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Protein diffusion on DNA

Jasmina Dikic¹, Georgij Kostiuk², Virginijus Siksnyš², Ralf Seidel^{1*}

¹Institute for Molecular Cell Biology, University of Münster, Münster, Germany

²Institute of Biotechnology, Vilnius University, Vilnius, Lithuania

*ralf.seidel@uni-muenster.de

Diffusion is a major transport mechanism within living systems. Protein diffusion along elongated cellular structures (e.g. cytoskeletal filaments or DNA), often termed one-dimensional diffusion, has recently gained increasing interest. This is because confinement of the diffusion path can enhance the success rate of localizing a target on the particular structure. Here we focus on a new aspect, namely that protein diffusion along DNA can be itself a central part of an enzymatic reaction. Using magnetic tweezers and fluorescence techniques we provide single-molecule observations of the monomeric restriction enzyme BcnI which needs to turn on DNA to cut both strands of the helix. We reveal on one hand the orientation of the enzyme bound to its target site, and on the other hand the one-dimensional diffusion of the enzyme along DNA under different ionic conditions. Both observations provide evidence for a mechanism of the enzyme where indeed a monomer cuts both DNA strands in a sequential manner.

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