

ESI Senior Research Fellow Lecture Course Winter Term 2024/25

The Erwin Schrödinger International Institute for Mathematics and Physics (ESI) of the University of Vienna offers the following Lecture Course held by a Senior Research Fellow in residence during the Winter Term 2024/25:

Geometry of Gauge Theories: old and new Thomas Strobl (U of Lyon)

Lecture Course (520036 VU)**Time:** 11:00 - 12:45 h (with 15 minutes break)**Start:** Wednesday, October 16, 2024**Further dates:** Every Wednesday till November 27, 2024**End:** Wednesday, November 27, 2024**Venue:** Erwin Schrödinger Institute, Schrödinger Lecture Hall**Abstract:**

Principal and associated bundles play an important role in differential geometry and govern the geometrical setting of the Standard Model of particle physics: Interaction forces or particles correspond to connections in principal bundles, matter fields or particles to sections in bundles associated to the principal ones. Starting from the 90's other type of gauge theories made their appearance, which are no more governed simply by Lie groups and Lie algebras. In particular, the generalization of the latter to Lie groupoids, algebroids, and higher Lie algebras become central. We first introduce or recall the notions mentioned above. We then present some of the more general geometric setting needed to define topological and non-topological gauge theories such as the AKSZ sigma models, Curved Yang-Mills-Higgs theories, and higher gauge theories. At least some of those theories will be defined and studied on the way.

Contents of the course:

1. Lie algebroids and groupoids, higher Lie algebras/oids and their super geometric description.
2. Overview: Principal and associated bundles, connections, covariant derivatives and curvature. The geometrical setting underlying the standard model of particle physics and GR.
3. The Chern-Simons theory and the Poisson sigma model, and (time permitting) their joint generalization to AKSZ sigma models.
4. Q-bundles and gauge theories and characteristic classes.
5. Yang-Mills gauge theories and their generalization to Curved-Yang-Mills-Higgs gauge theories.
6. (Time permitting) Principaloid Bundles.

Aim of the course:

This course aims at introducing to some of the geometry of modern gauge theories. We want to provide a short overview of the standard, traditional setting of principal bundles, introduce mathematical notions such as Lie algebroids and Lie groupoids, and present some of the more recent gauge theories as they appeared in mathematical physics in the last two or three decades.

Course website: <https://www.esi.ac.at/events/e560/>Christoph Dellago
Director