Measuring a cosmological distance-redshift relationship using only gravitational wave observations of binary neutron star coalescences

Chris Messenger, Jocelyn Read

(Submitted on 28 Jul 2011 (v1), last revised 2 Dec 2011 (this version, v2))

Detection of gravitational waves from the inspiral phase of binary neutron star coalescence will allow us to measure the effects of the tidal coupling in such systems. These effects will be measurable using 3rd generation gravitational wave detectors, e.g. the Einstein Telescope, which will be capable of detecting inspiralling binary neutron star systems out to redshift z=4. Tidal effects provide additional contributions to the phase evolution of the gravitational wave signal that break a degeneracy between the system's mass parameters and redshift and thereby allow the simultaneous measurement of both the effective distance and the redshift for individual sources. Using the population of O(10^3-10^7) detectable binary neutron star systems predicted for the Einstein Telescope the luminosity distance--redshift relation can be probed independently of the cosmological distance ladder and independently of electromagnetic observations. We present the results of a Fisher information analysis applied to waveforms assuming a subset of possible neutron star equations of state. We conclude that for our range of representative neutron star equations of state the redshift of such systems can be determined to an accuracy of 8-40% for z<1 and 9-65% for 1<z<4.

Comments:	5 pages, 1 figure, submitted to Phys. Rev. Lett
Subjects:	**General Relativity and Quantum Cosmology (gr-qc)**; Cosmology and Extragalactic Astrophysics (astro-ph.CO)
Cite as:	**arXiv:1107.5725 [gr-qc]**
	(or **arXiv:1107.5725v2 [gr-qc]** for this version)

Submission history

From: Chris Messenger [view email]
[v1] Thu, 28 Jul 2011 14:34:56 GMT (31kb,D)
[v2] Fri, 2 Dec 2011 11:20:01 GMT (28kb,D)

Download:

- PDF
- Other formats

Current browse context:
gr-qc
< prev | **next >**
new | recent | 1107

Change to browse by:
astro-ph
astro-ph.CO

References & Citations

- INSPIRE HEP
(refers to | cited by)
- NASA ADS

Bookmark(what is this?)