**Key words:** Gravitational Waves, Kilonova

| **ESOcast Episode 133: ESO Telescopes Observe First Light from Gravitational Wave Source** | |
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| **00:00**<br>**[Visual starts]**<br>**[Narrator]**<br>1. Astronomers using a fleet of ESO telescopes have observed a visible counterpart to gravitational waves for the first time: a kilonova from merging neutron stars. | Zooming in on the kilonova in NGC 4993 |
| **00:18**<br>**ESOcast intro**<br>2. New ESOcast introduction | New ESOcast introduction |
| **00:26**<br>**[Narrator]**<br>3. On August 17, 2017, the LIGO–Virgo collaboration detected gravitational waves rippling through the fabric of space-time.<br><br>Just two seconds later two space telescopes from ESA and NASA also detected a short gamma-ray burst coming from the same area of the sky.<br><br>This coincidence had never been seen before and raised hopes that astronomers had witnessed a cataclysmic event — two neutron stars combining in an explosive merger.<br>If so, a visible-light counterpart known as a kilonova was expected to follow.<br><br>The hunt was on! | Zooming in on the kilonova in NGC 4993<br><br>Night timelapse at Paranal<br><br>Neutron star merger animation ending with kilonova explosion |

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| **01:16**<br>**[Narrator]**<br>4. ESO and ESO-partnered telescopes in Chile joined other observatories to search for a new light source. They were looking for a needle in a haystack — a faint new glimmer amid millions of stars.<br><br>But amazingly, they found it just a few hours later — in the galaxy NGC 4993, 130 million light-years from Earth. | Various ESO telescopes at Paranal<br><br>Changing colour time-lapse from VISTA |
| **01:45**<br>**[Narrator]**<br>5. Over the next few weeks, astronomers used a host of ESO telescopes with more than 10 different instruments to record the kilonova.<br><br>Neutron star mergers are the furnaces where most of the chemical elements heavier than iron are forged.<br>The kilonova, an event 1000 times brighter than a typical nova spreads the newly-formed elements into the surrounding space.<br><br>These include the gold in jewelry, the platinum in catalytic converters in cars and uranium in nuclear reactors. | Various ESO telescopes<br><br>Neutron star merger animation ending with kilonova explosion |
| **02:21**<br>**[Narrator]**<br>6. Such an explosion had never been confirmed before, but now one could be studied in great detail! The ESO observations revealed an extraordinary and rapidly changing event, closely mirroring theory.<br><br>Heavy, radioactive elements were shot into space at one-fifth the speed of light. In just a matter of days the kilonova's colour changed rapidly from blue to red, faster than any other observed stellar explosion. | Night timelapse<br>Artist's impression of merging neutron stars<br><br>Annotated artist's impression of merging neutron stars<br>Animation of spectra of kilonova in NGC 4993 |

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| **02:57**<br>**[Narrator]**<br>7. Thanks to the rapid reaction of groups of skilled scientists and ESO's very wide array of instruments, this kilonova was located and studied across a swath of wavelengths in a matter of days.<br><br>This event marks the start of a new era of multi-messenger astronomy. For the first time in history we can now combine light signals with gravitational waves, to provide a totally new way to probe the Universe. | Telescopes, kilonova explosion animation, night timelapses |
| **03:30**<br>**[Outro]** | *Produced by ESO, the European Southern Observatory.*<br>*Reaching new heights in Astronomy.* |