MA-m & Minimum Taper Length of Target Magnet *vs*. 100-cm Δ*B*/*B*

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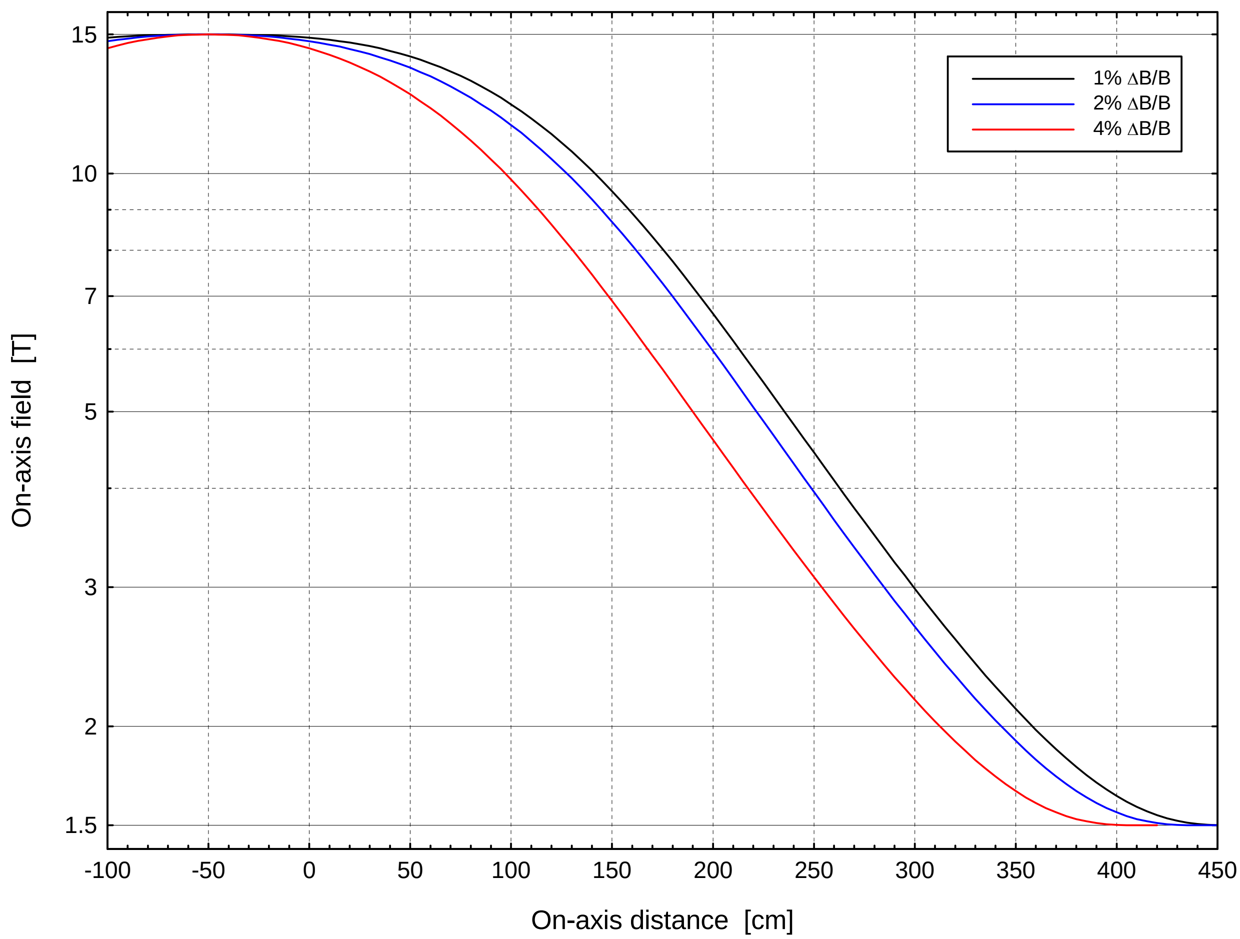
The graphs below reveal the benefits of adopting my suggestion, made many months ago, of removing all field-taper constraints other than demanding zero slope at each end. The field profile can ramp from 15 T to 1.5 T over a length of as little as 460 cm or so. If the taper begins at $z = -50$ cm, the center of a target region 100 cm long, the field profile can bottom out as early as $z = 410$ cm (red curve) if the field homogeneity ΔB/B of the target region is 4% ($\Delta B = 0.6$ T). If the field homogeneity is 1% ($\Delta B = 0.15$ T), the taper bottoms out at $z = 456$ cm (black curve).

This study models the Target Magnet by two solenoids: a main one surrounding the target region and a subsidiary one just beyond the end of the field ramp. If needed for field homogeneity, the upstream coil is notched near its midplane. The current density is 18 A/mm^2 in the main coil and 45 A/mm^2 in the subsidiary one, much like comparable coils in "Target15to1.5T5m1+5.xlsx" of 6/18/2013. Iteratively adjusting the ends and outer diameter of each coil (and of the notch, if any) minimizes a weighted sum of the taper length and megamp-meters of conductor.

Field Profile of Fast-Taper Target Magnets with 1, 2 & 4% ΔB/B at –100 cm and Zero



The graph below reveals that demanding higher field quality (or, equivalently, maintaining a fixed field quality over a greater target length) incurs a relatively modest penalty in conductor cost and field-taper length. For example, even the fivefold improvement in field homogeneity from 5% to 1% increases the conductor usage by only 20% (687/573 – 1) and the minimum taper length by 14% [(456+50)/(394+50) -1].