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**Spontaneous Four-Wave Mixing of de Broglie Waves: Beyond Optics** KAREN KHERUNTSYAN, University of Queensland, V. KRACHMALNICOFF, J.-C. JASKULA, M. BONNEAU, G.B. PARTRIDGE, V. LEUNG, D. BOIRON, C.I. WESTBROOK, Institut d'Optique, Univ. Paris-Sud XI, P. DEUAR, Institute of Physics, Polish Academy of Sciences, P. ZIN, Andrzej Soltan Institute for Nuclear Studies, Poland, M. TRIPPENBACH, Institute of Theoretical Physics, University of Warsaw, Poland — We investigate the atom-optical analog of degenerate four-wave mixing of photons by colliding two Bose-Einstein condensates (BECs) of metastable helium and measuring the resulting momentum distribution of the scattered atoms with a time and space resolved detector. For the case of photons, phase matching conditions completely define the final state of the system, and in the case of two colliding BECs, simple analogy implies a spherical momentum distribution of scattered atoms. We find, however, that the final momenta of the scattered atoms instead lie on an ellipsoid whose radii are smaller than the initial collision momentum. Our first-principles numerical simulations using the positive-P method and approximate analytical calculations agree well with the measurements, and reveal a subtle interplay between many-body effects, mean-field interaction, and the anisotropy of the source condensate.

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