Constraining non-commutative space-time from GW150914

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The gravitational wave signal GW150914, recently detected by LIGO and Virgo collaborations, is used to place a bound on the scale of quantum fuzziness of non-commutative space-time. We show that the leading non-commutative correction to the phase of the gravitational waves produced by a binary system appears at the 2nd order of the post-Newtonian expansion. This correction is proportional to $\Lambda^2 \equiv |\theta^{0i}|^2/(l_P t_P)^2$, where $\theta^{\mu\nu}$ is the antisymmetric tensor of non-commutativity. To comply with GW150914 data, we find that $\sqrt{\Lambda} < 3.5$, namely at the order of the Planck scale. This is the most stringent bound on non-commutative scale, exceeding the previous constraints from particle physics processes by ~ 15 orders of magnitude.

Summary

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