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Getting into that "Room at the Bottom" of DNA Analysis using Tunable Nanoscale Confinement

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A wide range of life-preserving processes, such as DNA transcription and repair, rely on weak intermolecular interactions and slow dynamics which occur at high concentrations, over long time periods, and often under confinement. Visualizing dynamic processes can present a challenge to fluorescence microscopy, the work horse for resolving biological processes at the molecular scale. To address this challenge, we present new in vitro diagnostics which use tunable and transverse nanoscale confinement to bring biomolecules into crisp view under previously inaccessible conditions, approaching those in the human body. We tackle the challenge of manipulating and visualizing long strands of DNA for genomic analysis, ultimately extracted from single cells (Berard et al, PNAS 2014 and Commentary). Further, we develop nanoscale spectroscopy methods to establish how conformational DNA fluctuations regulate transcription and gene expression, which remains an open and compelling question.

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