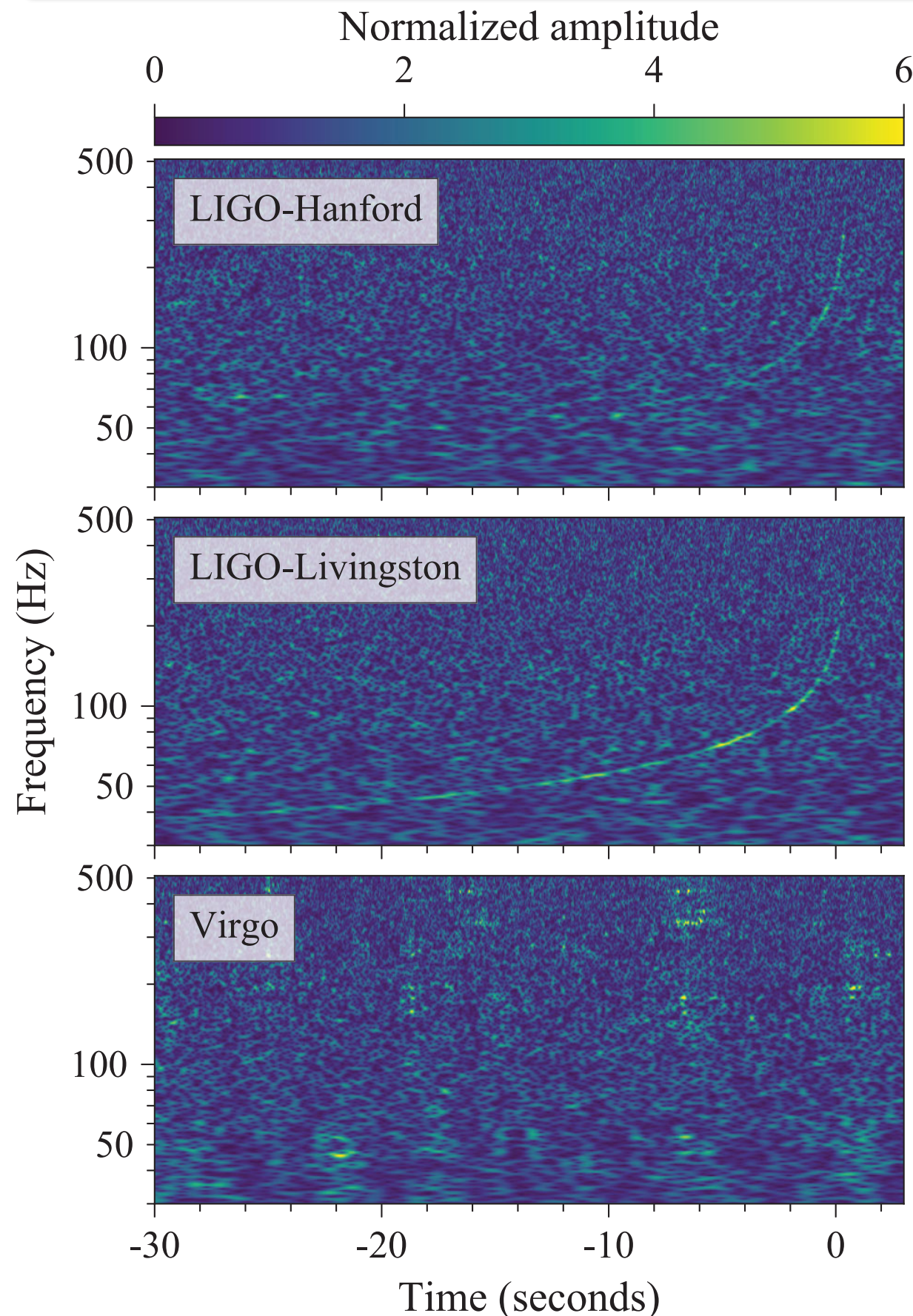
FIG. 1. The AMS boron to carbon ratio (B/C) as a function of rigidity in the interval from 1.9 GV to 2.6 TV based on 2.3 million boron and 8.3 million carbon nuclei. The dashed line shows the single power law fit starting from 65 GV with index $\Delta = -0.333 \pm 0.014(\text{fit}) \pm 0.005(\text{syst})$.

Main results of the year: First detection of gravitational waves by Virgo

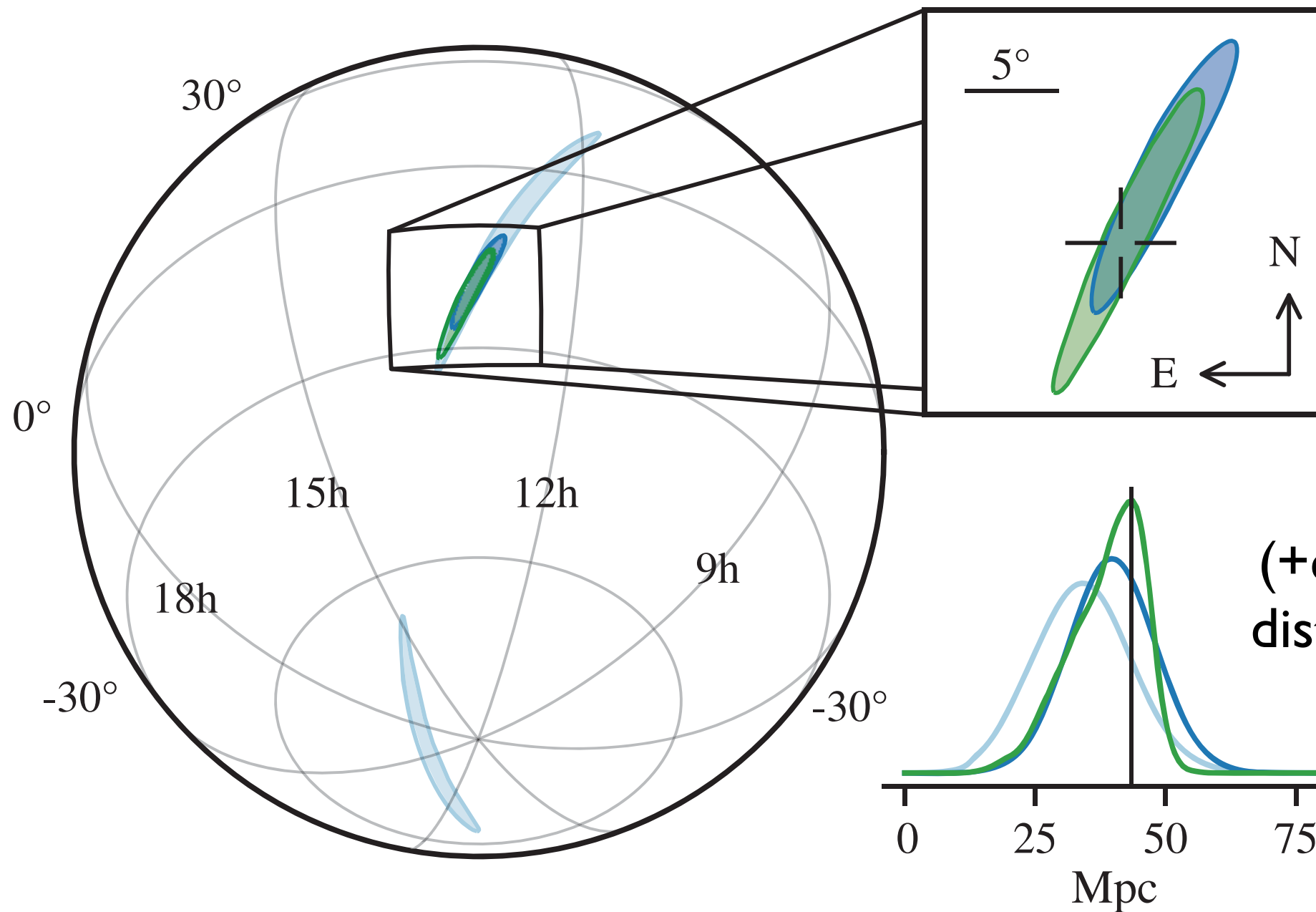


Times are shown from August 4, 2017, 10:30:43 UTC.

Main results of the year: First detection of a kilonova by gravitational waves & electromagnetic waves



- Detection August 17th, publication October, 16th
- Fusion of 2 objects with mass between 1.1 and 1.5 solar mass. Unknown result (NS or BH)
- No signal from Virgo → event “in the shadow” → localisation précise enough thanks to the **three** interferometers

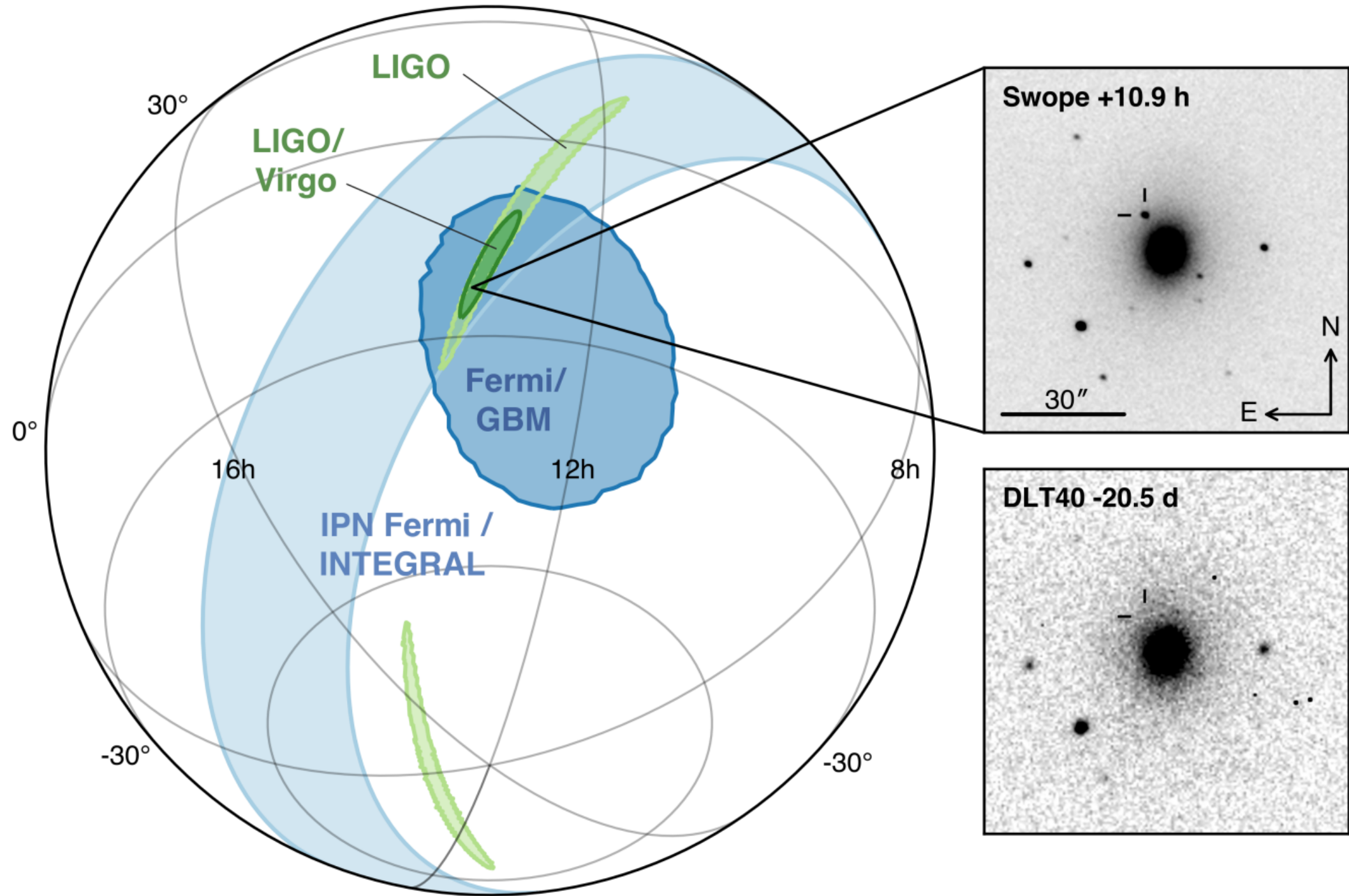


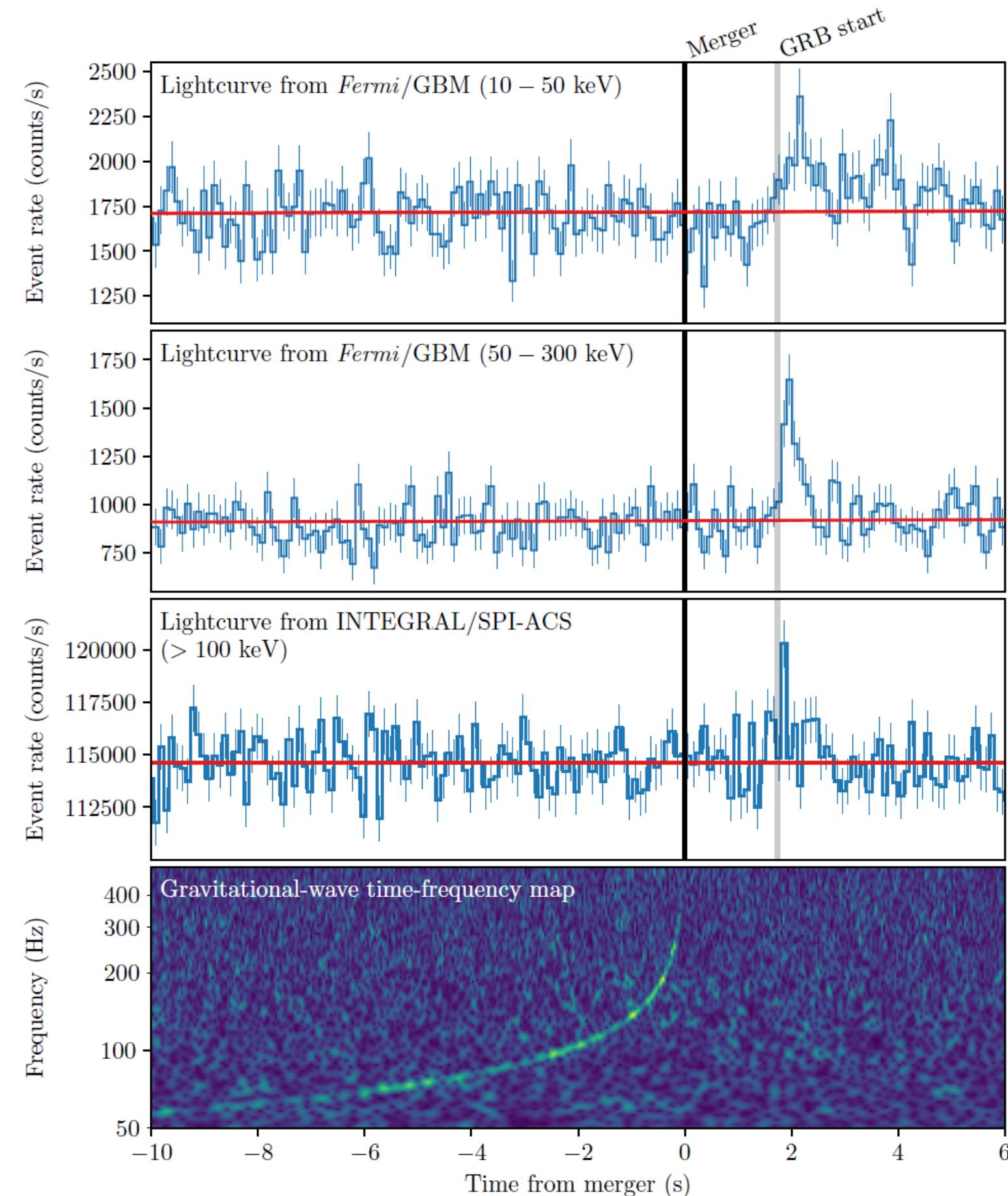
theoretical redshift
(+cosmo parameters) &
distance estimation from
GW signal
(NGC 4993)

Cosmology

[light blue : 2 LIGO 190 deg², dark blue : + VIRGO 31 deg², green : with improved method 28 deg²]

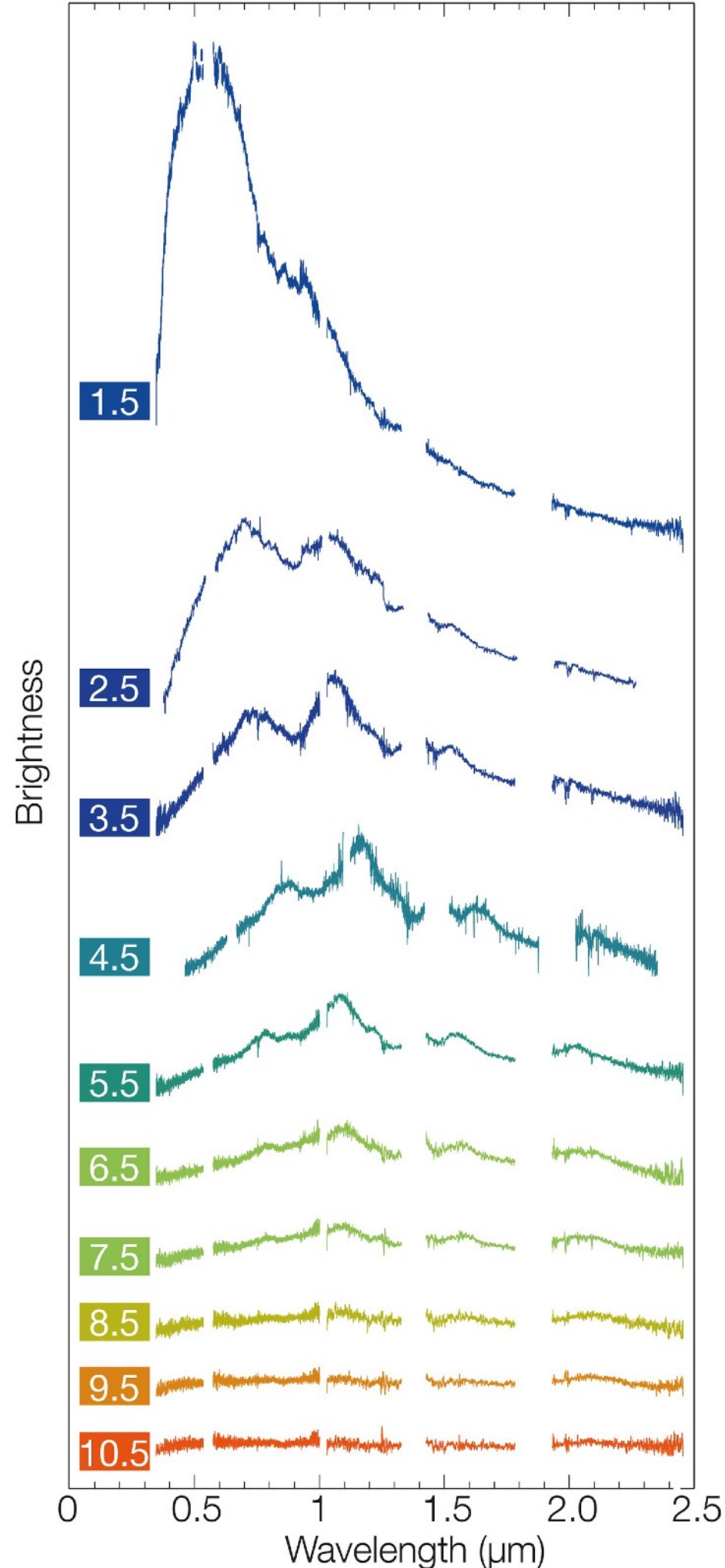
First electromagnetic counterpart detected by Swope Supernova Survey (ϕ Im, NIR, Chili),
~ 10,9 hour after the GW signal.
At the time only the GBM detector of Fermi had access to this part of the sky.
Event seen in the INTEGRAL data.





Less than 2 seconds between
fusion and gamma flare.

H.E.S.S. upper limit :
0.22 days after GW
 $F < 3.9 \cdot 10^{-12} \text{ erg.cm}^{-2}.\text{s}^{-1}$ (90%)
in the range [0.28-2.31] TeV



stamp = time in day after fusion

Color = main color of the object at that time

(Xshooter, VLT, ESO data)

kilonova : the fusion produces nuclear reactions allowing production of nuclei heavier than Iron due to the high neutron abundance. This hot matter cools down and spreads out: light in gamma, then X, then blue to red.

Synthesis of astro/cosmo activities, past, present and future

	2012	2019	2029
CMB & SZ effect	Planck	NIKA / NIKA2 <i>LiteBird ?</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		
<i>phenomenology</i>	quantum gravity & cosmology		

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

it is only a scheme !

Discussions for future driving scientific projects

Axe Matières noire et baryonique dans les plus grandes structures de l'univers

Amas de galaxies avec NIKA2, Euclid, LSST (LPSC) & LSST (LAPP)

Étalonnage des observables de masse pour Euclid & LSST avec les données SZ de Planck & NIKA2.

Parfait timing des 3 expériences couvrant toute la durée du futur LabEx, expertise du groupe démontrée avec Planck.

Discussions for future driving scientific projects

Axe Annihilation de matière noire dans les galaxies

Détection indirecte avec NIKA2, Euclid, LSST, phénoménologie (LPSC), LSST, CTA (LAPP) & phénoménologie (LAPTh)

- * Pour les amas, possibilité d'obtenir les profils centraux via SZ par NIKA2
- * Pour les galaxies naines, irrégulières et les amas : catalogue de positions des amas par LSST/Euclid
- * Pour les amas proches : distribution de matière noire par effet de lentille gravitationnelle par LSST/Euclid

Dans tous les cas, signal gamma par CTA et choix des cibles, prédiction du bruit de fond astrophysique & interprétation avec les groupes Phénoménologie.

Parfait timing des 4 expériences couvrant toute la durée du futur LabEx, expertise du groupe démontrée avec H.E.S.S. et AMS + USINE.

Discussions for future driving scientific projects

Axe Matière baryonique en état extrême

Suivi multi-longueurs d'onde et multi-messagers des alertes GRB issues de LIGO/Virgo (LAPP) par Auger, NIKA2, LSST (LPSC) & CTA, LSST (LAPP), prédiction et interprétation en collaboration avec le groupe Phénoménologie (LAPTh)

LSST : possibilité de participer à la politique de suivi d'alerte, besoin d'algorithmes de choix, au programme de la prochaine réunion LSST France

CTA : politique exacte reste à définir, mais prendra la suite de H.E.S.S où cette activité a commencé au LAPP.

Auger : contribue par la recherche de photons et de neutrinos d'énergie extrême

Possibilité de lien avec ALICE car l'équation d'état de ces objets super-denses intervient dans le calcul du signal attendu.