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Testing Gravity with wide binary stars like α Centauri

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This talk describes a novel way to test the hypothesis that gravity does not follow the standard Newton/Einstein model at low accelerations. This MOND hypothesis (Milgrom 1983) correctly predicted that astronomers would find a very tight correlation between the internal acceleration within galaxies calculated according to standard physics (visible mass + Newtonian gravity) and that inferred kinematically e.g. from rotation curves. This has recently been confirmed across a huge range in galaxy properties, including morphological type (Lelli+ 2017). Thanks to GAIA, it will soon be possible to perform a novel and almost direct test of MOND. This will involve the orbital velocities of wide binary stars separated by ~3-20 kAU. In MOND, the orbital velocities in the Solar neighbourhood are typically ~20% higher than in Newtonian gravity despite the external field effect (EFE) from the rest of the Galaxy, which I carefully include in my calculations (Banik+ 2018). As a result, the velocity distribution of wide binaries would extend to values that are infeasible in Newtonian gravity. MOND has a greater effect without the EFE, but this is unlikely on theoretical grounds. I consider a number of systematic issues that could hamper this test. Recently ionised systems are not likely to be very problematic as sufficiently strong encounters with passing stars and molecular clouds should be rare. The presence of an additional low-mass companion to one of the stars is expected to be the most serious issue. If not directly detectable, its presence can still be inferred from the resulting astrometric and/or radial velocity acceleration of the affected star, which greatly exceeds (~1000x) that due to genuine wide binary orbital motion.

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