Optimized Target Parameters and Meson Production by IDS120h with Focused Gaussian Beam and Fixed Emittance (Update)

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Target Studies

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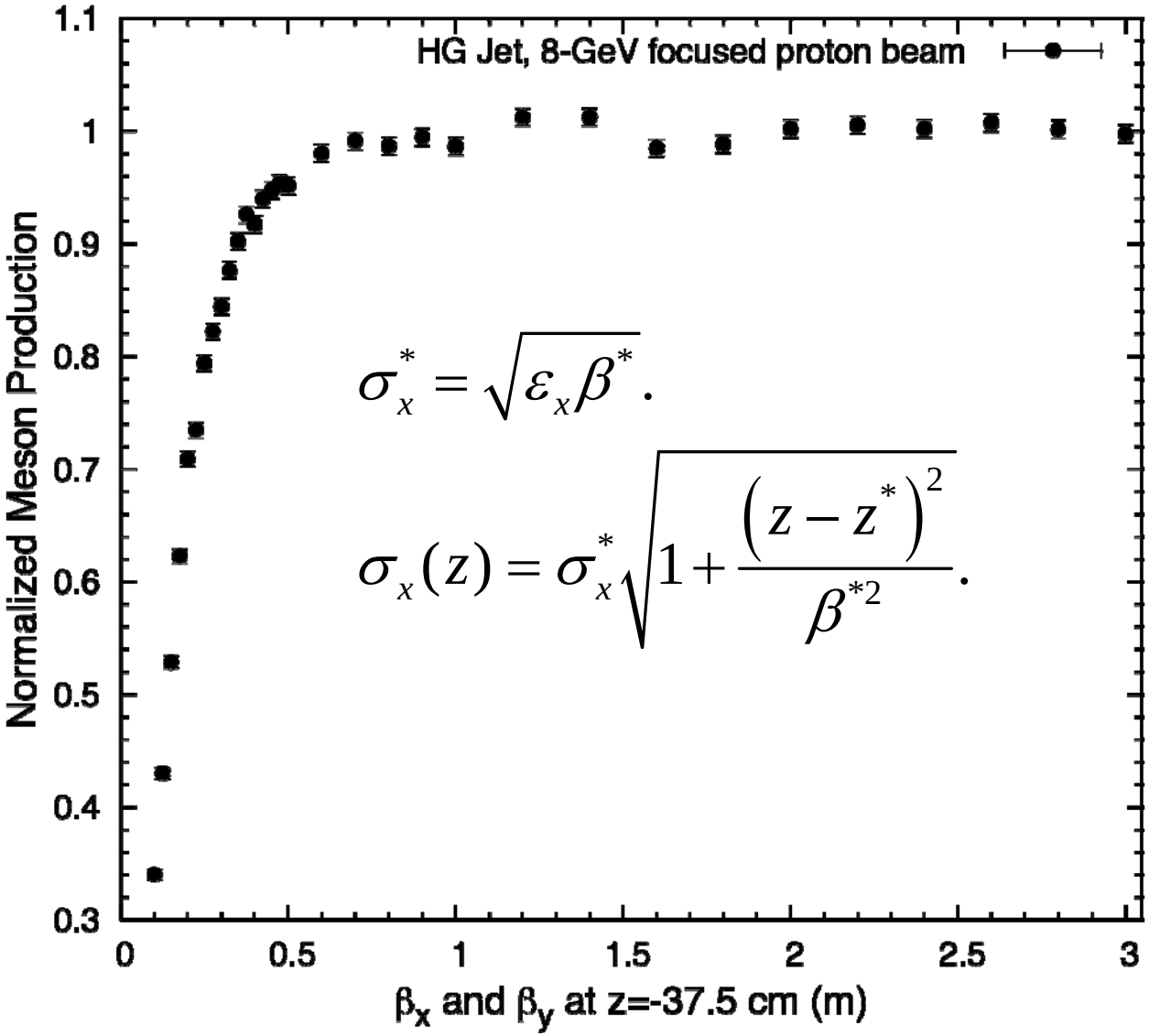
Optimized Target Parameters and Meson Productions at 8 GeV (Non-Focused Gaussian beam, Zero emittance)

Target Jet	HG	GA
Emittance/ μ m	0	0
Target radius/cm	0.404	0.44
Beam radius/cm (Fixed at 30% of target radius)	0.1212	0.132
Crossing angle between beam and Jet at z=-37.5 cm/mrad	20.6	13
Beam angle at z=-37.5 cm/mrad	117	88
Jet angle at z=-37.5 cm/mrad	137.6	101
Meson Production (400000 protons)	130254	113297

Focused Incident Proton Beam at 8 GeV

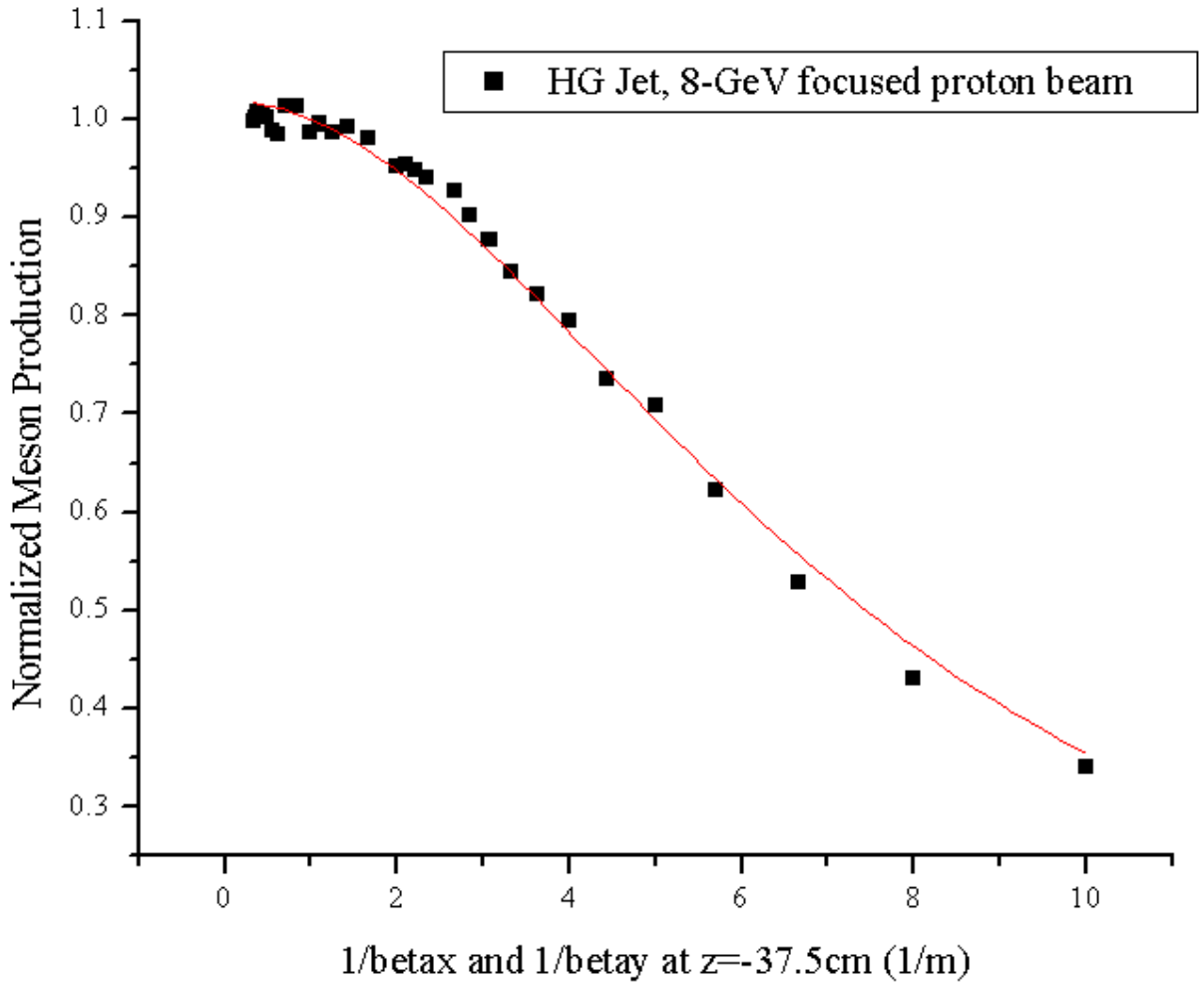
(Beam radius is fixed at 0.12 cm at z=-37.5 cm)



Relative normalized meson production is 0.84 of max at β^* of 0.3 m for $\varepsilon_x = \varepsilon_y = 5$ μm.

For low β^* (tight focus) the beam is large at the beginning and end of the interaction region, and becomes larger than the target there.

Focused Incident Proton Beam at 8 GeV (Cont'd) (Beam radius is fixed at 0.12 cm at z=-37.5 cm)



Non-Linear Fit
(Growth/sigmoidal, Hill)

$Y=N/(1+K2/beta^{-2})$
N=1.018
Sqrt(K2)=0.1368

Linear emittance is 5 μm with beam radius of 0.1212 cm and β^* of 0.3 m.

Optimization Procedures
(Focused Beam and Fixed Beam Emittance)

Optimization method in each cycle

(1) Vary beam radius σ^*, while vary the β^* at the same time to fix the beam emittance;

(2) Vary target radius;

(3) Vary beam/jet crossing angle;

(4) Rotate beam and jet at the same time to keep the crossing angle same.

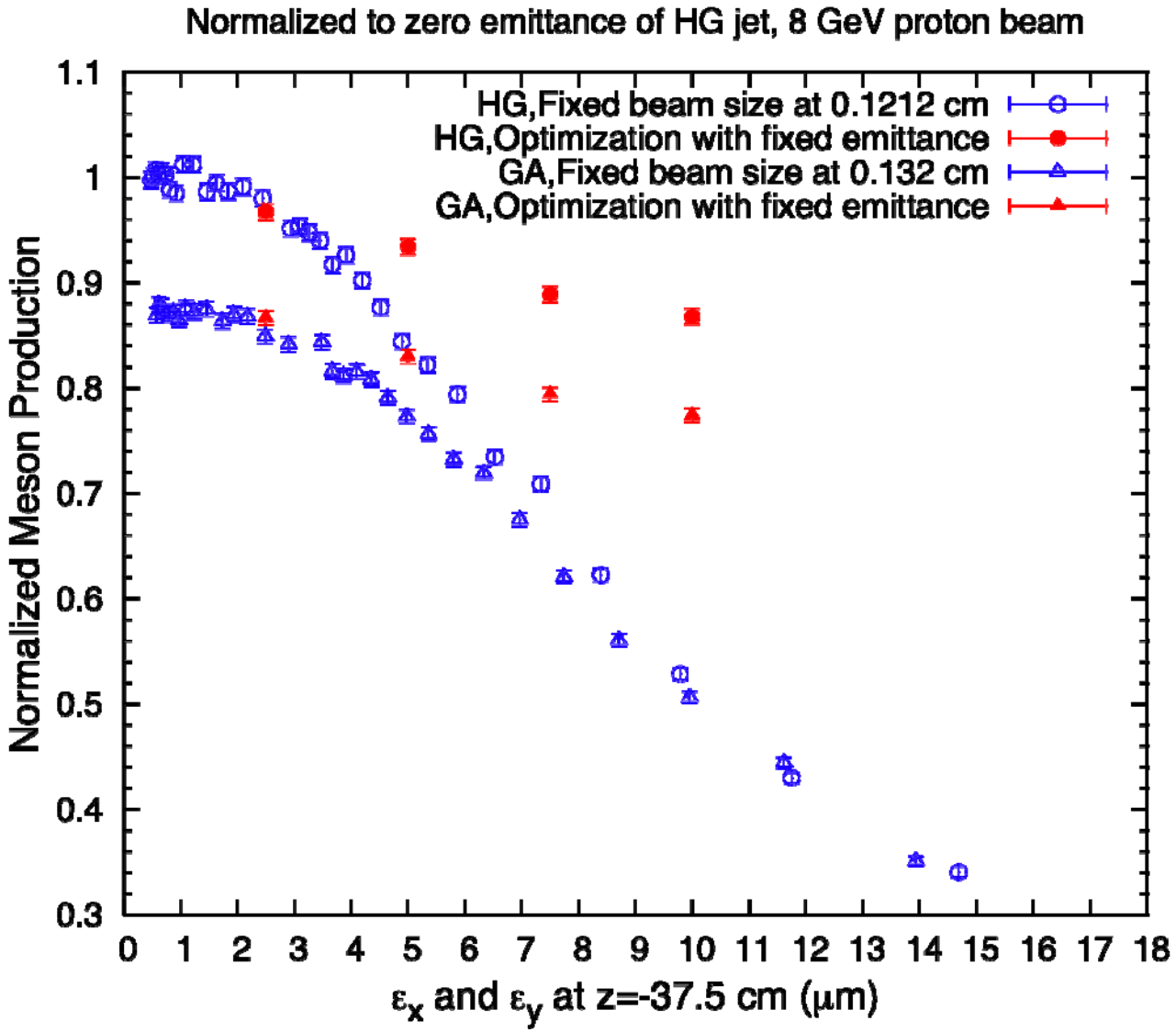
Optimized Target Parameters and Meson Productions at 8 GeV and Different Emittance (HG Jet Case)

Emittance/ μ m	2.5	5	7.5	10
Target radius/cm	0.47	0.548	0.60	0.65
Beam radius/cm	0.135	0.15	0.2025	0.2325
Crossing Angle/mrad	23	26.5	29.3	32
Beam angle/mrad	118	127	131	135
Jet angle/mrad	141	153.5	160.3	167
Meson production (400000 protons)	125991	121697	115760	113020

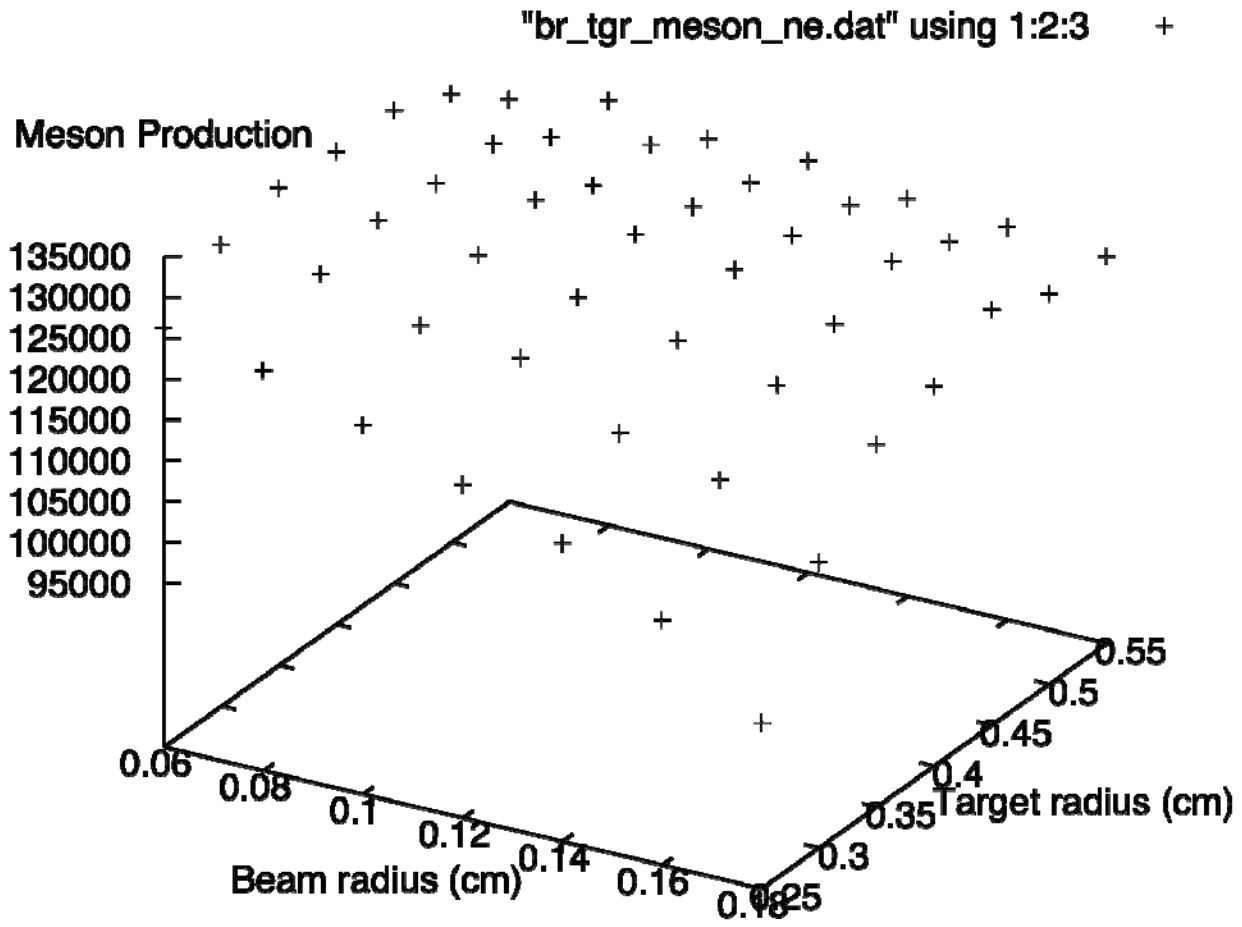
Optimized Target Parameters and Meson Productions at 8 GeV and Different Emittance (GA Jet Case)

Emittance/ μ m	2.5	5	7.5	10
Target radius/cm	0.51	0.60	0.658	0.71
Beam radius/cm	0.1275	0.1725	0.2025	0.2325
Crossing Angle/mrad	15.3	18.4	21.7	23
Beam angle/mrad	92	97	97	100
Jet angle/mrad	107.3	115.4	118.7	123
Meson production (400000 protons)	112888	108107	103441	100860

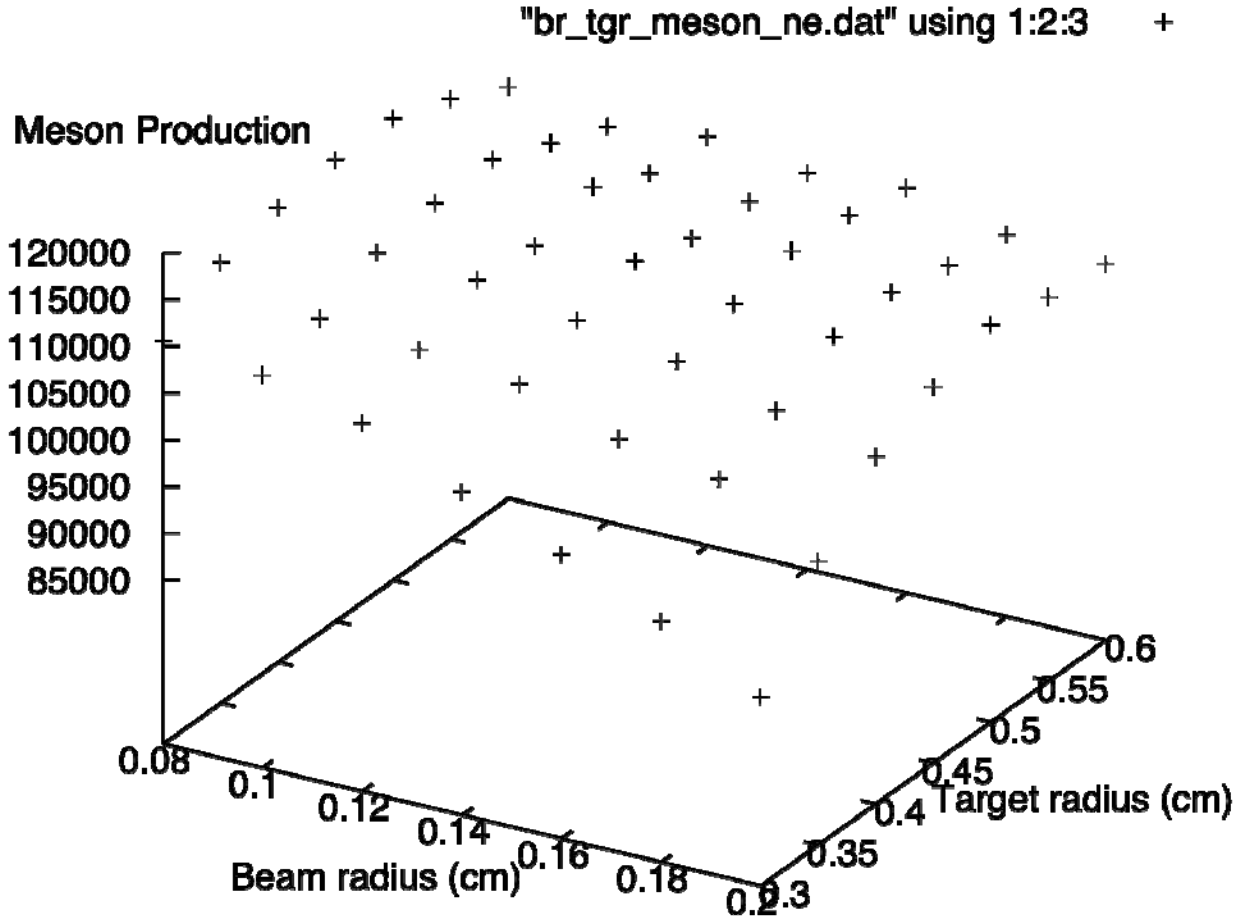
Optimization with Fixed or Variable Beam Size *vs.* Beam Emittance



HG Jet, Zero emittance, 8 GeV



GA Jet, Zero emittance, 8 GeV



Optimization for Production at z = 50 m (MARS) and z = 250 m (ICOOL) (GA Jet, 8GeV beam, 5 μ m emittance)