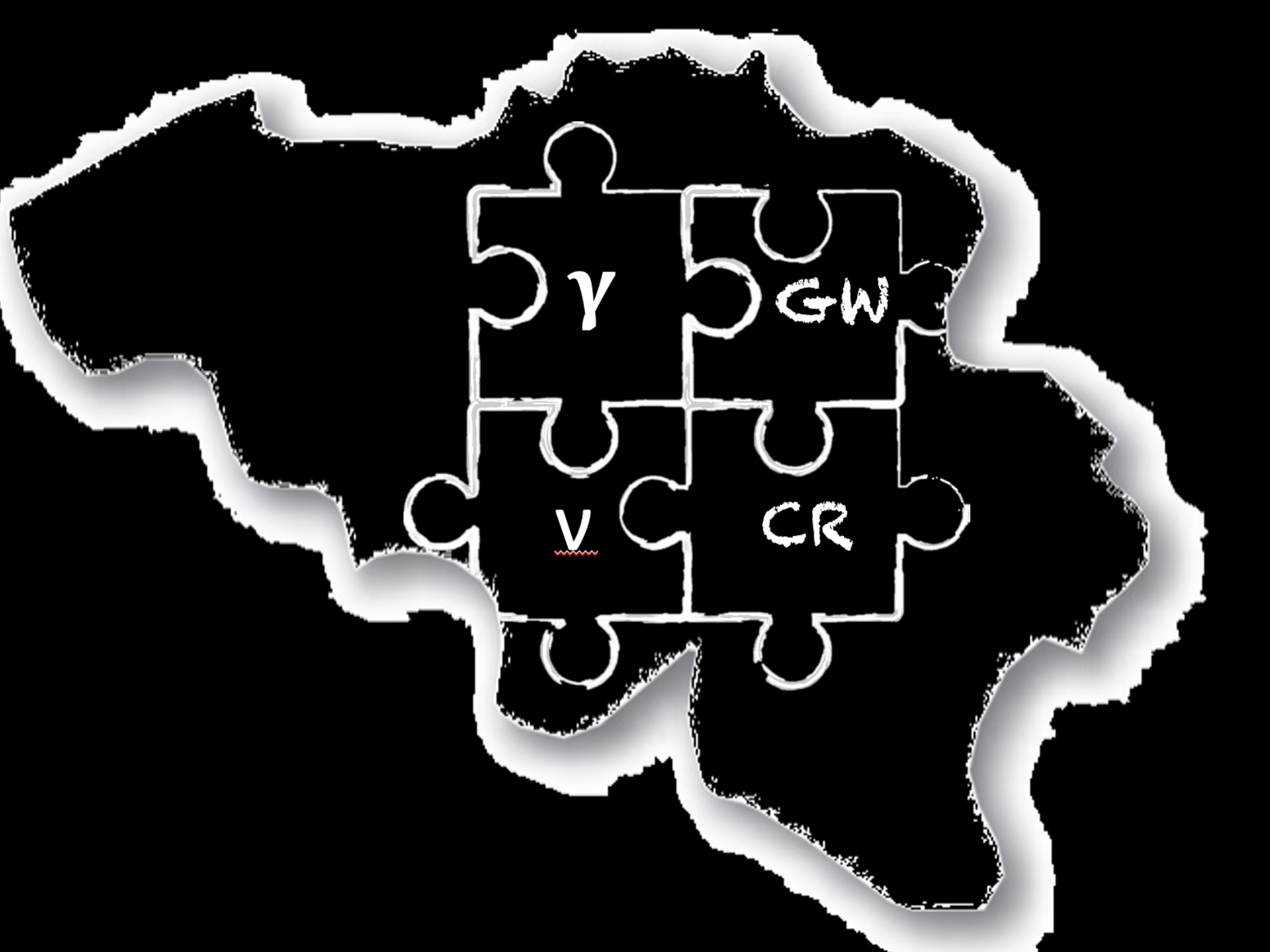
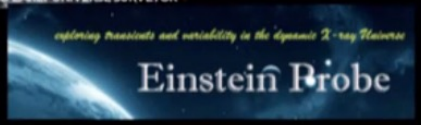
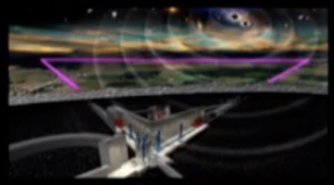

γ
GW
ν
CR

A REVOLUTION IN OUR KNOWLEDGE OF THE EARLY UNIVERSE, FUNDAMENTAL PHYSICS AND TRANSIENT ASTROPHYSICS…





M. Branchesi

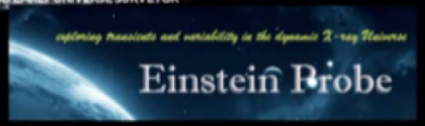
A REVOLUTION IN OUR KNOWLEDGE OF THE EARLY UNIVERSE, FUNDAMENTAL PHYSICS AND TRANSIENT ASTROPHYSICS…

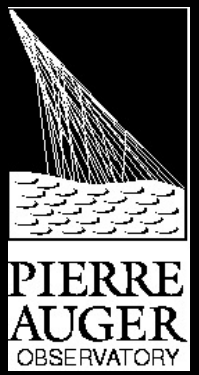
M. Branchesi

+ access to optical telescopes

+ LOFAR

A REVOLUTION IN OUR KNOWLEDGE OF THE EARLY UNIVERSE, FUNDAMENTAL PHYSICS AND TRANSIENT ASTROPHYSICS...



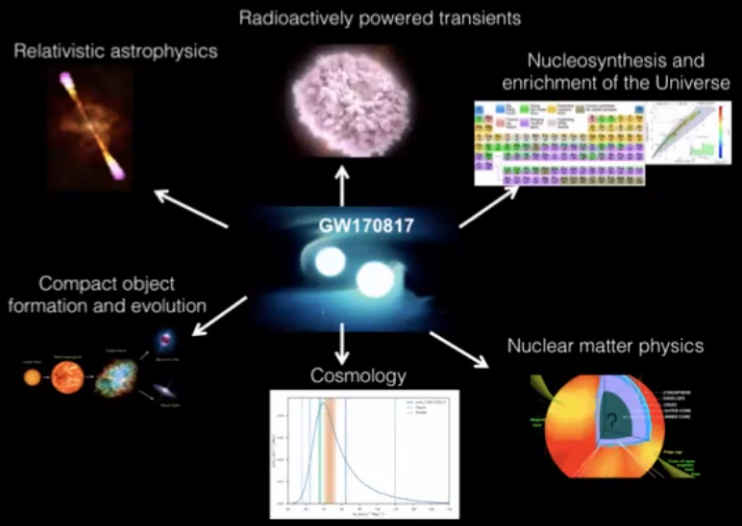


M. Branchesi

Ghirlanda et al. 2019, Science

A relativistic energetic and narrowly-collimated jet successfully emerged from neutron star merger GW170817!

M. Branchesi



- Large increase of detection rate
  - population of BNS/NSBH/BBH
  - detections along the cosmic history
- Better parameter estimation

- Higher chance to detect other sources and counterparts: core-collapse SN, new-born neutron stars, magnetars, FRBs, neutrinos

Kilonova/GW - EOS constraints

Kilonova/GW - Nucleosynsthesis

GRBs – BNS/NSBH merger up to high z

Relativistic jet properties

Jet-less/jet GRBs

GRB/stable NS remnant

Link to Star Formation History

Emission mechanism

Cosmology

M. Branchesi

Multi-messenger synergies

Optical telescopes: TAROT, MASTER, LCOGT, ZTF, LSST…
- Easy access follow-up of large error box
- Characteristation of the potential counterpart with spectroscopy (nature, redshift…)

X-ray telescopes: Swift, INTEGRAL, SVOM, ATHENA…
- Very clean sky
- Provide transient triggers (GRB, AGN, Novae…)
- ToO program (not so easy access)

γ-ray telescopes: Fermi-LAT
- All-sky complete monitoring
- Provide transient triggers (GRB, AGN…)

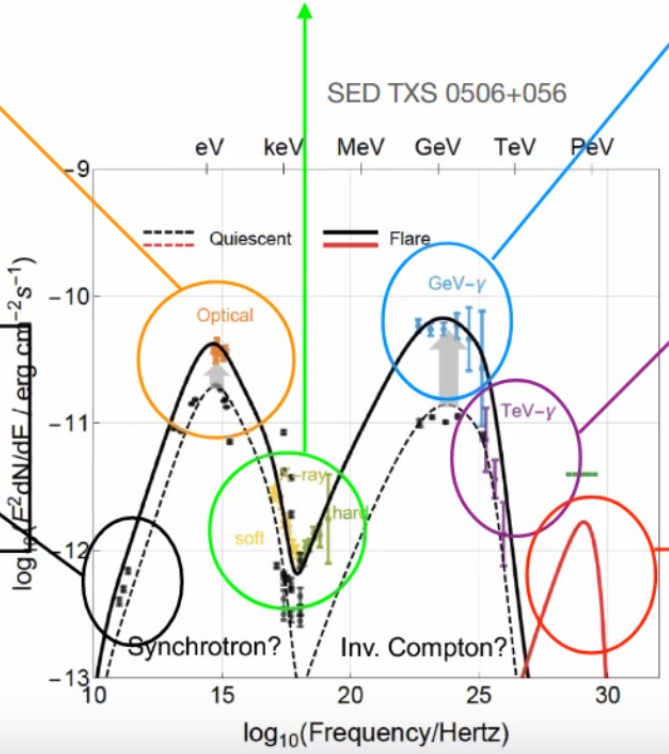
VHE γ-ray telescopes: HESS, MAGIC, CTA…
- Most natural common science case
- Follow-up (not easy access)

VHE γ-ray telescopes: HAWC, LHAASO…
- All-sky monitoring
- Provide triggers

Neutrino telescopes: ANTARES, IceCube, KM3NeT, GVD…
- Mutual follow-up
- Confirmation of sources, improve significance

Radio telescopes: Parkes, MWA, Lofar, Nenufar, ASKAP, SKA, VLBI…
- Provide triggers (FRB…)
- Follow-up

+ link with LIGO/VIRGO
+ SK, SNEWS



D. Dornic

Not to scale

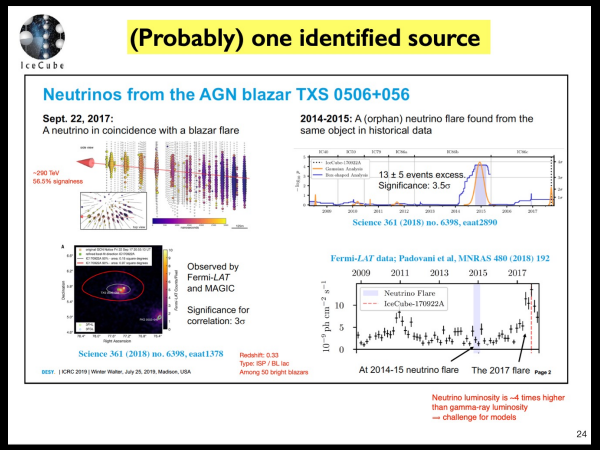
Alert systems
Coordination
in between
instruments

(Prioritization
of candidates)

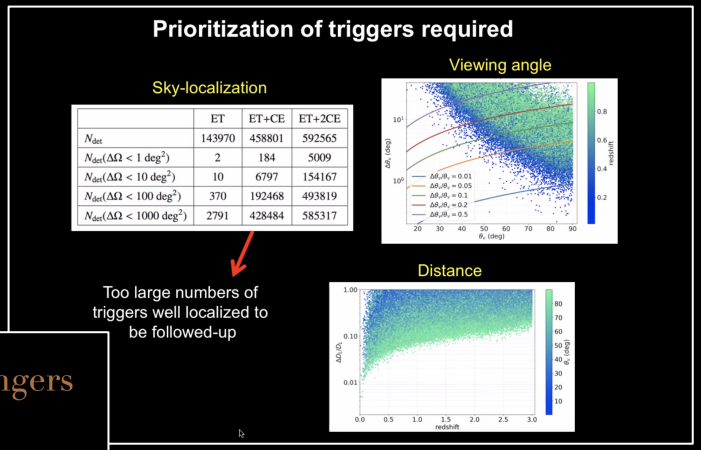
Joint analysis

Interpretation

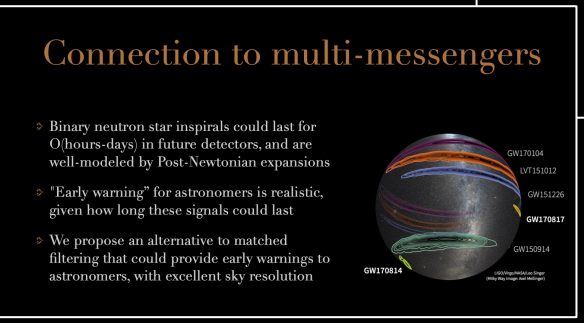
t



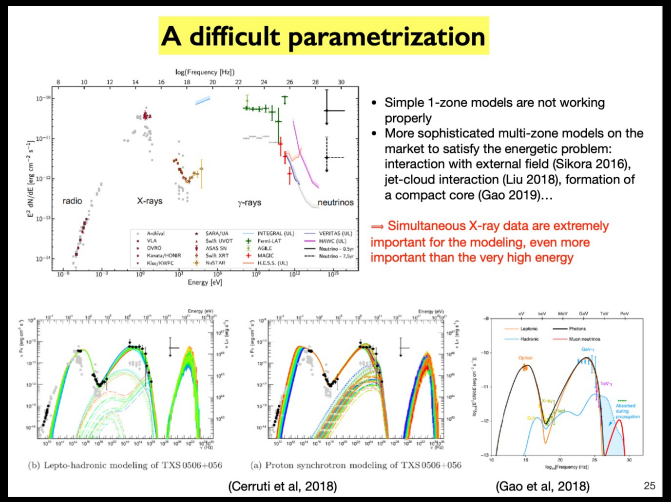
D. Dornic



M. Branchesi



A. Miller

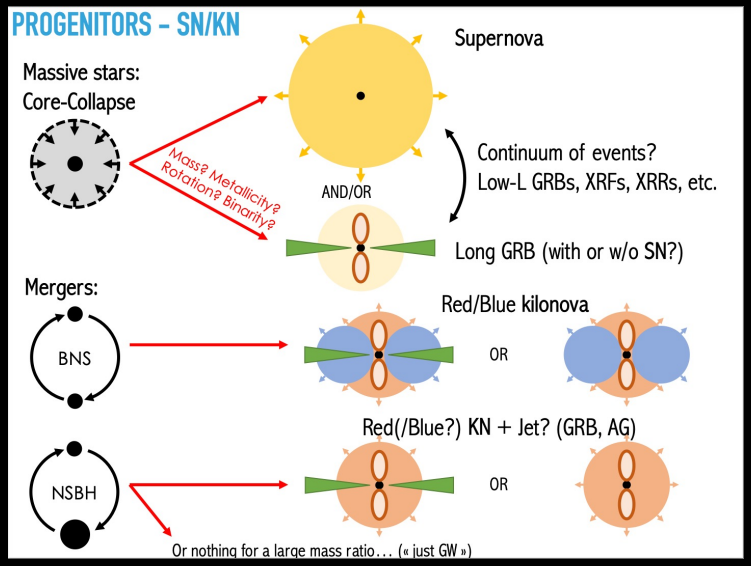


D. Dornic

There is a need for

- Preparation
- Coordination
- High quality data set (multi-wavelength + multi-messenger)
- Exchange within instruments
- Exchange between communities

Joint efforts?



BNS MERGERS: GW+EM

- GW/bright SGRB: current limitation = GW horizon (wait for O5? ET?)
- Other counterparts: best case = kilonova (less anisotropic)

Searching the KN remains very difficult
(a weak transient on a week timescale in a large error box)

Some expected improvments:
- more interferometers in the GW network: better localization
- LSTT (large fov + deep limit mag. – cadence?)

Needs dedicated follow-up instruments (an example: GRANDMA)

- Afterglow: very difficult without an accurate localization with the KN
- Rare MM-detections can be complemented by other (EM-only) channels:
  SGRB+AG ; SGRB+AG+KN ; orphan KN? ; orphan AG?

F. Daigne

Binary mergers

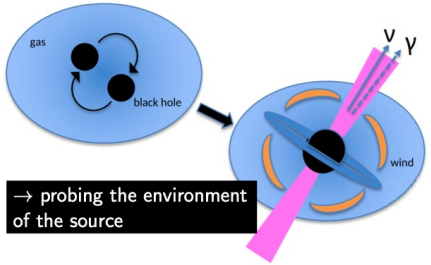
Phys. Rev. D 93, 044019
Phys. Rev. D 93, 123015

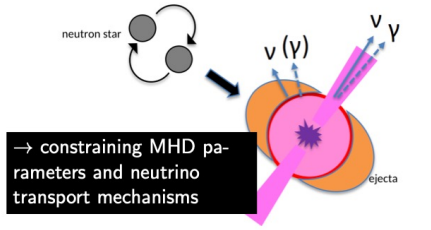
4

Mergers of compact objects (Neutron Stars -NS-, Black Holes -BH-) are established gravitational wave (GW) emitters.

- **BNS** (NS+NS) or **NSBH** (NS+BH): may produce short Gamma-Ray Bursts with neutrino production
- **BBH** (BH+BH): neutrinos may be produced in the accretion disks of the BHs

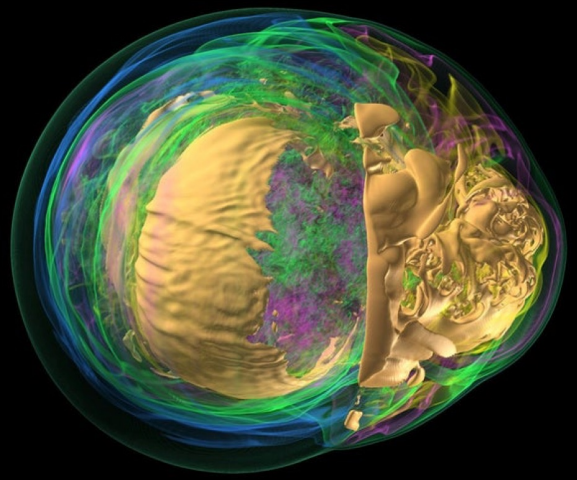
Spectrum	$E^{-\gamma}$ often considered in searches and MeV/GeV emission?
Shape	isotropic (not realistic at high energy) or presence of directional jet?
Timing	GW170817 + GRB170817A observation hints to prompt signal for BNS





M. Lamoureux

Neutrinos from core-collapse supernovae



D. Dornic

Joint efforts?

- Search for “non-obvious” joint observations
- Extraction of physical constraints in multi-messenger analyses (observation + non-observation)
- Computing ressources for joint analyses
- Coordination for follow ups (shifts, MoU, data sharing,…)
- Definition of prioritization for follow ups