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Optical signatures of long-ranged interactions between Rydberg excitons VALENTIN WALTHER, THOMAS POHL, Aarhus University, SJARD OLE KRGER, STEFAN SCHEEL, University of Rostock, JULIAN HECKTTER, MARC AMANN, MANFRED BAYER, TU Dortmund — The excitation of semiconductor excitons to Rydberg states [1] opens up interesting opportunities to explore effects of strong correlations both on the excitonic level as well as in the optical response. Here, we calculate the interactions between such pairs of excitons in cuprous oxide [2], showing that van der Waals interactions are dominant in the low-density regime. These strong interactions can give rise to giant optical nonlinearities [3], which we evaluate by fully accounting for the excitons' coherences at low densities and which compare favorably with experiment. Finally, we demonstrate that pump-probe spectroscopy can provide detailed information about the nature of Rydberg exciton interactions. [1] T. Kazimierczuk, D. Fröhlich, S. Scheel, H. Stolz & M. Bayer, Nature 514, 343 (2014) [2] V. Walther, S. Krüger, S. Scheel & T. Pohl, PRB 98, 165201 (2018) [3] V. Walther, J. Rohne & T. Pohl, Nat. Comm. 9, 1309 (2018)

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