Optimized Parameters For A Mercury Jet Target

X. Ding, D. B. Cline *UCLA*

H. Kirk, J. S. Berg *BNL*

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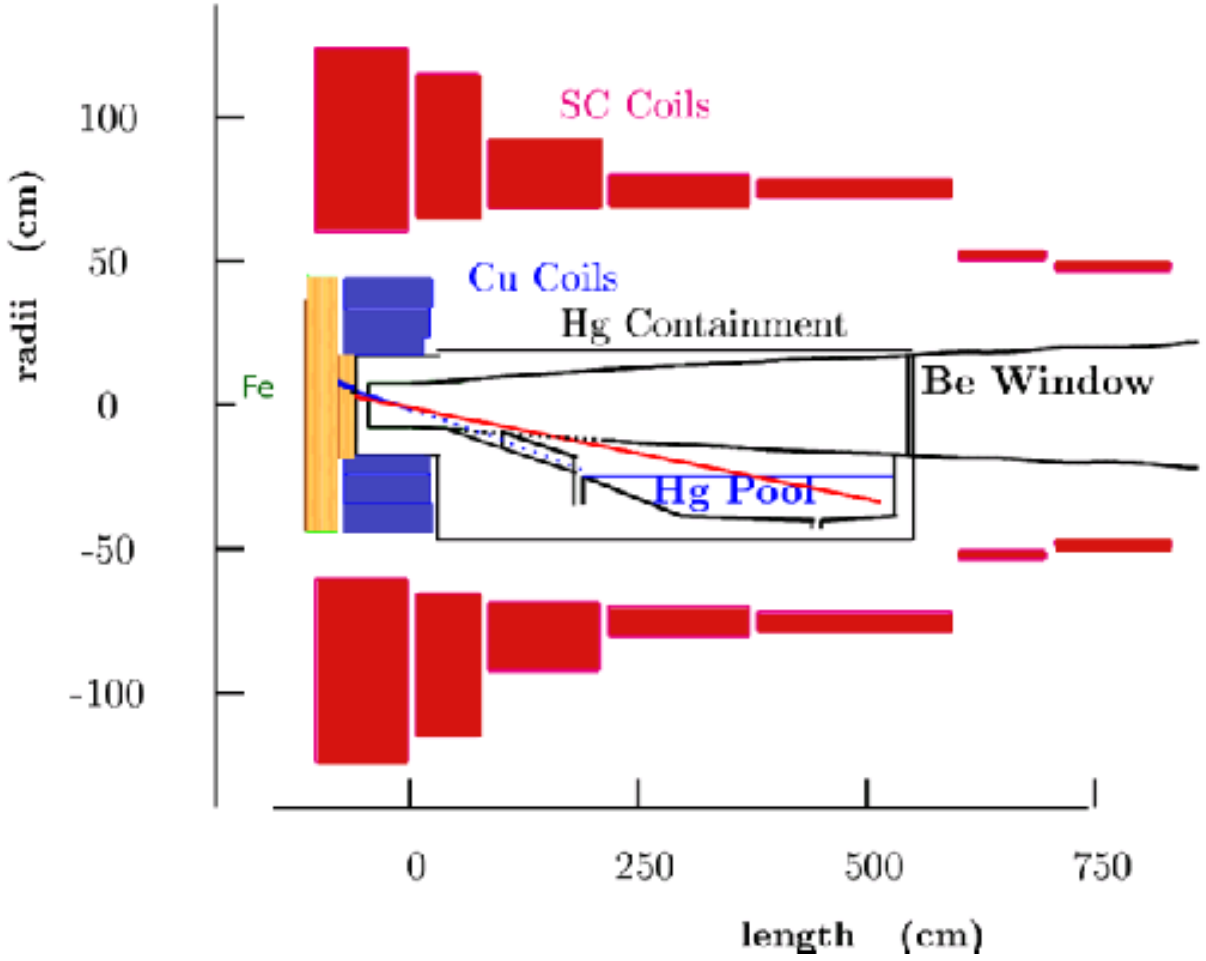
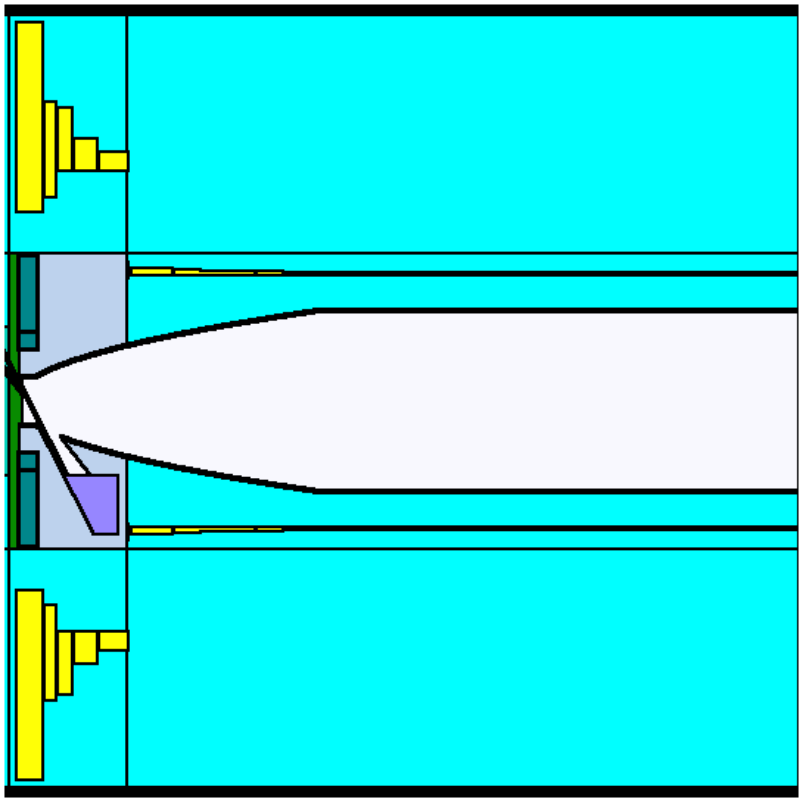
Outline

1. Optimization method
2. Target radius, beam angle and jet/beam crossing angle vs. proton kinetic energy
3. Normalized meson production

The Neutrino Target Concept



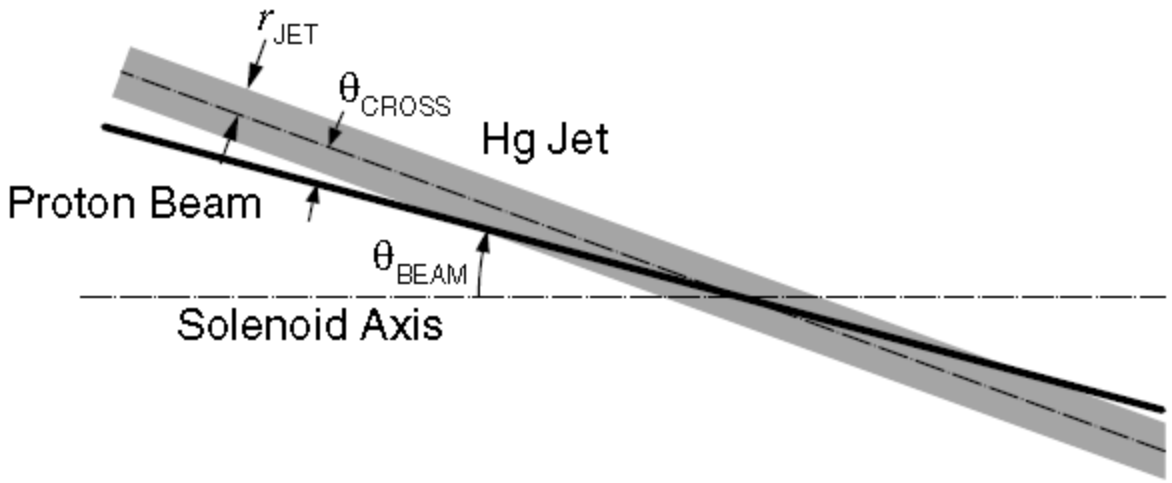
The Target/Collection System



Count all the pions and muons that cross the transverse plane at z=50m.

For this analysis we select all pions and muons with 40 < KE< 180 MeV.

Hg Jet Target Geometry



Previous results: Radius 5mm, θ_{beam} =67mrad
$\Theta_{crossing}$ = 33mrad

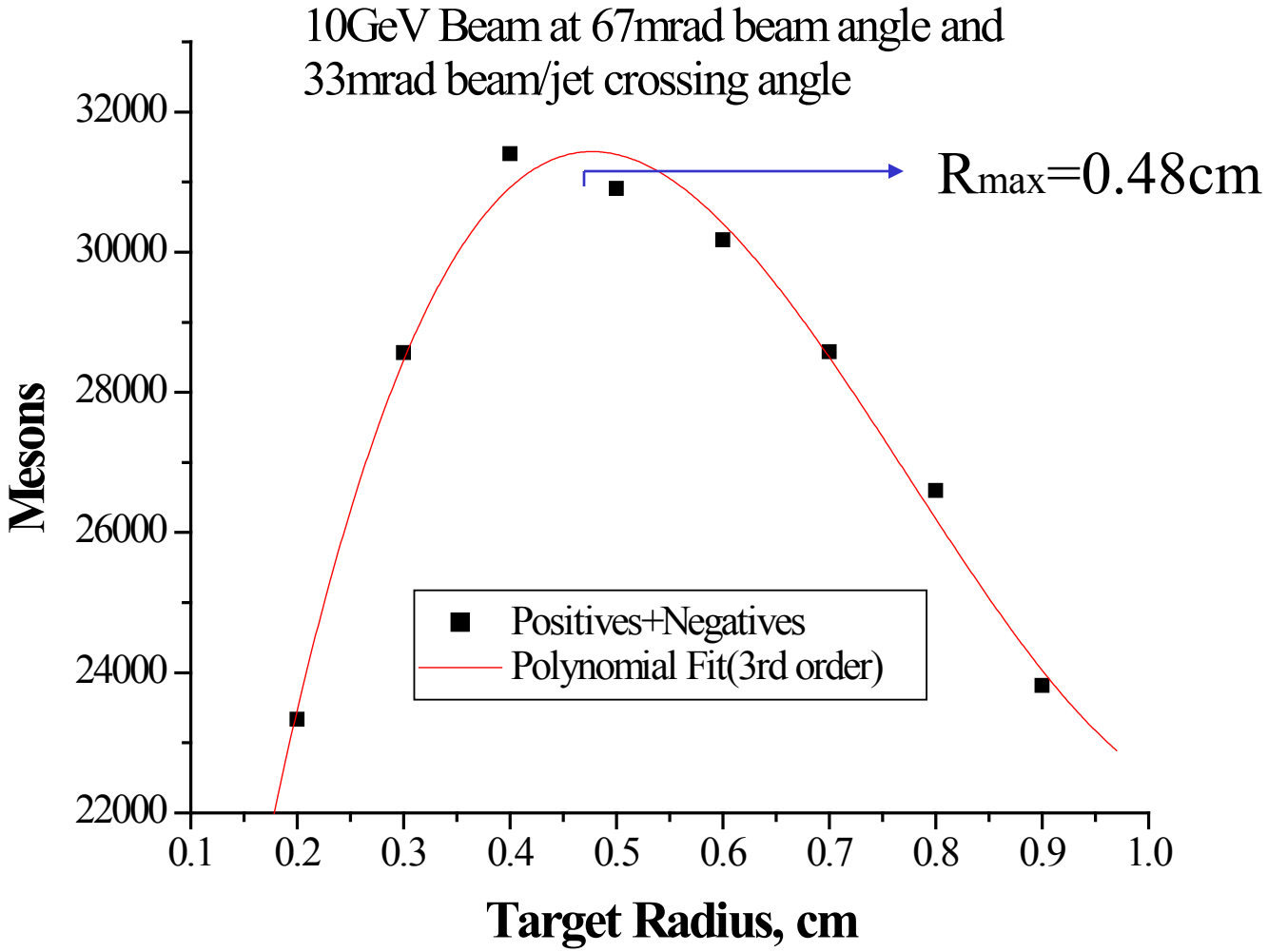
Optimization Method

1) Vary the target radius with previous results of θ_{beam}=67mrad and θ_{cross}=33mrad. Add all positive and negative mesons from the target/collection system. Plot them and make polynomial fit to find the new radius corresponding to the peak of mesons;
2) Vary the beam angle with above new target radius so as to find the new angle at the peak;
3) Vary the beam/jet crossing angle with above both new target radius and beam angle to find the new crossing angle at the peak;
4) Repeat the above procedure until convergence.

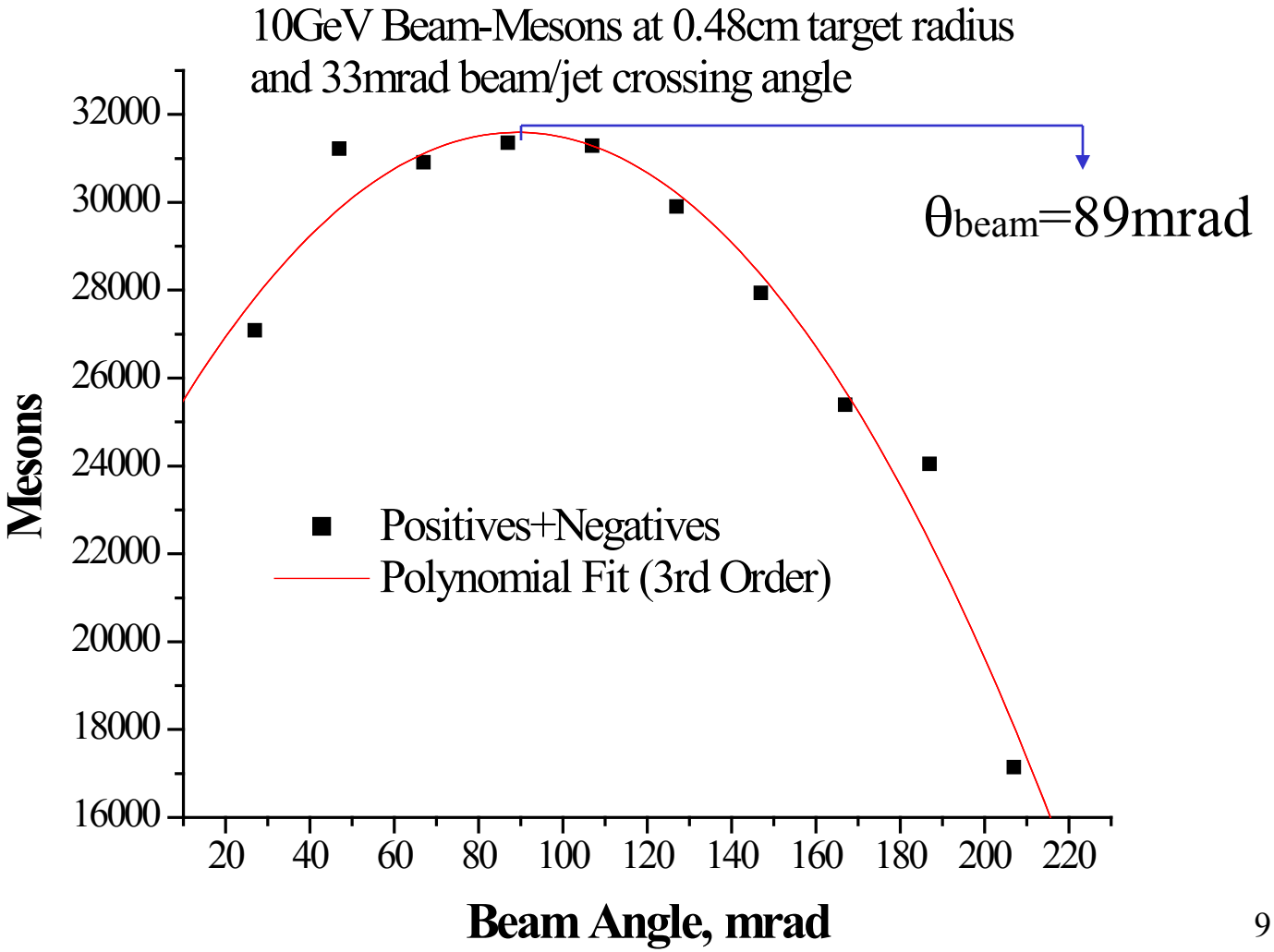
Initial Target Parameters

Beam Energy GeV	Beam Angle mrad	Beam/Jet Crossing Angle mrad
2, 4, 6, 8, 10, 12, 14, 50, 100	67	33

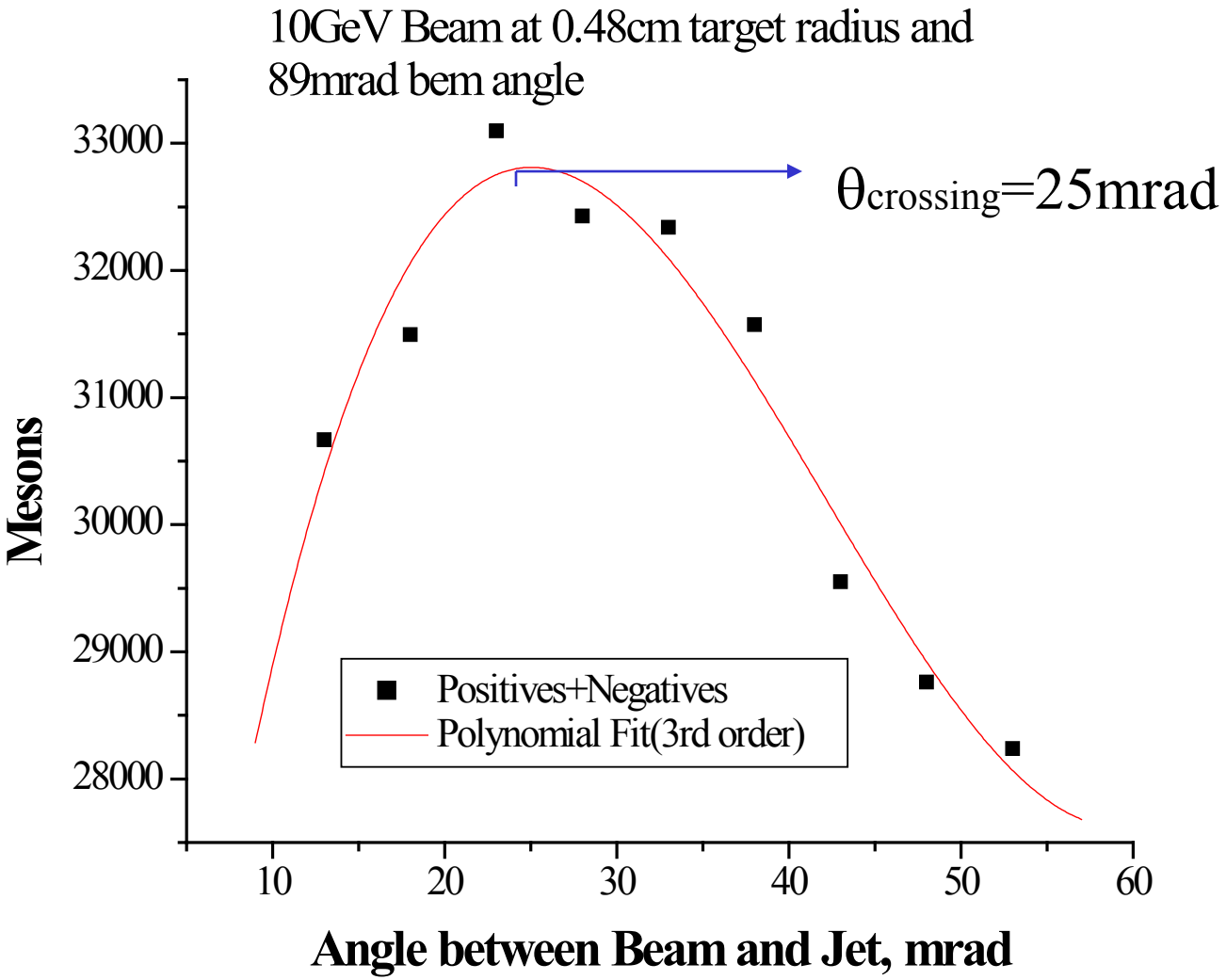
Step 1: Vary the Target Radius



Step 2: Vary the Beam Angle

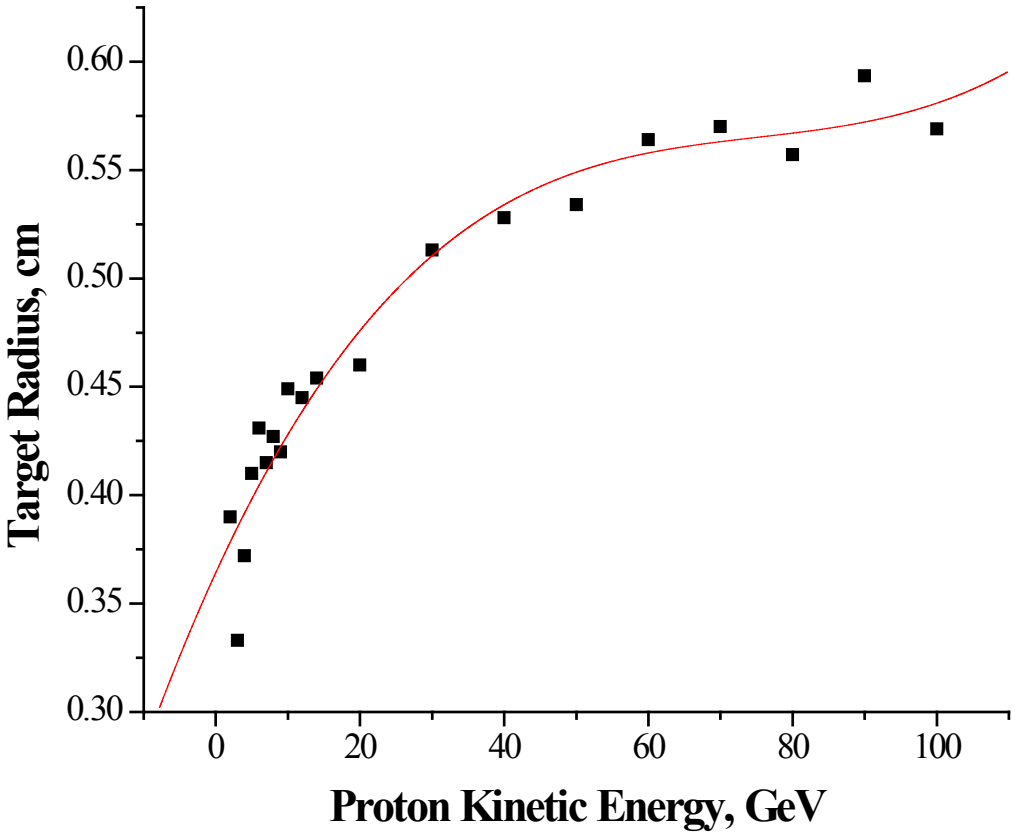


Step 3: Vary the Beam/Jet Crossing Angle

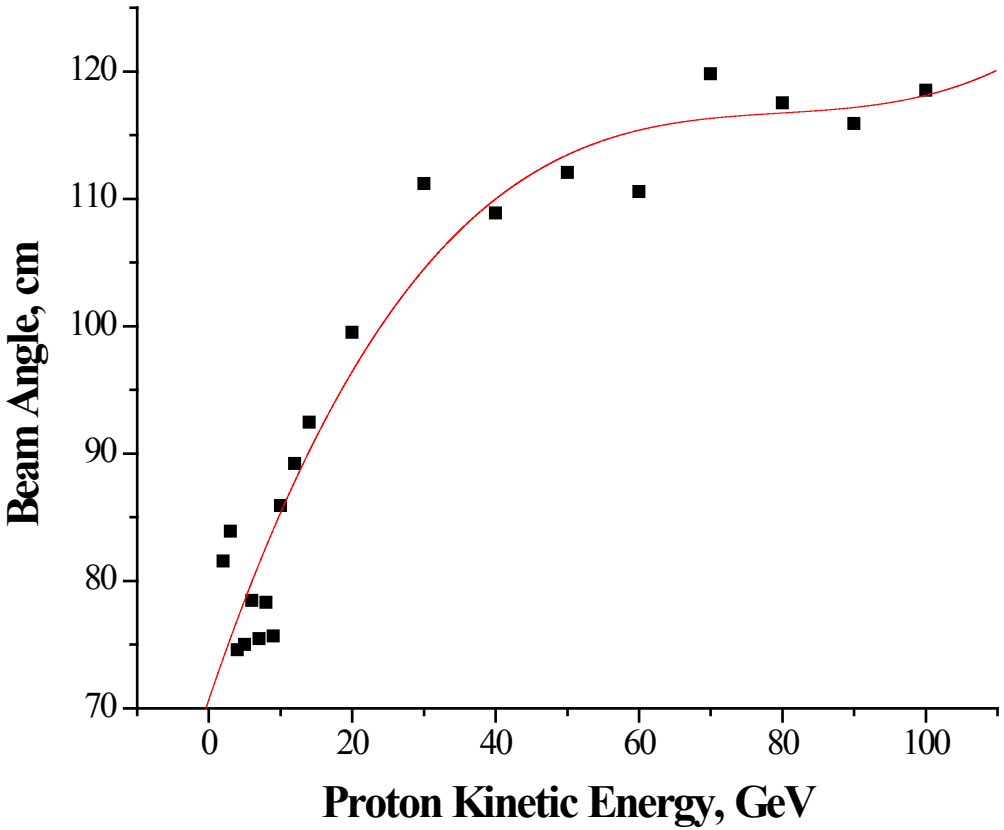


Beam Energy GeV	Run No.	Vary Target Radius Cm/Mesons	Vary Beam Angle mrad/Mesons	Vary Beam/Jet Crossing Angle mrad/Mesons
50	zero		67	33
	1st	0.65/ 111063	138/ 125871	26.5/ 126145
	2nd	0.59/ 127089	129/ 127709	25/ 124165
	3rd	0.57/ 128246	127/ 127700	23/ 127168
	4th	0.55/ 128382	124/ 127760	23.36/ 126560

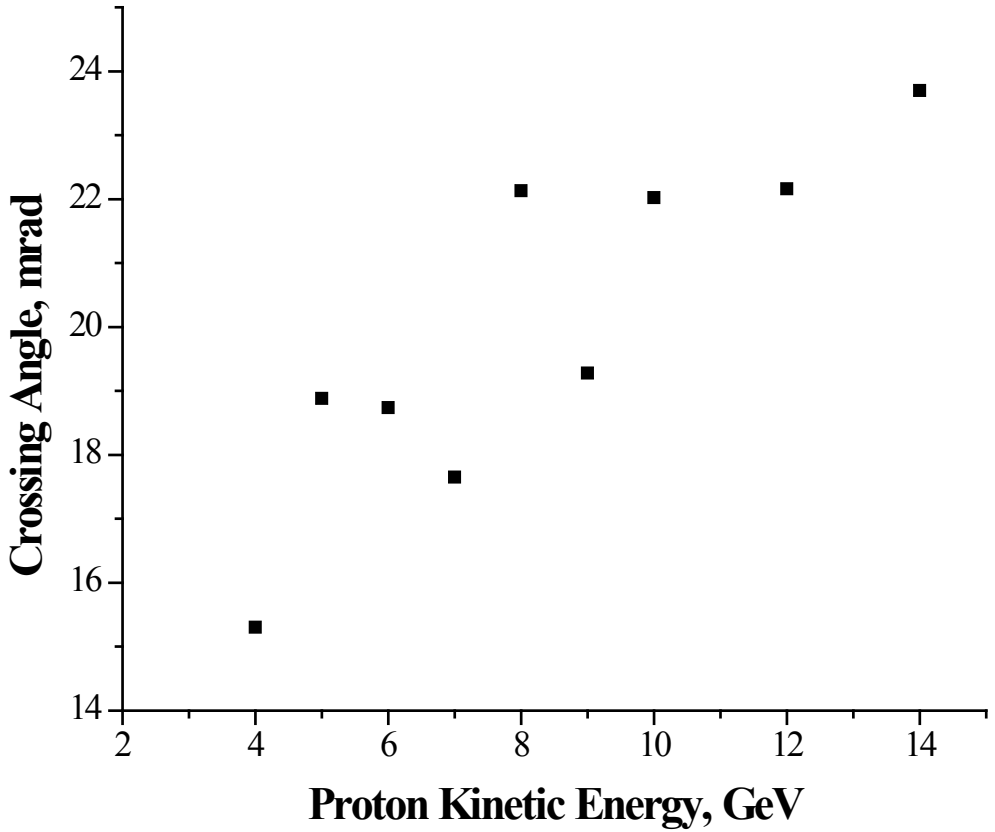
Target Radius vs Beam Energy



Beam Angle vs Beam Energy



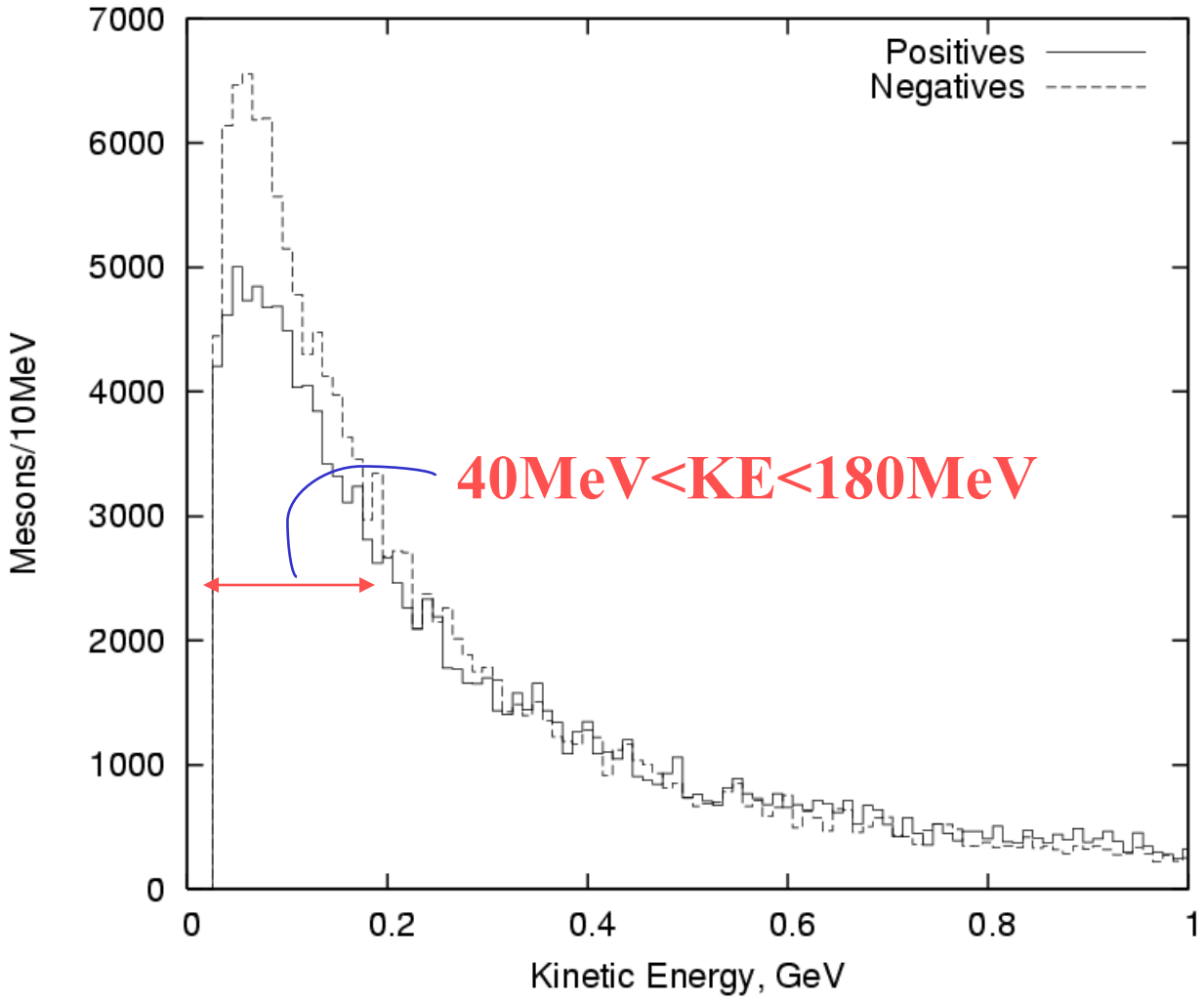
Crossing Angle vs Beam Energy



Note:

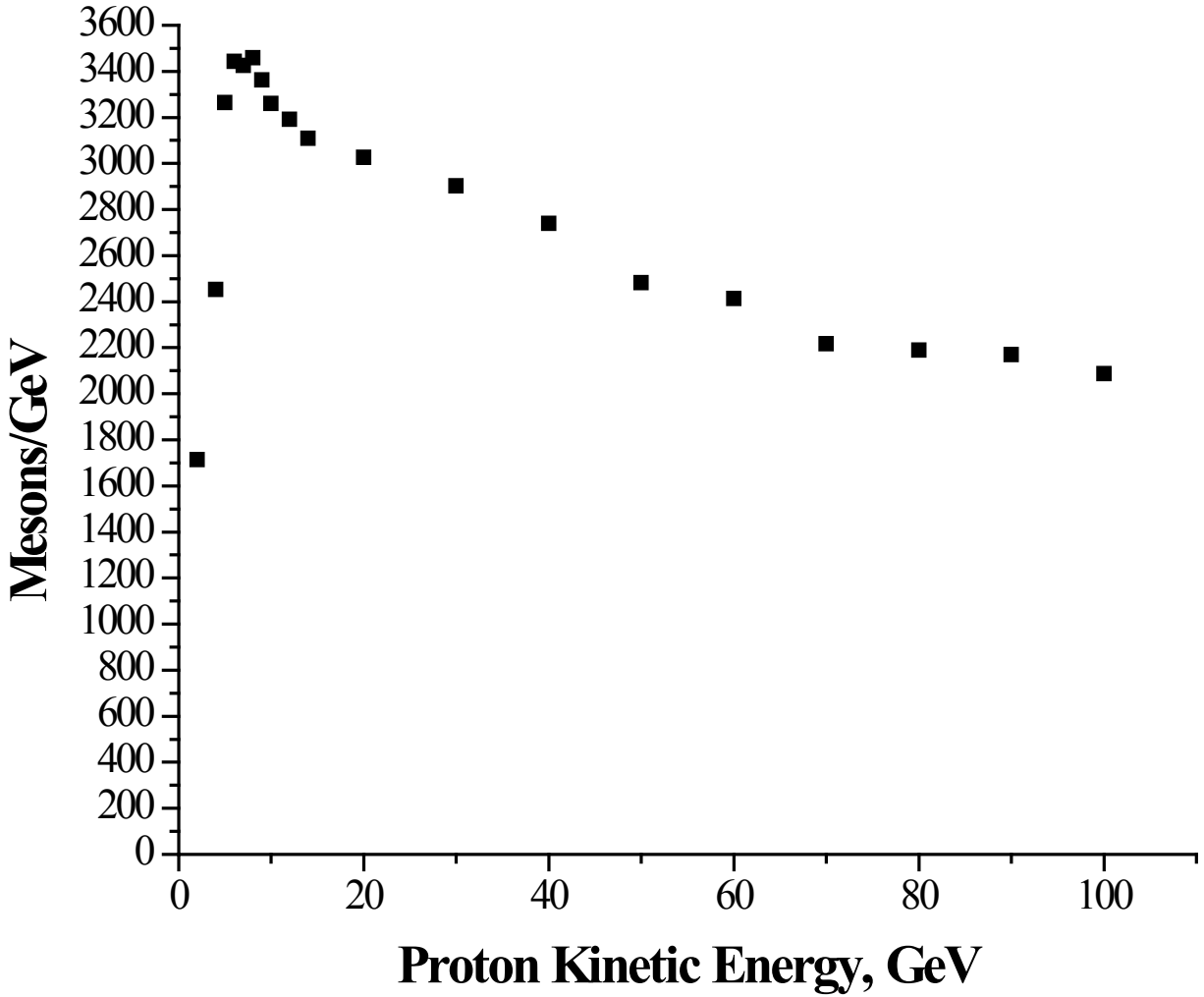
The initial beam angle and crossing angle at 5, 7 and 9 GeV are 77 mrad and 22mrad, respectively. At 3 GeV, they are 77mrad and 15.3 mrad.

50GeV Beam-Mesons at 50m



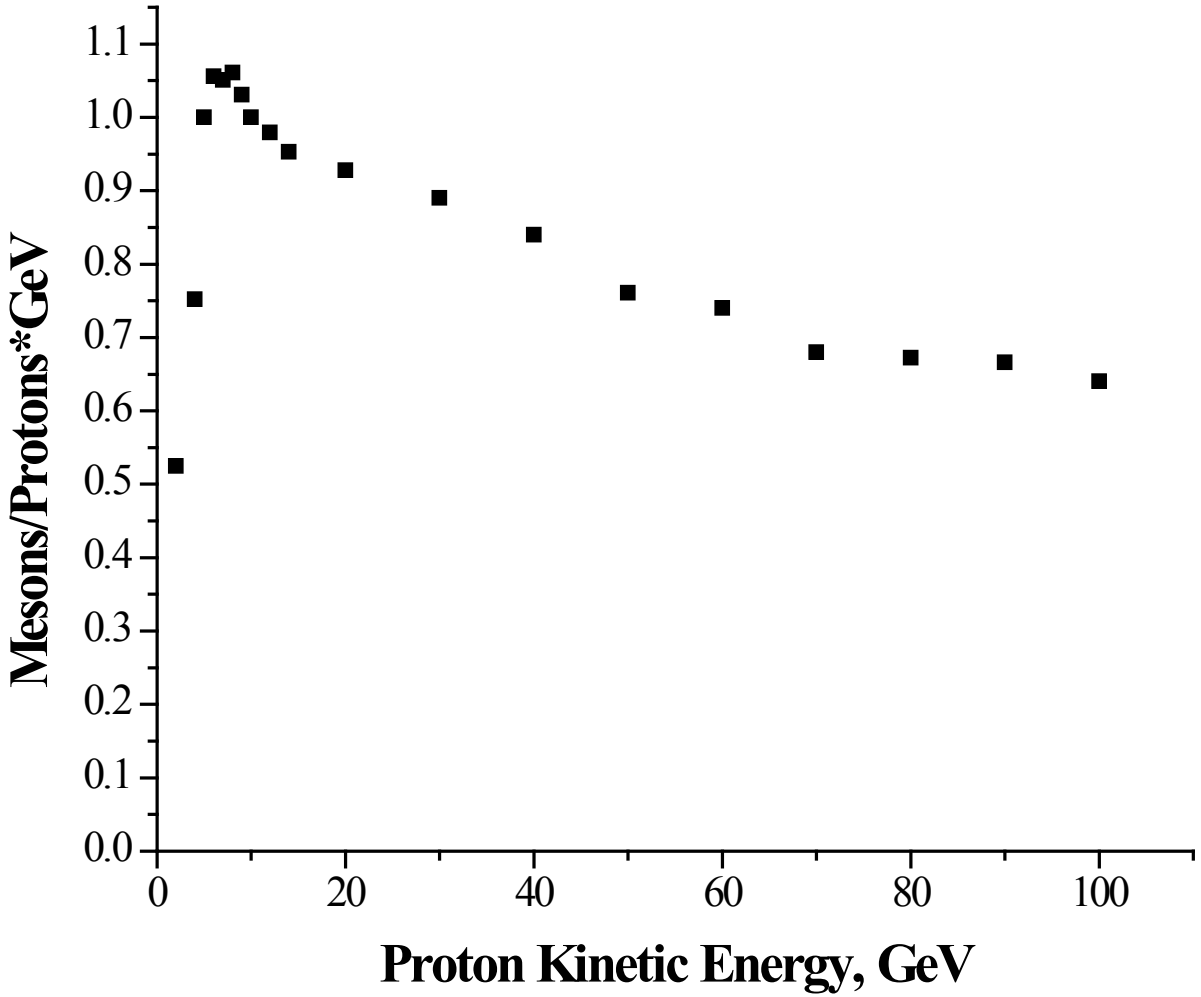
Normalized Meson Production

(Normalized to beam power)



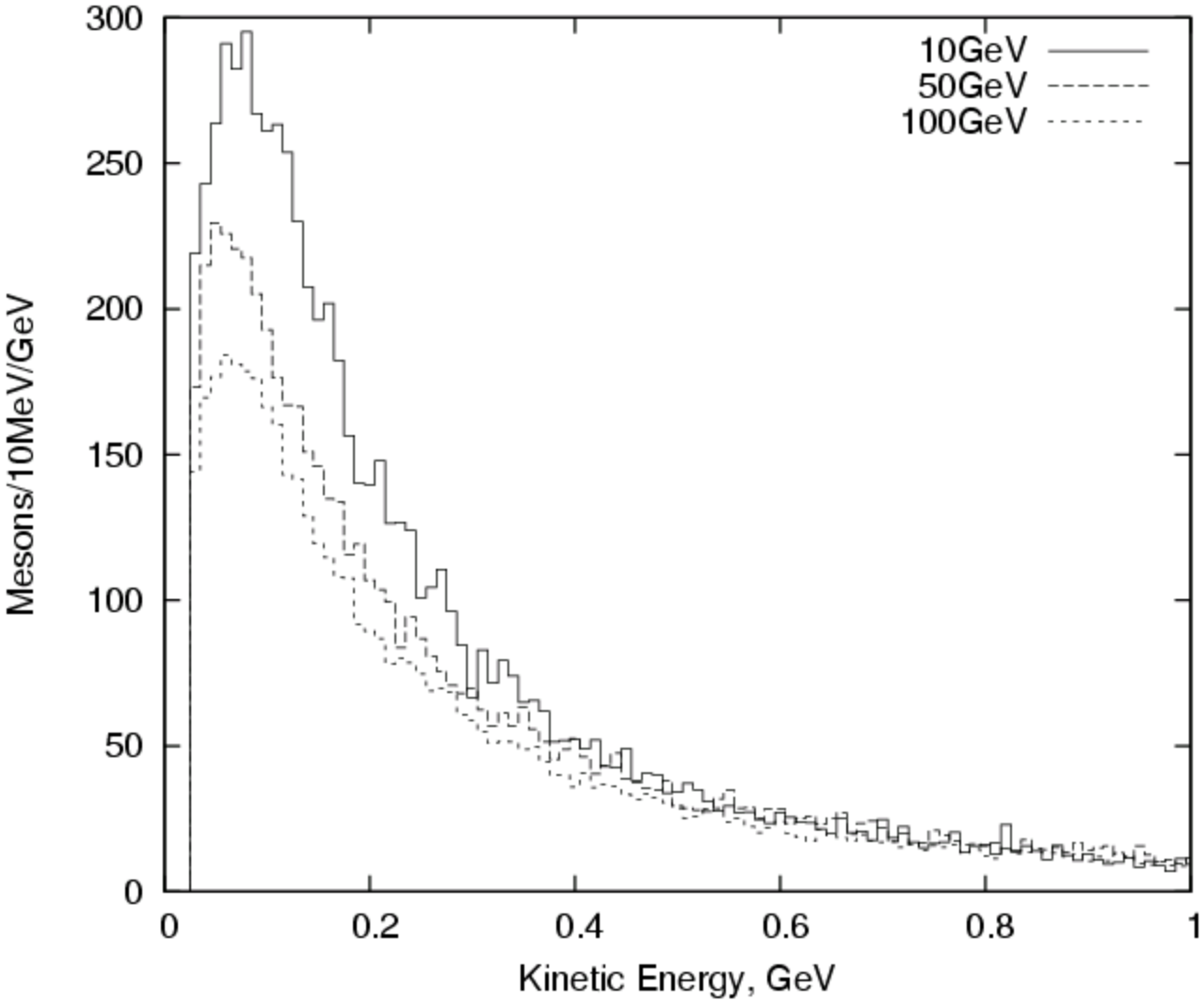
Normalized Distribution

(Normalized to 10 GeV)



Normalized Mesons at 50m

(Positives+Negatives)



Summary

- The target parameters including target radius, beam angle and beam/jet crossing angle are optimized with MARS code.
- The mesons production at z=50m is relatively efficient around 5~15 GeV of proton kinetic energy.