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SCIENTIFIC SEMINAR

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Helmholtz-Zentrum Dresden-Rossendorf

The Fire of Minimal Life: Metabolic Heat Flow from Lipidome-Tuned Synthetic Cells

The synthetic minimal cell JCVI-syn3B derived from the pathogenic bacterium Mycoplasma mycoides possesses restricted capability to synthesize lipids (Breuer et al., Elife e36842,2019). This allows tuning the plasma membrane lipid composition in defined culture media in which we have recorded metabolic heat flow curves to elucidate the metabolic consequences of lipidomes of varying complexity. A calorimetric correlate of the Monod Equation (Fahmy, Microorganisms, 2022, 1397) described heat flow data for the glycolysis-based metabolism over the full culture life span. Division rates and relative biomass yields were obtained in response to seven different plasma membrane compositions. Combined with lipidome analyses, the lipid class-dependent energetic cost of cell division was derived. Adding sphingomyelin to an otherwise minimal lipidome of only two fatty acids strongly reduced energy dissipation but at the same time slowed down cell division. In general, lipidomes that support physical contrast formation with respect to charge and intrinsic curvature are metabolically favorable indicative of the molecular requirements that tether proteins of the divisome, such as FtsZ and Sepf, to the plasma membrane. Cell mass, heat production and division rate in all diets followed remarkably strict mathematical relations, rendering JCVI-syn3B an extraordinary model organism from which the physics of life in its simplest form can be derived. Using these benchmarks, we develop web-based tools for the analysis of heat flow data from a large variety of microorganisms (https://metabolator.hzdr.de/).

Thursday, 22 May 2025, 11:00 a.m.

Host: Jochen Rink

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