Target: pion yields & energy deposition

John Back
University of Warwick

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Plans for EU Design Study Task 4.3

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  - Supervised by Steve Boyd & myself (& RAL)

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  - Target choice: liquid metal jet, powdered (tungsten) jet, solid target (**graphite** or tungsten)
  - Optimise secondary **pion production** from proton beam hitting target
  - Study **solenoidal** (baseline) and **horn** (new) magnet arrangements for pion focusing
  - Assess **shielding requirements** and **radiation load**: input to WP 7 (magnet design)
  - Incorporate more engineering details: target support structure
  - Optimise proton beam energy and size σ; angle between target & proton beam (proton driver WP)

- **Simulation software**:
  - Implement geometry using **pyg4ometry** package (python), based on earlier work (MARS & FLUKA)
  - **BDSIM** (Geant4) & **FLUKA** (CERN): pion yields and energy deposition, using *identical* **pyg4ometry** setup
    - Also **MARS** if it could be made available at RAL or CERN
  - **BDSIM** target could be plugged into a complete end-to-end Muon Collider simulation
  - Hadronic model updates since historical (~10 years ago) Neutrino Factory & Muon Collider studies

- **Milestone** for D4.3: **report on target system (design & performance)**
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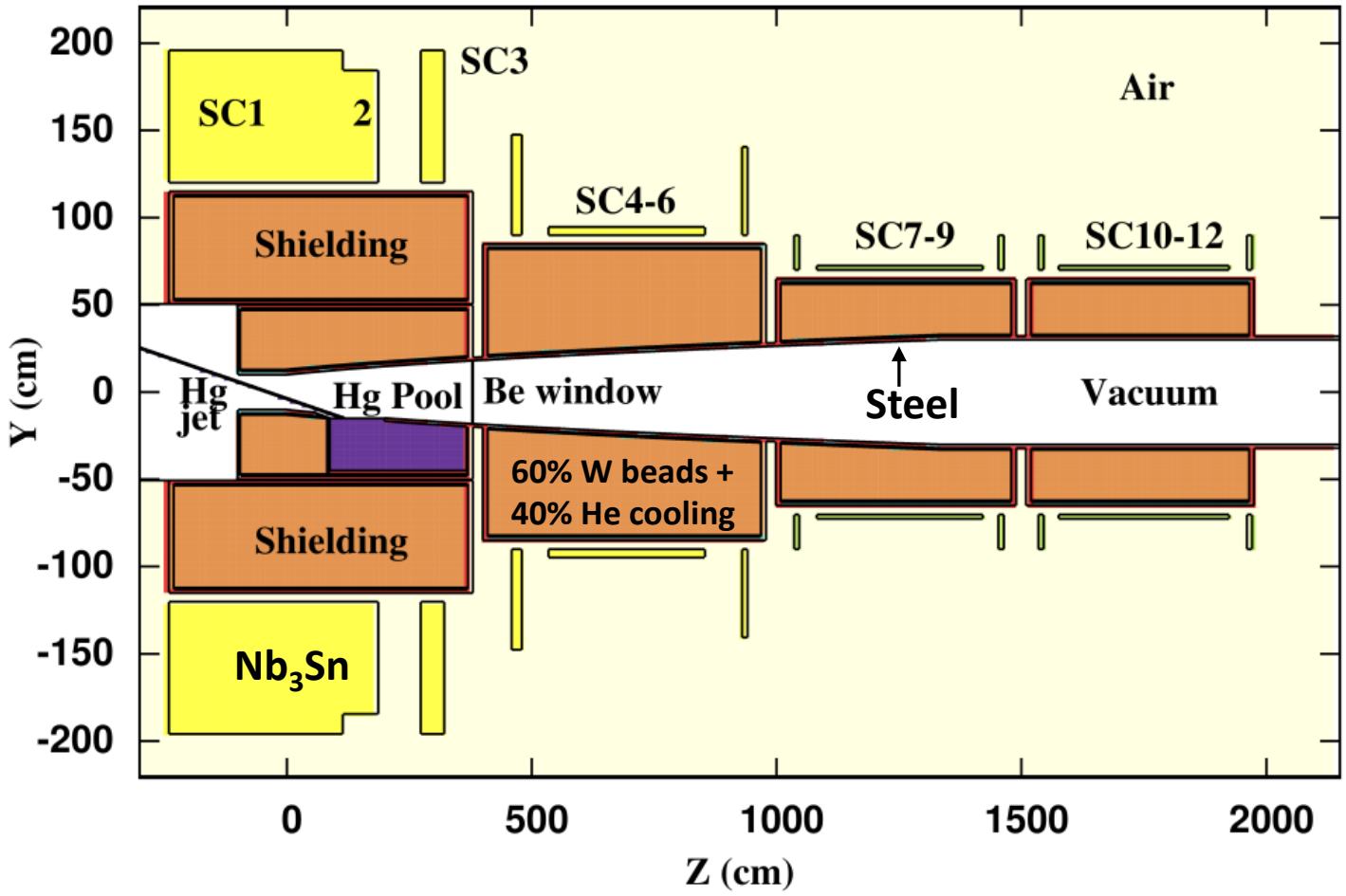
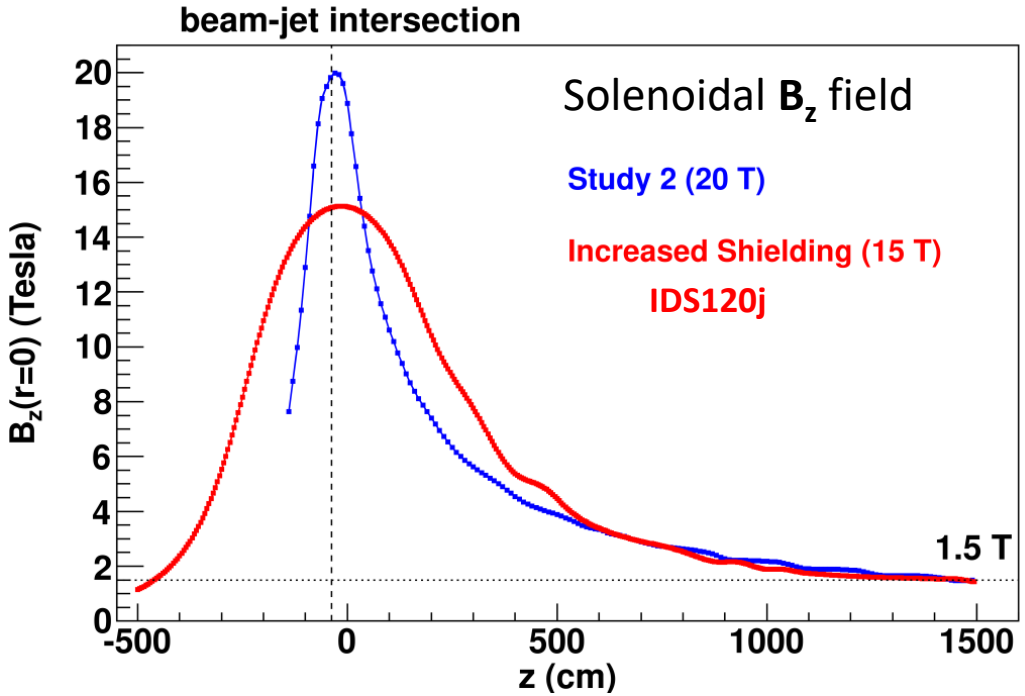
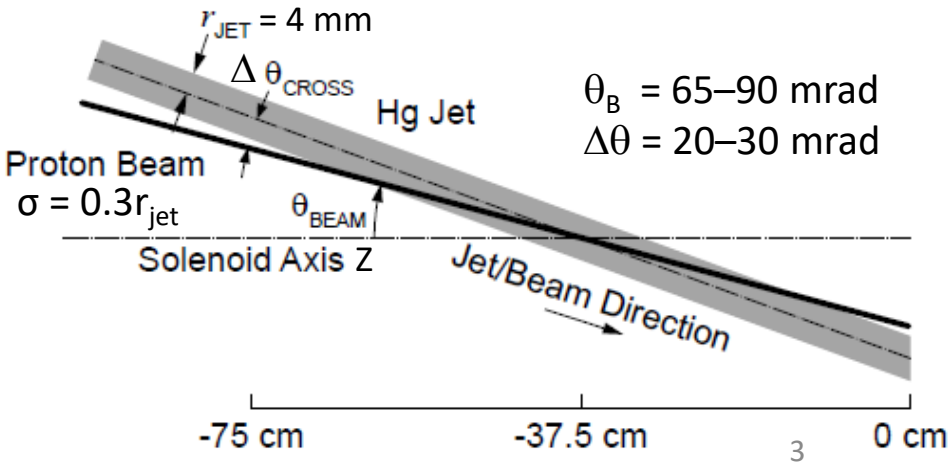
Muon Collider/Neutrino Factory target layout





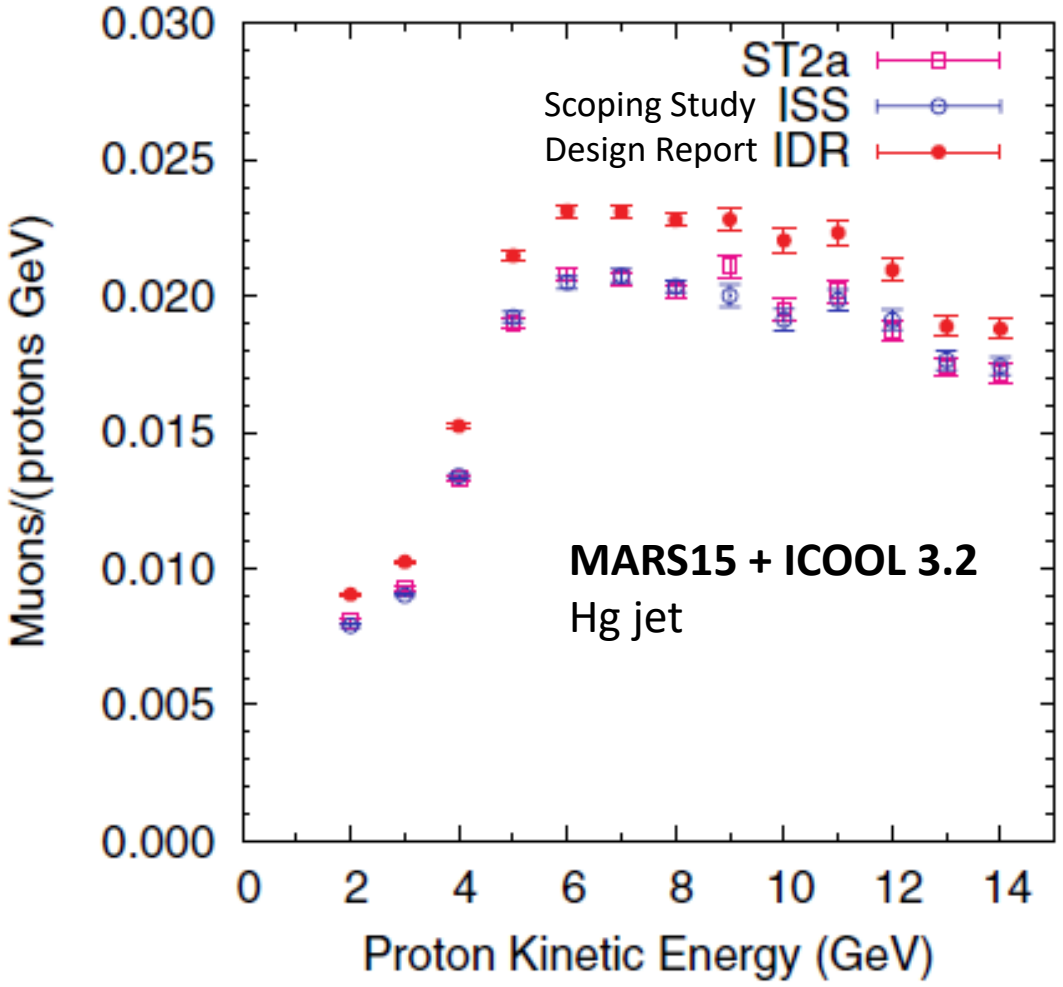


"**IDS120j**": International Design Study, 120 cm SC inner radius, version j

Same magnet arrangement: Hg jet, W solid or powder, graphite

Muon Collider/Neutrino Factory pion & muon yields

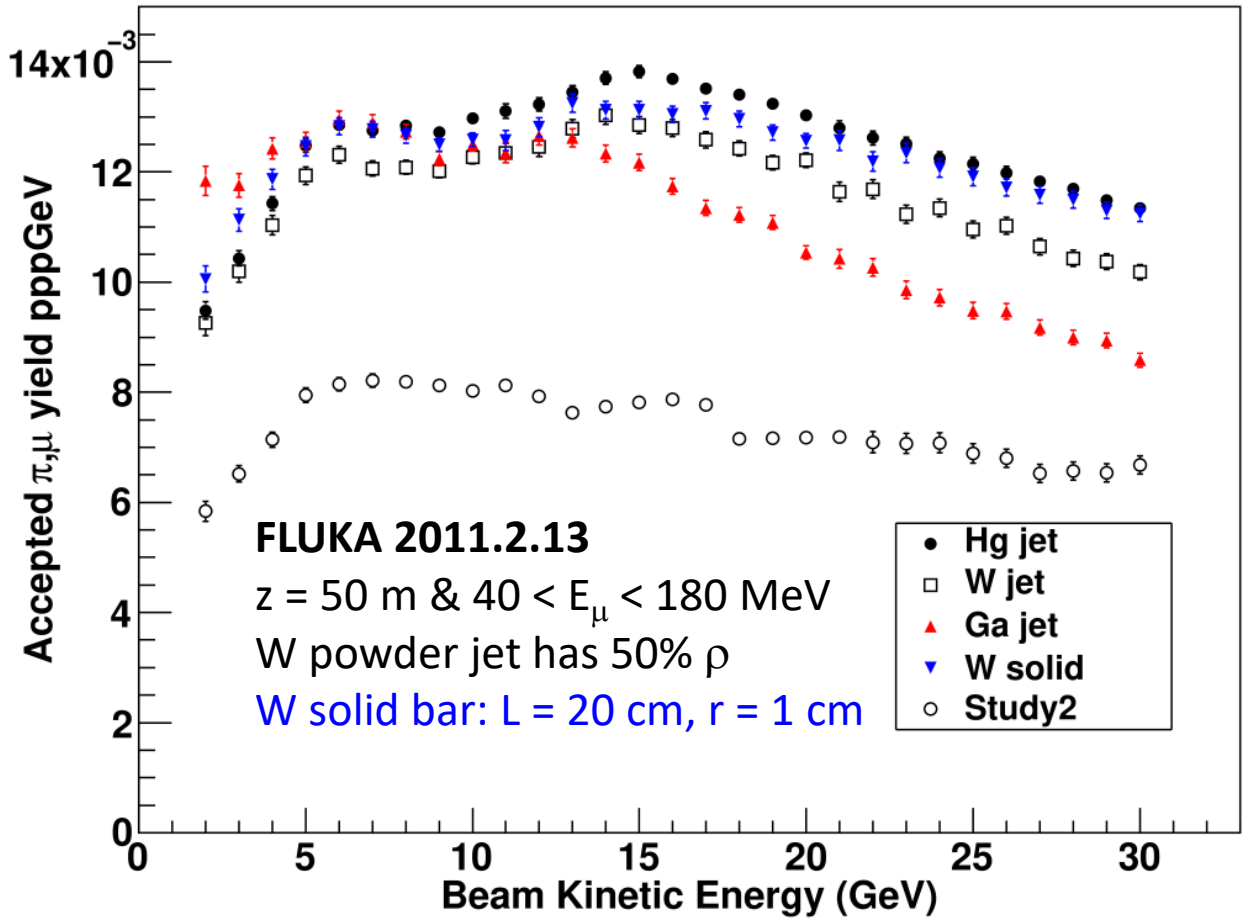
Total $N(\mu^+) + N(\mu^-)$



X. Ding et al., Phys. Rev. ST AB 14, 111002 (2011)

Ga jet study: **X. Ding et al.,** MOPPC044, IPAC12

Charge-averaged 0.5x[$N(\mu^+) + N(\mu^-)$]

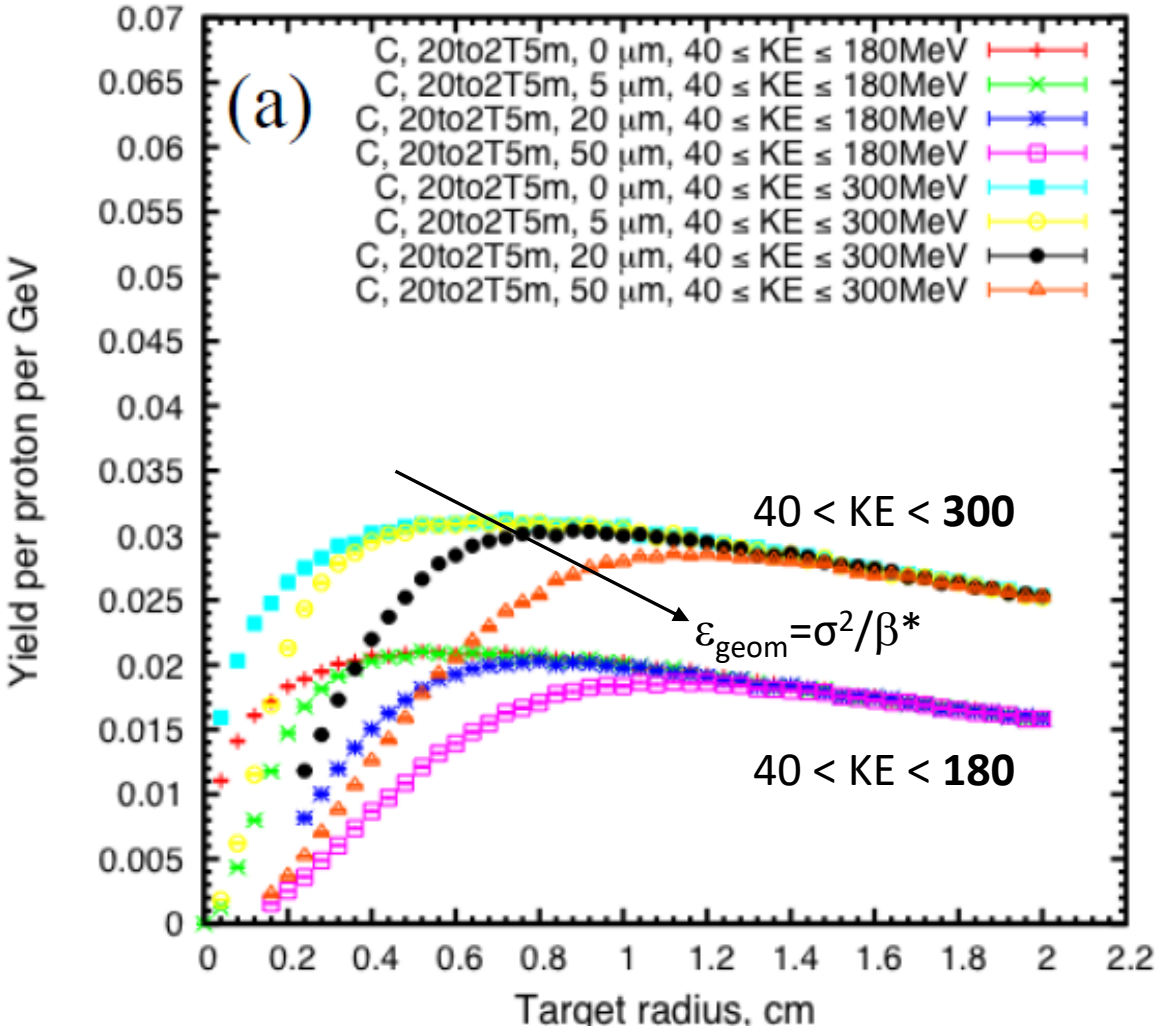


J. Back et al., Phys. Rev. ST AB 16, 021001 (2013)

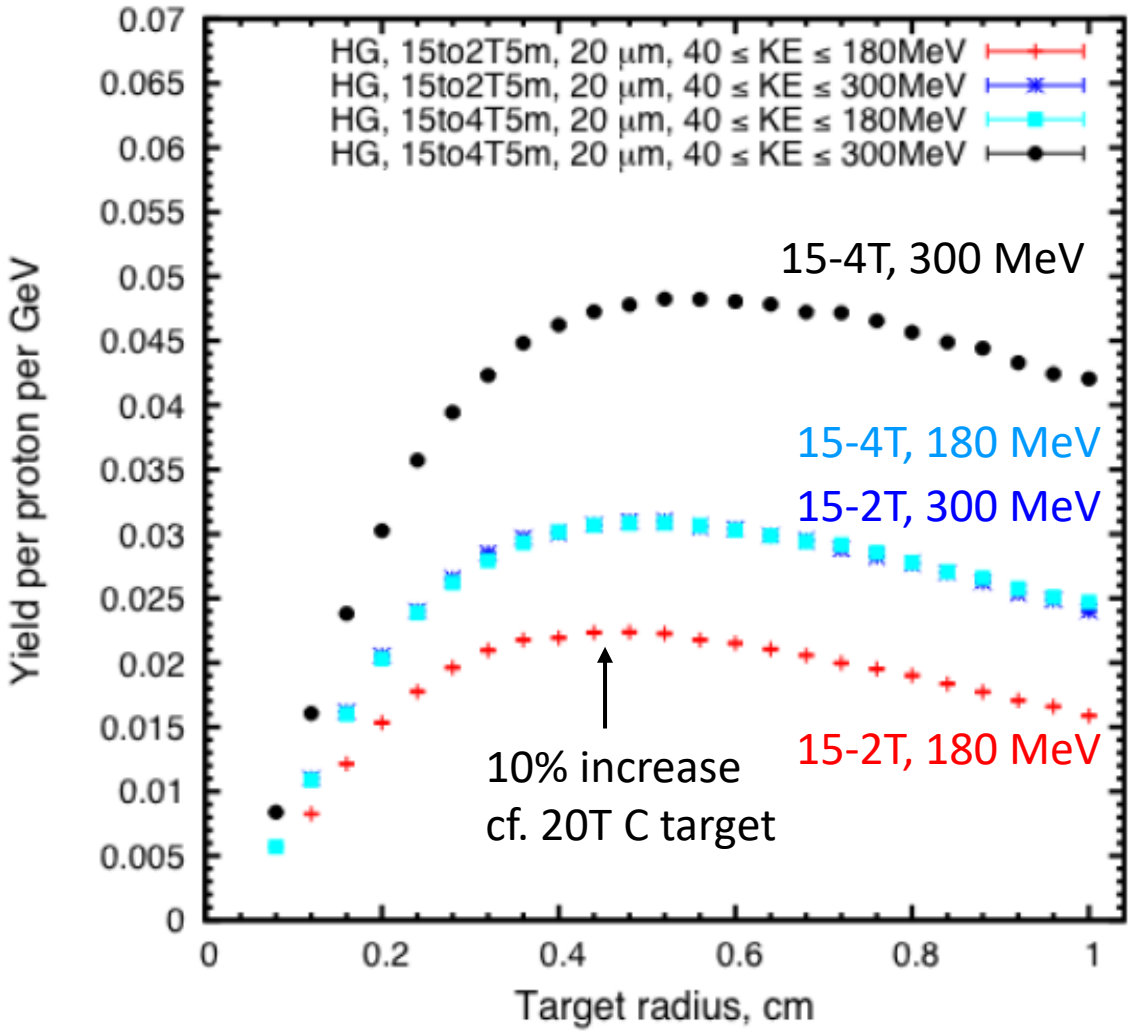
W jet idea: **C. Densham et al.**, WE1GRC04, PAC09

Graphite & Hg yields vs target radius (6.75 GeV p beam)

Graphite rod L = 80 cm, B = **20T** – 2T over 5m, **1 MW**

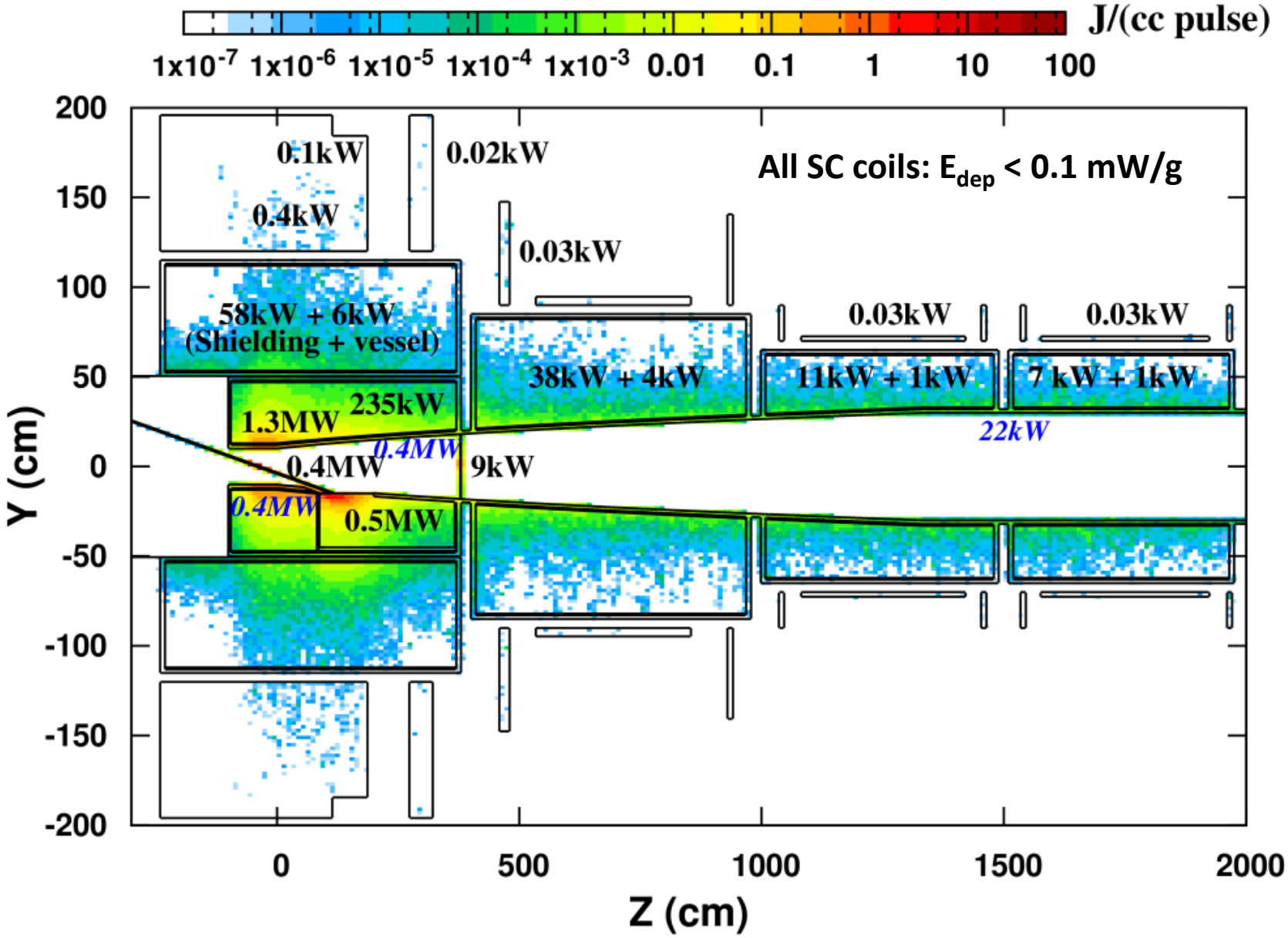


Hg jet, B = **15T** – 2T or 4T over 5m, **4 MW**



MARS15(2014) study: **X. Ding et al.,** [TUPMY044, IPAC16]

Muon Collider energy deposition (FLUKA 2011.2.13)



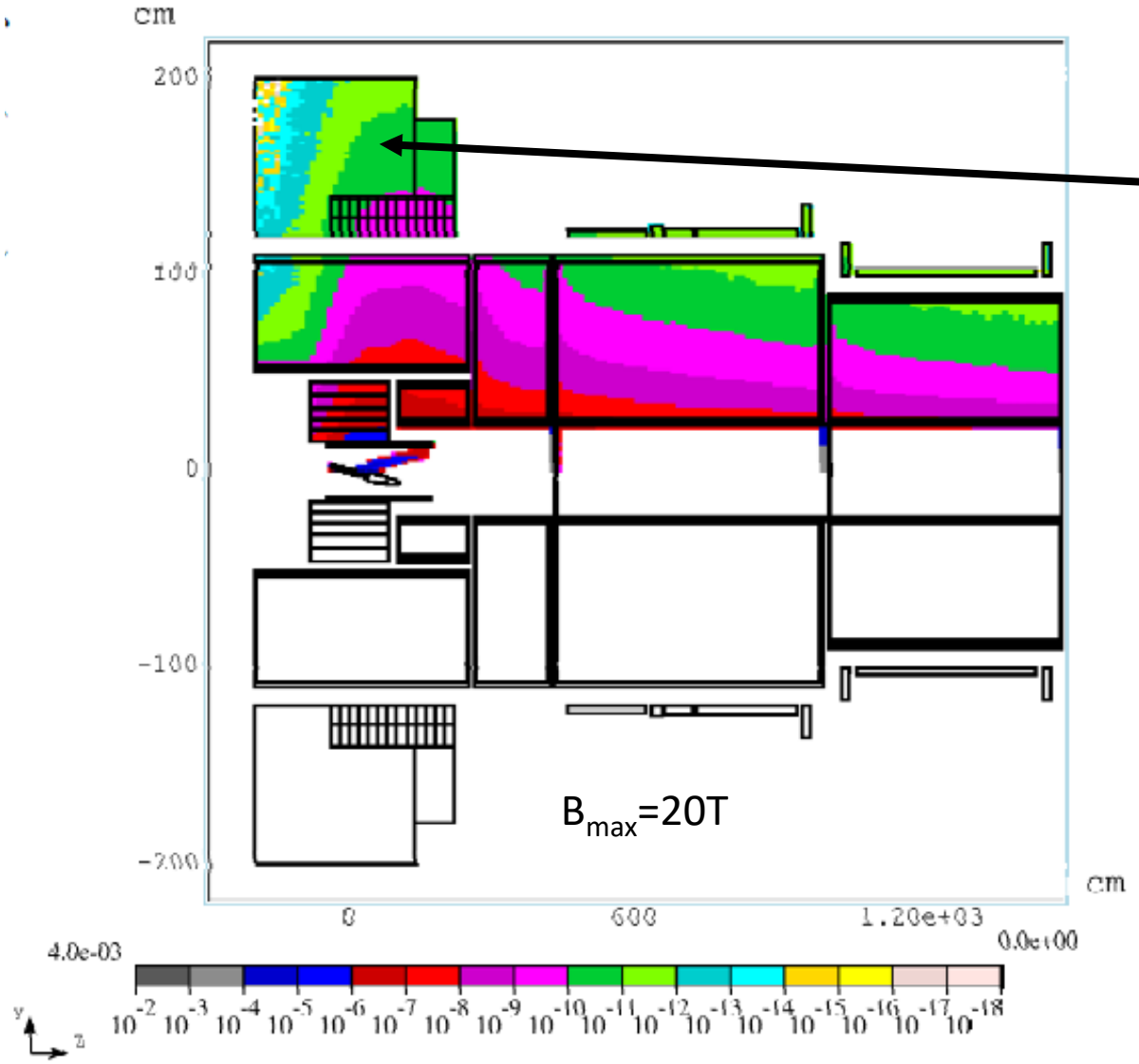
Phys. Rev. ST AB 16, 021001 (2013)

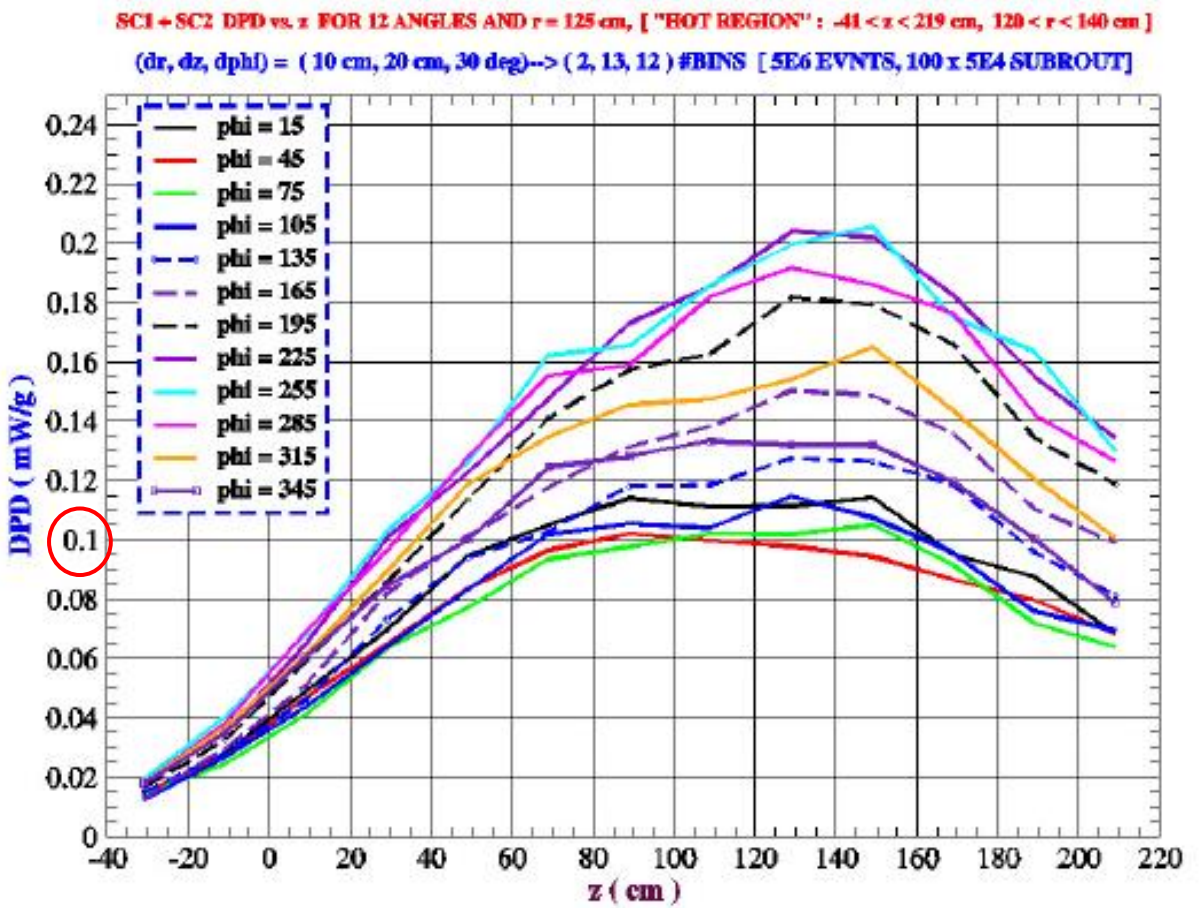
Hg jet target, B_{max} = 15T
IDS120j geometry

p beam:
8 GeV, 4MW, 50Hz,
3.125 x 10^{15} s^{-1}

Agrees with MARS15 (~10%)
N. Souchlas et al., WEPPD036, IPAC12

Graphite target energy deposition: 4 MW & MARS15(2014)





Power density in SC coils 1+2 vs z axis for different ϕ

Solenoidal helices: target π production peaks at $\phi = 235^o$

For 4MW, max E_{dep} = 0.2 mW/g = 2 x safe limit

K. McDonald et al., THPRI088, IPAC14

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