Magnet Options for Q1 and Q2 (Ring-Ring and Linac-Ring)

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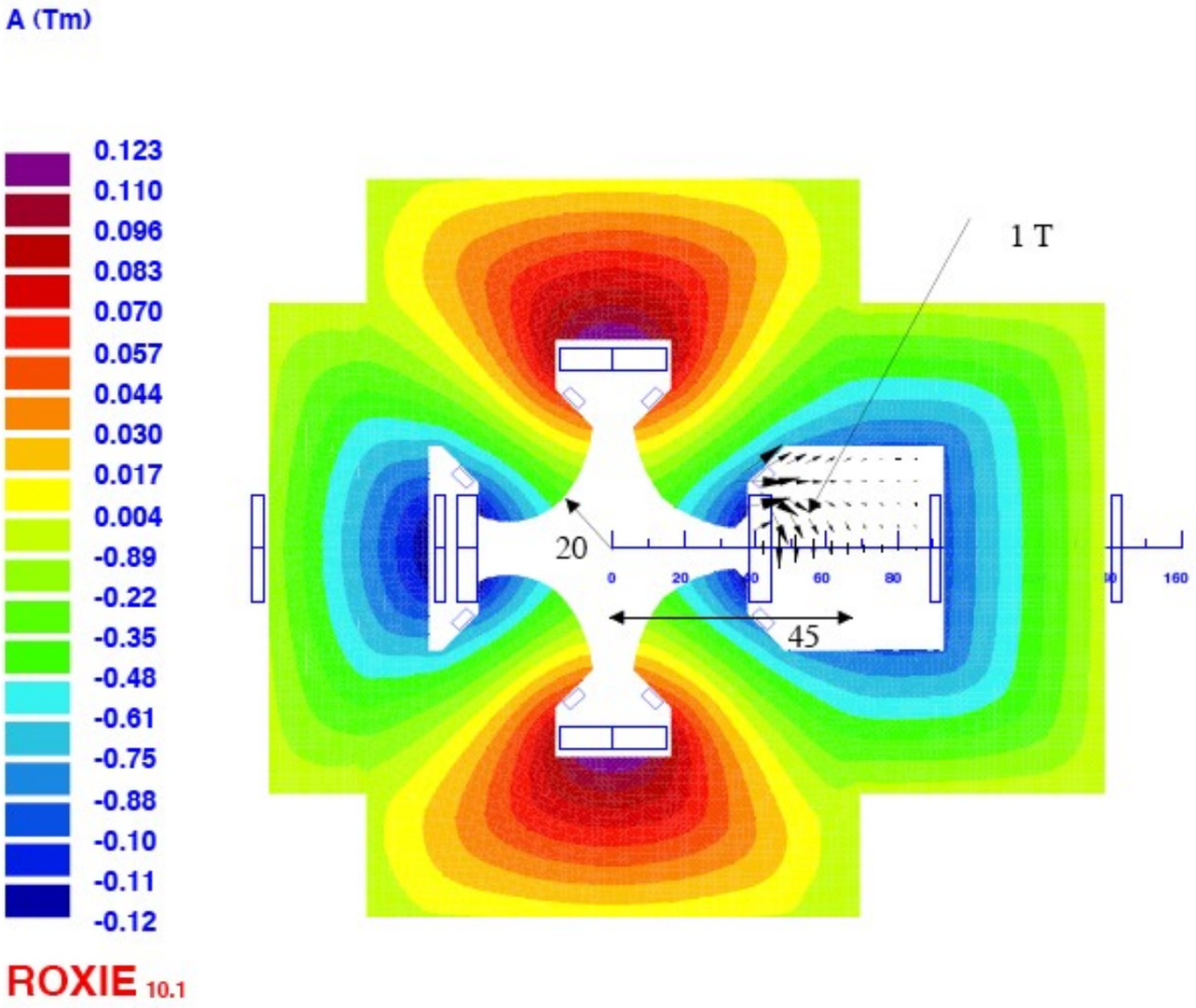
Ring-Ring

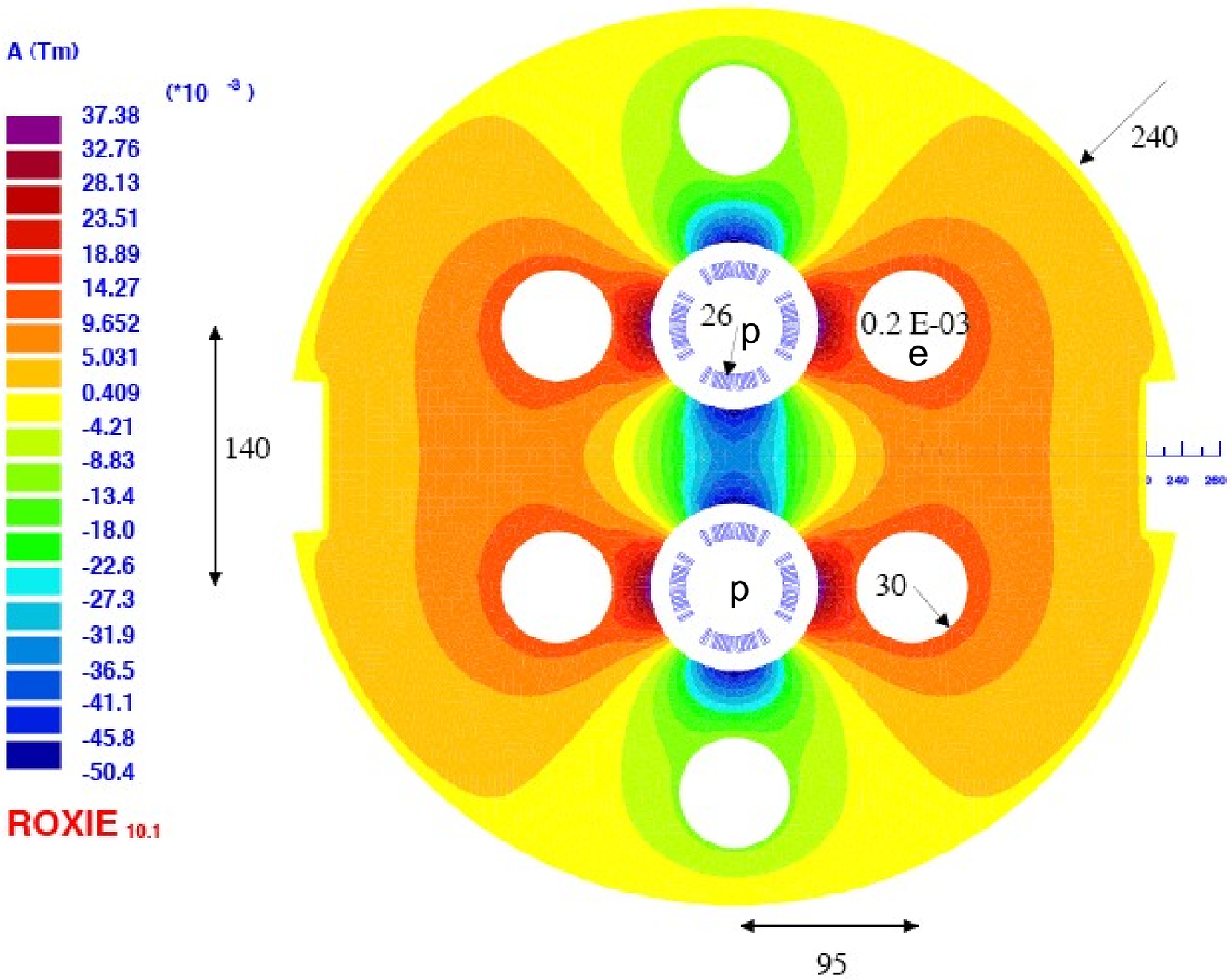
130 T/m
Aperture radius 35 mm (one beam pipe for pp)
Aperture radius 26 mm (two beam pipes)
Field free region for e-beam (as close as possible to p-beam

Ring-ring superferric (KEKb type) magnet



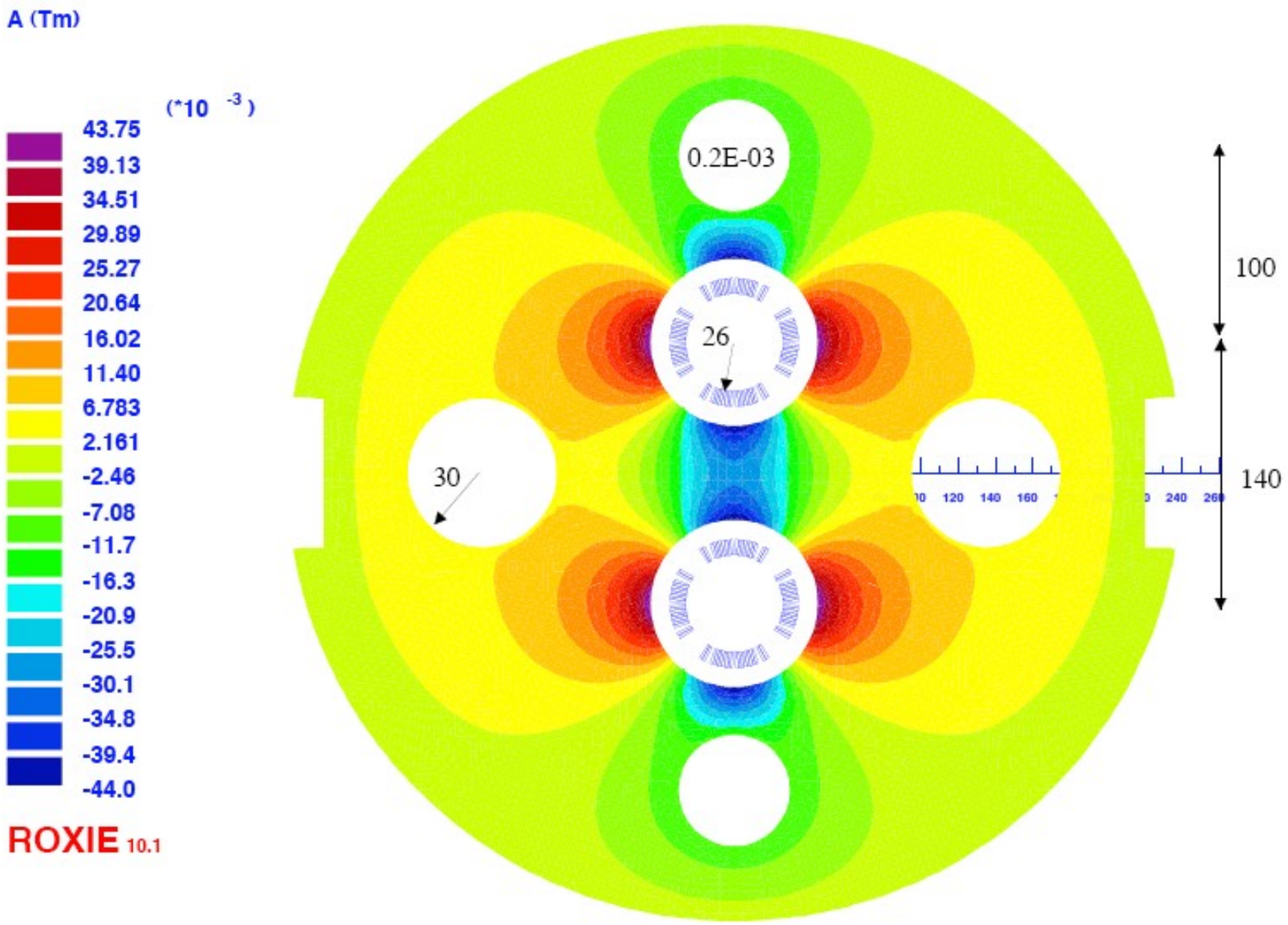
SC (Nb-Ti), Two Apertures (Vertical)

Ring-Ring option2, double aperture, MQY cable, 7400 A



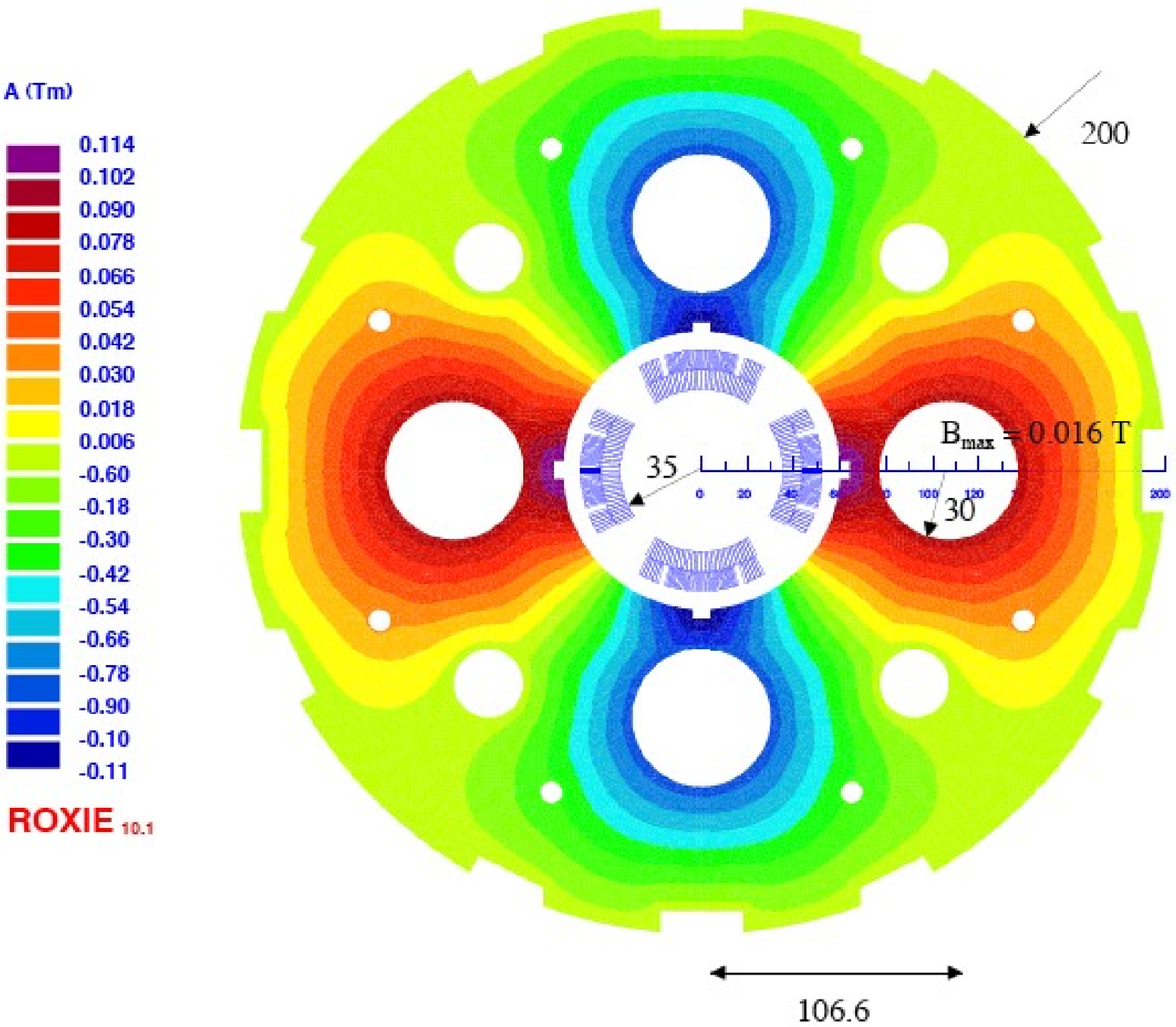
SC (Nb-Ti), Two Apertures (Horizontal)

Ring-ring option 3: MQY cable, 7400 A



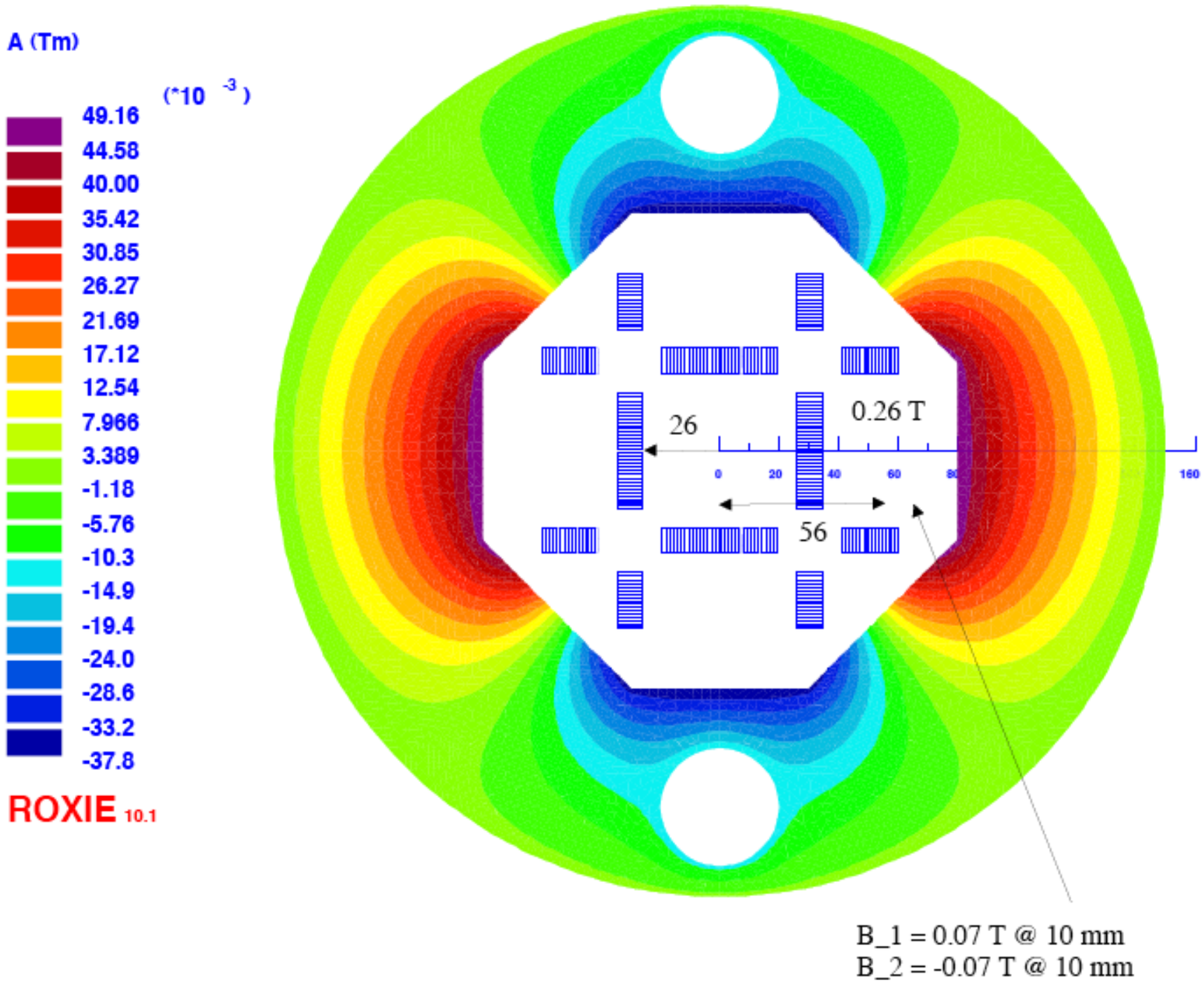
SC (Nb-Ti), Single Aperture

Ring-Ring option. Single aperture magnet for two proton beams, 127 T/m, 4600 A, MQY cable



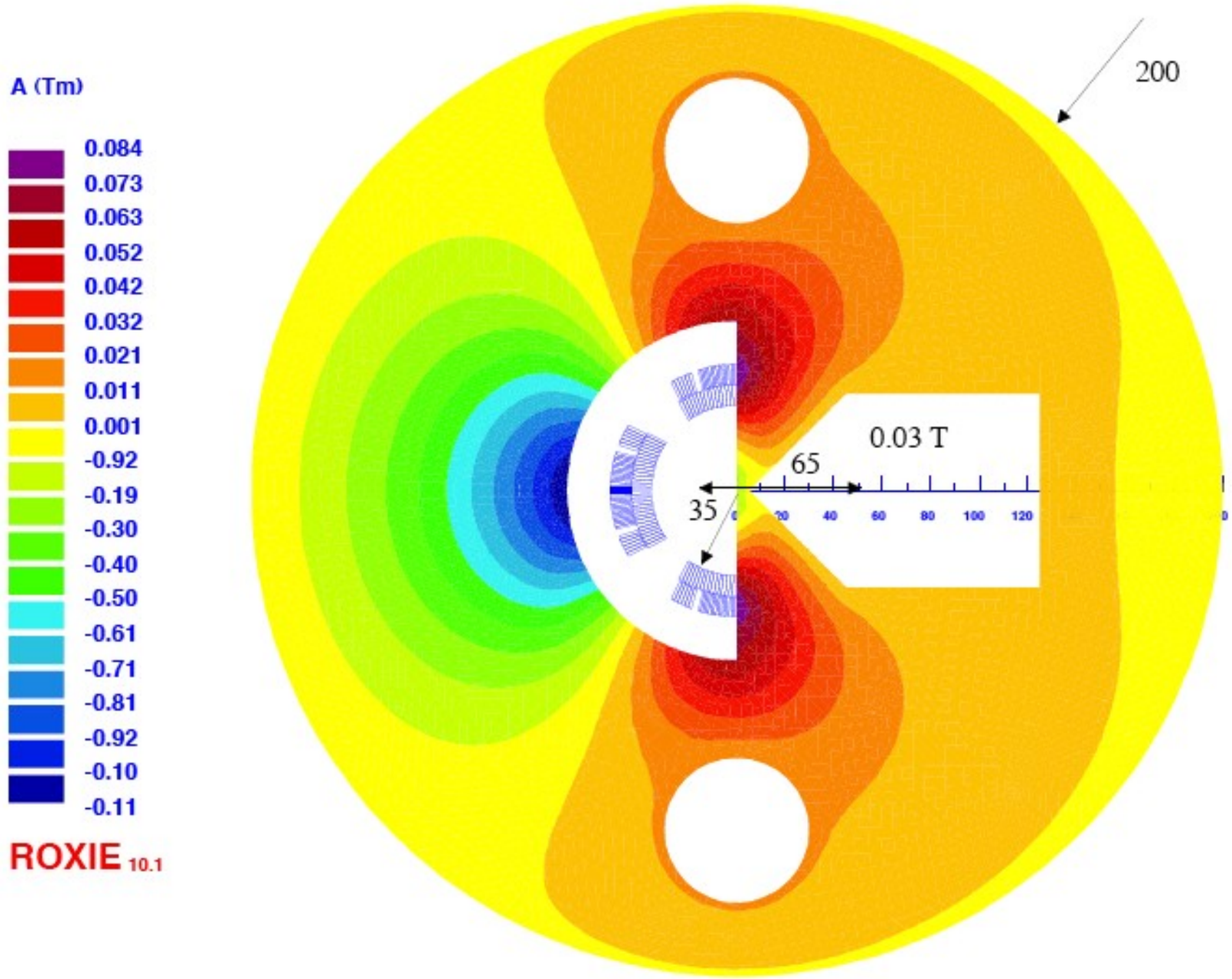
Racetrack Coils (Gupta Proposal for Quadrupole “Testbed”

Ring-ring option with racetrack coils, MQY non-keystoned cable, 5400 A



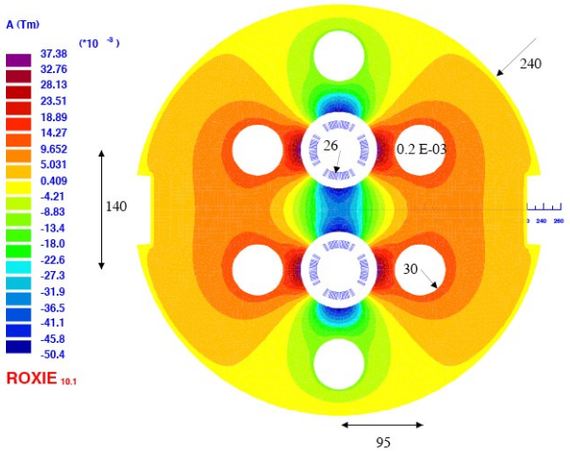
Half-Quadrupole (SC version of the HERA Magnet)

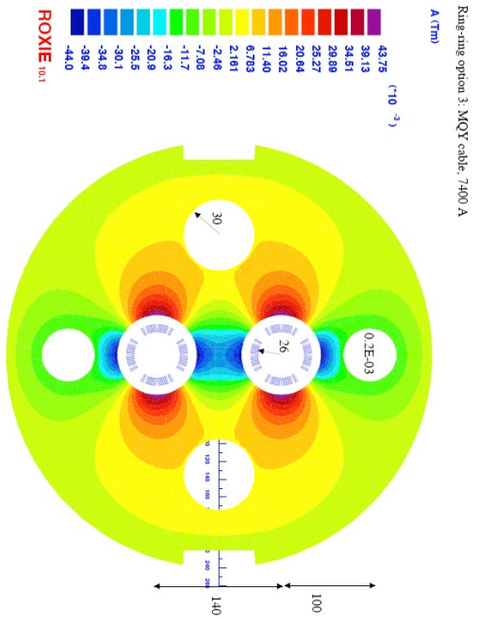
Ring-ring option half-quadrupole, 4900 A, Gradient 137 T/m,
+ 2.5 T dipole field from feeddown



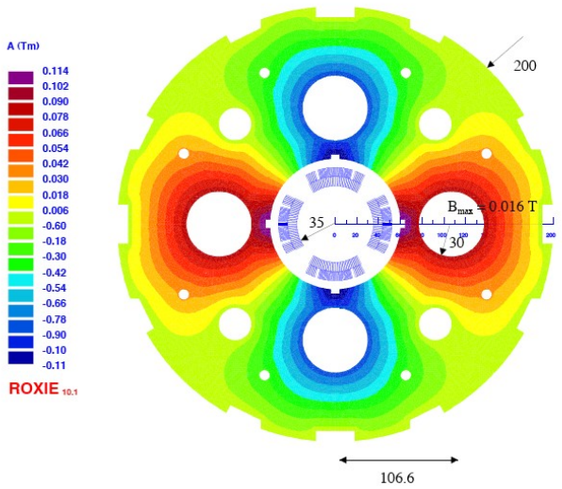
Four Remaining Options for Ring-Ring

Ring-Ring option2, double aperture, MQY cable, 7400 A

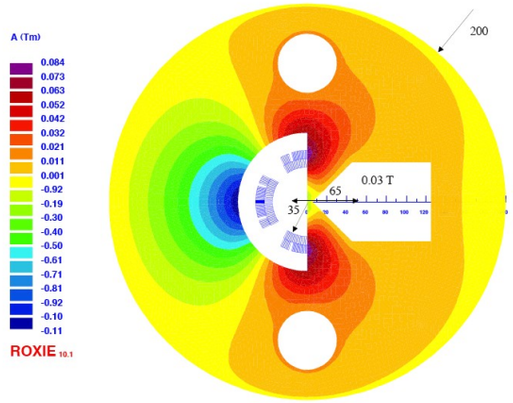




Ring-Ring option. Single aperture magnet for two proton beams, 127 T/m, 4600 A, MQY cable



Ring-ring option half-quadrupole, 4900 A, Gradient 137 T/m,
+ 2.5 T dipole field from feeddown



Double aperture (vertical)	Double aperture (horizontal)	Single aperture (for pp) (Q2)	Mirror (Q1)
7400 A MQY cable	7400 A MQY cable	4600 A MQY cables	4900 A MQY cables
95 mm Septum	100 mm	107 mm	65 mm
0.2 E -3 T Fringe field in e-pipe	0.2 E -3 T	0.016 T	0.03 T

Linac-Ring Option

23 mm Aperture, 300 T/m, small septum

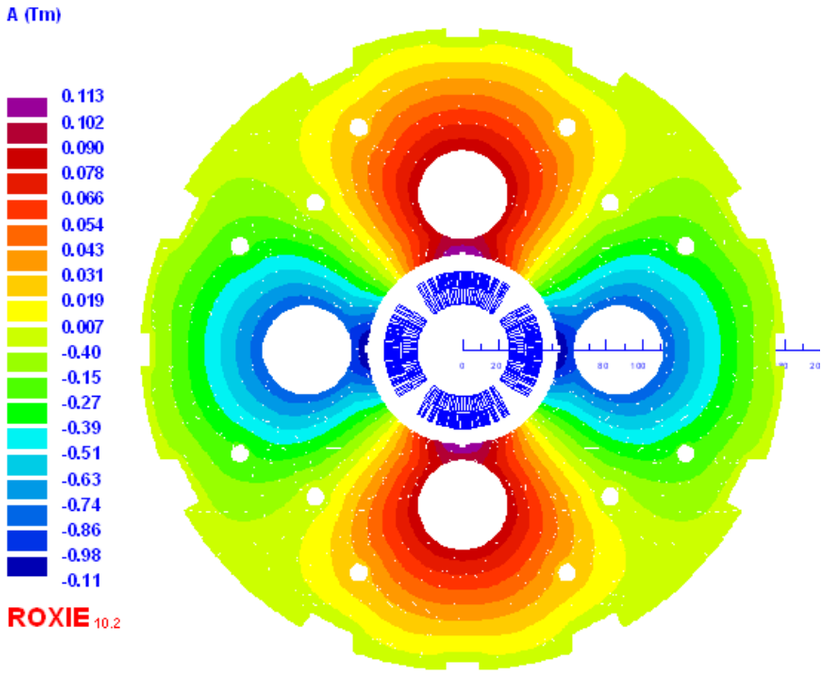
Study limitations in magnet design for Nb-Ti and Nb3Sn technology

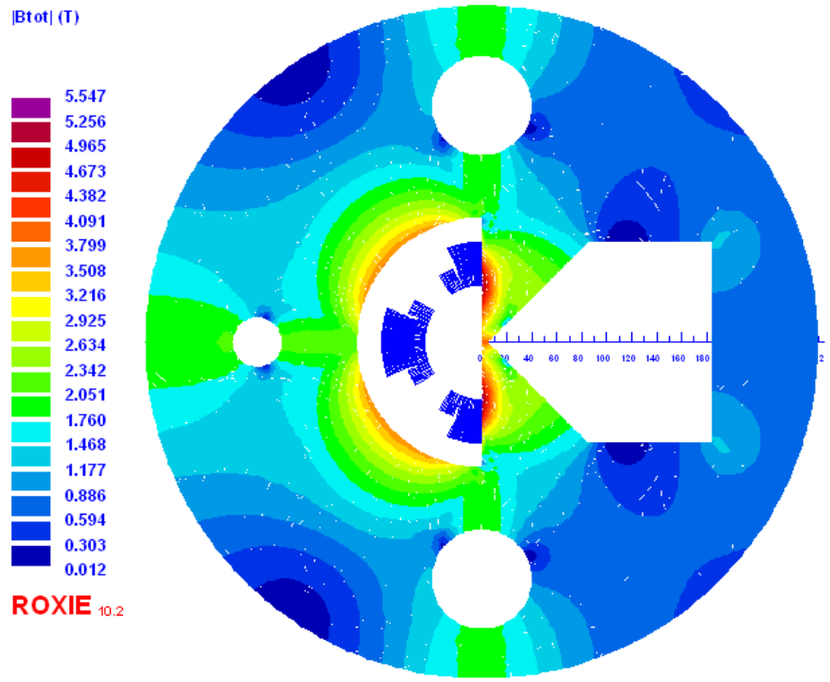
Nb-Ti LHC main dipole cable parameter

Nb3Sn in accordance with measurements on single strands for CLIC wiggler development (HFM46) and goals for the development of cables for HE-LHC, Inner-triplet upgrade, 11 T dipoles etc.
(2500 A/mm^2) at 12 T and 4.2 K and operation at about 80% on the load-line.

But:
Mechanical structure far from trivial
Setting errors (large persistent current)
Lengths issues arise (curing, unit lengths of cables)

Comparison Q1 for Ring-Ring and Linac-Ring





NbTi: 6700 A, 248 T/m at 88% LL Nb3Sn: 8600 A, 311 T/m, at 83% LL	NbTi: 4500 A, 145 T/m, 3.6 T at 87% Nb3Sn: 5700 A, 175 T/m, 4.7 T at 82% on LL (Four layer coil !)
23 mm aperture 87 mm septum	46 mm (half) aperture 63 mm septum (space for p and e-beams)
0.03 T, 3.5 T/m in e-beam pipe 0.09 T, 9 T/m in e-beam pipe	0.37 T, 18 T/m 0.5 T, 25 T/m

NbTi at 1.8 K, Nb3Sn at 4.2 K