VFFA magnet prototype

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- Single magnet prototype
- Triplet implementation

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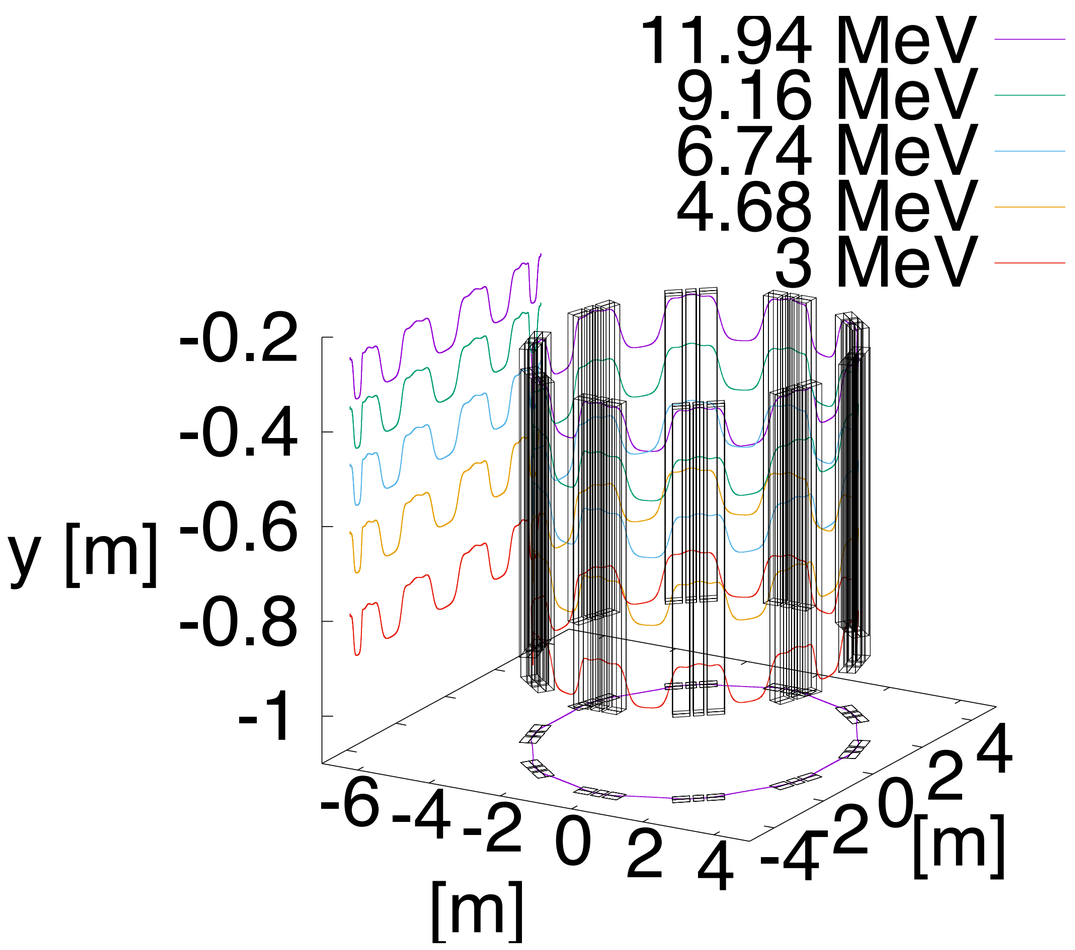
Motivation

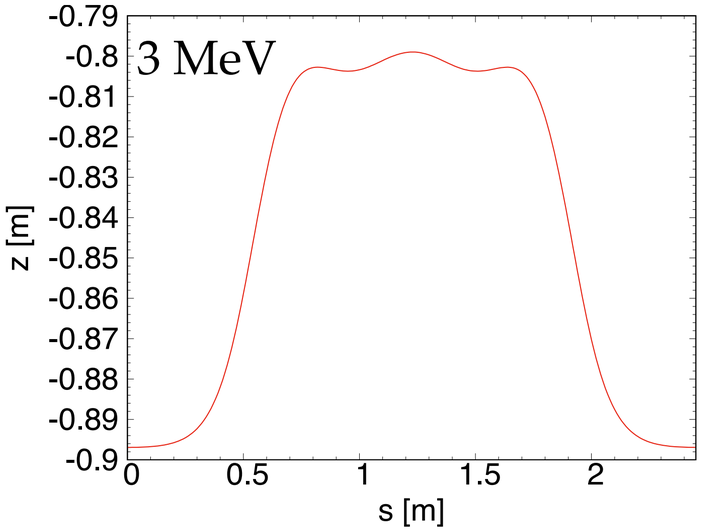
- Design realistic magnet respecting scaling VFFA law:

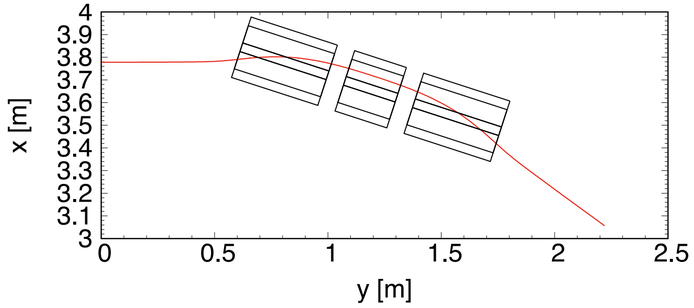
$$B = B_0 e^{m(z-z_0)}$$

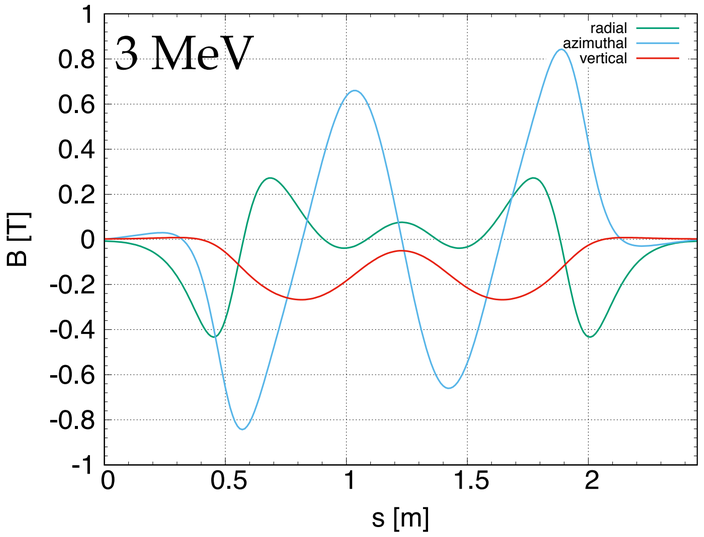
- Modelling tools development.
- Build expertise to SC FFA magnet (coil dominated magnet).

FETS-FFA ring









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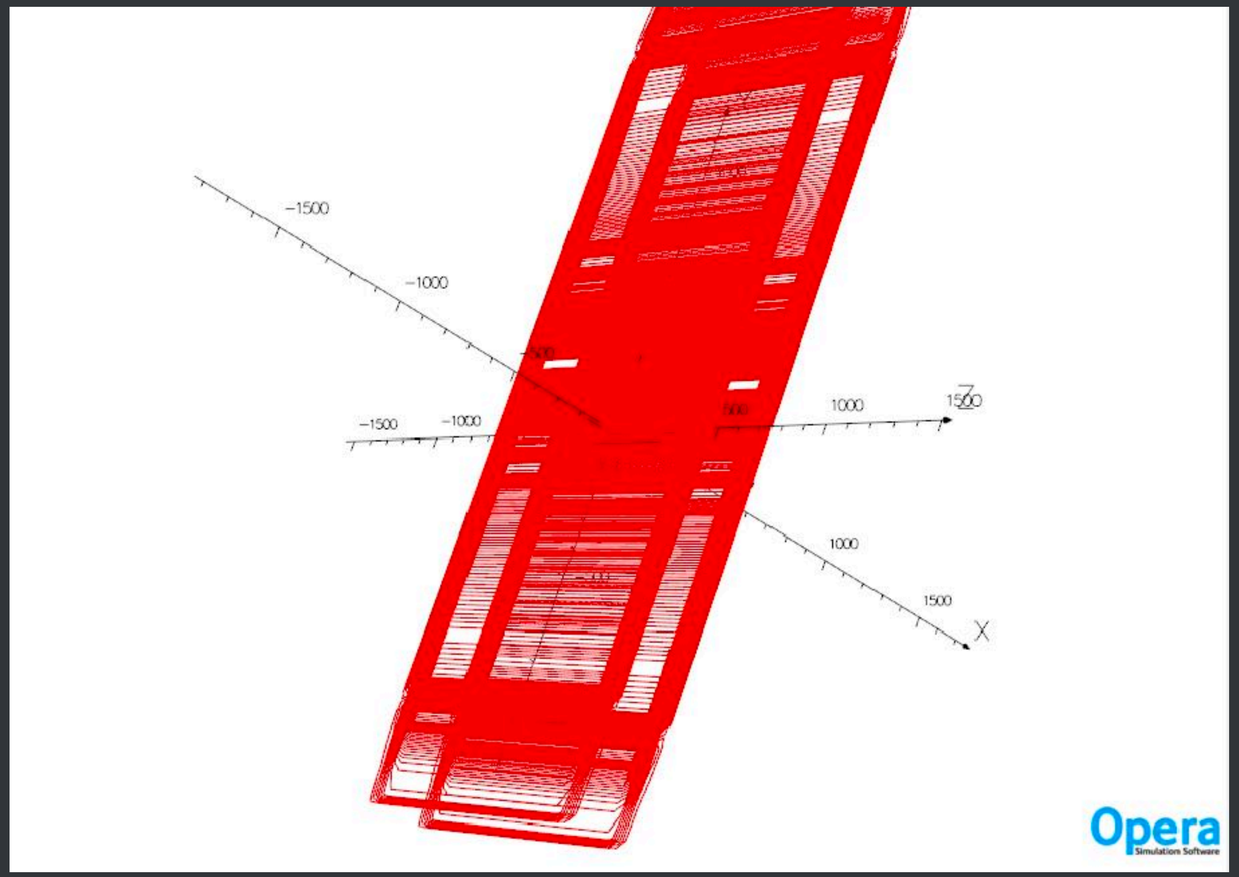
Single magnet test

- Use of reverse Biot-Savart law code developed by S. Brooks to have a set of coils reproducing VFFA tanh field fall-off model.
- 1 m-long magnet (40 cm later)
- m-value=1.28 m^{-1}
- 50 cm excursion as good field region
- Symmetric magnet
- ±11 cm gap size



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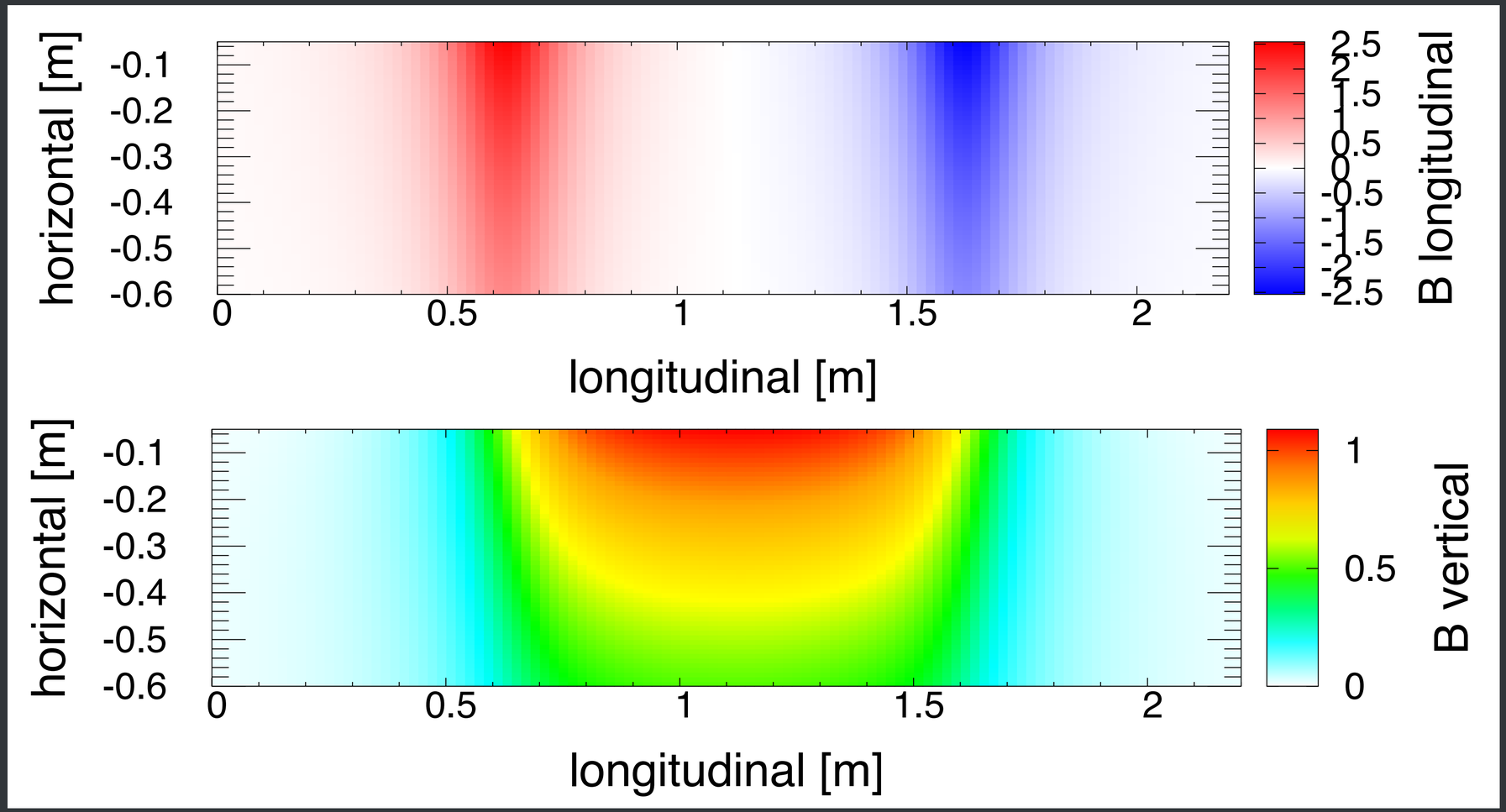
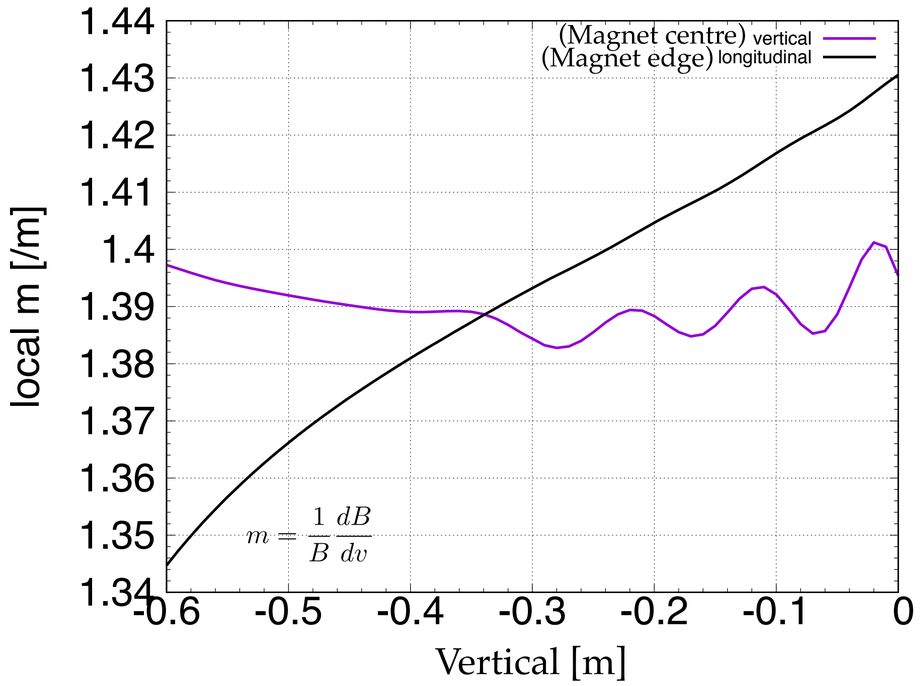
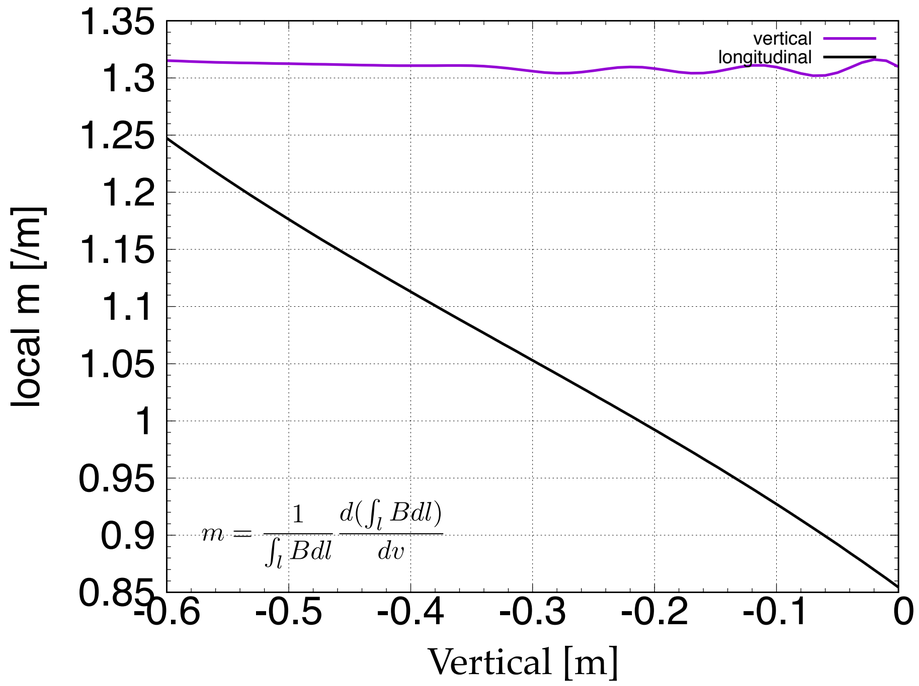
Field map from coils

In the median plane

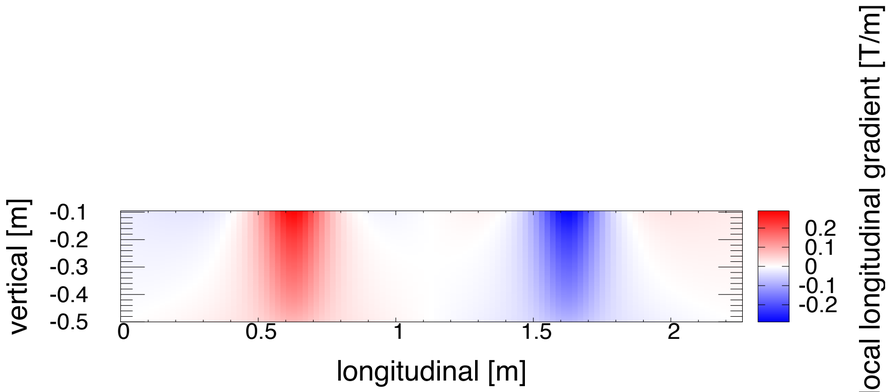


m-value of field map

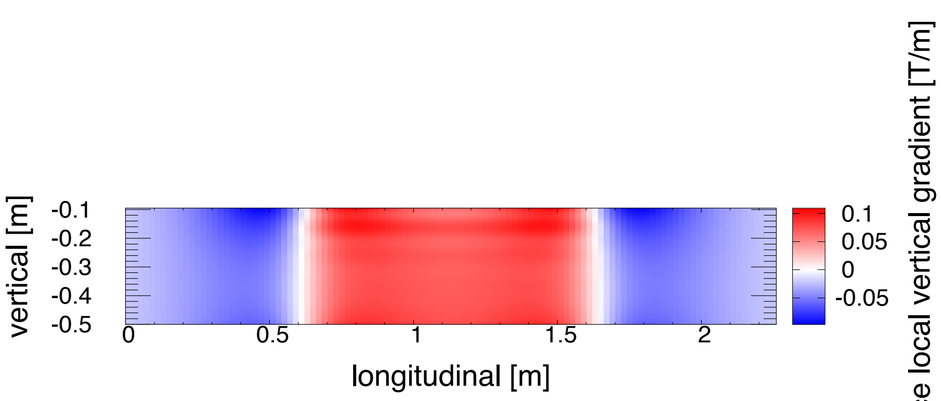




Map accuracy



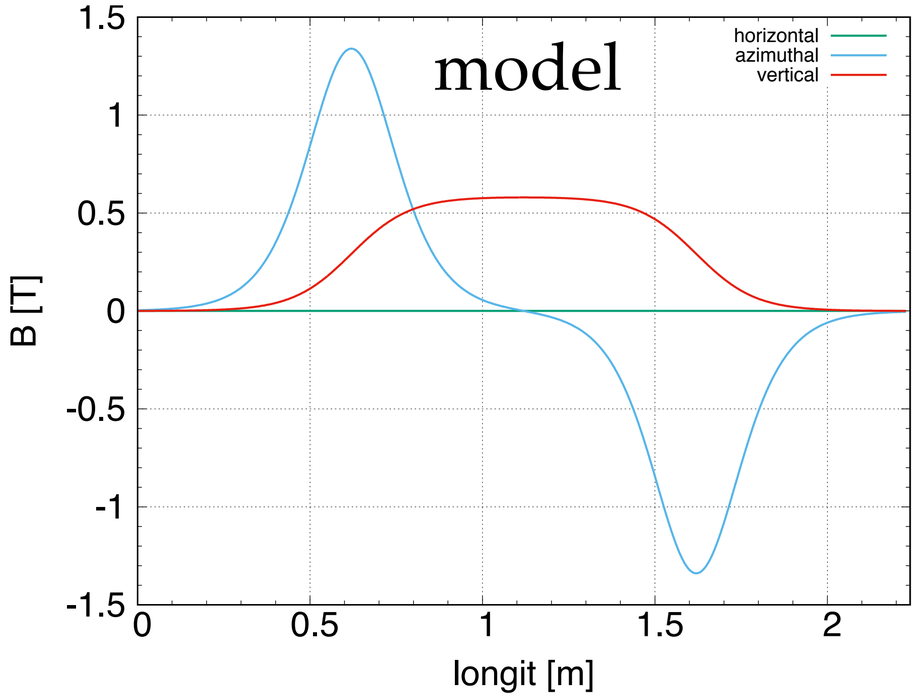
$$diff = \left[\frac{dB_{long}}{dz} - m_{ref}B_{long}\right] / e^{m(z-z_0)}$$

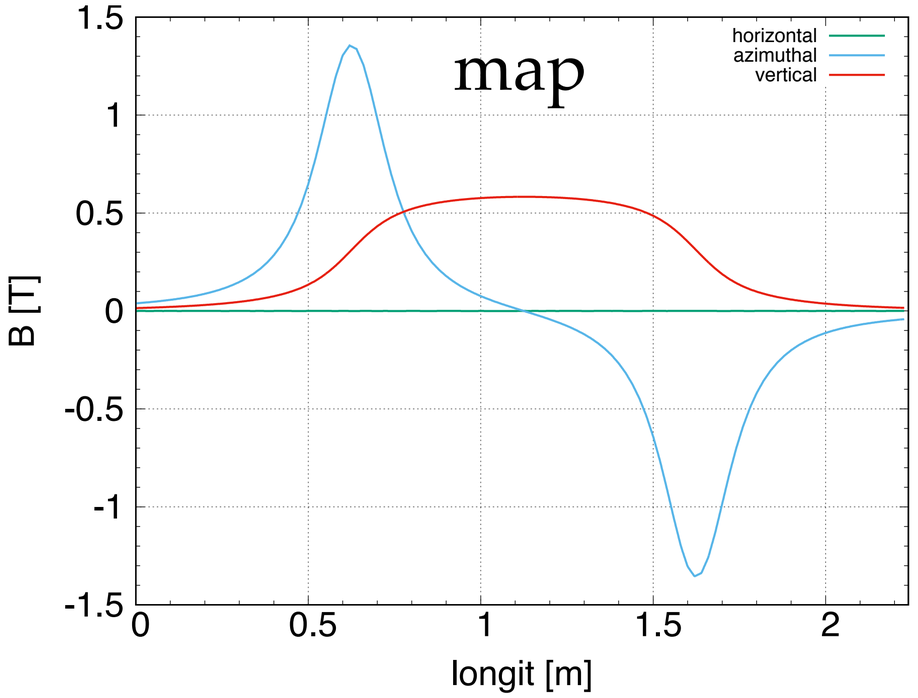


$$diff = \left[\frac{dB_{vert}}{dz} - m_{ref}B_{vert}\right] / e^{m(z-z_0)}$$

Comparison with model

Field in the mid plane



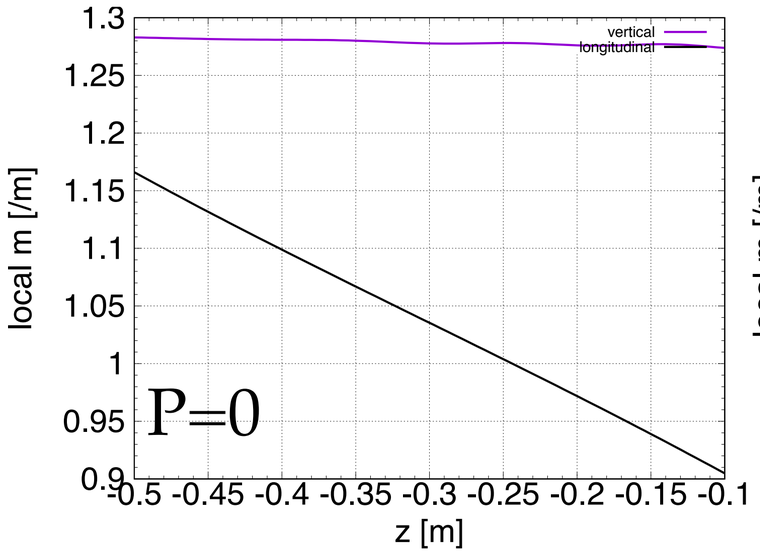


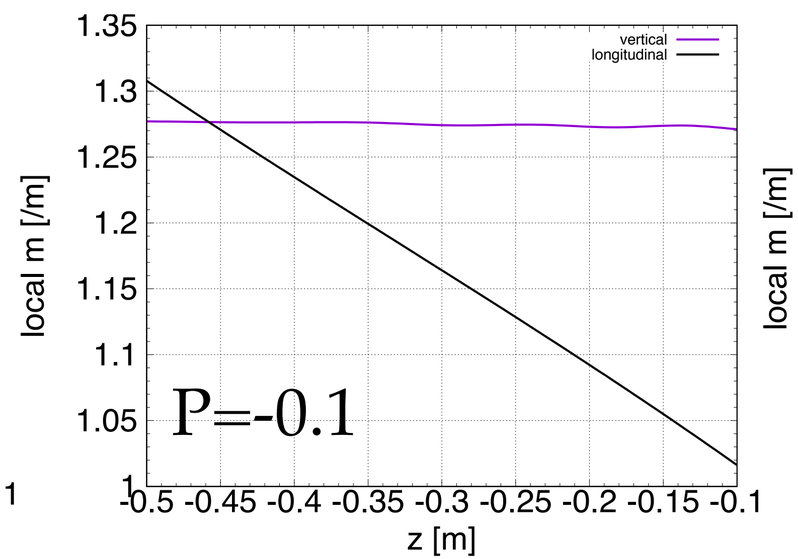
Fringe field tanh characteristic length of the model: 17 cm

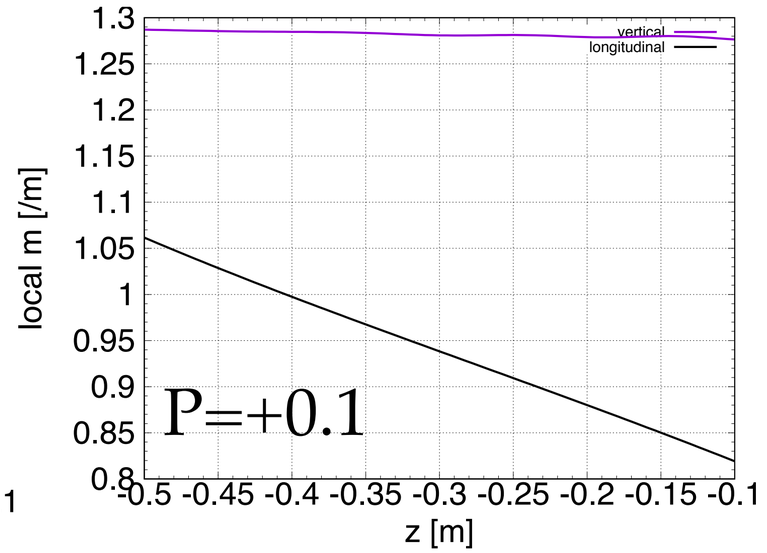
First optimisation

m_{input}=1.25 m^{-1}

$$B = B_0 * \left(e^{m(z-z_0)} + P(z) \right)$$







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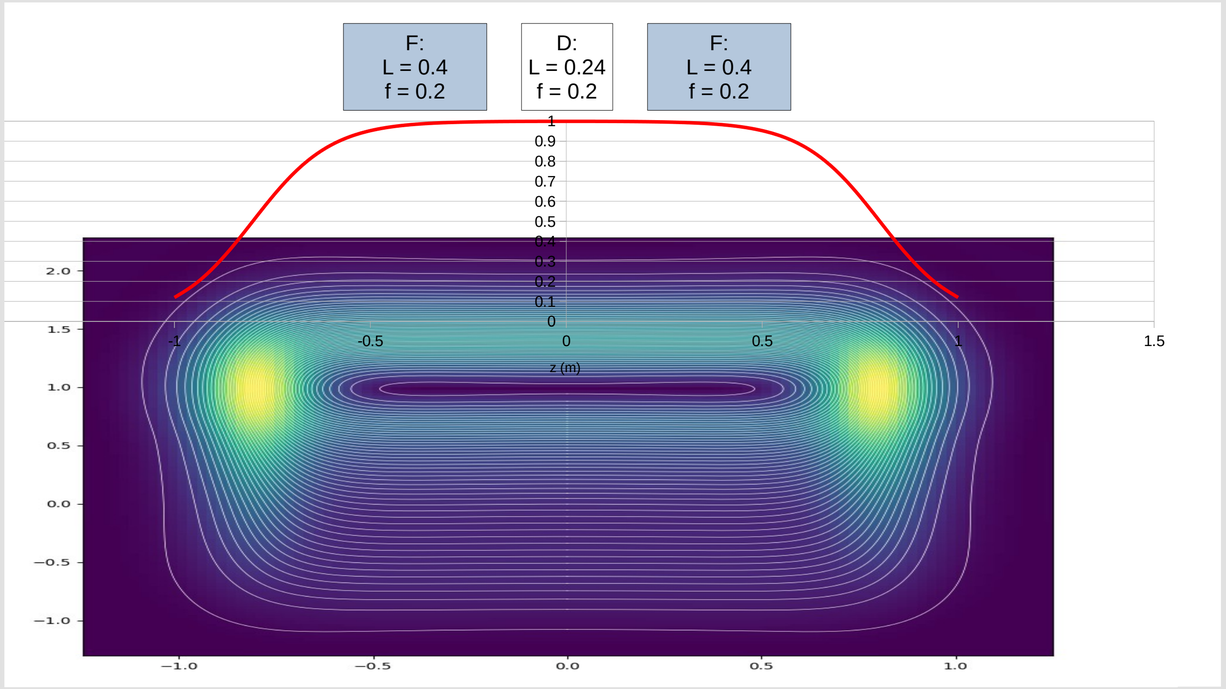
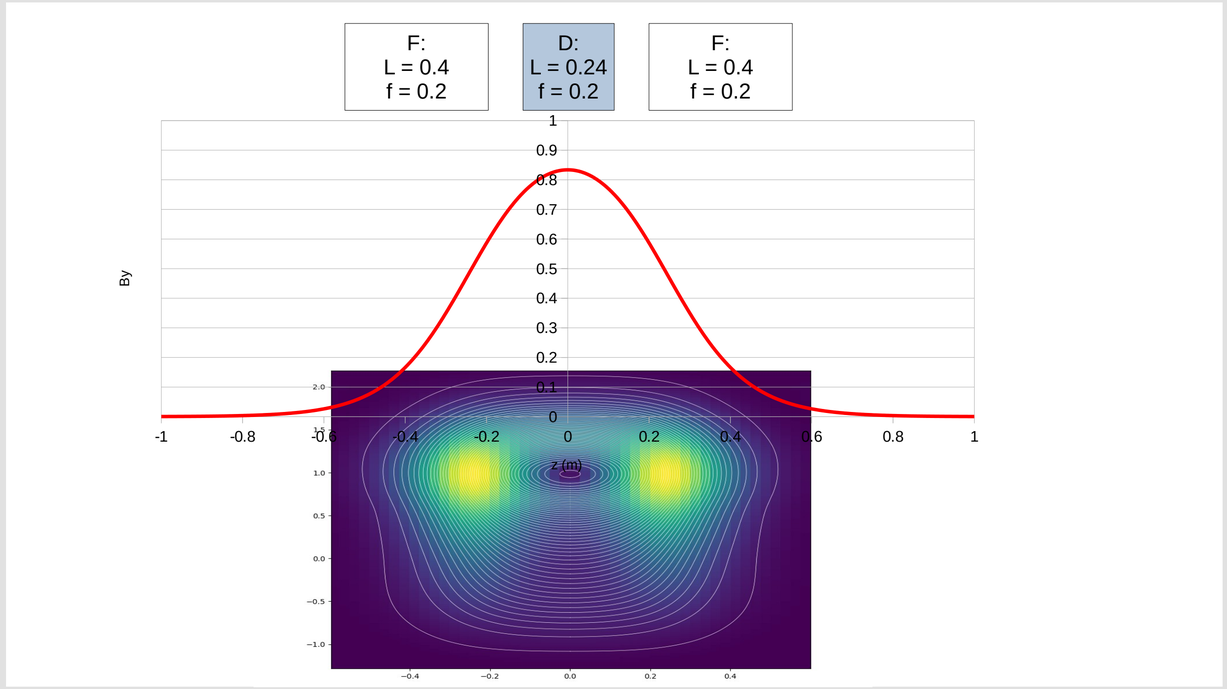
Example of triplet implementation





- Merging of both F magnet in one set of coils
- Superposition of F and D coils

Lattice potential problems

- Magnets tend to be longer than in model, so drift space becomes smaller than designed.
- Drift space is not field free area, with strong stray fields (~100 Gauss). Any addition of ferro-magnetic material in the drift spaces may cause distortion of the scaling law, like in KURNS FFA main ring.

Conclusion

- Long magnet investigated first to decouple fringe field and body field
- Reverse Biot Savart law used so far with crude optimisation by hand, need of automatisation.
- Superposition/merge of magnets maybe needed for the triplet implementation.
- Need for finite element computation (OPERA) to take into account shielding at a later stage.

Questions ?

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Thank you for your attention