



the DAWN
of MULTI-MESSENGER
ASTROPHYSICS:
gravitational &
electromagnetic
waves,
no neutrinos yet

Giovanni Andrea Prodi

Università di Trento e INFN,
LIGO and Virgo Collaborations

**GW170817 papers by LIGO-Virgo plus
other collaborations**

http://public.virgo-gw.eu/gw170817_papers/

LIGO-Virgo data release

<https://losc.ligo.org/events/GW170817/>



Preparation for a multi-messenger astronomy



- **Observations by advanced Gravitational Wave detectors**

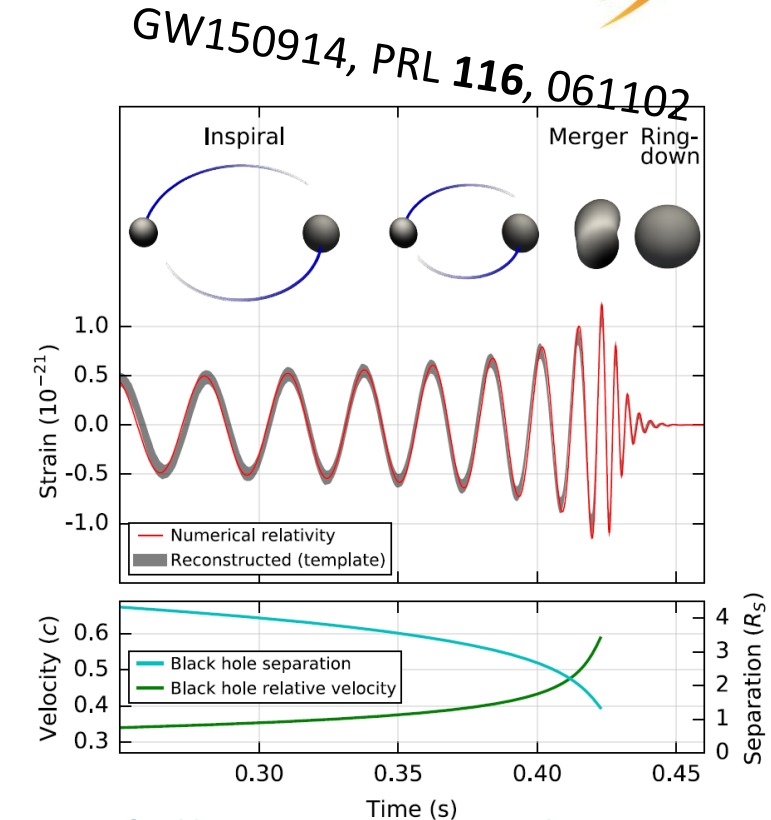
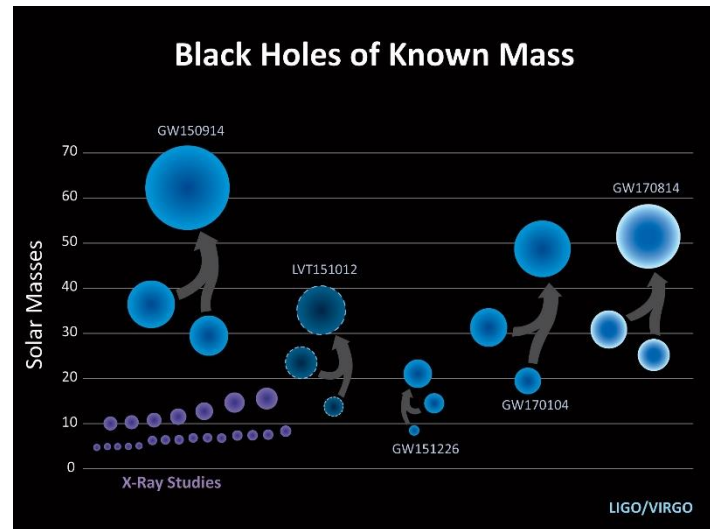
- ✓ First direct observations of Gravitational Waves
- ✓ Tests of General Relativity in strong field regime
- ✓ Discovery of a **population**

of Black Holes

NO counterparts found

Abbott et al, 2016a, ApJL, 826, L13

followup of GW150914



- **a multimessenger coordination for rapid followup of triggers was fully operational**

agreements with about 90 partners

coverage of the electromagnetic spectrum (earth and space telescopes) and

High Energy Neutrinos

Ready ? GOOO !

Aug.17, 2017, h12:41:04 UTC



about 60 groups/collaborations participated to the investigations of

GRB170817A – GW170817 – AT2017fgo

THE ASTROPHYSICAL JOURNAL LETTERS, 848:L12 (59pp), 2017 October 20

<https://doi.org/10.3847/2041-8213/aa91c9>

© 2017. The American Astronomical Society. All rights reserved.

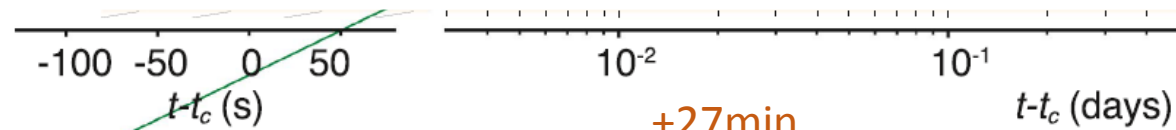
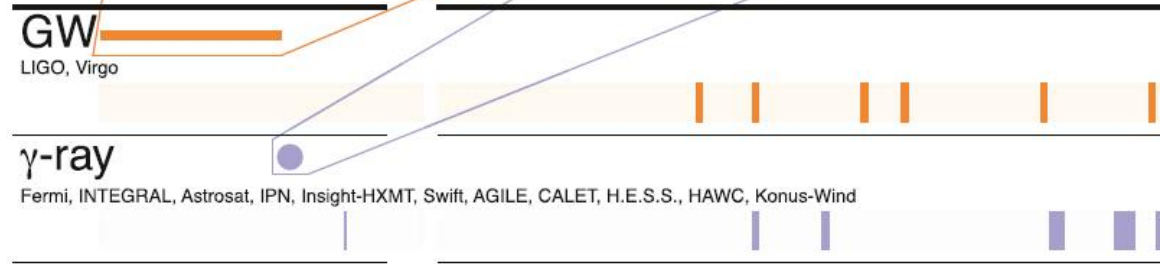
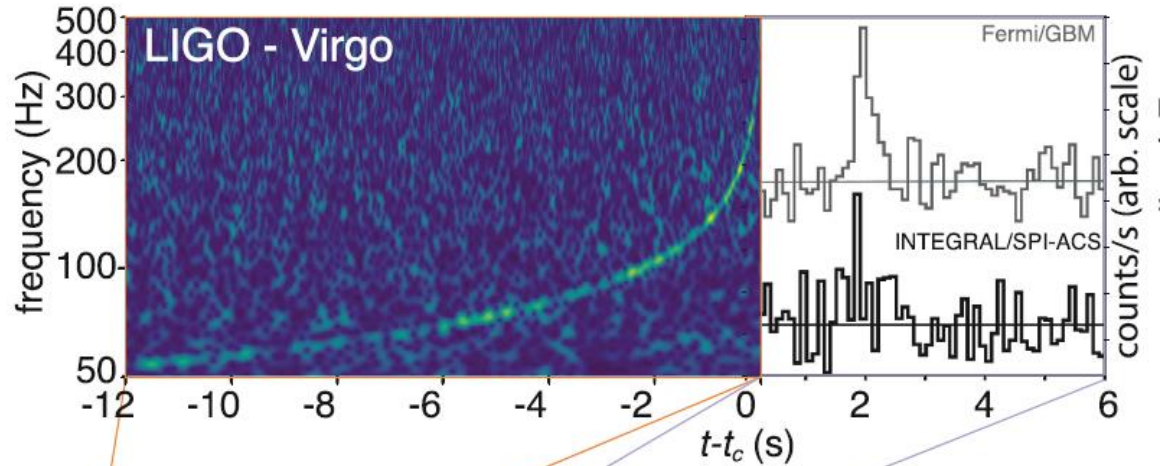
OPEN ACCESS



Multi-messenger Observations of a Binary Neutron Star Merger

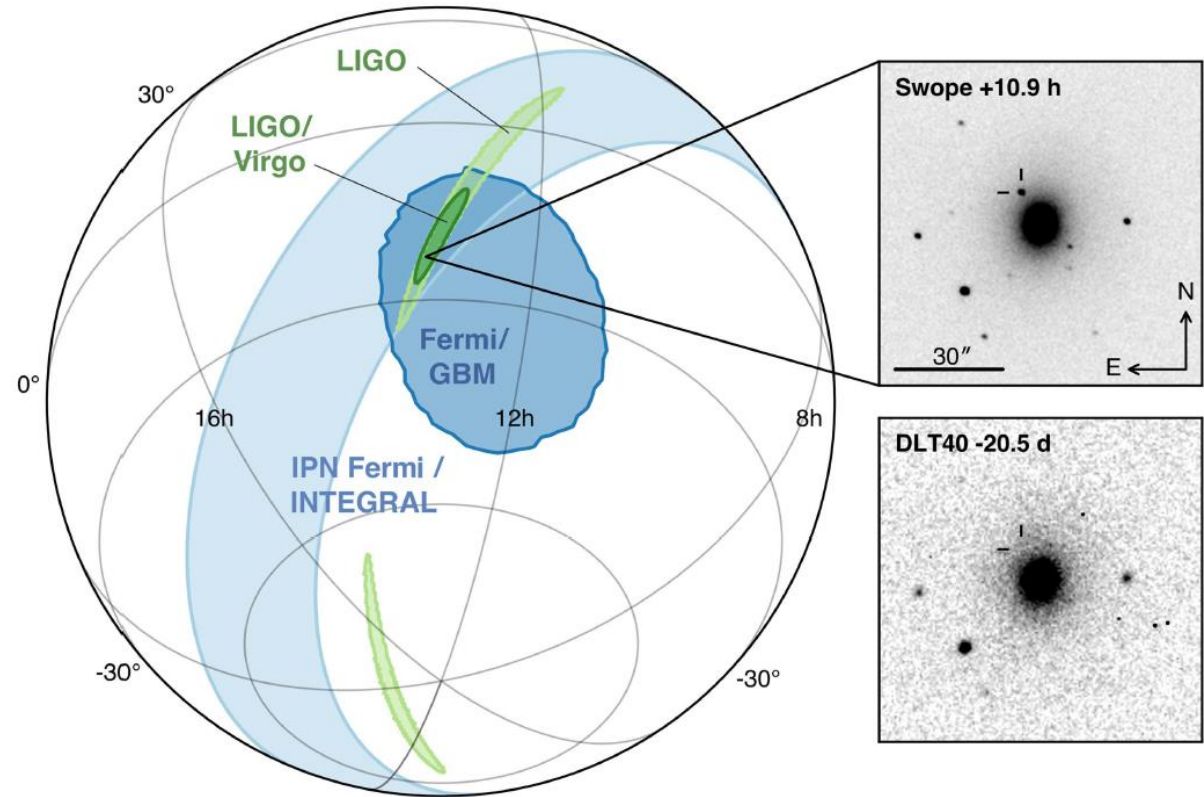
LIGO Scientific Collaboration and Virgo Collaboration, Fermi GBM, INTEGRAL, IceCube Collaboration, AstroSat Cadmium Zinc Telluride Imager Team, IPN Collaboration, The Insight-Hxmt Collaboration, ANTARES Collaboration, The Swift Collaboration, AGILE Team, The 1M2H Team, The Dark Energy Camera GW-EM Collaboration and the DES Collaboration, The DLT40 Collaboration, GRAWITA: GRAvitational Wave Inaf TeAm, The Fermi Large Area Telescope Collaboration, ATCA: Australia Telescope Compact Array, ASKAP: Australian SKA Pathfinder, Las Cumbres Observatory Group, OzGrav, DWF (Deeper, Wider, Faster Program), AST3, and CAASTRO Collaborations, The VINROUGE Collaboration, MASTER Collaboration, J-GEM, GROWTH, JAGWAR, Caltech-NRAO, TTU-NRAO, and NuSTAR Collaborations, Pan-STARRS, The MAXI Team, TZAC Consortium, KU Collaboration, Nordic Optical Telescope, ePESSTO, GROND, Texas Tech University, SALT Group, TOROS: Transient Robotic Observatory of the South Collaboration, The BOOTES Collaboration, MWA: Murchison Widefield Array, The CALET Collaboration, IKI-GW Follow-up Collaboration, H.E.S.S. Collaboration, LOFAR Collaboration, LWA: Long Wavelength Array, HAWC Collaboration, The Pierre Auger Collaboration, ALMA Collaboration, Euro VLBI Team, Pi of the Sky Collaboration, The Chandra Team at McGill University, DFN: Desert Fireball Network, ATLAS, High Time Resolution Universe Survey, RIMAS and RATIR, and SKA South Africa/MeerKAT

Chronicles of the dawn of multimessenger astronomy



+14s
GRB170817A GNC Notice
FERMI GBM

+27min
GW170817 GNC Notice



+5h
GW170817 GNC Circular
 sky map 31 deg²

+12h
SSS17a GCN Circular
IM2H Swope
 OPTICAL TRANSIENT
 -> AT2017fgo

IPN localization
FERMI GBM – INTEGRAL SPI ACS

Chronicles ...

- Optical: more identifications of the transient in a few hours
 - early photometric data UV-OPT-IR
 - rapid dimming of UV (day)
 - unusual brightness in IR
 - not a SN
 - No prompt X-ray
 - No prompt radio
 - X counterpart at 9d
 - **Radio counterpart at 16.4d**
 - No neutrinos
- Source is occulted by the Sun

