LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

ARNOLD SOMMERFELD CENTER FOR THEORETICAL PHYSICS

Sommerfeld Theory Colloquium

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A quantitative understanding of Min-protein pattern formation in vivo and in vitro

Intracellular processes must be precisely organized in space and time. A paradigmatic example is the symmetric division of bacteria, which, in E. coli, is orchestrated by the ATP-driven oscillation of Min proteins between the cell poles. Remarkably, two proteins of the Min system are sufficient for this pattern-formation process. Even so, this seemingly simple system forms a kaleidoscope of different reaction-diffusion patterns in vitro, without clear connections to the in vivo patterns. These in vitro Min patterns remain a workhorse of designing life-like functionality in synthetic cells. It thus remains a central question how the rich pattern-formation process of this simple system can be understood quantitatively, starting from the molecular interactions. We show theoretically that a comprehensive understanding is possible, uncovering that changes in the membrane-binding of one of the proteins, MinE, explain the differences between patterns in cells and in a dish. We verify this prediction by constructing experimental phase diagrams of Min pattern formation. This shows that a conceptual reactiondiffusion system grounded in the known biochemistry of the Min proteins captures their diverse spatiotemporal self-organization quantitatively, offering an instructive platform to study the physiological implications of and the physical principles underlying the rich phenomenology of intracellular protein patterns.

Wednesday, 16 December 2026, 16:15h, Room A348, Theresienstr. 37/III

Prof. Erwin Frey