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STUDY OF ELECTRON PAIRS
BELOW THE Z^0 MASS
PRODUCED IN $\bar{p}p$ COLLISIONS AT $\sqrt{s} = 540$ GeV

The UA2 Collaboration

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ABSTRACT

From an integrated luminosity of $\int \mathcal{L} dt = 116 \text{ nb}^{-1}$, 10 events are found which contain an electron pair of mass in the range $12 < M^{ee} < 26 \text{ GeV}/c^2$ and of electron transverse momenta $p_T^e > 5 \text{ GeV}/c$. The expected background from fake electrons is estimated to be 2.2 ± 0.6 events. The production characteristics of this sample are described, as well as some features of the associated event topology. Comparisons are made with the expectations for such electron pair production from the Drell-Yan mechanism and from the semi-leptonic decay of heavy flavours.

1. INTRODUCTION

In earlier publications [1], we reported the observation of eight identified electron pairs with mass $M^{ee} > 50 \text{ GeV}/c^2$ [2]. All events could be interpreted as resulting from the process

$$\begin{aligned} \bar{p} + p &\rightarrow Z^0 + \text{anything} \\ &\rightarrow e^+ + e^- \text{ or } e^+ + e^- + \gamma. \end{aligned}$$

In this letter, we extend our search to electron pairs of lower mass ($12 < M^{ee} < 50 \text{ GeV}/c^2$). Our motivation for this search was the expectation of lepton pair production with mass $M^{ee} < M_Z$ from a wide range of models. In particular, at the present integrated luminosity, $\int \mathcal{L} dt = 116 \text{ nb}^{-1}$, it is expected that electron pairs with mass $M^{ee} < 26 \text{ GeV}/c^2$ should be observable due to the Drell-Yan (D-Y) process [3,4] and due to the production and subsequent semi-leptonic decay of heavy flavour (H-F) pairs, particularly $b\bar{b}$ [5,6]. The production of electron pairs is also possible in SUSY models [7], composite models [8] and excited-lepton models [9], and an upper limit on the electron pair production cross section due to such processes is of interest.

We find 10 events with an electron pair satisfying the kinematic bounds $12 \text{ GeV}/c^2 < M^{ee} < 50 \text{ GeV}/c^2$, $p_T^e > 5 \text{ GeV}$ and $\Delta\phi^{ee} > 60^\circ$. The background due to fake electrons is estimated to be 2.2 ± 0.6 events.

2. DETECTOR

The UA2 detector has been described in detail elsewhere [10], so only its main features are discussed here.

At the centre of the apparatus a vertex detector [11] measures charged particle trajectories and the most likely ionisation associated with these trajectories in a region with no magnetic field. From the reconstructed tracks, the position of the event vertex is determined with a precision of ± 1 mm in all directions.

In the central region of the detector, that is in the polar angle range $40^\circ < \Theta < 140^\circ$, particles traverse a cylindrical tungsten converter of 1.5 radiation lengths thickness, which is located in front of a cylindrical multi-wire proportional chamber. This chamber localizes electromagnetic showers initiated in the tungsten with a precision of ± 3 mm (verified using electrons from a test beam). For the data of the present analysis, a 20° azimuthal section of the preshower chamber was not operational. Electron candidates traversing this section of the detector have been excluded.

Particles coming from the interaction point in the polar angle interval $40^\circ < \Theta < 140^\circ$ enter the central calorimeter [12]. The calorimeter is built in a tower structure of 240 independent cells, which point to the interaction region. Each cell is segmented longitudinally into an electromagnetic compartment of 17 radiation lengths thickness, followed by two hadronic compartments of ~ 2 absorption lengths each. Except for the first 15 nb^{-1} of integrated luminosity, which is excluded in this analysis, the calorimeter covers the full azimuthal acceptance.

The two forward regions ($20^\circ < \Theta < 37.5^\circ$ and $142.5^\circ < \Theta < 160^\circ$) are each equipped with twelve coils, equally spaced in azimuth, which generate a toroidal magnetic field with a mean bending power of 0.38 Tm. Each of the corresponding sectors is instrumented with:

a) three drift chambers [13], which are used in association with the event vertex to measure charged particle momenta [$\Delta(1/p) \approx 1.4\%$ $(\text{GeV}/c)^{-1}$],

b) a lead-iron converter of 1.4 radiation lengths thickness, which is followed by a proportional-tube array [14], that localizes electromagnetic showers initiated in the converter with a precision of ± 6 mm,

c) an electromagnetic calorimeter consisting of ten independent cells covering 15° in Φ and 3.5° in Θ . Each cell of the calorimeter is divided into two independent longitudinal compartments (24 radiation lengths and 6 radiation lengths thickness, respectively) to provide rejection against hadrons.

Because of the magnetic coils, $\sim 20\%$ of the azimuthal acceptance is obscured in the forward regions.

The response of the calorimeters to both electrons and hadrons as well as the stability of that response have been studied in detail [12]. The energy resolution for electrons is measured to be $\sigma_E/E = 0.14/\sqrt{E}$ (E in GeV) in the central region and $0.17/\sqrt{E}$ in the forward calorimeters. For the data of this paper, the systematic uncertainty in the energy calibration is on average $\pm 1.5\%$. The cell-to-cell calibration uncertainty has a distribution with an r.m.s. spread of 2.2% .

3. TRIGGER

The trigger [15] was implemented to be sensitive to electrons of high transverse momentum, and so all photo-multiplier gains of the calorimeters were adjusted to give signals proportional to the deposited transverse energy. Trigger thresholds were applied to the linear sum of electromagnetic signals in 2×2 -cell matrices. In the central calorimeter all 2×2 matrices were considered, while in the forward regions only those consisting of cells in the same sector were considered. A trigger signal was generated when at least two such 2×2 -cell matrices, separated in azimuth by at least 60° , exceeded a nominal threshold between 4 and 4.5 GeV. Because of variations in the trigger threshold, a cut $E_T > 5$ GeV was later applied on the reconstructed

energy clusters^{*)} and, in addition, the measured trigger efficiencies were taken into account for acceptance evaluations.

To reduce background from non- $\bar{p}p$ collisions, a coincidence was required with two signals, obtained from hodoscopes [16] in the polar angle range $0.47^\circ \div 2.84^\circ$ with respect to the beams on each side of the collision region. The hodoscopes gave a coincidence signal in more than 98% of all non-diffractive collisions.

4. DATA SAMPLE AND ANALYSIS CRITERIA

Initially, events resulting from sources other than $\bar{p}p$ collisions were rejected. This was less than 5% of the sample and resulted mainly from beam-gas background.

A search was then made for events with at least two electrons of $E_T > 5$ GeV, an electron being characterised by :

- a) energy deposition in the calorimeter with lateral size and leakage into hadronic compartments consistent with that expected for electrons,
- b) a track measured in the vertex detector and where relevant in forward chambers,
- c) a charge equivalent to at least two minimum-ionising particles (mip) in the central preshower detector and 6 mip in the forward preshower detector,
- d) good spatial matching of the above signals.

Furthermore, in the forward regions good matching was required between the momentum reconstructed from the track, and the deposited electromagnetic energy. Because of the differing construction of the forward and central detectors, the criteria a) ÷ d) were applied separately in the two regions.

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^{*)} For the definition of energy clusters see ref. [1].

The selection criteria were motivated by the selections required for the W^+ and Z^0 analysis and, where possible, are identical to the cuts of table 1 in ref. [1]. A few energy-dependent cuts, however, were slightly changed as discussed below.

For electrons in the central calorimeter, the ratio of the hadronic energy, E_{had} , to the cluster energy, E_{cl} (the sum of the electromagnetic cell energies plus the leakage into the hadronic compartments of the cluster cells) must be less than $H_0 = 0.023 + 0.034 \cdot \ln E_{\text{cl}}$. The efficiency is estimated from test beam data to be 96% for isolated electrons of the type expected from the Drell-Yan process. The cut on the cluster radius of < 0.5 cell units (r.m.s.) is compatible with an efficiency of $> 97\%$ as expected for isolated electrons. In the forward calorimeters, the hadronic leakage cut of 2% (3% if the cluster contains adjacent cells) is fully efficient. Equivalent to the radius cut of the central region, we require for electron candidates in the forward regions that the energy fraction (charged and neutral) in cells adjacent to the cluster is less than 10%. This cut is also fully efficient for isolated electrons.

In the central region, a track is required to point to the energy cluster. The probability for the observed energy pattern to agree with that expected for an electron must exceed 10^{-4} . Furthermore a signal of charge $Q > 2$ mip in the preshower detector is required to align with the track within a distance $d_0 = 7$ mm at the preshower detector. In the forward regions, a preshower signal is required above a threshold of 6 mip. The position along the magnetic field direction of the preshower cluster is required to be consistent with that of the centroid of the calorimeter energy cluster, and to be aligned within 20 mm of a reconstructed forward track. The momentum determined from the track and the calorimeter energy deposition must agree within 4 s.d. (about 94% efficiency including radiative effects).

In both the central and forward regions, a correction is applied to the measured energy as a function of the track impact and angle to take account of the spatial variation of the calorimeter response. The form of this correction has been determined from test beam data.

To remove electrons from photon conversion in the vertex detector (about 0.05 r.l. in the forward regions and 0.02 r.l. in the central region), we require track coordinates in at least one of its two innermost chambers. This accounts for 60% of the material traversed by the tracks, the remainder being due to the vacuum pipe. In the regions of magnetic field, conversions are also identified if another particle of opposite charge exists with an angular separation of less than 30 mr from the electron candidate. To reject events resulting from the overlap of a charged track with a photon (or photons) in the central detector, we require that any other signal in the preshower counter within 60 mm of the track impact has a charge less than that associated with the track itself.

A consequence of the criteria described above is that electrons will be rejected if they are not sufficiently isolated from other activity in the event. In particular electrons resulting from the semi-leptonic decay of heavy flavour (primarily $b\bar{b}$) states will be detected with reduced efficiency (see section 6).

After applying these criteria to both electrons of the candidate pair, 13 events remain (including 3 Z^0 events) that satisfy the selection:

$$\begin{aligned} M^{ee} &> 12 \text{ GeV}/c^2, \\ p_T^e &> 5 \text{ GeV}/c, \\ \Delta\Phi^{ee} &> 60^\circ. \end{aligned}$$

We have estimated the detection efficiencies for isolated electrons to be 69% in the central region and 78% in the forward regions. The observation of only 3 Z^0 events after applying the selection criteria to both electrons is consistent with these efficiencies.

The mass distribution of the other 10 events is shown in fig. 1, and relevant event characteristics are listed in table I. Eight of the events have both electron candidates in the central region (C-C category) and two events have one electron in a forward region (C-F category).

5. BACKGROUND EVALUATION AND ELECTRON QUALITY

To estimate the background expected from fake electrons and to study both the efficiency of the applied cuts and the quality of the resulting electron candidates, a sample of 2159 highly electromagnetic two-cluster candidates were selected. In this sample, isolation criteria (the cut on cluster radius in the central region and the cut on adjacent energy in the forward regions) were made less stringent. At least one of the following selection criteria were required in this sample for each arm of the cluster pair:

a) In the central region either the existence of a track or of a preshower signal in the "cone" defined by the calorimeter cluster and the event vertex.

b) In the forward regions, a good match between one of the following combinations: track and preshower, preshower and energy cluster (with a track into the same cluster), or track and energy cluster.

From this sample of two-cluster events, we get two independent background estimates for the C-C and C-F category, respectively. From the measured p_T -dependent single-arm rejection factors obtained by applying successive cuts to this sample (assuming that the successive cuts act independently on each arm of the cluster pair), we evaluate a background estimate due to misidentified single hadrons or two-jet events of 2.2 ± 0.6 events (1.7 ± 0.5 events in the C-C category and 0.5 ± 0.2 events in the C-F category). Independently of whether the initial sample has no track requirement or no preshower requirement, the resulting background estimates are in good agreement. Furthermore, we have verified that the rejection obtained by applying successive cuts to one arm of the cluster pair is, within statistics, independent of the cuts applied to the second cluster. We have also checked that the shape of the resulting 2-cluster mass distribution is, within statistics, unchanged. The estimated background is superimposed on fig. 1. For $M^{ee} > 26 \text{ GeV}/c^2$ (i.e. above the maximum observed electron pair mass), the background is estimated to be 0.3 events.

We now discuss the validity of the selection criteria in the final event sample, where relevant by relaxing specific cuts to study the increased event sample and the corresponding background estimate.

(i) Hadron leakage.

For the forward regions, there is no evidence of either an efficiency loss or a background of fake electrons. For the central region, a mean hadronic leakage excess of only 50 MeV is measured, suggesting no abnormal behaviour. Two of the 18 electrons in the central region have a small associated energy in the second hadronic compartment. The overlap of an electron and a hadron of the underlying event accounts for less than 0.4 such events, and since the track impacts are not near a cell boundary such configurations are unlikely for isolated electrons.

(ii) Lateral energy leakage.

If cuts on the lateral energy leakage are relaxed, two additional events are accepted. Both events are inconsistent with expectations of electron behaviour. The estimated background also increases by 2 events.

(iii) Track-cluster match.

If the probability requirement on the track-cluster match is replaced by a similar cut on the preshower-cluster match, 2 events are introduced. The result is consistent with the expected track reconstruction efficiency, and the estimated background is barely affected. No events are introduced if the p vs. E requirement of the forward direction is relaxed.

(iv) Track-preshower match.

A comparison between the track-preshower match of forward electrons from low mass pairs and from $W^\pm$ or Z^0 decay shows that the reconstruction accuracy is similar in each case. No new event is introduced if this cut is relaxed. The associated preshower charge is distributed as for $W^\pm$ or Z^0 decay electrons. From test beam measurements and Monte Carlo simulations, a preshower efficiency of $(90 \pm 5)\%$ is estimated. In the central region, the energy dependence of the track-preshower match and the associated preshower charge are more pronounced. In the energy region considered the mean preshower efficiency is estimated to be $(85 \pm 5)\%$.

If the track-preshower match is relaxed in the central and forward regions (to values $d < 22$ mm and $\Delta x, \Delta y < 100$ mm, respectively), 5 more events are accepted. The estimated background increases by 7 events. From quoted efficiencies, $2 \div 3$ additional events would have been expected in the signal sample.

If the requirement of isolation of the preshower signal is relaxed in the central region, 2 events are introduced but with an associated increase in background of 1.5 events.

(v) Track ionisation.

In this analysis no selection has been made on the track ionisation, I , because of its poor efficiency. A comparison of the track ionisation with that from $W^\pm$ and Z^0 decays shows consistency with the expected 80% efficiency for $1 < 2$ mip, obtained from $W^\pm$ and Z^0 decays and from minimum ionising tracks. No additional event is introduced if the selections used to eliminate photon conversions are dropped.

As an illustration, we show in fig. 2 the distributions of some parameters used to describe the electrons: the quality of the track-cluster match in the central region, the match between the reconstructed track momentum and the deposited electromagnetic energy in the forward regions, the distance between the track and the preshower cluster position, the charge measured in the preshower counters and the track ionisation measured in the vertex chamber. The distributions are consistent with electron behaviour.

Each event was scanned using an interactive graphics display. All candidate electrons were judged satisfactory, although (see section 6) the existence of hadronic activity near some electrons made the track multiplicity higher than for a truly isolated electron such as from $W^\pm$ or Z^0 decay. This could result in some deterioration of the electron identification, but that deterioration should be reflected in all background estimates.

6. EVENT CHARACTERISTICS

We first study properties of the event topology, after removing the candidate electrons and also associated jets if any, of $E_T^J > 3$ GeV. We compare these properties to the same quantities for minimum-bias events, and for $W^\pm$ and Z^0 events [1]. The mean deposited transverse energy in the rest of the event, $\langle \hat{E}_T \rangle = 14.8 \pm 1.6$ GeV, is significantly larger than that of minimum bias events, $\langle \hat{E}_T \rangle = 8.8 \pm 0.2$ GeV, or $W^\pm$ and Z^0 events, $\langle \hat{E}_T \rangle = 9.0 \pm 1.1$ GeV.

The mean of the measured total charged particle multiplicity, $\langle n_{ch} \rangle = 22.3 \pm 1.6$, is compared to $\langle n_{ch} \rangle = 14.7 \pm 0.2$ for minimum bias events, or $\langle n_{ch} \rangle = 16.4 \pm 0.8$ for $W^\pm$ and Z^0 events.

Furthermore (see table I), 4 of the 10 candidate pairs have an associated jet of $E_T^J > 3$ GeV, generally at small angle to one of the electrons.

This hadronic activity is further quantified by evaluating the hadronic energy E^{ass} (excluding the electron) in a limited region around the electron impact (± 3 cell units in Φ corresponding to $\Delta\Phi = \pm 45^\circ$ and ± 4 cell units in Θ corresponding to $\Delta\Theta = \pm 40^\circ$). A comparison is made with $W^\pm$ and Z^0 electrons in fig. 3. All Z^0 electrons and 90% of the $W^\pm$ electrons satisfy a selection $E^{ass} < 6$ GeV. Electrons from the D-Y process would be expected to be isolated approximately as $W^\pm$ and Z^0 electrons, but the data do not show a well defined category of isolated electrons. Of the 10 candidate pairs, only 3 events pass a selection $E^{ass} < 6$ GeV. (The associated backgrounds are 2.2 ± 0.6 and 0.9 ± 0.3 , respectively.) Their mass values are shaded in fig. 1. These three events could be ascribed to D-Y.

Cross section evaluations for the Drell-Yan process have recently been made by Altarelli et al. [17]. Using a parametrization of their results for the dependence on the pair mass M^{ee} , transverse momentum $p_T^{ee}(M^{ee})$ and rapidity $y^{ee}(M^{ee})$, we have generated Monte Carlo events and have passed them through the full analysis chain. In addition to the geometric acceptance, the effect of kinematic cuts is taken into account. Also included are the effects of detector efficiency,

trigger efficiency and calorimeter resolution. Given systematic errors on the luminosity ($\pm 17\%$) and on the normalisation ($\pm 12\%$ on the average) due to uncertainties in the mass scale, and assuming the quoted cross section [17] $\sigma_{DY} = 230 \pm 70 \text{ pb}$ for $M^{ee} > 12 \text{ GeV}/c^2$, 2.5 ± 1.0 events are expected to be detected in the apparatus.

It is further expected that some of the observed candidate pairs result from decay of heavy flavours [5]. After accounting for the detector acceptance, the dominant contribution is expected from $b\bar{b}$ production with subsequent semileptonic decay. However, the detector acceptance to such a process depends sensitively on the selection criteria, and especially on the cuts $p_T^e > 5 \text{ GeV}/c$ and $M^{ee} > 12 \text{ GeV}/c^2$. Configurations in which the electrons carry most of the parent quark momentum and therefore are nearly back-to-back in the transverse plane, are preferred. Hence it is difficult to separate these event configurations from those due to the D-Y process. Furthermore, small changes in the energy cut significantly affect the expected rate for electron pairs due to $b\bar{b}$ production. For example by changing the p_T^e -cut from 3.5 to 5 GeV/c, the rate of electron pair production from this source is reduced by a factor of 4-5 [5].

Typical QCD calculations predict a cross section of 100-200 pb [5,18,19] for electron pair production from $b\bar{b}$ states, with $p_T^e > 5 \text{ GeV}/c$. These calculations, however, do not include higher order corrections, which should further increase the cross section.

Using the ISAJET program [18] we have generated electron pairs from bb production and have fully processed these events to evaluate the acceptance. If we assume a cross section of $150 \pm 50 \text{ pb}$, we estimate 3.0 ± 1.2 events (1.8 ± 0.7 with $E^{ass} < 6 \text{ GeV}$) to be detected in the apparatus.

Therefore, the 10 events observed are in reasonable agreement with our expectations of 3.0 ± 1.2 events from H-F, 2.5 ± 1.0 events from D-Y and 2.2 ± 0.6 events from background.

The data are characterized (see table I) by a strong back-to-back orientation of the produced electrons in the transverse plane. Furthermore, we measure a value $\langle p_T^{ee} \rangle = 2.8 \pm 0.7 \text{ GeV}/c$ for the mean p_T of the electron pairs. This behaviour is well predicted by

D-Y models in the considered mass range (fig. 4), and it is kinematically preferred for $b\bar{b}$ production near threshold. The rapidity distribution is consistent with being flat within the detector acceptance.

Finally, and of relevance to searches for high-mass lepton pairs not resulting from Z^0 production, we place a limit $\sigma < 130$ pb (90% CL) on the production of (e^+e^-) pairs with $M^{ee} > 26$ GeV/c², assuming acceptance corrections for the D-Y process.

7. SUMMARY

We have searched for electron pairs originating from sources other than Z^0 decays in the 1983 data. Ten events are found in the mass range $12 \text{ GeV/c}^2 < M^{ee} < 26 \text{ GeV/c}^2$, with an expected background due to fake electrons of 2.2 ± 0.6 events.

The total event rate is consistent with the combined expectation from the D-Y process and from heavy flavour production. However, because of kinematic constraints, the two event categories cannot be separated event-by-event.

An upper limit of 130 pb (90% CL) for the production of electron pairs with mass $M^{ee} > 26 \text{ GeV/c}^2$ is determined.

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Table Ia. Electron pair and event properties. (C-C = central-central, C-F = central-forward, with the charge sign given for the forward electron.)

Event	Pair Config.	M^{ee} (GeV/c ²)	p_T^{ee} (GeV/c)	$\Delta\phi^{ee}$ (°)	E_T^J (GeV)	y^{ee}
A	C-F(-)	25.1	0.1	179	-	0.06
B	C-C	13.2	8.2	123	-	-0.12
C	C-C	14.8	1.2	176	-	0.21
D	C-C	13.0	2.8	176	-	-0.02
E	C-C	13.2	2.2	161	-	-0.83
F	C-C	12.4	1.9	161	5.5	0.63
G	C-F(-)	19.4	0.8	174	3.7	-0.37
H	C-C	14.1	4.7	168	5.7	-0.87
I	C-C	13.5	3.6	164	4.1	-0.17
J	C-C	13.3	2.4	159	-	1.05

Table Ib. Properties of the individual electrons.

Event	θ_1 (°)	ϕ_1 (°)	θ_2 (°)	ϕ_2 (°)	E_T^1 (GeV)	E_T^2 (GeV)	E_1^{ass} (GeV)	E_2^{ass} (GeV)
A	139.4	176.0	36.1	357.0	7.8	7.8	0.8	2.5
B	83.5	284.5	120.9	47.6	9.8	5.0	2.5	3.3
C	49.5	337.0	115.3	160.9	6.7	5.7	5.1	4.4
D	98.7	138.3	79.0	314.7	7.9	5.2	6.3	3.8
E	139.8	270.1	125.5	109.6	6.6	6.6	1.5	6.3
F	78.6	22.4	37.0	221.0	5.9	5.5	13.2	7.3
G	144.5	197.0	66.4	22.6	7.5	7.2	5.5	6.2
H	133.5	329.3	136.2	161.0	9.7	5.2	3.8	7.6
I	114.5	15.1	75.0	211.1	8.1	5.0	7.7	4.6
J	46.5	277.4	32.1	76.4	6.8	6.5	8.0	4.9

FIGURE CAPTIONS

Fig. 1 Electron pair mass distribution. The shaded area indicates three events with less than 6 GeV hadronic energy (E^{ass}) associated with each selected electron (section 6). The superimposed curve shows the estimated background of misidentified 2-jet events.

Fig. 2 Some parameters describing the quality of the electrons.

Central-central electron pairs:

- a) Quality of the track-energy cluster match^{#1},
- b) Track-preshower match^{#1},
- c) Charge measured in the central preshower detector^{#2}.

Central-forward electron pairs:

- d) Match between measured momentum and deposited energy of the forward electron vs. track-cluster match of the associated central electron^{#1},
- e) Track-preshower match^{#1},
- f) Charge measured in the forward preshower detector^{#2}.

All pairs:

- g) Ionisation (in mip) measured in the vertex detector.

Upper curve: electrons from W^+ and Z^0 decay;

lower curve: electrons from low mass pairs

(shaded: $E^{\text{ass}} \leq 6$ GeV).

Two electron tracks do not have a measured ionisation and are excluded.

#1 Full circle: low mass electron pair with $E^{\text{ass}} > 6$ GeV;
 open circle: low mass electron pair with $E^{\text{ass}} \leq 6$ GeV;
 triangle: $Z^0 \rightarrow e^+e^-$.

#2 Dashed line: electrons from W^+ and Z^0 decay;
 full line: electrons from low mass pairs (shaded:
 $E^{\text{ass}} \leq 6$ GeV).

Fig. 3 Associated hadronic energy E^{ass} of
 a) low mass electron pairs ($\bullet$), compared
 with electron pairs from Z^0 decay (Δ);
 b) individual electrons from low mass pairs (—),
 compared with electrons from Z^0 and W^+ decay (---).

Fig. 4 Normalised p_T^{ee} distribution after acceptance correction.
 The events with $E^{\text{ass}} \leq 6$ GeV (on each arm) are shaded.
 Superimposed is the normalised distribution expected
 for pure D-Y production [17].

Fig. 1

Fig. 2

Fig. 3

Fig. 4