



## Sommerfeld Theory Colloquium

Prof. Marianne Bauer

TU Delft

Optimal signal processing in gene regulation

The development of natural organisms relies on many intricate regulatory circuits that control the expression of genes. These regulatory systems ensure that gene regulation is precise enough for the organism to be able to develop healthily; yet, the signals that act as inputs for this regulation are subject to stochastic fluctuations. Do these signals and regulatory systems obey general principles? In this talk, I will discuss attempts for identifying principles using two examples that span the spectrum from precise to noisy gene expression outputs. In fly embryo development, the expression of core patterning genes occurs with high precision. I will show how binding site regions that process relevant transcription factor signals should optimally be designed and how this is consistent with experimental observations; for example, that they can involve clustering transcription factors, or that they should activate genes non-monotonically, which has recently been suggested as a feature of gene regulation out of equilibrium. Second, I will show how this information approach also applies to noisy signals: in a population of cultured stem cells exposed to synthetic Wnt stimuli, the expression of downstream genes appears highly noisy. Yet, with appropriately chosen signals, the cellular response can be precise enough to allow reliable differentiation into two distinct states. I will show how these signals can be identified, and that we can learn about the space of naturally occurring signals from these experiments.

Wednesday, 13 May 2026, 16:15h, Room A348, Theresienstr. 37/III

Prof. Erwin Frey