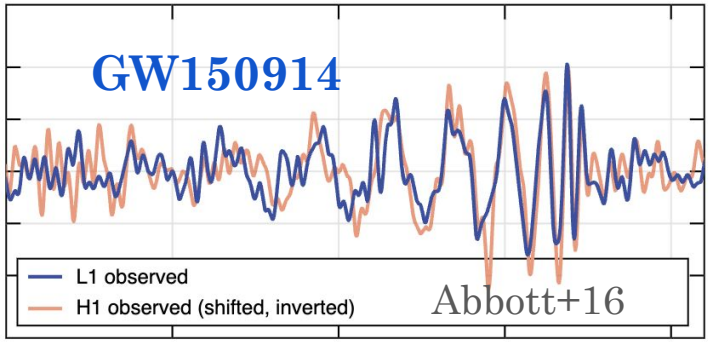

Gravitational-Wave (GW) Astrophysics
Lecture 2

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Department of Physics,
University of Warsaw

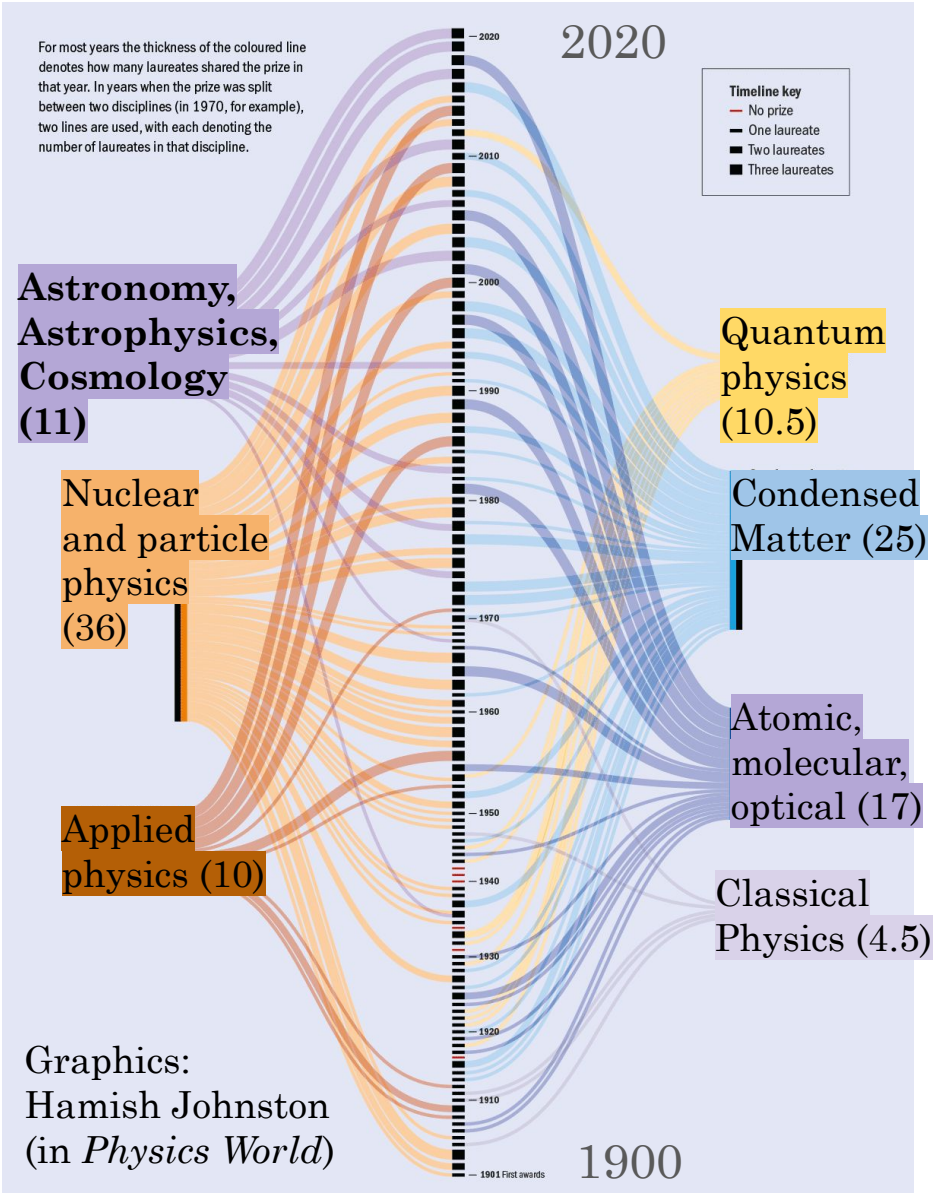
Warsaw, 13.10.2026

Lecture 2

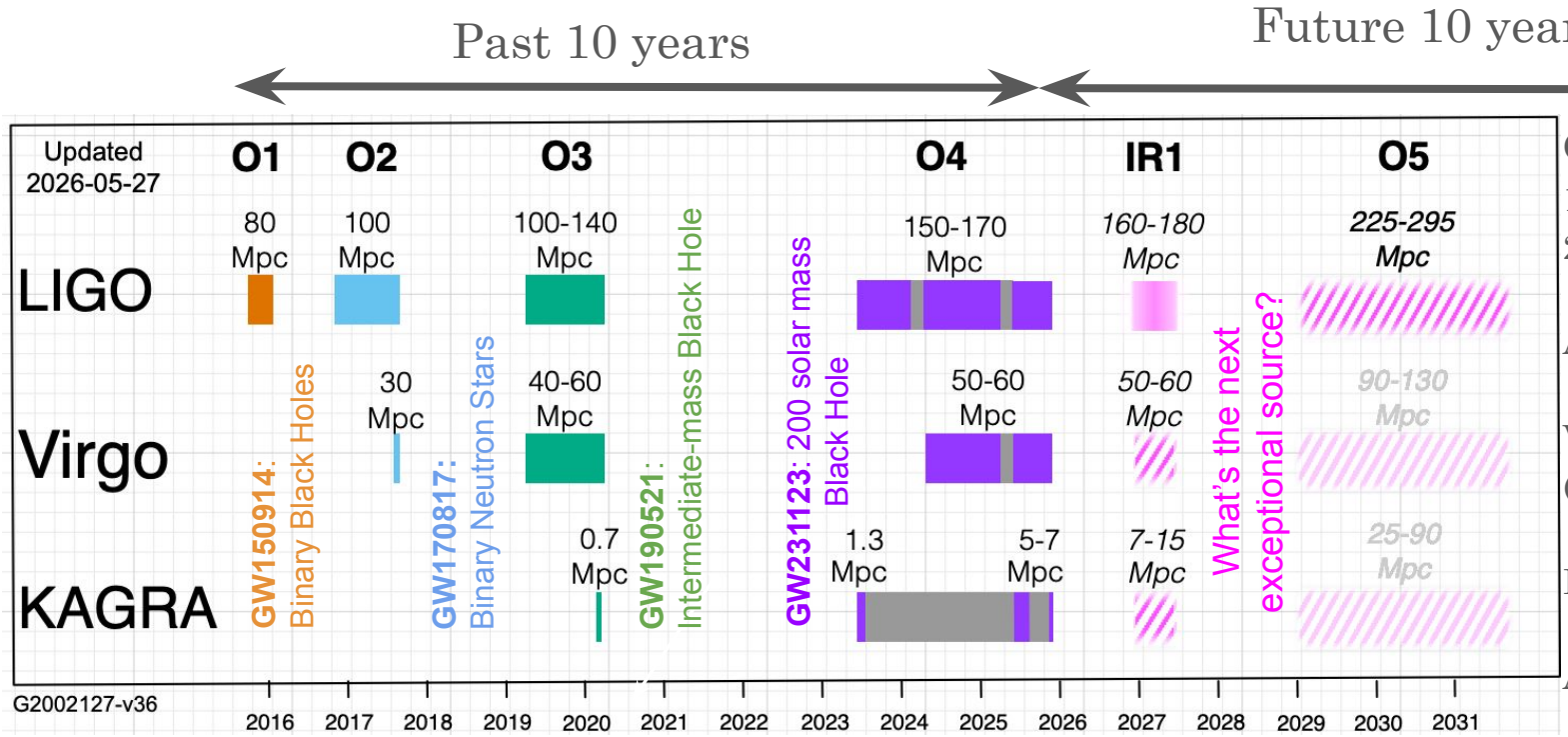
Introduction to GW Astrophysics

Extraordinary period of discovery in Astrophysics (It's worth looking at the sky)

- **The role of Astronomy, Astrophysics & Cosmology in discovery has grown greatly in the recent years.**
- Since 1900: around 15 Nobel Prizes
- Last decade: 7 Nobel Prizes
  - 4 are directly linked to General Relativity (2017: gravitational waves, 2019: theoretical cosmology, 2020: supermassive BH, 2020: BHs are consequence of GR)
  - 3 use astronomical data (2011: expansion of the Universe, 2015: neutrino oscillations, 2019: exoplanets)
- **Last week: observing high-energy neutrinos of astrophysical origin**



Observing Timeline



O6 Goals:
1. pushing facilities
2. 3G pathfinders

A# (400-600 Mpc)

Virgo_nEXT (260-500Mpc)

KAGRA+

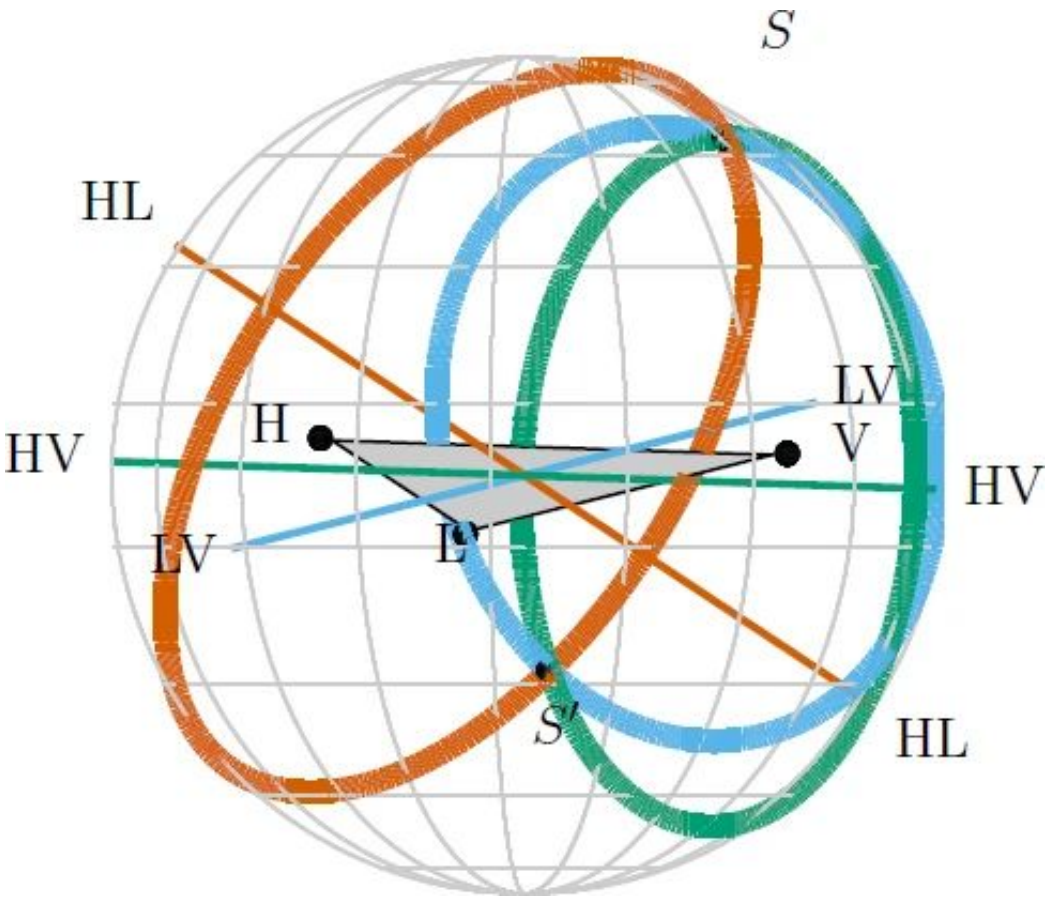
Australian detector?

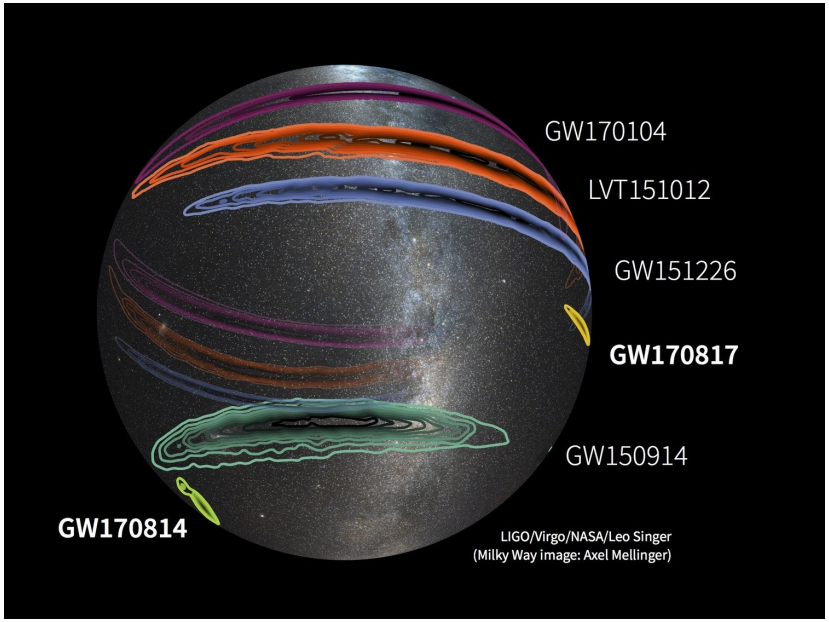
- O4: 24 months total
- LIGO: up to 180 Mpc, around 160 Mpc
- Virgo: around 55 Mpc
- KAGRA: reached 7 Mpc

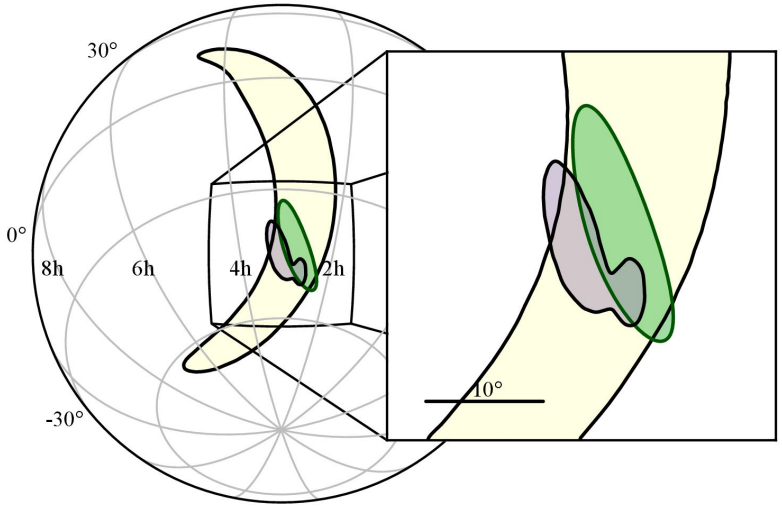
Observing news:
https://observing.docs.ligo.org/plan/

LVK papers:
https://pnp.ligo.org/ppcomm/Papers.html

Triangulation





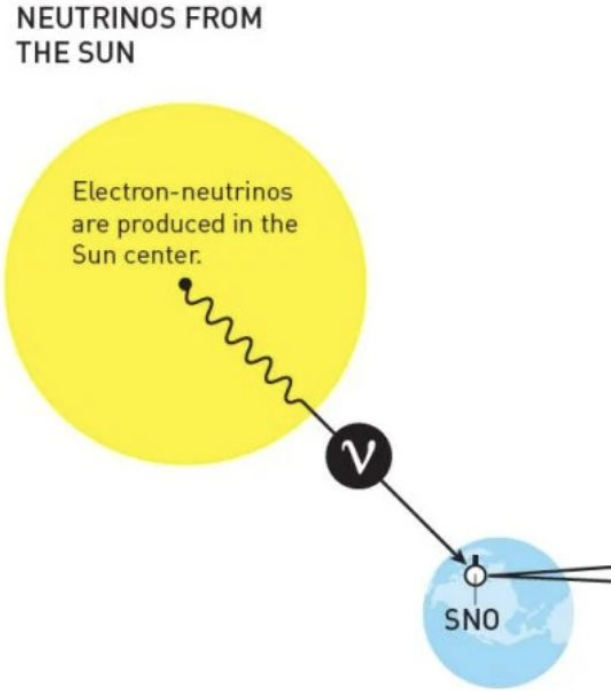


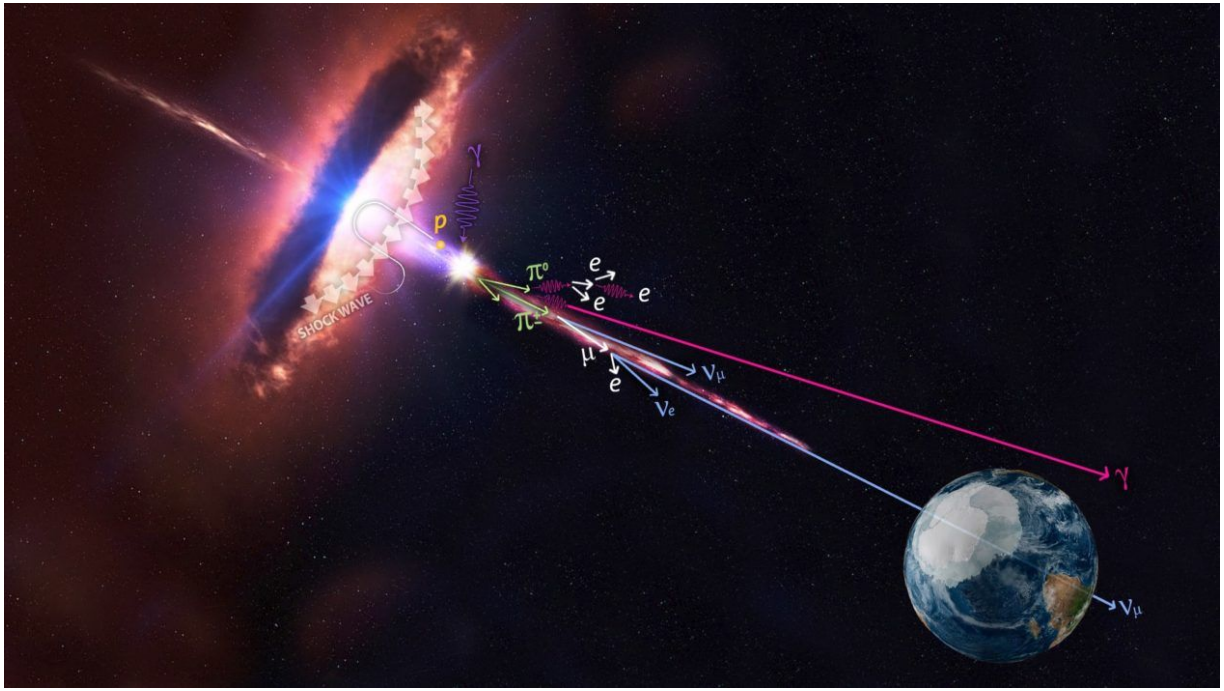
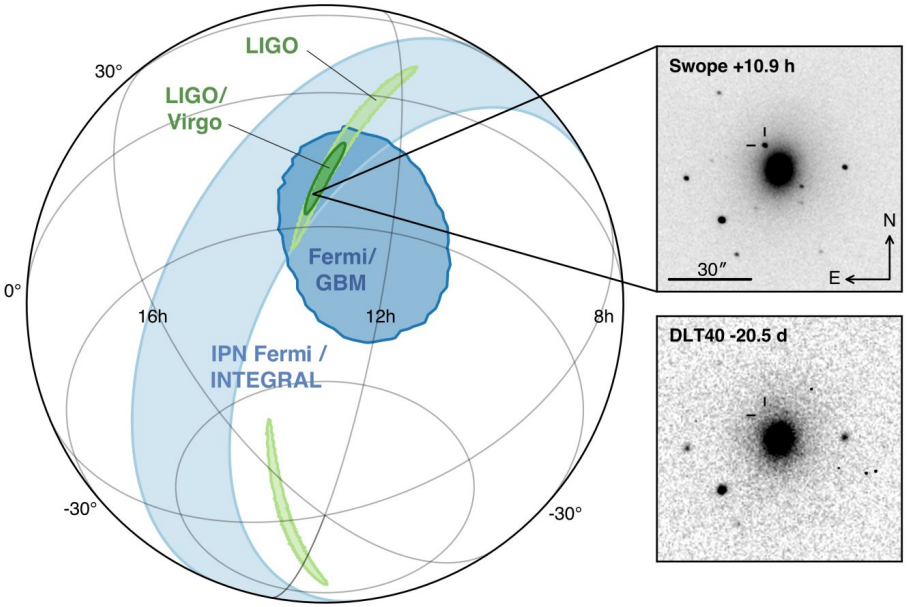
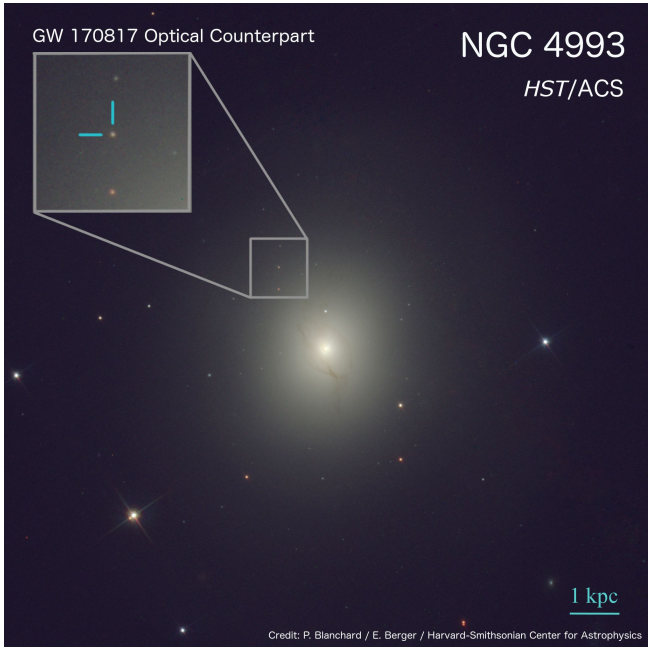
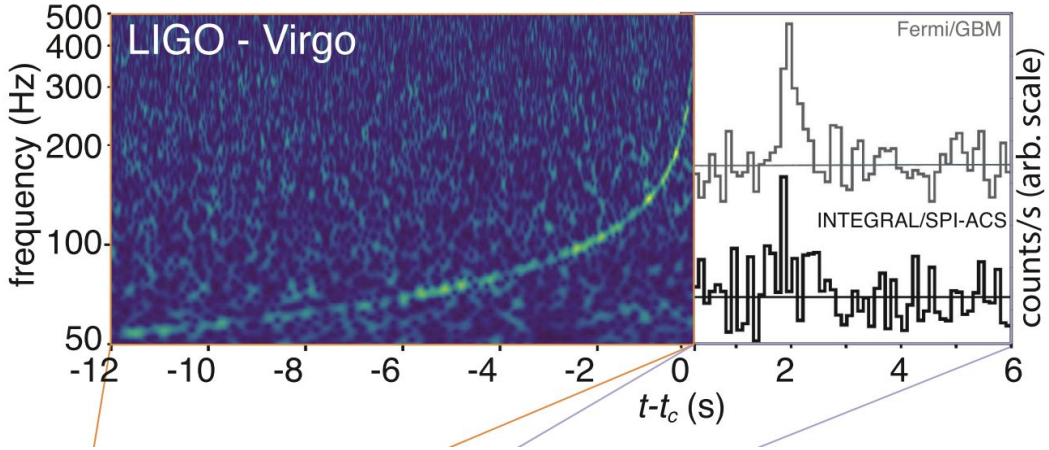
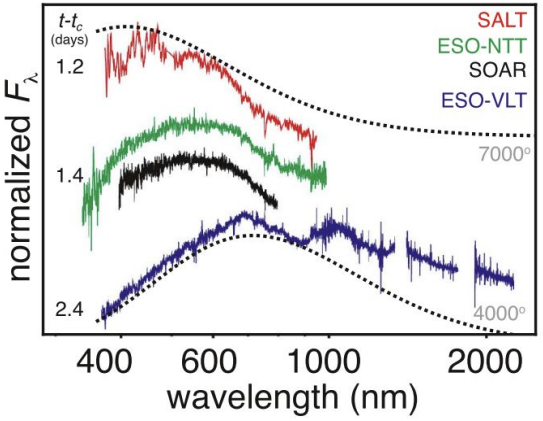
Multi-messenger Astronomy

"Messengers" - distinctive signals carrying unique information about a source. They provide deeper insight into the most extreme events in the Universe.

	BBH	**BNS**	**CCSN**
Gravitational Waves (dynamics, mass distribution)	Observed	Observed	Possible
Electromagnetic Radiation (emission processes, environment, temperature, density)	possible	Observed	Observed
Neutrino (mainly thermodynamics, hadronic/nuclear processes)		Possible	Observed
Cosmic Rays (acceleration processes, nucleosynthesis)		Possible	Possible

Multi-messenger Astronomy





Multi-messenger Astronomy
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