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VLZ 12: Quark matter and the origin of the Universe

(1 credit point)

Background:

Physics is a thriving and alive science with intelectual challenges, presenting innumerable research problems on topics ranging from the largest galaxies to the smallest subatomic particles. Physicists have managed to bring understanding, order, consistency, and predictability to our universe and they will continue to do so. Generally, in physics text books we find physics presented as a complete science in which the major advances happened at the time of Newton, or perhaps early in the 20th century. Only towards the end of such a book the „modern" physics is covered, but usually this includes only discovery made thorough the 1960s.

Motivation:

My main motivation for this lectures is to challenge (and change) this perseption, because physics is an exciting and dynamic dyscypline, continuously on the verge of new discovery and life-changing applications. It is the "hottest" enterprise around. Because I am actively carrying out research, I know that many of cutting-edge results can be explained in their essence even to the first-year student. Therefore, during these lectures I will stay at a qualitative level, skipping all mathematical and other technical details. I hope they will be a good tool to engage students' imagination and to better prepare them for future courses in their chosen fields (admittedly, hoping that a few students could be converted to physics majors along the way).

Program:

In these lectures some of the amaizing frontiers of current physics research will be introduced. I will touch upon some basics of the Standard Model and discuss the most exciting experiments where nuclear and particle physicists are probing deeper and deeper into the smallest constituients of matter. I will explain the QCD phase diagram, probably the most important single figure of our field. We will visit together RHIC (BNL,USA) and LHC (CERN) experiments to try to understand how these facilities are used to answer the most intriguing questions of our times (e.g. what couses different elementary particles to have different masses, what happened after Big Bang, what are true elementary constituents of the universe, where is a phase transition between hadronic and partonic worlds, is Critical Point really there, etc.)

Basic literature:

1. http://www.star.bnl.gov/central/physics/
2. http://www.phenix.bn.gov/phenix/WWW/intro/physics/
3. D.Perkins „Introduction to High Energy Physics"
4. R.K.Ellis et al, „QCD and Collider Physics"
5. C.-Y. Wong „Introduction to High-Energy Heavy-Ion Collisions"