Lattice QCD - Fall 2017 ETH Zürich

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Exercise Nr. 10

Discussion on December 5th, 14:45

1) Literature

Read the article by McLerran and Svetitsky [1] on the Monte Carlo simulations for SU(2) Yang Mill theory at **finite temperature**. Try to understand why the Polyakov loop is an order parameter of the Yang Mills deconfinement transition.

[1] L. D. McLerran and B. Svetitsky, Phys. Lett. 98 (1981)

2) SU(2) at Finite Temperature

Extend your SU(2) program by a measurement routine for the (system averaged) Polyakov loop $\bar{L}$, where

$$L(\vec{x}) = \mathrm{Tr} \prod_{\tau=1}^{N_\tau} U_0(\vec{x},\tau) \quad , \quad \bar{L} = \frac{1}{V} \sum_{\vec{x}} L(\vec{x}).$$

Measure the expectation value of the modulus of the Polyakov loop, $\langle|\bar{L}|\rangle$, for various β on a $8^3 \times 4$ lattice, and if your program is fast enough, on a $12^3 \times 4$ lattice. In the transition region, where the expectation values rises rapidly with the temperature, take the data points in smaller intervals in β. Keep the data for next week's exercise!

Alexander Markovich Polyakov

(born 27 September 1945) is a theoretical physicist, formerly at the Landau Institute in Moscow, currently at Princeton University.
He is known for a number of basic contributions to quantum field theory, including work on what is now called the 't Hooft-Polyakov monopole in non-abelian gauge theory, independent from Gerard 't Hooft. His paper "Infinite conformal symmetry in two-dimensional quantum field theory", with Alexander Belavin, and Alexander Zamolodchikov, from 1984, has classic status. His path integral formulation of string theory had profound and lasting impacts in the conceptual and mathematical understanding of the theory. He also played an important role in elucidating the conceptual framework behind renormalization independent of Kenneth G. Wilson's Nobel prize winning work. He formulated pioneering ideas in gauge/string duality long before the breakthrough of AdS/CFT using D-branes.
Other insightful conjectures that came years or even decades before active work by others include integrability of gauge and string theories and certain ideas about turbulence. Alexander Polyakov was awarded the Lars Onsager prize (together with A. Belavin and A. Zamolodchikov) in 2011, Dirac Medal and the Dannie Heineman Prize for Mathematical Physics in 1986, the Lorentz Medal in 1994, and the Oskar Klein Medal in 1996. He has been elected to the Russian Academy of Sciences in 1984 and the U.S. National Academy of Sciences (NAS) in 2005.

[from http://en.wikipedia.org/wiki/Alexander_Markovich_Polyakov]