Coexistence of coil and globule domains within a single DNA chain

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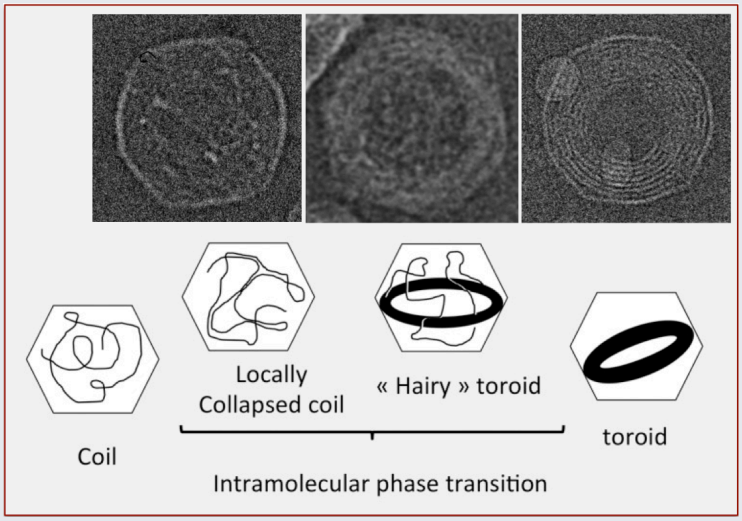
The semi-flexible highly charged DNA chain may be found either in an extended conformation, the coil, or condensed into a highly dense and ordered structure, the toroid. The transition, also called collapse of the chain, can be triggered in different ways, for example by changing the ionic environment. Using cryo-electron microscopy, we observed individual DNA molecules one by one, kept separated and confined inside a protein shell, the envelope of a bacterial virus (80 nm in diameter). We showed that the collapse transition is not a two states reaction: for subcritical concentrations of polycations (spermine 4+), part of the DNA is condensed and organized in a toroid and the other part of the chain remains uncondensed around. Two states coexist along the same DNA chain. We imaged these 'hairy' globules and described both the global conformation of the chain and the local ordering of DNA segments inside the toroid.



In a cell nucleus, DNA chains are always confined and exposed to low amounts of condensing polycations. These complex intermediate conformations, with coexistence of neighbouring condensed/uncondensed segments, are therefore of the highest interest: by a local tuning of the condensation, they should provide a fine regulation of the activity of the molecule.

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