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Build-up cavity enhanced photoionization of ultracold atoms as a source for focused ion beams GIJS TEN HAAF, STEINAR H.W. WOUTERS, DANIEL F.J. NIJHOF, PETER H.A. MUTSAERS, EDGAR J.D. VREDENBREGT, Eindhoven University of Technology — Focused ion beams (FIBs) are indispensable tools in the semiconductor industry and materials science as they offer the possibility for in situ sample manipulation at the nanometer length scale. The FIB probe size is limited by aberrations of the electrostatic lens system and the transverse reduced brightness and energy spread of the ion beam. Here we present measurements of these beam parameters for a new FIB source that is based on the photoionization of a magneto-optically compressed beam of ^{85}Rb atoms. Recent measurements have shown that the transverse reduced brightness of the atomic beam is six times higher than that of the industry standard liquid metal ion source. Furthermore, comparison of current measurements with numerical calculations of the two-step photoionization shows that 75% of the atoms can be ionized when using a build-up cavity to enhance the intensity in the ionization laser beam. The maximum current measured to date is 600 pA. A retarding field analyser is used to measure the energy spread of the beam which is mostly determined by the range over which the atoms are ionized inside an electric field that is needed to prevent disorder-induced heating. The experimental results will be presented together with their implications for the FIB probe size.

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