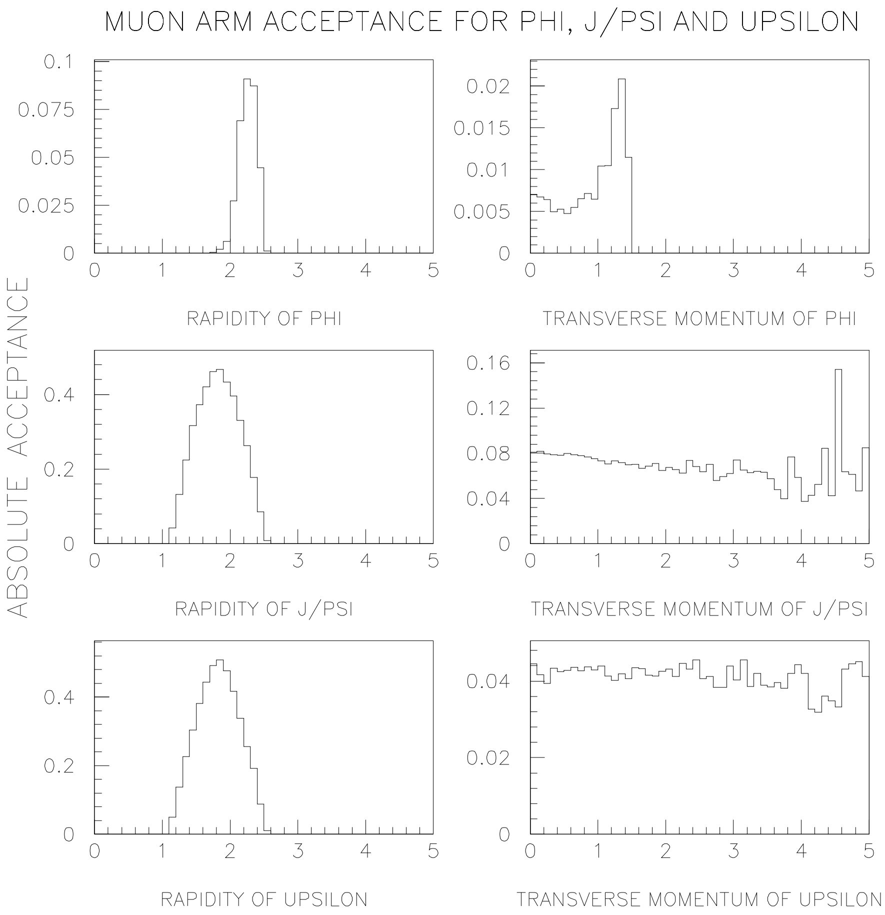

Figure 10.4: Rapidity and transverse momentum dependence of the absolute acceptance for the ϕ, J/ψ, and Υ.

mesons in nucleon-nucleon collisions can be expressed as ([1, 2])

$$\begin{aligned} B_R\sigma &= A_R\, e^{-14.7\tau}, \\ \tau &= \frac{M_R}{\sqrt{s}}. \end{aligned} \tag{10.1}$$

Here M_R is the resonance mass, B_R is the branching ratio of the vector meson decay to $\mu^+ + \mu^-$ and A_R is the normalization coefficient. The original parameterization in Ref. [2] was given in terms of $d\sigma/dy|_{y=0}$, whereas we have chosen to use the integrated cross section. Further details on the rapidity- and p_T-distributions of vector meson production can be found in Ref. [1]. Values of A_R for the six most important vector mesons can be found in Table 10.2. The $B_R\sigma$ values for minimum bias heavy ion reactions between identical nuclei A + A have been obtained from the nucleon-nucleon values by scaling with $A^{2\alpha}$, where $\alpha_{\rho,\phi} = 0.85$,

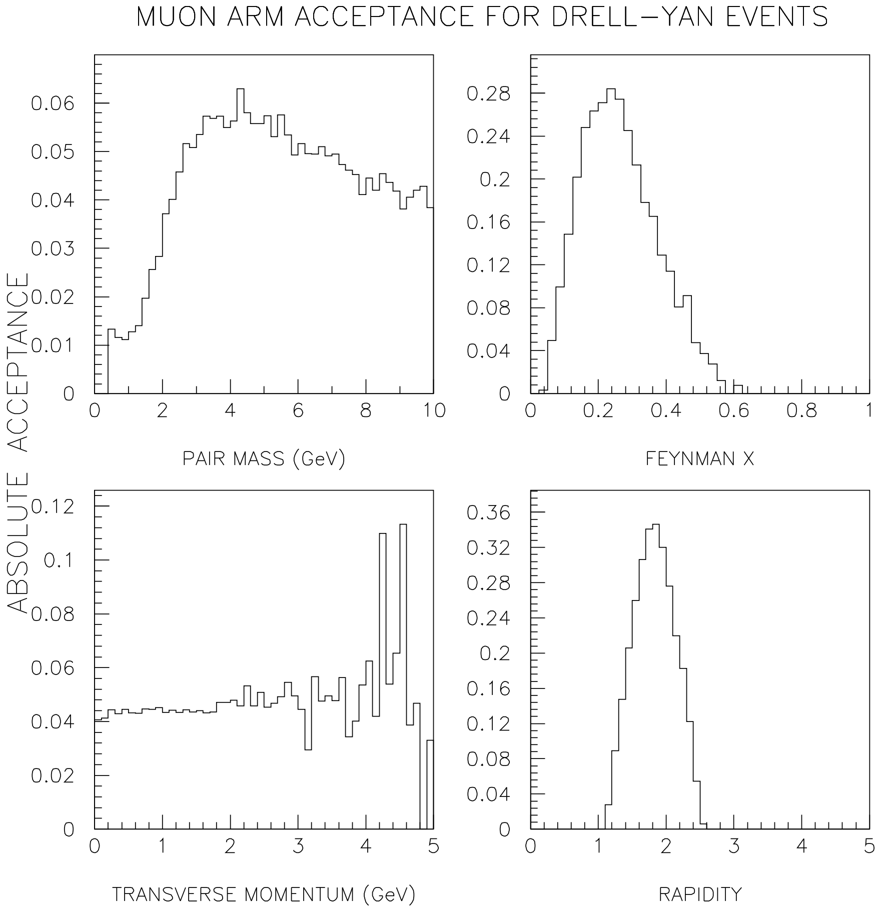

Figure 10.5: The absolute acceptance of dimuons originating from Drell-Yan production as a function of pair mass, x_F, p_T and rapidity.

$\alpha_{J/\psi,\psi'} = 0.90$ and $\alpha_{\Upsilon,\Upsilon'} = 0.95$. For central collisions the cross sections have been assumed to scale with $A^{4/3\alpha}$, where the factor 4/3 in the exponent describes the scaling of the number of binary nucleon-nucleon collisions. This scaling for central collisions agrees very well with Gerschel and Hufner's parameterization of J/ψ cross sections in nucleus-nucleus collisions at SPS energies [5].

Based on the cross sections given in Table 10.2 and Ref. [1], the number of accepted dimuon events per RHIC year (assumed to be 3000 hours at a nominal luminosity of 2×10^{27} for Au + Au and 1.5×10^{29} for p + Au) are calculated and shown in Table 3.3.

Note the large yields obtained with the muon detector. The nearly two million accepted J/ψ events in a nominal RHIC year allow a detailed subdivision of the data set to study impact parameter, rapidity, and p_T dependences. The errors quoted for central Au + Au events in Table 3.4 have been obtained by estimating the statistical errors involved in the

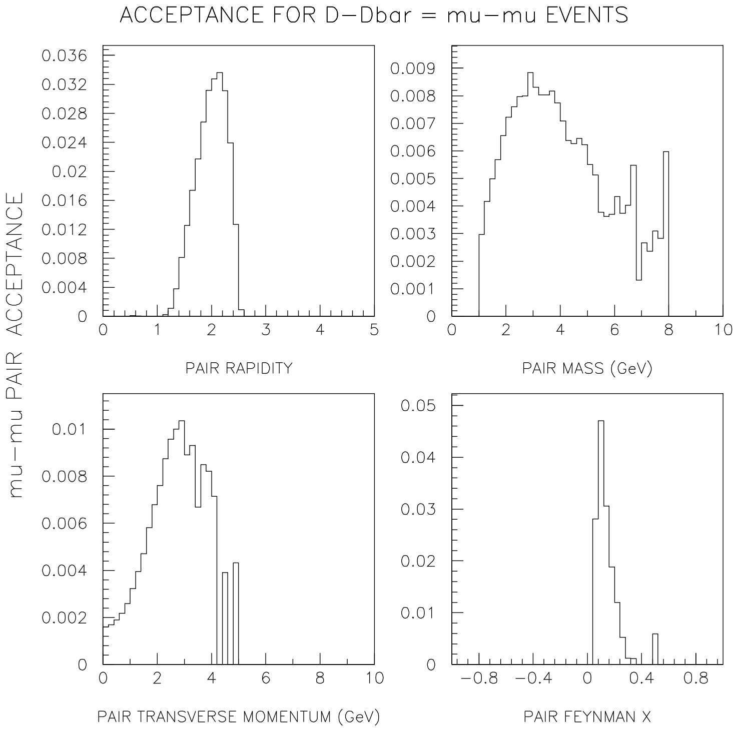

Figure 10.6: The absolute acceptance of dimuons originating from D$\bar{\mathrm{D}}$ production as a function of rapidity, pair mass, p_T, and x_F.

Table 10.2: Cross sections for production of vector mesons decaying into the dimuon exit channel in 100+100 GeV/c Au + Au collisions. A_R and B_R are defined in the main text. P_e is the production probability per event. Central events are defined as the most central 1% of the reaction cross section.

		Minimum Bias Au + Au		Central Au + Au	
	A_R (cm^2)	$B_R\sigma$ (cm^2)	P_e	$B_R\sigma$ (cm^2)	P_e
ρ	6.07×10^{-30}	3.96×10^{-26}	6.46×10^{-3}	4.92×10^{-27}	8.02×10^{-2}
ϕ	9.34×10^{-31}	6.09×10^{-27}	9.94×10^{-4}	7.56×10^{-28}	1.23×10^{-2}
J/ψ	1.43×10^{-31}	1.48×10^{-27}	2.42×10^{-4}	1.63×10^{-28}	2.66×10^{-3}
ψ'	2.15×10^{-33}	2.00×10^{-29}	3.26×10^{-6}	2.29×10^{-30}	3.74×10^{-5}
Υ	3.08×10^{-34}	3.80×10^{-30}	6.20×10^{-7}	4.84×10^{-31}	7.90×10^{-6}
Υ'	3.08×10^{-35}	3.80×10^{-31}	6.20×10^{-8}	4.84×10^{-32}	7.90×10^{-7}

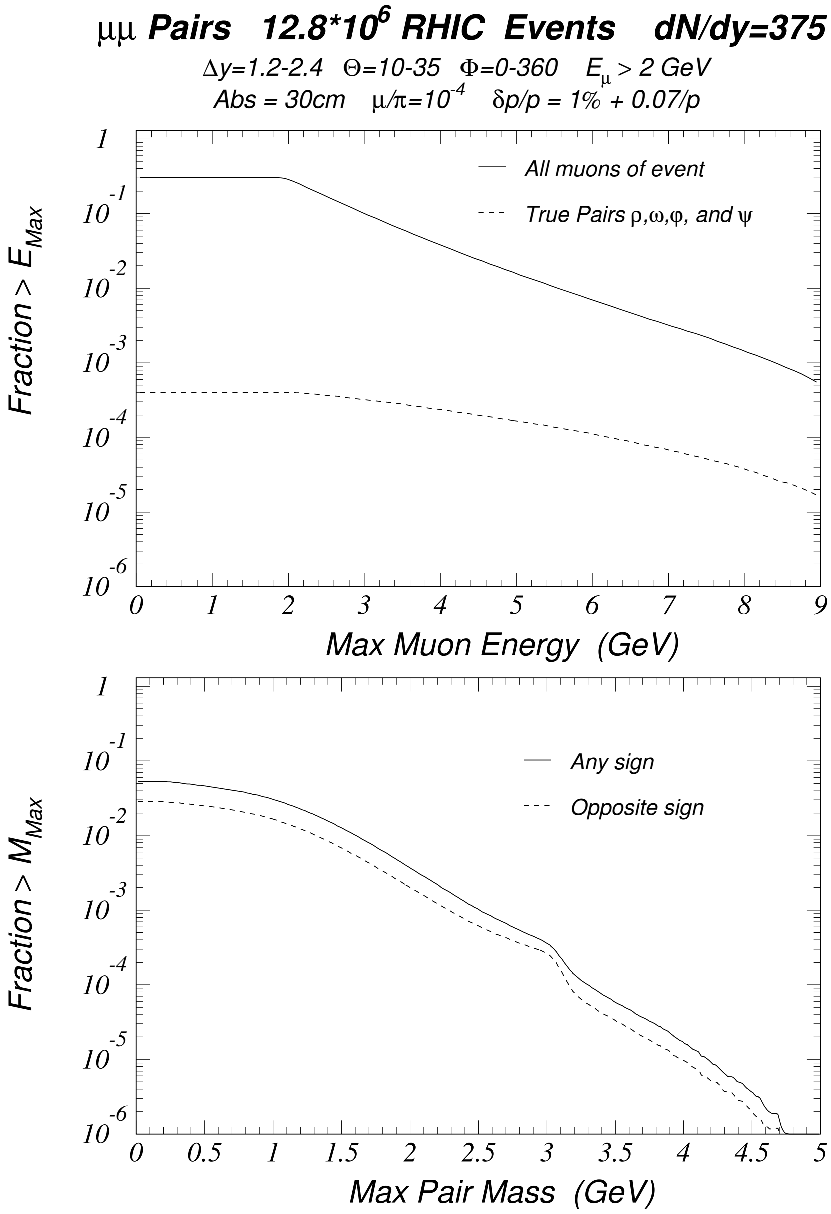

Figure 10.7: Possible muon trigger probabilities. Top: Fraction of Au + Au central events with at least one accepted muon above the abscissa energy for all muons (solid) and muons originating from vector meson decay (dashed). Bottom: Fraction of Au + Au central events with at least one accepted muon pair with an invariant mass above the abscissa mass.

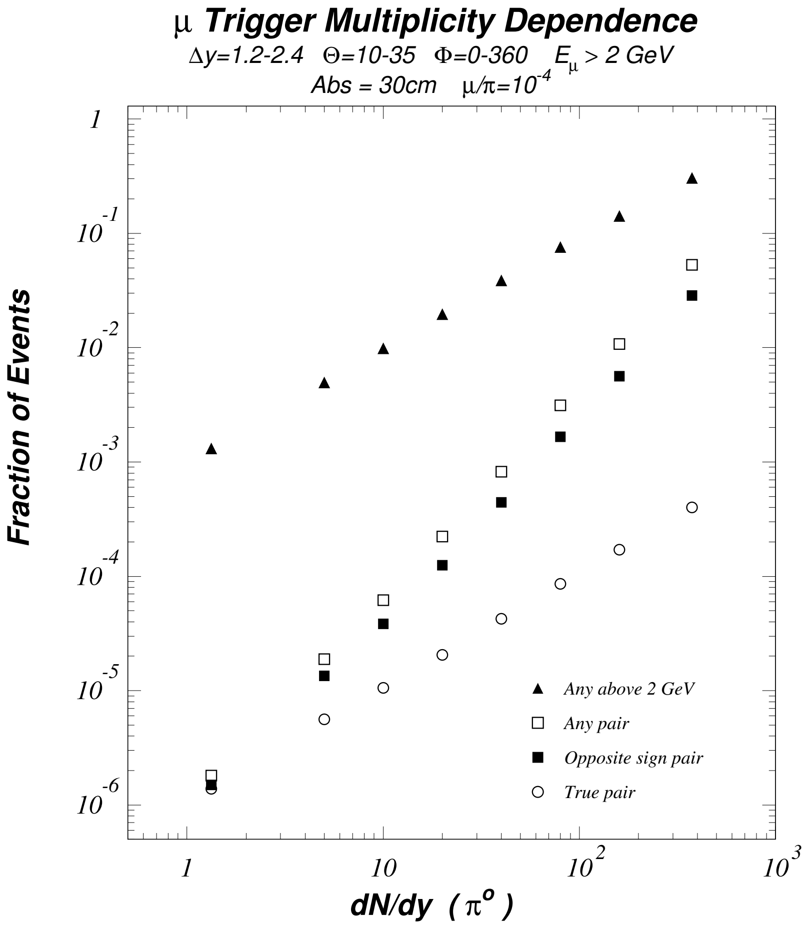

Figure 10.8: Muon trigger probabilities as a function of the neutral pion rapidity density.

subtraction of the combinatorial background below the resonances. It is noteworthy, that even though the ρ and ϕ resonances have substantial background their yield can nevertheless be estimated to better than 10%. This will make the muon detector the primary tool in PHENIX for studying the ρ. It should also be stressed, that since events which yield a muon pair in the muon acceptance constitute only approximately 6% of all central Au + Au collisions (see Fig. 10.7b or Fig. 10.8 for a multiplicity of 5000–7000 particles) the dimuon trigger rate will be sufficiently low, that all dimuon events can easily be recorded without downscaling.

For M_{inv} < 4 GeV/c^2 the continuous background from D$\bar{\mathrm{D}}$ decay is larger than the Drell-Yan background and poses a serious problem. As described in Section 10.4.5, we expect to evaluate the magnitude of this background from measurements of electron-muon coincidences.