The WiggleZ Dark Energy Survey: constraining the evolution of Newton's constant using the growth rate of structure

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We constrain the evolution of Newton's constant using the growth rate of large-scale structure measured by the WiggleZ Dark Energy Survey in the redshift range $0.1 < z < 0.9$. We use this data in two ways. Firstly we constrain the matter density of the Universe, $\omms$ (assuming General Relativity), and use this to construct a diagnostic to detect the presence of an evolving Newton's constant. Secondly we directly measure the evolution of Newton's constant, $\Geff$, that appears in Modified Gravity theories, without assuming General Relativity to be true. The novelty of these approaches are that, contrary to other methods, they do not require knowledge of the expansion history of the Universe, $H(z)$, making them model independent tests. Our constraints for the second derivative of Newton's constant at the present day, assuming it is slowly evolving as suggested by Big Bang Nucleosynthesis constraints, using the WiggleZ data is $\ddotGeff(t_0)=-1.19 \pm 0.95\cdot 10^{-20}h^2 \textrm{yr}^{-2}$, where h is defined via $H_0=100 h km s^{-1}Mpc^{-1}$, while using both the WiggleZ and the Sloan Digital Sky Survey Luminous Red Galaxy (SDSS LRG) data is $\ddotGeff(t_0) =-3.6\pm 6.8\cdot 10^{-21}h^2 \rm{yr}^{-2}$, both being consistent with General Relativity. Finally, our constraint for the rms mass fluctuation σ_8 using the WiggleZ data is $\sigma_8=0.75 \pm 0.08$, while using both the WiggleZ and the SDSS LRG data $\sigma_8=0.77 \pm 0.07$, both in good agreement with the latest measurements from the Cosmic Microwave Background radiation.

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