# ESI

**Erwin Schrödinger International Institute
for Mathematical Physics**

**universität wien**

# ESI SENIOR RESEARCH FELLOW LECTURES

## Summer Term 2012

The Erwin Schrödinger International Institute of Mathematical Physics (ESI) of the University of Vienna offers the following lectures held by Senior Research Fellows in residence during the summer term 2012. For more information and related literature please visit the ESI home page www.esi.ac.at

### Fundamentals and highlights of algebraic quantum fields

**Prof. Detlev Buchholz** (Universität Göttingen, Institut für Theoretische Physik)
Friday, 11:00 - 13:00 (260350 VO) and 14:00 - 15:00 (260351 SE)
ESI, Erwin Schrödinger Lecture Hall
Course begin: April 20, 2012

### Mathematics and complete fluid systems

**Prof. Eduard Feireisl** (Academy of Sciences of the Czech Republic, Institute of Mathematics)
Wednesday, 9:00 - 11:00 and 11:00 - 12:00 (250132 VO)
ESI, Erwin Schrödinger Lecture Hall
Course begin: March 7, 2012

For abstracts on both lecture courses please see the next page.

Joachim Schwermer
Director, ESI

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**Prof. Detlev Buchholz** (Universität Göttingen, Institut für Theoretische Physik),
**Fundamentals and highlights of algebraic quantum fields, Abstract:**

Fundamentals and highlights of algebraic quantum field theory. After a brief introduction into the basic concepts and methods of the algebraic approach to local relativistic quantum physics, a survey will be given of its applications to various problems of physical interest. The topics covered are (a) Pretheories: towards the construction of models, (b) Structure of physical state space: sectors, charge classes and beyond, (c) Symmetries and statistics: established results and new insights, (d) Short dis- tance analysis: scaling algebras and renormalization group. It is the aim of these lectures to explain the physical ideas underlying these topics and to provide the necessary mathematical tools for their analysis. In the accompanying seminar special themes of current interest will be presented by participants and invited speakers. Credit can be obtained for this course by giving a talk.

**Prof. Eduard Feireisl** (Academy of Sciences of the Czech Republic, Institute of Mathematics),
**Mathematics and complete fluid systems, Abstract:**

This Lecture Course is devoted to the modern mathematical theory of complete fluid systems - the fluid flows satisfying the basic physical principles of conservation of *mass*, *momentum*, and *energy*. Our approach is based on the concept of *weak solution* introduced in the monograph [M]. The main topics include:

- Basic equations of mathematical fluid dynamics, the Navier-Stokes-Fourier system
- Weak vs. strong formulation, basic properties, advantages, shortcomings
- Nonlinear equations and *a priori* bounds, global dissipation inequality and related questions
- Relative entropies, weak-strong uniqueness, long-time behavior of complete fluid systems
- The property of (weak) sequential stability
- Principal ideas of the mathematical theory of global-in-time large data solutions, the effective viscous pressure, commutator estimates, div-curl lemma
- More advanced topics related to complete fluid systems, model reduction and singular limits—

BIBLIOGRAPHY

[M] E. Feireisl and A. Novotný: *Singular limits in thermodynamics of viscous fluids*. Birkhäuser-Verlag, Basel, 2009.