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A new test of relativistic time dilation with laser spectroscopy of heavy ions in a storage ring GERALD GWINNER, University of Manitoba, Winnipeg, Canada, GUIDO SAATHOFF, SASCHA REINHARDT, DIRK SCHWALM, Max-Planck-Institute for Nuclear Physics, Heidelberg, Germany, GERHARD HUBER, SERGEJ KARPUK, CHRISTIAN NOVOTNY, Mainz University, Mainz, Germany — We report on a new, improved test of time dilation in special relativity via the relativistic Doppler-effect. An optical transition with rest-frequency ν in $^7Li^+$ ions, stored at a speed of $\beta = 0.065$ in the TSR heavy-ion storage ring in Heidelberg, was used. The Doppler-shifted excitation frequencies ν_p and ν_a for laser beams travelling parallel and antiparallel with respect to the ions were measured simultaneously using saturation spectroscopy. The resonance conditions $\nu = \gamma(1-\beta)\nu_p$ and $\nu = \gamma(1+\beta)\nu_a$ yield the relation $\nu_p\nu_a = \nu^2$, if $\gamma = \sqrt{1-\beta^2}$, as predicted by SR. Deviations, e.g. caused by the existence of preferred frames, are parametrized by $\gamma = \gamma_{SR}(1 + \alpha\beta^2 + ...)$. We have determined a new limit of $\alpha < 2.2 \times 10^{-7}$, a 10× improvement over other techniques. This result is limited by the knowledge of ν, and not by the accuracy of our measurement. Our new measurement at $\beta = 0.025$ will serve as an improved rest-frequency measurement and will improve the limit on α further.

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