New capture solenoid design

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MAP Friday Meeting

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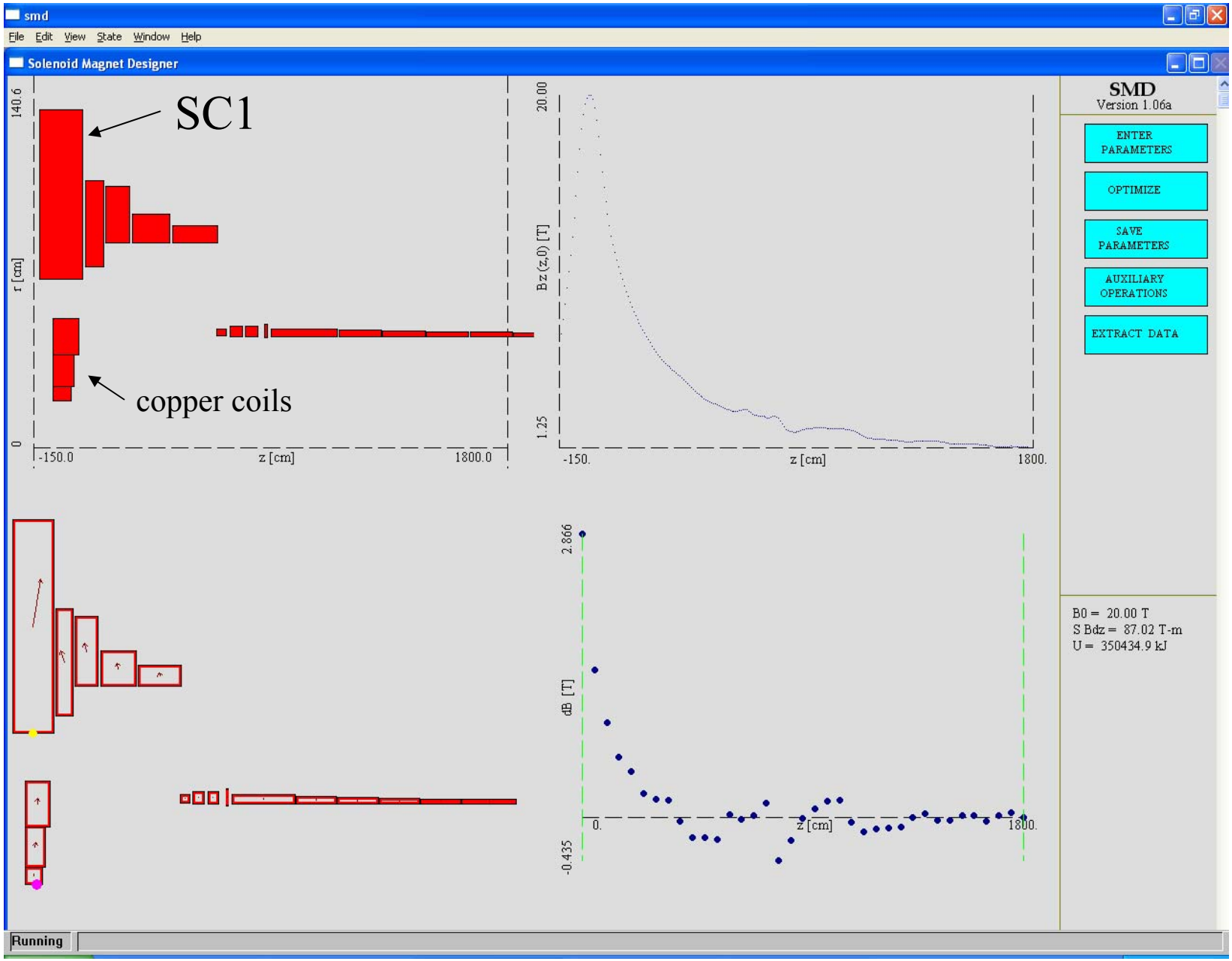
Introduction

- protecting the superconducting magnets near the target from radiation is one of the major unresolved R&D issues for MAP
- many problems need to be addressed
  1) average heat load on 4K cryogenic system
  2) peak heat fluctuations causing quenches
  3) limited lifetime due to radiation damage
  4) constraining very large forces on magnets
- new approach discussed here to alleviating problems 1-3
  increase inner radius of magnets near target
  allows additional shielding between target and coils

Study 2 design



Problems with Study 2 design

- cryogenic heat load on SC1 ~ 20 kW at 4 K
- lifetime from radiation damage ~4 years for 4 MW beam
- enormous force on iron plug
- iron plug blocks access to front of target

→ need <u>new design</u>

- larger inner radius to allow more shielding
- longer flat region over target to eliminate Fe plug
- new taper to 1.5 T used in IDS front end design

Field profiles

- "end" of target defined as z = 0

Study 2

had iron plug to smooth field near jet entrance
downfield profile
20 T at z = -30 cm
falls to 1.25 T at 18 m

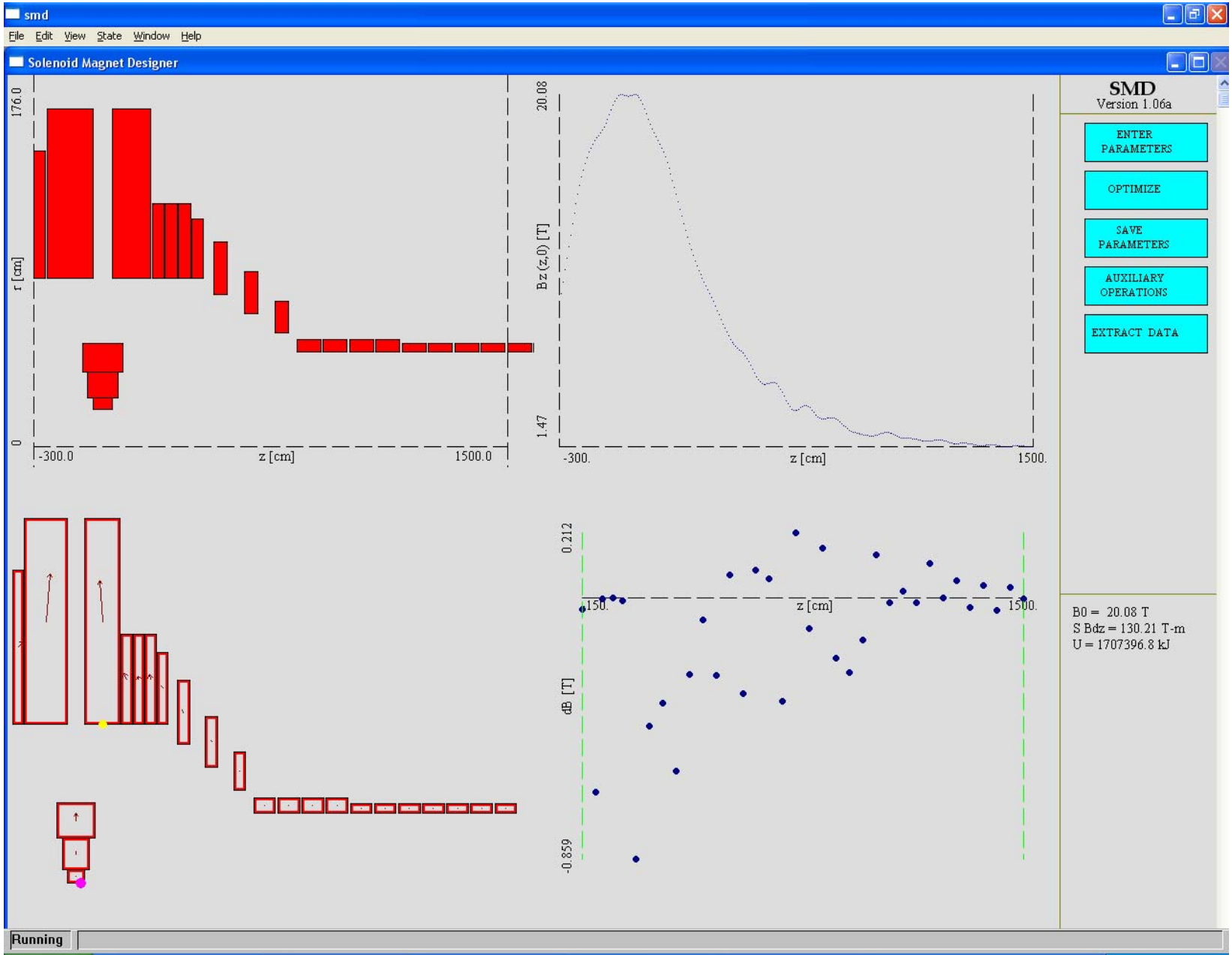
$$B(z) = \frac{B_o}{1 + k\,z}$$

IDS-NF

uses Kevin Paul profile (flat at end points)
20 T at z = -37 cm
falls to 1.5 T at 15 m

$$B(z) = \frac{\Phi / \pi}{a_o + a_2\,z^2 + a_3\,z^3}$$

New design ids80d



Comparison

	r_{inner} [cm]	B_p [T]	hoop [MPa]	F_z [MNt]	$\delta B_o/B_o$ [%]	flat [cm]
Study 2	64	20.2	217	168	5	60
ids80d	80	20.2	376	282	0.4	75

- disadvantage is larger hoop stress and forces

Summary

- have new capture magnet design with additional space for shielding
- need MARS studies to determine reduction in heat deposition
- need engineering analysis of increased forces on magnets
- another alternative
  - replace Cu coils with HTS layer at 80 cm
  - new design by Bob Weggel
- miniworkshop on target capture systems
  - organized by Harold Kirk
  - at BNL on November 29-30