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Speed of Gravity and Cosmology Constraints from Binary Neutron Stars using Time Delays between Gravitational Waves and Short Gamma-ray Bursts.

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The landmark detection of a gravitational wave (GW) from the Binary Neutron Star Merger (BNS) GW170817 and its electromagnetic counterparts allowed us to study the Universe in a totally new way. Among the several discoveries made possible by GW170817, we can find the tightest constraints on the speed of gravity and the first measure of the Hubble constant (H0). Both these two measures were possible thanks to several assumptions that might not be granted with future detections. In fact, the speed of gravity was measured using agnostic assumptions on the prompt-time delay between the GW and the short Gamma-ray burst (sGRB), while the measure of H0 was possible thanks to the identification of the source host galaxy. In this talk, I will discuss how by relaxing the assumptions on GW-sGRB prompt time delay and identification of host galaxy still permits to infer the speed of gravity and H0 with populations of GW sources. By simulating populations of GW-sGRB detections with future observing runs, we find that: (i) it will be possible to jointly fit the GW-sGRB prompt-time delay distribution together with the speed of gravity and (ii) it will be possible to measure the Universe expansion even if the case that the source host galaxy is not observe. In particular, the latter result is made possible thanks to a new technique that I explored able to assign a redshift to the source using the GW-sGRB observed time delay.

Primary authors: IAMPIERI, Leonardo; PANNARALE GRECO, Francesco (Istituto Nazionale di Fisica Nucleare); MASTROGIOVANNI, Simone (Istituto Nazionale di Fisica Nucleare)

Presenter: IAMPIERI, Leonardo

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