

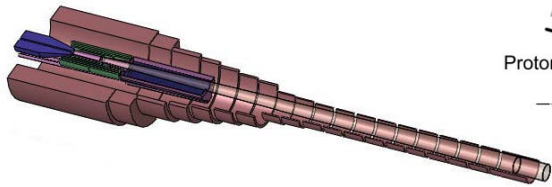
# INFLUENCE OF PROTON BEAM EMITTANCES ON PARTICLE PRODUCTION OFF A MUON COLLIDER TARGET

(IPAC13, TUPFI069)

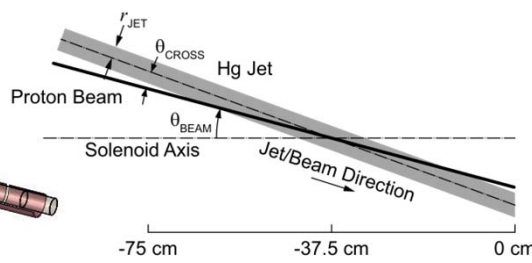
X. Ding<sup>5</sup>, J.S. Berg<sup>1</sup>, D. Cline<sup>5</sup>, V.B. Graves<sup>2</sup>, H.G Kirk<sup>1</sup>, K.T. McDonald<sup>4</sup>, H.K. Sayed<sup>1</sup>, N. Souchlas<sup>3</sup>, R.J. Weggel<sup>3</sup>  
<sup>1</sup>BNL, Upton, NY 11973, USA, <sup>2</sup>ORNL, Oak Ridge, TN 38731, USA,  
<sup>3</sup>Particle Beam Lasers, Inc., Northridge, CA 91324 USA  
<sup>4</sup>Princeton University, Princeton, NJ 08544, USA, <sup>5</sup>UCLA, Los Angeles, CA 90095, USA

The geometric parameters of a free Hg or Ga jet target for a Muon Collider or Neutrino Factory were optimized to maximize particle production by an incident, parallel proton beam with kinetic energies (KE) between 2 and 16 GeV using the MARS15 code. The optimized parameters were: the radius of the proton beam, the radius of the liquid jet, the crossing angle between the jet and the proton beam, and the incoming proton beam angle. We extended our optimization to focused proton beams for special cases of transverse emittances of 2.5, 5 or 10  $\mu\text{m-rad}$  at a KE of 8 GeV. We also studied the effect of a shift of the beam focal point relative to the intersection point of the beam and the jet.

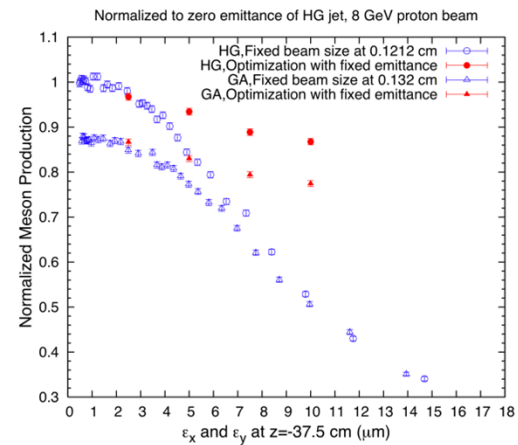
## 1. IDS120h target system,



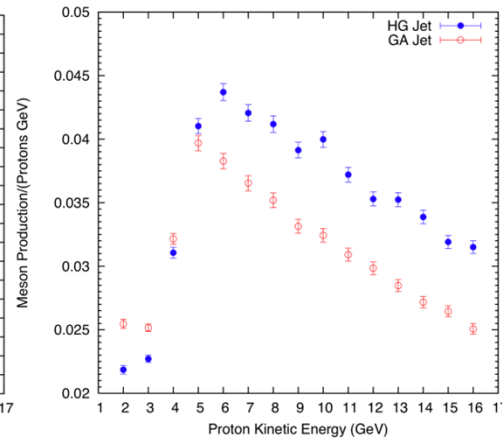
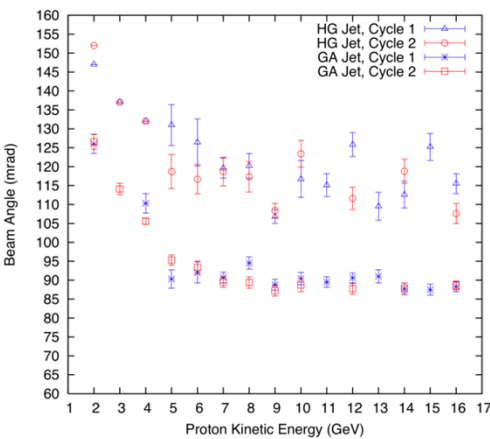
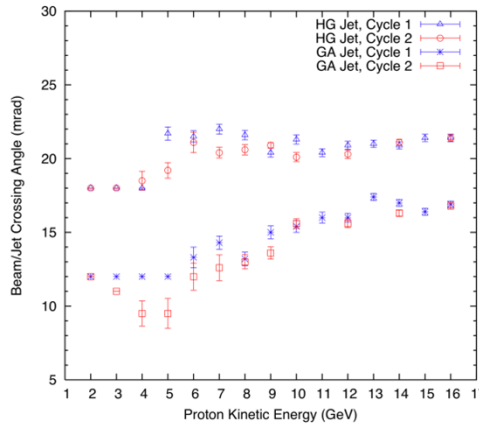
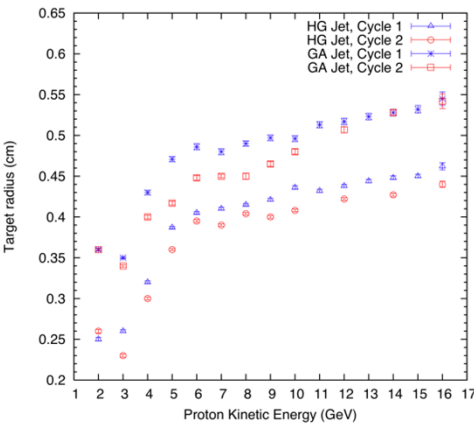
## and mercury jet target geometry



## 3. Influence of proton beam emittance on particle production

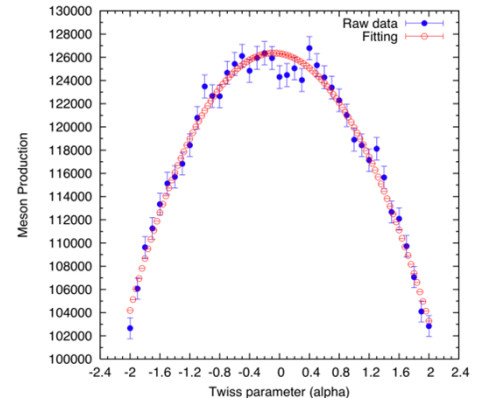


## 2. Optimized target parameters and meson production for incoming proton beam with zero emittance



Meson production decreases with increasing proton beam emittance, but careful optimization keeps this decrease to 7% for a Hg-jet target and 4% for a Ga-jet target for a proton beam of 8 GeV kinetic energy and transverse emittance  $\epsilon = 5 \mu\text{m-rad}$ , compared to the case of zero emittance beams. The optimized meson production a Ga-jet target is then about 88% of that for a Hg-jet target.

## 4. Effect of shift of the beam focal point



Meson production peaks when the beam focal point is about 5 cm upstream of the beam/jet interaction point, but the increase compared to focal point at the interaction point is negligible.

Meson production at low proton KE (below 4 GeV) may be higher for Ga than for Hg.