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Prof. Jordan Nash
Chairperson of the SPS
and PS Experiments Committee (SPSC),
Imperial College London, UK

Prof. Eckard Elsen
Director for Research and Computing,
CERN, Geneva, Switzerland

Dear Colleagues,

In 1986 Matsui and Satz (Phys. Lett. B 178 (1986) 416) formulated a conjecture that color screening in the deconfined phase would reduce the binding of charm quarks and antiquarks to produce charmonia. Thus, a suppression of charmonia production in nuclear collisions was suggested as the evidence of deconfinement. Results obtained on J/ψ yield at the CERN SPS following the conjecture served as the basic argument for the CERN press release on the observation of a new state of matter in 2000. However, this conclusion remains preliminary, as long as data on open charm are not available.

I am writing this letter to emphasize a very interesting physics opportunity for the CERN SPS. It is given by a possibility to measure open charm production by the upgraded NA61/SHINE experiment. Color screening reduces charmonia production, so that at a given collision energy, the relative fraction of charm going into charmonia should in nuclear collisions be less than it is in proton-proton interactions at the same energy. However, to support this interpretation measurements of open charm (D mesons) in Pb+Pb collisions and proton-proton interactions are evidently needed. Up to now, these measurements have not been possible at the CERN SPS. Note that the ideal energy range for a study of medium effects on J/ψ production is that of the SPS. The low number of produced c and anti- c quarks reduces the probability of their recombination into a charmonium (Braun-Munzinger, Stachel, Phys.Lett. B490 (2000) 196) – in comparison to the LHC case – dramatically.

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Thus the lower limit of charmonia yield is given by their statistical production at hadronization (Gazdzicki, Gorenstein, Phys.Rev.Lett. 83 (1999) 4009). As a consequence the proposed measurements of open charm production in nuclear collisions at the SPS energies would allow NA61/SHINE to complete a crucial part of the CERN heavy ion program.

I was also suggested by Kostyuk, Gorenstein, and Greiner (Phys. Lett. B 519 (2001) 207) that the enhancement of open charm production in Pb+Pb collisions may appear due to the broadening of the available phase space caused by the presence of strongly interacting medium. Consequently, an enhancement of open charm yield in nucleus-nucleus collisions with respect to the direct extrapolation of proton-proton data may signal the creation of quark-gluon medium. The c - anti- c pair created with an invariant mass below the open charm threshold, $2 m_D = 3.7$ GeV, can be nevertheless transformed to a D - anti- D pair in nucleus-nucleus collisions, where missing energy can be taken from the quark-gluon plasma. In proton-proton interactions this is not possible, the subthreshold c - anti- c pairs must be transformed into non-charmed states. The enhancement of open charm yield at the CERN SPS energies due to deconfined medium may be large; a factor of about 5 is expected.

I hope that all these remarks will be useful while you consider the NA61/SHINE proposal to measure open charm.

Kind regards,

Prof. Mark Gorenstein



S.Perepelytsya
Scientific Secretary
of the Bogolyubov Institute for Theoretical Physics

