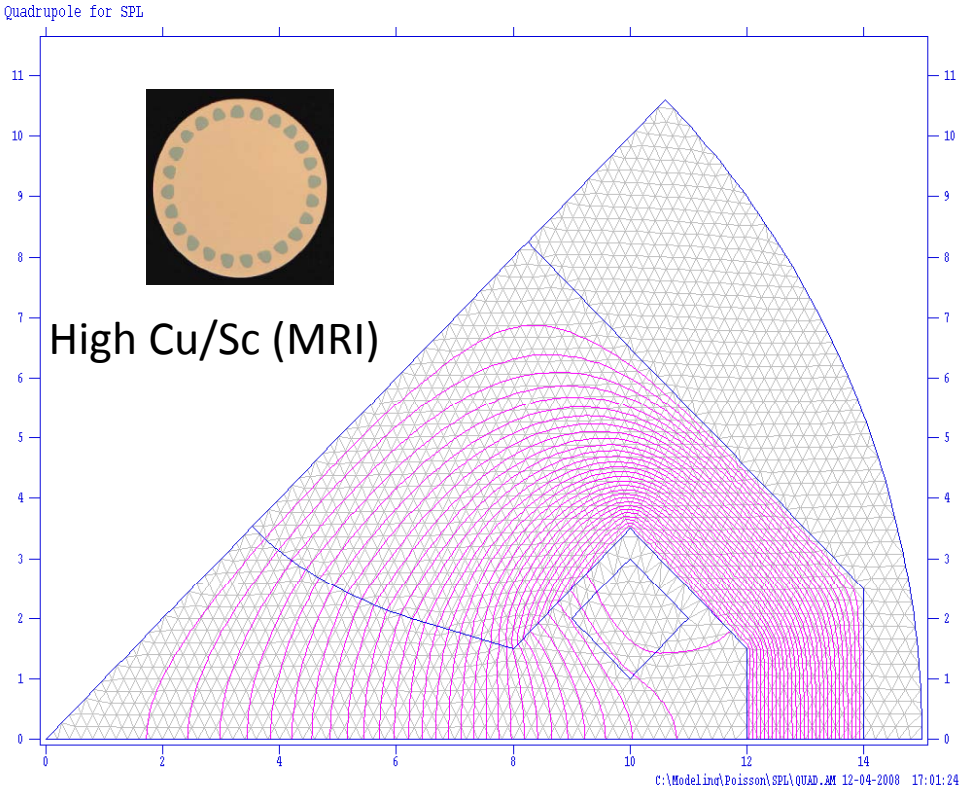
Quadrupoles for the SPL

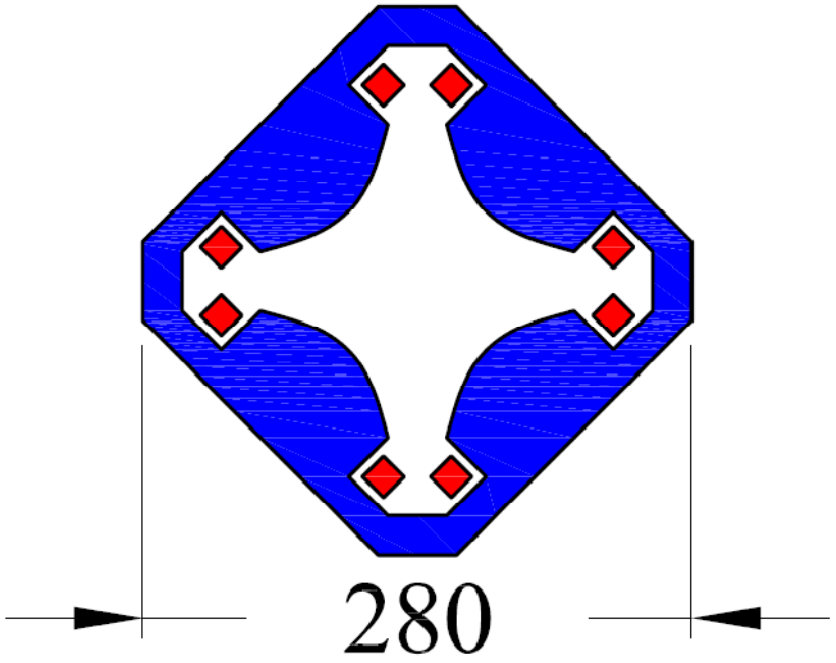
THE REQUIREMENTS

- DC operated
- Cold (4.2 or 1.9 K)
- Aperture 100 mm
- Gradient 6 T/m
- Magnetic length 450 mm : the same for all magnets ?
- Supplied in series or individually ?
- Requirements on the fringe field ?
- Requirements on field harmonics ?
- How many ?
- Beam losses ?

Iron Dominated Superconducting Quadrupole

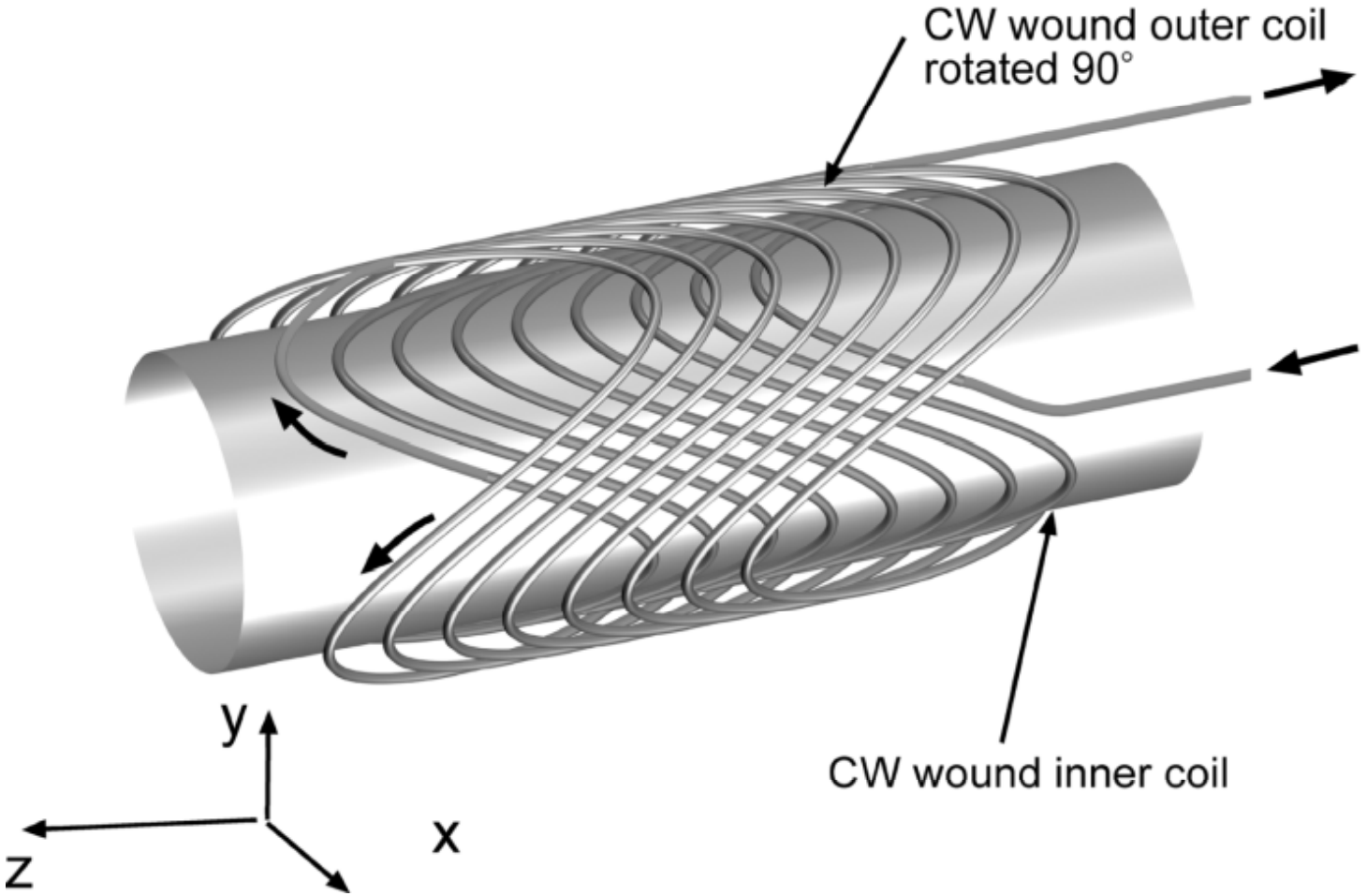


NI=6000 A for G=6T/m in 2D



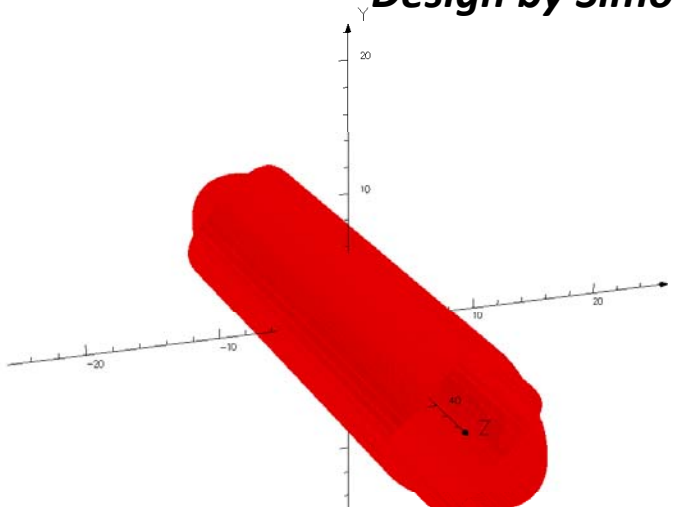
Cross-section by ONE SINGLE lamination !

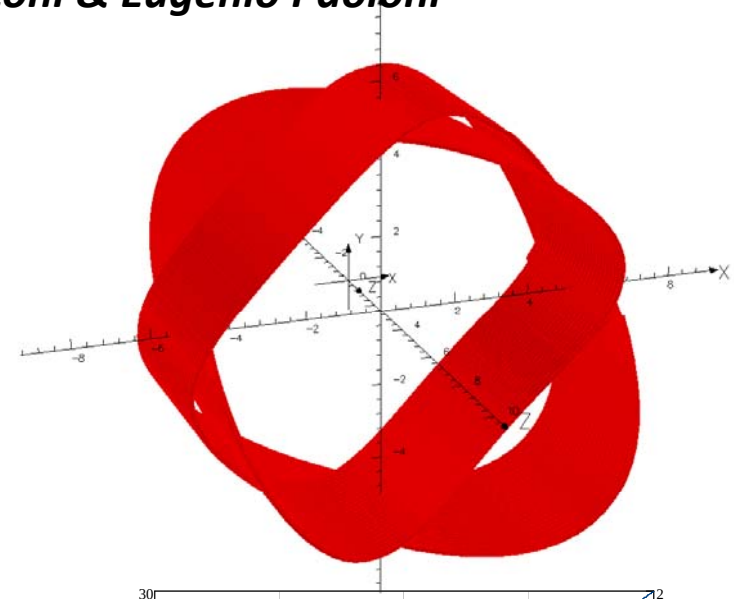
Current Dominated Double Helix Quadrupole

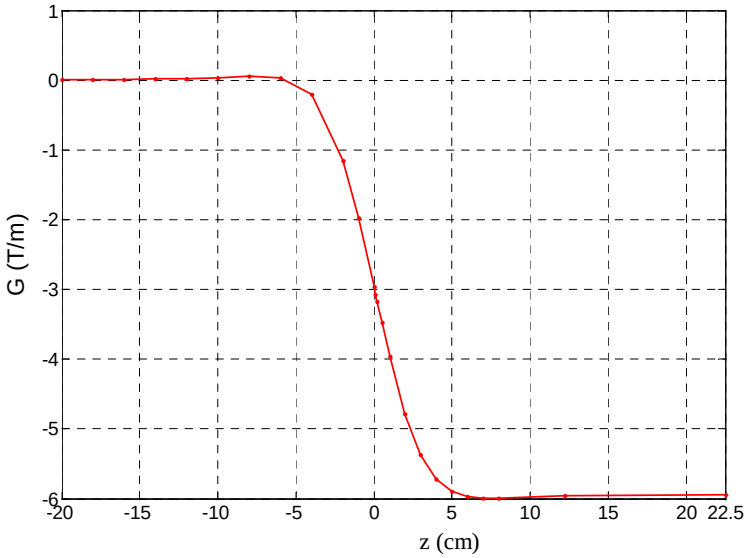


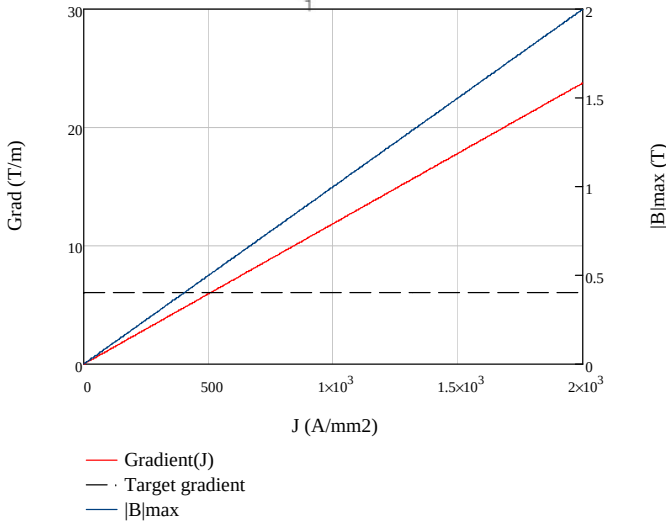
Current Dominated Double Helix Quadrupole

Design by Simona Bettoni & Eugenio Paoloni



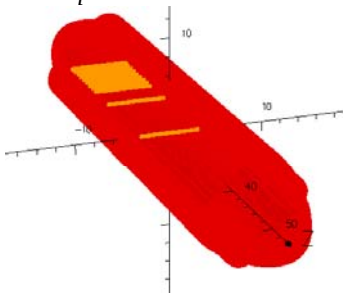






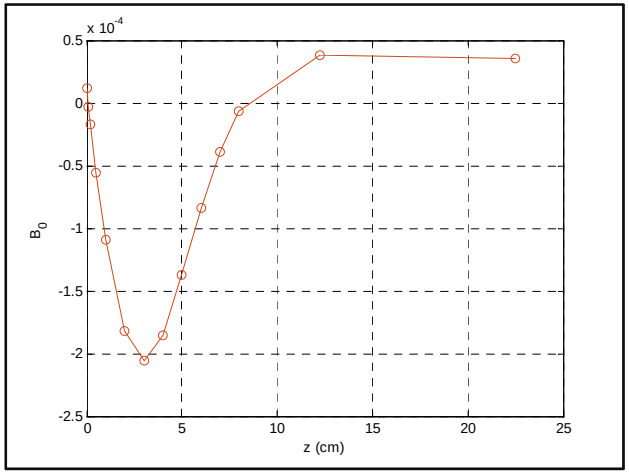
Field quality along the z axis

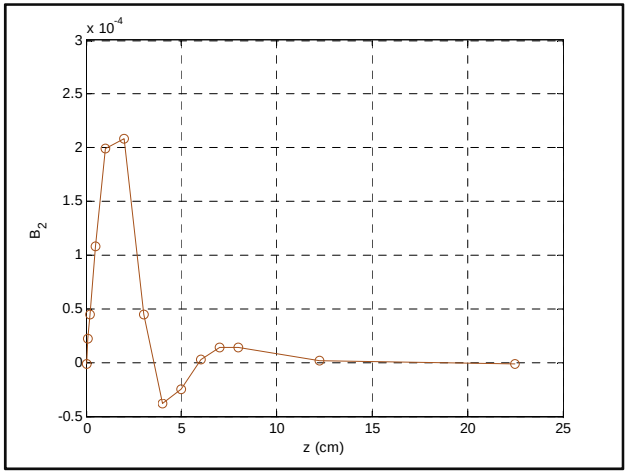
$$By(x) = \sum_i b_i \cdot x^i \qquad B_i(x) \equiv \frac{b_i \cdot x^i}{b_1 \cdot x}$$

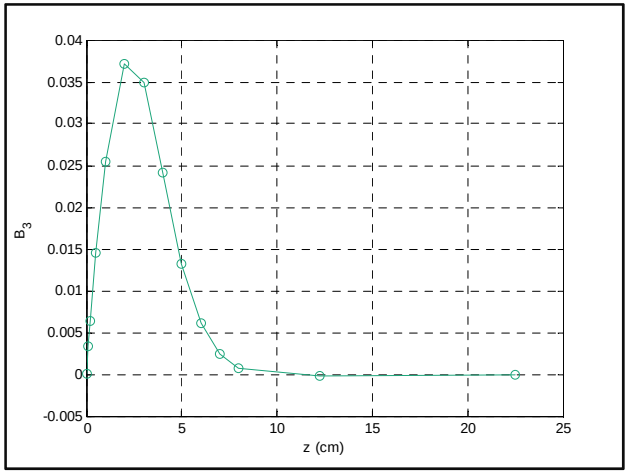


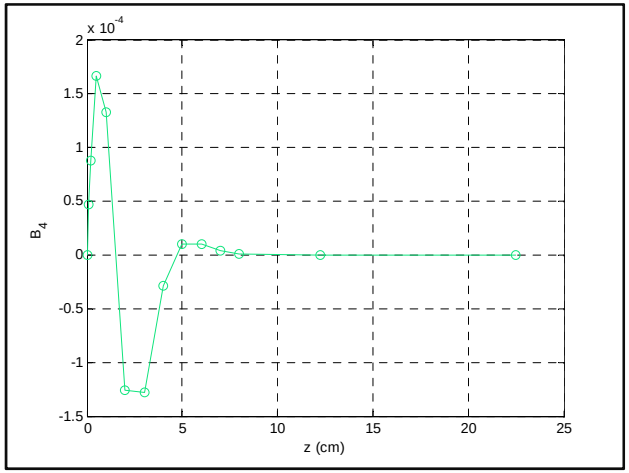
At the coil center (z = 22.5 cm, x_fit = ±3 cm)

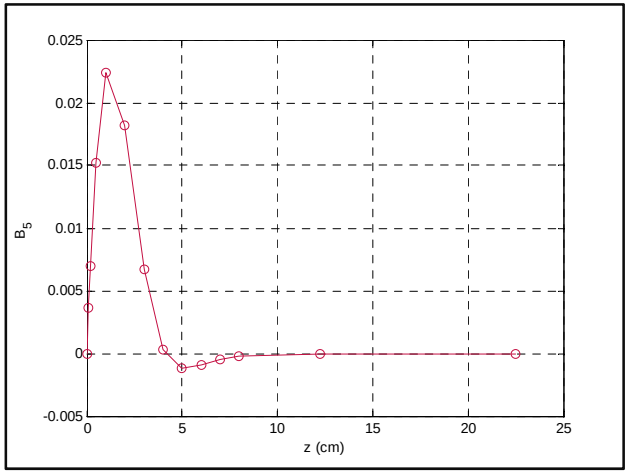
B0	B2	B3	B4	B5
1.22E-05	-9.24E-07	2.05E-07	-1.28E-08	-6.55E-06



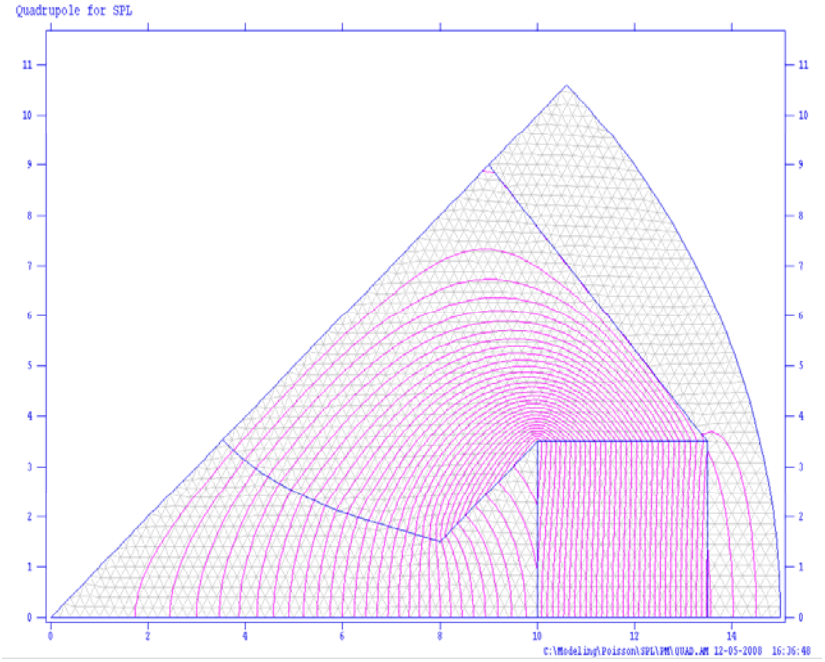


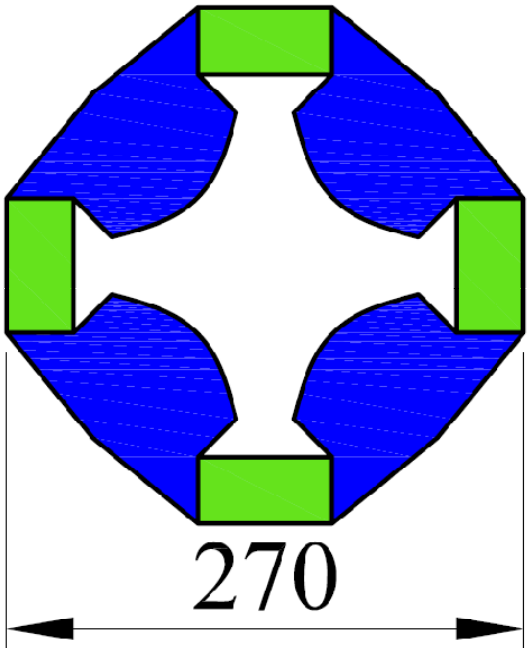






Environmental Friendly Quadrupole





Different configurations are possible with permanent magnets

Hybrid solution with trimming coils can also be envisaged

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CONCLUSIONS

- The required field gradient is not an issue and can be achieved with several designs
- The magnet size can be very compact
- 3D design to compute the influence on adjacent systems and possibly design shielding plates
- Some of the requirements anticipated in the introduction need iteration