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**Impurity bound states in  $d$ -wave superconductors with subdominant order parameters**<sup>1</sup> MAHDI MASHKOORI, KRISTOFER BJÖRNSON, ANNICA BLACK-SCHAFFER, Uppsala University — Single magnetic impurity induces intra-gap bound states in conventional  $s$ -wave superconductors (SCs) but, in  $d$ -wave SCs only virtual bound states can be induced. However, in small cuprate islands a fully gapped spectrum has recently been discovered [1,2]. In this work, we investigate the real bound states due to potential and magnetic impurities in the two candidate fully gapped states for this system: the topologically trivial  $d + is$ -wave state and the topologically non-trivial  $d + id'$ -wave (chiral  $d$ -wave state). Using the analytic T-matrix formalism and self-consistent numerical tight-binding lattice calculations, we show that potential and magnetic impurities create entirely different intra-gap bound states in  $d + is$ -wave and chiral  $d$ -wave SCs. Therefore, our results suggest that the bound states mainly depend on the subdominant order parameter. Considering that recent experiments have demonstrated an access to adjustable coupling  $J$  [3], impurities thus offer an intriguing way to clearly distinguish between the chiral  $d$ -wave and topologically trivial  $d + is$ -wave state. [1] Gustafsson, David, et al., Nat. Nanotechnol. 8, 25 (2013). [2] Black-Schaffer, Annica M., et al., Phys. Rev. Lett. 110, 197001 (2013). [3] Hatter, Nino, et al. Nat., Comm. 6, 8988 (2015).

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Mahdi Mashkooori  
Uppsala University

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