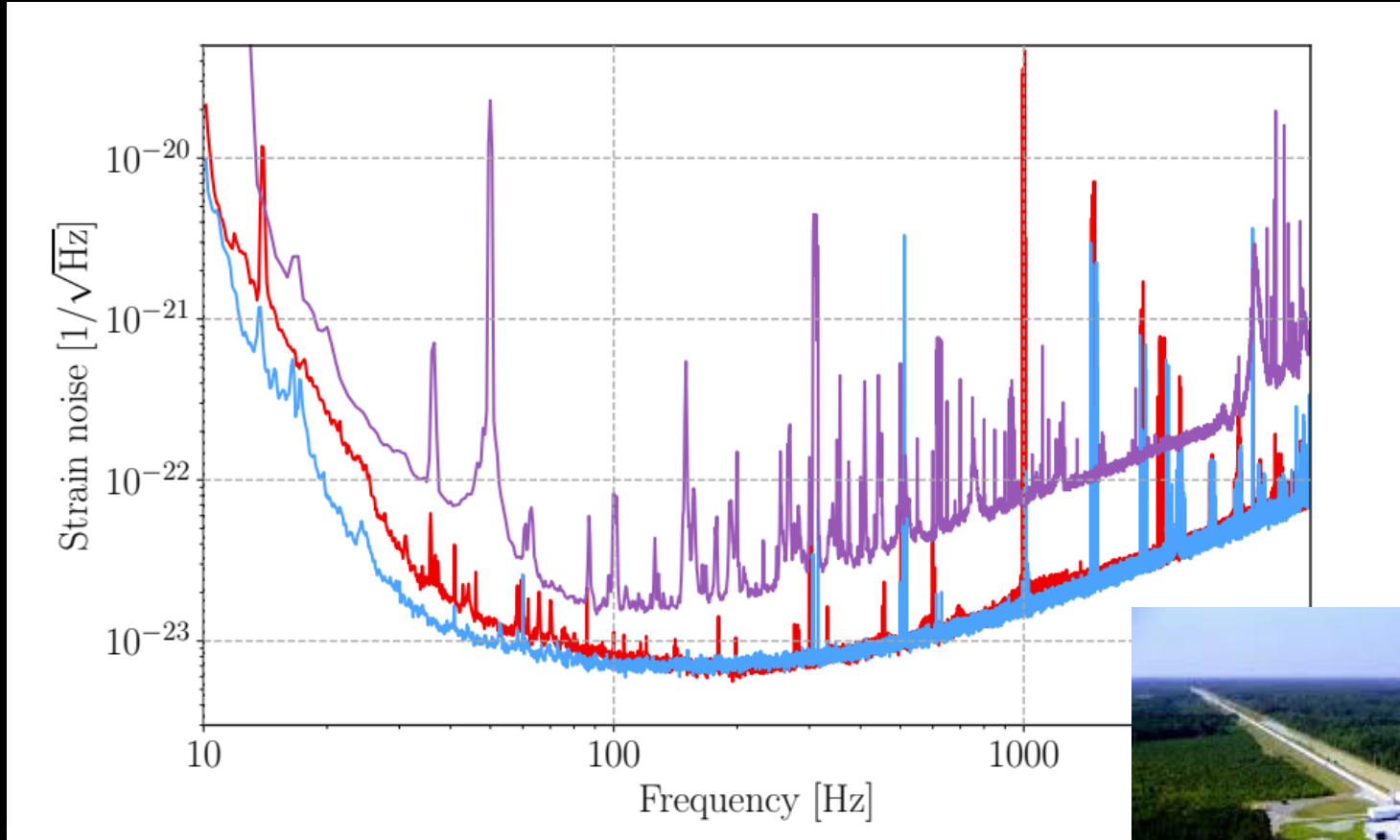


# MOM

## Multimessenger Observatory Model

Study of gravitational wave in association with extreme astrophysical phenomena.

# Ground-based GW Interferometric Detectors



GWTC-1: A Gravitational-Wave Transient Catalog of [Compact Binary Mergers](#) Observed by LIGO and Virgo during the First and Second Observing Runs [arXiv:1811.12907v2]

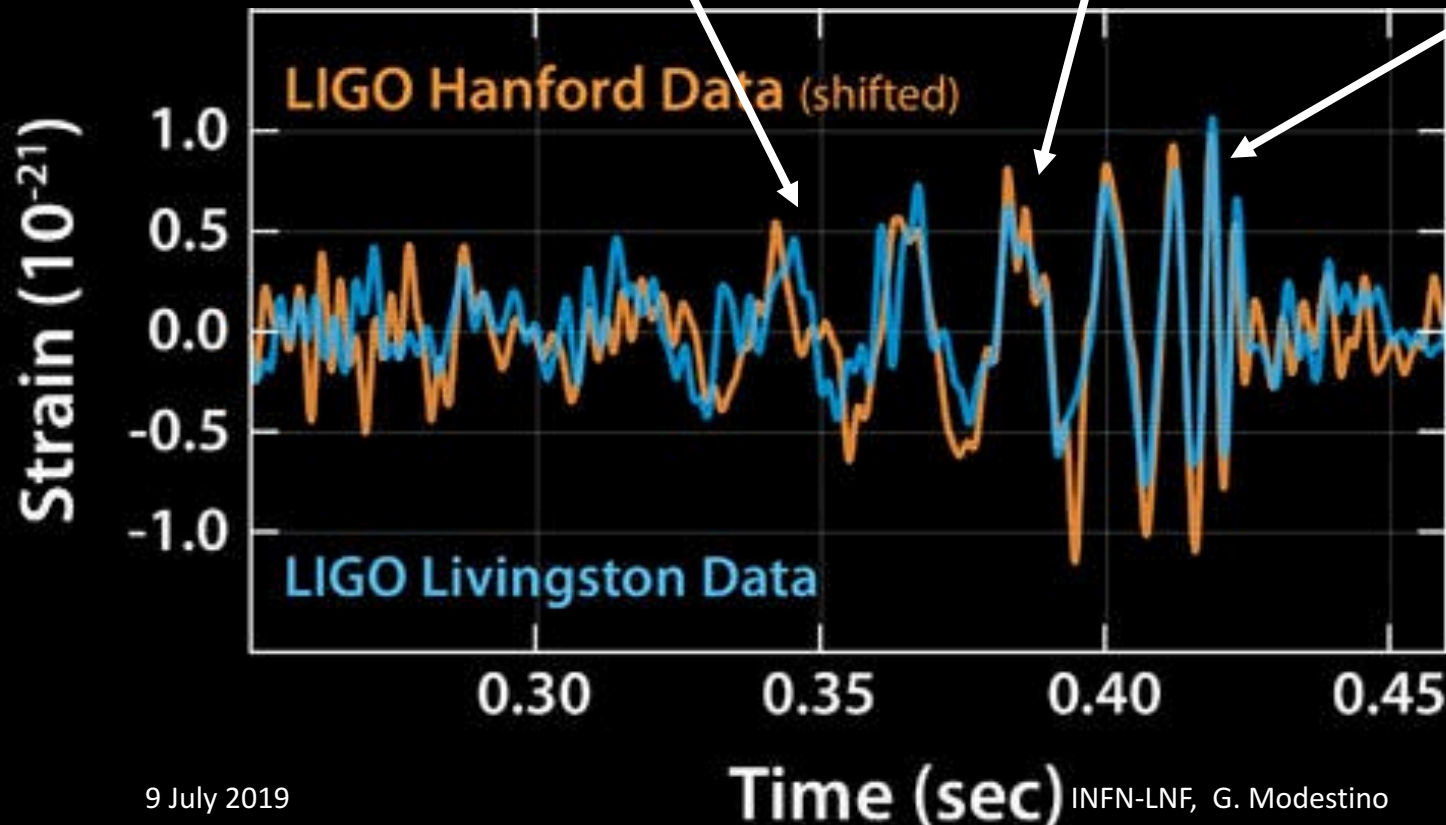
# Observation of Gravitational Waves from Compact Binary Merger <sup>(1)</sup>

## GW candidate selection

1) Two massive objects orbit one another creating a sequence of GW

2) The frequency increases as well as the emitted GW energy while the orbits shrink

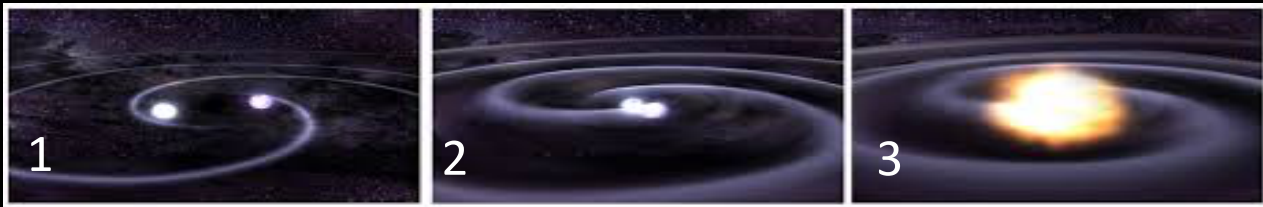
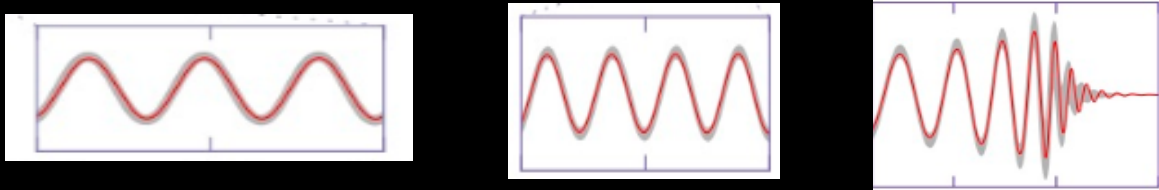
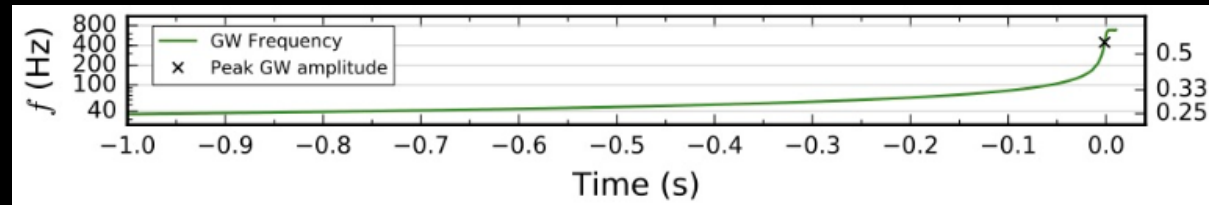
3) After a huge spike, the two compact objects form a single one



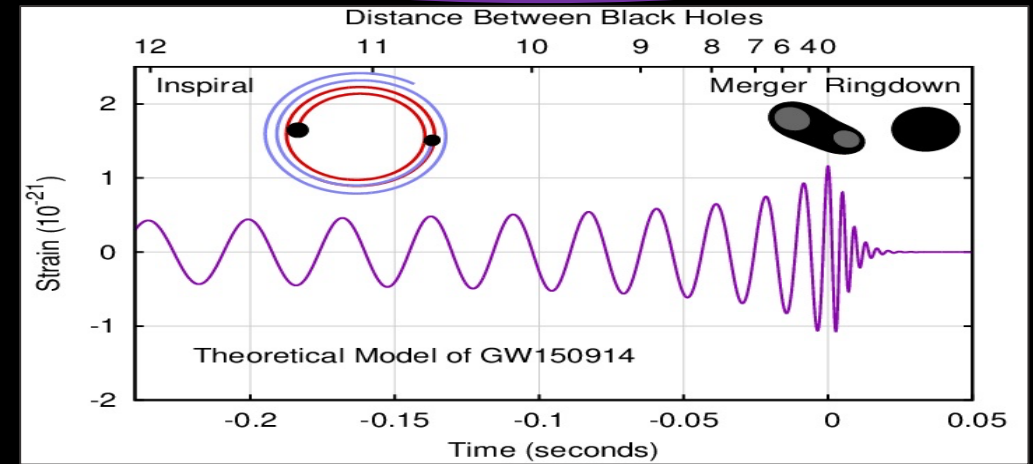
A) The output signals by two or more GW detectors are overlapped and correlated, after optimal matched filter

# Observation of Gravitational Waves from Compact Binary Merger <sup>(2)</sup>

## Black Holes or Neutron Stars?

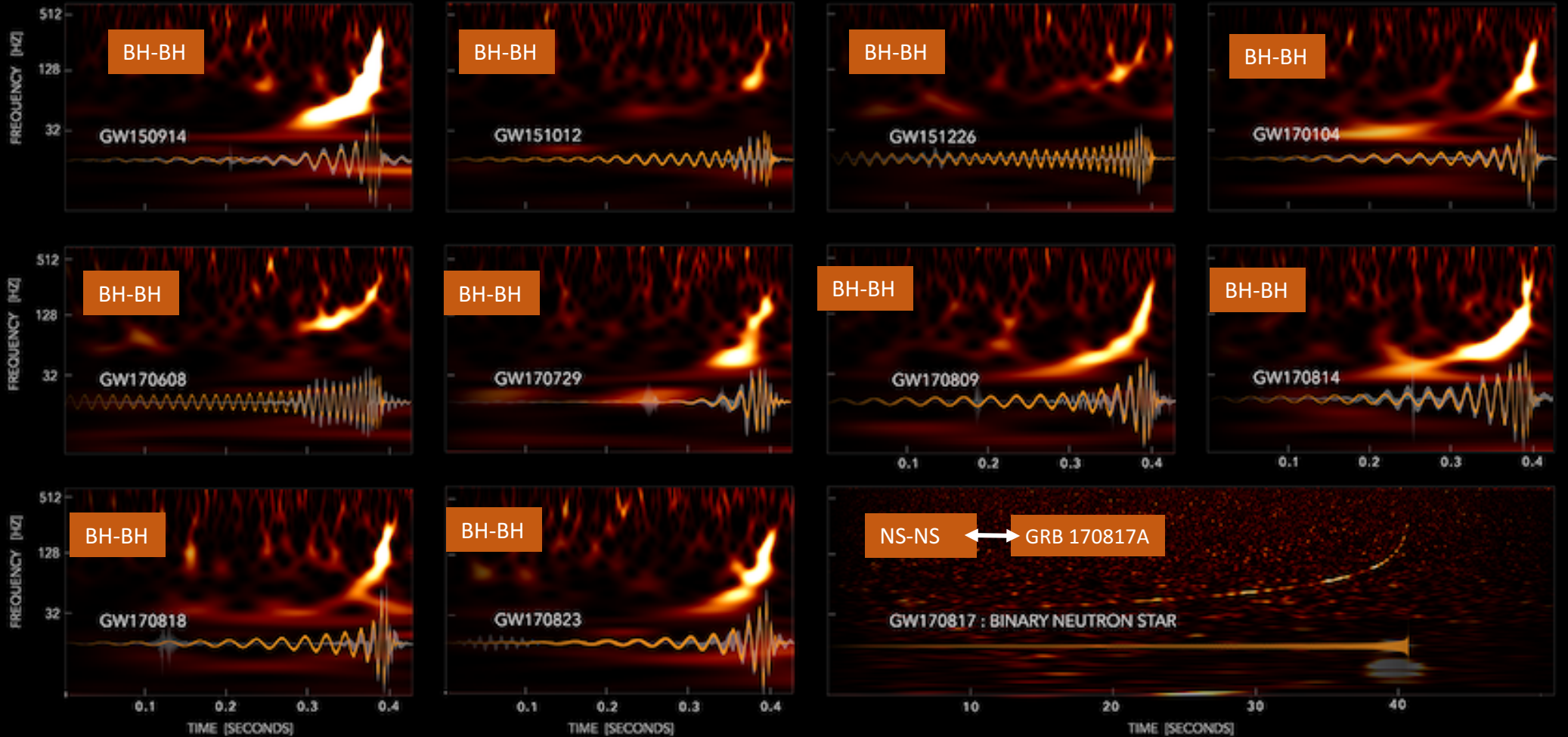


## B) Template form study [h(t)]



## C) EM Transient Search

GWTC-1: A Gravitational-Wave Transient Catalog of Compact Binary Mergers Observed by LIGO and Virgo during the First and Second Observing Runs [arXiv:1811.12907v2]



LIGO-VIRGO DATA: [HTTPS://DOI.ORG/10.7935/82H3-HH23](https://doi.org/10.7935/82H3-HH23)

WAVELET (UNMODELED) EINSTEIN'S THEORY

IMAGE CREDIT: S. GHONGE, K. JANI | GEORGIA TECH

# EM Transient - GW (impulsive) sources

Supernova

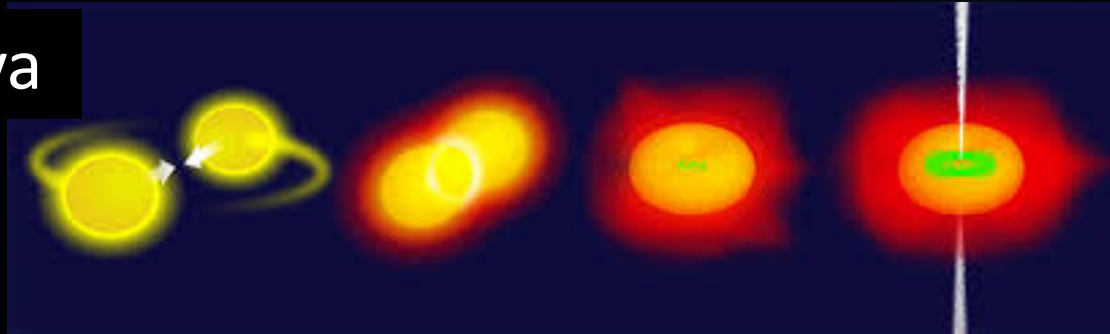


Collimate jet



Magnetar

kilonova



NS-NS merger

NS-BH merger



Isotropic emission

# Searching for correlation between impulsive GW and EM signals

G. Modestino, & G. Pizzella, LNF-97/038, 1997

G. Modestino *et al.* (ROG Coll.), Front. Object in Astr. Part. Phys (World Scientific, Singapore), 295, 1998

P. Astone *et al.* (ROG Coll.), LNF-98-001, 1998

L. Amadio, M. Bassan, A&A Suppl. Ser. **138**, 605, 1999

G. Barbiellini, M. Bassan *et al.* A&A Suppl. S. **138**, 603, 1999

P. Astone *et al.* (ROG Coll.), Phys. Rev. Lett. **84**, 14, 2000

P. Astone *et al.* (ROG Coll.), Phys. Rev. D **66**, 102002, 2002

P. Astone *et al.* (ROG Coll.), Phys. Rev. D **71**, 042001, 2005

P. Astone *et al.* (ROG Coll.), Class. Quantum Grav. **23**, S169, 2006

P. Astone *et al.* (ROG Coll.), Class. & Quantum Grav. **21** S759, 2006

P. Astone *et al.* (ROG Coll.), Phys. Rev. D **76**, 102001, 2007

G. Modestino & G. Pizzella, A&A **364**, 419, 2000

G. Modestino & A. Moleti, Phys. Rev. D **65** 022005, 2002

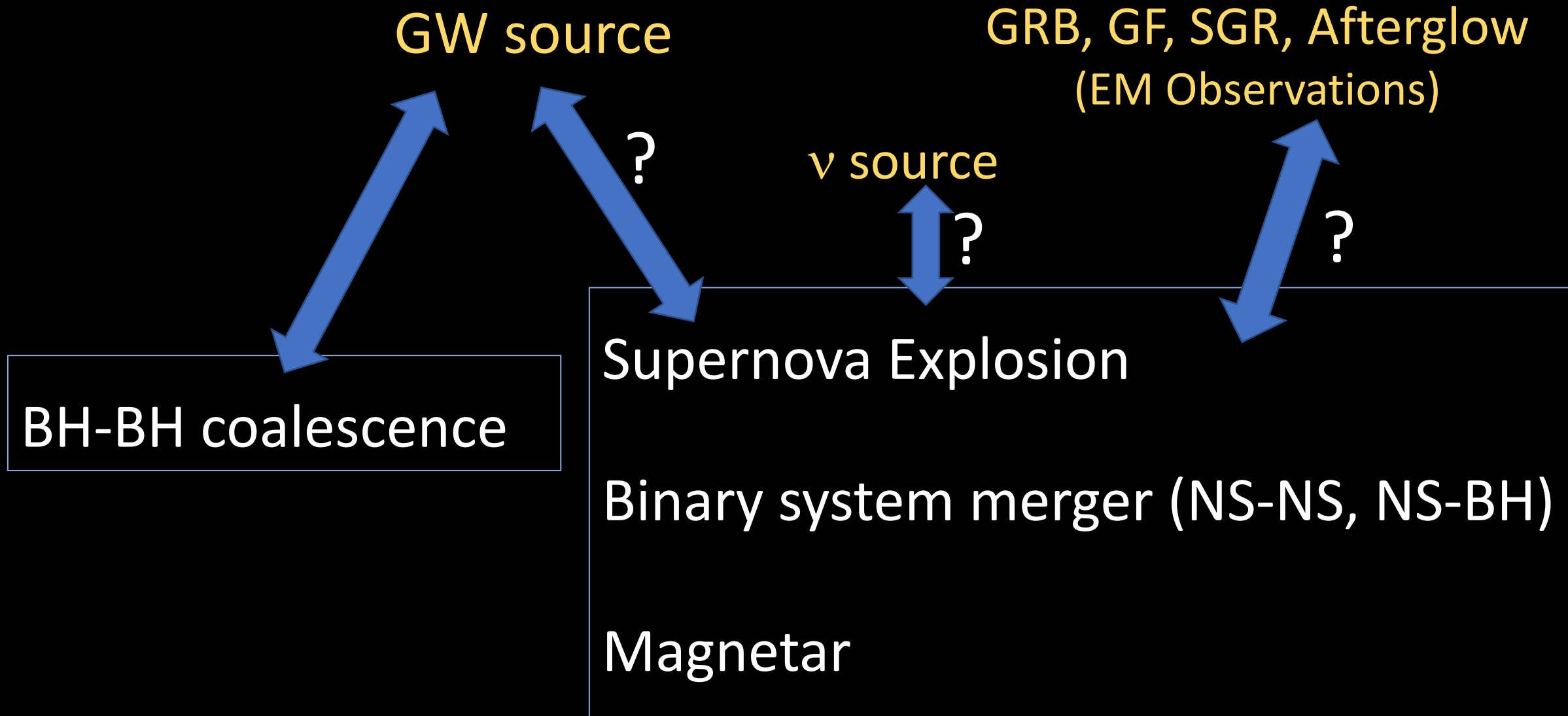
G. Modestino & G. Pizzella, Phys. Rev. D **83**, 062004, 2011

LNF "Copyright" > 50%

LNF Multimessenger  
Experimental  
Observation



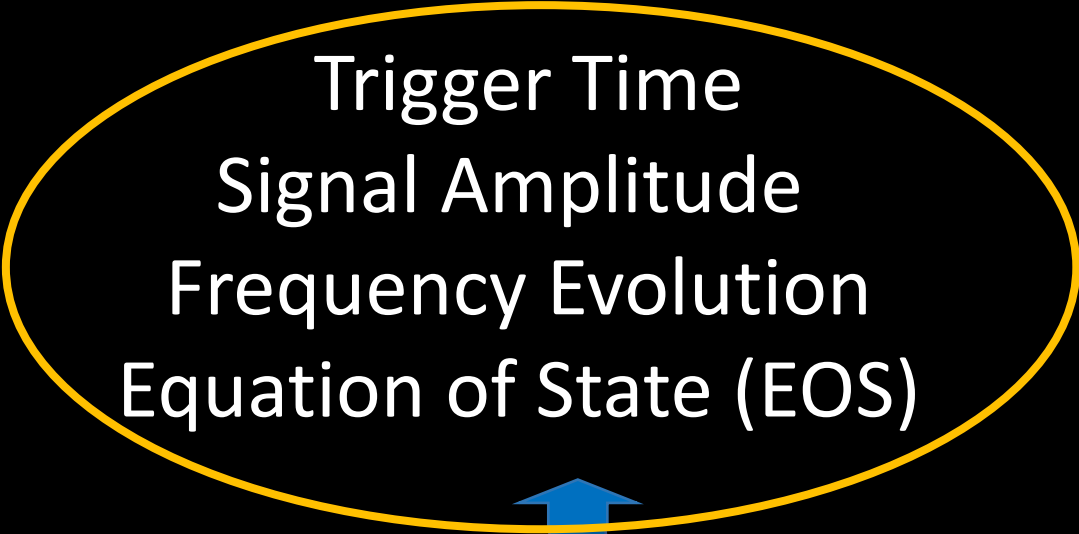
# Multimessenger Observation Questions





# Multimessenger Observation Strategy

## GW signal measurement



## EM detection (GRB, GF, SGR, Afterglow)



## Correlation analysis

# Multimessenger Observation Model

## The measurement results are reported in a single outline

- Collecting the most accredited theoretical models for impulsive signals (supernova, kilonova, magnetar, binary compact system merger, NS-NS, NS-BH)
- Comparing the observed events in light of EOS and of experimental physical parameters (using referenced scientific bibliography, Open Data, Galactic Circular Network (GCN), InterPlanetary Network (IPN), Open Catalogs by EM Telescope)

$$E_{GW} = f(t, f, h_{+,X}, L_{EM}, \Delta t_{EM}, D, \dots)$$

# Multimessenger Observatory Model

## MOM

- G. Modestino (100% resp.), 2 associazioni in definizione
- Richieste 2020 @ CSN2 : 5 k€ partecipazione a conferenze e coordinamenti

### Conferences 2020

**3rd meeting of the GWVerse COST action** - Gravitational Waves, Black Holes and Fundamental Physics 13-16 January 2020 IFPU, Miramare campus, Trieste, Italy

**WG1: Astrophysics** "...this COST action will also use electromagnetic and astro particle observations ..."

**IWARA2020**-9th International Workshop on Astronomy and Relativistic Astrophysics 06 Sep 2020 - 12 Sep 2020 Mexico City, Mexico (... Black hole physics and astrophysics; Gamma-ray emission in the Universe; Gravitational waves;...)

**PUMA2020**-Probing the universe with multi-messenger astronomy 28 Sep 2020 - 02 Oct 2020 Sestri Levante, Italy

Abstract: A conference to gather an overview of the status and future prospects of astrophysics and cosmology with a multimessenger approach. The conference will feature only plenary sessions on the following topics: astrophysics with electromagnetic waves, astrophysics with gravitational waves, astroparticle physics and neutrino astrophysics, nuclear astrophysics, cosmology.



WG1: Gwvers COST action

MOM

Multimessenger Observatory Model

Study of gravitational wave in association with other extreme astrophysical phenomenon

An overview on correlated signals from theoretical and experimental point of view

An easier forecast on future programs