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Electronic spin transport in gate-tunable black phosphorus spin valves JIAWEI LIU, Centre for Advanced 2D Materials, National University of Singapore, AHMET AVSAR, Electrical Engineering Institute and Institute of Materials Science and Engineering, cole Polytechnique Fdrale de Lausanne (EPFL), JUN YOU TAN, BARBAROS OEZYILMAZ, Centre for Advanced 2D Materials, National University of Singapore — High charge mobility, the electric field effect and small spin-orbit coupling make semiconducting black phosphorus (BP) a promising material for spintronics device applications requiring long spin distance spin communication with all rectification and amplification actions. Towards this, we study the all electrical spin injection, transport and detection under non-local spin valve geometry in fully encapsulated ultra-thin BP devices. We observe spin relaxation times as high as 4 ns, with spin relaxation lengths exceeding 6 μm. These values are an order of magnitude higher than what have been measured in typical graphene spin valve devices [1-3]. Moreover, the spin transport depends strongly on charge carrier concentration and can be manipulated in a spin transistor-like manner by controlling electric field. This behaviour persists even at room temperature. Finally, we will show that similar to its electrical and optical properties [4], spin transport property is also strongly anisotropic. [1]. N. Tombros et al. Nature 448, 5714 (2007). [2]. A. Avsar et al. Nano Lett., 11(6), 2363-8 (2011) [3]. A. Avsar et al., NPG Asia Materials, 8, e274 (2016). [4]. F. Xia et al., Nature Commun., 5, 4458 (2014).

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