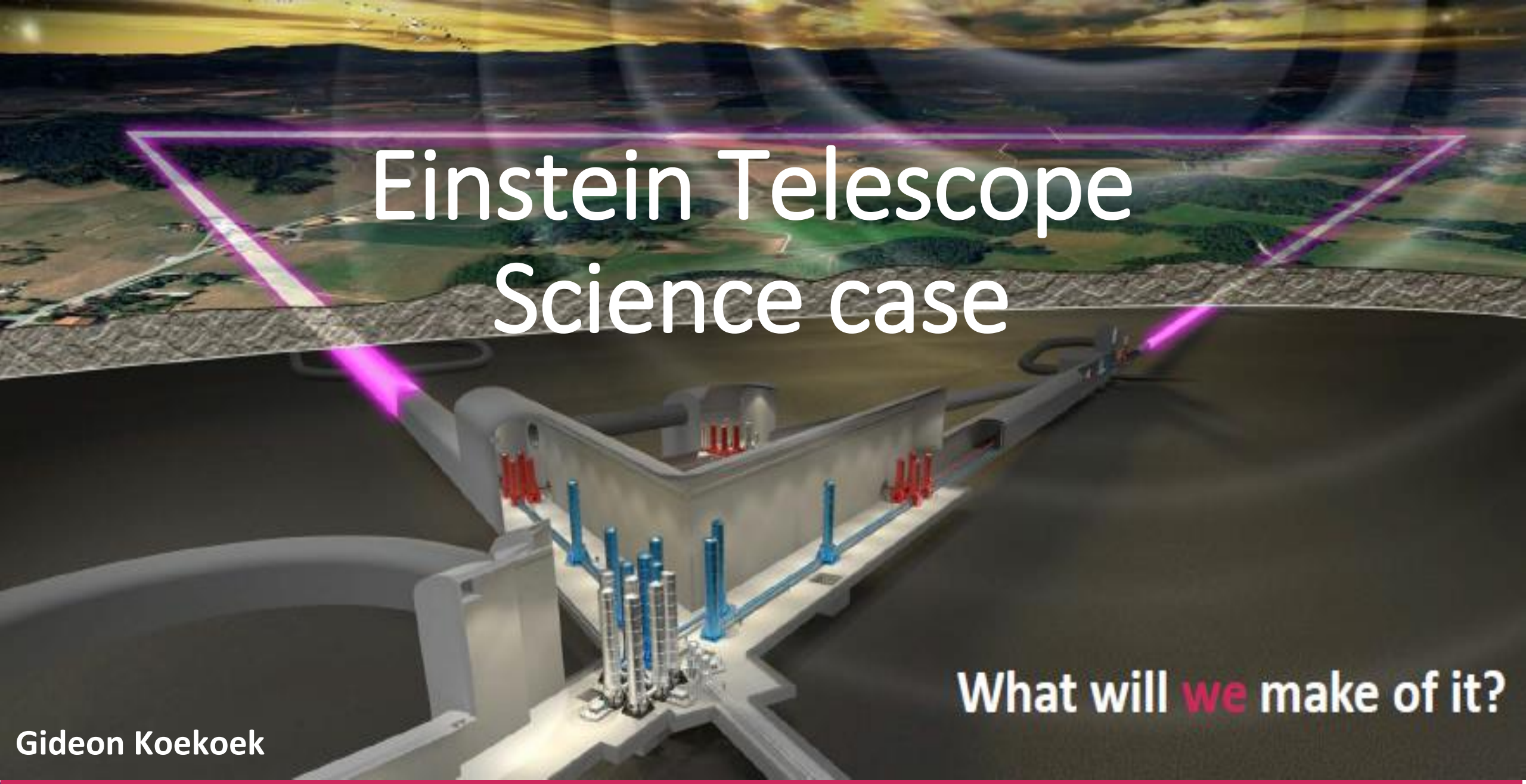
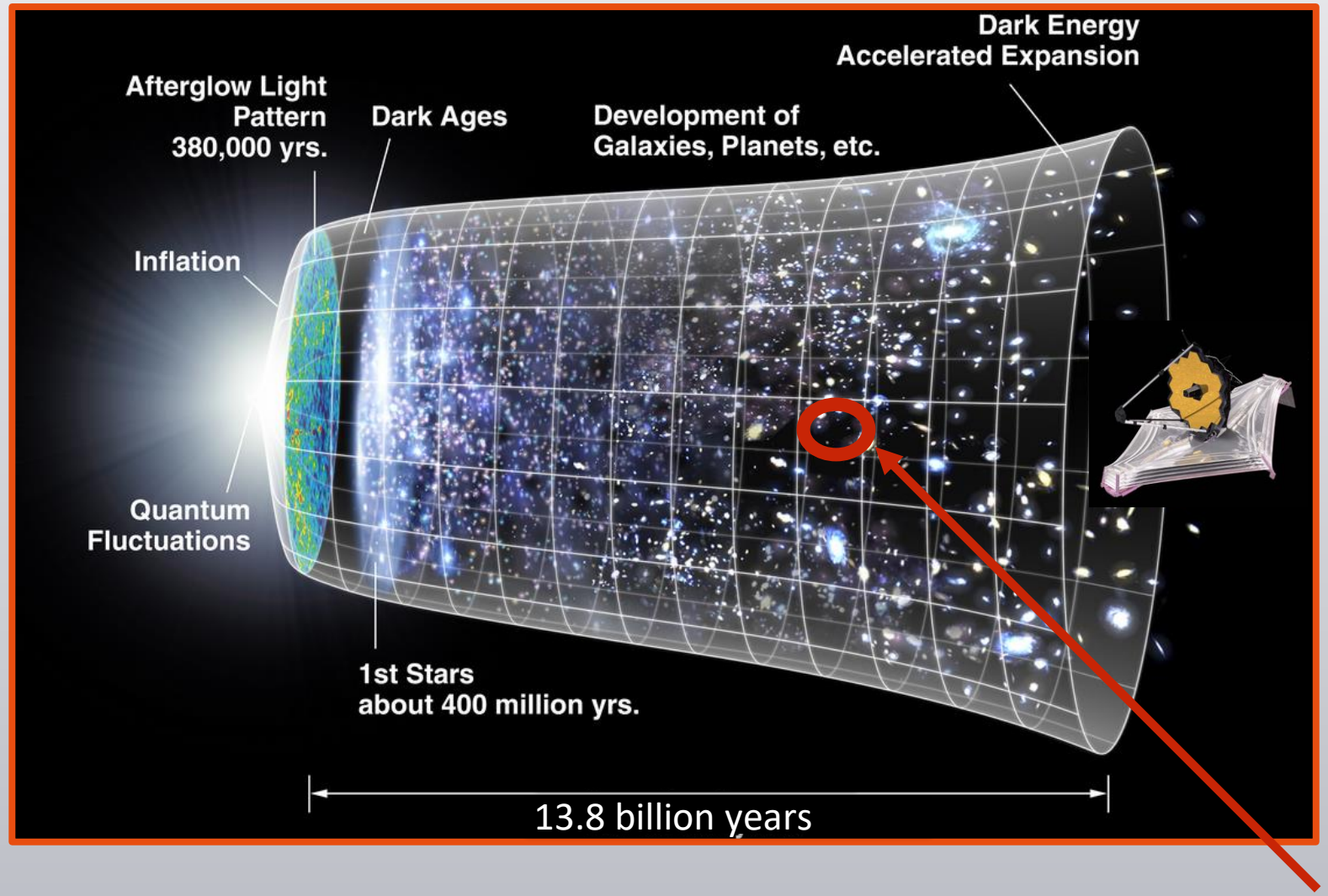
Einstein Telescope Science case

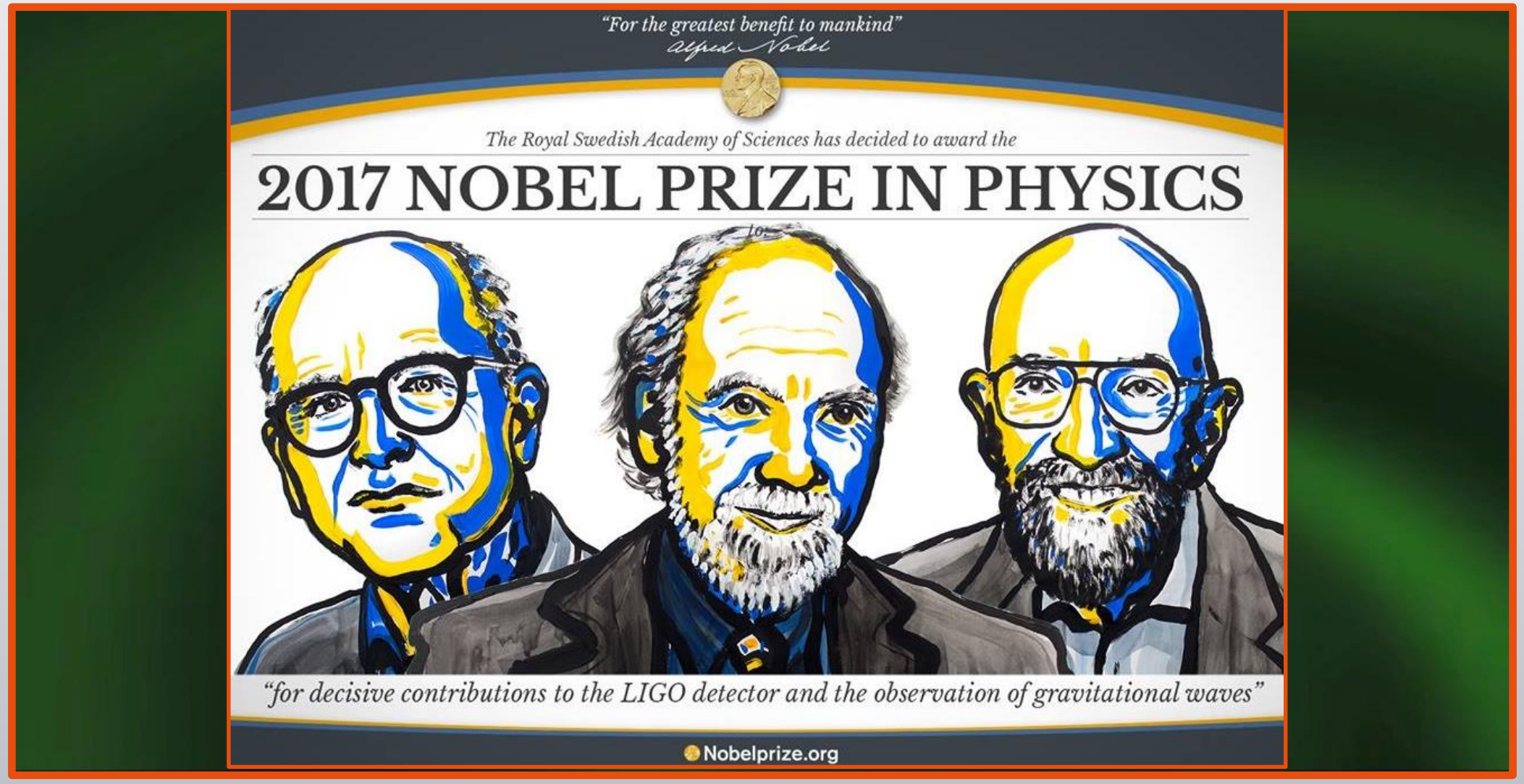


Gideon Koekoek



- First Light started to shine about 380.000 years after the Big Bang
- About 95% of the Universe is dark

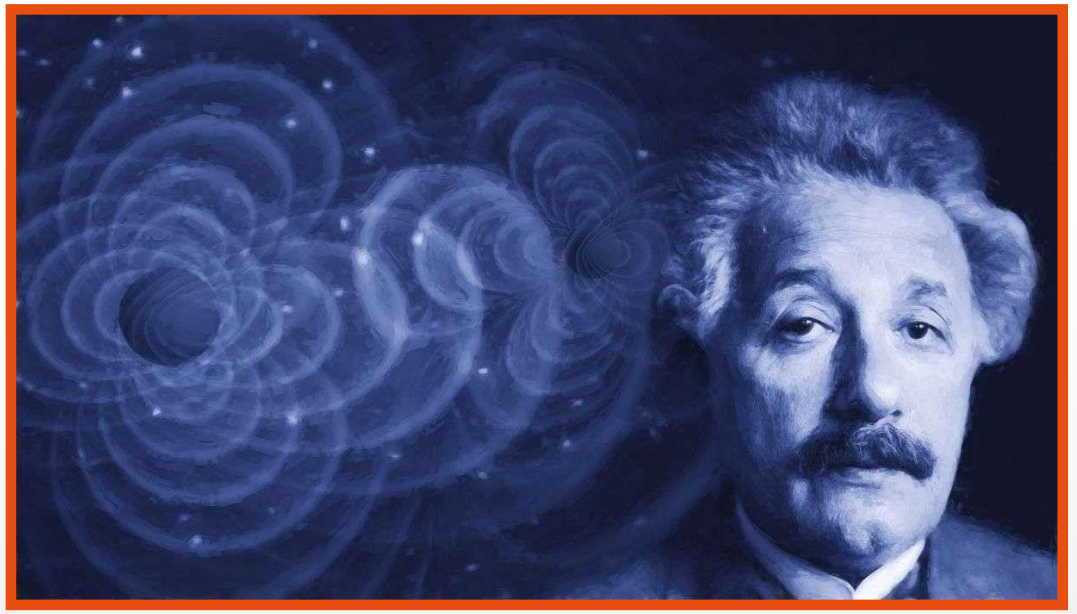
Something beautiful happened here!

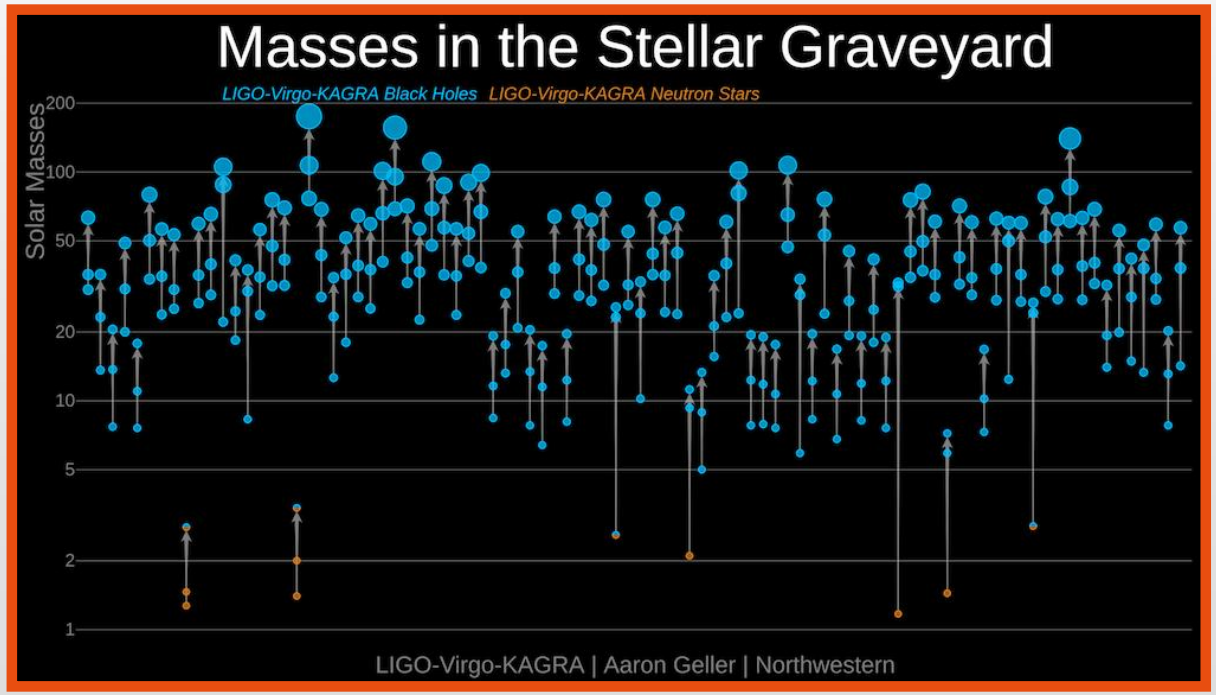

"For the greatest benefit to mankind"
Alfred Nobel
The Royal Swedish Academy of Sciences has decided to award the
2017 NOBEL PRIZE IN PHYSICS
to
"for decisive contributions to the LIGO detector and the observation of gravitational waves"
Nobelprize.org

We measure about one gravitational wave per week(!).

Current catalogue of detections: 100+

LIGO-Virgo Collaboration:
catalog.cardiffgravity.org/



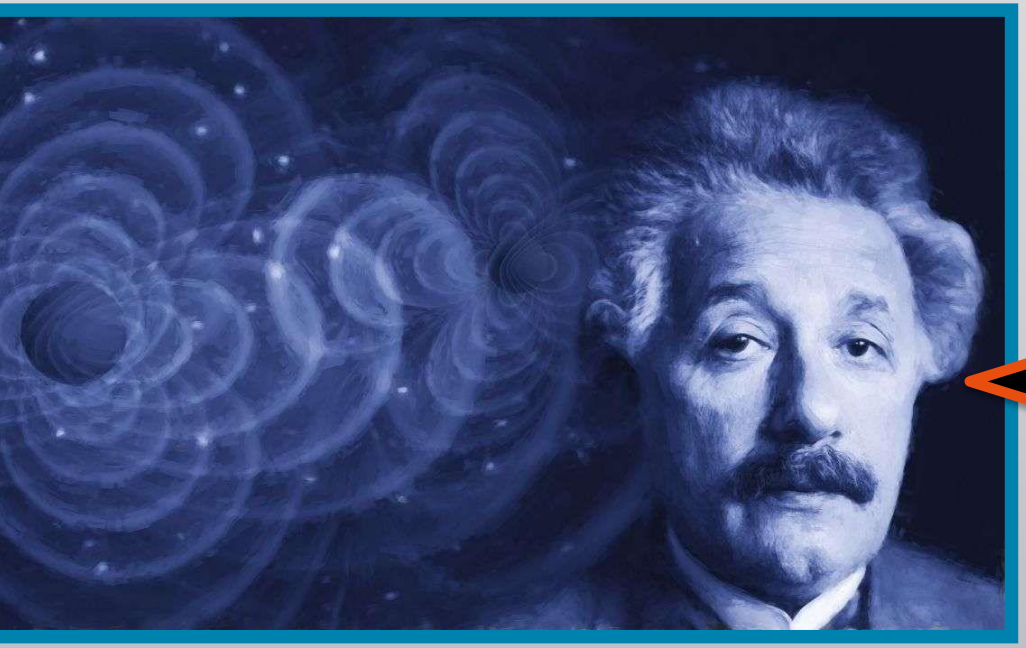


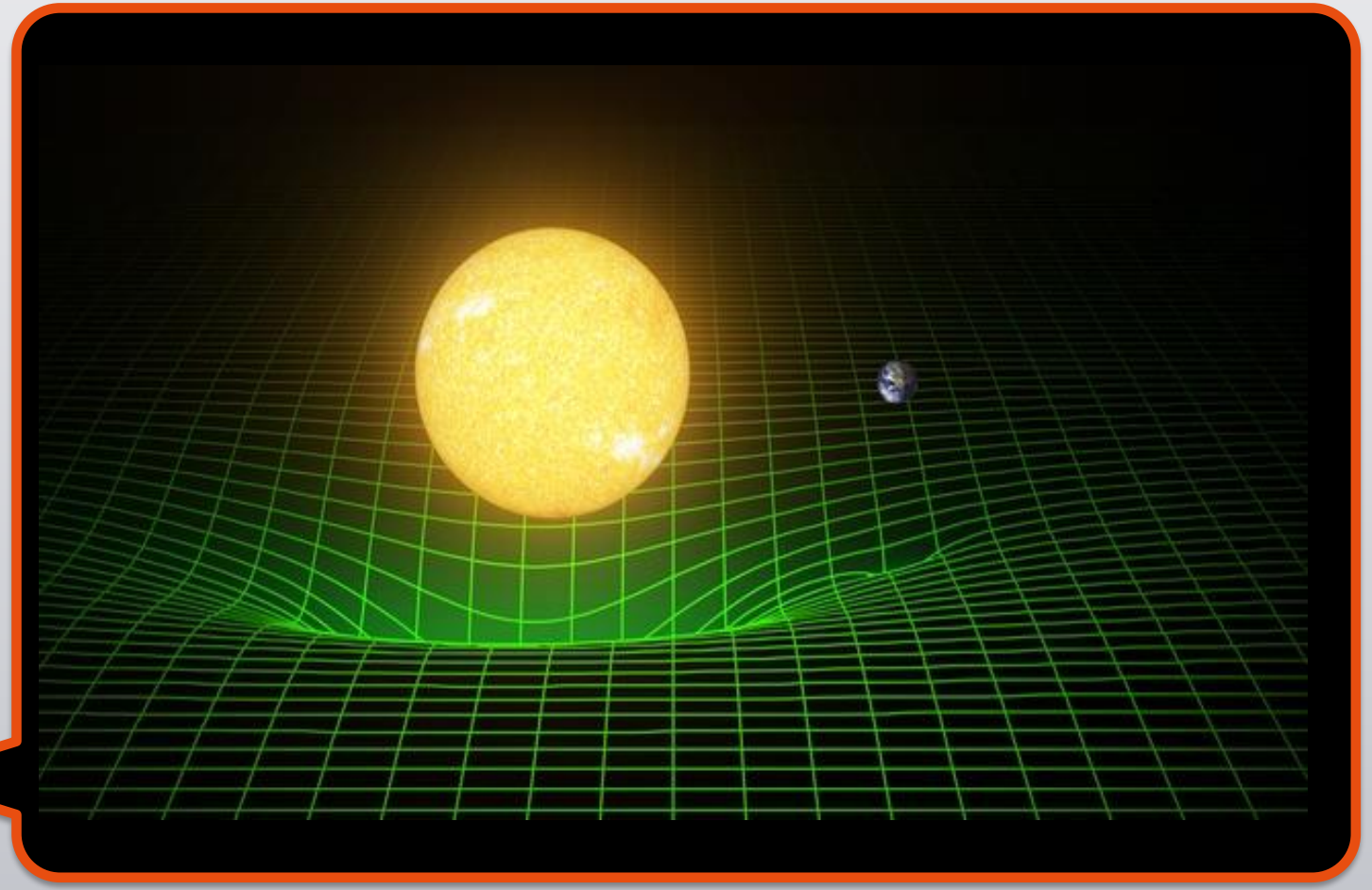
What are gravitational waves?

dr. Gideon Koekoek: gideon.koekoek@maastrichtuniversity.nl

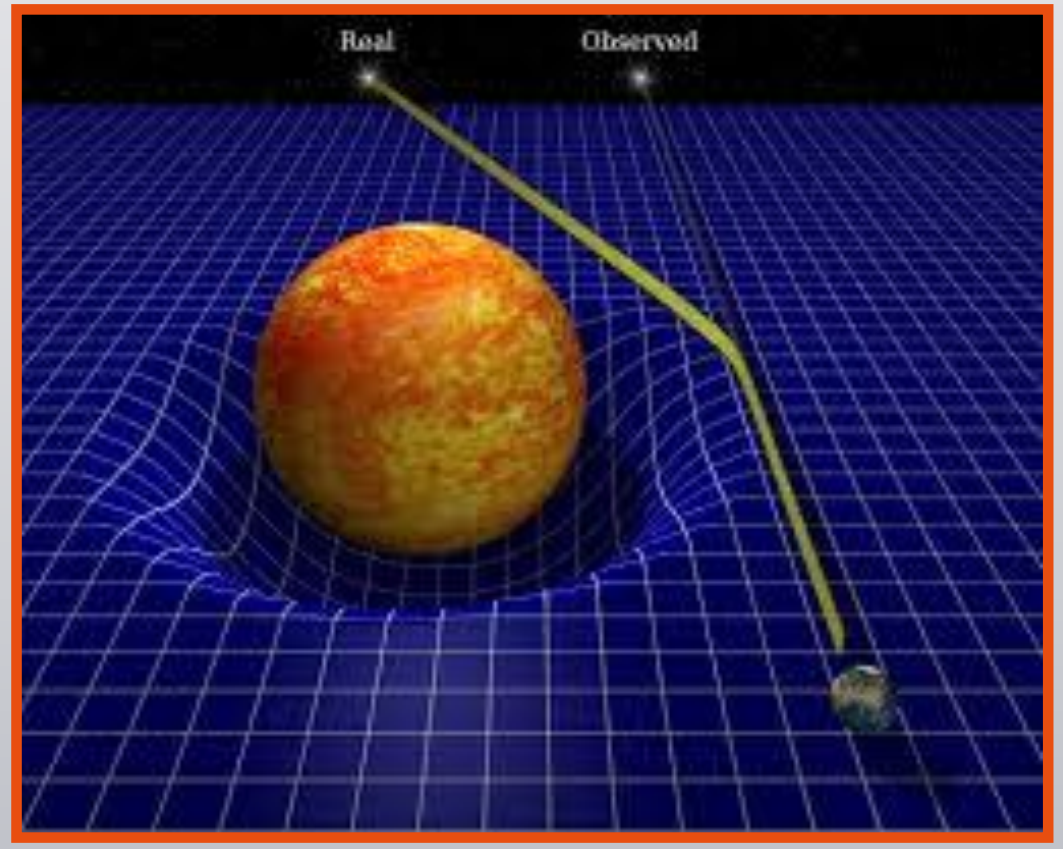
Einstein's General Relativity:

Gravity = curved spacetime

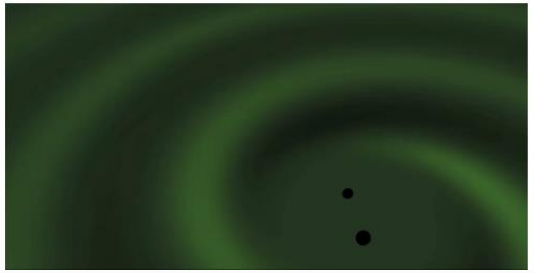


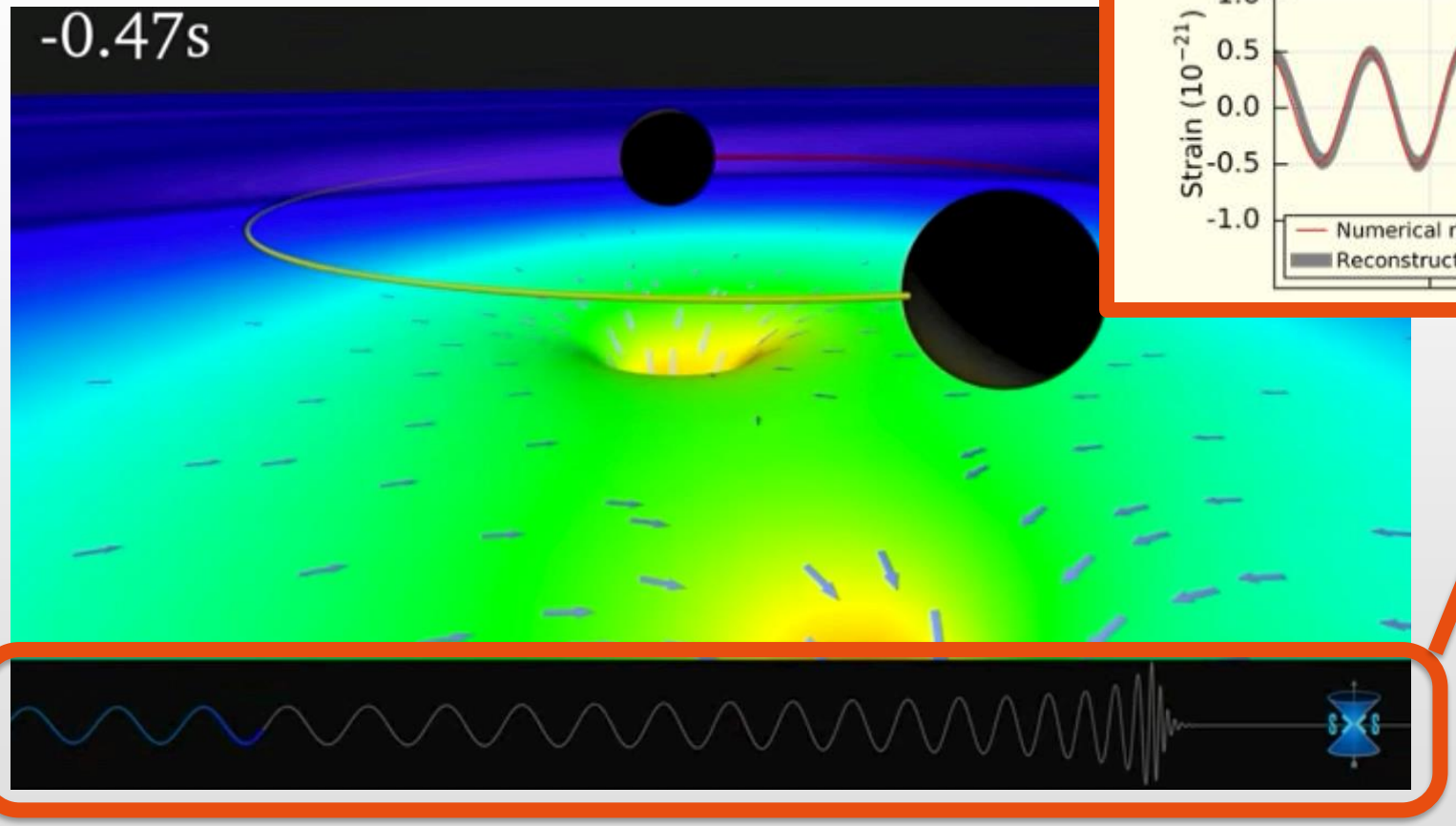


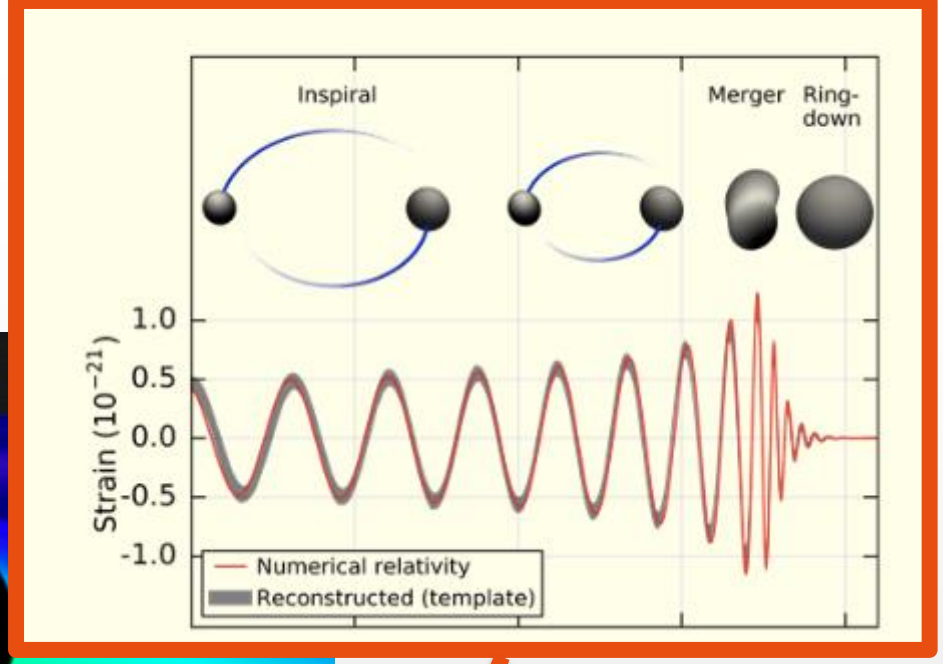
Curved spacetime: example 1



Curved spacetime: example 2







Characteristic shape of gravitational wave from a binary merger

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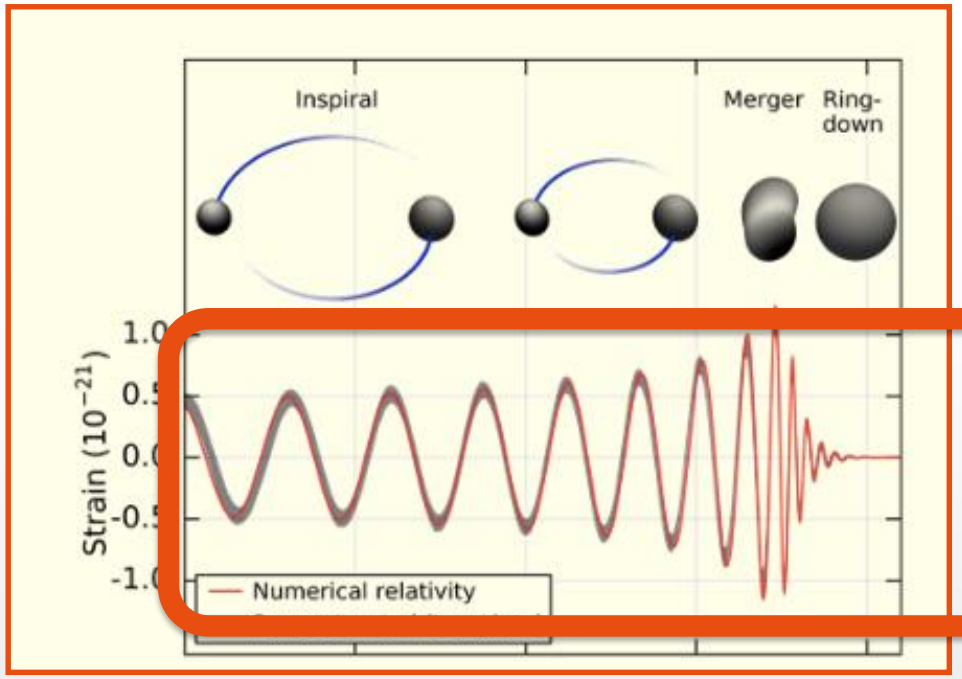
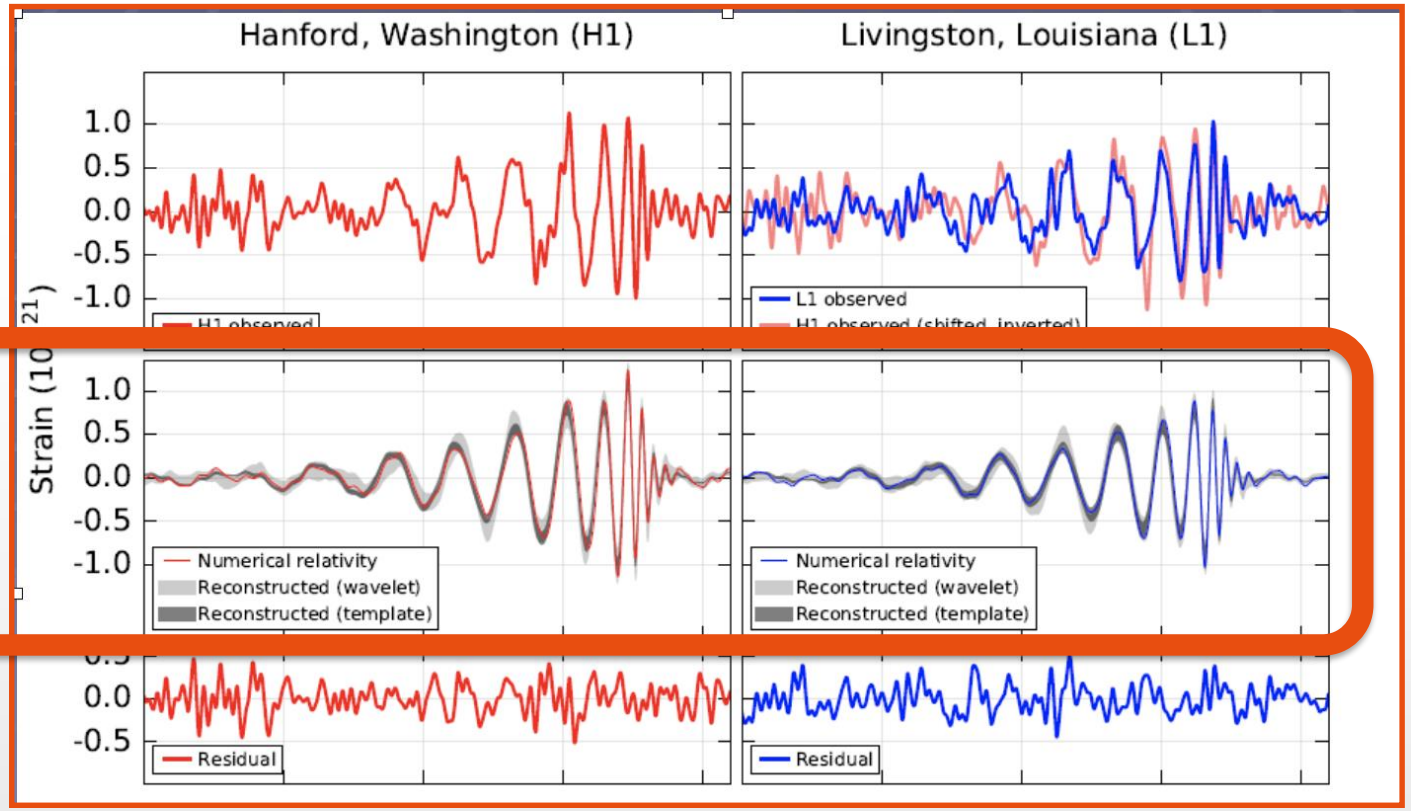


Theory



Measurements

www.einsteintelescope.nl/blog/2022/01/26/discovery-museum-maakt-online-reeks-over-einstein-telescope/

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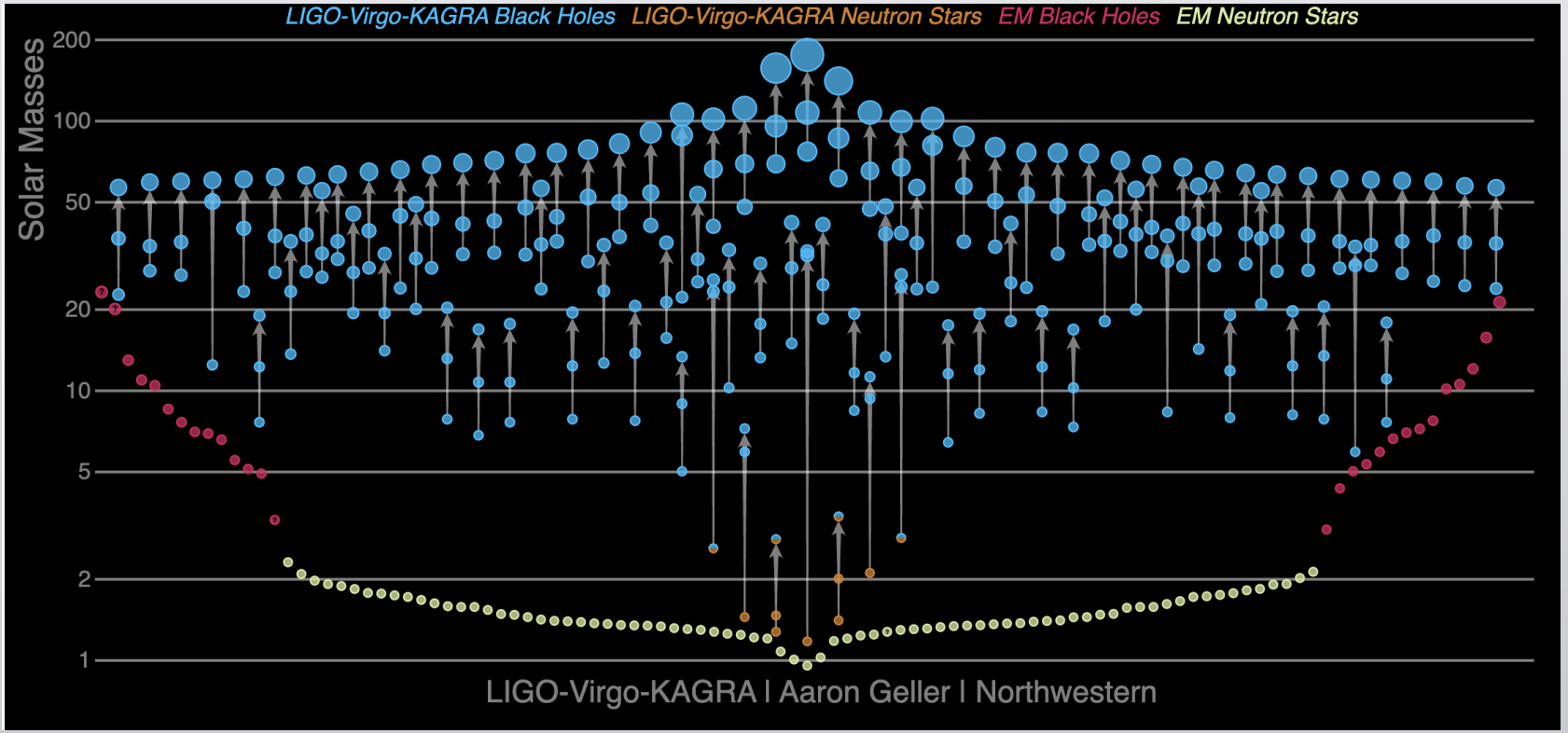
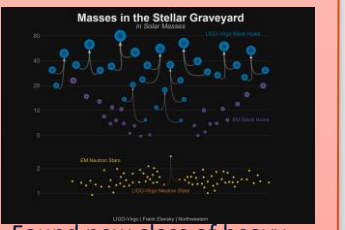
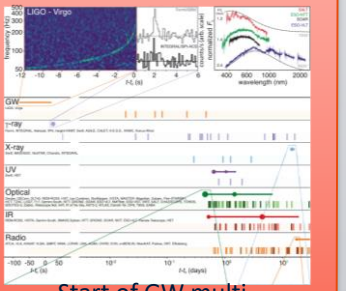
Current* catalogue (*Summer 2023)



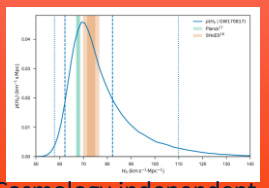
media.ligo.northwestern.edu/gallery/mass-plot



Found new class of heavy stellar mass BBH



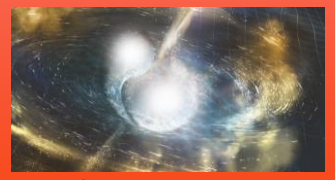
Start of GW multi-messenger astronomy



Cosmology independent of distance ladder

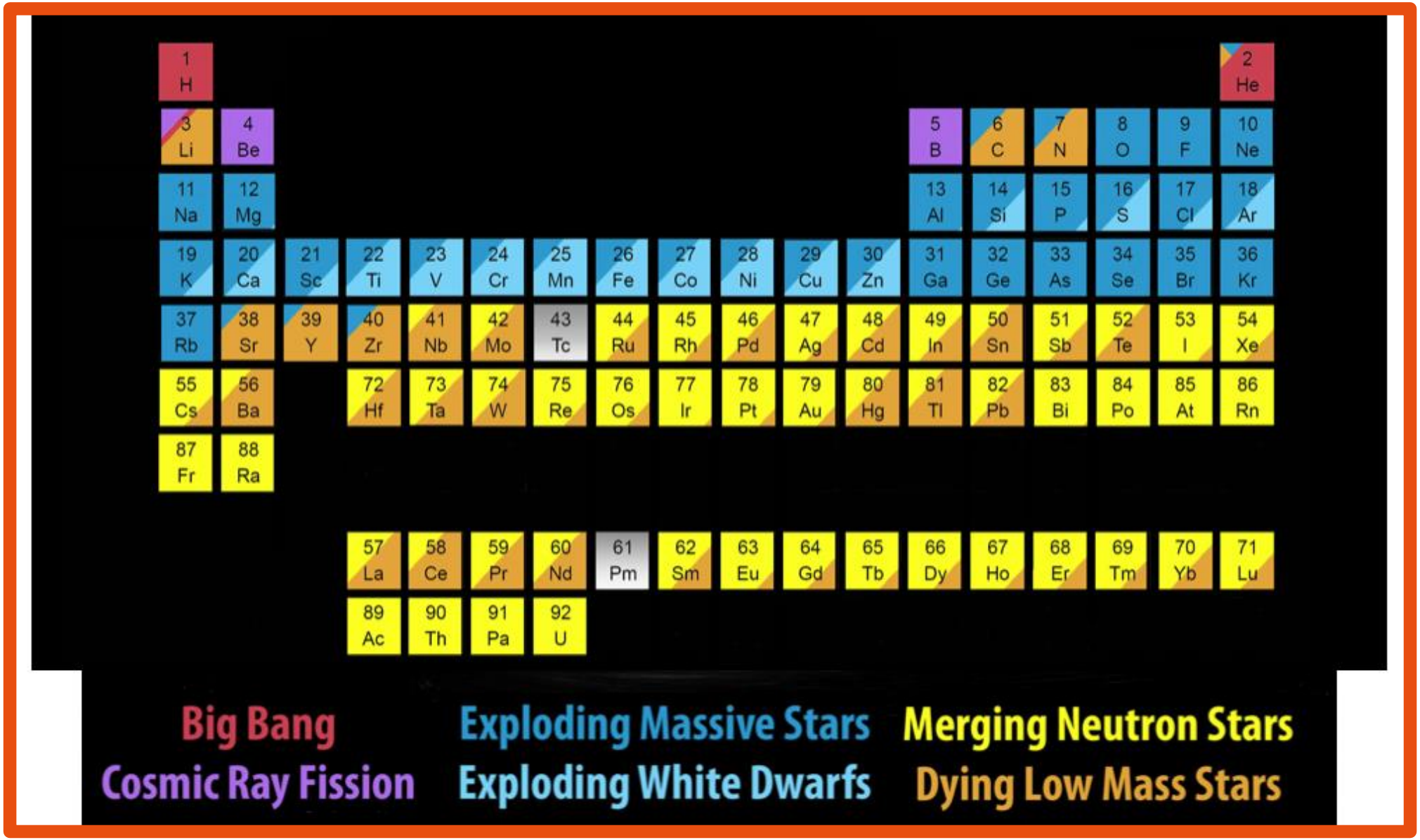
Ruled out some proposed EOS of neutron stars

Confirmed Kilonova and R-process



Confirmed BNS as origin for some GRBs

August 2017: Colliding neutron stars



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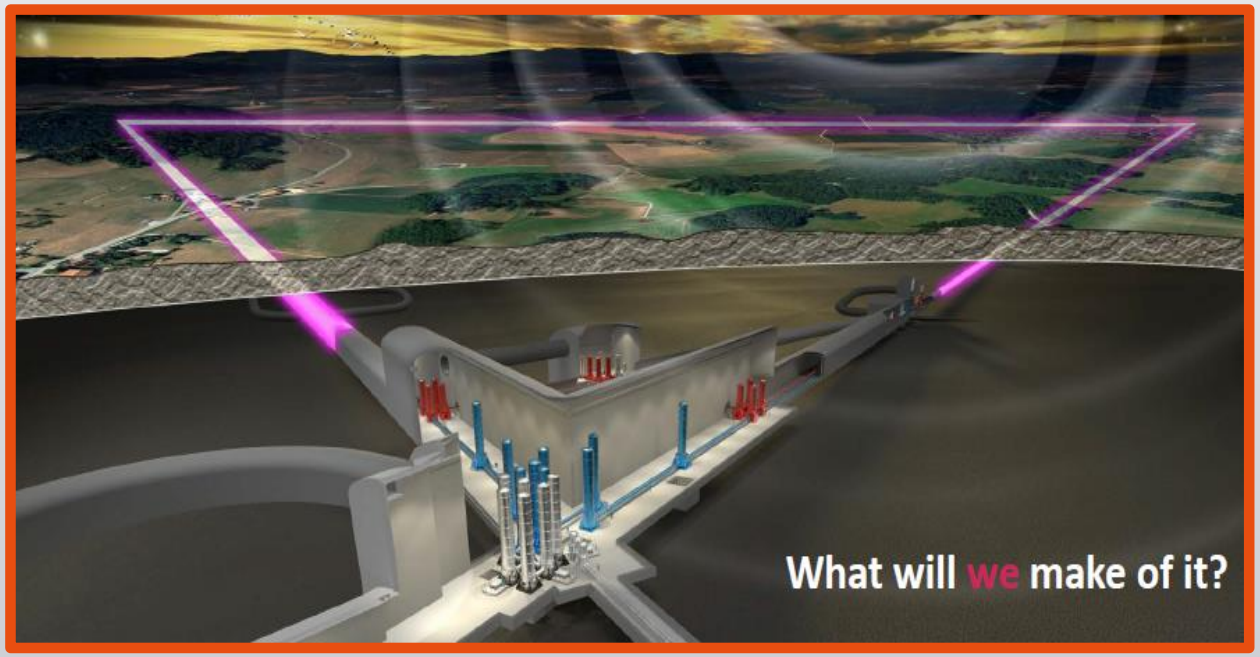
Gravitational waves offer us..

- .. a new window on the universe,
- .. opportunity to measure the very big and the very small
- .. measurements of the past and the future,
- .. a photo of the origin of the universe.
- …..

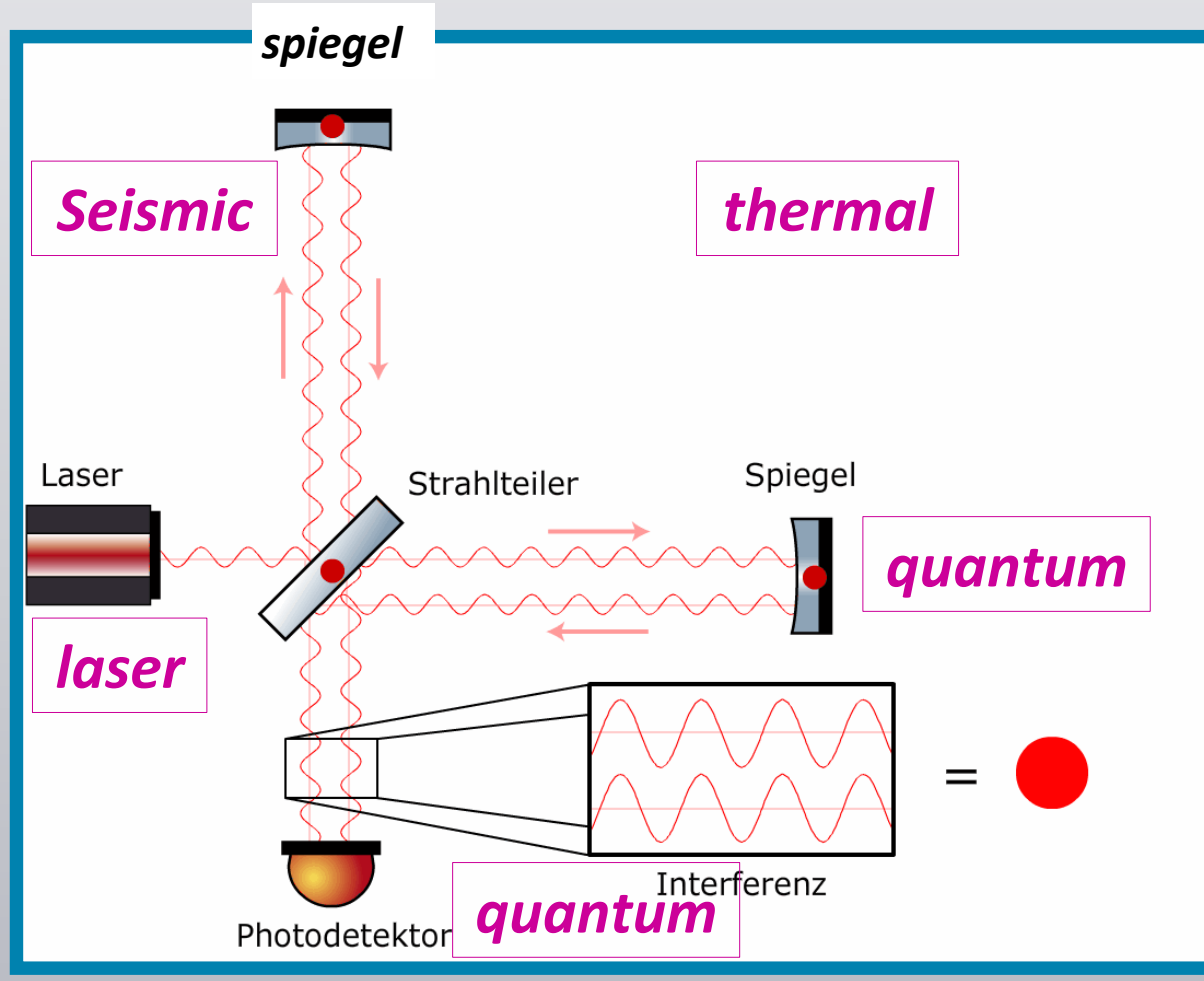


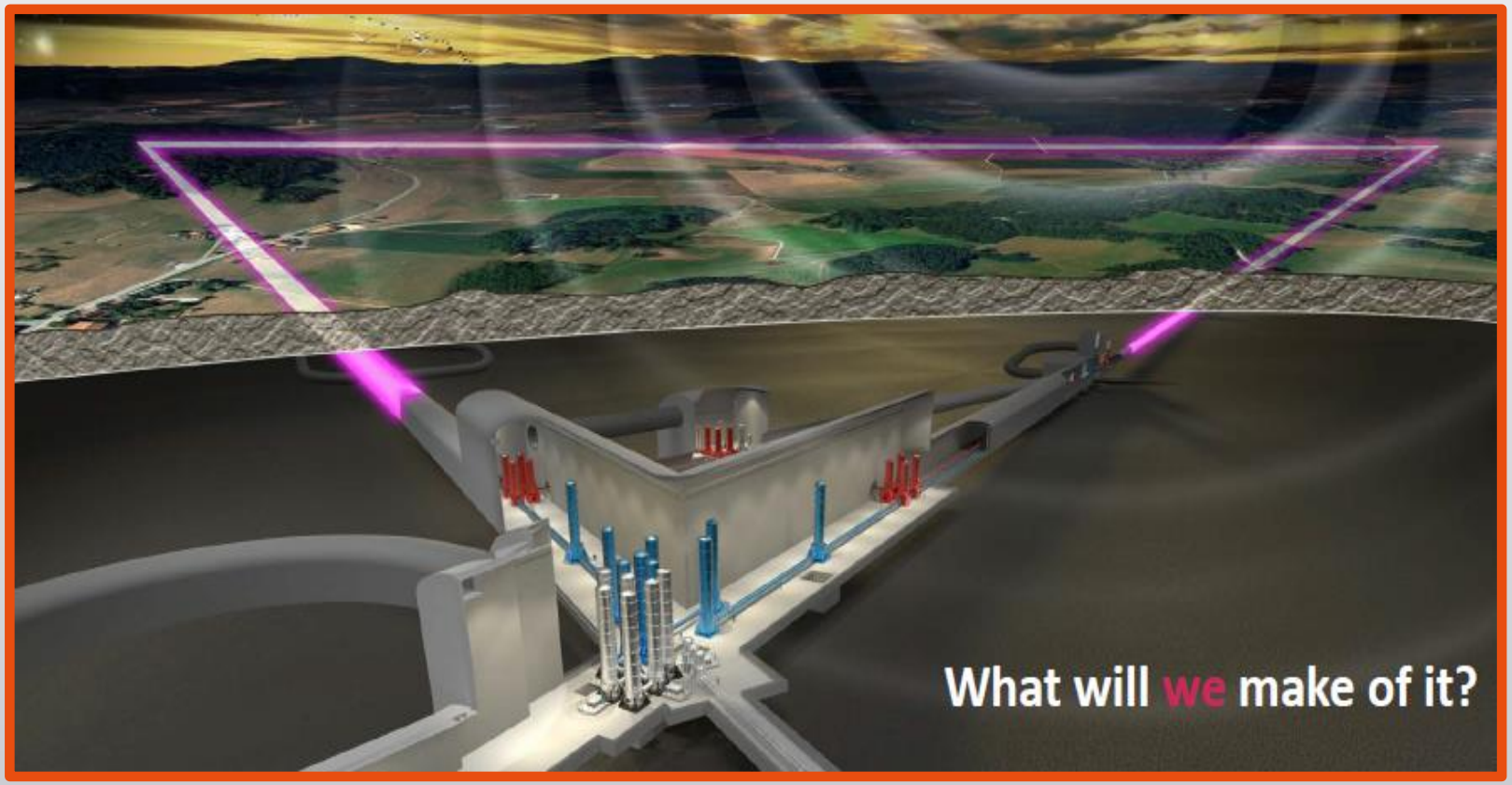
- **Connection**
  - Science
  - Technology & industry
  - Society

Maastricht University

Measuring gravitational waves

Virgo detector, Italië. www.virgo-gw.eu/





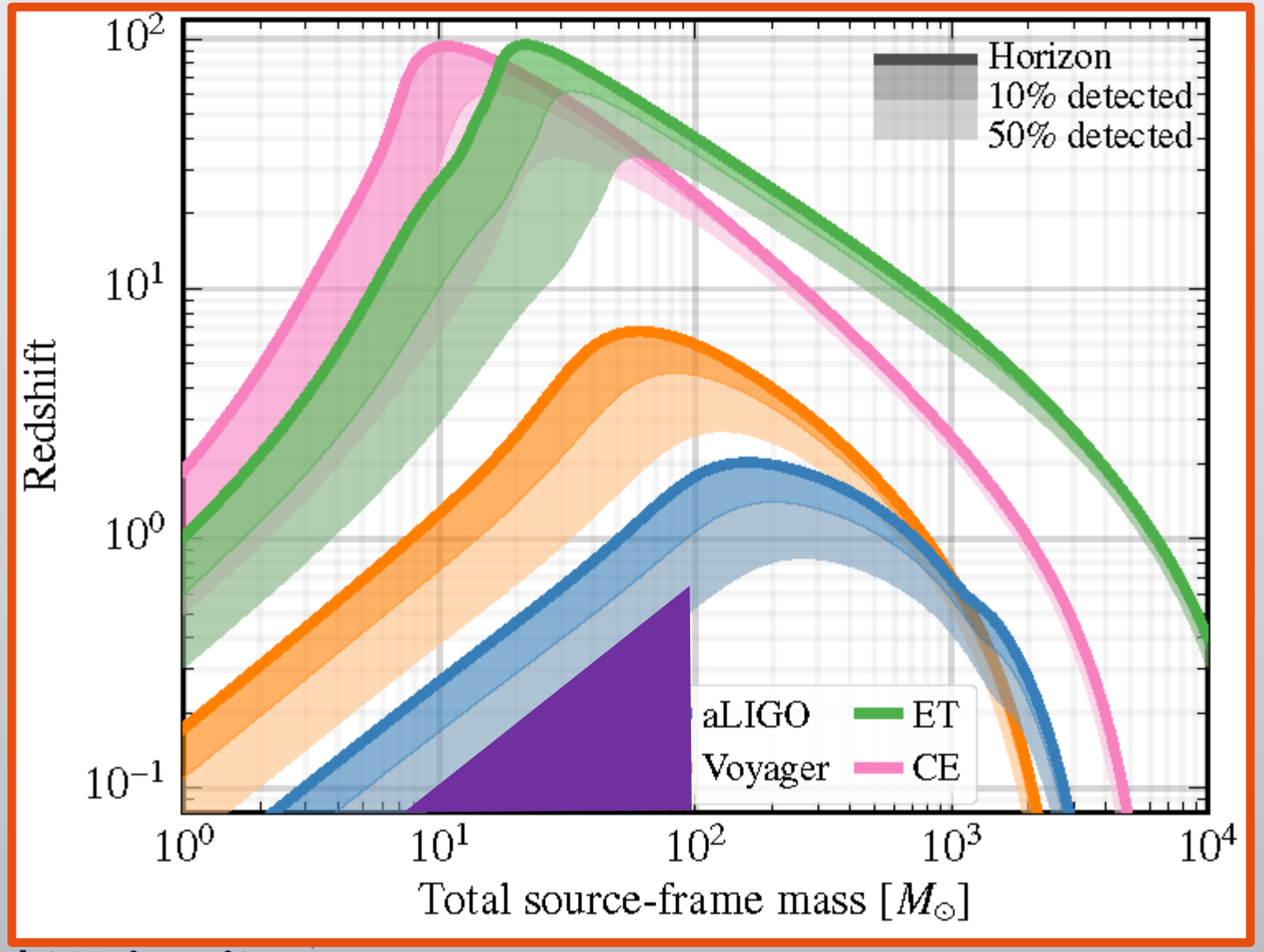
- Underground laboratory
- Three arms, each 10 km long,
- low temperature, in vacuum
- European collaboration
- filled to the brim with new technologies

ET EINSTEIN TELESCOPE

ET will measure about 1 million gravitational waves per year!

Maastricht University

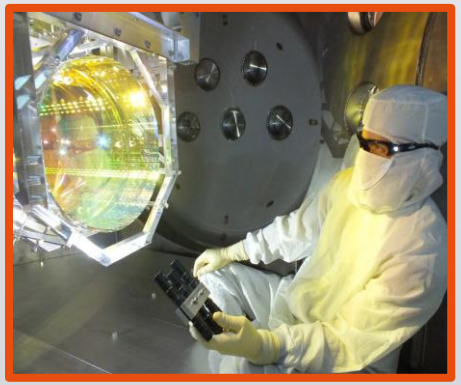
Einstein Telescope will measure..



..the entire visible Universe!

ETpathfinder:
Development of new technologies

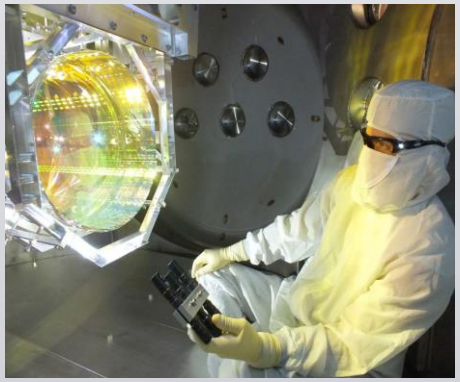
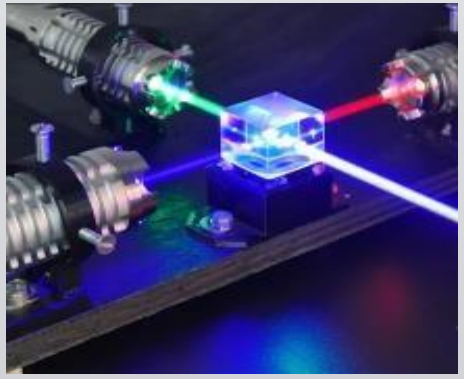
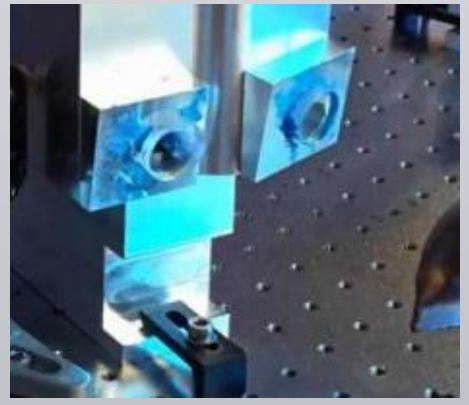
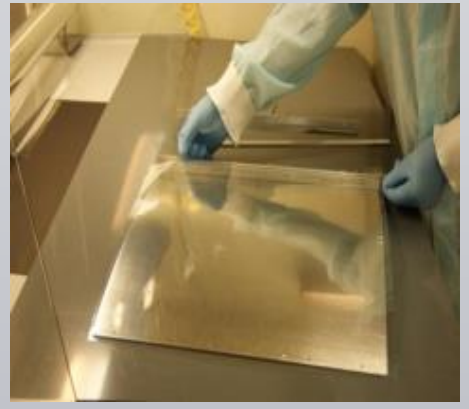
Maastricht

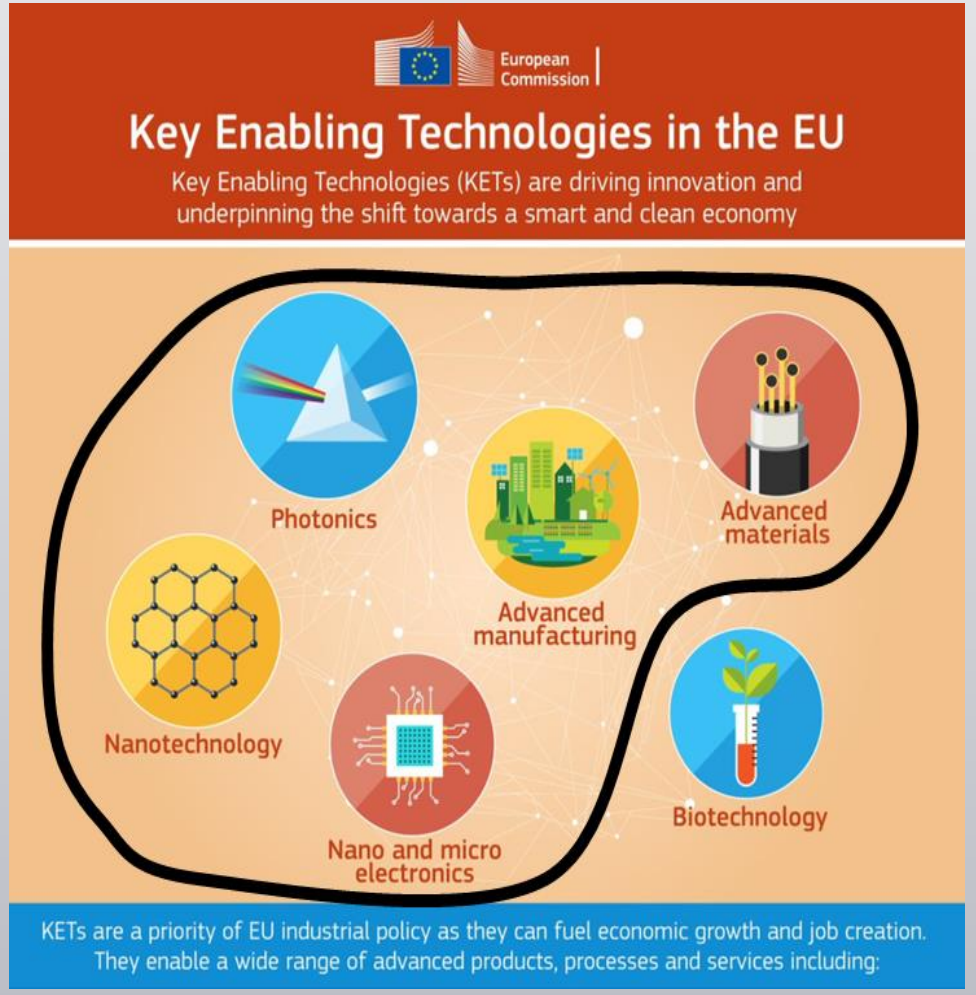


ETpathfinder:

Small version of the Einstein Telescope, meant to research and develop new measuring techniques.

New technologies include..

controls	(quantum) optics	lasers
		
		
sensors	**materials**	**algoritms**



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