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Measuring cold atomic momentum distributions with matterwave interferometry[1] MAX CAREY, JACK SAYWELL, DAVID ELCOCK, MOHAMMAD BELAL, TIM FREEGARDE, University of Southampton — We describe the 1-D measurement of the momentum distribution of cold atoms by matterwave interferometery. After introducing the concept with a 2-pulse Ramsey sequence [1], we show an elegant practical application that employs a 3-pulse Mach-Zehnder interferometer [2] whereby, by varying the temporal asymmetry between the two free evolution periods, the momentum distribution is manifest in the frequency domain of the interferometer output. The technique, which is analogous to Fourier transform spectroscopy [3], is particularly suited to ultracold samples. We present specific results using a Raman pulse interferometer to measure the velocity distributions of freely-expanding clouds of ^{85}Rb atoms with temperatures of 33 μK and 17 μK. Quadrature measurement yields these distributions with excellent fidelity, comparing favourably with conventional Doppler and time-of-flight techniques and revealing artefacts in standard Raman Doppler methods that we attribute to off-resonant excitation [4]. [1] M. Carey et al., J. Mod. Opt. **65**, 657 (2018). [2] M. Carey et al., arXiv:1802.02190, submitted (2018). [3] A. A. Michelson, Lond. Edinb. Dubl. Phil. Mag. **31**, 338 (1891). [4] I. G. Hughes, J. Mod. Opt. **65**, 640 (2018).

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