

## A tribute to Emmy Noether a hundred years after she obtained her habilitation thesis

## Institute Colloquium



04.12.2019

Campus Golm

Building 9  
Room 2.22

**14:00** Elizabeth Mansfield (University of Kent)

### Noether's Theorem, both smooth and discrete

Noether's laws arise when a variational principle is invariant under a Lie group action. The most famous of these laws are conservation of energy, linear momentum and angular momentum in mechanical systems, and their extensions to optical systems, water waves, and to field theories.

In this talk I will illustrate progress, first in the understanding of the mathematical structure of Noether's conservation laws for a geometrical Lie group action, and second, their adaptation to various discrete versions.

One main theme has been to understand the mathematical structure of the laws in terms of invariants and an equivariant frame.

Another main theme has been to embed the laws, a priori, into numerical schemes, so that we can claim that the scheme truly incorporates the physical symmetries of the underlying model. I will indicate how we may get around the famous 'no go' theorem by Ge and Marsden and achieve this last. Time permitting, I will show how Noether's Second Theorem, where the group action involves functions satisfying PDE (rather than just parameters) may also be extended to difference systems.

**15:00**

**15:30** David E. Rowe (University of Mainz)



### On the Background to Emmy Noether's Theorems on Conservation Laws in Invariant Variational Systems

During the war years, Emmy Noether taught courses in Göttingen, though these were offered officially under David Hilbert's name. This was soon after Einstein visited Göttingen to deliver six lectures on his new theory of general relativity, which sparked Hilbert's interest in erecting a unified field theory based on variational methods. Noether assisted Hilbert in his efforts to push this program forward, but her collaboration with Felix Klein was far more important. Together they worked on deriving the formal properties of conservation laws in GR. Noether's famous paper from 1918 appeared alongside an important paper by Klein that exploited her second theorem on differential identities linked with conserved quantities. In 1916, a Swiss student, Rudolf J. Humm, came to Göttingen hoping to become an expert on relativity. After briefly describing Humm's interactions with Hilbert and Einstein, this talk will describe Emmy Noether's unpublished paper from 1916 on energy conservation in general relativity, parts of which were transcribed by Humm in 1918.