

Memorandum

To: Members of the SPS Committee

From: J. Stachel for the CERES/NA45 Collaboration

Subject: Physics impact of a run with Indium beam in 2003

This memo addresses a request by the Research Board to report on the physics impact of a run with Indium beam in 2003 reduced to 30 days as compared to the originally foreseen 37 days, also vis-a-vis the already existing data from the 2000 Pb-Au run. It supplements the information on the unique physics opportunities of an Indium run presented to the SPSC in our addendum SPSC-033 from October and memo SPSC/M-692 from December 2002.

In our original proposal we had planned 3 days for setup of the experiment and this time cannot be reduced. Therefore for a total duration of the heavy ion run of 30 days there would be 27 days of data taking as compared to 34 in the original plan. The impact would be a reduction of the statistics to about 80 %. We have performed a simulation reflecting the reduced statistics and the result is shown in Fig 1, while in Fig. 2 we repeat as a reference the expected result with the full 37 day run. We conclude that albeit the errors overall are a little larger (12 %) the main goals – the sensitivity to lineshape in the ρ/ω region, the A dependence of the enhancement, and the centrality dependence of the enhancement – are still achievable.

The comparison to the results from the 2000 Pb-Au run has to be based on a simulation of the expected results since we do not yet have an electron pair mass spectrum. The calibration and corrections in the inhomogeneous electric and magnetic fields have proven very difficult and time consuming. A data production run through 3 of the 33 Million events in January 2003 showed that still some improvements are necessary to achieve the design resolution. The implementation is close to completion and the simulation reflects what we will obtain based on our current understanding of the data. Fig. 3 shows a simulated electron pair invariant mass spectrum as expected from the 2000 data.

The three main physics reasons that make the Indium run unique were discussed in our memo from December 2002 and here we only briefly summarize the relevance vis-a-vis the existing data from 2000.

i) The expected data sample even from a 30 day Indium run is still far superior in significance to any data CERES has taken before as can be seen comparing Figs. 1 and 3. This is particularly relevant for the lineshape in the ρ/ω region. In part this is due to the high multiplicity in Pb-Au collisions in connection with the high trigger centrality.

ii) The argument on the A dependence requires measurement with another symmetric collision system.

iii) The centrality dependence will not be measured with the 2000 data since, to maximize the signal, only the most central 8% of the collisions were recorded.

Therefore our previous conclusion holds that the expected results will be unique and of great importance to the topic of creation of a new state of matter in heavy ion collisions.

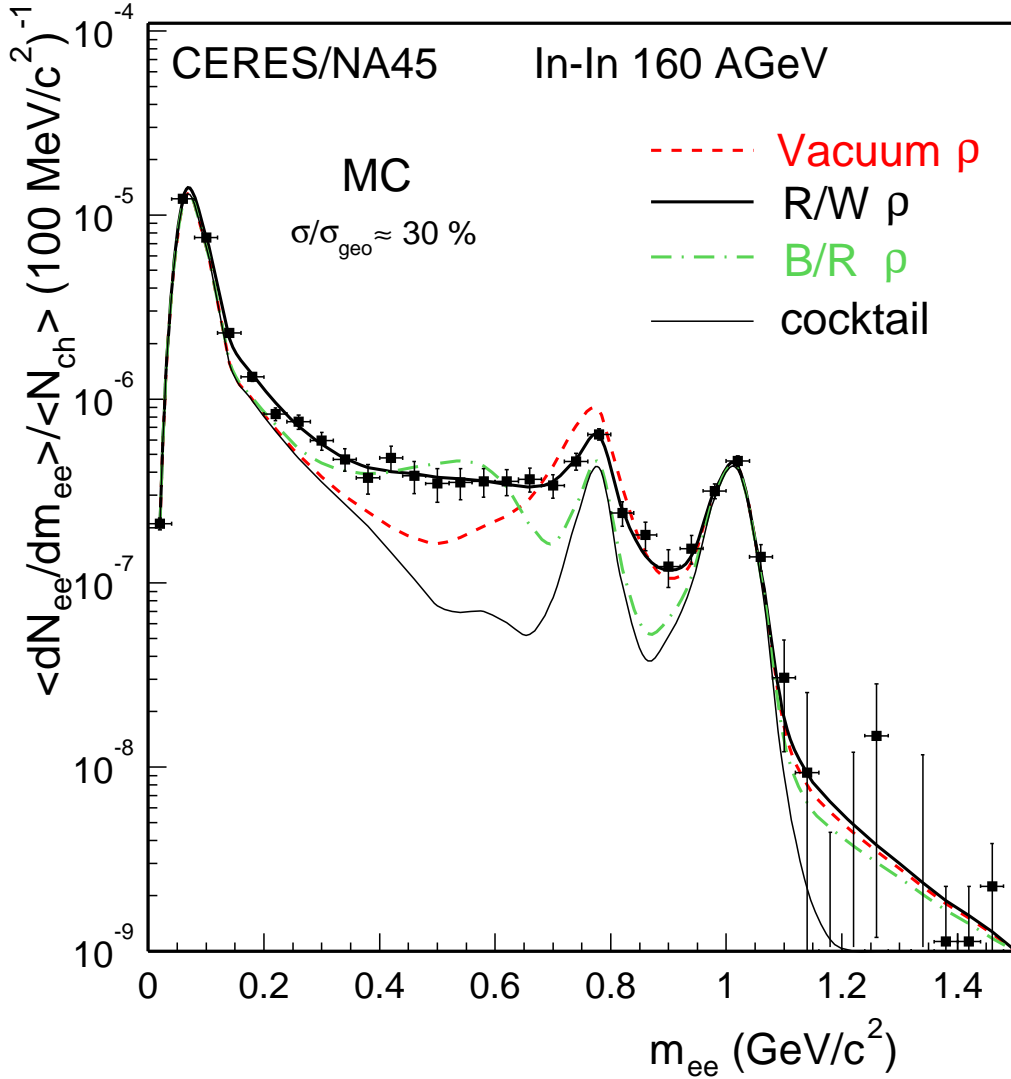


Figure 1: Invariant e^+e^- pair mass spectrum simulated for the statistical significance and resolution expected for a 30 day In run. The three curves show theoretical predictions (provided to us by R. Rapp) without (vacuum ρ) and with in-medium ρ modification. For the latter, two of the different possible theoretical scenarios have been chosen. The data points are simulated for the Rapp/Wambach (R/W) scenario. To exhibit explicitly the ω line-shape, the hadronic decay cocktail without the ρ is shown as well.

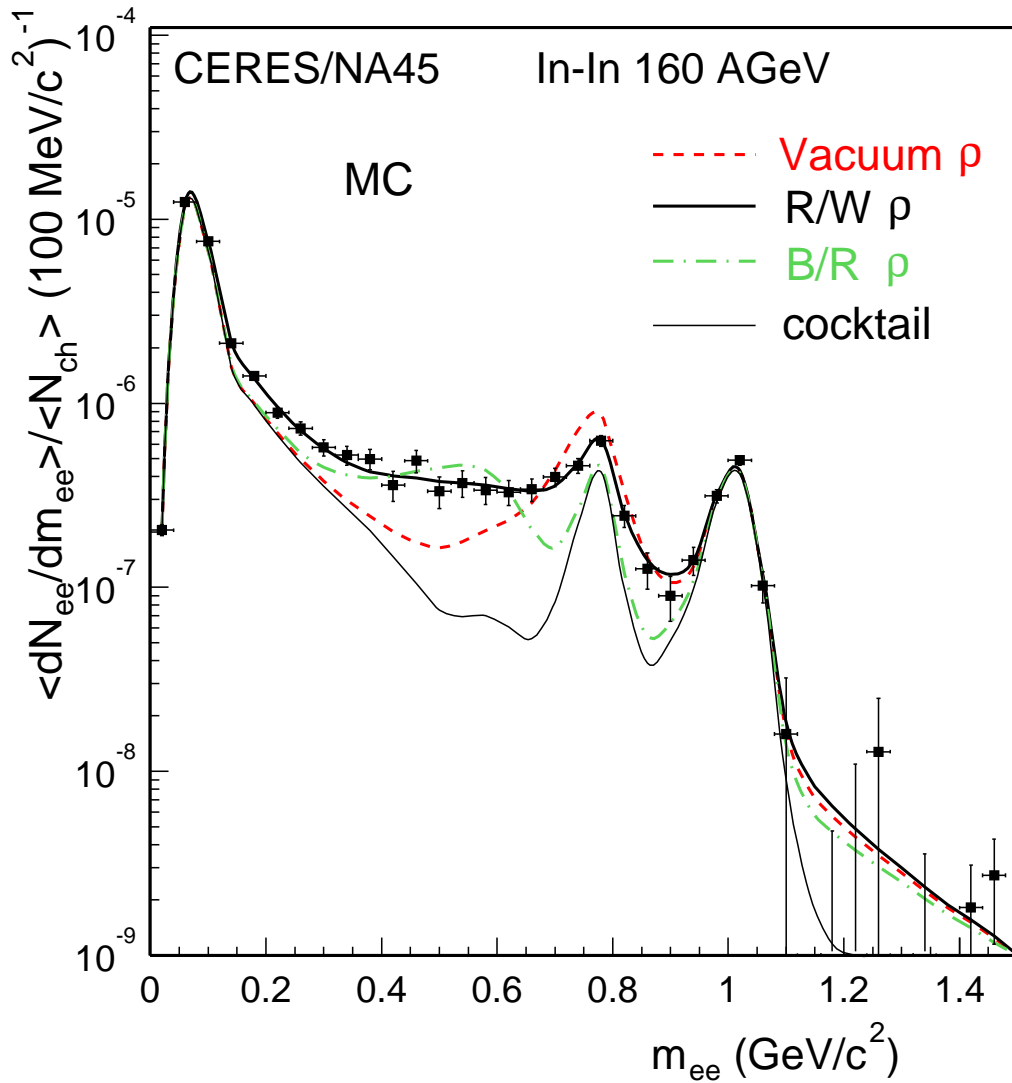


Figure 2: Invariant e^+e^- pair mass spectrum simulated for the statistical significance and resolution expected for a 37 day In run. Otherwise as Fig.1.

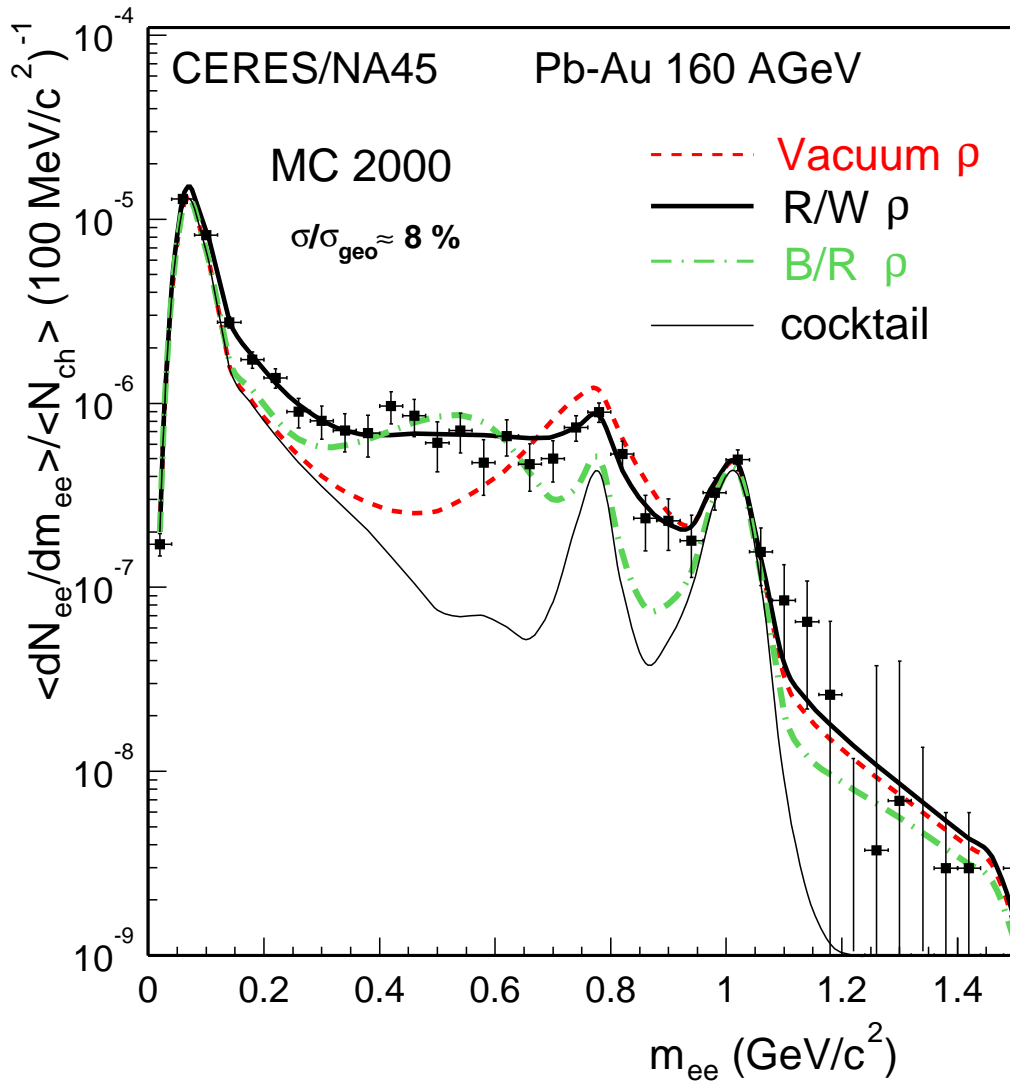


Figure 3: Invariant e^+e^- pair mass spectrum simulated for the statistical significance and resolution expected for the 2000 Pb-Au run. Otherwise as Fig. 1.