First results from the CMD3 Detector at the VEPP2000 Collider

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Regular data taking started at the VEPP2000 e^+e^- Collider with CMD3 and SND detectors. Energy scan for center-of-mass energy from 1 GeV to 2 GeV has been performed with about 20 pb^{-1} per detector. We present first preliminary results from the CMD3 detector.

1 Introduction

Production of low energy hadrons in e^+e^- collisions remains an interesting experimental area due to its important contribution to the Standard Model (SM) calculations of the muon anomalious magnetic moment and $\alpha(s)$.

An e^+e^- collider of the next generation, VEPP2000 [1], has been constructed and started regular data taking in BudkerINP, Novosibirsk, Russia. It is designed to cover a center-of-mass ($E_{c.m.}$) energy from hadron production threshold up to 2 GeV.

Two detectors [2], SND and CMD3, have been prepared for the rich physics program at the VEPP2000 collider. During next few years we plan to scan the available energy range to measure the hadron production cross sections with a percent or better accuracy level, as well as a study production dynamics for the multi-hadron channels.

In this paper we present preliminary results from the first energy scan of the 1-2 GeV center-of-mass energy region obtained with the CMD3 detector.

2 The VEPP2000 Collider

The VEPP2000 collider is described elsewere [1] and the layout is shown in Fig. 1. A special feature of the machine is the using of the solenoidal focusing for the interaction regions. This new approach allows to suppress beam-beam effects and store larger currents. During the energy scan, reported here, a luminosity up to $2{\cdot}10^{31}$ $\text{cm}^{-2}\text{sec}^{-1}$ has been demonstrated, limited by the positron current. With a new positron source, currently under construction, the designed luminosity is 10^{32} $\text{cm}^{-2}\text{sec}^{-1}$.

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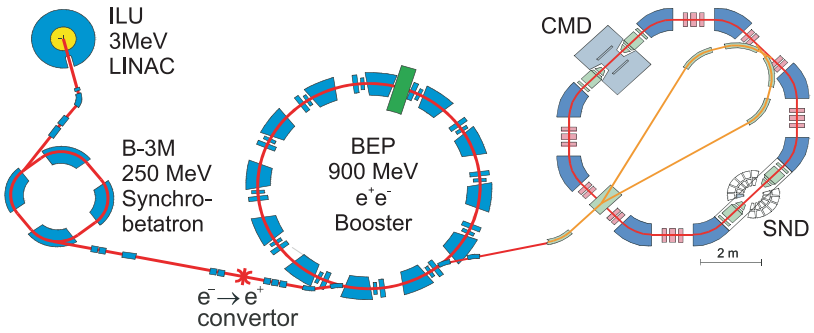

Figure 1: The layout of the VEPP2000 complex. The locations of the CMD3 and SND detectors are shown.

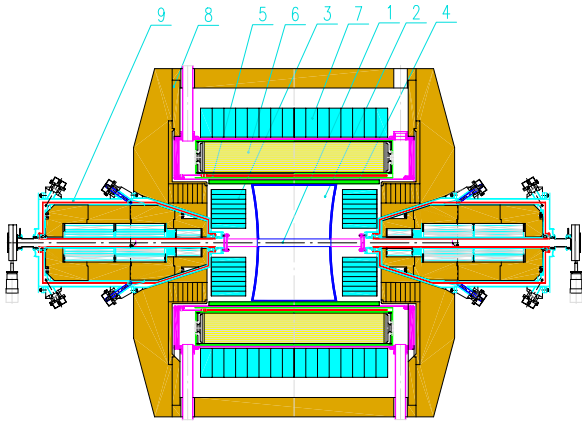

Figure 2: The CMD3 detector: 1-Interaction region; 2-Drift chamber; 3-BGO end cap calorimeter; 4-Z-proportional chamber; 5-SC magnet ; 6-LXe calorimeter; 7-CsI calorimeter; 8-Yoke; 9-Focusing solenoids.

3 The CMD3 Detector

The CMD3 detector is described elsewere [2] and detector elements are shown in Fig. 2. It is a general purpose magnetic detector, providing good spatial and momentum resolutions for the charged particles [3], and very good (about 1-2 mm) spatial resolution for photons in the LXe calorimeter [4], as well as good photon energy measurement. The detector performance is demonstrated in Fig. 3, where DC and calorimeter responses are shown for collinear events at $E_{c.m.}$=1.975 GeV. A relatively clean selection of the processes $e^+e^- \to e^+e^-$, $P\overline{P}$, K^+K^-, $\pi^+\pi^-$ can be performed using detector subsystems.

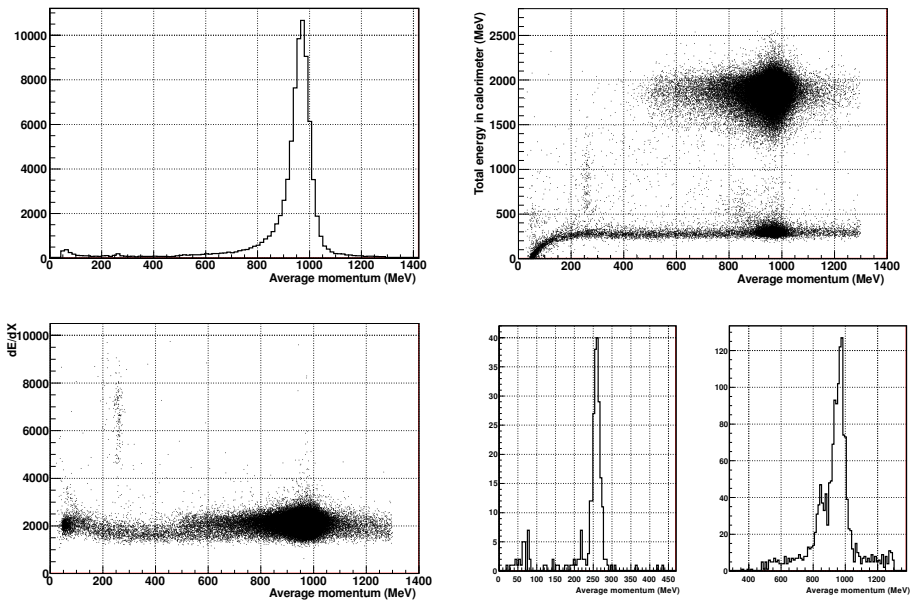

Figure 3: The CMD3 detector performance at $E_{c.m}$=1.975 GeV for collinear events: (top left) the average momentum ; (bottom left) the dedx DC measurement versus average momentum; (top right) the total energy deposition in the calorimeter versus average momentum; (bottom right) the $e^+e^- \to P\overline{P}$ signal from dedx>3000 selection and $e^+e^- \to K^+K^-$ and $e^+e^- \to \pi^+\pi^-$ signals from calorimeter energy deposition selection.

4 First Physics results

We perform the energy scan in the 1-2 GeV center-of-mass energy, collecting data at 40 energy points with about 0.5 pb^{-1} integrated luminosity. This luminosity corresponds to 200000 to 50000 events of Bhabha events (per point) used for the luminosity measurements and from a few hundred to a few thousand of multihadrons events like $\pi^+\pi^-\pi^0$, $2(\pi^+\pi^-)$, $2(\pi^+\pi^-)\pi^0$, $K^+K^-\pi^+\pi^-$, 6π etc.

As shown in Fig. 3(bottom), a simple requirement of dEdX>3000 gives a very clean signal of the $e^+e^- \to P\overline{P}$ process with about 200 events per energy point. We estimate the cross section for four energy points above the threshold and show in Fig. 4 a comparison of our preliminary results with other measurements.

In this paper we also show our preliminary measurement of the $e^+e^- \to 3(\pi^+\pi^-)$ cross section. We detect five and six charged tracks and using the total energy for six tracks and missing mass for five tracks select candidates for the $e^+e^- \to 3(\pi^+\pi^-)$ reaction with almost no background, as shown in Fig. 5(left). Our cross section measurement is shown in Fig. 5(right) in comparison with recent BaBar data.

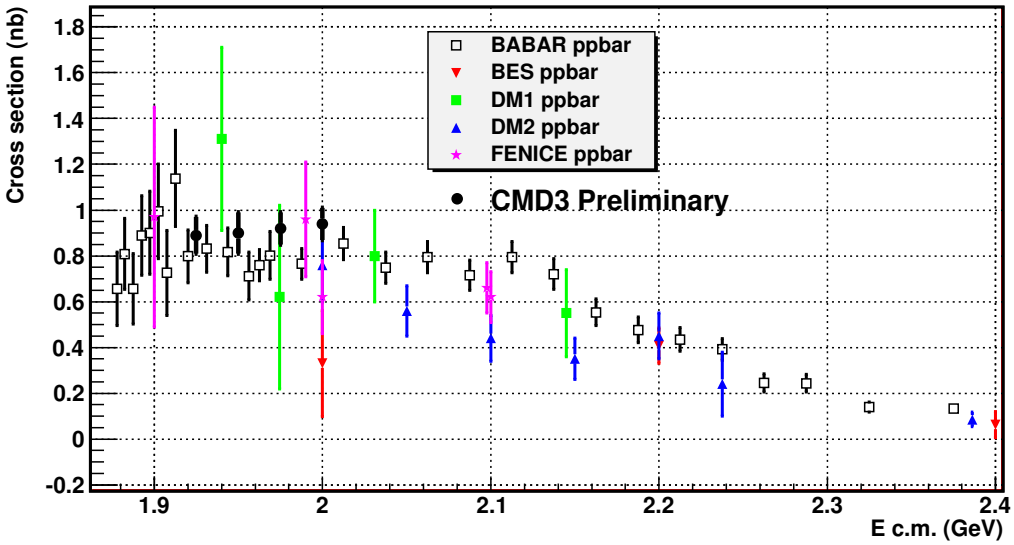

Figure 4: The CMD3 study of the $e^+e^- \to P\overline{P}$ process in comparison with other measurements.

Acknowledgments

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References

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[3] Nucl. Instr. and Meth. A, Volume 623, Issue 1, 1 November 2010, Pages 114-116

[4] Nucl. Instr. and Meth. A, Volume 598, Issue 1, 1 January 2009, Pages 266-267.

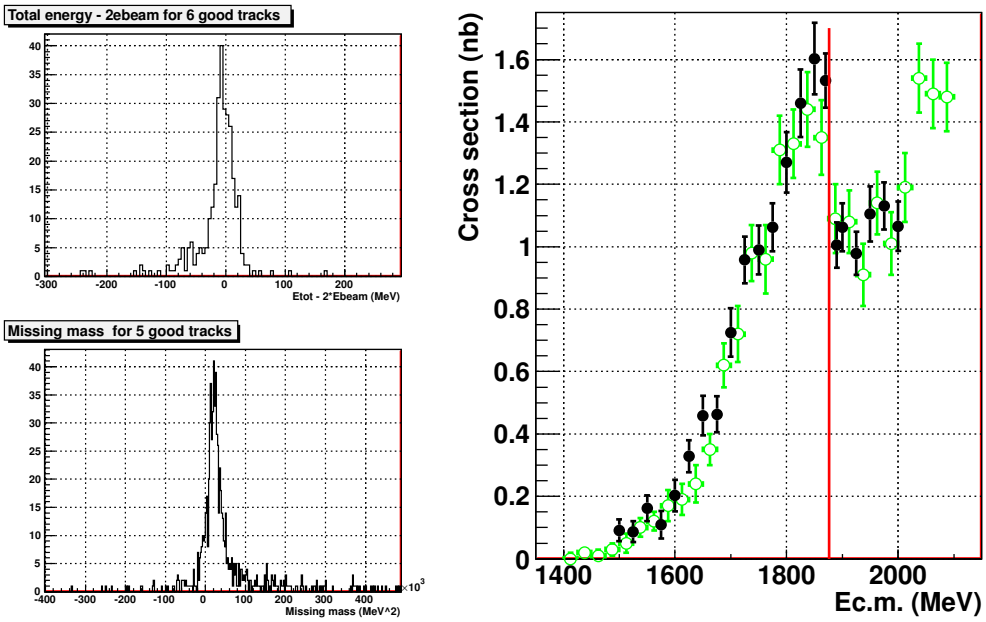

Figure 5: The CMD3 study of the $e^+e^- \to 3(\pi^+\pi^-)$ process: (left) the difference of the 6 pions total energy and $E_{c.m.}$ (top) and missing mass for 5 tracks (bottom); (right) the $e^+e^- \to 3(\pi^+\pi^-)$ cross section measured by CMD3 detector (dots) in comparison with the BaBar data (open circles). Line shows the $P\overline{P}$ threshold.