Prof. Volker Betz (TU Darmstadt)

Enhanded binding for a quantum particle in a quantized field

When a particle interacts with a quantized field, its effective mass increases: since the particle has to drag field deformations around with itself when it moves, it appears to be heavier than without the coupling. One effect of this phenomenon is that, when coupled to a quantum field, a quantum particle can have a bound state in a potential well that is too shallow to produce a bound state for the bare particle. This is referred to as enhanced binding.

The above reasoning is expected to be true on physical grounds, but enhanced binding has to be proved mathematically in concrete models. The task is to show that for a certain family of operators H_α (representing the quantum system, and parametrized by the coupling strength α), H_0 does not have L^2 eigenvector, but H_α does for large enough α.

Several approaches exist for this task. I will present one that relies probabilistic methods, more precisely on functional integrals and the Gaussian correllation inequality. I will first introduce the model, then motivate the use of functional integrals, and finally give an outline ofd the method.

This is based on joint work with Tobias Schmidt (Darmstadt) and Mark Sellke (Harvard).