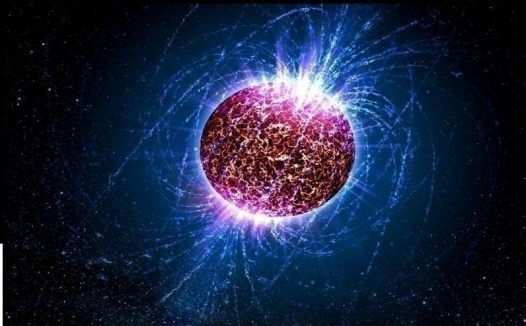


Dark matter in neutron stars

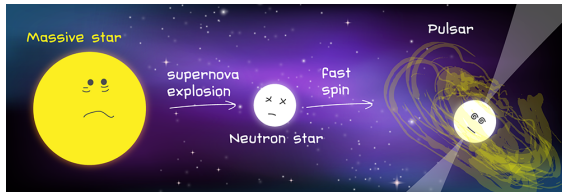
Violetta Sagun

Centre for Physics of the University of Coimbra (CFisUC), University of Coimbra



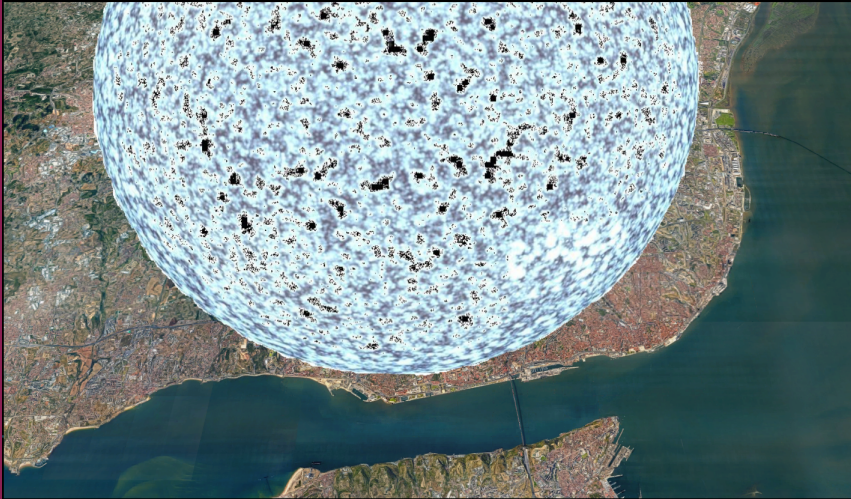
Neutron star

- the last stage of massive star evolution, produced in core collapse supernova explosion. Usually detected as a pulsar
- the most compact and exotic astrophysical objects in the universe that are accessible by direct observations
- the most extreme objects in terms of the rotation speed, density, radius, magnetic field, etc.



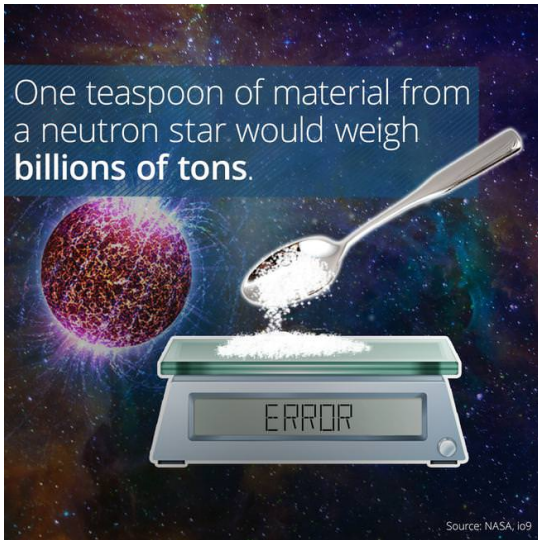
	Neutron star	White dwarf	Sun
$M_{max} (M_{\odot})$	2	1.44	1
$R (km)$	11-12	10^4	$7 \cdot 10^5$
$n_c (g/cm^3)$	$10^{14} - 10^{15}$	10^7	10^2
rotation speed (s)	$10^{-3} - 1$	100	$2 \cdot 10^6$
$B (G)$	$10^8 - 10^{16}$	100	1
$T (K)$	$10^6 - 10^{11}$	10^3	10^5

Neutron star has a size of Lisbon



A teaspoon of neutron star matter

One teaspoon of material from
a neutron star would weigh
billions of tons.



Source: NASA, Io9

Dark matter candidates

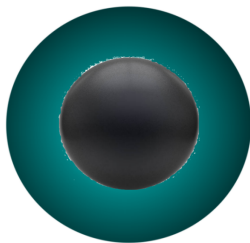


credits: Symmetry magazine

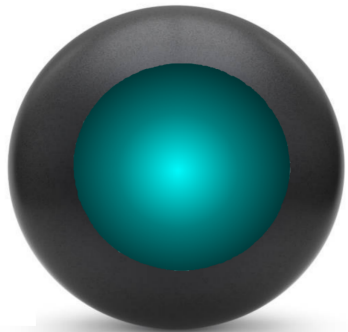
Dark matter and neutron star structure



dark matter core



dark core inside a NS



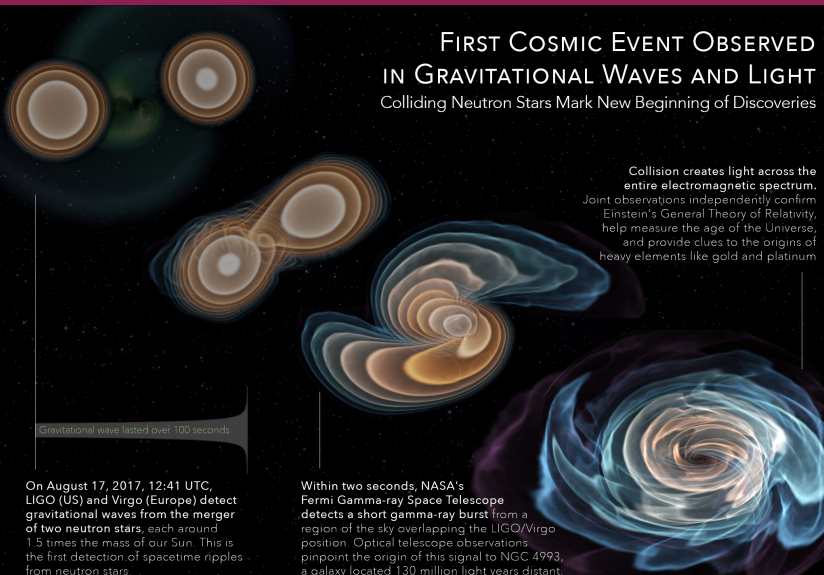
dark halo around a NS

Coalescence of a binary system of two neutron stars

FIRST COSMIC EVENT OBSERVED IN GRAVITATIONAL WAVES AND LIGHT

Colliding Neutron Stars Mark New Beginning of Discoveries

Collision creates light across the entire electromagnetic spectrum. Joint observations independently confirm Einstein's General Theory of Relativity, help measure the age of the Universe, and provide clues to the origins of heavy elements like gold and platinum

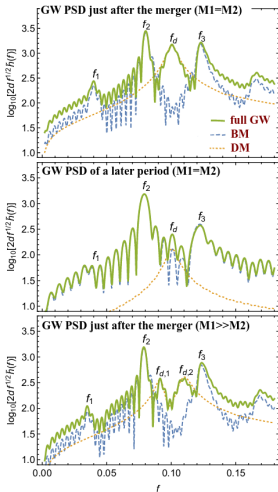


Gravitational wave lasted over 100 seconds

On August 17, 2017, 12:41 UTC, LIGO (US) and Virgo (Europe) detect gravitational waves from the merger of two neutron stars, each around 1.5 times the mass of our Sun. This is the first detection of spacetime ripples from neutron stars.

Within two seconds, NASA's Fermi Gamma-ray Space Telescope detects a short gamma-ray burst from a region of the sky overlapping the LIGO/Virgo position. Optical telescope observations pinpoint the origin of this signal to NGC 4993, a galaxy located 130 million light years distant.

Effect of DM on GW waveform



The DM cores may produce a supplementary peak in the characteristic GW spectrum of NS mergers, which can be clearly distinguished from the features induced by the baryon component

J. Ellis et al., PLB, 781, 607 (2018)

M. Bezares et al., PRD, 100, 044049 (2019)

Thanks for your attention!

