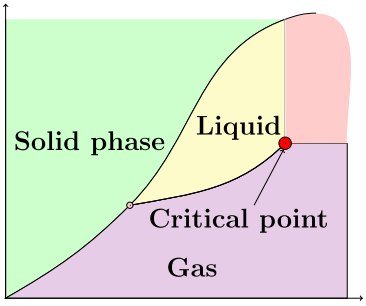
Sujet de stage de Master 1

Service de *Physique de l'Univers, Champs et Gravitation*

année académique 2021-2022

Conformal field theories and universality of second order phase transitions (E. Skvortsov)



Let's have a look at the phase diagram of virtually any substance. It is hard to say anything about any generic point on this diagram as the properties will heavily depend on the material we took. However, there is one point where it is not the case – the critical point where the coexistence curve of gas and liquid ends. This is the point of the second order phase transition.

One remarkable property of second order phase transitions is *universality*, i.e. properties of completely different systems in the critical point and its neighborhood turn out to be the same. For example, these properties are the same for water (basically, any other liquid) and, surprisingly, magnet at the Curie point.

One more remarkable property of second order phase transitions is that any system at the critical point exhibits an enhanced symmetry: the symmetry group jumps from the usual translations plus rotations to a much bigger conformal symmetry. At the same time, the behavior of the system is described by a special class of quantum field theories that are called conformal field theories.

The goal of the project is to understand the phenomenon of universality and the basic properties of conformal field theories.

The most important references are:

[1] Scaling and Renormalization in Statistical Physics Series: Cambridge Lecture Notes in Physics, John Cardy, University of Oxford

[2] TASI Lectures on the Conformal Bootstrap, David Simmons-Duffin, https://arxiv.org/abs/1602.07982