

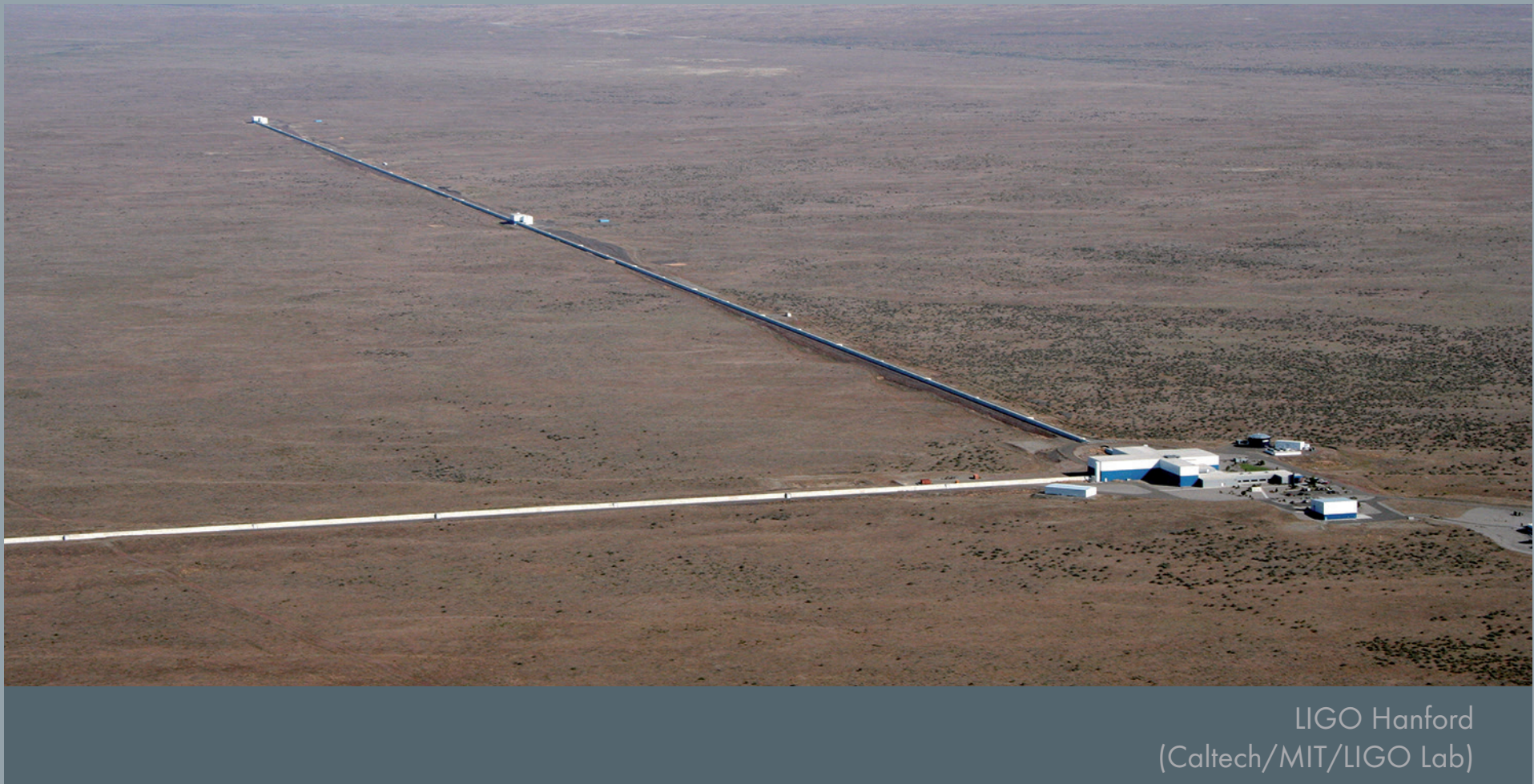
Searching for Gravitational Waves

“We did it” (D. Reitze, 11/02/2016), the breakthrough

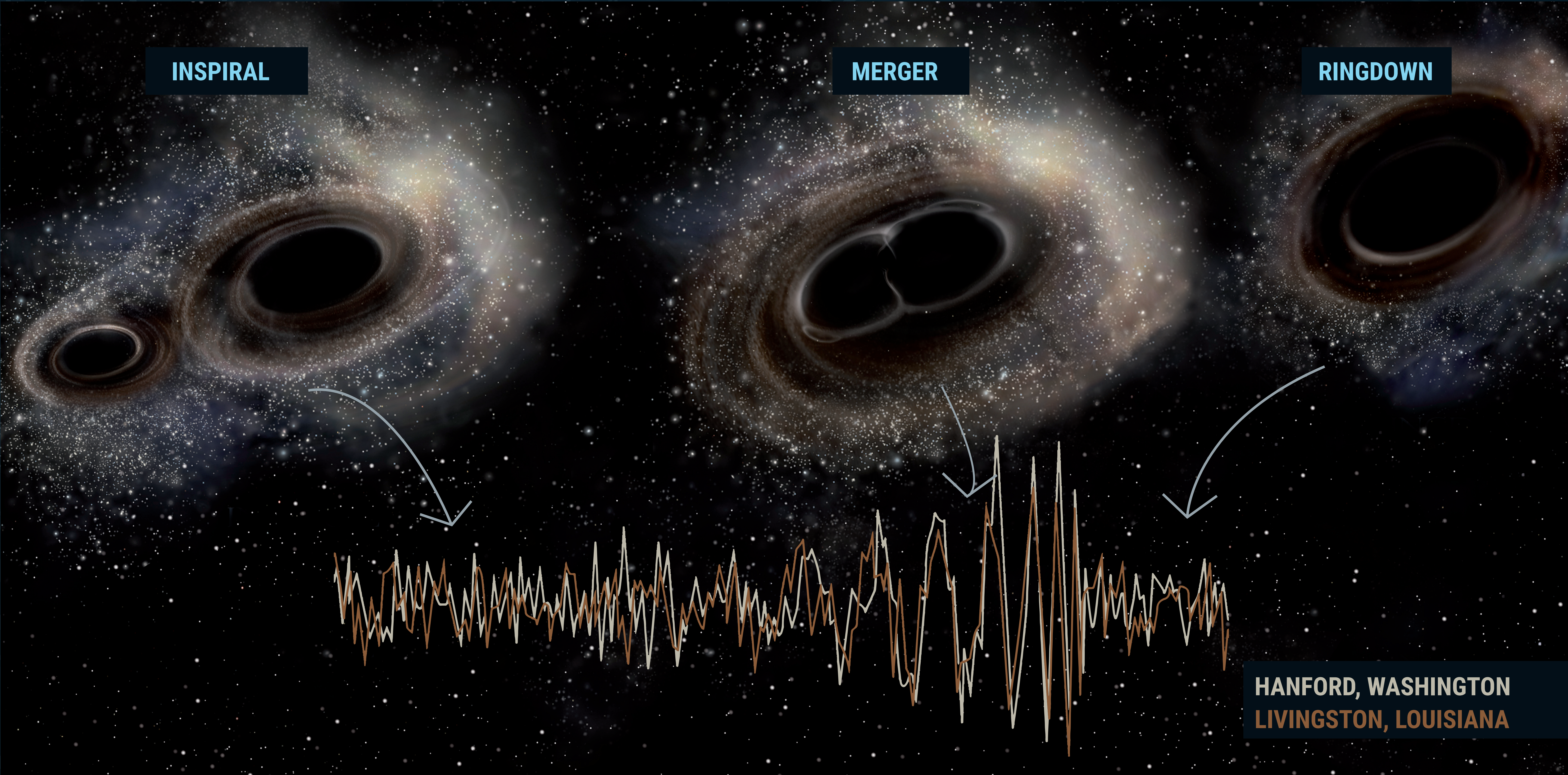
In 2015, LIGO (Laser Interferometer Gravitational wave Observatory) detected gravitational waves for the first time.

They originated from two orbiting and colliding black holes. All this happened 1,000 million light years away from us. They were 36 and 29 times more massive than the Sun. During the process, they formed a new black hole with the mass of 62 Suns.

$36 + 29 = 62$? The difference in mass is not a mistake: it was converted into energy that was carried away by gravitational waves. This energy, released within fractions of a second, could cover our energy consumption on Earth for much longer than the age of our universe.



The LIGO detectors in Hanford (top) and Livingston (bottom) have two 4 km-long tunnels through which they send laser beams. If a gravitational wave passes through, these arms change by a fraction of the size of a proton. This means that it takes more (or less) time for the laser beam to travel along the arm. It is through this change in the arrival time that one measures gravitational waves.



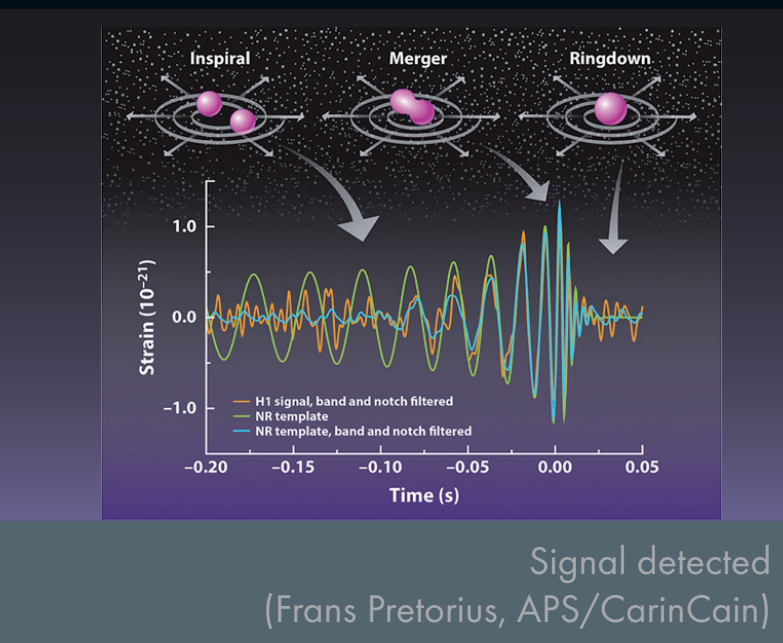
HANFORD, WASHINGTON
LIVINGSTON, LOUISIANA

(LIGO, NSF, Illustration A. Simonnet (S.S.U.))

Illustration of the inspiralling black holes (left), their collision (middle) and them settling down as a single new black hole (right). Below, you can see the corresponding gravitational wave signal that LIGO measured.

2015

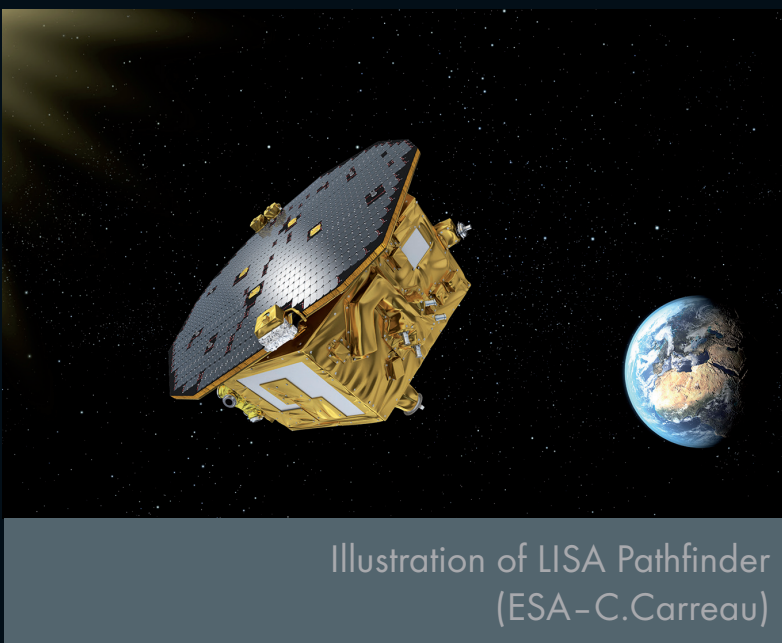
LIGO



LIGO started looking for gravitational waves in 2002 and detects them directly for the first time on 14 September 2015 (2017 Nobel prize).

2015-16

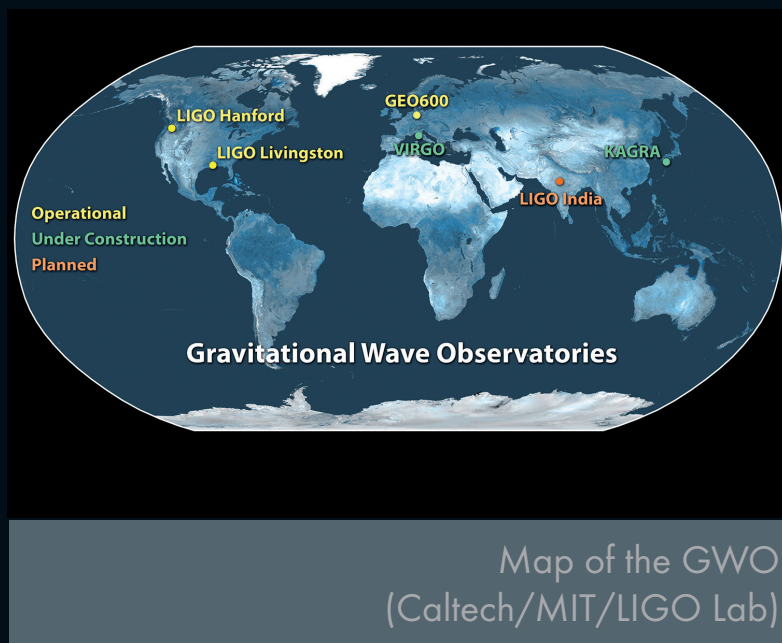
LISA Pathfinder



It successfully tests the technology for LISA (Laser Interferometer Space Antenna), a detector like LIGO but much larger and in space.

2020s

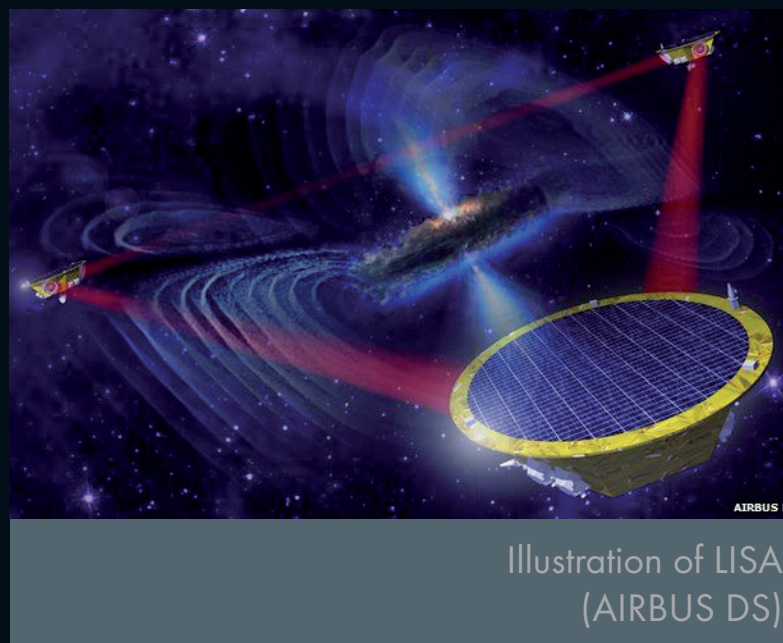
A worldwide network of detectors



It will ‘listen’ to merging stellar-mass black holes or neutron stars, and supernovae.

2030s

LISA



LISA will hear how galaxies merge. It will also detect stars and stellar-mass black holes falling into the supermassive black hole in the centre of galaxies - and much more that we have not foreseen.

