“Fast DNA sequencing by electrical means”

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“Precision medicine” refers to the ability of tailoring drugs to the specific genome of an individual rather than to an average population [1]. It is however not yet feasible due the high cost and slow speed of present DNA sequencing methods. I will discuss several strategies to accomplish this feat. In particular, I will focus on a DNA sequencing protocol that requires the measurement of the distributions of transverse *tunneling* currents during the translocation of single-stranded DNA into nanopores [2-5]. I will show that such a sequencing approach can reach unprecedented speeds, thus opening up the possibility for personalized medicine. Recent experiments support these theoretical predictions and are a step forward toward making personalized medicine a reality [6]. I will also present recent results on a new sequencing strategy that uses transverse *ionic* currents in lieu of tunneling currents, and analyze the possibilities and limitations of such an approach [7].

[1] M. Zwolak, M. Di Ventra, *Rev. Mod. Phys*. 2008, **80**, 141.
[2] M. Zwolak and M. Di Ventra, *Nano Lett*. 2005 **5**, 421.
[3] J. Lagerqvist, M. Zwolak, and M. Di Ventra, *Nano Lett.,* 2006 **6**, 779.
[4] J. Lagerqvist, M. Zwolak, and M. Di Ventra, *Biophys. J.* 2007, **93**, 2384.
[5] M. Krems, M. Zwolak, Y.V. Pershin, and M. Di Ventra, *Biophys. J.* 2009, **97**, 1990.
[6] T. Ohshiro, K. Matsubara, M. Tsutsui, M. Furuhashi, M. Taniguchi and T. Kawai, *Nature: Scientific Reports*, 2012, 2, 501.
[7] J. Wilson and M. Di Ventra, arxiv 2013.

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