CHARMONIUM PRODUCTION IN Pb – Pb COLLISIONS
AT 158A GeV

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FOR THE NA50 COLLABORATION

The NA50 experiment at CERN SPS studies charmonia and Drell-Yan production in the $\mu^+\mu^-$ decay channel at 158A GeV. The data collected in Pb-Pb collisions during 1995, 1996 and 1998 run periods show that the $J/\psi$ is anomalously suppressed in central collisions. This observed suppression pattern can be considered as a strong indication of the production of Quark-Gluon Plasma.


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1 Introduction

Non-perturbative Quantum Chromodynamics calculations predict that under extreme conditions of temperature and energy density a phase transition occurs from ordinary nuclear matter to a deconfined state of quarks and gluons: the Quark-Gluon Plasma (QGP). Such extreme conditions should be achieved in ultrarelativistic heavy ions collisions and the deconfined phase should be characterized by the appearance of theoretically predicted signatures.

The suppression of charmonium states has been predicted to be an unambiguous probe of deconfinement [1]. The formation of the $c\bar{c}$ bound states would be suppressed in the QGP due to the screening of the attractive color force which binds the two quarks together (Debye screening). $J/\psi$ and $\psi'$ resonances are produced in the very early stage of the collision and are expected to weakly interact with the other hadrons, so that they can carry information about the existence of a deconfined status.

Experiment NA38 at CERN SPS has studied those vector meson resonances in the $\mu^+\mu^-$ decay channel, using proton, Oxygen and Sulphur beams on several targets.

$J/\psi$ suppression has been observed to increase monotonically and continuously from lighter to heavier interacting nuclei and this result is fully consistent with an ordinary nuclear absorption model.

The NA50 experiment is an upgrade version of NA38 and studies Pb-Pb collisions at 158 GeV/c$^2$.

The results presented here concern the high mass region of the dimuon mass spectrum, where the main contribution are due to the dimuons coming from the Drell-Yan process and from the leptonic decay of the $J/\psi$ and $\psi'$. Data refer to 1995, 1996 and 1998 NA50 run periods.

2 Experimental setup and data taking conditions

A schematic overview of the NA50 experiment is shown in Fig. 1. It consists mainly of a muon spectrometer which includes a hadron absorber, an air gap toroidal magnet, 8 multiwire proportional chambers for muon tracking and a system of 6 scintillator hodoscopes, for triggering purposes. The covered rapidity window is $2.8 \leq y_{lab} \leq 4.0$ ($0 \leq y_{cm} \leq 1$).

The event centrality is measured independently by means of three detectors. The electromagnetic calorimeter, made of Lead and scintillating fibres, measures the neutral transverse energy released in the acceptance window $1.1 \leq \eta_{lab} \leq 2.3$. The very forward calorimeter ("Zero Degree Calorimeter" or ZDC) is made of quartz fibres embedded in Tantalum slabs and measures the energy of the spectator nucleons in the acceptance window $\eta_{lab} \geq 6.3$ [4]. A two planes high granularity silicon strip detector measures the multiplicity of charged particles in the acceptance window $1.5 \leq \eta_{lab} \leq 3.5$.

Incident ions are counted by a quartz beam hodoscope (BH), located approximately 33 m upstream the target. This detector is also used to detect pile-up