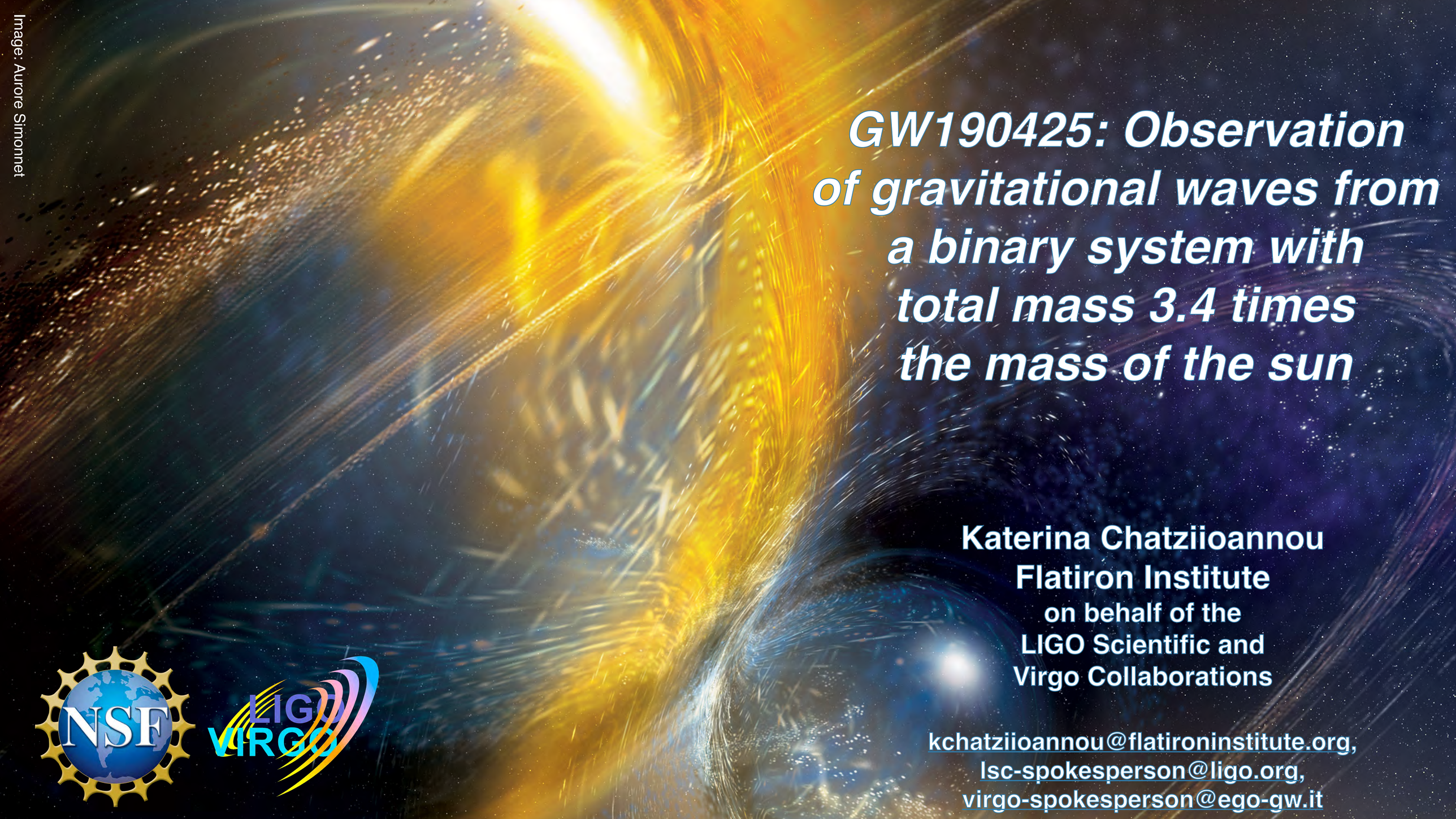

Image: Aurore Simonnet

GW190425: Observation of gravitational waves from a binary system with total mass 3.4 times the mass of the sun

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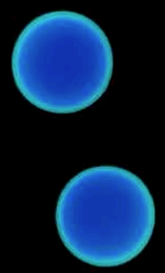
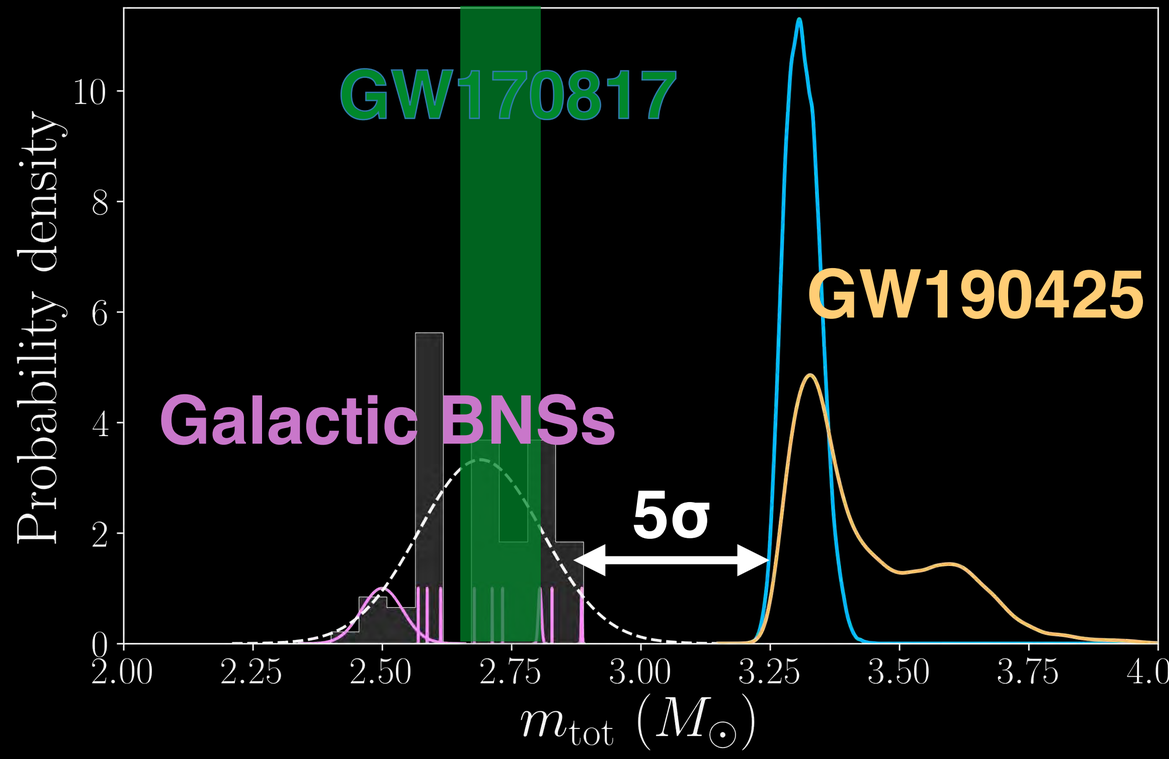
GW190425: A new class of binary systems

Movie: Dietrich, Tichy, CoRe, Ossokine, Buonanno

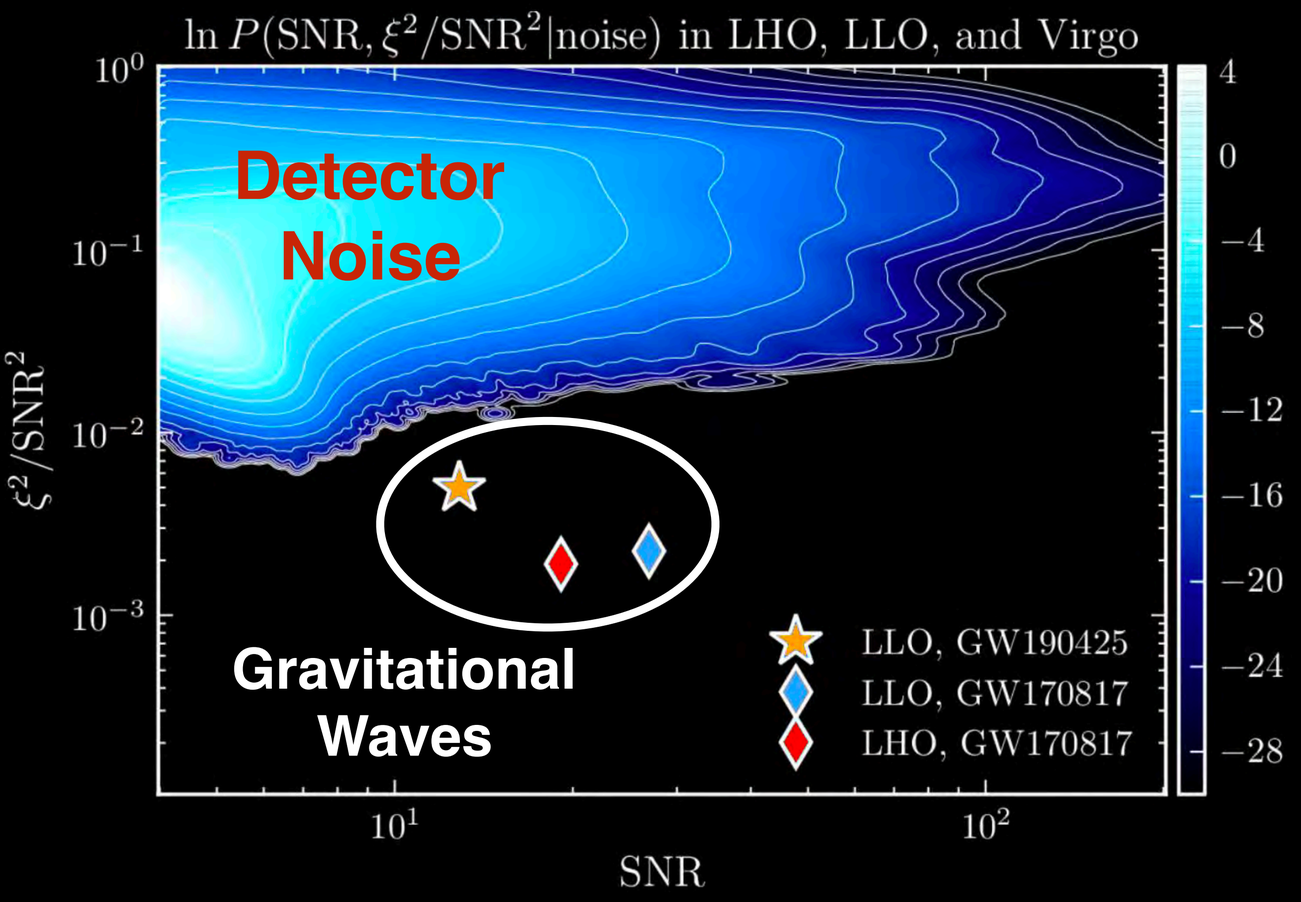


Gravitational waves from the collision of two objects with masses 1-2.5 solar masses were detected on April 25, 2019

- The individual masses are consistent with neutron stars
- The pair is more massive than all known neutron star binaries in the Galaxy and GW170817
- We cannot rule out the possibility of black hole(s)
- The existence of such a system further challenges binary formation theories



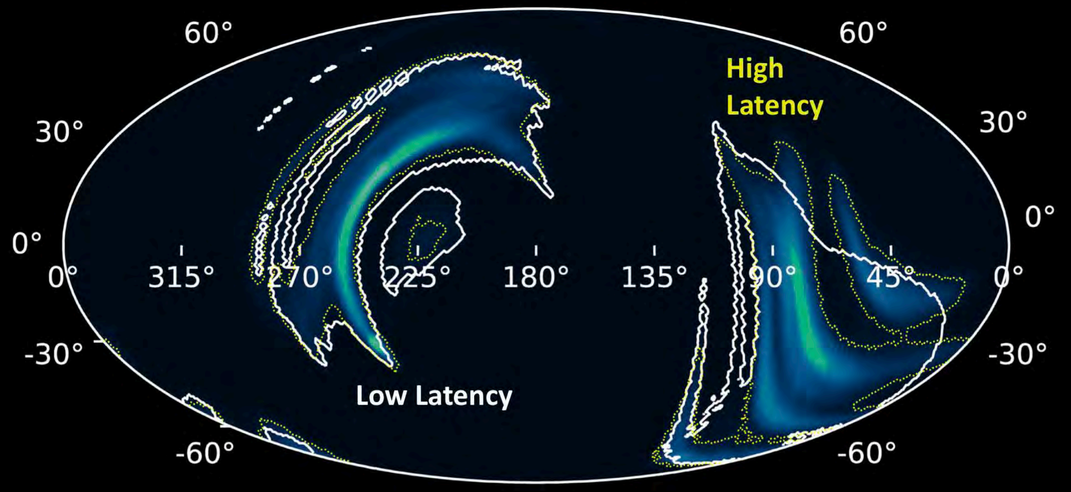
Single-detector event



- Three currently operational detectors
- LIGO-Hanford was offline at the time of the event
- The signal was detected only in LIGO-Livingston (440 million light years average range) with signal-to-noise ratio 12.9
- Virgo (156 million light years average range) did not contribute to detection, but the data were used in subsequent analyses

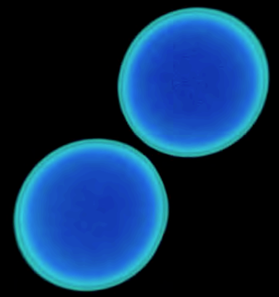
Despite being detectable by only one detector we are confident of GW190425's astrophysical origin because it is inconsistent with any single-detector background trigger ever recorded

Search for electromagnetic radiation



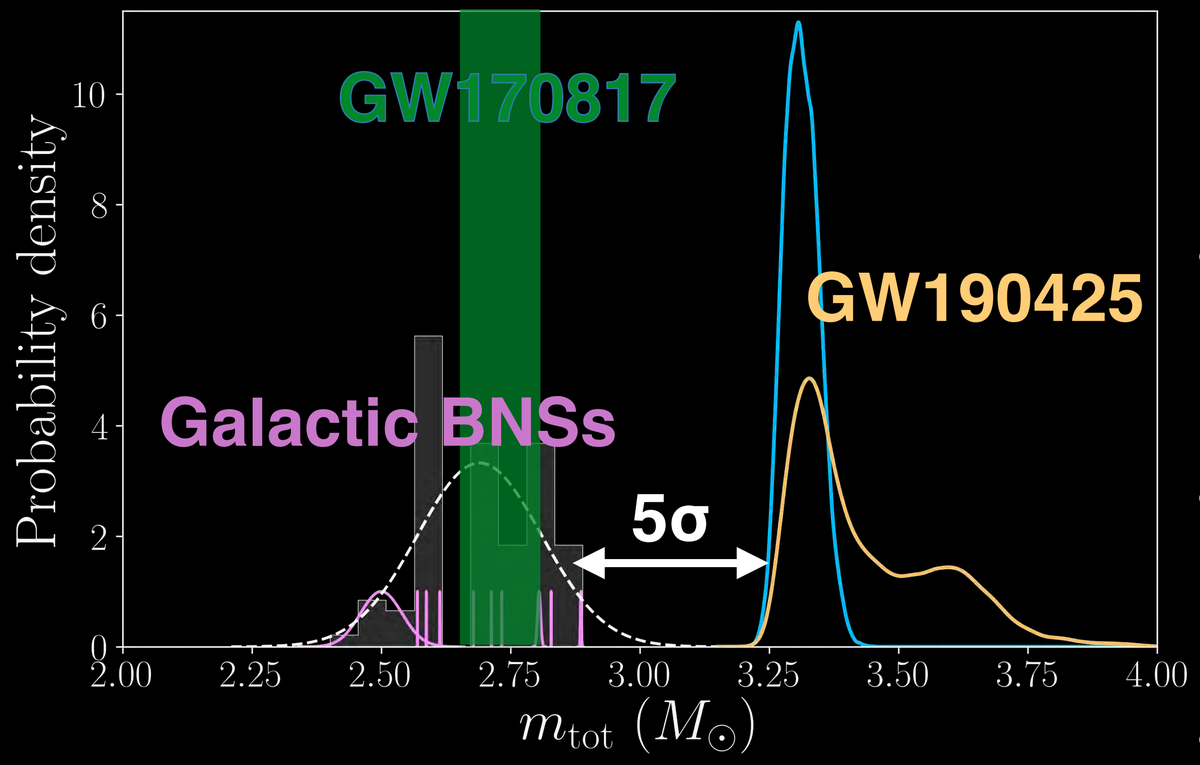
- An alert was distributed after 43 minutes, but without a confirmed detection of light
- Accurate sky localization is not possible for single-detector events
- Distance 287-744 million light years
- No constraints on the binary inclination

The final remnant star probably collapsed immediately into a black hole "swallowing" all the material



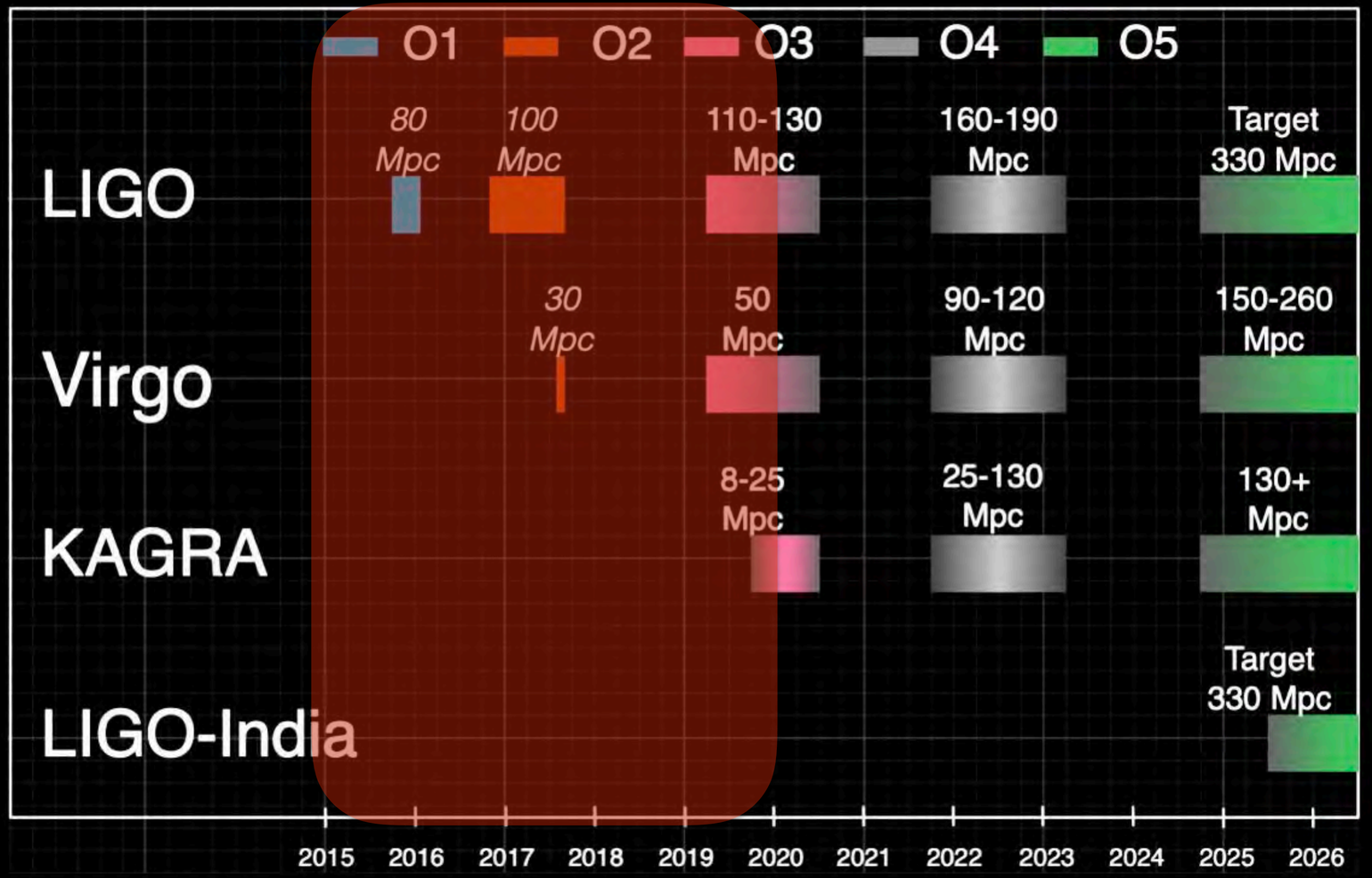
Movie: Dietrich, Tichy, CoRe, Ossokine, Buonanno

Astrophysical implications



- The individual masses are consistent with neutron stars but the pair of them is more massive than all known neutron star binaries
- The inferred event rate is potentially in tension with theoretical predictions
- Formation mechanisms are constrained by masses, rate, and galactic observations
- More unlikely interpretations are possible

Current observing status: second half of O3



- The 3rd observing run ends on April 30th
- The Japanese KAGRA detector will begin observing with limited sensitivity in the coming weeks

A total of 43 (unretracted) alerts have been shared with the scientific community and analyses are ongoing

Summary

1. First **gravitational-wave detection** announcement from the third observing run

2. The source is a previously undetected type of system, likely a **massive neutron star binary**

3. Cannot rule out **more exotic scenarios** about the nature of the binary

4. No confirmed **electromagnetic** counterpart detection

5. GW190425 further **challenges our theories** about how these pairs form and merge

- Manuscript under review by ApJL, available at https://dcc.ligo.org/LIGO-P190425/public
- More material (data, science summary, movies, artwork, etc.) available at https://www.ligo.org/detections/

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