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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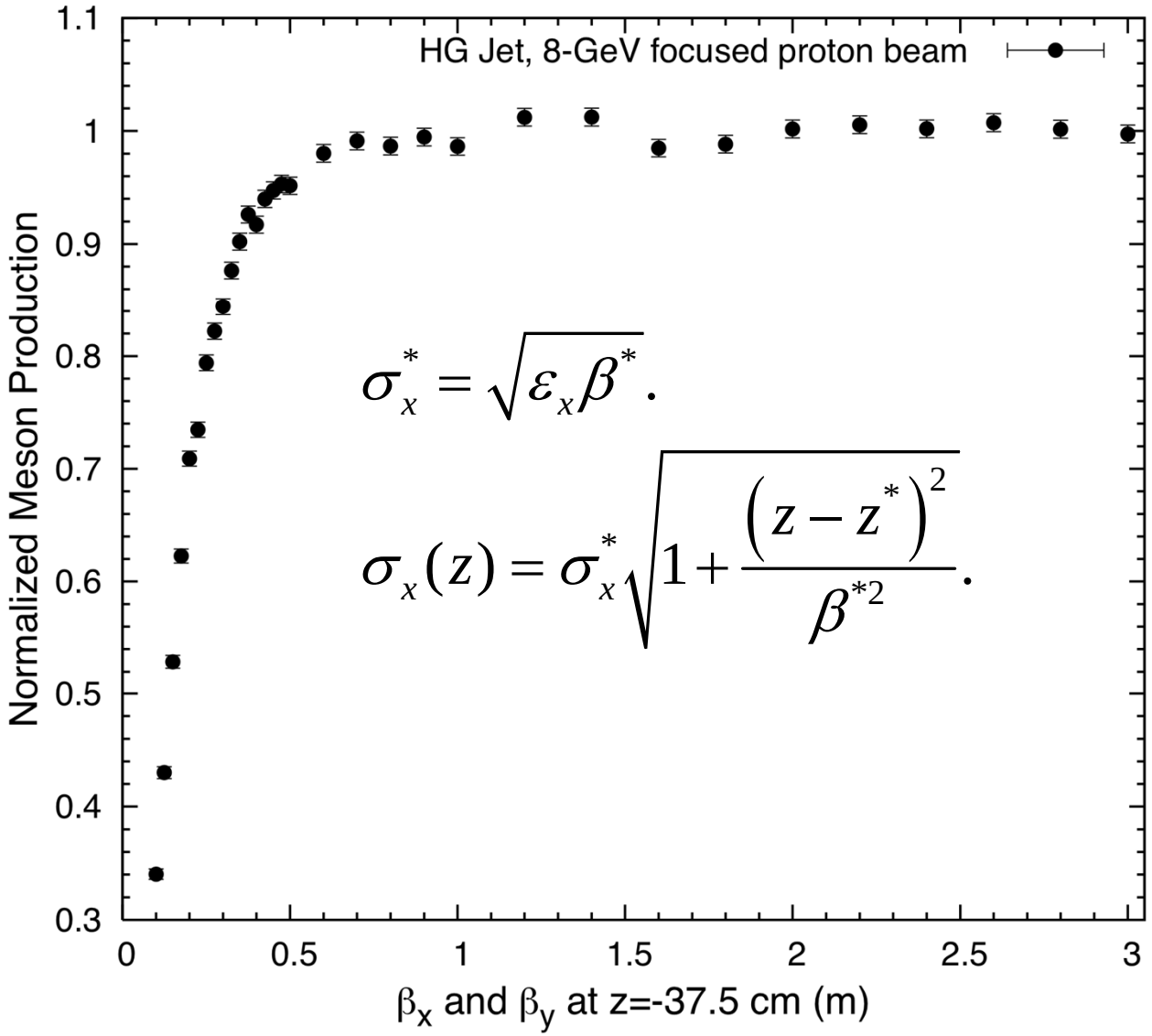
Focused Incident Proton Beam at 8 GeV

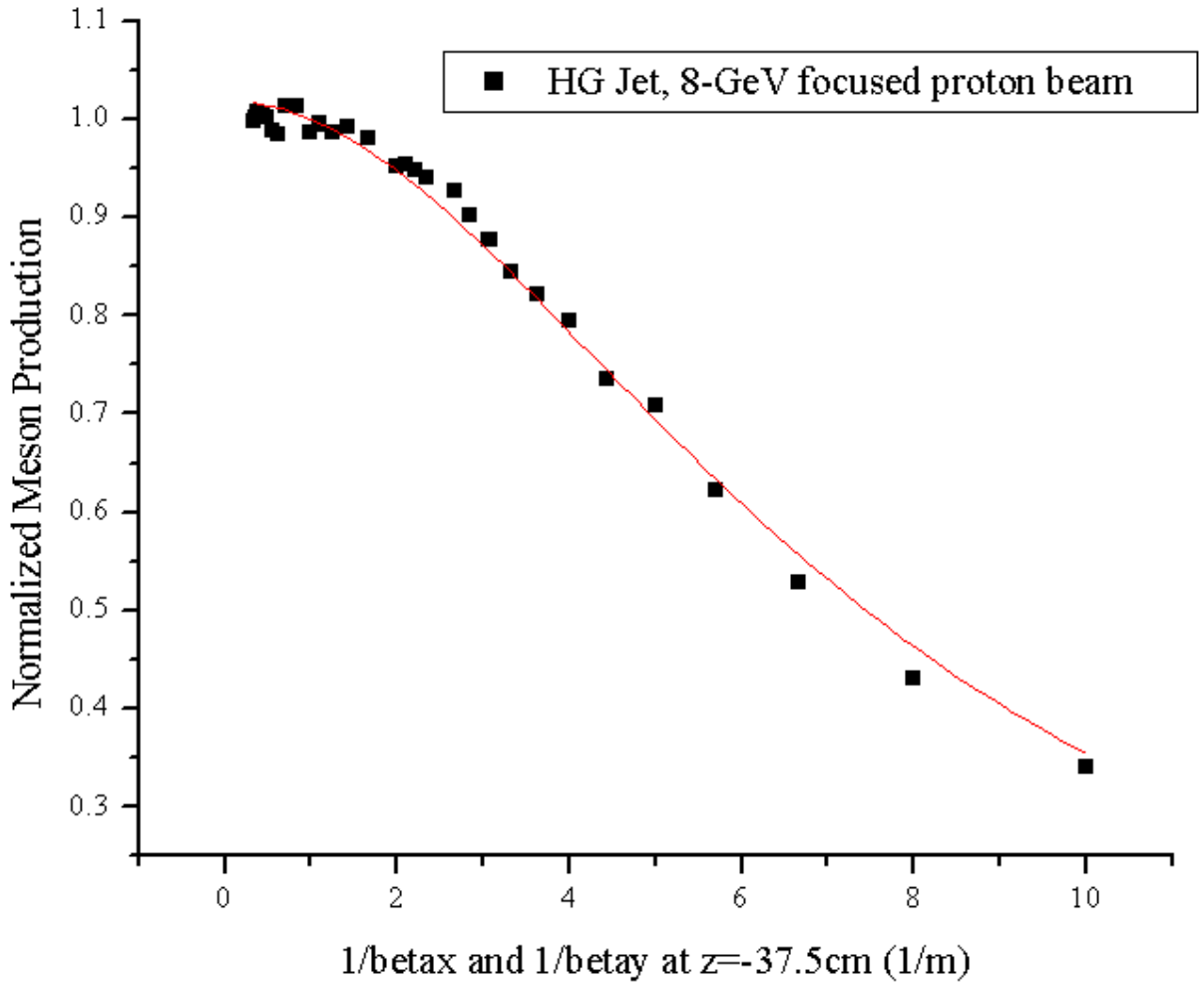
(Beam radius is fixed at 0.12 cm at z=-37.5 cm)



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 of target parameters

- Fixed beam emittance ($\varepsilon_{K\sigma}$) to $\pi\,(\sigma)^2/\beta$
- Optimization method in each cycle

  (Vary beam radius or beam radius σ^*, while vary the β^* at the same time to fix the beam emittance; Vary beam/jet crossing angle; Rotate beam and jet at the same time)

  We also optimized the beam radius and target radius separately (not fixed to each other).

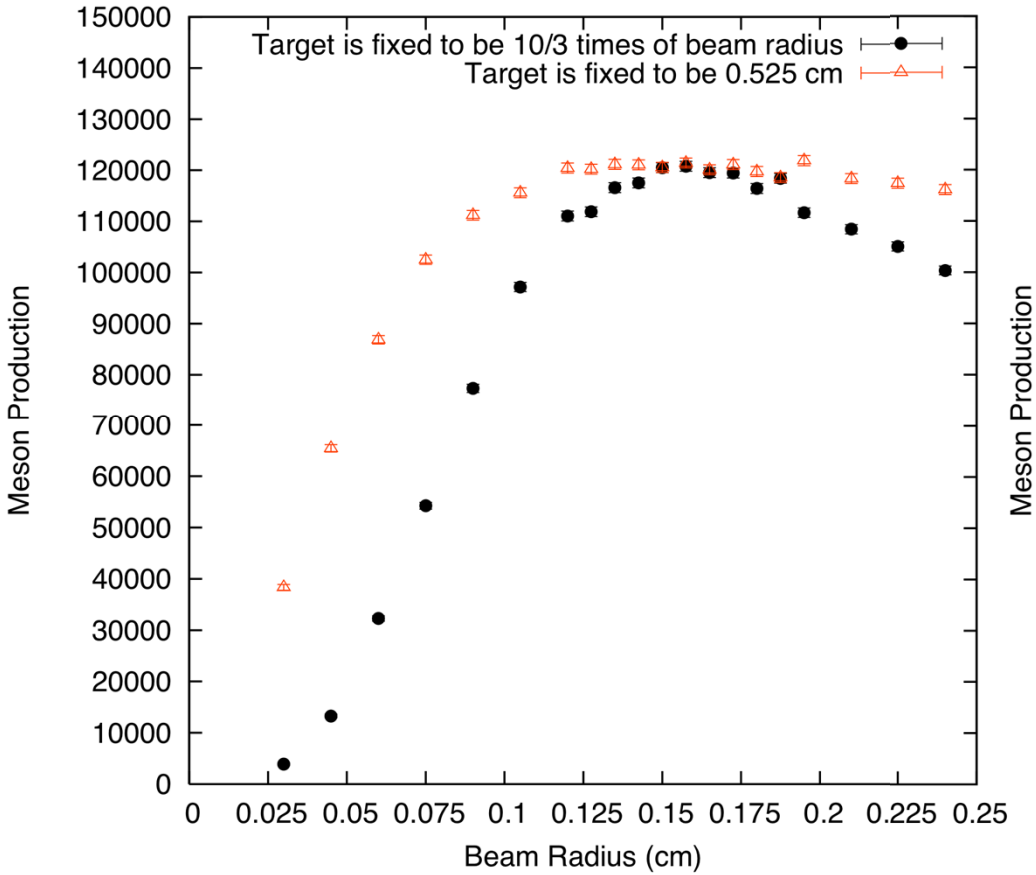
Optimized Target Parameters and Meson Productions at 8 GeV

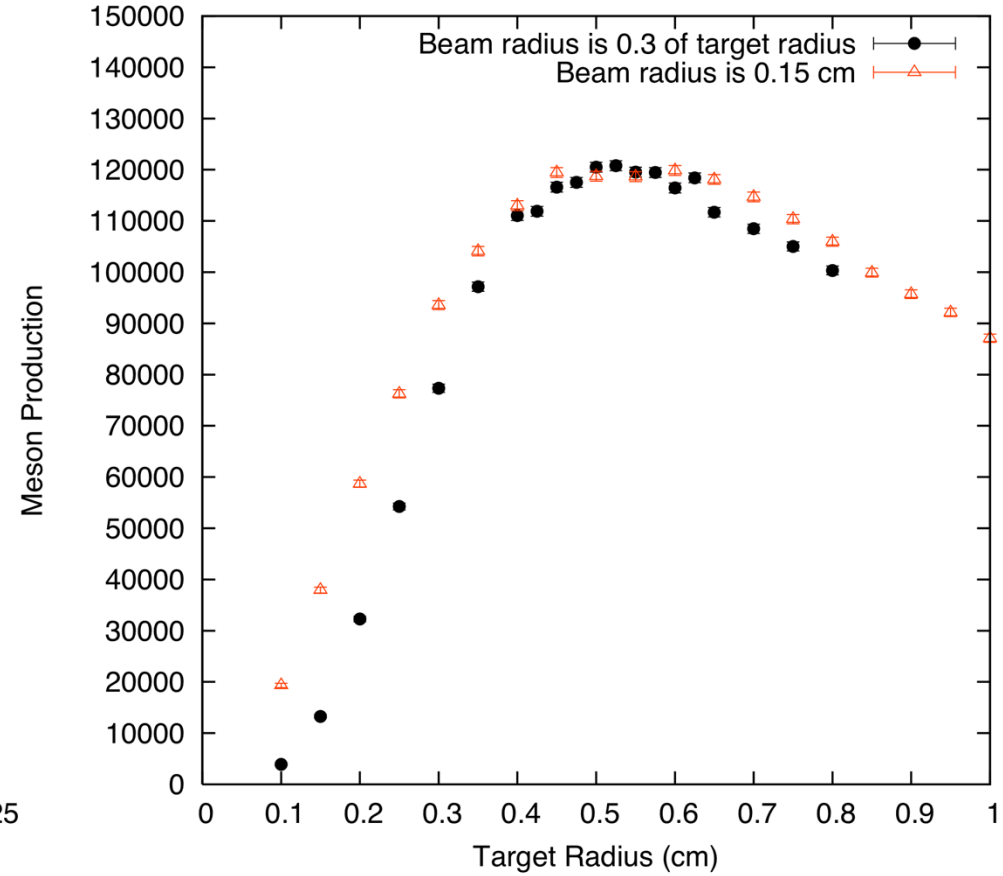
(Linear emittance is fixed to be 4.9 μm)

	Radius (cm)	Beam/jet crossing angle (mrad)	Beam angle/Jet angle (mrad)
Initial	0.404 (target)	20.6	117/137.6
1st Run	0.525 (target)	25	120/145
Old 2nd Run (vary target radius and beam radius is fixed to be 0.3 of target radius)	0.544 (target)	25.4	120/145.4
New 2nd Run (vary beam radius with fixed target radius of 0.525 cm; vary target radius with fixed beam radius of 0.15 cm.)	Beam radius: 0.15 Target radius: 0.548	26.5	127/153.5

Optimize beam radius and target radius separately

(Linear emittance is fixed to be 4.9 μm)





We found almost no improvement in optimized meson production if the beam radius is not fixed at 30% of target radius and optimized separately!

Optimized Meson Productions at 8 GeV

(Linear emittance is fixed to be 5 μm)

Gaussian Distribution	Meson Production
Simple (0.404cm/20.6mrad/117mrad)	32563
Focused beam with fixed beam radius of 0.1212 cm at z=-37.5 cm (0.404cm/20.6mrad/117mrad)	27489 (-15.6% less than Simple)
Focused beam with fixed Emittance at 5 μm (0.544cm/25.4mrad/120mrad)	30025 (-7.8% less than Simple) (8.9% more than Focused beam of radius at 0.1212 cm)
Focused beam with fixed Emittance at 5 μm (0.15 cm (beam)/0.54cm(target)/26.5mrad(crossing)/127mrad(beam)	30187

Optimized Target Parameters and Meson Productions at 8 GeV

(Linear emittance is fixed to be 2.5 μm)

	Beam Radius (cm)	Target Radius (cm)	Beam/jet crossing angle (mrad)	Jet angle (mrad)
Initial	0.404*0.3	0.404	20.6	137.6
1st Run	0.12	0.45	23	138
2nd Run	0.135	0.47	23	141

Gaussian Distribution	Meson Production
Focused beam with fixed Emittance at 2.5 μm (0.135 cm (beam)/0.47 cm(target)/23 mrad(crossing)/118 mrad(beam)	(less than Simple) (more than Focused beam of radius at 0.1212 cm)

Optimized Target Parameters and Meson Productions at 8 GeV

(Linear emittance is fixed to be 7.5 μm)

	Beam Radius (cm)	Target Radius (cm)	Beam/jet crossing angle (mrad)	Jet angle (mrad)
Initial	0.404*0.3	0.404	20.6	137.6
1st Run	0.2025	0.56	26.7	146.7
2nd Run	0.2025	0.60		

Gaussian Distribution	Meson Production
Focused beam with fixed Emittance at 7.5 μm (0.2025 cm (beam)/0.60 cm(target)/ mrad(crossing)/ mrad(beam)	(less than Simple) (more than Focused beam of radius at 0.1212 cm)

Optimized Target Parameters and Meson Productions at 8 GeV

(Linear emittance is fixed to be 10 μm)

	Beam Radius (cm)	Target Radius (cm)	Beam/jet crossing angle (mrad)	Jet angle (mrad)
Initial	0.404*0.3	0.404	20.6	137.6
1st Run	0.2325	0.60	29	153
2nd Run	0.2325	0.65	32	167

Gaussian Distribution	Meson Production
Focused beam with fixed Emittance at 10 μm (0.2325 cm (beam)/0.65cm(target)/32mrad(crossing)/135 mrad(beam)	27641 (-15% less than Simple) (60 % more than Focused beam of radius at 0.1212 cm)

Optimization with Fixed Emittance