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# SEARCH FOR J/ψ LIKE RESONANCE BELOW 3 GeV IN $e^+e^-$ ANNIHILATION

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The discovery of the J/ψ resonance and the measurement of its small width ($\Gamma_{tot}$ = 70 keV) have stimulated an intense experimental search for new narrow resonances in other mass region [1]. The search at $e^+e^-$ storage rings is carried out by changing the energy of the colliding beams in steps determined by the energy resolution of the machine ($\Delta E/E \approx 10^{-3} E_{GeV}$). The result presented hereafter refers to a scan made at ADONE, in the mass interval $W = 2.5$–$3.0$ GeV in steps of 1 MeV. The effective luminosity per bin was $\approx 0.2\,nb^{-1}$. The experimental set-up is composed of 16 counter telescopes covering the full azimuth and the range of polar angle from 44° to 136° with respect to the beam line. Each telescope is made up of four counters. From the collision region outwards one finds HOD 1 (0.5 cm thick), HOD 2 (2.5 cm), HOD 3 (35.0 cm), HOD 4 (4.0 cm). HOD 1, HOD 2, HOD 4 are plastic scintillation counters (see ref. [2] for a more complete description of the apparatus).

Two and half radiation lengths of Pb and Fe are placed between HOD 3 and HOD 4. The apparatus has cylindrical symmetry around the beam axis and covers a solid angle $\Delta\Omega = 0.75 \times 4\pi$ for a point-like interaction region.

The trigger logic requires:

a) at least two charged particles passing in two different telescopes through HOD 1, HOD 2, and HOD 3;

b) the OR of the HOD 1 counters has to be time (within ±15 ns) with the collision signal given by a beam pick-up electrode;

c) the time of flight between HOD 1 and HOD 4 (separation 130 cm) should correspond to that of particles coming from the source. The last two criteria reduce the cosmic ray flux triggering the apparatus to about 1% of the initial level.

For each event the pulse height, the time information and the pattern of all the counters are recorded.

Events with the following characteristics are labelled for further processing:

d) total energy loss in HOD 3 greater than 400 MeV;

e) at least two HOD 4 counters fixed.

The set of events fulfilling conditions a) through e) was analysed as follows. Two body coplanar events, which fire opposite telescopes was discarded; contributions to this sample are mainly given by $e^+e^- \to e^+e^-$, $e^+e^- \to \mu^+\mu^-$ and beam gas background events. Events are accepted if they occur within a ±6 ns interval with respect to beam-beam collision time. Cosmic rays and

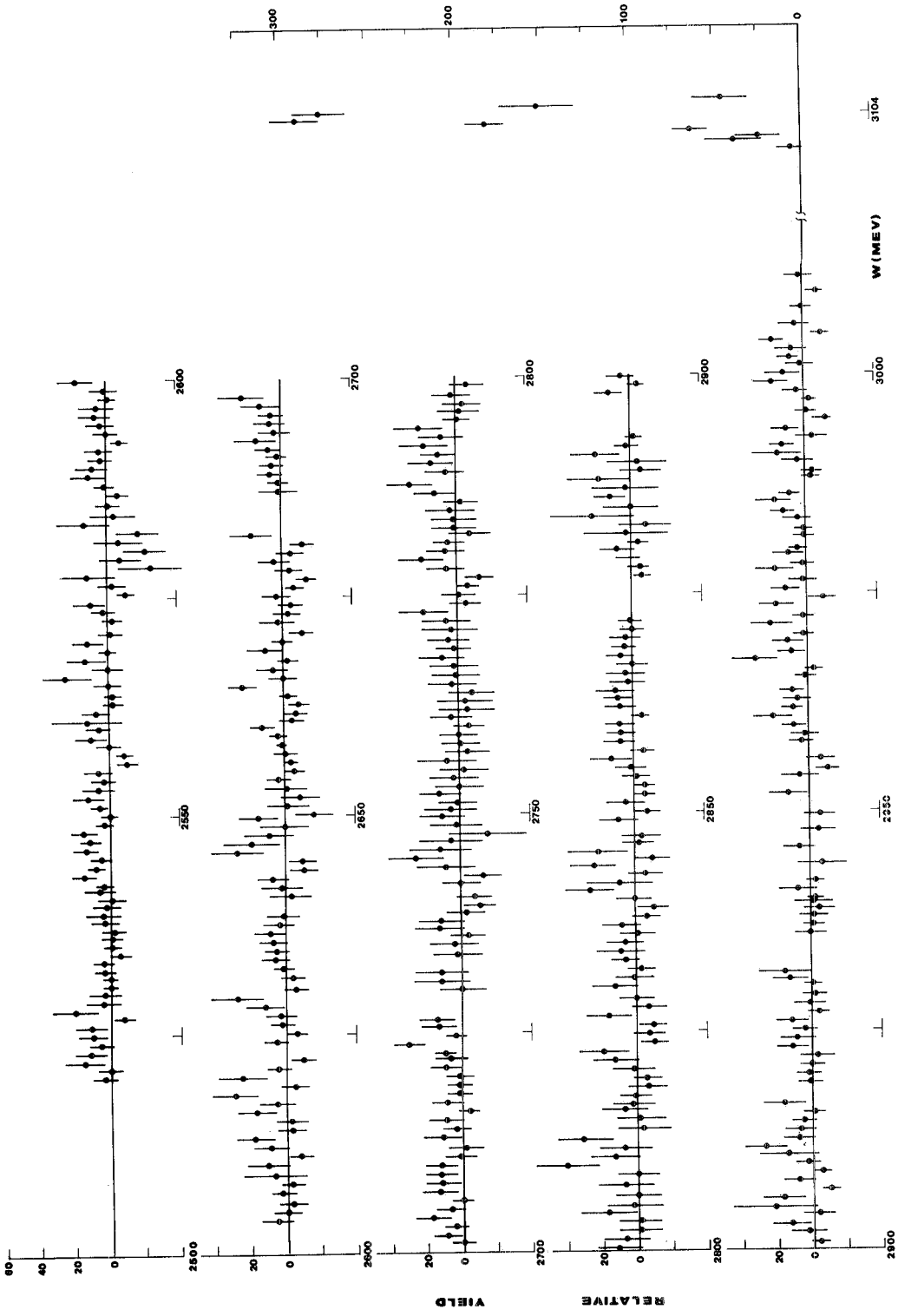


Fig. 1. Relative yield as function of the centre of mass energy.

part of the machine background are further reduced by this selection.

The residual machine background has been measured in non colliding beam conditions and was subtracted after normalization to the total trigger rate. (We have estimated that under usual running conditions, beam gas interactions produce about 99% of our triggers.)

The cosmic ray background remaining in our time window was determined when Adone was not in operation; a correction term (always less than 20%) proportional to the running time was applied.

The result of this analysis is shown in fig. 1. The search of a $J/\psi$-like resonance with a total width much smaller than the centre of mass energy spread (r.m.s. 2.5 MeV) was carried out by looking for a resonant-like shape over a smooth background. Assuming that the efficiency of our set-up for the hypothetical resonance x is the same as for the $J/\psi$, the result of this experiment excludes the existence of such a resonance in the 2.5–3.0 GeV mass interval with an integrated cross section larger than 1/10 of the $J/\psi$ integrated cross section, i.e.

$$\int \sigma_x(e^+e^- \to \text{hadrons})\,dW < \frac{1}{10}\int \sigma(e^+e^- \overset{\circ}{\to} J/\psi \to \text{hadrons})\,dW.$$

The result presented by our group on the upper limit for the existence of $J/\psi$-like resonances in the mass interval 2.5–3.0 GeV are in agreement with the results collected at the same time at Adone by two different experimental set-ups.

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