

LIGO (5 points).

The first detection of gravitational waves GW150414 was announced in 2016 by the collaboration LIGO (Laser Interferometer Gravitational-Wave Observatory). The detected signal corresponds to the merger of two black holes with masses of $35M_{\odot}$ and $30M_{\odot}$, which when joined formed a black hole of $62M_{\odot}$. Ignoring the rotational energies of the black holes, you may assume that the energy released by this process (E_{GW}) is emitted solely in the form of gravitational waves, that were observed by the interferometer in 2015. You are given that the explosion of a supernova (SN) releases $E_{SN} = 2 \times 10^{44} \text{ J}$.

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| 1.1 | To find out which of these two events (SN, GW) releases more energy, estimate the energy ratio $\frac{E_{SN}}{E_{GW}}$. | 5.0pt |
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