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Temporal long-range order in exciton-polariton condensates ALEX HAYAT, CHRISTOPH LANGE, LEE ROZEMA, ROCKSON CHANG, SHREYAS POTNIS, HENRY VAN DRIEL, AEPHRAIM STEINBERG, University of Toronto, MARK STEGER, DAVID SNOKE, University of Pittsburgh, LOREN PFEIFFER, KENNETH WEST, Princeton University — We demonstrate temporal long-range off-diagonal order in microcavity exciton-polariton dynamic condensation, by interference between two separate condensates, generated at different times and with different momenta. In our pulsed resonantly-injected condensates, stimulated polariton-polariton scattering results in spectral narrowing of the dynamic condensates and thus in longer coherence times. We study the temporal decay of the long-range order by monitoring the interference visibility between the condensates. We show that it strongly depends on the excitonic fraction of the polaritons and the corresponding polariton-polariton interaction strength, as well as on the temperature and pump intensity. Moreover, polariton interaction yields a blue shift of the condensate energy, which appears as a time-dependent shift in the interference pattern. These results show a direct evidence of temporal long-range order in dynamic condensates as well as demonstrate a new method for probing their ultrafast dynamics, opening new directions in the fundamental study of coherence in matter.

> Alex Hayat University of Toronto

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