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Pendellösung Interferometry Measures the Neutron Charge Radius and Constrains New Physics BENJAMIN HEACOCK, National Institute of Standards and Technology, TAKUHIRO FUJIIE, Nagoya University, ROBERT HAUN, University of Maryland, ALBERT HENINS, National Institute of Standards and Technology, KATSUYA HIROTA, Nagoya University, TAKUYA HOSOBATA, RIKEN Center for Advanced Photonics, MICHAEL HUBER, National Institute of Standards and Technology, MASAAKI KITAGUCHI, Nagoya University, DMITRY PUSHIN, University of Waterloo, HIROHIKO SHIMIZU, Nagoya University, MASAHIRO TAKEDA, RIKEN Center for Advanced Photonics, ROBERT VALDILLEZ, North Carolina State University, YUTAKA YAMAGATA, RIKEN Center for Advanced Photonics, ALBERT YOUNG, North Carolina State University
— We use neutron pendellosung interferometry to measure the thermally-averaged, single-atom coherent elastic scattering amplitudes for the (111), (220), and (400) Bragg reflections in silicon. The data is used to make the first competitive neutron scattering determination of the neutron mean-square charge radius in over twenty years with experimental systematics which are notably different from prior measurements. Additionally, the tabulated scattering amplitudes are used to constrain a Yukawa-modification to gravity over the 20 pm to 10 nm length scale range.

Benjamin Heacock
National Institute of Standards and Technology

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