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Photonic Phase Gate via an Exchange of Fermionic Spin Waves in a Spin Chain ALEXEY GORSHKOV, California Institute of Technology, USA, JOHANNES OTTERBACH, Universitat Kaiserslautern, Germany, EUGENE DEMLER, Harvard University, USA, MICHAEL FLEISCHHAUER, Universitat Kaiserslautern, Germany, MIKHAIL LUKIN, Harvard University, USA — We propose a new protocol for implementing the two-qubit photonic phase gate. In our approach, the π phase is acquired by mapping two single photons into atomic excitations with fermionic character and exchanging their positions. The fermionic excitations are realized as spin waves in a spin chain, while photon storage techniques provide the interface between the photons and the spin waves. Possible imperfections and experimental systems suitable for implementing the gate are discussed. [Reference: Phys. Rev. Lett. 105, 060502 (2010)]

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