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Large-Area Lithography: Where Special Relativity and Nanotechnology Meet RALF K. HEILMANN, JUAN C. MONTOYA, MARK L. SCHATTENBURG, Space Nanotechnology Laboratory, M.I.T., Cambridge, MA 02139, USA — Optical lithography is the dominant technology for the patterning of macroscopic objects (such as 300 mm silicon wafers) with nanometer scale features (such as transistors and integrated circuits). In the semiconductor industry wafer overlay control between different patterning steps is supposed to shrink below 10 nm, which demands nanometer-level position control for the fast-moving wafer stages in industrial steppers and scanners. Most of these stages are controlled via displacement measuring interferometry, which is based on the (classical) Doppler shift that a laser beam undergoes upon reflection from a mirror attached to the moving stage. However, neglected relativistic effects due to stage motion can already require corrections on the nanometer scale for today's lithography tools [1]. We will describe a technique to demonstrate these relativistic effects with our nanometer-precision large-area grating patterning and metrology tool, the so-called nanoruler [2]. [1] R. K. Heilmann, P. T. Konkola, C. G. Chen, and M. L. Schattenburg, "Relativistic corrections in displacement measuring interferometry," J. Vac. Sci. Technol. B **18**, 3277 (2000). [2] R. K. Heilmann, C. G. Chen, P. T. Konkola, and M. L. Schattenburg, , "Dimensional metrology for nanometer-scale science and engineering: Towards sub-nanometer accurate encoders," Nanotechnology **15**, S504 (2004).

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