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SSC-SDE
SOLENOIDAL DETECTOR NOTES

SSC MUON ACCEPTANCE STUDIES
November 15, 1989

Steve Errede

SSC MUON ACCEPTANCE STUDIES

Steve Errede
The University of Illinois
Urbana-Champaign
November 15, 1989

A series of η and P_T acceptance studies of the SSC Large Solenoid Detector Muon SubSystem were carried out using the latest version of the ISAJET (V6.24) Monte Carlo event generator. 1000 events (each) of the following reactions were generated:

$$Z^o \rightarrow \mu^+\mu^-,\ M_{Z^o} = 91.1\, GeV/c^2$$
$$Z' \rightarrow \mu^+\mu^-,\ M_{Z'} = 200\, GeV/c^2$$
$$Z' \rightarrow \mu^+\mu^-,\ M_{Z'} = 500\, GeV/c^2$$
$$Higgs \rightarrow Z^o\, Z^o \rightarrow 2(\mu^+\mu^-),\ M_{H^o} = 400\, GeV/c^2$$
$$Higgs \rightarrow Z^o\, Z^o \rightarrow 2(\mu^+\mu^-),\ M_{H^o} = 800\, GeV/c^2$$

It was *not* the intention of this initial study to be all-encompassing, but merely to gain a better understanding of the impact of geometrical acceptance requirement(s) for various interesting physics processes, and to also gain a better understanding of the P_T dependence of the acceptance, from the standpoint of view of triggering on muons, most likely in the $20 \leq P_T \leq 50\, GeV/c$ region, for various possible hardware trigger P_T thresholds.

The following sets of 6 plots show the % acceptance for the muons from each of these reactions. The muons in each event were initially required to pass an η cut of: no η cut, $|\eta_\mu| \leq 3.5$, or $|\eta_\mu| \leq 1.5$. A P_T cut on the remaining events was then imposed. The acceptance was calculated as the fraction of the events with muons first passing the η cut, then the P_T cut.

Additional studies of muon acceptance associated with these (and other reactions) will be made in the near future, reversing the order of these two cuts; requiring e.g. N out of M muons within the η cut; including momentum resolution smearing effects; trigger efficiency studies, etc.

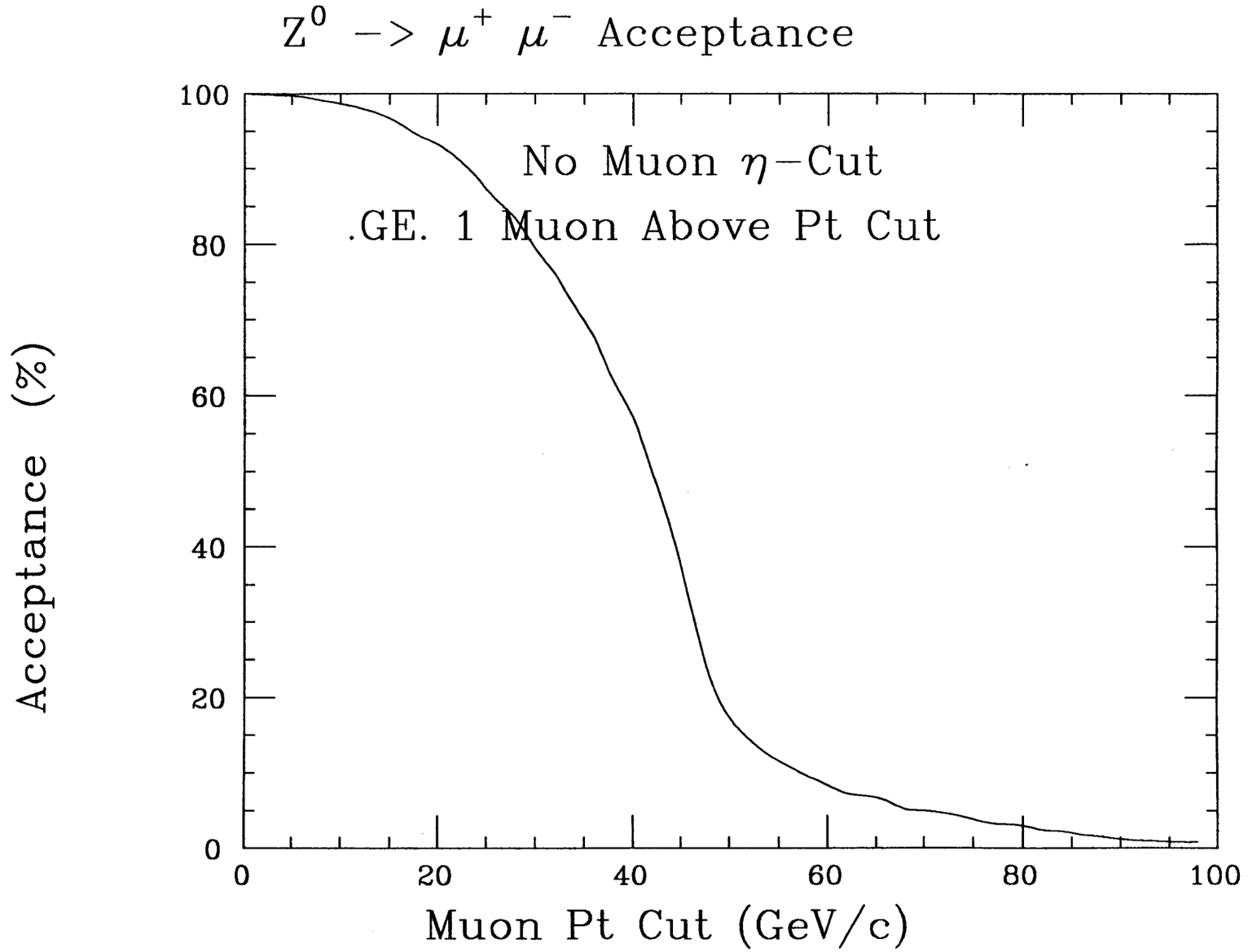
From the first set of 6 plots, the Z^o acceptance for $|\eta| \leq 3.5$ is $\sim 60\%$ if both muons are required to have $P_T \geq 20\,GeV/c$. Requiring both muons to be in the central ($|\eta| \leq 1.5$) region and above this P_T threshold drops the acceptance to $\sim 20\%$. The acceptance in P_T also rolls off fairly sharply above 20 GeV/c.

From the second set of 6 plots, the acceptance for a $200\,GeV/c^2$ $Z' \rightarrow \mu^+\mu^-$ and with muon $|\eta| \leq 3.5$ is $\sim 70\%$ if both muons are required to have $P_T \geq 20\,GeV/c$. Requiring both muons to be in the central ($|\eta| \leq 1.5$) region and above this P_T threshold again drops the acceptance to $\sim 20\%$. The acceptance in P_T is reasonably flat out to $\sim 60\,GeV/c$.

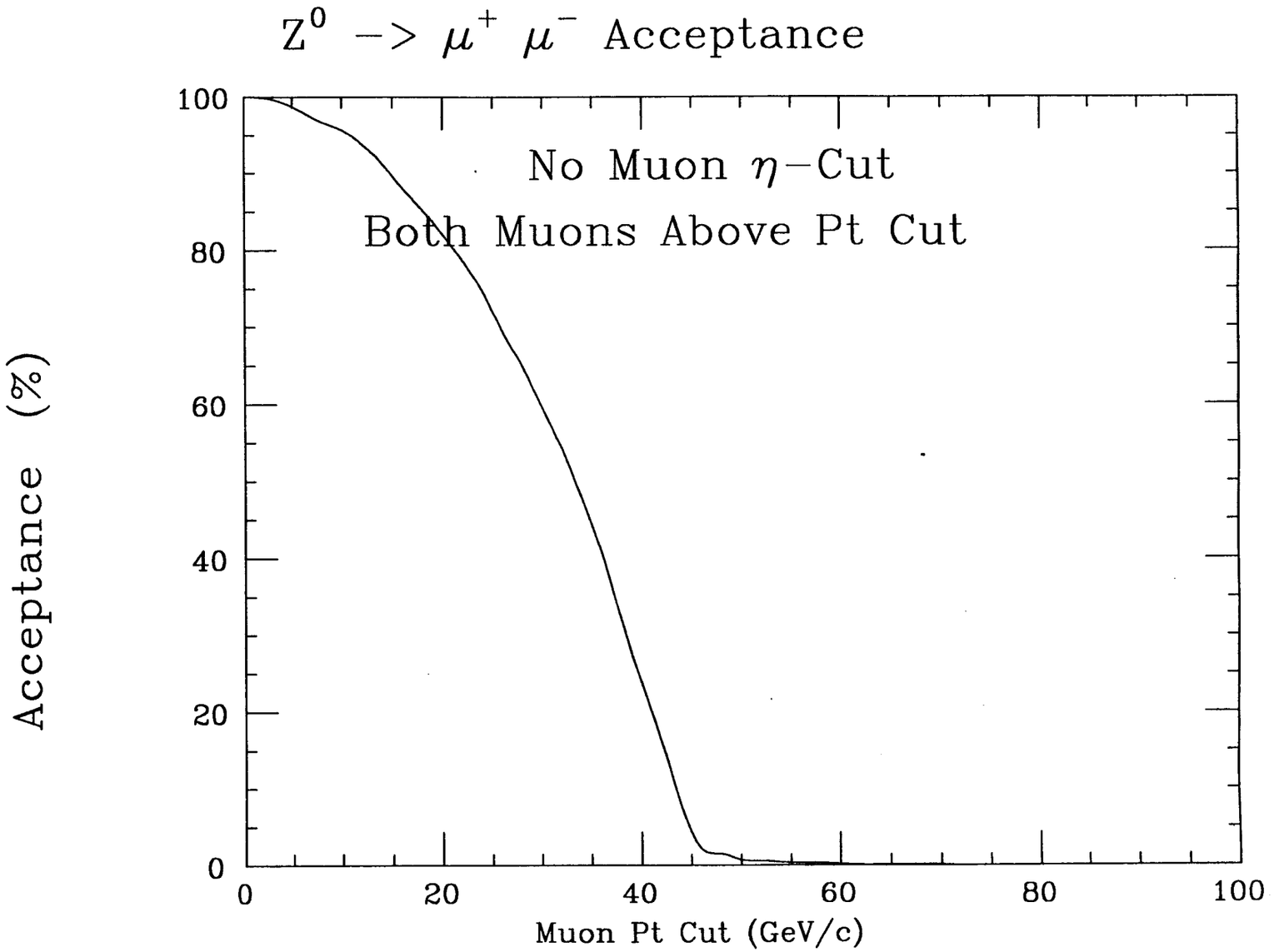
From the third set of 6 plots, the acceptance for a $500 GeV/c^2$ $Z' \rightarrow \mu^+\mu^-$ and with muon $|\eta| \leq 3.5$ is $\sim 85\%$ if both muons are required to have $P_T \geq 20 GeV/c$. Requiring both muons to be in the central ($|\eta| \leq 1.5$) region and above this P_T threshold again drops the acceptance to $\sim 30\%$. The acceptance in P_T is flat out to beyond $\sim 100\,GeV/c$.

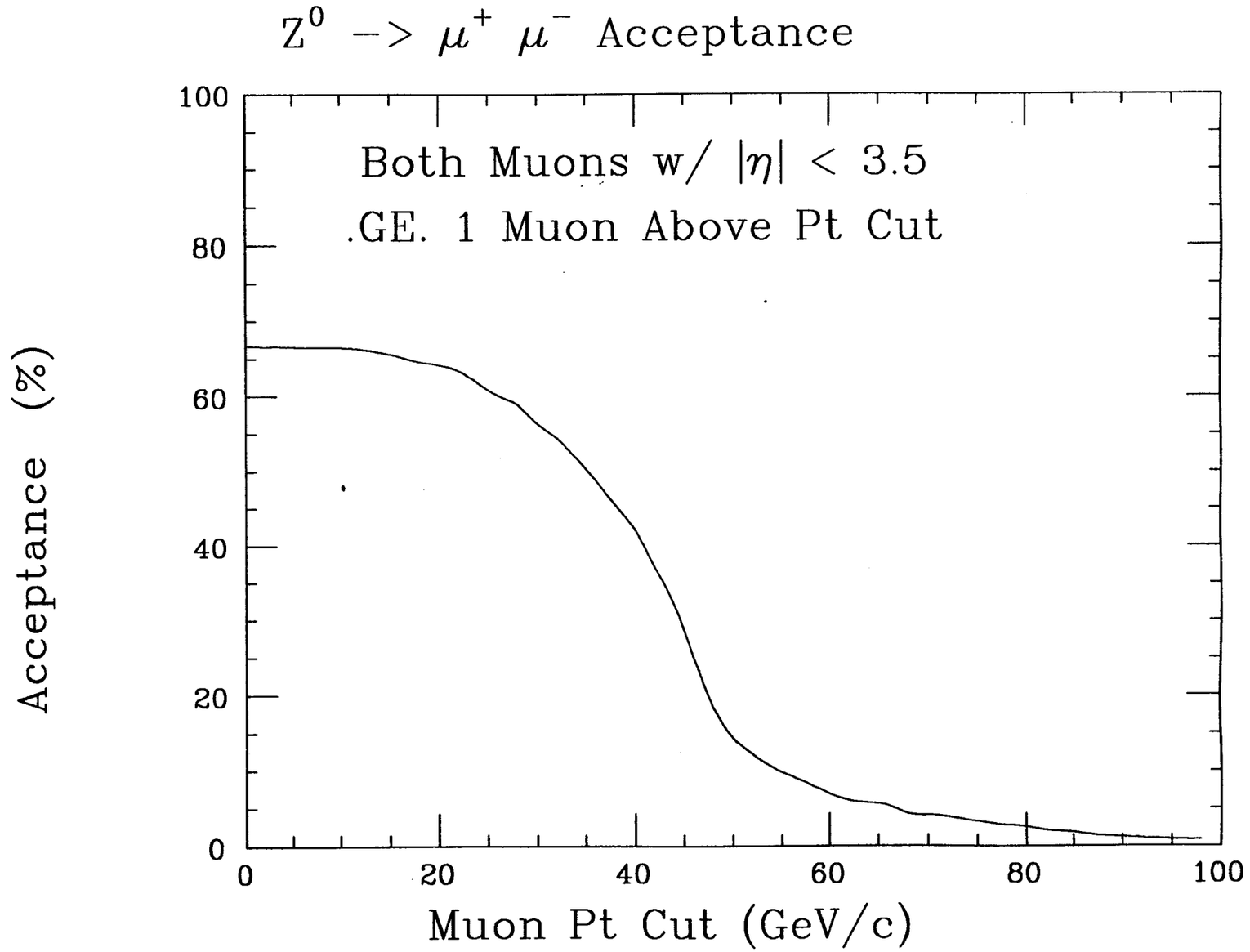
From the fourth set of 6 plots, the acceptance for a $400\,GeV/c^2$ $Higgs \rightarrow Z^oZ^o \rightarrow 4\,\mu's$ and with two or more muons with $|\eta| \leq 3.5$ is nearly $\sim 100\%$ if two or more muons from Higgs decay are required to have $P_T \geq 20\,GeV/c$. Requiring two or more muons to be in the central ($|\eta| \leq 1.5$) region and with two or more muons above this same P_T threshold decreases the acceptance to $\sim 75\%$. The acceptance in P_T is reasonably flat out to $\sim 40\,GeV/c$.

From the last set of 6 plots, the acceptance for a $800\,GeV/c^2$ $Higgs \rightarrow Z^oZ^o \rightarrow 4\,\mu's$ and with two or more muons with $|\eta| \leq 3.5$ is again very nearly $\sim 100\%$ if two or more muons from Higgs decay are required to have $P_T \geq 20 GeV/c$. Requiring two or more muons to be in the central ($|\eta| \leq 1.5$) region and with two or more muons above this same P_T threshold decreases the acceptance to $\sim 85\%$. The acceptance in P_T is reasonably flat out to $\sim 60\,GeV/c$.

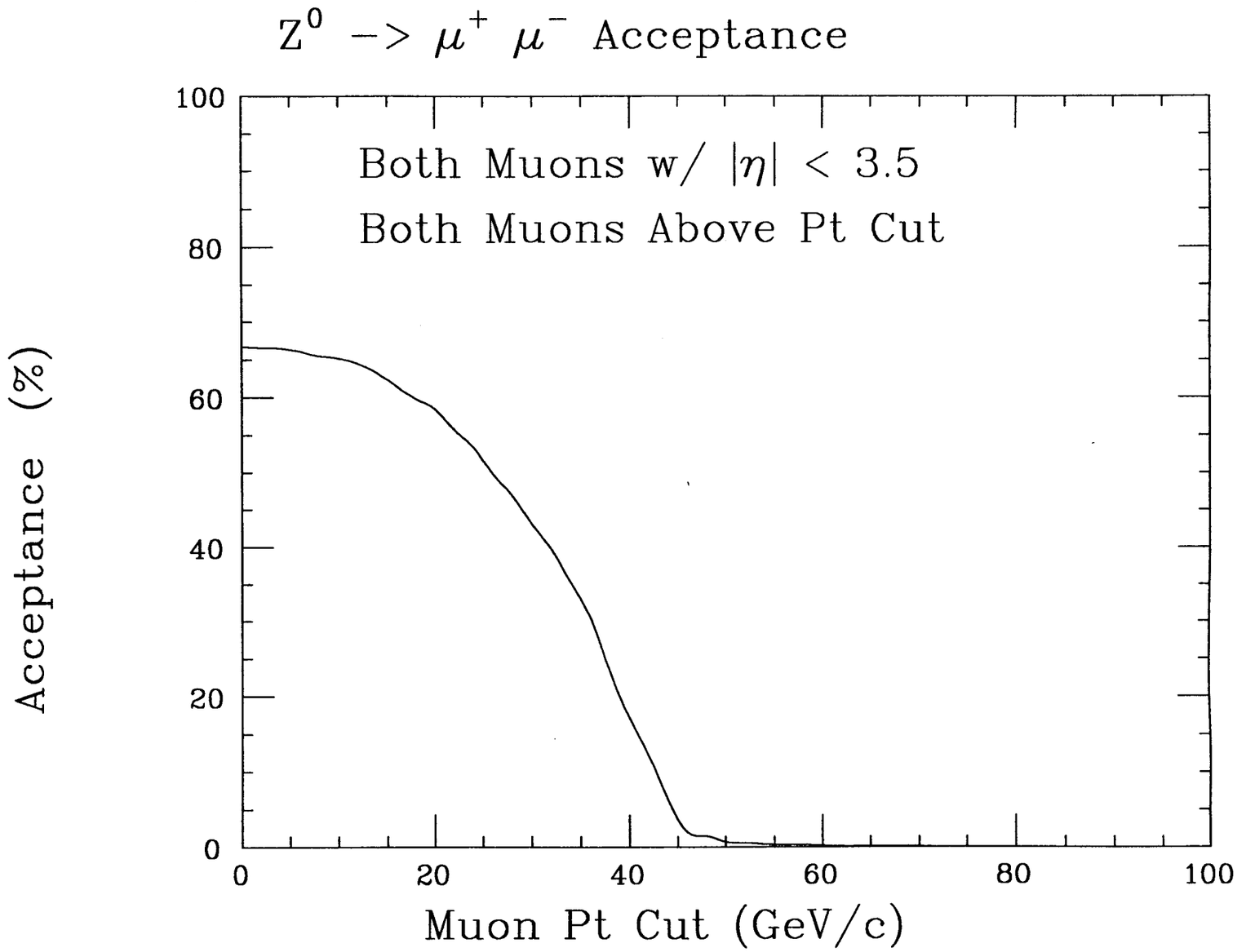

$Z^0 \to \mu^+ \mu^-$ Acceptance
No Muon η−Cut
.GE. 1 Muon Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
20
40
60
80
100

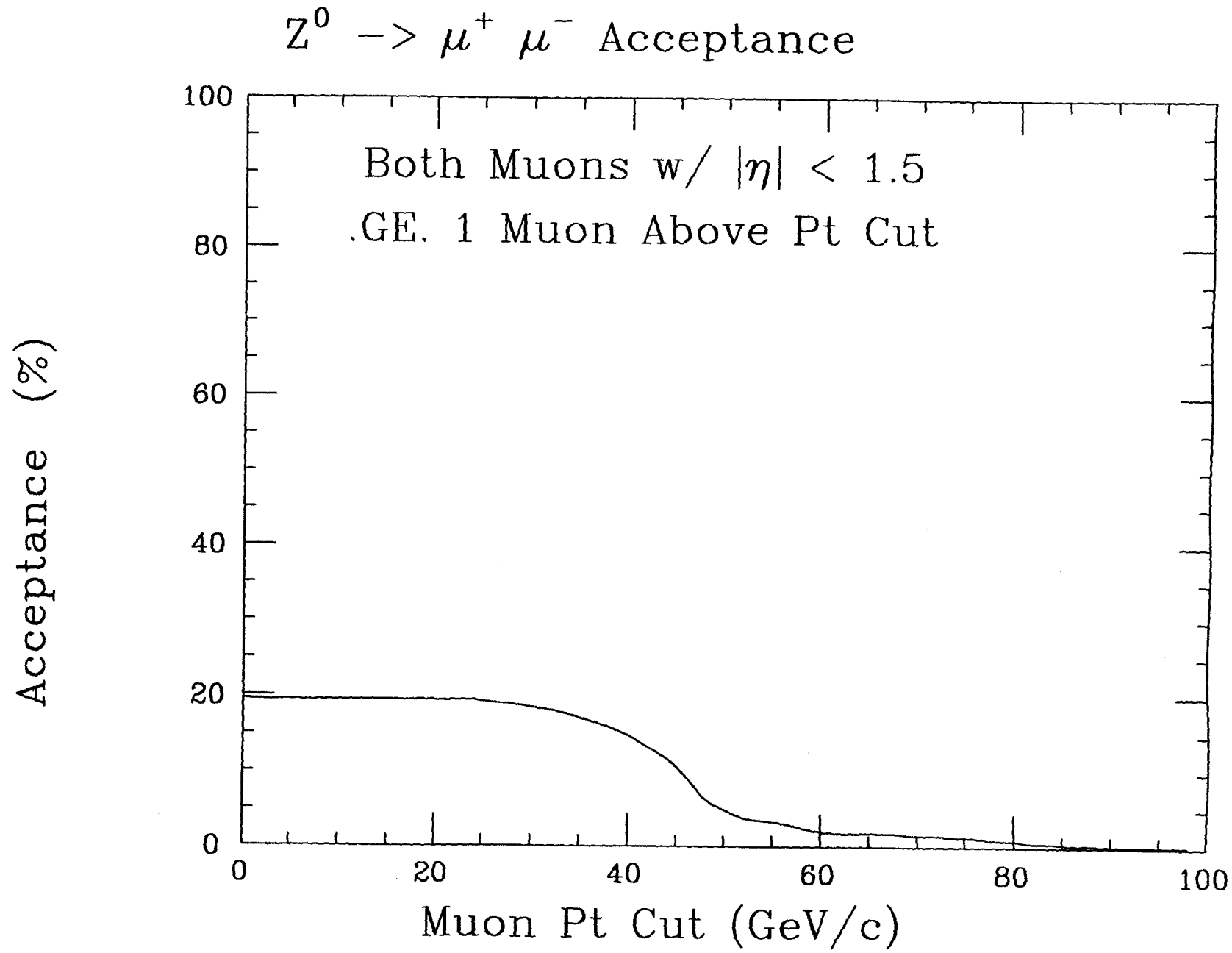
1a


$Z^0 \to \mu^+ \mu^-$ Acceptance
No Muon η−Cut
Both Muons Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
20
40
60
80
100

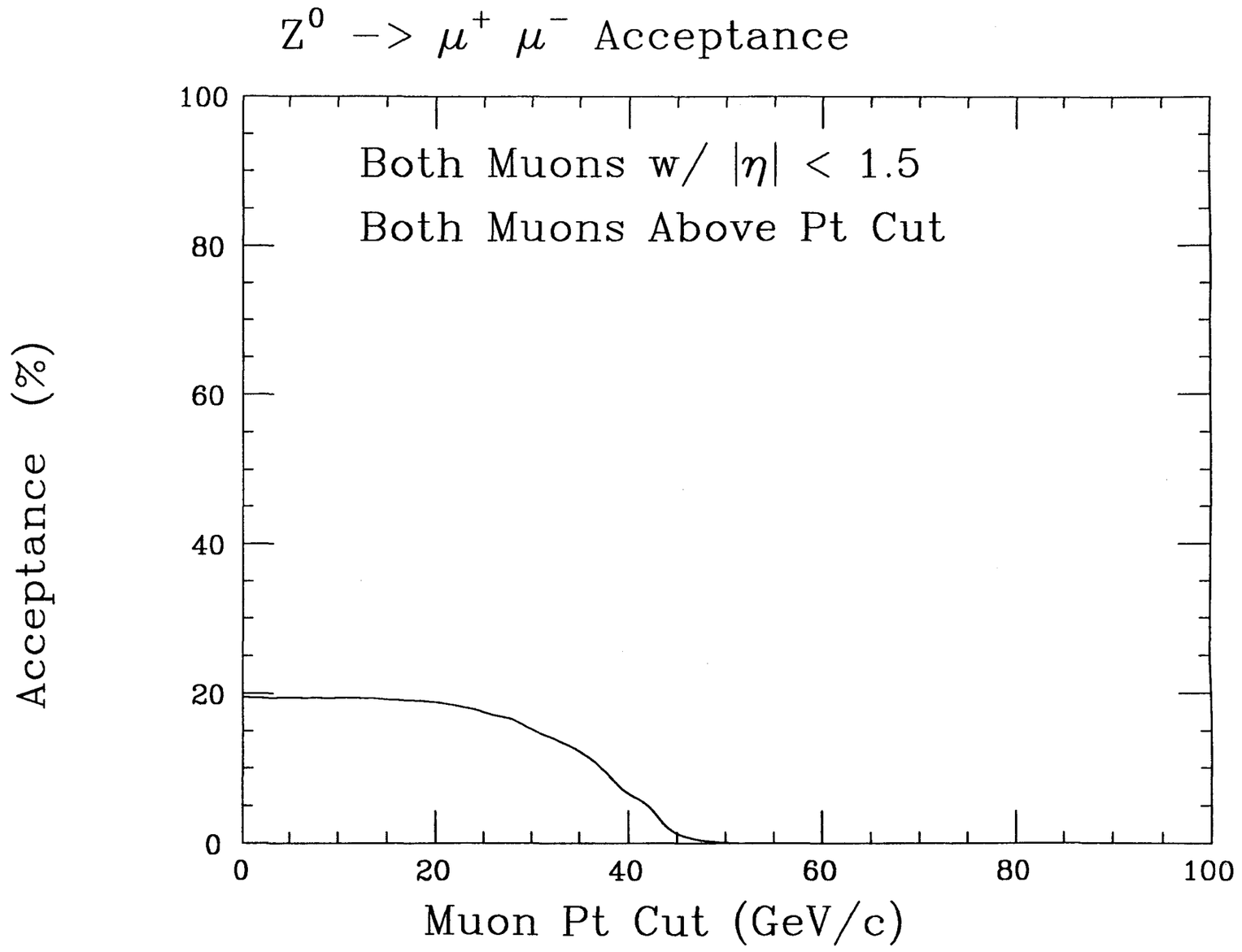

$Z^0 \to \mu^+ \mu^-$ Acceptance
Both Muons w/ $|\eta| < 3.5$
.GE. 1 Muon Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
20
40
60
80
100

1<

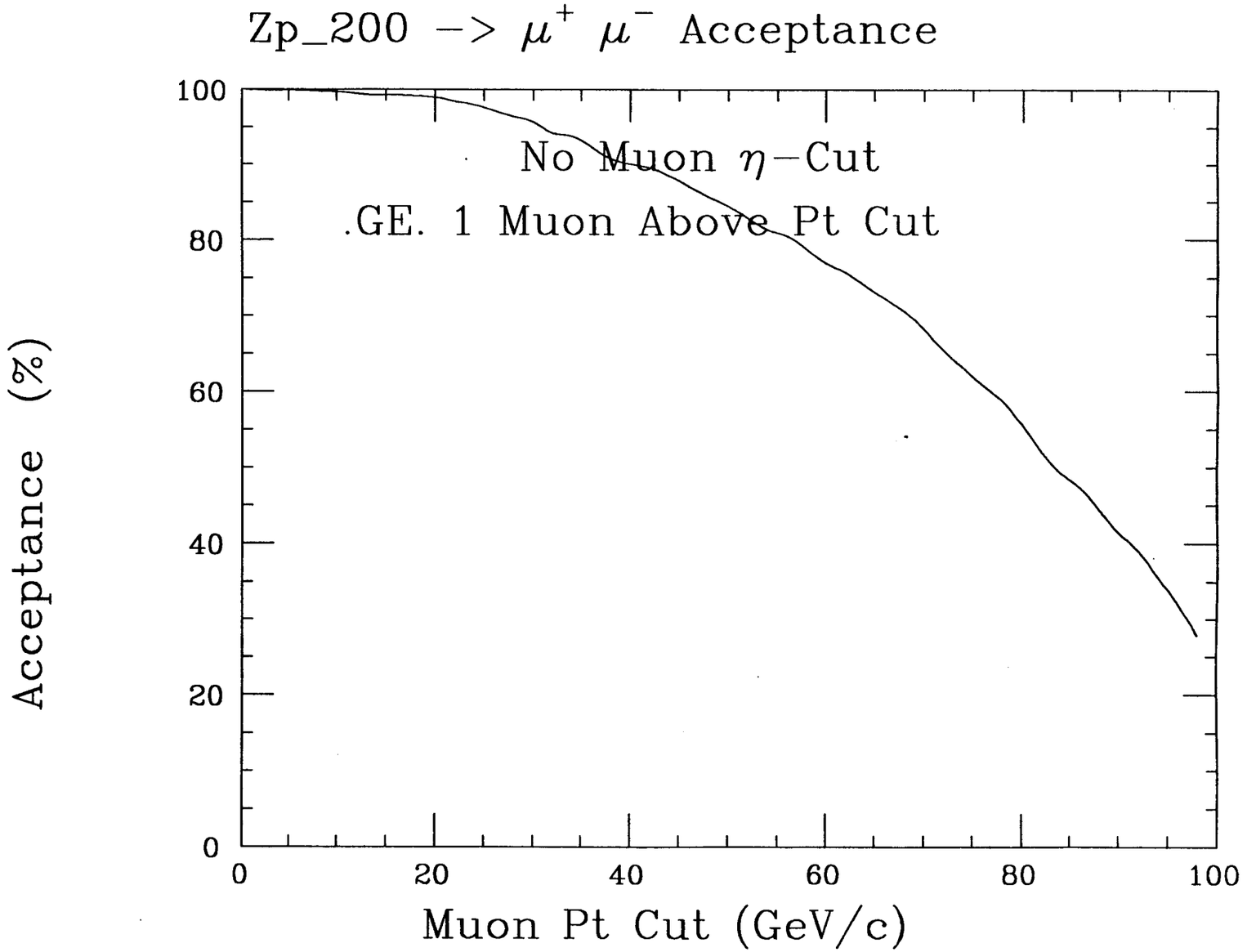

$Z^0 \to \mu^+ \mu^-$ Acceptance
Both Muons w/ $|\eta| < 3.5$
Both Muons Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
20
40
60
80
100


$Z^0 \to \mu^+ \mu^-$ Acceptance
Both Muons w/ $|\eta| < 1.5$
.GE. 1 Muon Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
20
40
60
80
100

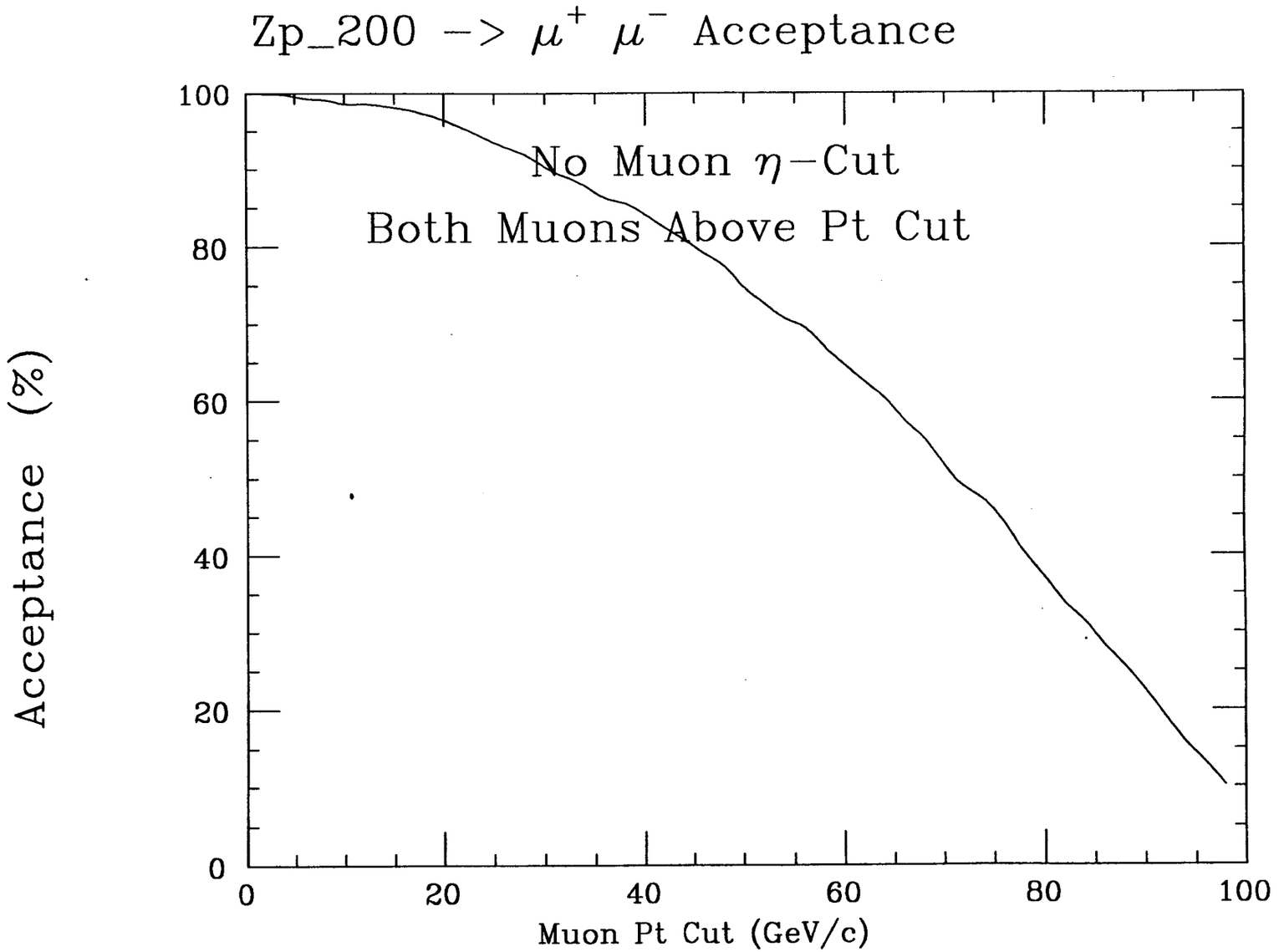
1e


$Z^0 \to \mu^+ \mu^-$ Acceptance
Both Muons w/ $|\eta| < 1.5$
Both Muons Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
20
40
60
80
100

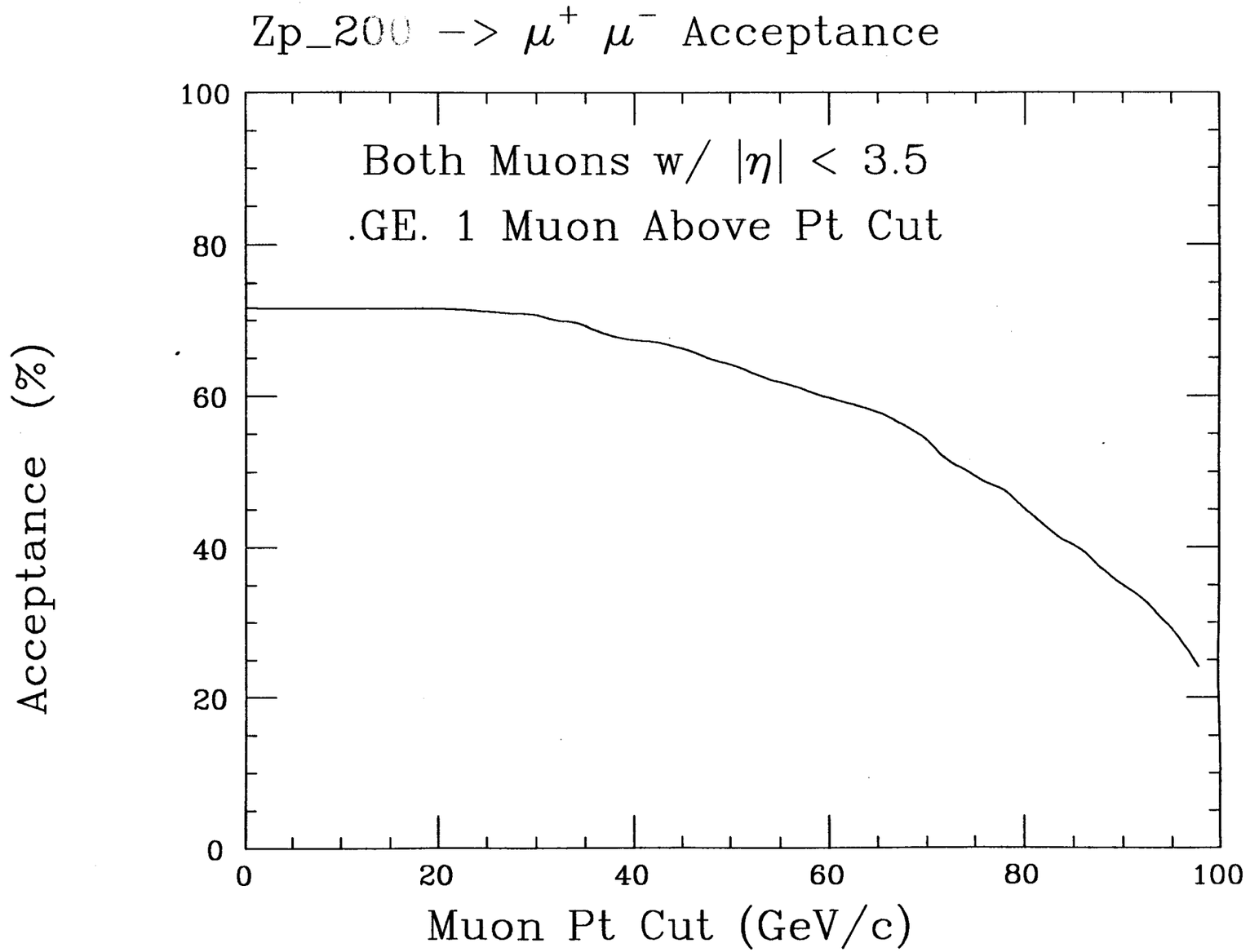
1F


Zp_200 -> $\mu^+ \mu^-$ Acceptance
No Muon η-Cut
.GE. 1 Muon Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
20
40
60
80
100

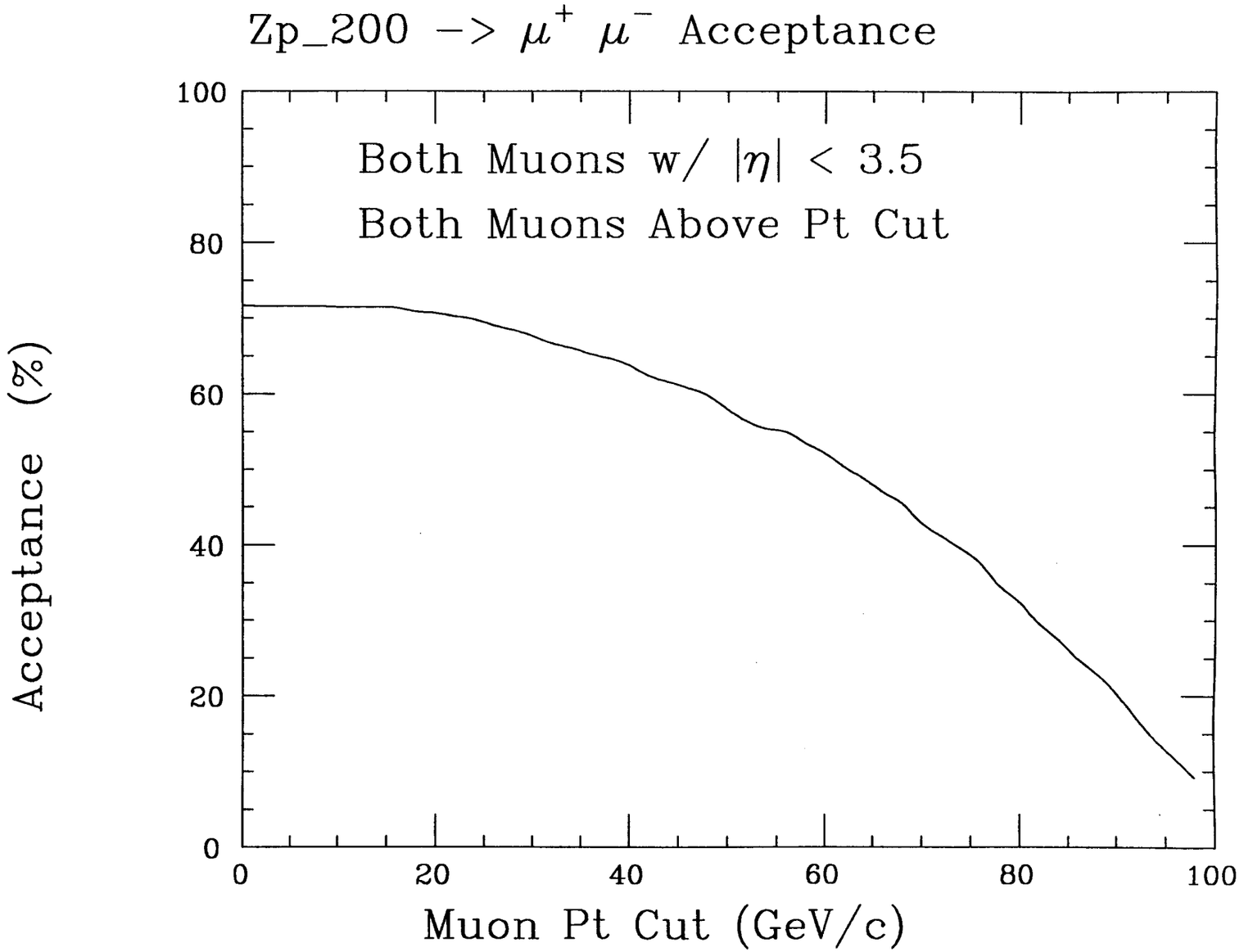
2a


Zp_200 -> $\mu^+ \mu^-$ Acceptance
No Muon η-Cut
Both Muons Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
20
40
60
80
100

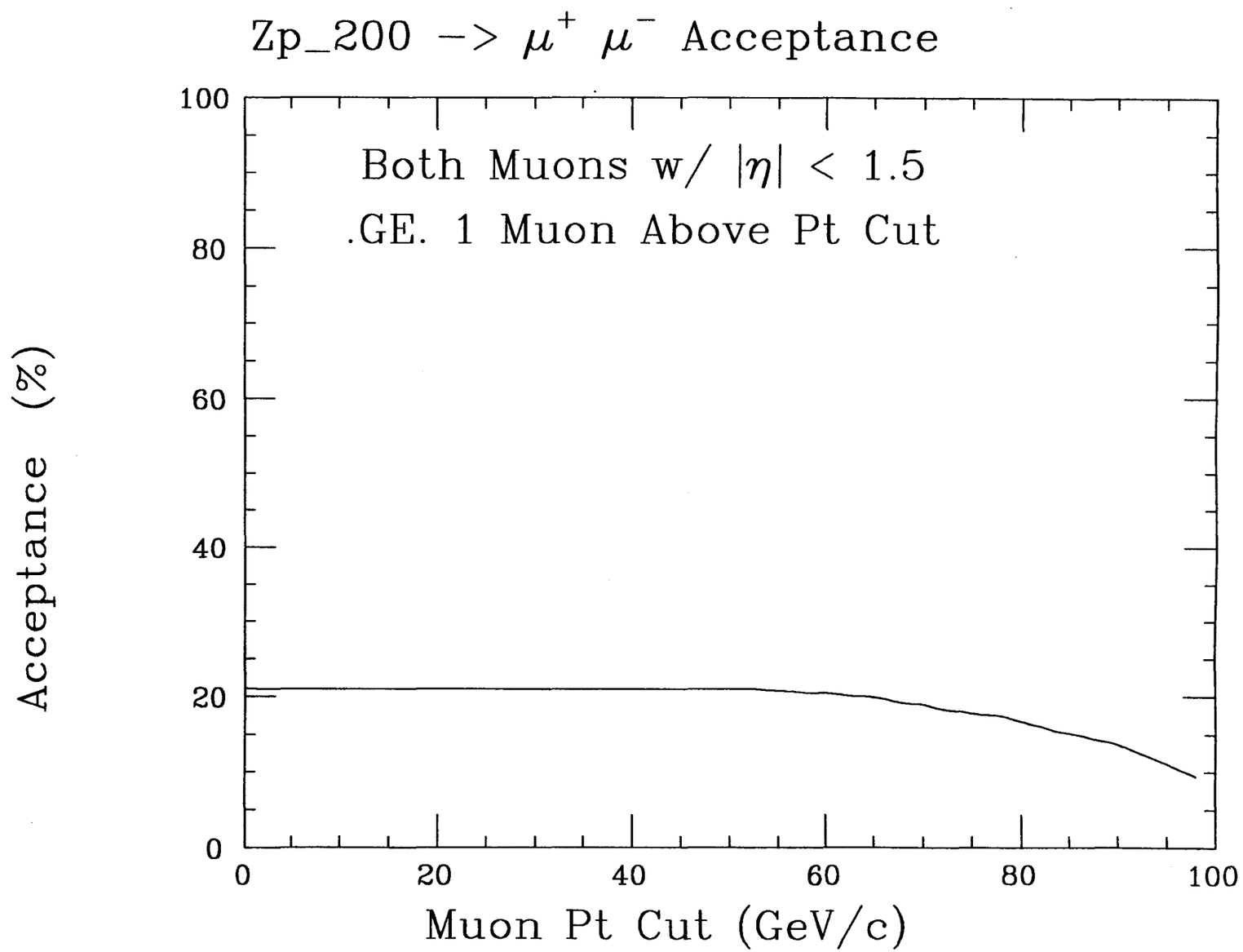
2b


Zp_200 -> $\mu^+ \mu^-$ Acceptance
Both Muons w/ $|\eta| < 3.5$
.GE. 1 Muon Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
20
40
60
80
100

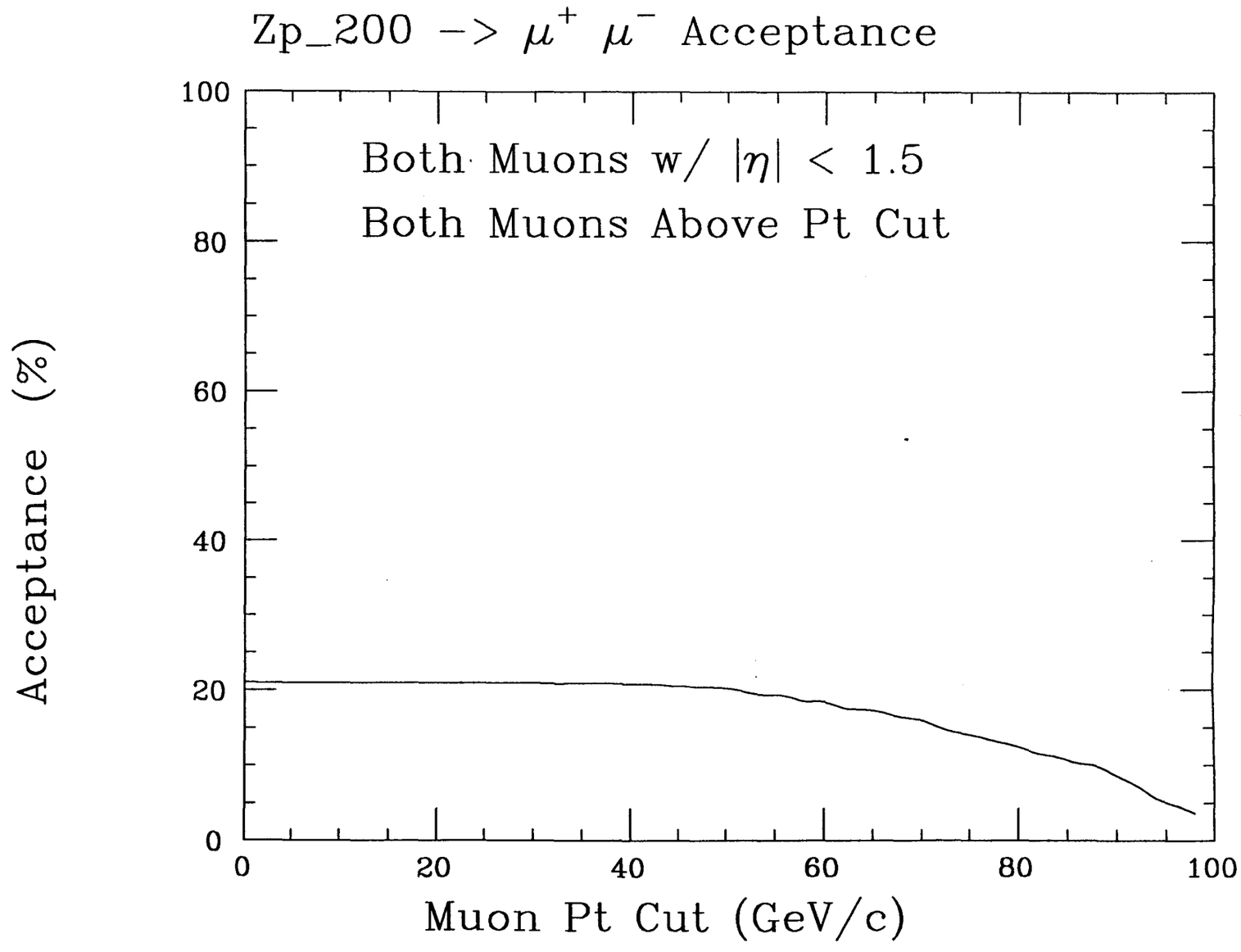
2c


Zp_200 -> $\mu^+ \mu^-$ Acceptance
Both Muons w/ $|\eta| < 3.5$
Both Muons Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
20
40
60
80
100

2d


Zp_200 -> $\mu^+ \mu^-$ Acceptance
Both Muons w/ $|\eta| < 1.5$
.GE. 1 Muon Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
20
40
60
80
100

2e


Zp_200 -> $\mu^+ \mu^-$ Acceptance
Both Muons w/ $|\eta| < 1.5$
Both Muons Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
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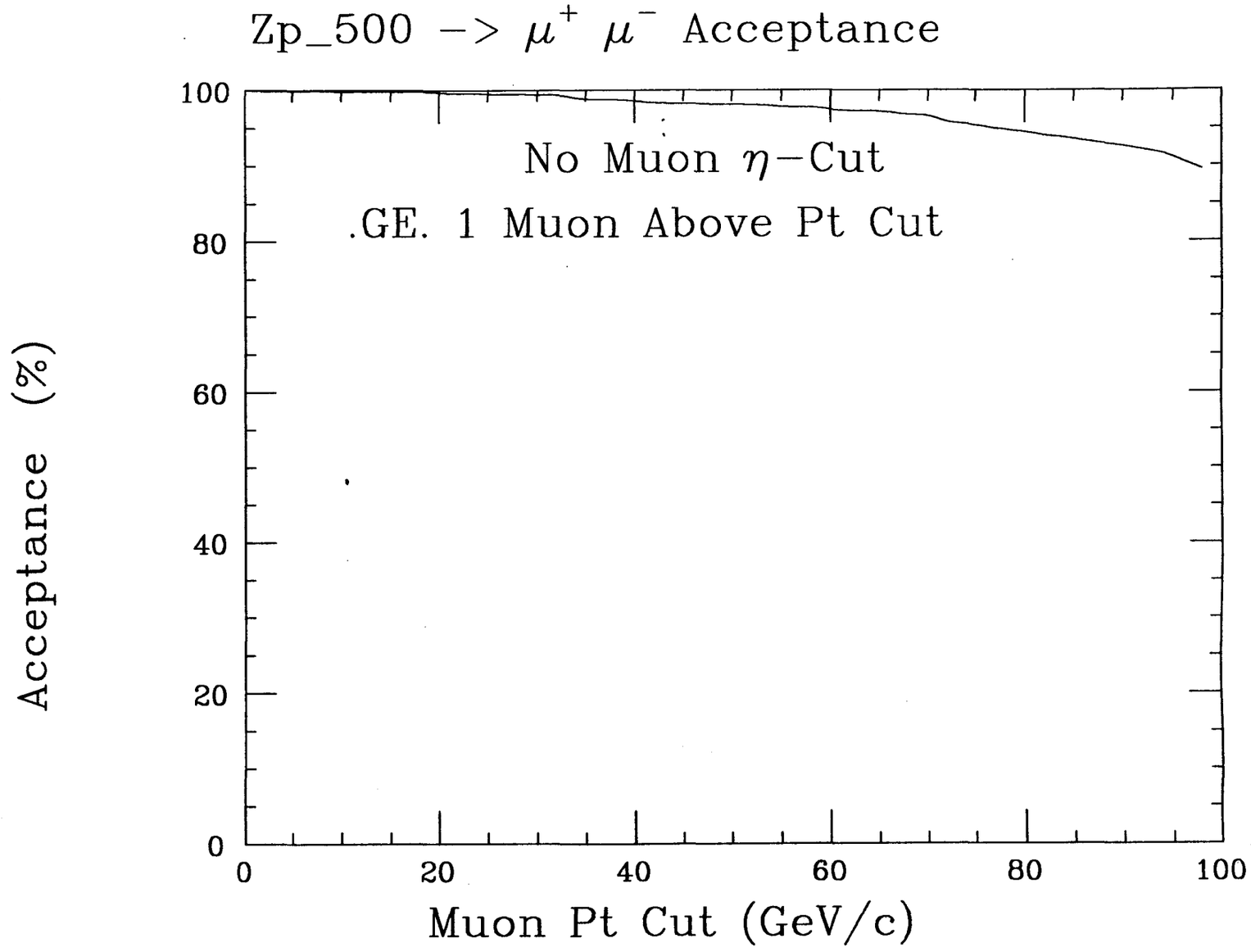
80
100

2F


Zp_500 -> $\mu^+ \mu^-$ Acceptance
No Muon η-Cut
.GE. 1 Muon Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
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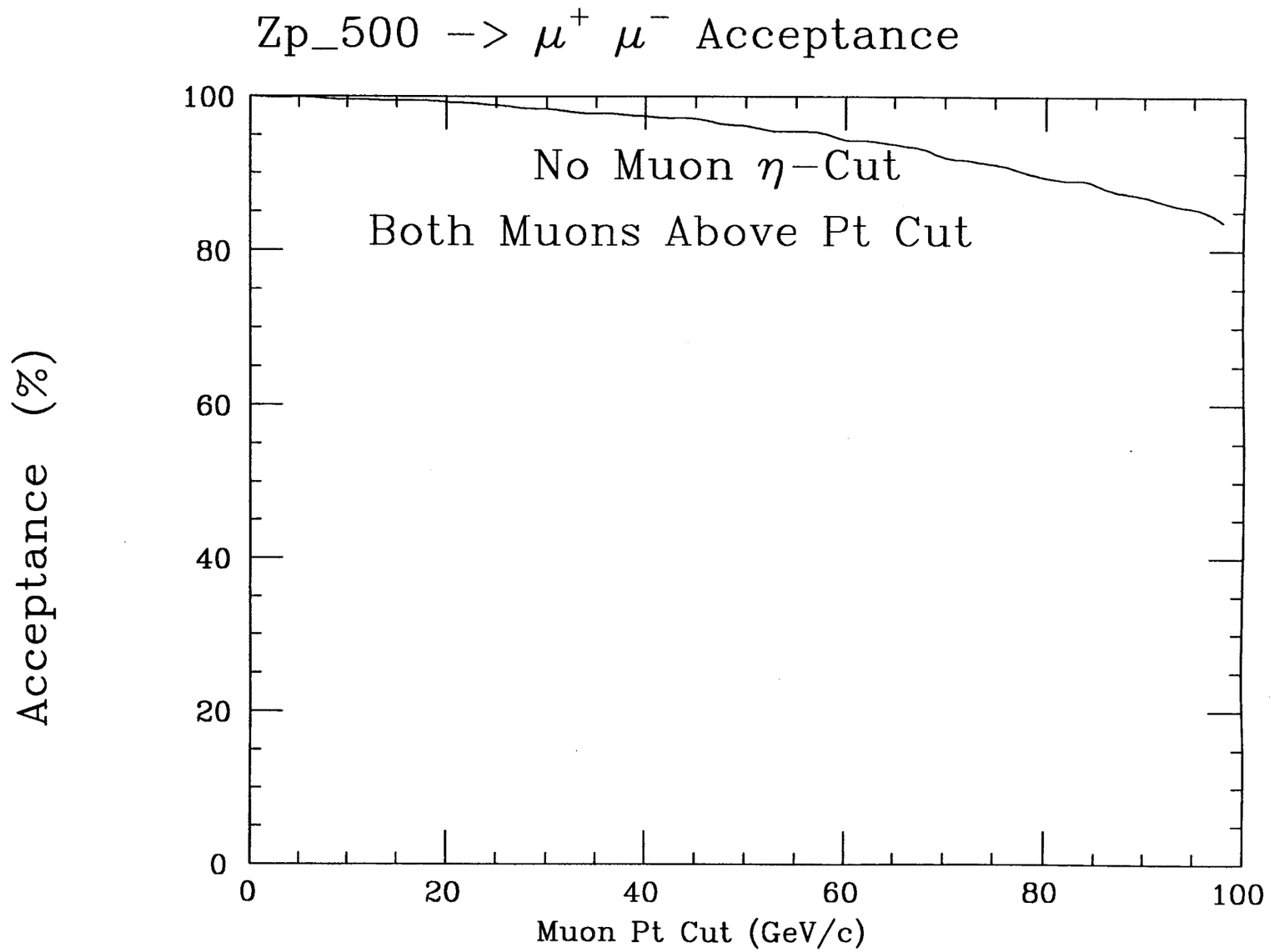
60
80
100

3a


Zp_500 -> $\mu^+ \mu^-$ Acceptance
No Muon η-Cut
Both Muons Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
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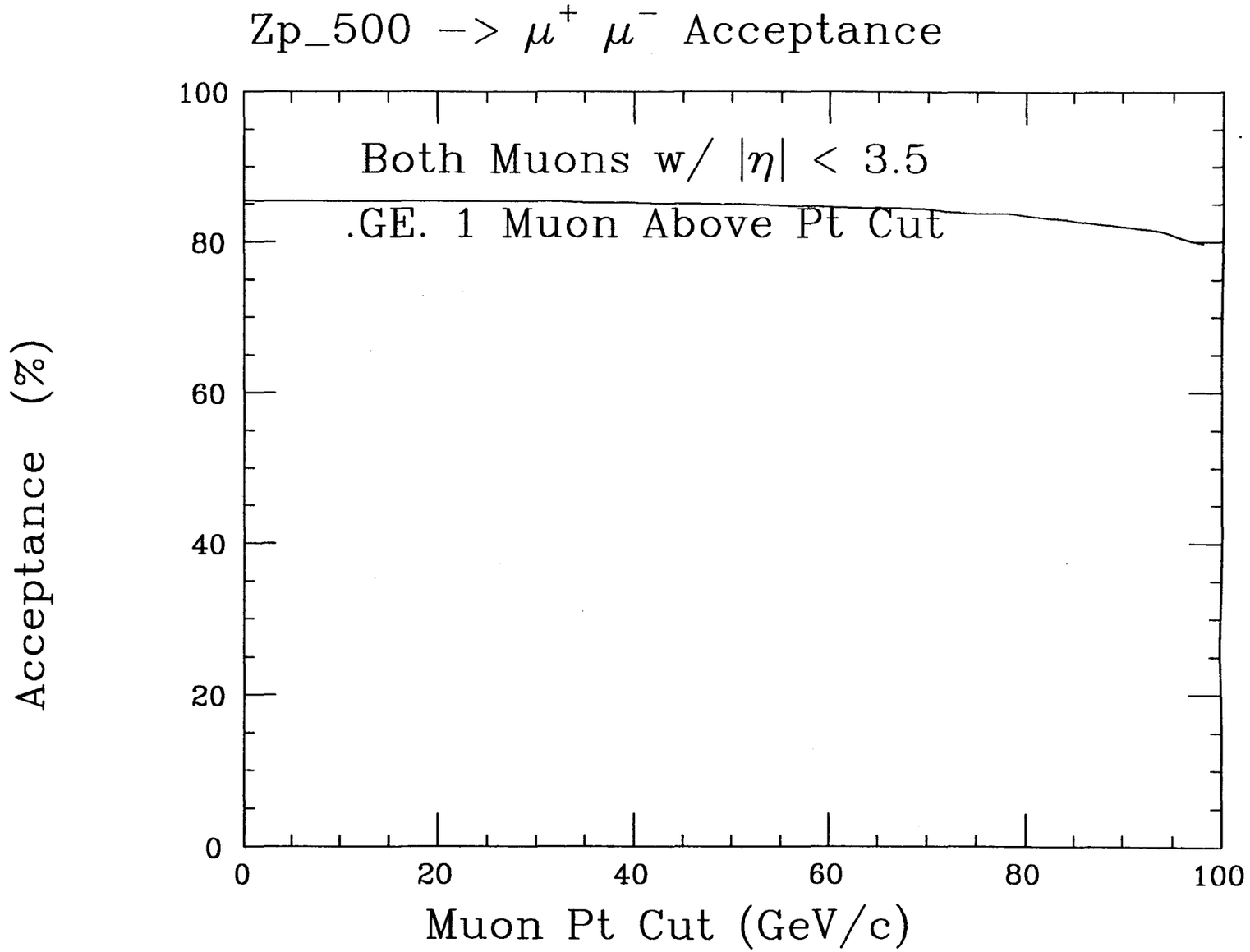
Zp_500 -> $\mu^+ \mu^-$ Acceptance
Both Muons w/ $|\eta| < 3.5$
.GE. 1 Muon Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
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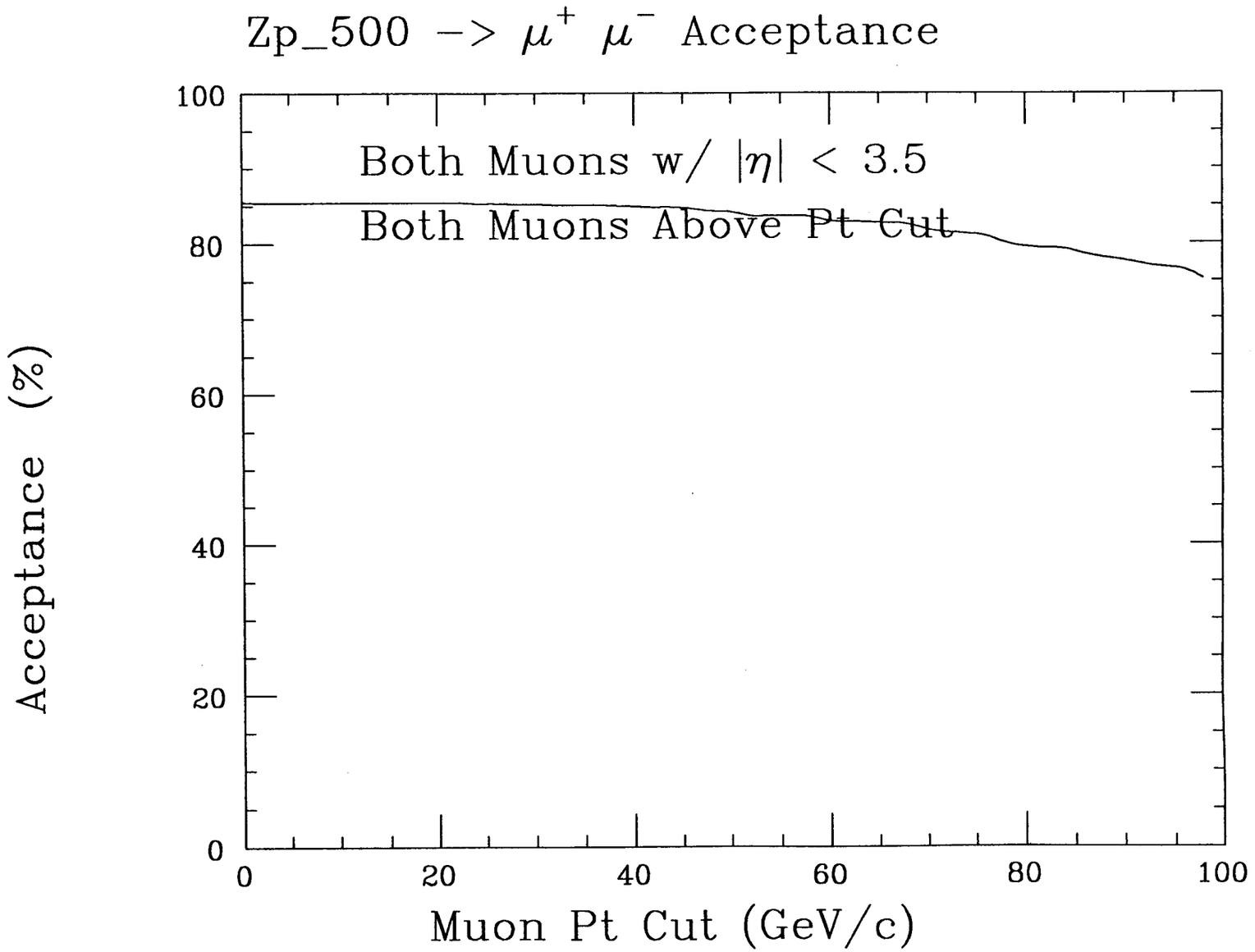
3c


Zp_500 -> $\mu^+ \mu^-$ Acceptance
Both Muons w/ $|\eta| < 3.5$
Both Muons Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
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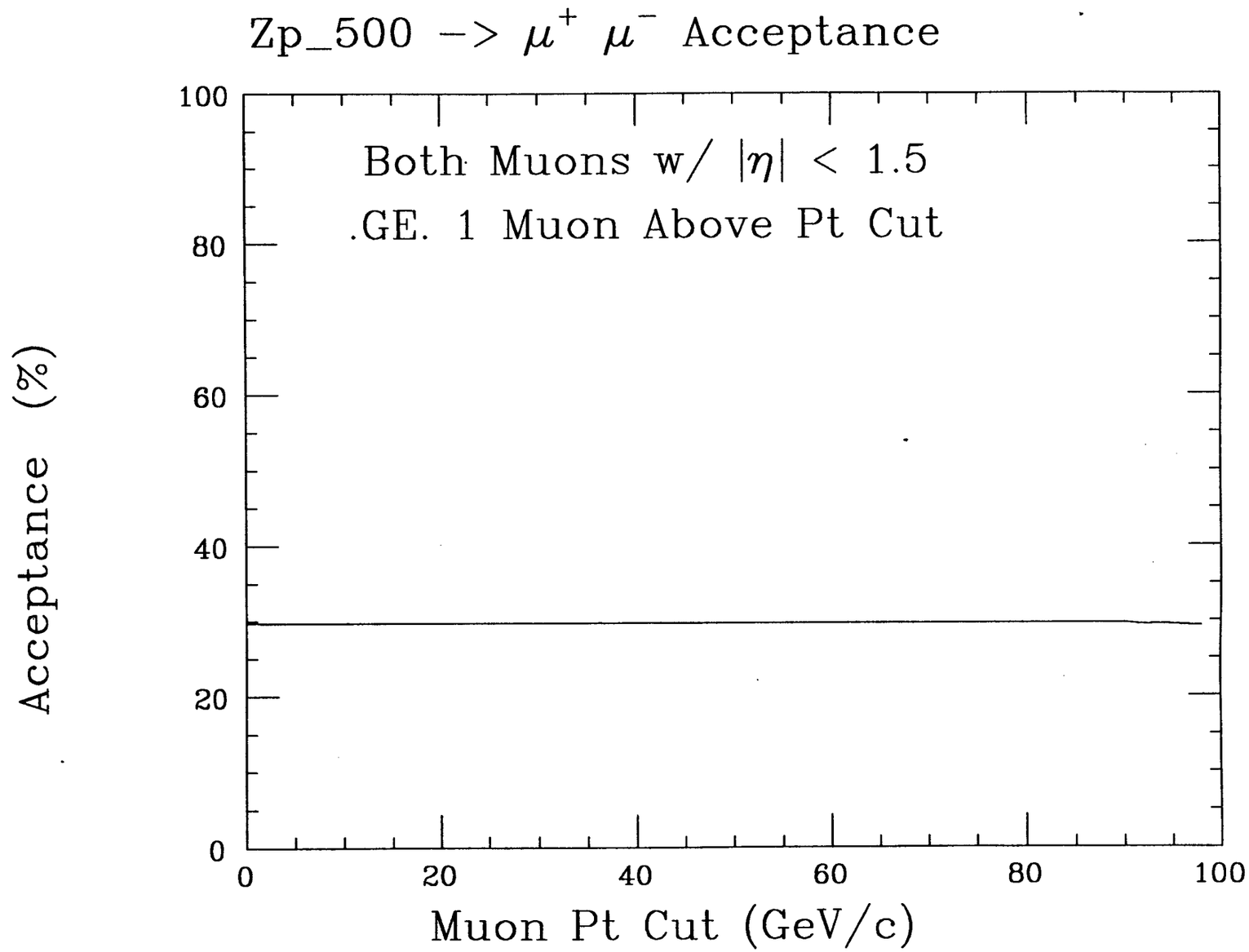
3


Zp_500 -> $\mu^+ \mu^-$ Acceptance
Both Muons w/ $|\eta| < 1.5$
.GE. 1 Muon Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
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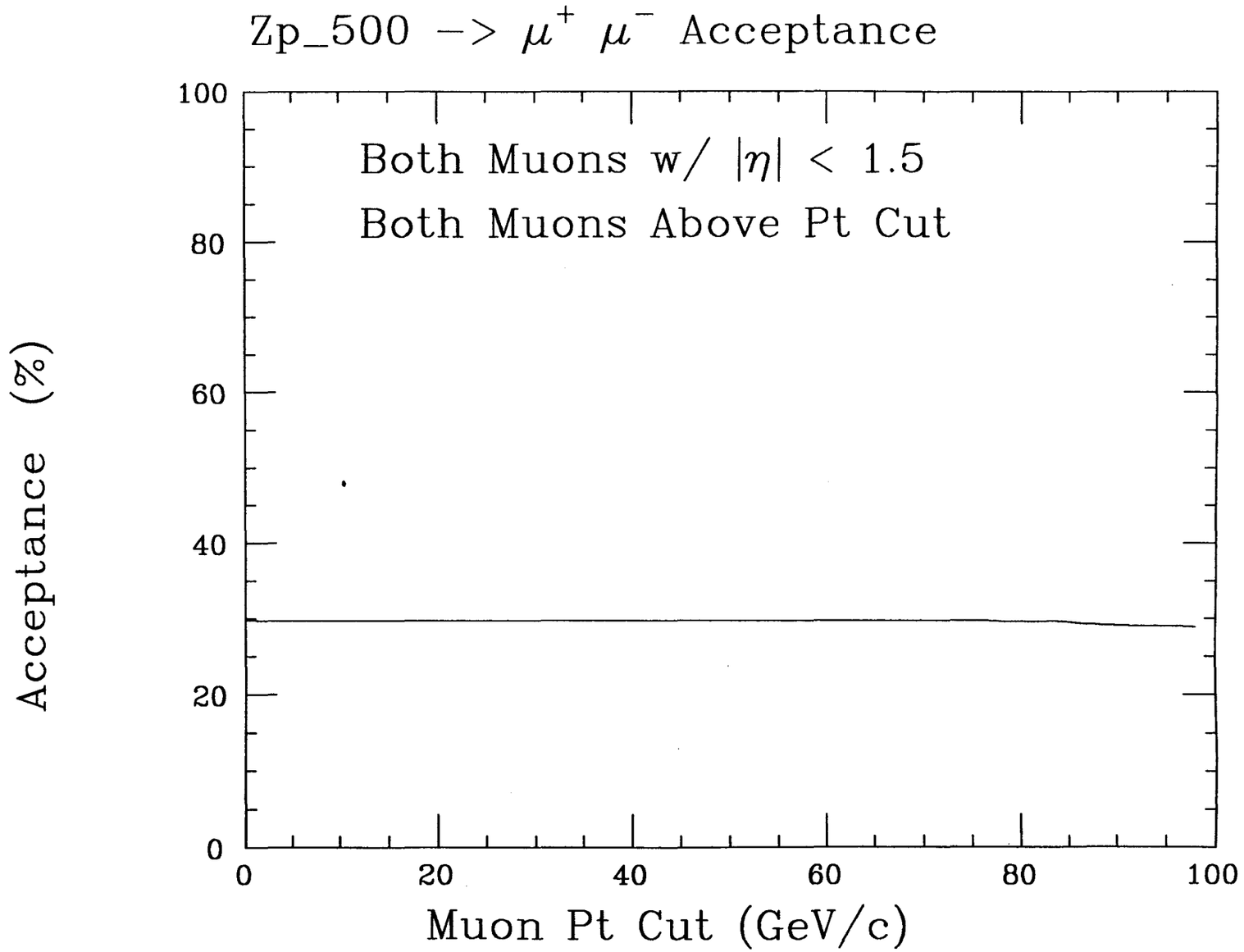
100

3e


Zp_500 -> $\mu^+ \mu^-$ Acceptance
Both Muons w/ $|\eta| < 1.5$
Both Muons Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
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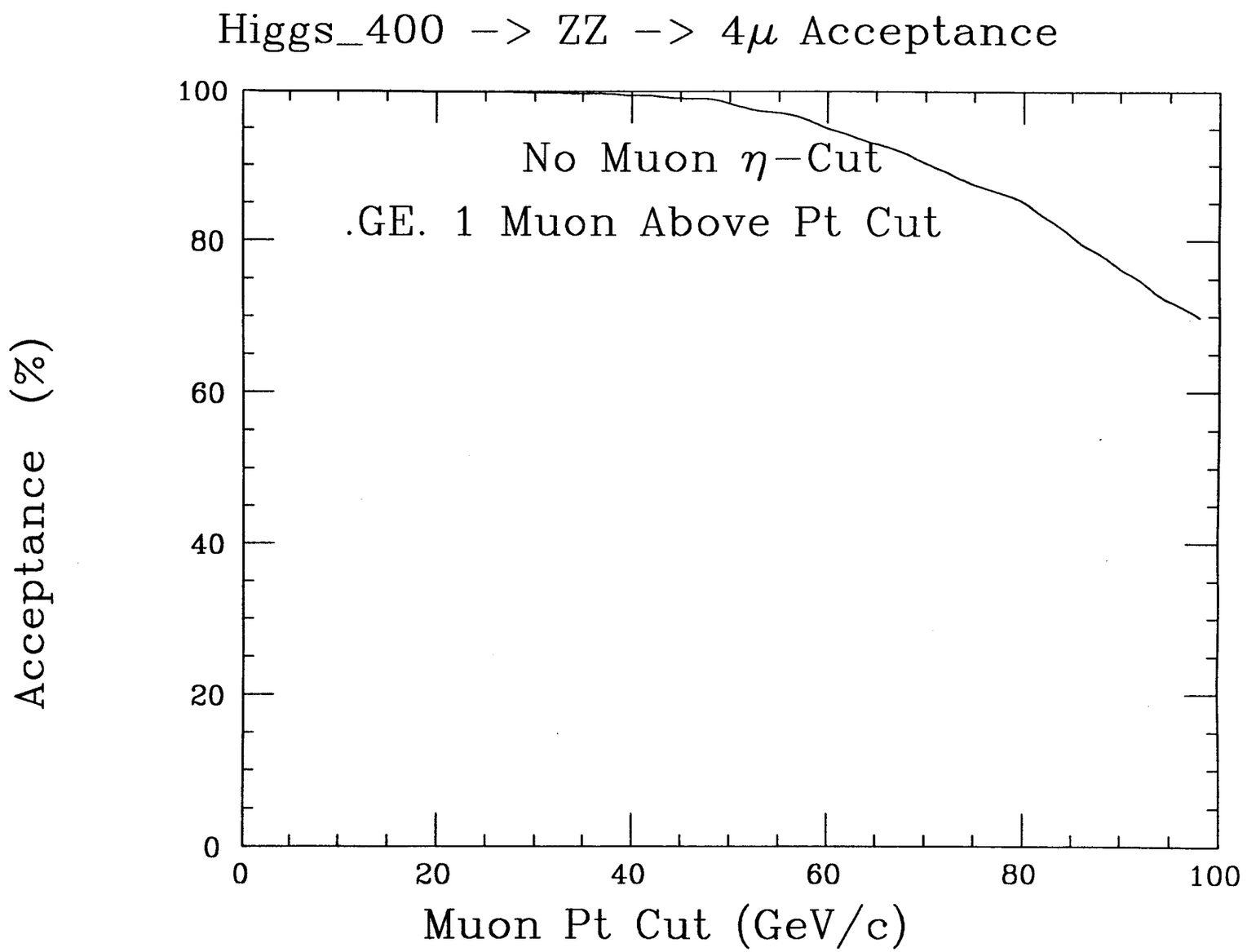
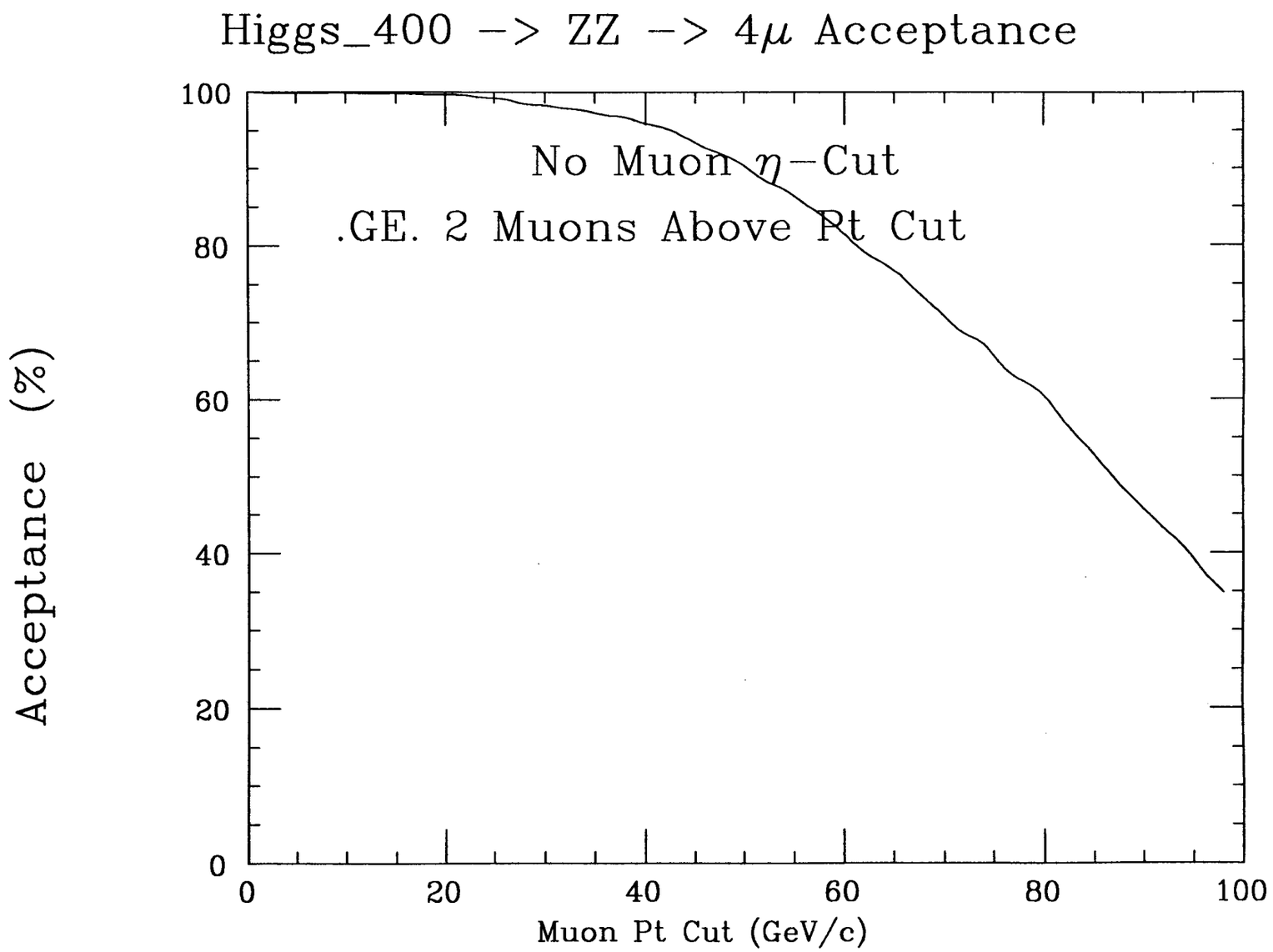
3.


Higgs_400 -> ZZ -> 4μ Acceptance
No Muon η−Cut
.GE. 1 Muon Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
20
40
60
80
100

4a


Higgs_400 -> ZZ -> 4μ Acceptance
No Muon η−Cut
.GE. 2 Muons Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
20
40
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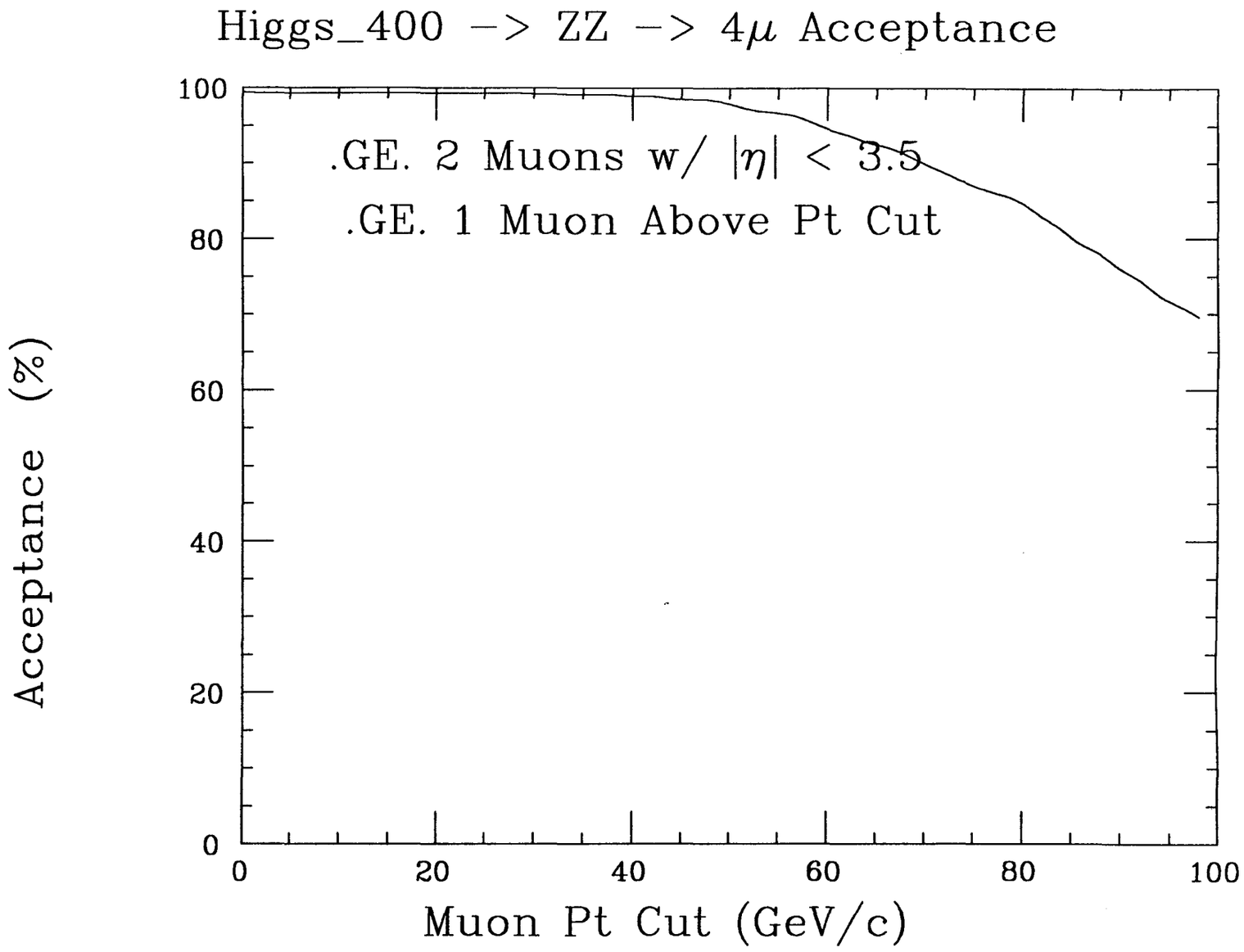
80
100

4t)


Higgs_400 -> ZZ -> 4μ Acceptance
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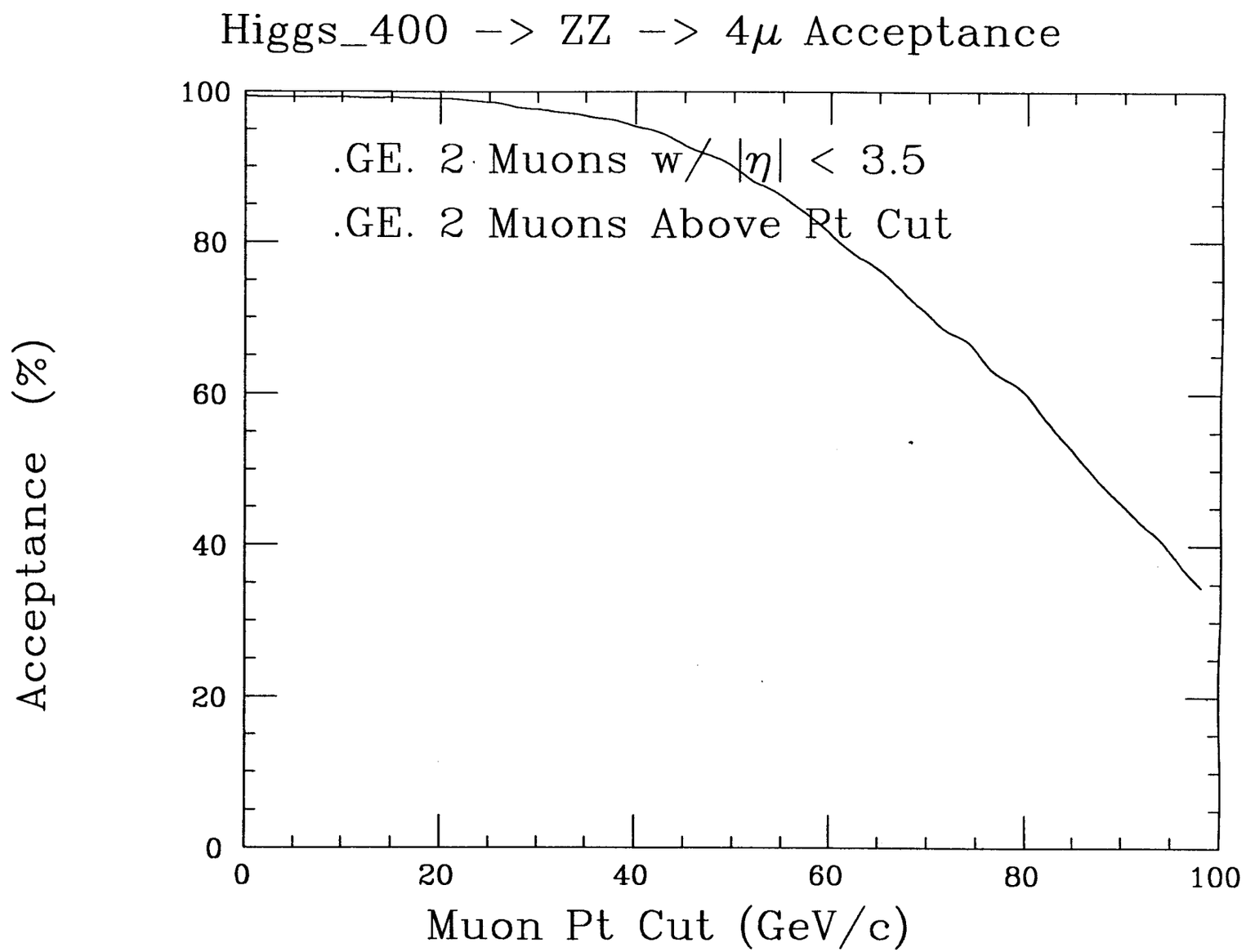
.GE. 1 Muon Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
20
40
60
80
100

4c


Higgs_400 -> ZZ -> 4μ Acceptance
.GE. 2 Muons w/ |η| < 3.5
.GE. 2 Muons Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
20
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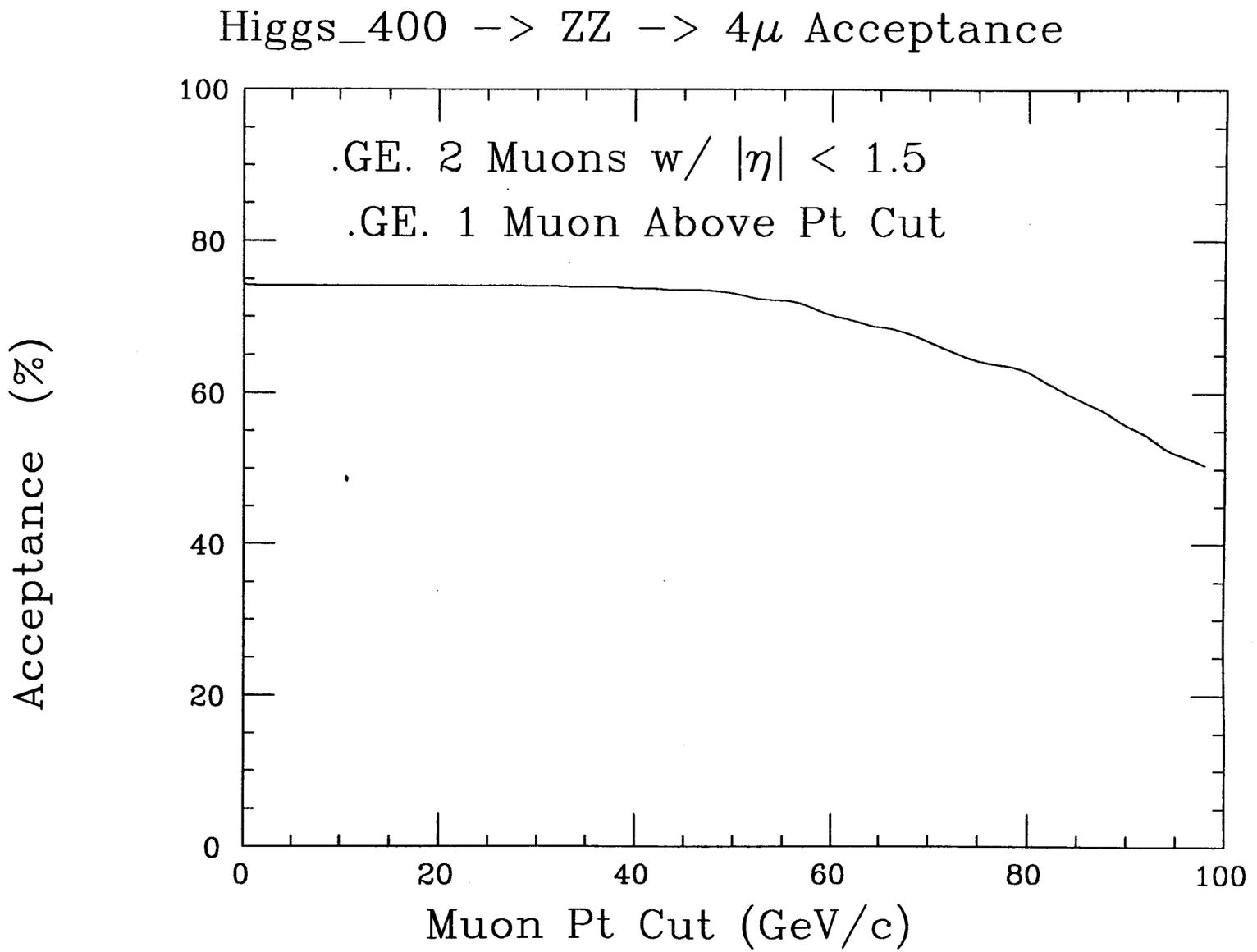
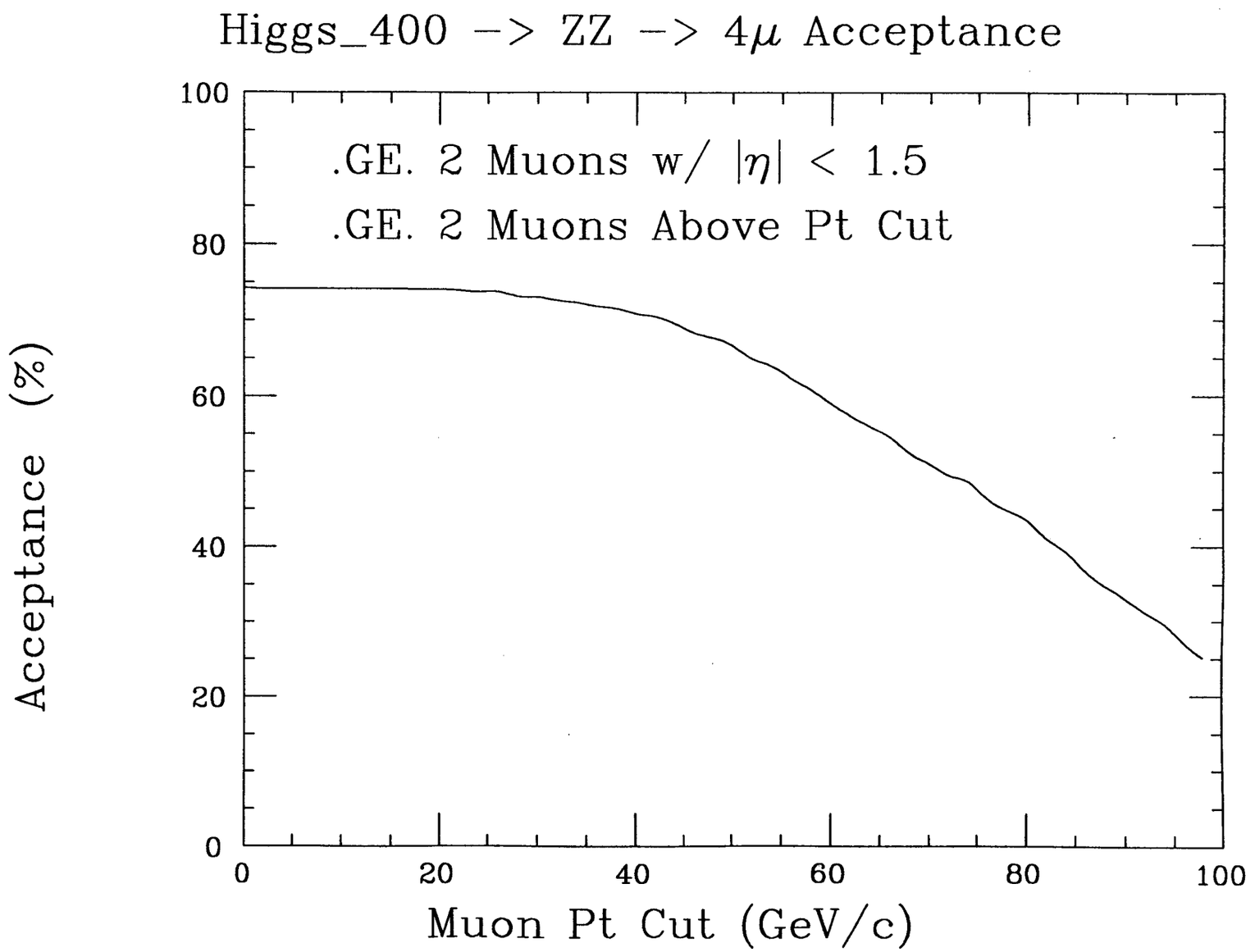
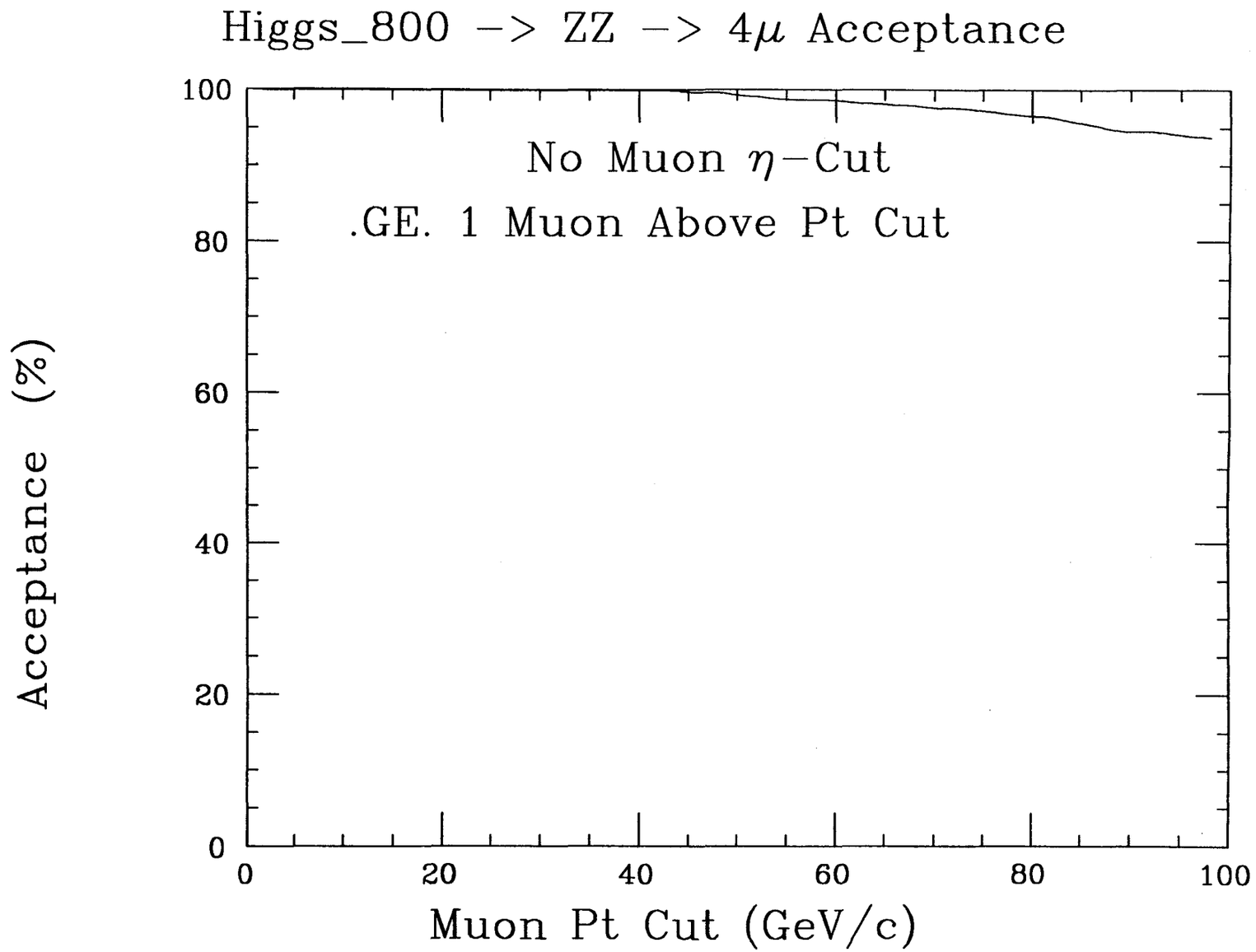
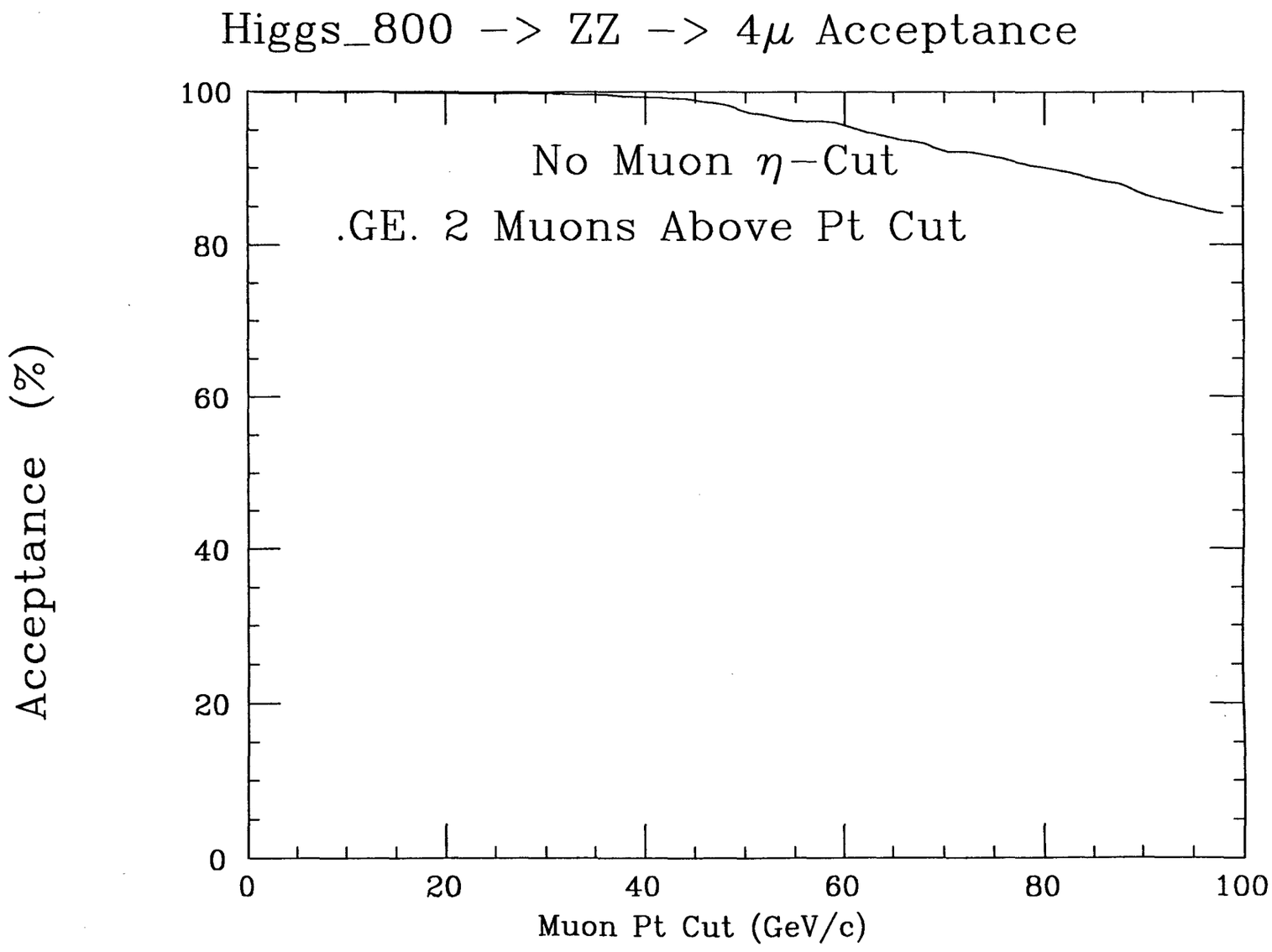
100

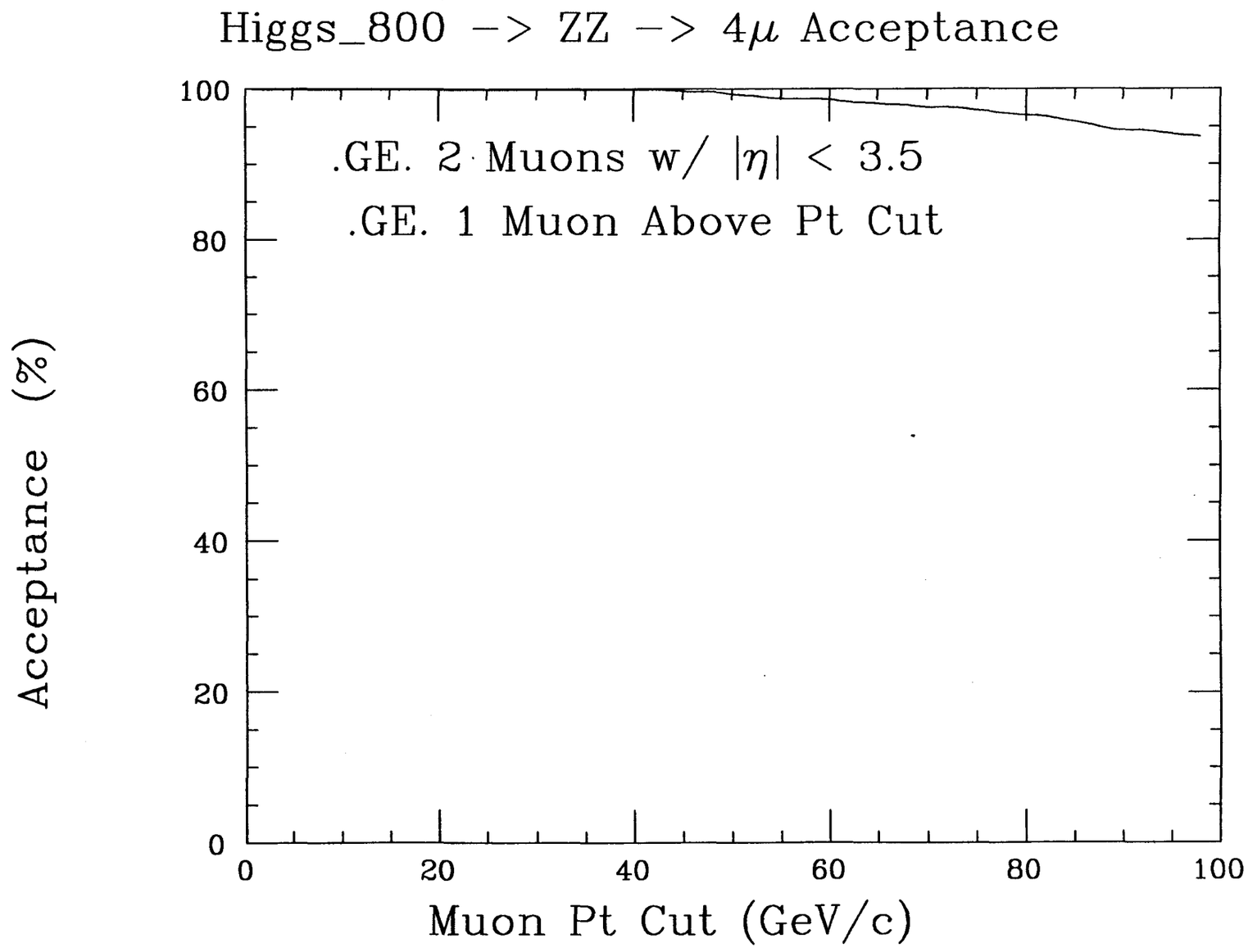

Higgs_400 -> ZZ -> 4μ Acceptance
.GE. 2 Muons w/ |η| < 1.5
.GE. 1 Muon Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
20
40
60
80
100

4e

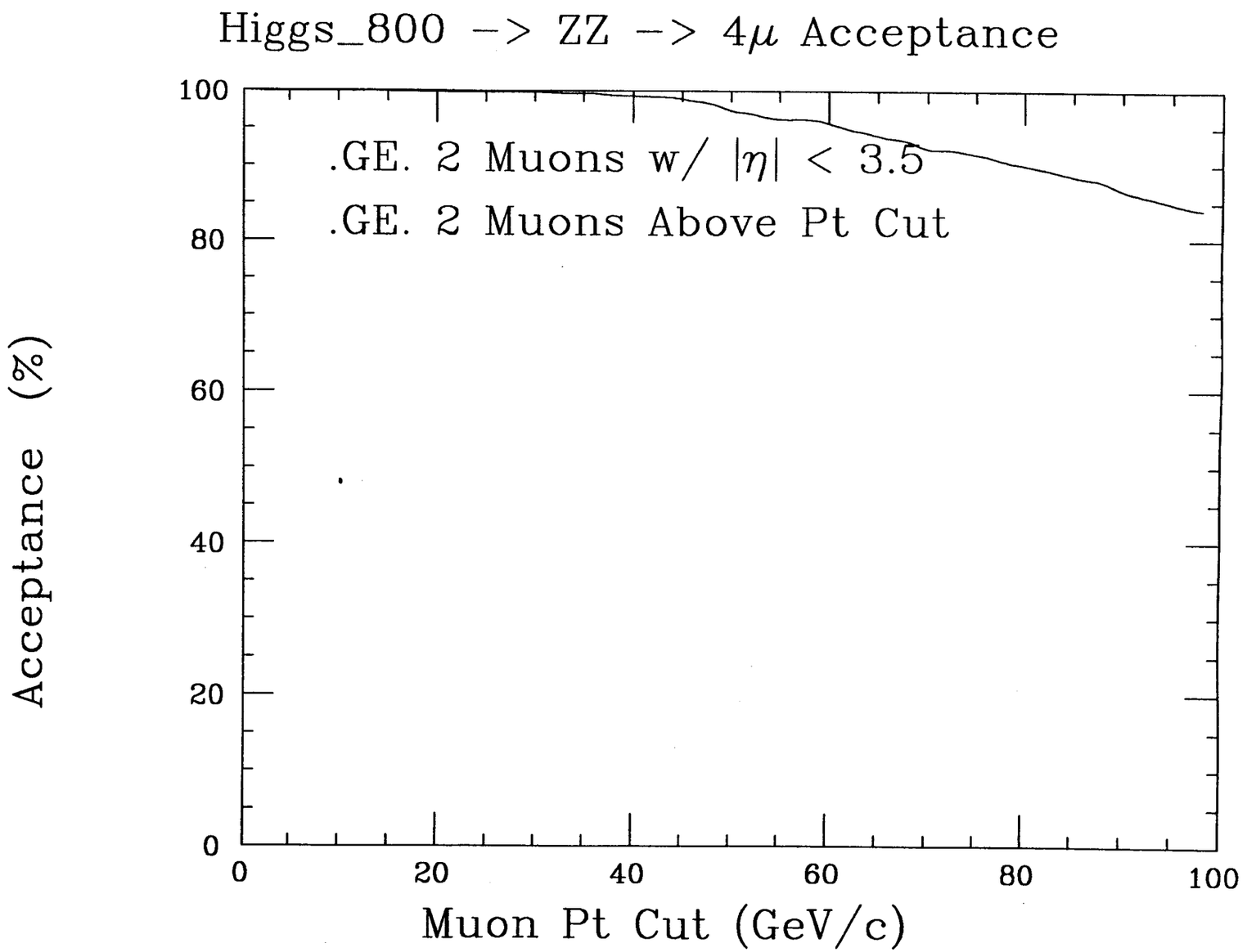

Higgs_400 -> ZZ -> 4μ Acceptance
.GE. 2 Muons w/ |η| < 1.5
.GE. 2 Muons Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
20
40
60
80
100

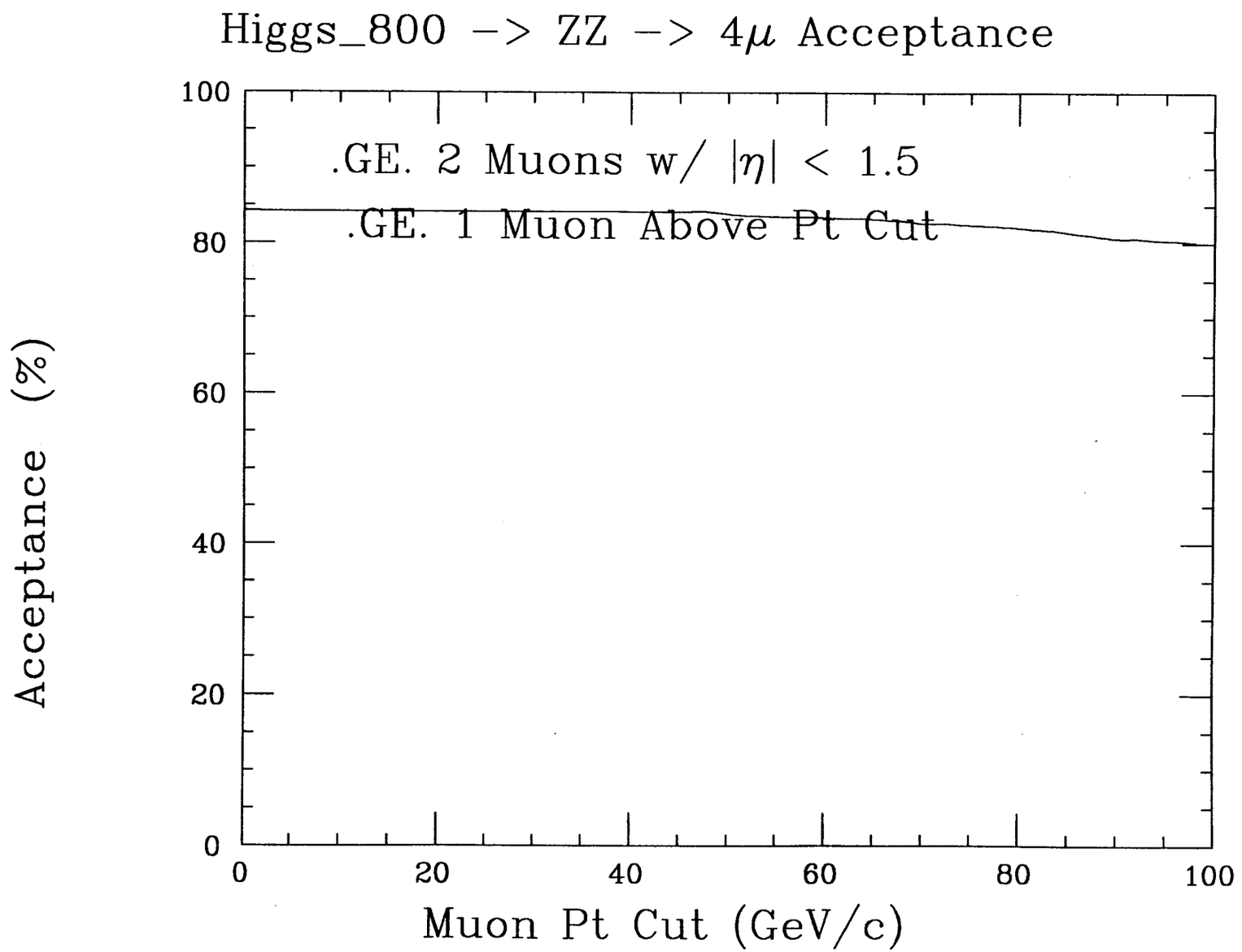

Higgs_800 -> ZZ -> 4μ Acceptance
No Muon η−Cut
.GE. 1 Muon Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
20
40
60
80
100

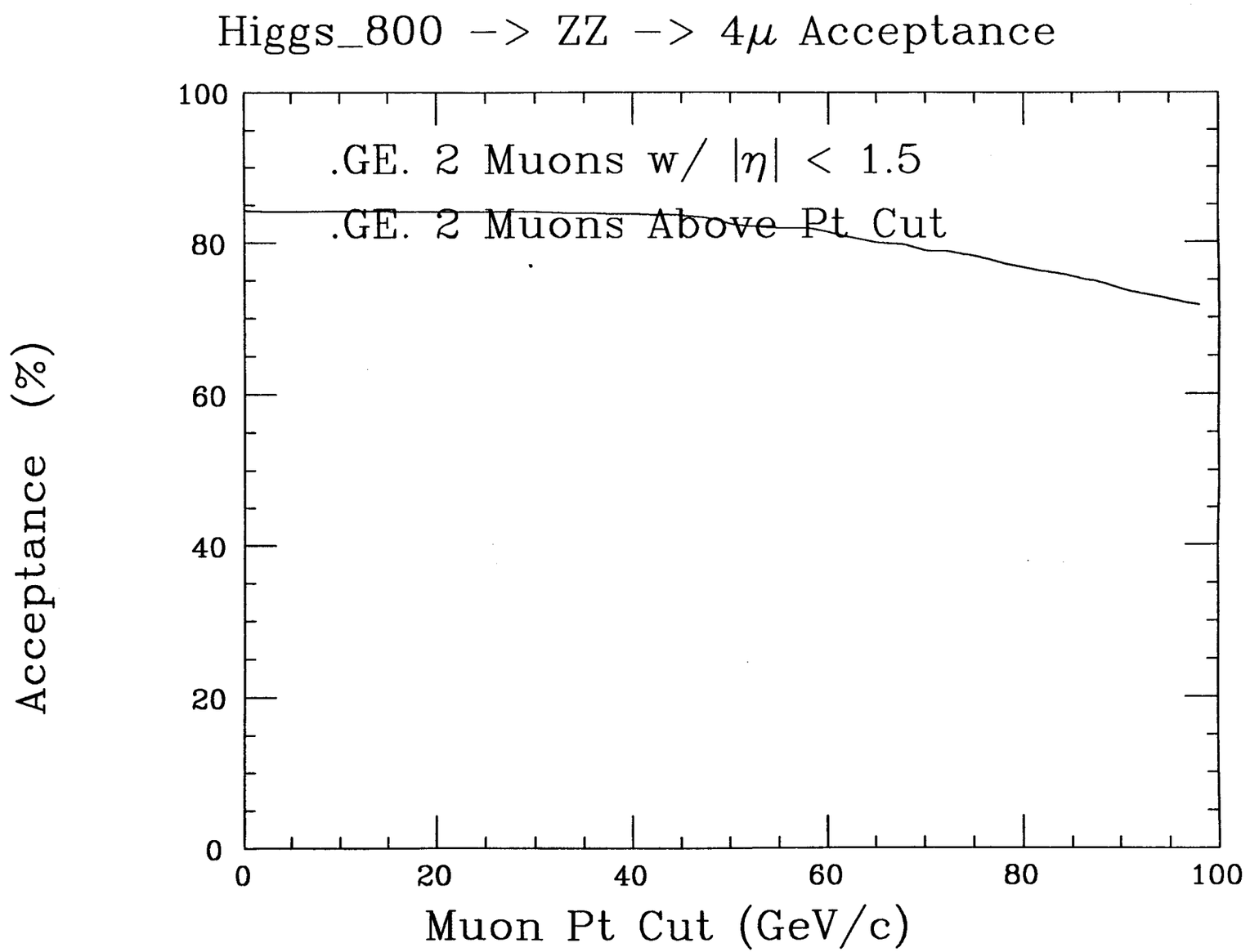

Higgs_800 -> ZZ -> 4μ Acceptance
No Muon η−Cut
.GE. 2 Muons Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
20
40
60
80
100


Higgs_800 -> ZZ -> 4μ Acceptance
.GE. 2 Muons w/ |η| < 3.5
.GE. 1 Muon Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
20
40
60
80
100

5e


Higgs_800 -> ZZ -> 4μ Acceptance
.GE. 2 Muons w/ |η| < 3.5
.GE. 2 Muons Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
20
40
60
80
100


Higgs_800 -> ZZ -> 4μ Acceptance
.GE. 2 Muons w/ |η| < 1.5
.GE. 1 Muon Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
20
40
60
80
100


Higgs_800 -> ZZ -> 4μ Acceptance
.GE. 2 Muons w/ |η| < 1.5
.GE. 2 Muons Above Pt Cut
Acceptance (%)
Muon Pt Cut (GeV/c)
0
20
40
60
80
100