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Constraints on cosmological viscosity from GW150914 observation

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It has been shown that gravitational waves propagate through ideal fluids without experiencing any dispersion or dissipation. However, if the medium has a non-zero shear viscosity, gravitational waves will be dissipated at a rate proportional to Gη. We test Dark Matter and Dark Energy models with non-zero shear viscosity by calculating the dissipation of GW150914 which propagates over a distance of 410 Mpc through the dissipative fluid and comparing the data with the theoretical prediction. We put an upper bound on the shear viscosity of the cosmological fluid as $< 10^9$ Pa sec which is close to the critical viscosity of fluids at which the viscous pressure becomes significant for the dynamics of the Universe. We show that future observations of gravitational waves at LIGO have the potential of detecting any possible viscosity of Dark Matter and Dark Energy. Finally, we comment on how this could be related to a lower bound on the self-interaction cross-section of Dark Matter.

Summary

Primary author: Dr GOSWAMI, Gaurav (Ahmedabad University)

Co-authors: Dr PRASANNA, A.R. (Physical Research Laboratory); MOHANTY, Subhendra (Physical Research Laboratory)

Presenter: Dr GOSWAMI, Gaurav (Ahmedabad University)

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