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Testing the foundations of quantum mechanics with multi-path interferometers ROBERT KEIL, THOMAS KAUTEN, THOMAS KAUFMANN, BENEDIKT PRESSL, University of Innsbruck, RENE HEILMANN, ALEXANDER SZAMEIT, Friedrich-Schiller-University Jena, GREGOR WEIHS, University of Innsbruck — Born's rule is one of the fundamental axioms of quantum mechanics and states that the probability density equates the squared magnitude of the wavefunction. Axioms in physics can't be theoretically proven, but only tested against experiments. Born's rule dictates the absence of higher order interference. Therefore, it can be tested by measuring the output signal of a multi-path interferometer with individually blockable paths. In this contribution, we present our latest results in this respect, improving previous experiments by two orders of magnitude in accuracy and precision. To this end, we implemented a five-path Mach-Zehnder interferometer in free space with improved power and phase stabilisation and increased photon flux. After compensating for the systematic effect of detector nonlinearities, we could bound the relative magnitude of higher order interferences to better than 10^{-4}. In order to reduce this bound further, we have started working towards optically integrated interferometers, which promise reduced footprint and superior stability. Our first attempt in this direction is a semi-integrated solution. In this Michelson-configuration, external micromirrors are individually moved to modulate the effective transmission of each interferometer arm. We present our preliminary results obtained from this waveguide interferometer, discuss its current limitations and indicate ways to overcome them.

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