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Quantum sequencing: opportunities and challenges

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Personalized or precision medicine refers to the ability of tailoring drugs to the specific genome and transcriptome of each individual [1,2]. It is however not yet feasible due the high costs and slow speed of present DNA sequencing methods. I will discuss a sequencing protocol that requires the measurement of the distributions of transverse tunneling currents during the translocation of single-stranded DNA into nanochannels [3-6]. I will show that such a quantum sequencing approach can reach unprecedented speeds, without requiring any chemical preparation, amplification or labeling. I will discuss recent experiments that support these theoretical predictions [7], the advantages of this approach over other sequencing methods, and stress the challenges that need to be overcome to render it commercially viable. [1] M. Di Ventra and M. Taniguchi, Nature Nanotechnology, 11, 117 (2016). [2] M. Zwolak, M. Di Ventra, Rev. Mod. Phys. 2008, 80, 141. [3] M. Zwolak and M. Di Ventra, Nano Lett. 5, 421 (2005). [4] J. Lagerqvist, M. Zwolak, and M. Di Ventra, Nano Lett., 2006 6, 779. [5] J. Lagerqvist, M. Zwolak, and M. Di Ventra, Biophys. J. 2007, 93, 2384. [6] M. Krems, M. Zwolak, Y.V. Pershin, and M. Di Ventra, Biophys. J. 2009, 97, 1990. [7] T. Ohshiro, K. Matsubara, M. Tsutsui, M. Furuhashi, M. Taniguchi and T. Kawai, Nature: Scientific Reports, 2012, 2, 501.