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A 100 ev/μb K^+p EXPERIMENT AT 7 GeV/c IN BEBC

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This is a letter of intention for $6x10^5$ pictures in BEBC filled with Hydrogen exposed to a R.F. separated beam of K^+ at 7 GeV/c.

The present "world sample" of K^+ interactions in hydrogen bubble chamber, at all energies above 3 and up to 16 GeV/c corresponds to a sensitivity of about 100 ev/μb. Only two exposures (at 12 and 16 GeV/c) are above the 10 ev/μb level.

Taking advantage of the large volume of BEBC it is possible to gain at least an order of magnitude in statistics over any single experiment performed this far and to double the world sample with all the new events at one energy.

Using a primary intensity of 20 K^+ per picture and a fiducial region of 2.5 meter length, an average of 3 interactions per picture is to be expected. 600.000 pictures would then correspond to 100 events for a cross section of 1 μb or to a total of 1.8 10^6 interactions.

The amount of physical information that can be extracted from these interactions is very large. Only the two most interesting subjects will be mentioned here:

a) <u>Kπ scattering</u>.

The largest effort made so far in the Kπ phase shift analysis is that of the Bruxelles-Cern-UCLA collaboration, that used data from the "International K^+p Bubble Chamber data collaboration"(1).

Their analysis is based on 77,267 events of the type:

$$K^+p \to K^+\pi^-\pi^+p \qquad (1)$$

and on 18,806 events of the type:

$$K^+p \to K^o\pi^o\pi^+p \qquad (2)$$

The proposed experiment will yield 175,000 examples of reaction (1) and 46,000 examples of reaction (2), from 600,000 measurements of 4-prong and 2-prong + V° topologies. Therefore more than twice the existing events will be obtained. Moreover all the sample will be at the same energy and will come from a single experiment allowing a more reliable extrapolation of the Kπ cross sections (the problem of the different normalization at the different incident momenta arising when different experiments are combined will not be present) helping in resolving the ambiguities between the various solutions. The mass resolution both for the 4C reaction (1) and the 1C reaction (2) will also be an important parameter of the experiment, particularly in connection with the existence of a narrow ($\Gamma \lesssim 30$ MeV) resonance in the δ_0^1 phase found as a possible solution by the authors of ref. 1).

It is not possible to know in advance what the "pointing error" in BEBC will be, so we cannot give a value for the mass resolution we hope to achieve. However, for a pointing error of 500 μ, the resolution will not be worse than that of a "conventional" hydrogen bubble chamber.

Moreover the relatively high γ ray conversion efficiency of BEBC will give us about 7000 events of the 1C reaction (2) with an associated γ ray, for which the resolution may be improved.

b) S = +1 mesons in the "Missing Mass Spectrometer" mode.

The Missing Mass Spectrometer MMS (2) and the Cern Boson Spectrometer CBS (3) have investigated the non strange boson spectrum from 0.5 to 3.0 GeV/c^2, with the missing mass method, achieving a mass resolution of 30 MeV (full-width) or larger by measuring the proton recoiling from an incident π^-, under conditions such that the measurement of one parameter only (the angle and the momentum respectively) allowed a good determination of the missing mass. The experiments were performed at various π^- energies, that gave access to different boson masses.

The unique possibility offered by BEBC of stopping particles of momenta up to 800 MeV/c, by "trapping" them in the magnetic field, together with the accurate measurements of ranges and angles that are common features of all hydrogen bubble chambers, make BEBC a very good competitor for the missing mass spectrometers.

In our case, i.e. with K^+ of 7 GeV/c, the measurement of all the protons stopping in the chamber with momenta between 200 and 800 MeV/c, would allow the study of the strange boson spectrum between 0.5 and 2.5 GeV/c^2 with statistics better than those of the MMS and CBS combined, and with a resolution equal or better than theirs.

In the combined spectrum of the MMS and CBS, resonances with a 5μb production cross section were shown with fairly good statistical accuracy. For the same cross section our experiment, having a sensitivity of 100 events/μb, would how 500 events in the peak, to be compared with 200-300 detected by the MMS and CBS.

Our resolution, computed assuming a ± 0.2% uncertainty in the beam momentum and errors of ±0.2° in angle and ±0.5% in momentum (by range) would be at most 25 MeV for a mass of 0.8 GeV and 20 MeV for a mass of 2.5 GeV, for the area indicated by A in the familiar θ-p plot of Fig.1. Fig.1 shows also the "windows" for the MMS (I) and CBS (II).

We mention last what is probably the biggest and the most obvious advantage of this experiment, that is the fact that for any anomaly detected in the missing mass spectrum all the information about the particles "on the other side" is available for measurement and is unbiassed.

The total number of events contained in the film is 1.8 million. At a scanning rate of 20 events/hour per scanning table, 10 tables working two shifts per day would complete the scanning in two years.

The total number of events to be measured for a) and b), is 1.0→1.2 10^6, if one neglects elastic events, very short protons, etc... Since half of them would consist of one track events (the proton) they could be measured very fast, even taking into account that secondary interactions of the protons would have to be measured, for a precise momentum determination.

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For two automatic measuring machines, this would imply two years of work.

The proposing group of Padova can supply 4 of the 10 scanning tables and 1 of the measuring machines(*) needed to complete the measurements in two years. Collaboration with a similarly equipped group is therefore desirable.

The required accuracy in the beam momentum (±0.2%) is such that the mass resolution is still mainly due to measurements errors. A spread in the beam momentum of ±0.5% would increase the error in the missing mass by about 50%.

Spokesman for the experiment is Prof.A.Bettini.

(*) The measuring machine, a PEPR, could be made available to this experiment for 50% of the time, yielding about 250.000 events per year.

REFERENCES

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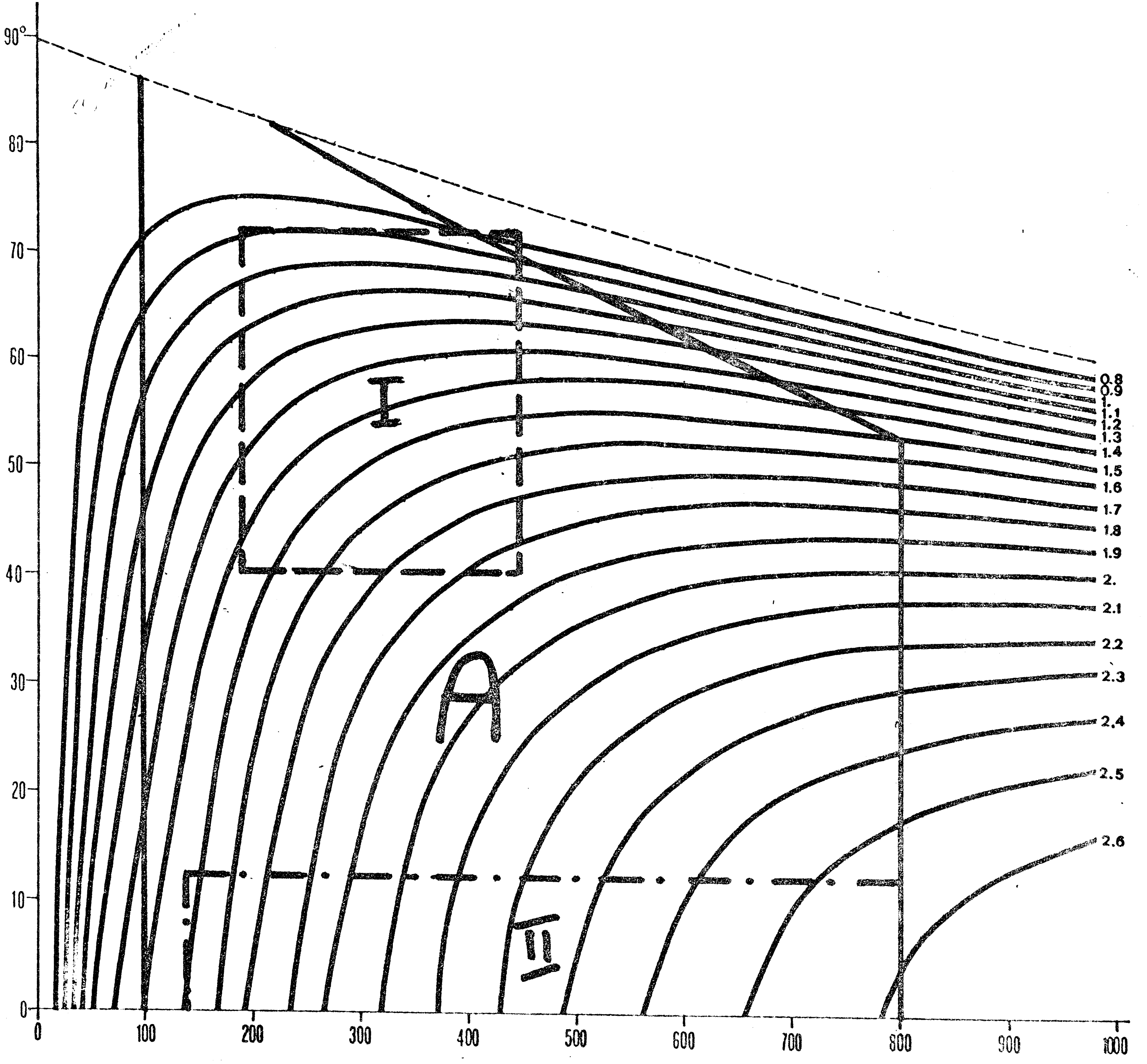
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