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Systems biochemistry of bacterial division: Reconstructing minimal divisomes in the test tube

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Systems biochemistry of bacterial division: Reconstructing minimal divisomes in the test tube

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The research in our laboratory aims at understanding how the elements of the bacterial division machinery - the divisome - work together as an integrated system to fulfil its essential function. To address these questions we develop and applied novel biochemical reconstitution approaches to assemble the minimal set of proteins needed to initiate division (the proto-ring complex) in systems that reproduce the spatio-temporal organization of the divisome at the cellular membrane and the crowded/confined intracellular space.

Using physical biochemistry and synthetic approaches, we study the activities, interactions and assembly properties of minimal reconstructions of the proto-ring structured in membrane-like systems, such as nanodics, micro-beads, bilayers, vesicles and micro-droplets. We also investigate the action of Min proteins and nucleoid-like structures (to reproduce Z-ring positioning mechanisms) on the properties of minimal divisomes.

The assembly of the divisome in the cell takes place in microenvironments characterized by the presence of high concentrations of unrelated macromolecules, often structured as soluble and/or membrane-bound dynamic networks. We apply and design synthetic reconstructions of these microenvironments to investigate the impact of the physicochemical properties of facsimile cell media on the reactivity and organization (in time and space) of minimal divisome assemblies.

These studies will contribute to define the precise conditions to build, with a minimum set of elements, functional division assemblies in the absence of cells. This integrated approach will help to complete our knowledge of how bacterial division works and will open new horizons to synthetic and biotechnological applications.

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