

# Update on Hg and C Target Distributions at 3 m

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# Review of Previous Talk

- Neuffer found significantly worse performance with C compared to Hg
  - Found larger emittance for C
- I looked at emittances at 3 m
  - Various Hg distributions had very different emittances
  - Neuffer used the one with the smallest emittance
  - C emittances were larger than Hg
  - C emittances better with do dump; with dump better with tilt

# Topics for This Talk

- Runs with Hg distributions from X. Ding, using recent MARS
- Look at energy spectrum

# New Distributions

- Hg,  $\theta_{\text{tilt}} = 117$  mrad,  $\theta_{\text{cross}} = 20.6$  mrad,  
 $\sigma_{\text{beam}} = 0.1212$  cm,  $r_{\text{target}} = 0.404$  cm, two settings  
of IQGSM (0,1)
  - Geometry same as 23-Mar-2013 and 06-Feb-2014 runs  
before, but not 28-Oct-2010
  - IQGSM gives a “choice of inclusive and exclusive event  
generators at nuclear inelastic interactions”
  - IQGSM=0: exclusive CEM (cascade exciton model?)  
for  $E < 3$  GeV, MARS inclusive for  $E > 5$  GeV,  
LAQGSM for some special cases. Old MARS default.

# New Distributions

- IQGSM=1: CEM for  $E < 0.3$  GeV, LAQGSM for  $0.5 \text{ GeV} < E < 8 \text{ GeV}$ , MARS inclusive for  $E > 10 \text{ GeV}$ . New MARS default.
- C with IQGSM=0 (earlier was with IQGSM=1), tilt, no dump

# Emittances

	$\mu^-+$	$\mu^- -$	$\mu^++$	$\mu^+ -$	$\pi^-+$	$\pi^- -$	$\pi^++$	$\pi^+ -$
101028	31.8	13.1	35.6	13.7	23.1	14.9	26.0	15.0
130323-XDing	41.2	16.4	43.8	17.2	33.1	21.4	32.8	21.2
140206-HSayed	44.2	25.0	44.2	25.0	33.8	31.9	32.6	31.0
141215-XDing-00-d	68.1	24.9	68.3	27.2	48.9	32.7	47.8	33.7
141215-XDing-00-n	49.8	22.7	51.2	24.6	35.1	27.1	35.3	28.3
141215-XDing-65-d	58.1	21.4	60.2	23.2	43.6	26.7	43.3	27.9
141215-XDing-65-n	51.5	22.1	52.7	23.9	36.5	26.0	36.6	27.4
150113-XDing-C-IQGSM0	52.4	23.1	52.1	23.8	38.2	28.4	37.3	28.1
150113-XDing-Hg-IQGSM0	29.5	13.7	31.8	14.0	20.5	15.1	20.7	14.8
150113-XDing-Hg-IQGSM1	30.4	13.4	34.5	15.2	21.1	14.4	21.9	15.1

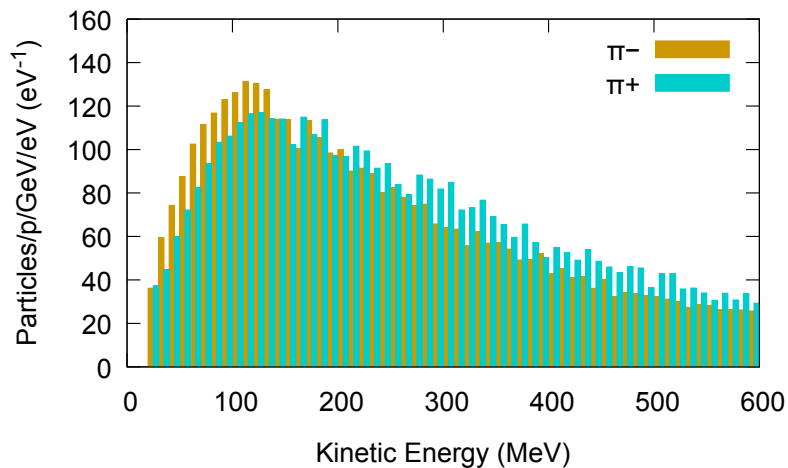
- Normalized canonical emittances in mm
- Large sign is sort of helicity
- Names to left are distributions, contain date
  - Carbon: two digit angle, d for dump, n for no dump

# Analysis

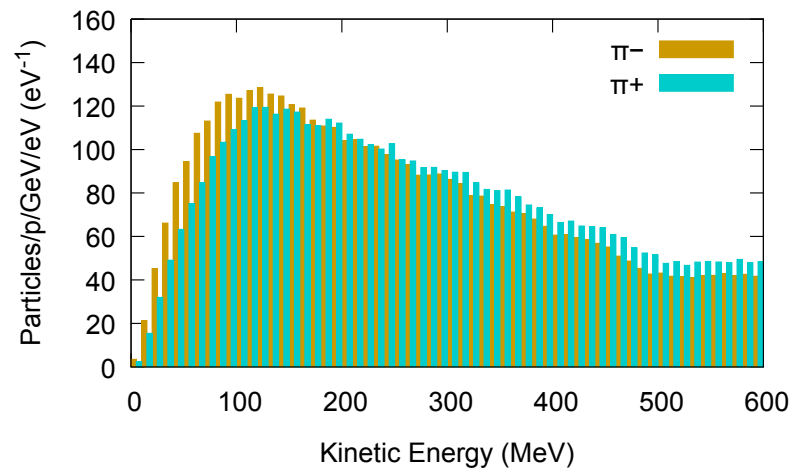
- IQGSM choice doesn't affect emittances
- Hg emittances are small with new MARS: like 28-Oct-2010 run.
- Don't understand why 23-Mar-2013 and 06-Feb-2014 emittances were higher

# Pion Distributions for Hg

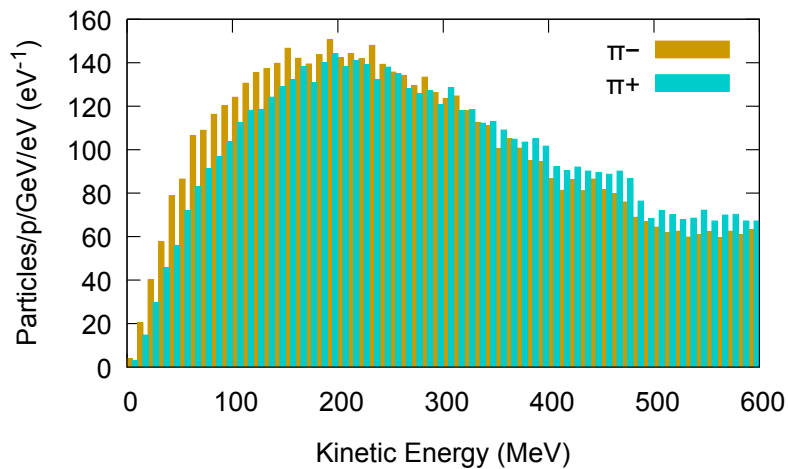
28-Oct-2010



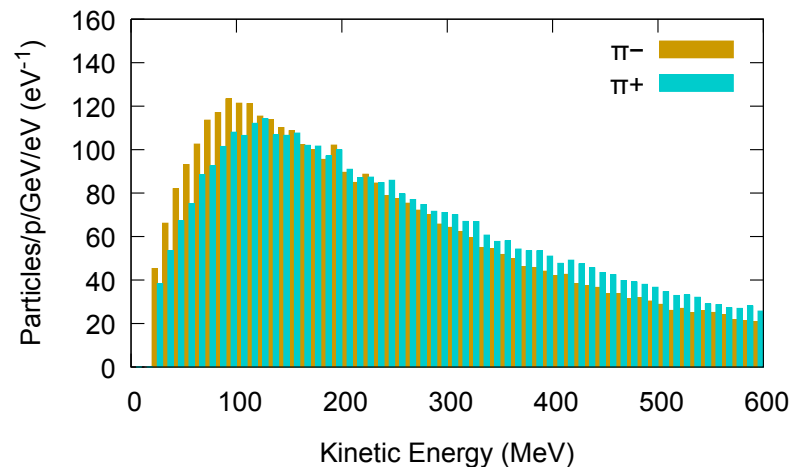
23-Mar-2013



06-Feb-2014



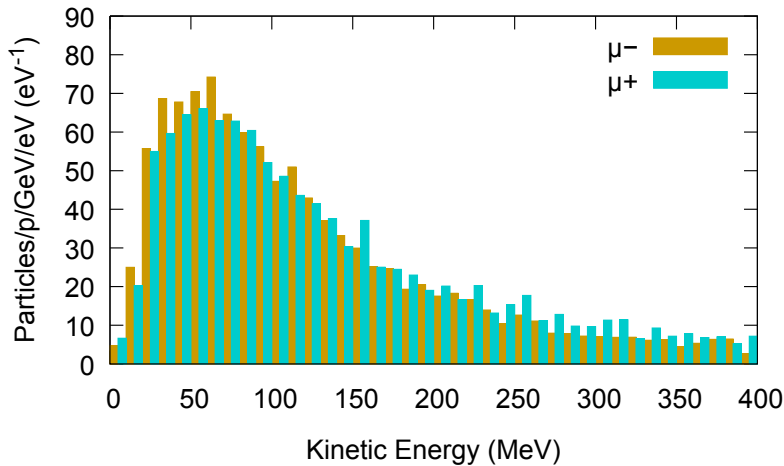
13-Jan-2015 IQGSM=0



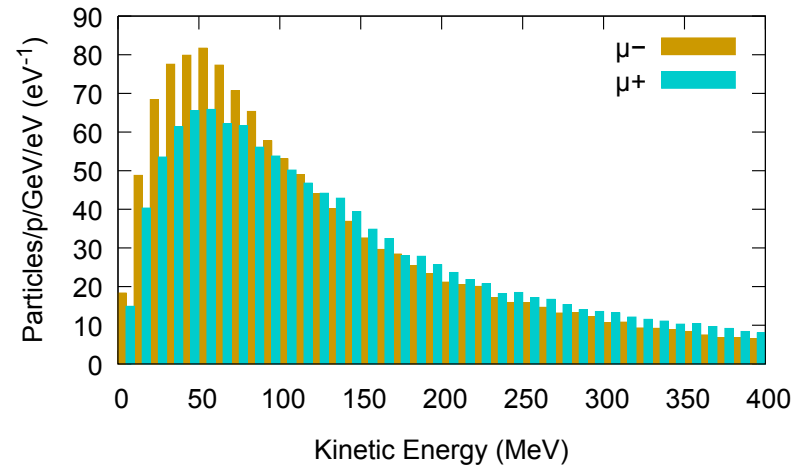


# Muon Distributions for Hg

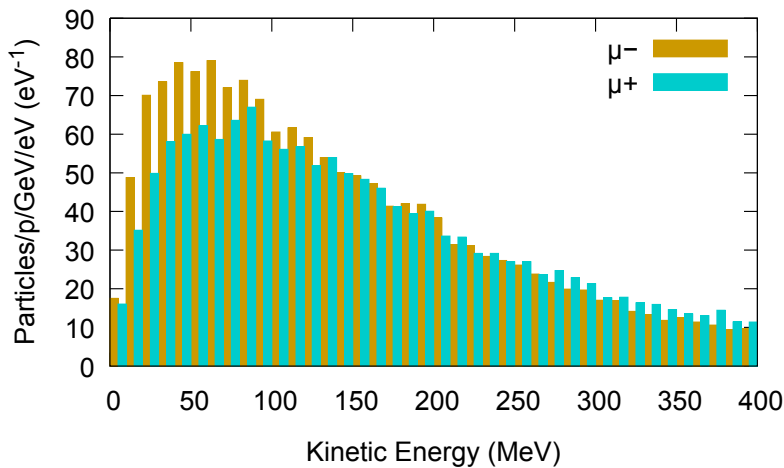
28-Oct-2010



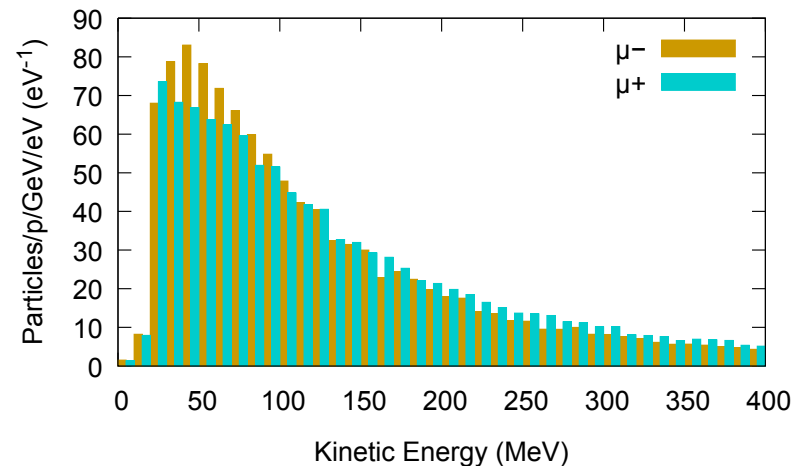
23-Mar-2013



06-Feb-2014

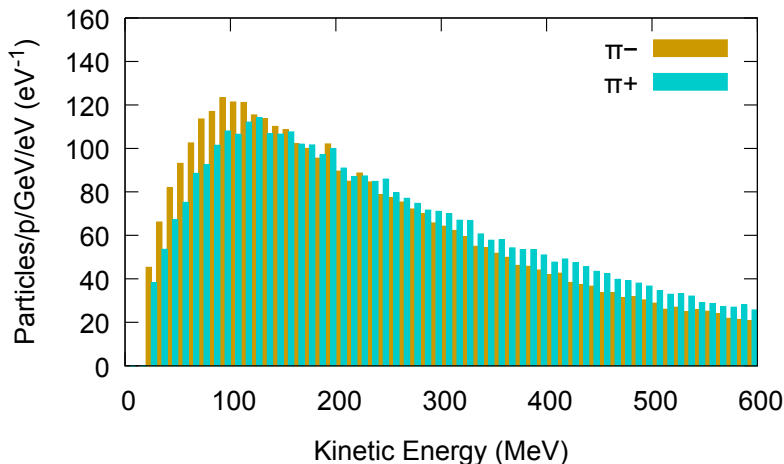


13-Jan-2015 IQGSM=0

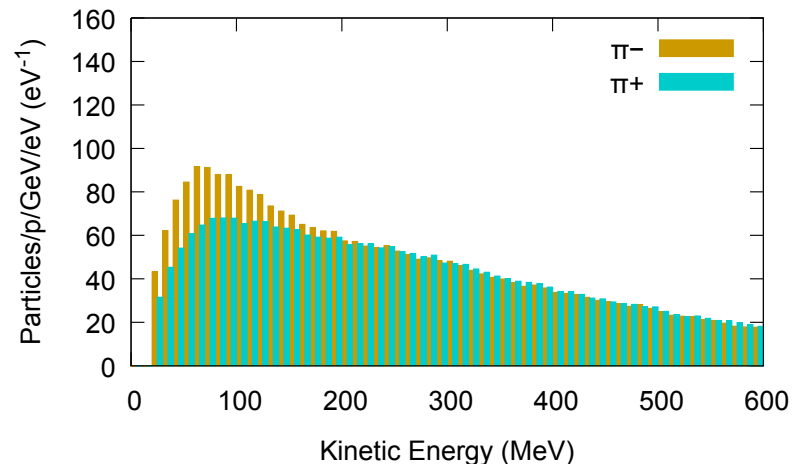


# Distributions for Hg, IQGSM

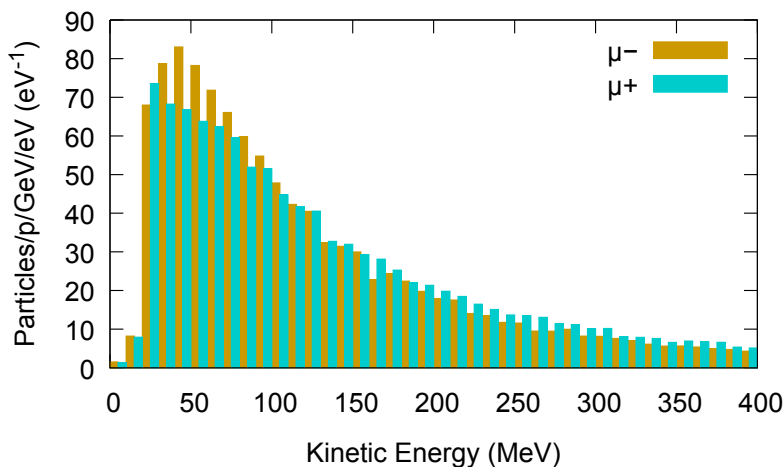
13-Jan-2015 IQGSM=0



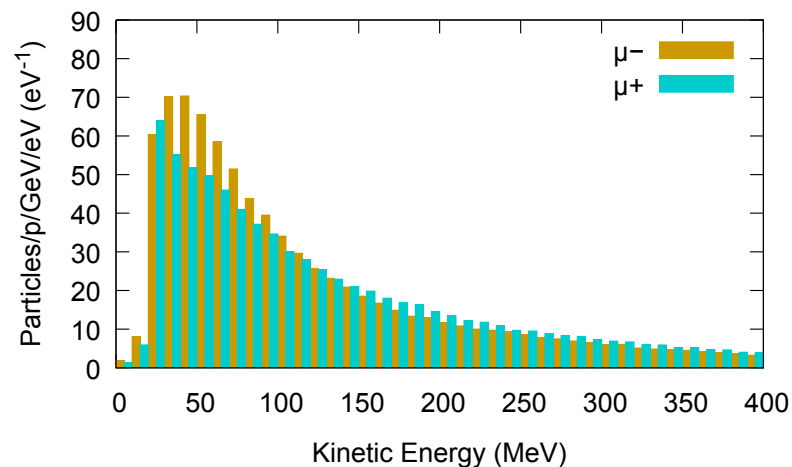
13-Jan-2015 IQGSM=1



13-Jan-2015 IQGSM=0



13-Jan-2015 IQGSM=1

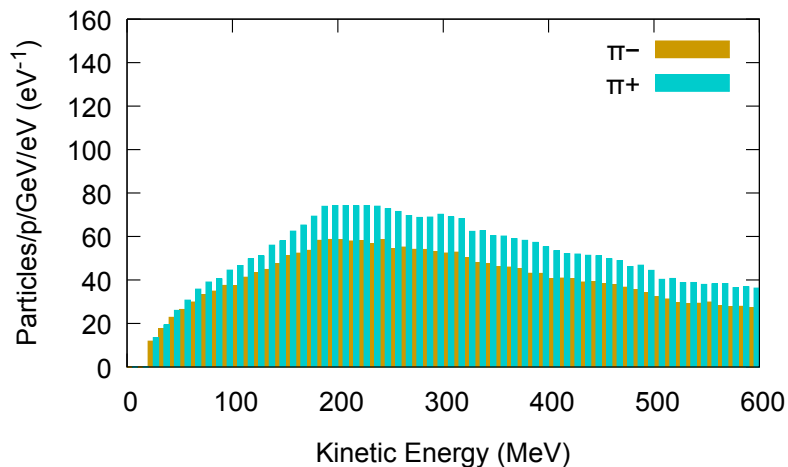


# Distributions for Hg

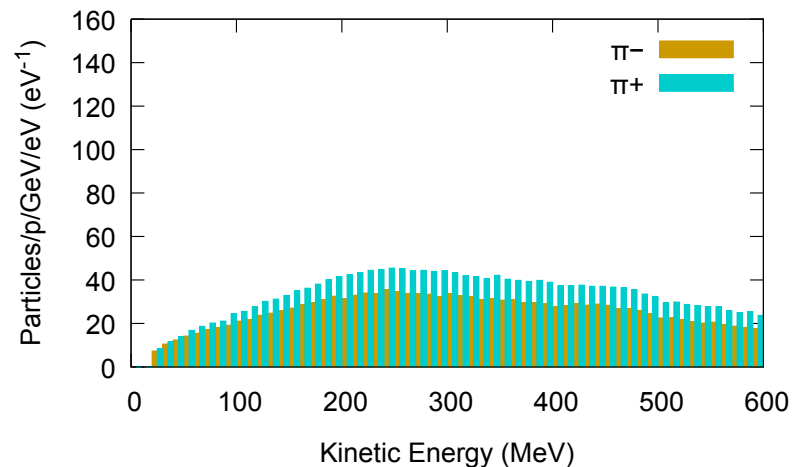
- Have IQGSM=0 for all cases
- Everything similar, except 06-Feb-2014
- IQGSM has a major impact on the number and spectrum
  - Will reduce difference between C and Hg

# C: Pions vs. Geometry

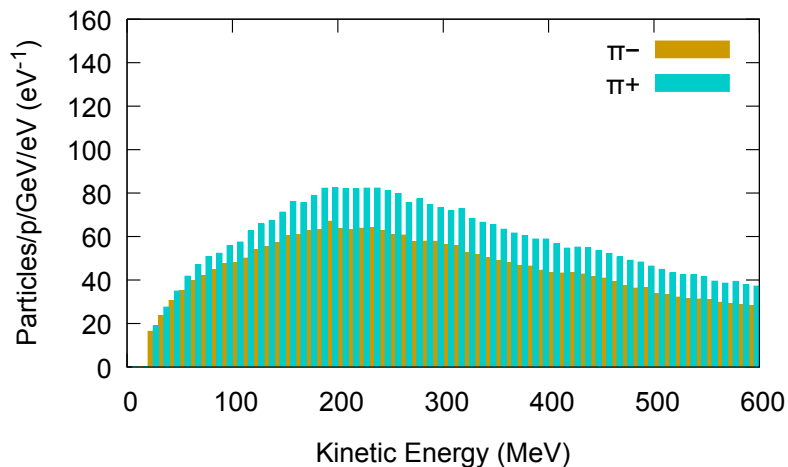
## No Tilt, No Dump



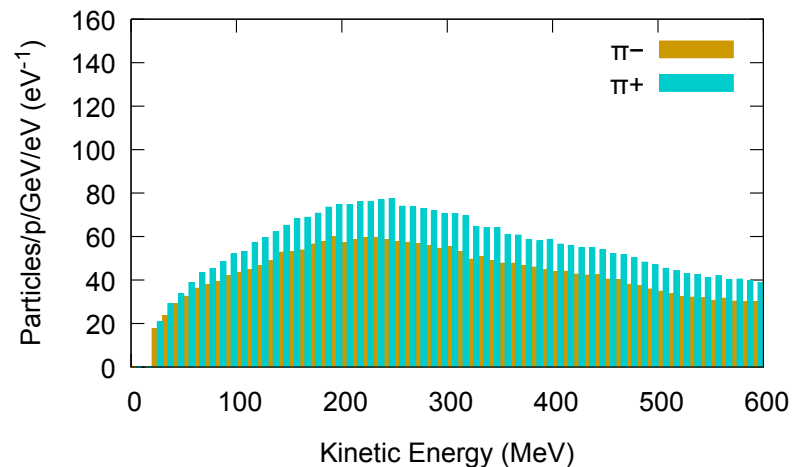
## No Tilt, With Dump



## With Tilt, No Dump

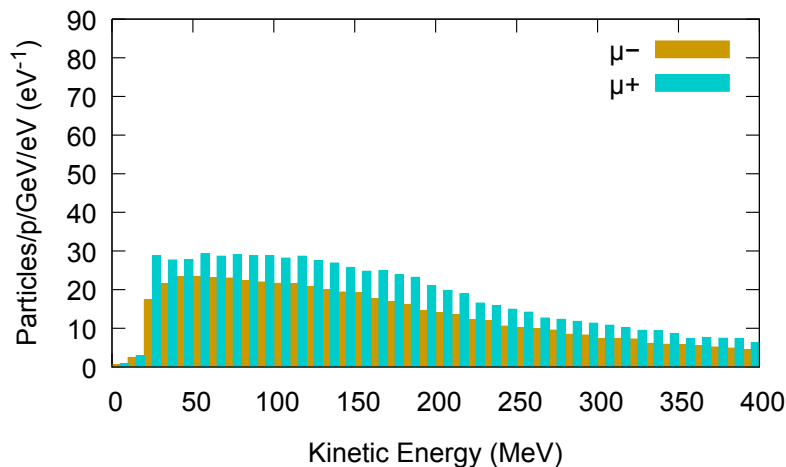


## With Tilt, With Dump

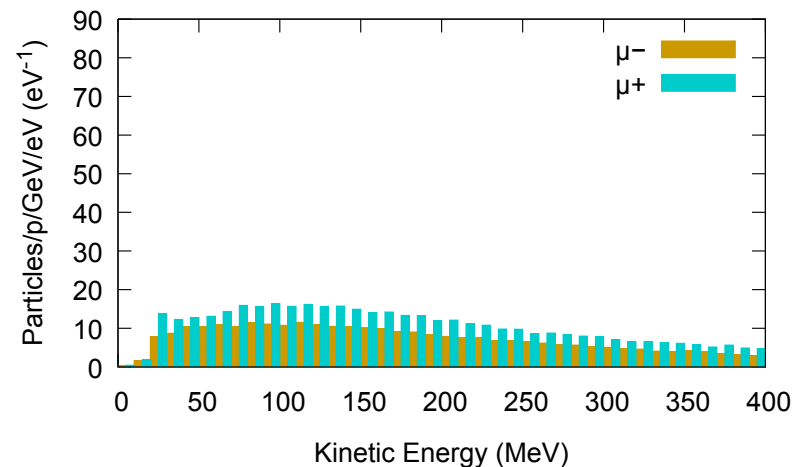


# C: Muons vs. Geometry

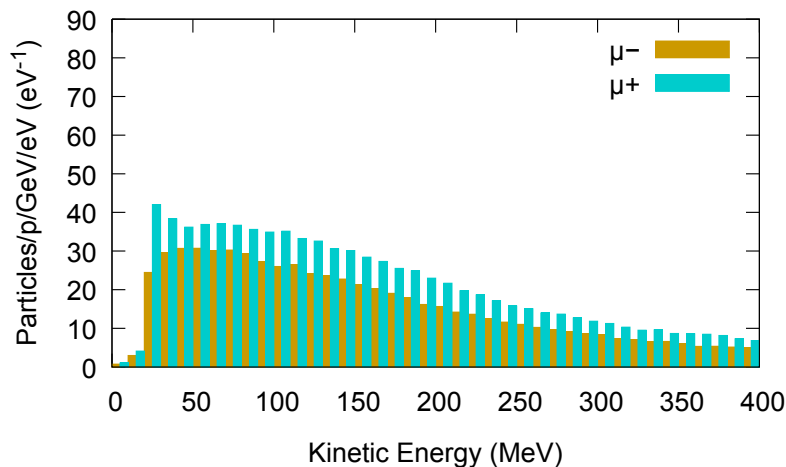
## No Tilt, No Dump



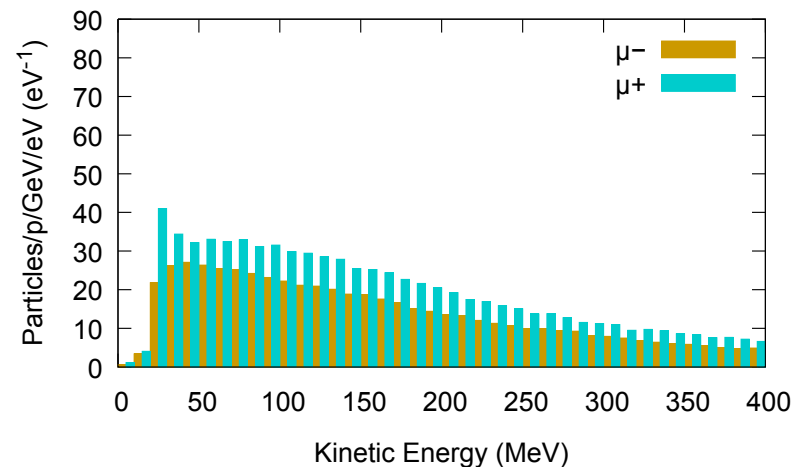
## No Tilt, With Dump



## With Tilt, No Dump



## With Tilt, With Dump

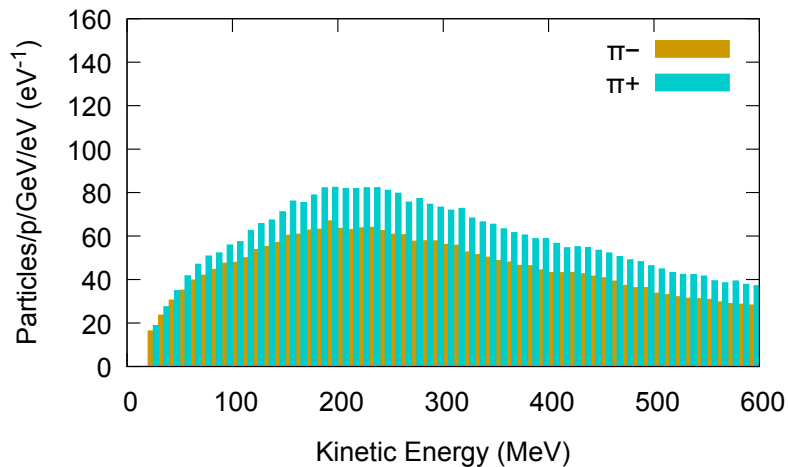


# C vs. Geometry

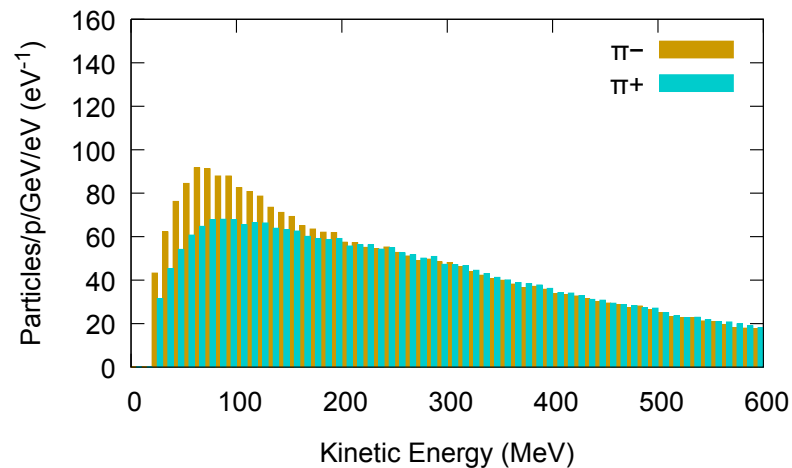
- Only major production hit is no tilt, no dump
- With tilt no dump is the best

# C vs. Hg

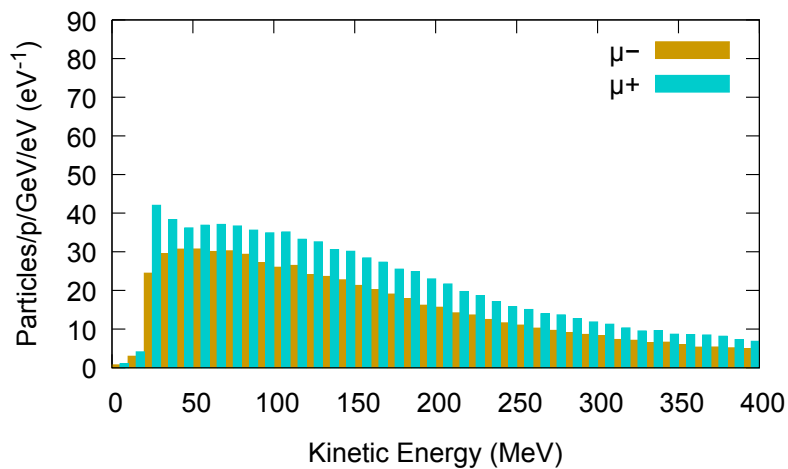
C



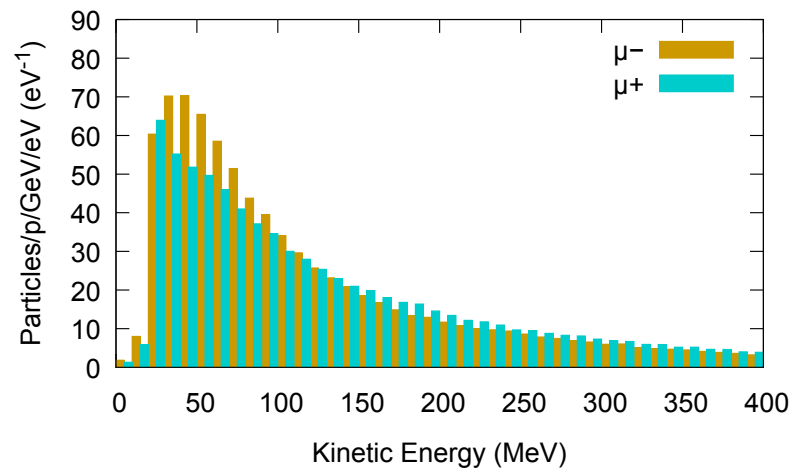
Hg



C



Hg



# C vs. Hg

- Similar total number of particles for Hg and C (need to check more carefully)
- Spectrum of C weighted to higher energy than Hg
- Should use very different NBPR to capture C than for Hg
- Entire system likely longer for C than Hg



# Conclusions

- Reasons for differences in Hg distributions still not understood
  - Results with latest MARS most similar earliest run which Neuffer used
- Use of IQGSM=1 over IQGSM=0 has significant negative impact
  - Are we sure which model is best?
- C emittances confirmed larger than Hg
  - Cause unknown: larger target?
- Nothing good about no tilt, no dump C configuration

# Conclusions

- Hg and C have similar particle counts, with C weighted to higher energy
  - NBPR and decay channel should be designed very differently for the two cases
- Some detailed MARS studies could help understand the unknowns