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(I) Fast and precise: How transcription factors find their targets

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Protein diffusion plays a ubiquitous role in molecular signalling pathways. As our understanding of the organization and compartmentalization of the cellular environment progresses, we start to better appreciate the complexity of the diffusive transport of proteins, and the control this transport may exert in signalling. One striking example of a diffusion-controlled process is the search of transcription factors for their target genes inside cell nuclei. We have investigated the target search strategies of two specific transcription factors active in the early fly embryo, Bicoid and Capicua, using different fluorescence methods. We observe the existence of a slow fraction of these proteins, which we attribute to the formation of small mobile phase-separated molecular condensates. I will discuss here how condensate formation may help target search efficiency, and increase both the speed and the precision with which gene expression can be activated or repressed.

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