



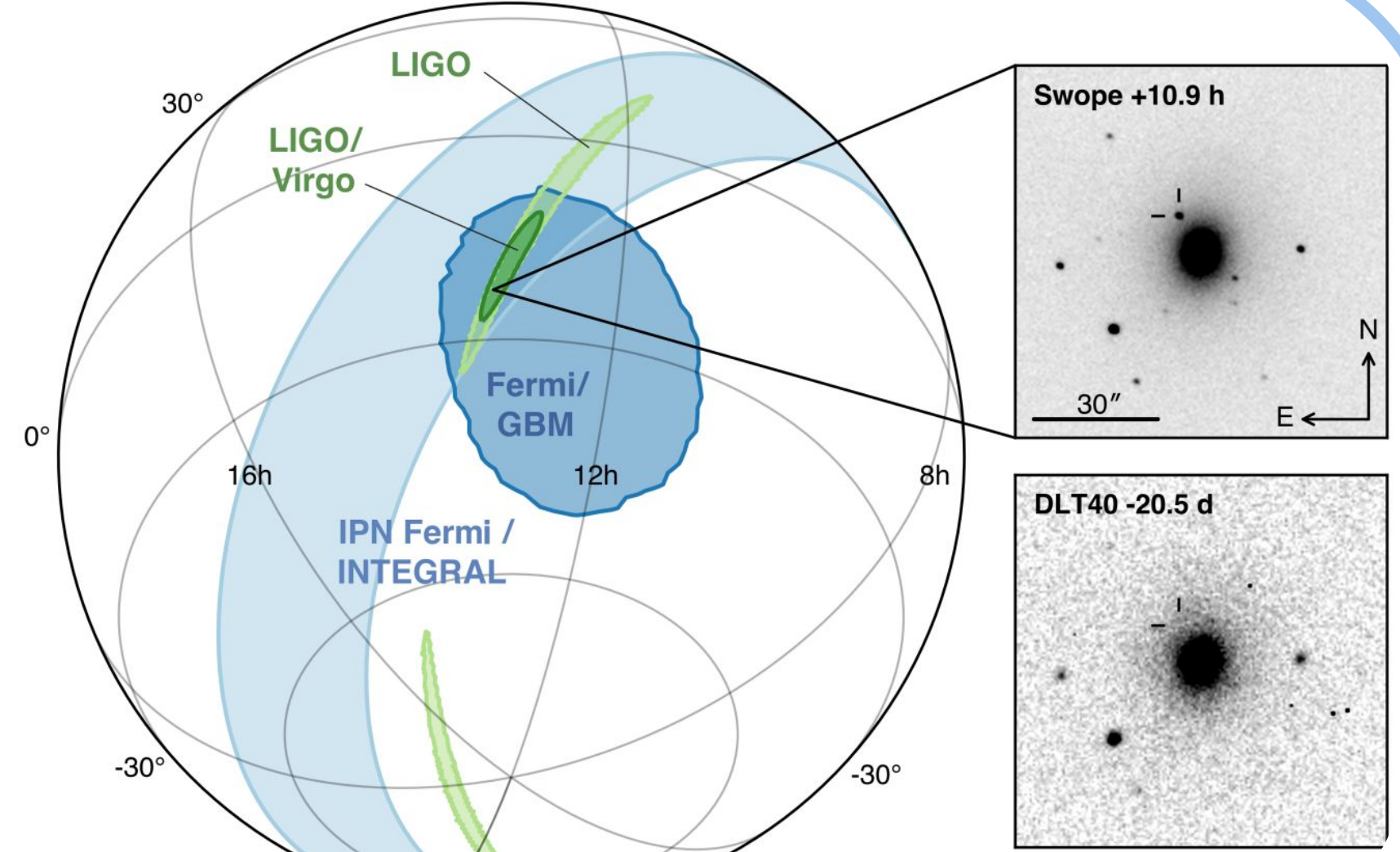
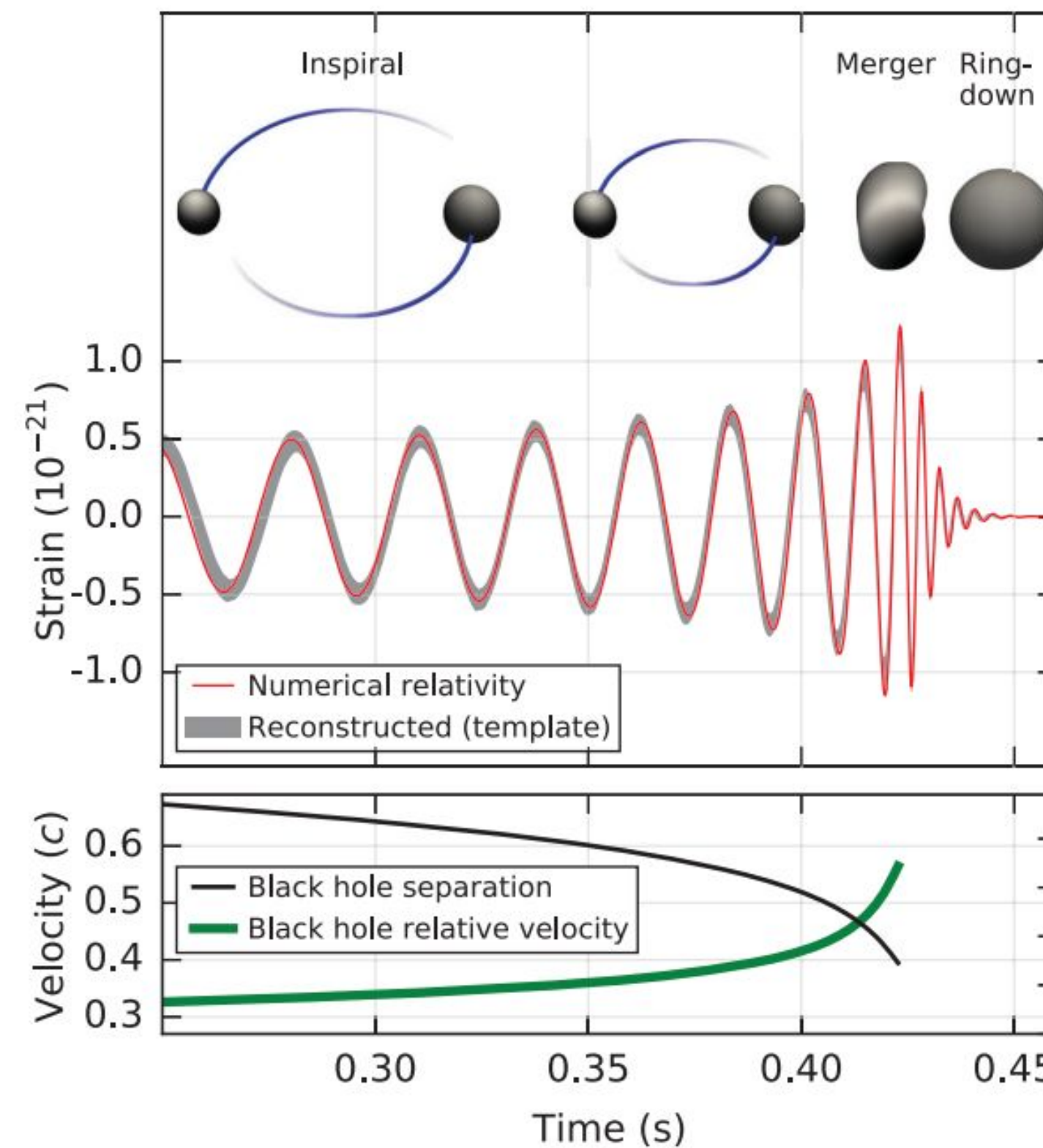
Istituto Nazionale di Fisica Nucleare
SEZIONE DI ROMA

Gravitational Waves & Experimental Gravitation

What are Gravitational Waves?

Gravitational Waves (GWs) are ripples in the space-time fabric produced by astrophysical processes, such as compact binary coalescences, supernova explosions and asymmetric rotating neutron stars.

GWs were first detected on 14th September 2015 from the coalescence of two black holes, almost 100 years after their prediction by Einstein. GWs provide another avenue to study our Universe.



Two milestones GW events. Left: strain signal of GW150914, the first detection of GWs. Top: sky localization and electromagnetic counterpart of GW170817, the first multi-messenger event.

Virgo



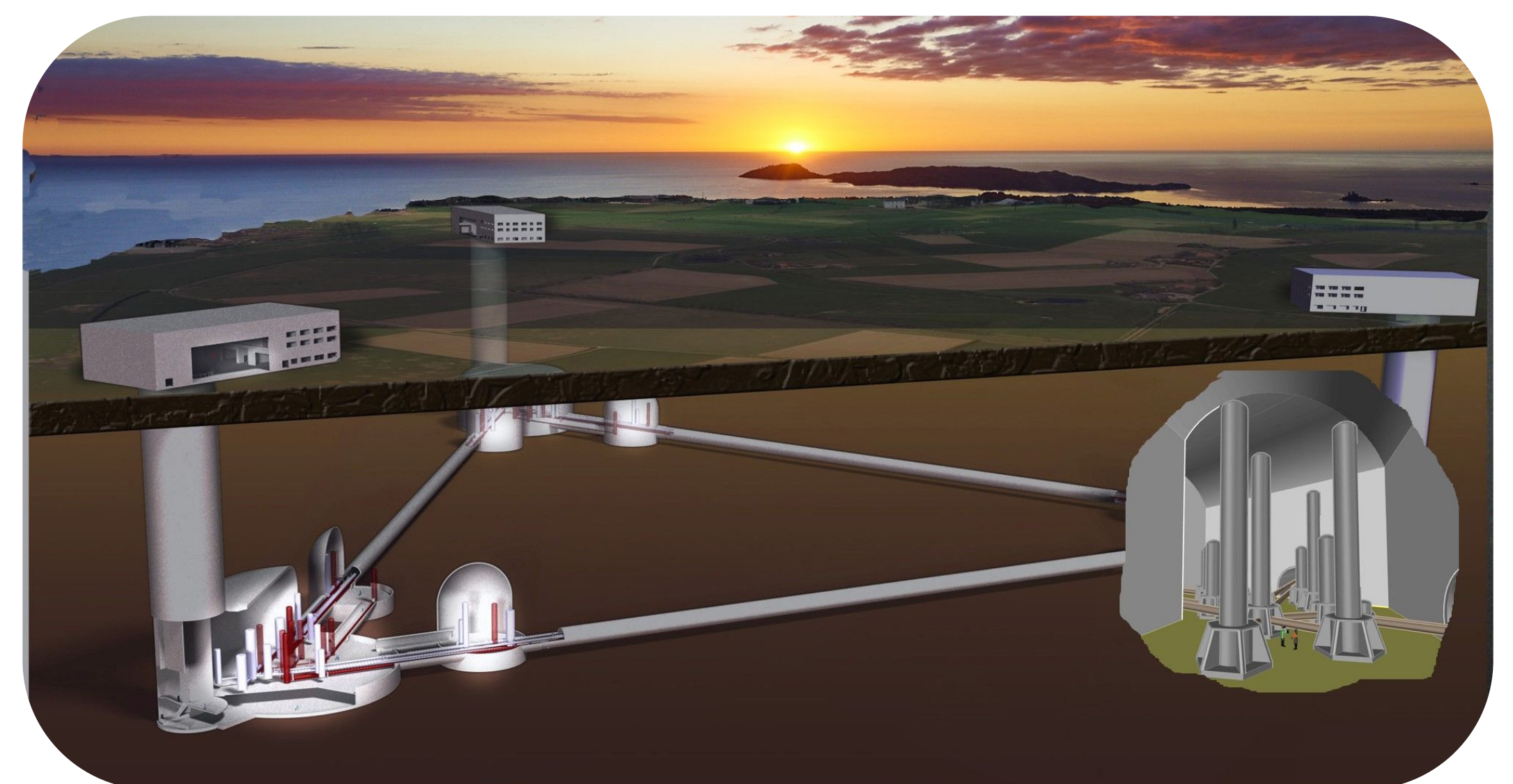
- Virgo is a GW detector operating in Cascina and it crucially contributed to GW detections. Virgo has a joint observing plan with other operating detectors such as LIGO and KAGRA for the next 7 years.
- The Virgo Rome group contributes to several hardware components of Virgo, such as the payloads, quantum noise reduction system and mirrors' coatings.
- We are on the forefront for the development and application of algorithms for GWs searches and physical implications for a plethora of astrophysical sources.



Einstein Telescope



- The Einstein Telescope is a cryogenic and underground next-generation GW detector planned to operate by 2035.
- We are active in characterizing the noise level of the Sardinian host site candidate for the ET. We are building up the large cryogenic payload system for ET.
- The increased sensitivity of ET will allow us to detect GW sources emitted ~ 2 Gyrs after the Big Bang. We are developing searches to detect and study a broad range of GW sources.



Archimedes



- If we account in the General Relativity equations the e.m. vacuum energy density fluctuations, we end up with the largest discrepancy between theory and experiment in all of science: 120 orders of magnitude.
- Archimedes is the experiment located in the Sos-Enattos mine, Sardinia, aimed to measure the interaction between zero point energy density of the quantum e.m. field and gravitational field.
- Archimedes probes even the existence of dark photons with mass in the 10^{-16} - 10^{-15} eV range.

