ZTF-FCT
Zientzia eta Teknologia Fakultatea
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# Algebraic Quantum Statistical Mechanics

**Lecturer**: Jean-Bernard Bru[1]

**Dates**: 4 October – 29 November 2010

**Schedule**: Monday and Tuesday (only in October), 14:45 – 16:45, Seminar room, Department of Mathematics, University of the Basque Country UPV/EHU.

**Abstract**:

The aim of the course is to give mathematical bases of the theory of phase transitions in quantum statistical mechanics. Phase transitions are studied via equilibrium states of a given quantum mechanical system, which can be mathematically defined in different ways: for instance, as minimizers of the free-energy density, as tangent functionals to convex functions (pressure) on a Banach space of interactions, or as KMS (Kubo-Martin-Schwinger) states. From the mathematical point of view, the existence of a phase transition for a quantum mechanical system can be seen via the transition to one equilibrium state to several ones at a specific temperature. Since von R. Haag's observation in the fifties, it is known that the existence of several equilibrium states implies several (not equivalent) representations of the observable algebra of the system. This remark motivates the introduction an algebraic formulation of quantum statistical mechanics without any (explicit) references to Hilbert spaces. This description will be the main subject of this course on the mathematics of quantum phase transitions.

**Bibliography**:

[1] H. Araki and H. Moriya, Equilibrium Statistical Mechanics of Fermion lattice Systems. Rev. Math. Phys. 15 (2003) 93–198.

[2] O. Brattelli and D. W. Robinson, Operator Algebras and Quantum Statistical Mechanics, Vols. I and II. 2nd ed. Springer. New York, 1996.

[3] G. Emch, Algebraic Methods in Statistical Mechanics and Quantum Field Theory. Dover. New York, 2000.

[4] R. B. Israel, Convexity in the theory of lattice gases. Princeton Series in Physics. Princeton Univ. Press, 1979.

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