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Deformation-Induced Precession of a Robot Moving on Curved Space SHENGKAI LI, YASEMIN AYDIN, OLIVIA LOFARO, JENNIFER RIESER, DANIEL GOLDMAN, Georgia Inst of Tech — Previous studies have demonstrated that passive particles rolling on a deformed surface can mimic aspects of general relativity [Ford et al, AJP, 2015]. However, these systems are dissipative. To explore steady-state dynamics, we study the movement of a self-propelled robot car on a large deformable elastic membrane: a spandex sheet stretched over a metal frame with a diameter of 2.5 m. Two wheels in the rear of the car are differentially-driven by a DC motor, and a caster in the front helps maintain directional stability; in the absence of curvature the car drives straight. A linear actuator attached below the membrane allows for controlled deformation at the center of the membrane. We find that closed elliptic orbits occur when the membrane is highly depressed ($\sim$10 cm). However, when the center is only slightly indented, the elliptical orbits precess at a rate depending on the orbit shape and the depression. Remarkably, this dynamic is well described by the Schwarzschild metric solution, typically used to describe the effects of gravity on bodies orbiting a massive object. Experiments with multiple cars reveal complex interactions that are mediated through car-induced deformations of the membrane.

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