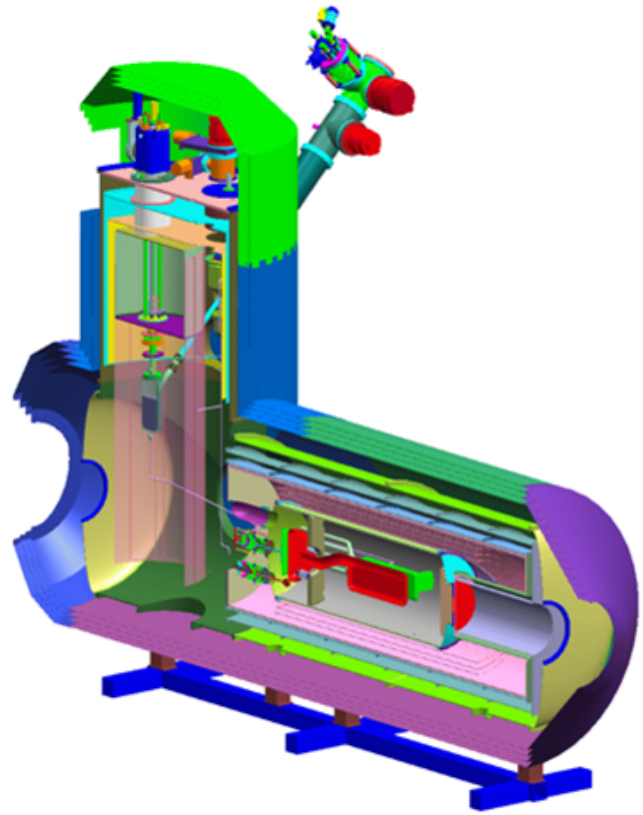
Holding Field for the Polarizing Mirrors

W. Korsch

ORNL, EDM Collaboration Meeting
May 25, 2006

UK UNIVERSITY OF KENTUCKY

EDM



Idea: Use Remanent Supermirror Polarizer

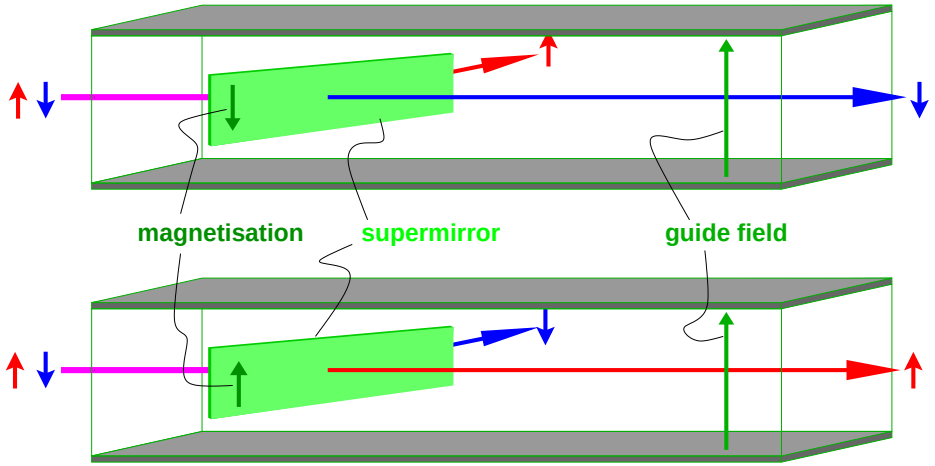


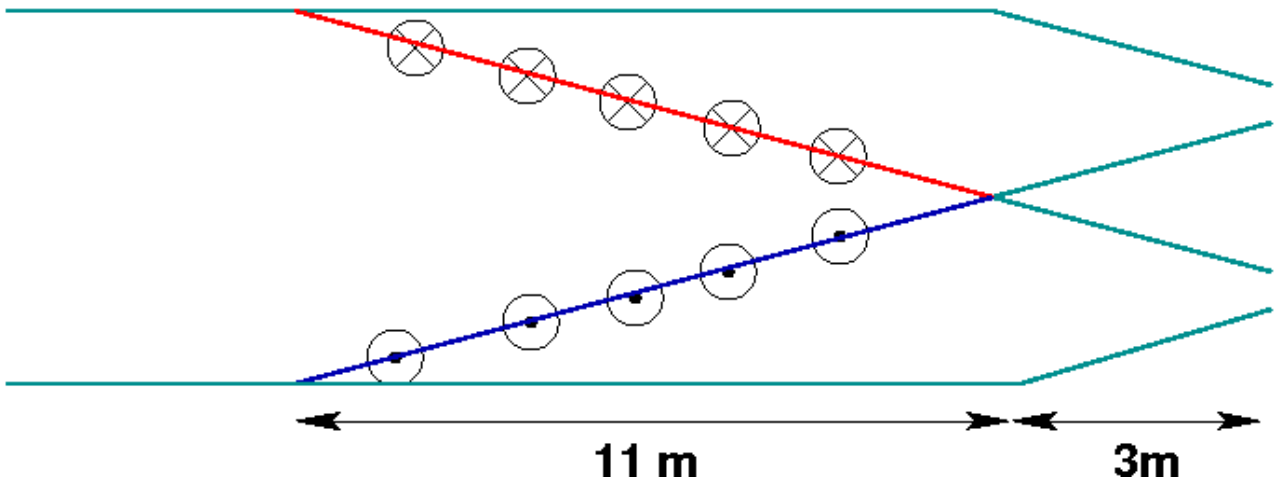
Figure from J. Stahn *et al.*

Remanent Supermirror

- Si wafers $\frac{5}{\sqrt{2}} \times \frac{5}{\sqrt{2}}$ inches^2
- coat with: Fe/Si, $Fe_{0.89}Co_{0.11}$/Si, or FeCoV/TiN_x (several hundred layers, thickness: several 10's of Å)

EDM

EDM Configuration



Advantages:

- ✗ Can use both spin states $\Rightarrow$ double flux
- ✗ High polarization

Challenges:

- ✗ High precision frame to support $\approx$ 420 wafers
- ✗ Geoff: *"Keep Mr. Maxwell happy."*

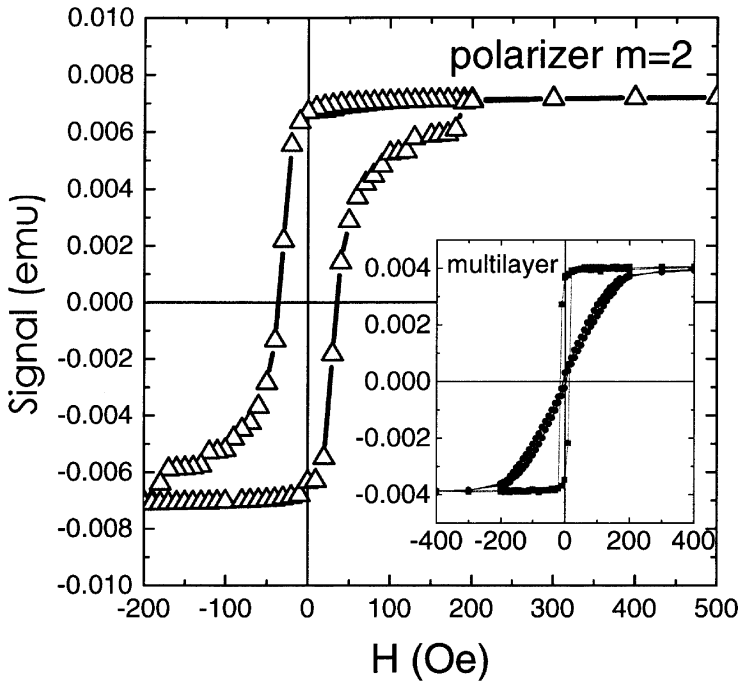
EDM

Field Requirements

Magnetic Field Configuration

- Guide field: static $\approx$ 5 - 20 G over 11m
- Magnetizing field: pulsed field, possibly as high as 300 G (up *a*nd down)
- Guide field to spin flipper: includes gradient field
- Guide field to target: from a few Gauss to 1 mG (horizontal)

- Fe/Si: 200 - 300 G (pulsed)
- FeCoV/TiN_x : possibly $\approx$ 50 G (pulsed)



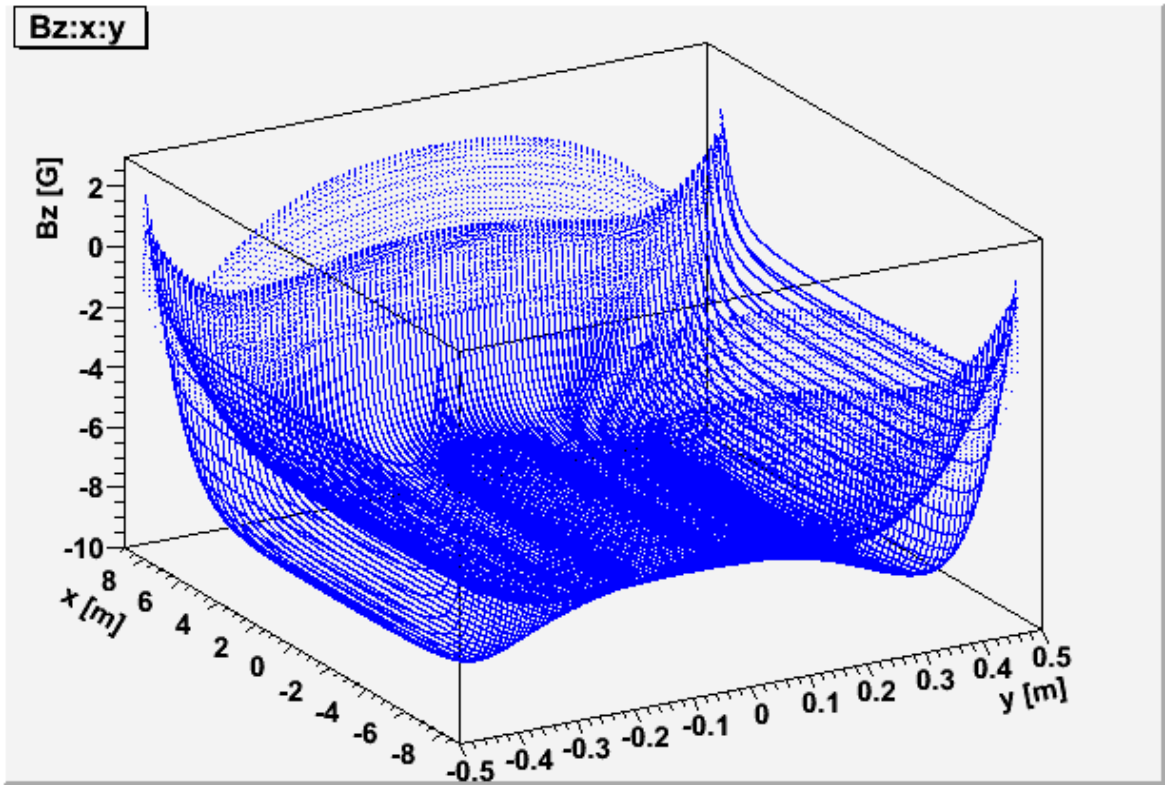
P. Böni et al.; Physica B 267 (1999)

- reduced layer thickness $\Rightarrow$ lower H_c (15 G)

EDM

... to get a feeling

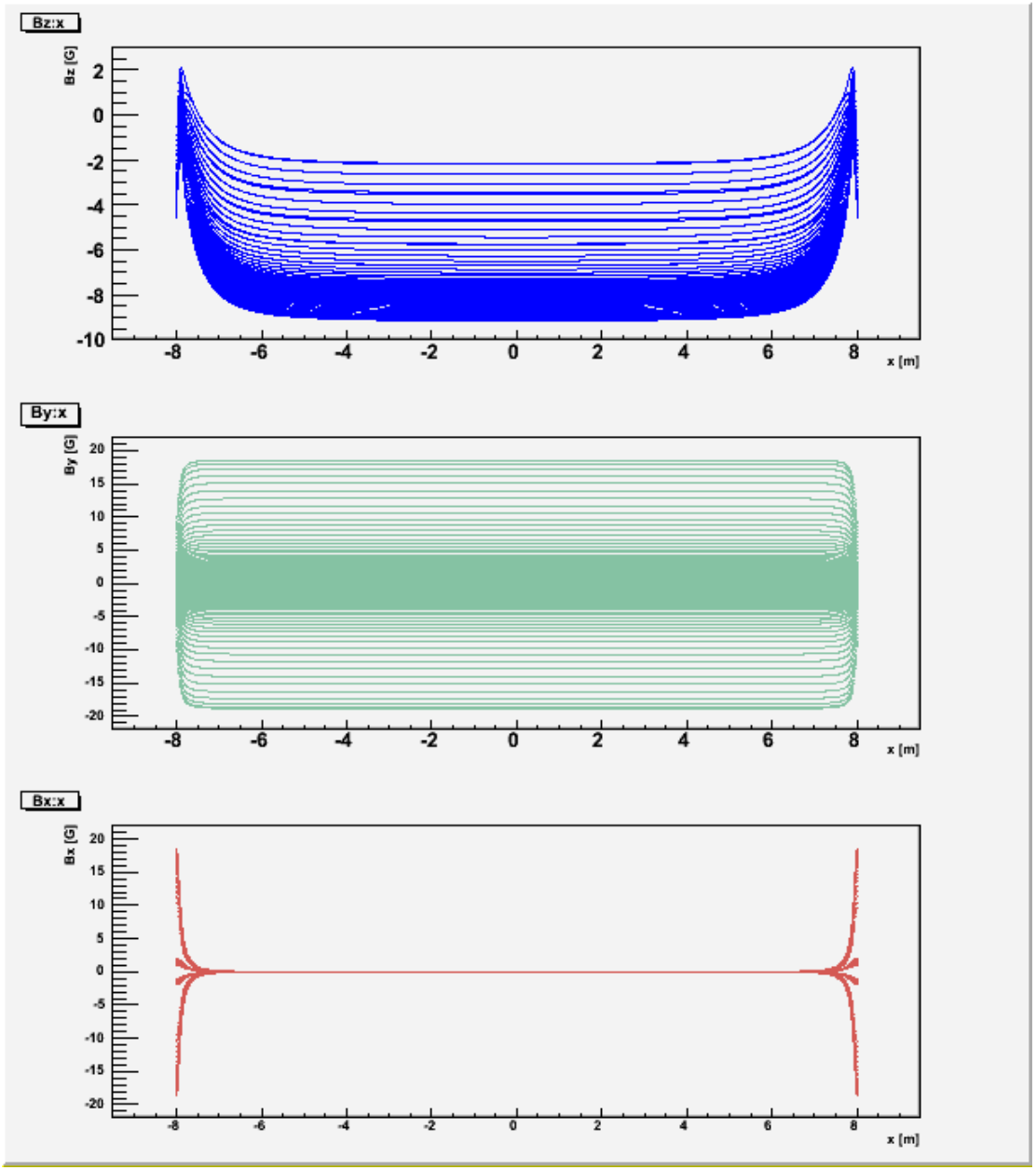
Try a rectangular “Helmholtz” coil configuration: 1 m $\times$ 0.5 m $\times$ 16 m



I = 1200 A turns

EDM

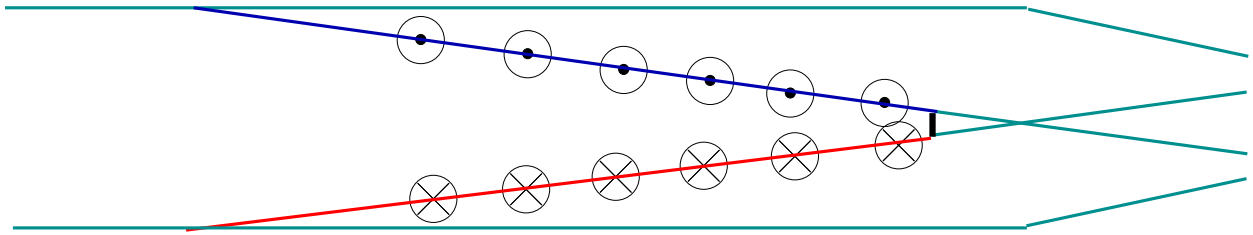
Field Components in Beam Direction



- pulsed fields possible
- too complicated, shielding etc.
- $\Rightarrow$ need iron yoke (permanent magnets?)
- $\uparrow$ *and* $\downarrow$ *fields???*

EDM

Implications

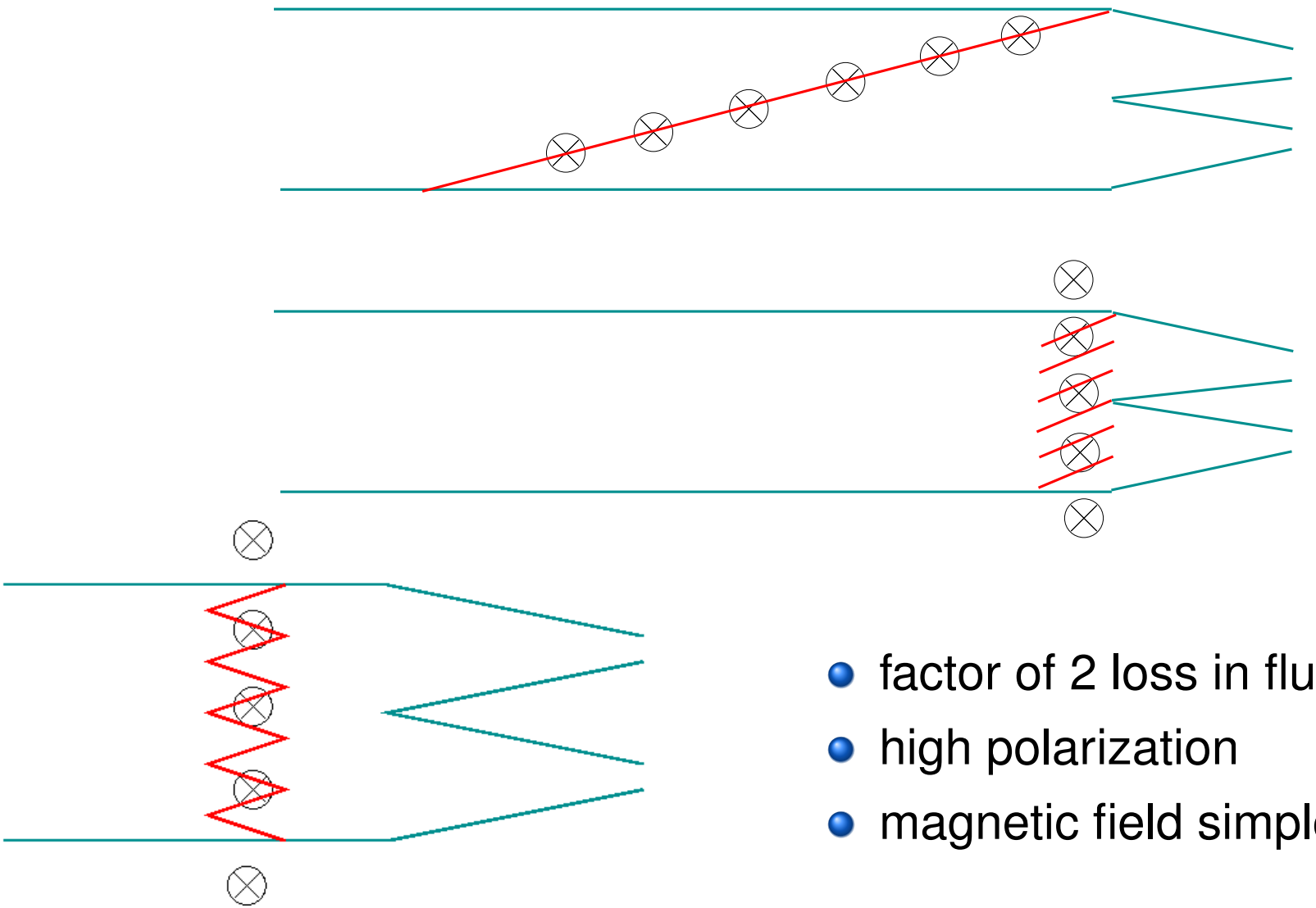


Collimation

- optimze $P^2 \times T$
- technical realization of polarizer magnetization ????

EDM

Alternatives?



- factor of 2 loss in fluence
- high polarization
- magnetic field simpler

EDM

To Do List

Computer Simulations

- Need careful MC simultions of guide w/ polarizer included $\Rightarrow$ reflectivity and polarization
- Finite Element Analysis: Guide field, spin flipper field, transition field (manpower?)
- Modeling of neutronics and magnetic field needs needs to be strongly coupled
- R & D for transition field?
- ...

EDM

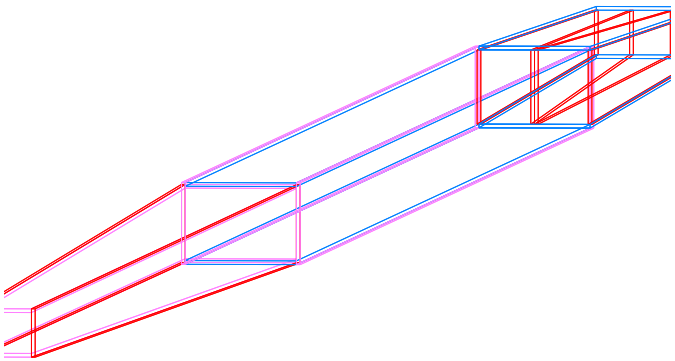
Using GEANT4 as Standard?

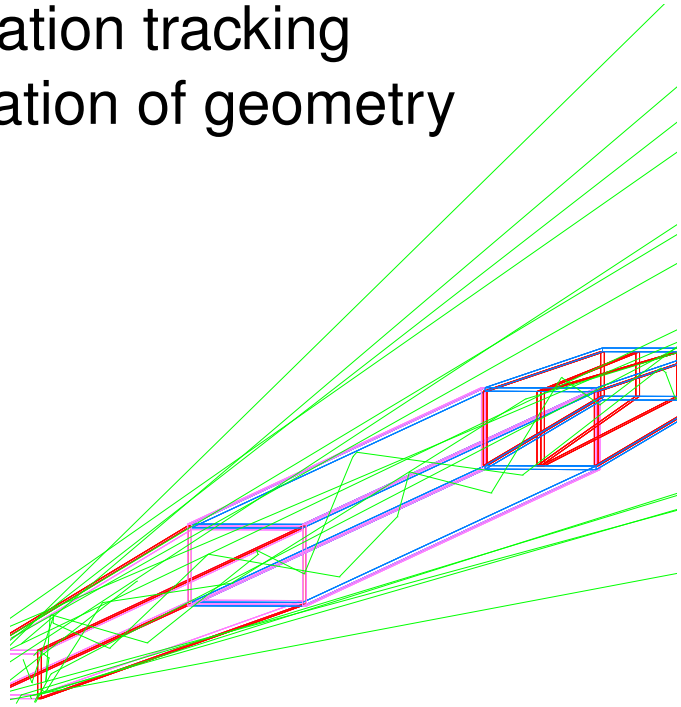
Disadvantages:

- ✗ Convert existing MC ray-tracing codes
- ✗ Learning curve (*C++*)

Advantages:

- ✗ Can easily be expanded to a more complete MC simulation
- ✗ UCN (!) classes exist already (F. Atchison, P. Fierlinger *NIM A, 2005*)
- ✗ Includes spin and polarization tracking
- ✗ Relatively simple modification of geometry





EDM