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An Undergraduate Test of Gravitational Time Dilation BRIAN PATTERSON, M. ALINA GEARBA, JERRY S. SELL, MARIO SERNA, United States Air Force Academy, M. SHANE BURNS, MICHAEL D. LEVEILLE, JEFFREY STEELE, Colorado College — Students at Colorado College and cadets at the US Air Force Academy have conducted an experimental test of gravitational time dilation. This relativistic effect, highlighted in the movie *Interstellar*, causes clocks to tick more slowly near massive objects. A terrestrial measurement of gravitational time dilation was made by comparing signals generated by a GPS frequency standard, which is based on sea-level time, to a cesium-beam frequency standard located at several different elevations across Colorado. The effect is small but observable; for the highest elevation studied (4302 m on the summit of Pikes Peak), a local clock ticks only 41 ns/day faster than a clock at sea level. Our results are consistent with the predictions of general relativity to within the experimental uncertainty. We briefly discuss implications of gravitational time dilation for GPS operations, since the GPS would be useless if time dilation effects are not compensated. This work was supported by grants from the Mellon Foundation fostering civilian/military collaboration.

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