MAGiC optics and shielding*

* Rough estimate

Scientific scope

MAGiC: single crystal diffractometer

Study of magnetic correlations

Applied Spintronics

Super-conductors

Multi-functional materials

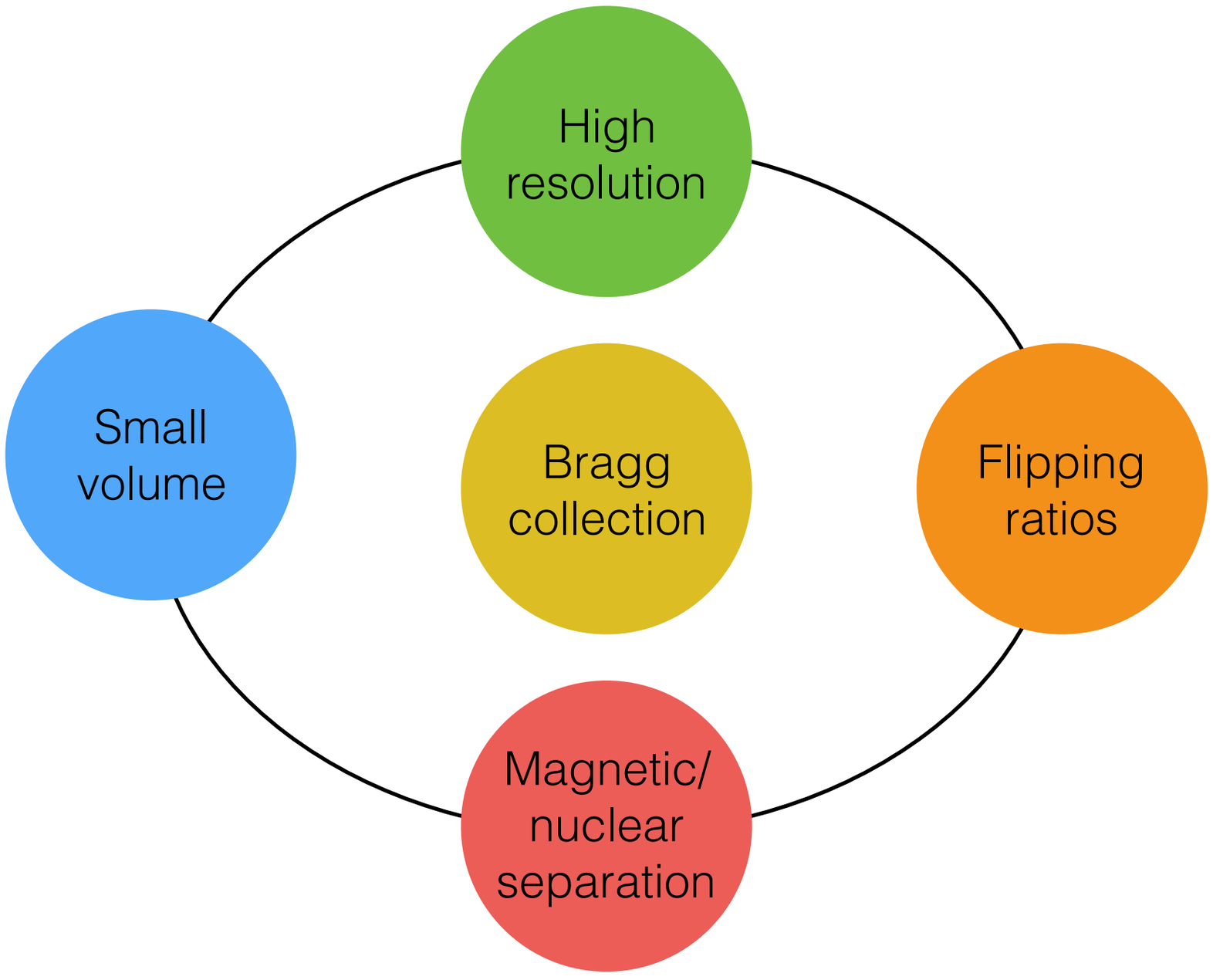
Quantum magnetism

Metal-insulator

Fundament. magnet.

Associated experiments

MAGiC: single crystal diffractometer



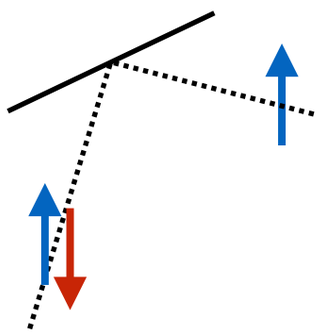
Associated optics requirements

MAGiC: single crystal diffractometer

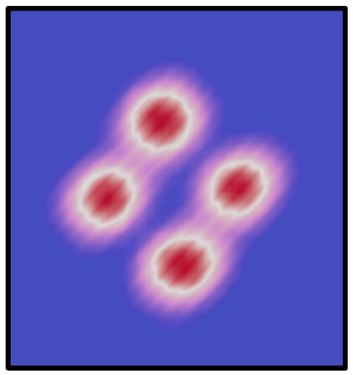
Study of magnetic correlations

2-6 Å

0.6-2.3 Å



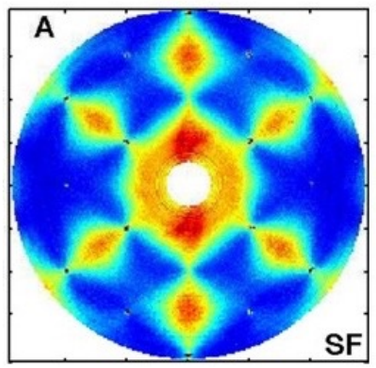
Incident beam polarization



$1\% < \Delta\lambda/\lambda < 14\%$

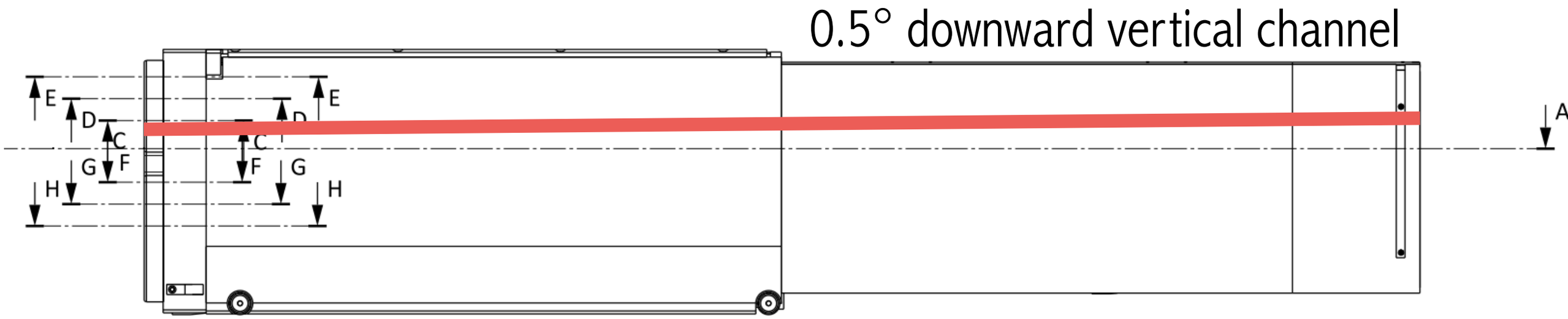
Divergence $\pm 0.3°$

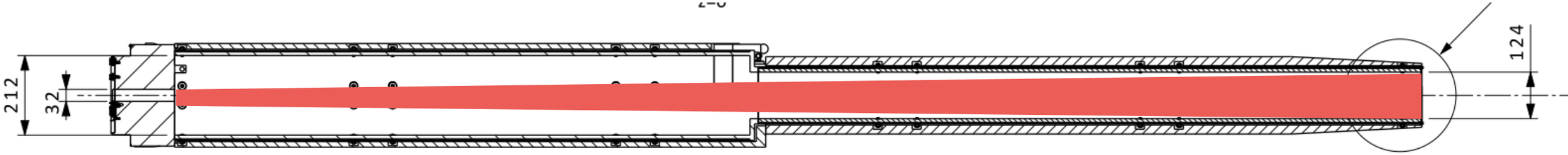
Sample size: $<8\ mm^3$

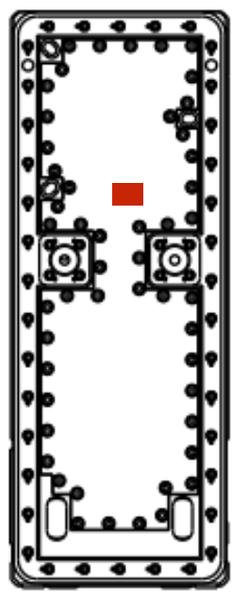


XYZ polarization analysis

Beam extraction







No super-mirrors in the beam extraction
Dimensions @ 2.0 m: 124x30 mm
Dimensions @ 5.5 m: 38x30 mm

Solid state bender: cold polarization

Bended silicon stack:

- 150 μm thick
- Dimensions: 30x30x50 mm
- @ 6m from moderator surface

3m curvature radius

0.86° bending

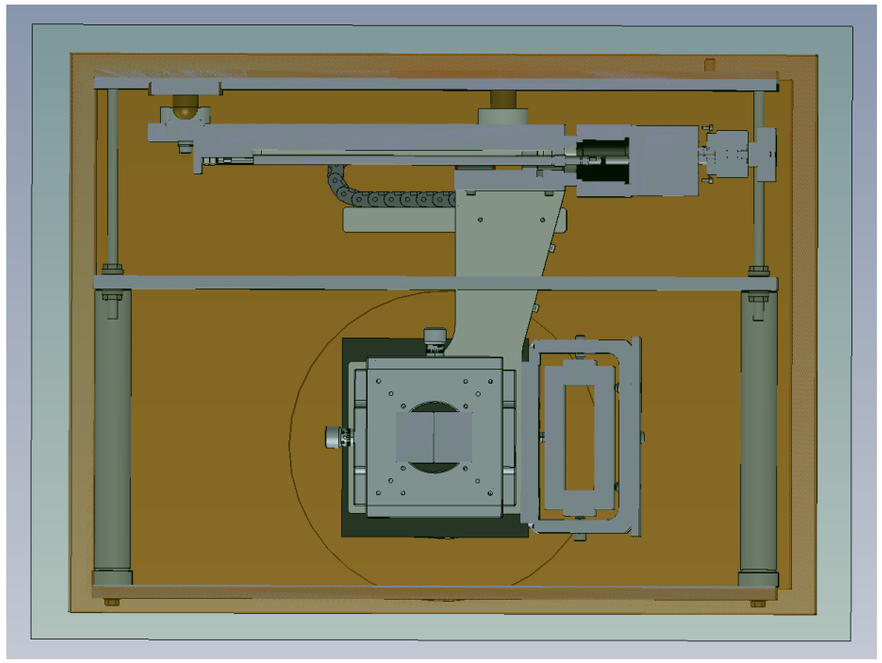
FeSi coating

<P> = 99% for 2 < λ < 6 Å

Expected cost:

- Wafers +coating: 60 000 €
- Saturation field: 2 000 €
- Positionning: 20 000 €

Total: 82 000 €

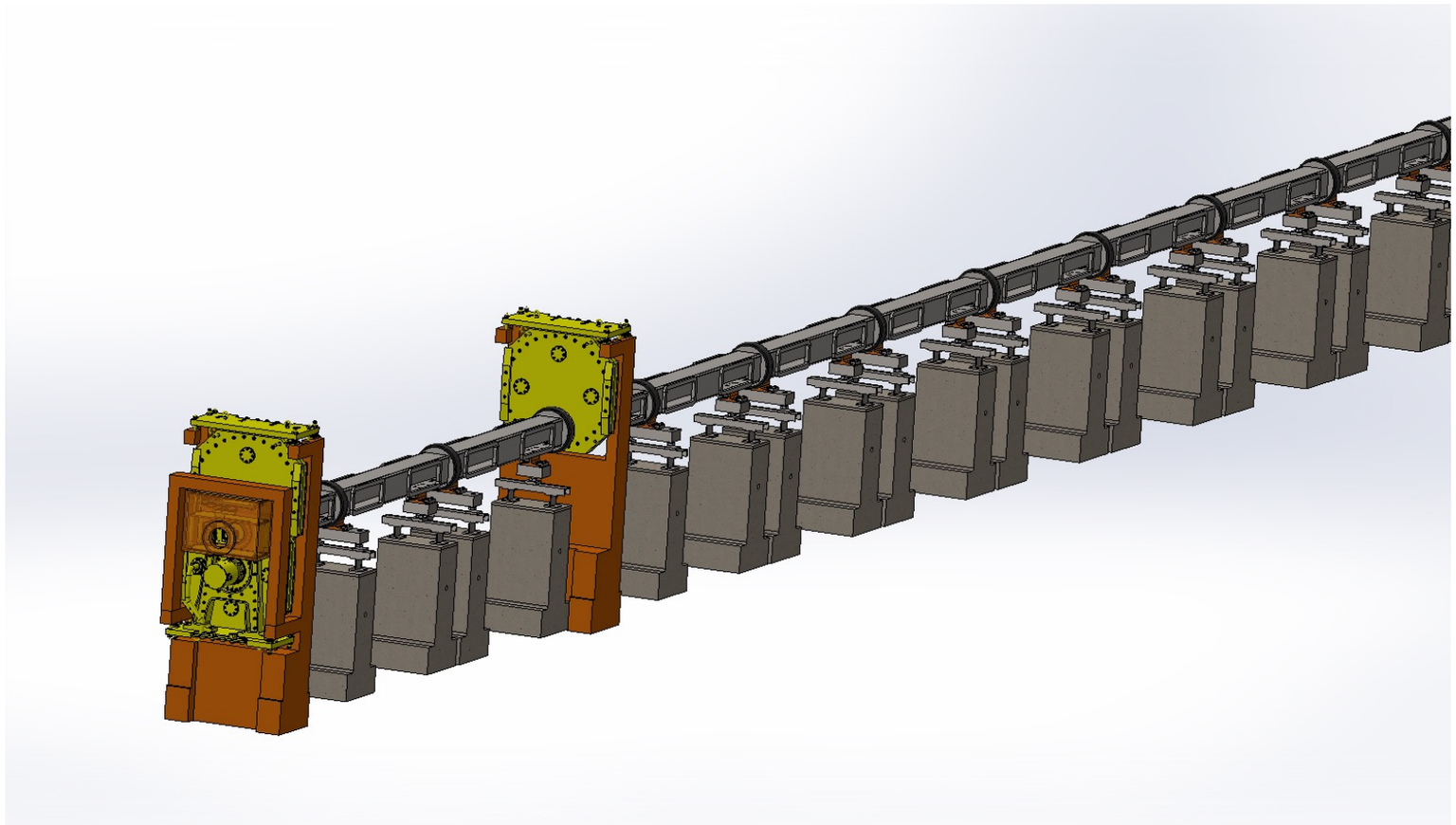


Choppers

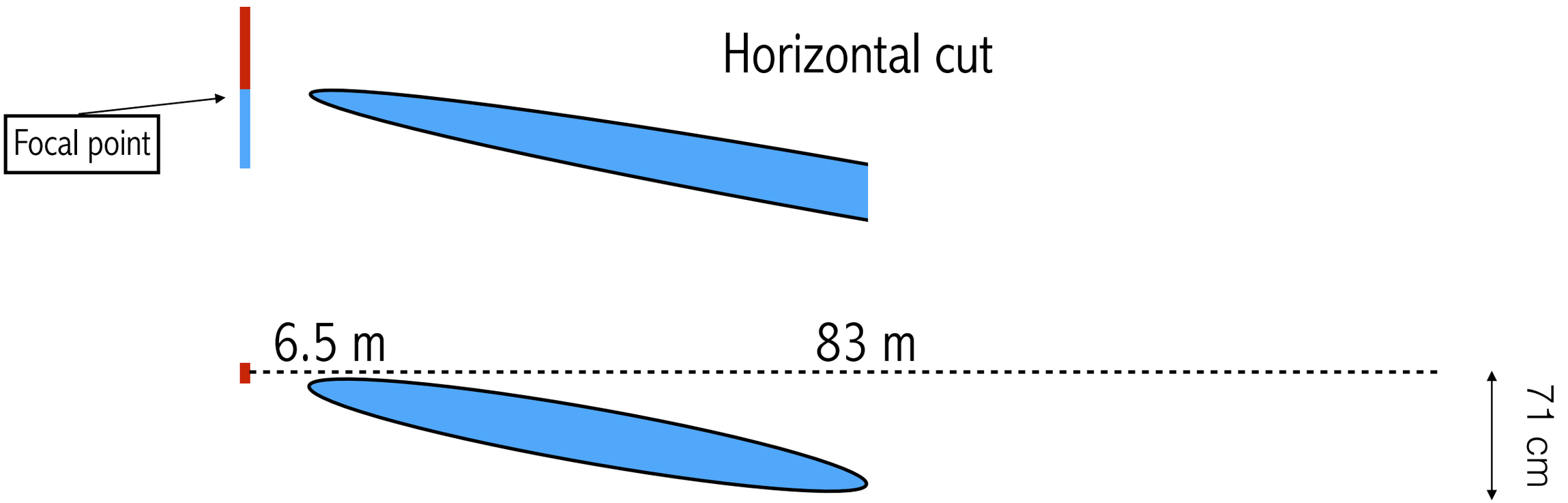
Pulse Shaping Choppers:
- 2 counter-rotative disks
- 45 cm diameter
- @ 6.2 m

Selection Chopper:
- @6.3 m

Band Chopper:
- @ TBD

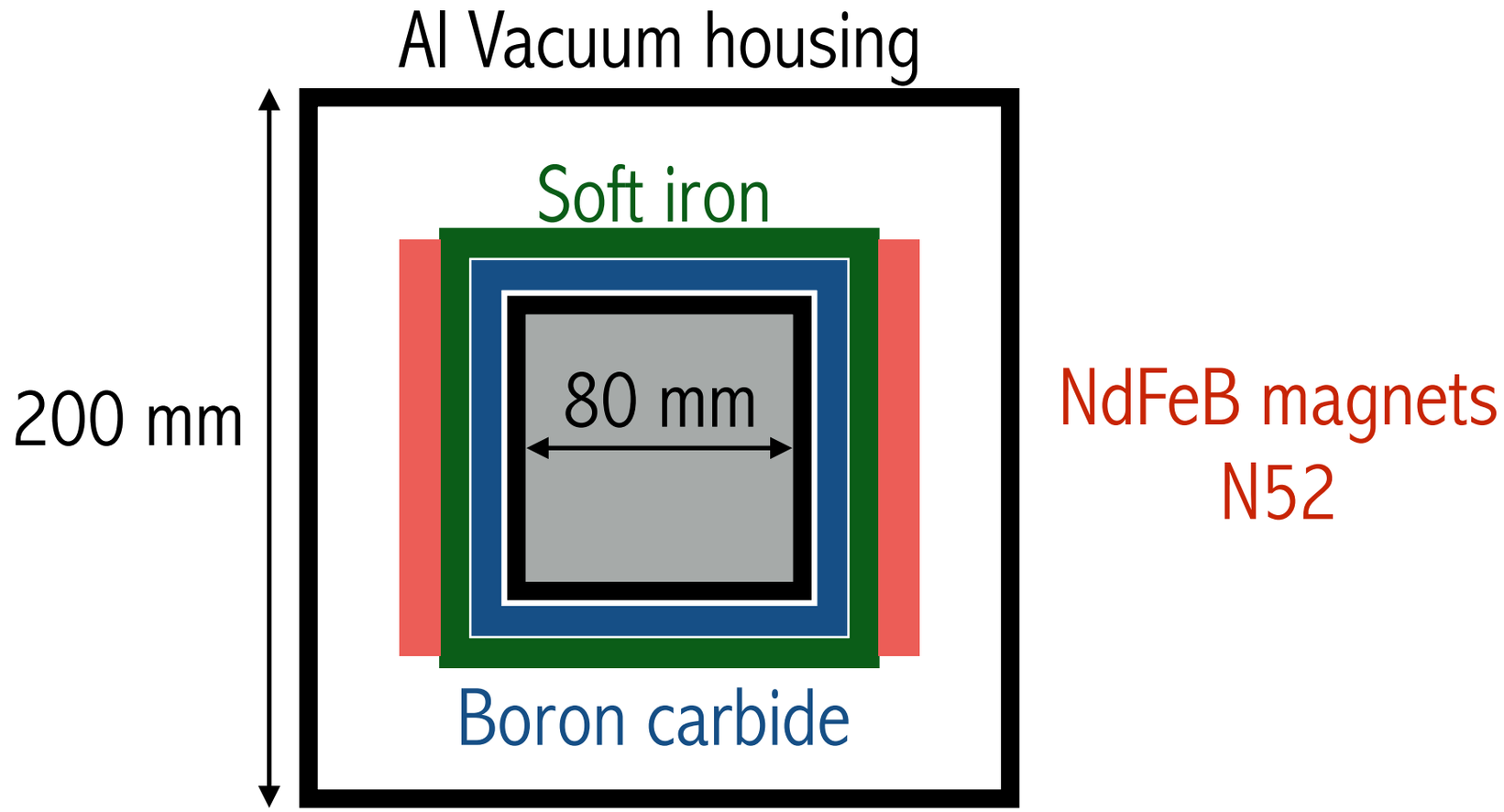


First ellipse 0.5° downward



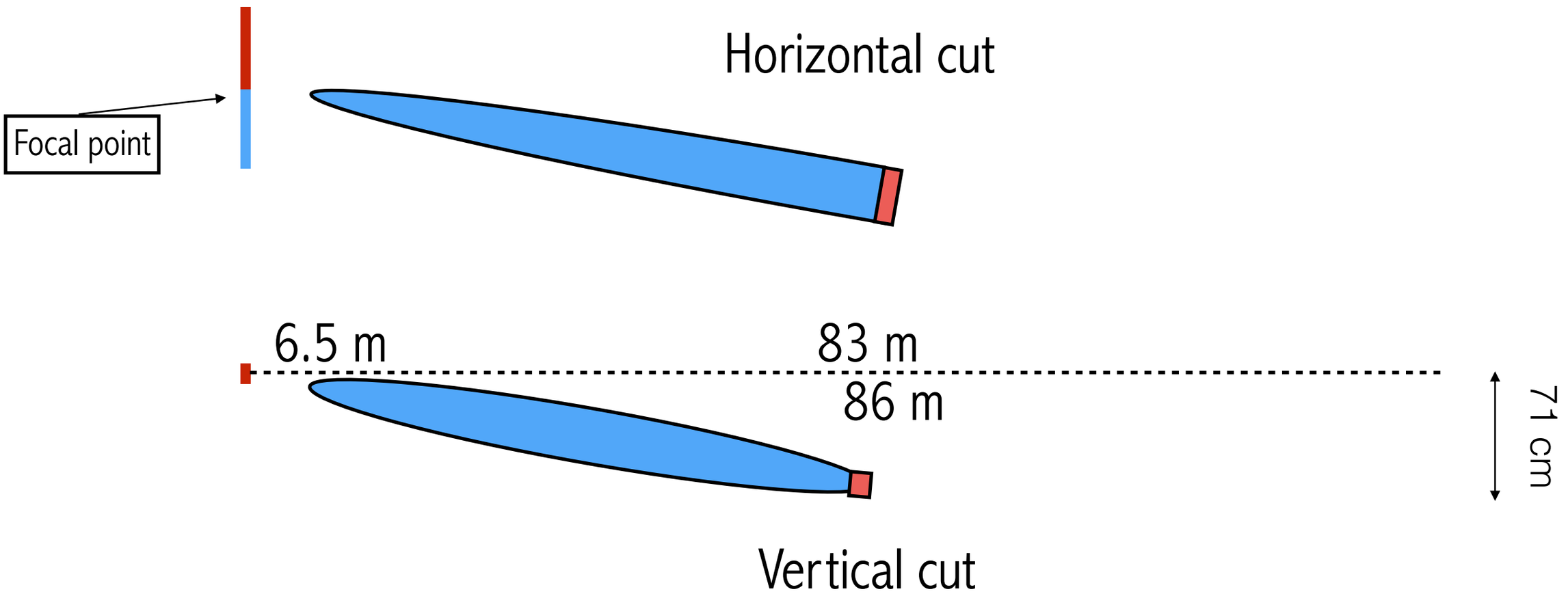
6.5 to 28.5 m	Al substrate	30x30 mm at entrance
28.5 to 83 m	Borkron substrate	80x80 mm max cross section
	20x20 cm carter	60 Gauss guide field
	NiTi coated	

First ellipse



Polarizer

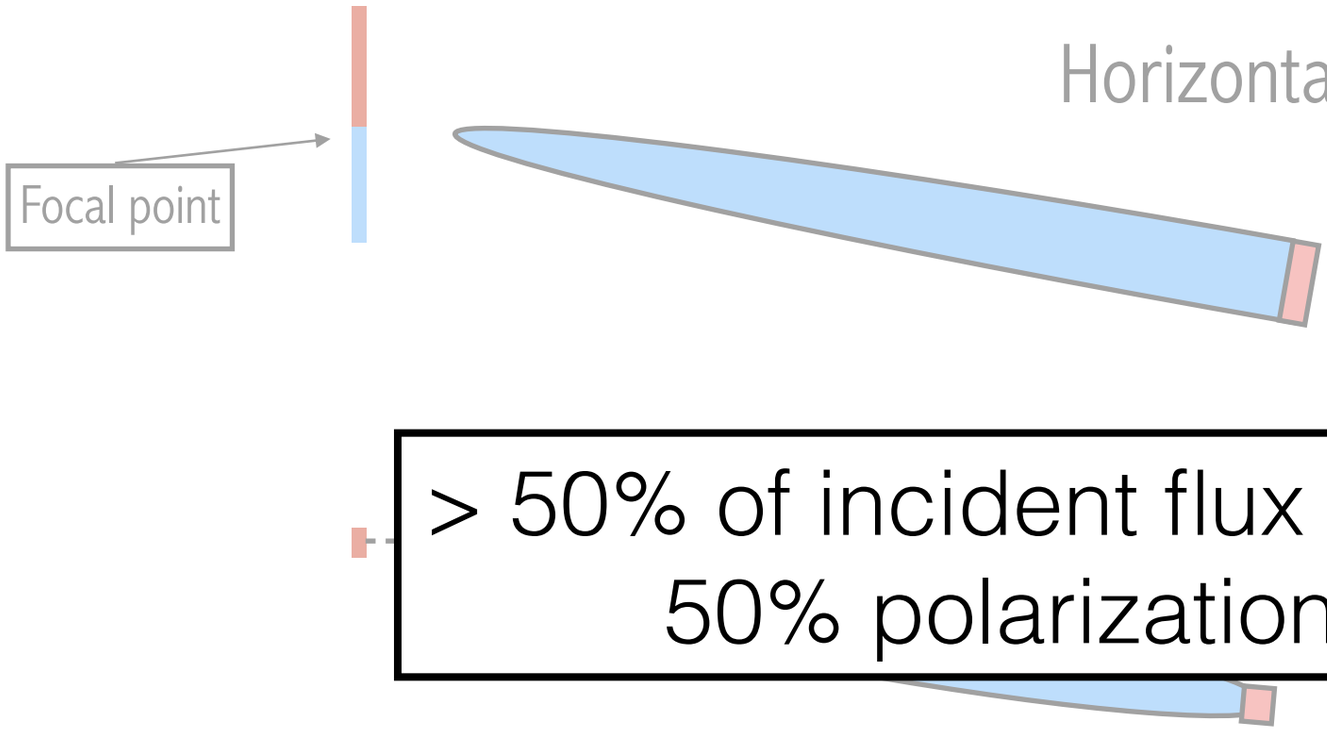
0.25° downward



83 to 86 m

Borkron substrate 80x52 mm cross section
4 channels on Si substrate (300 microns)
FeSi coated (top/bottom) NiTi (left/right)
1 kGauss saturation field

Polarizer



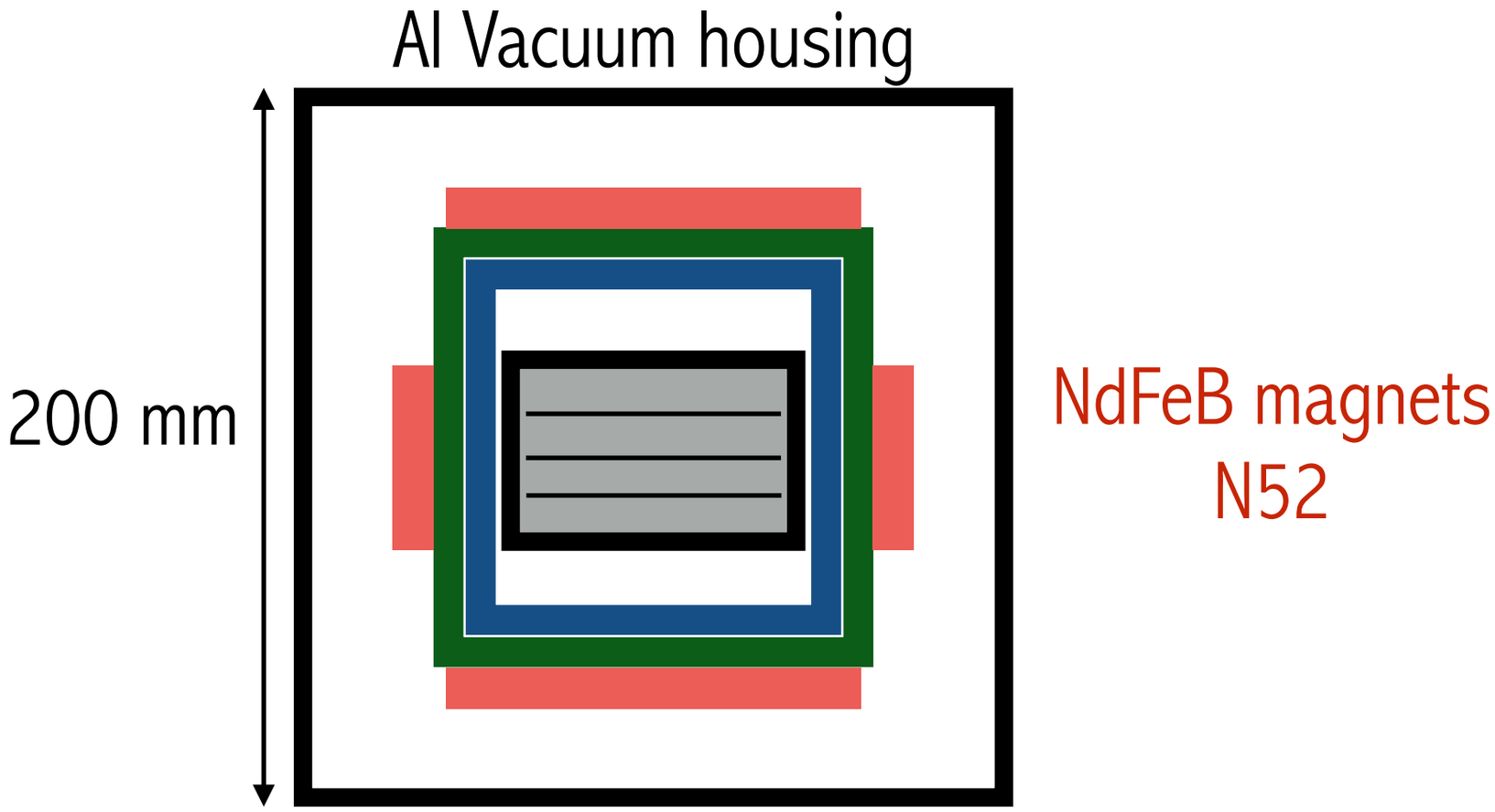
> 50% of incident flux is loss here !
50% polarization + LoS

Vertical cut

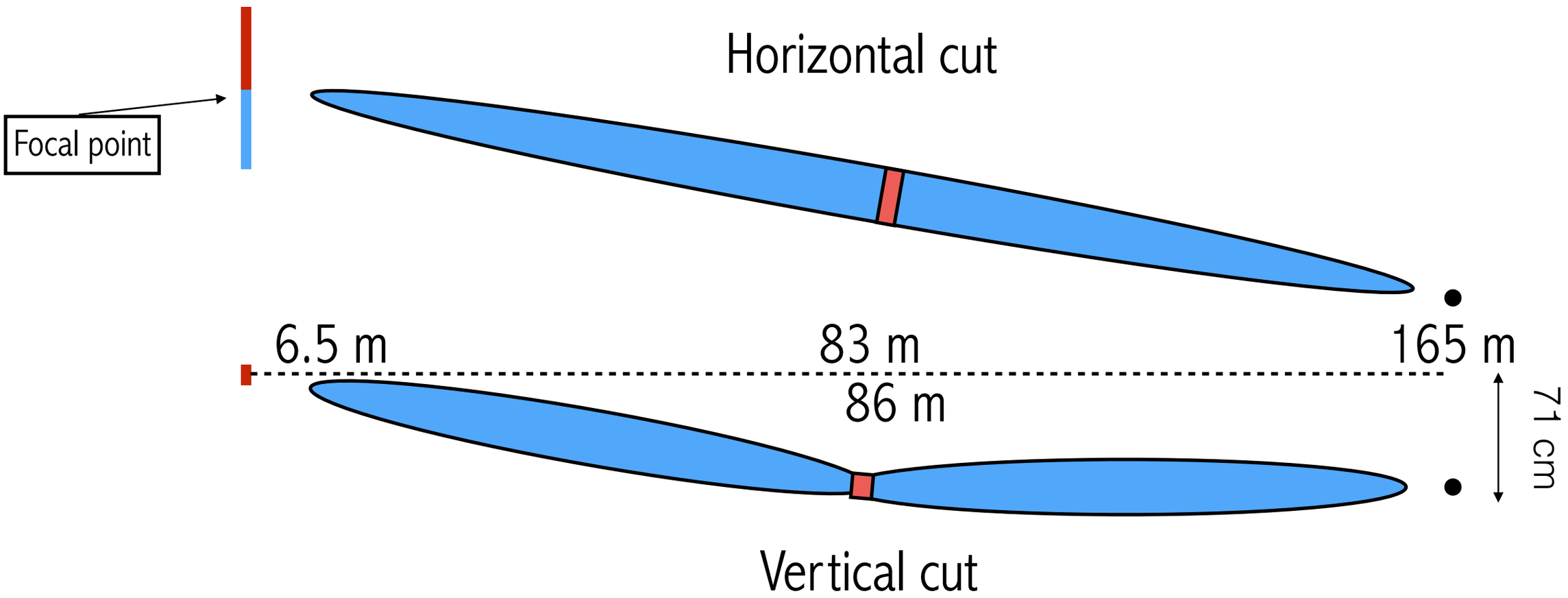
83 to 86 m

Borkron substrate 80x52 mm cross section
4 channels on Si substrate (300 microns)
FeSi coated (top/bottom) NiTi (left/right)
1 kGauss saturation field

Polarizer



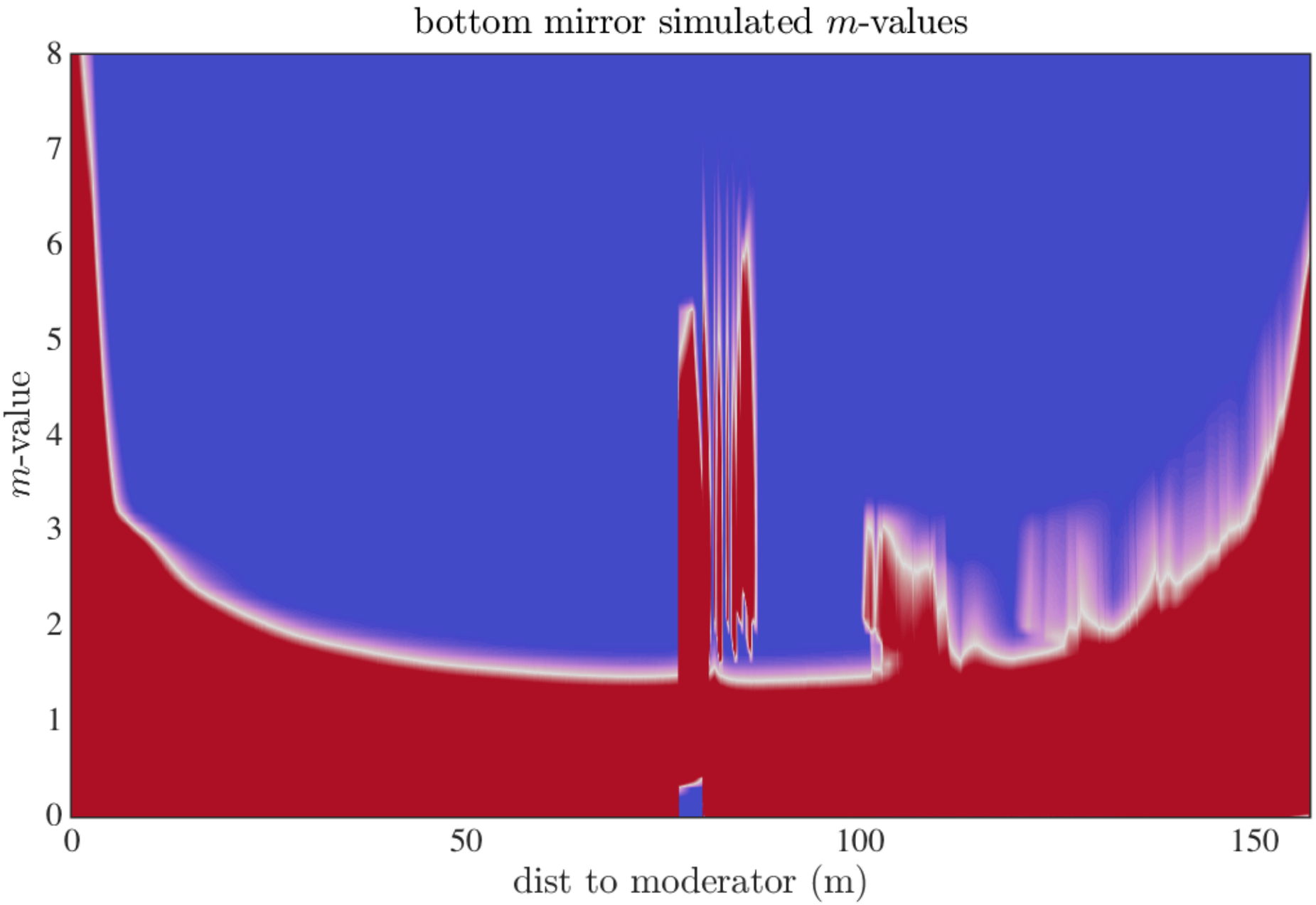
Second ellipse horizontality regained



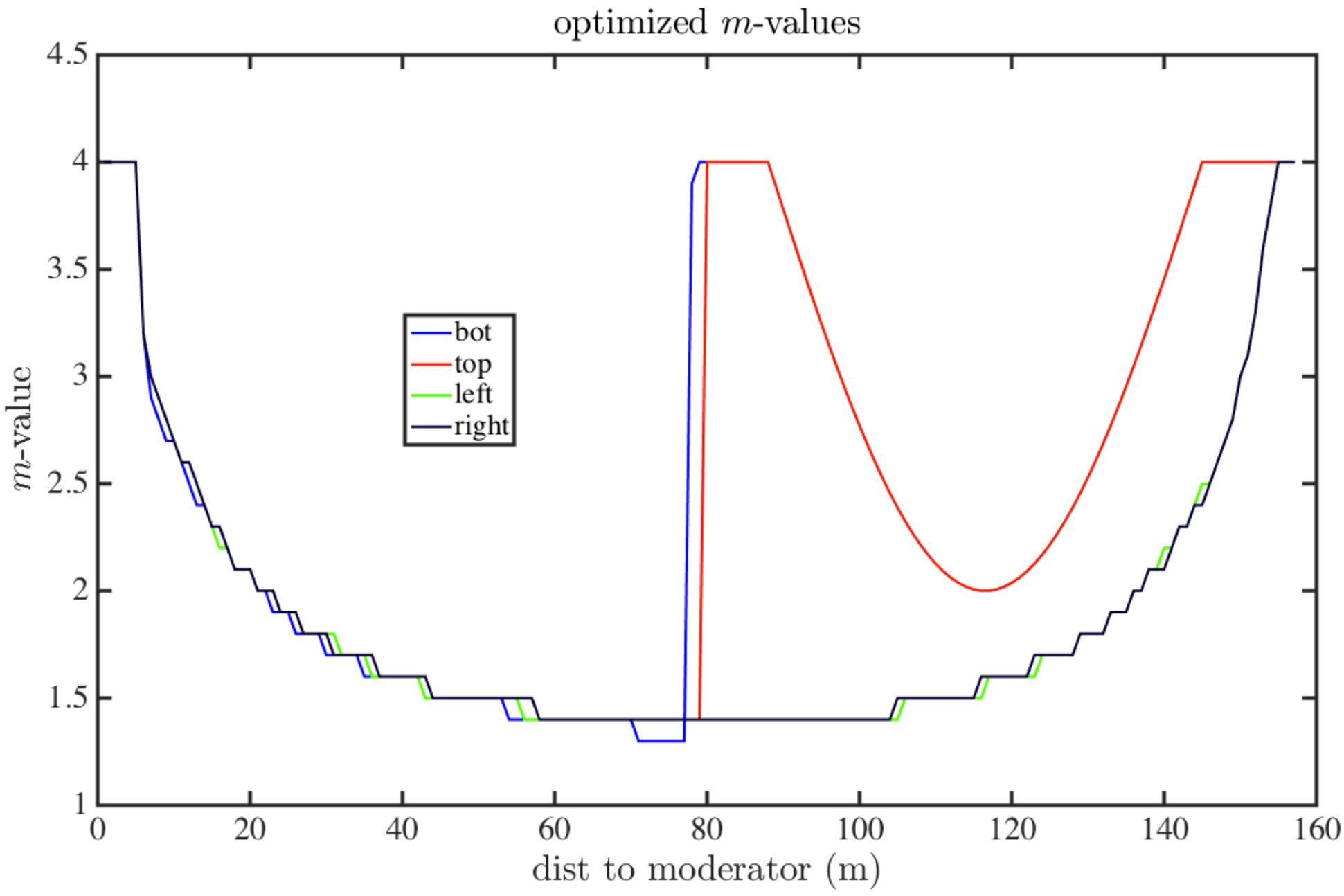
86 to 163 m

Borkron substrate 80x80 mm cross section
NiTi coated
60 Gauss guide field

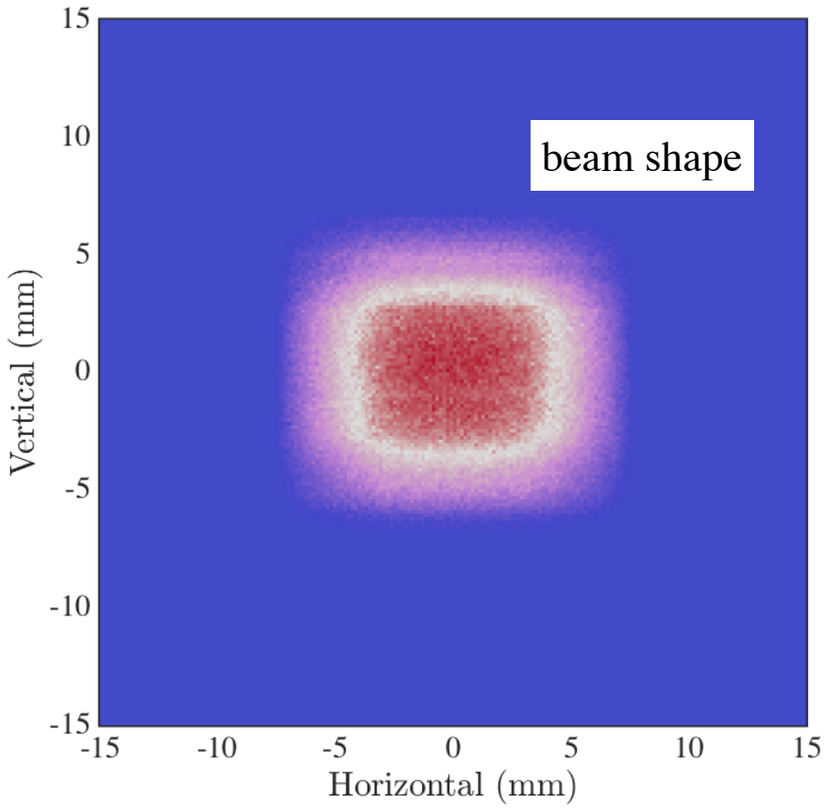
m-coating optimization

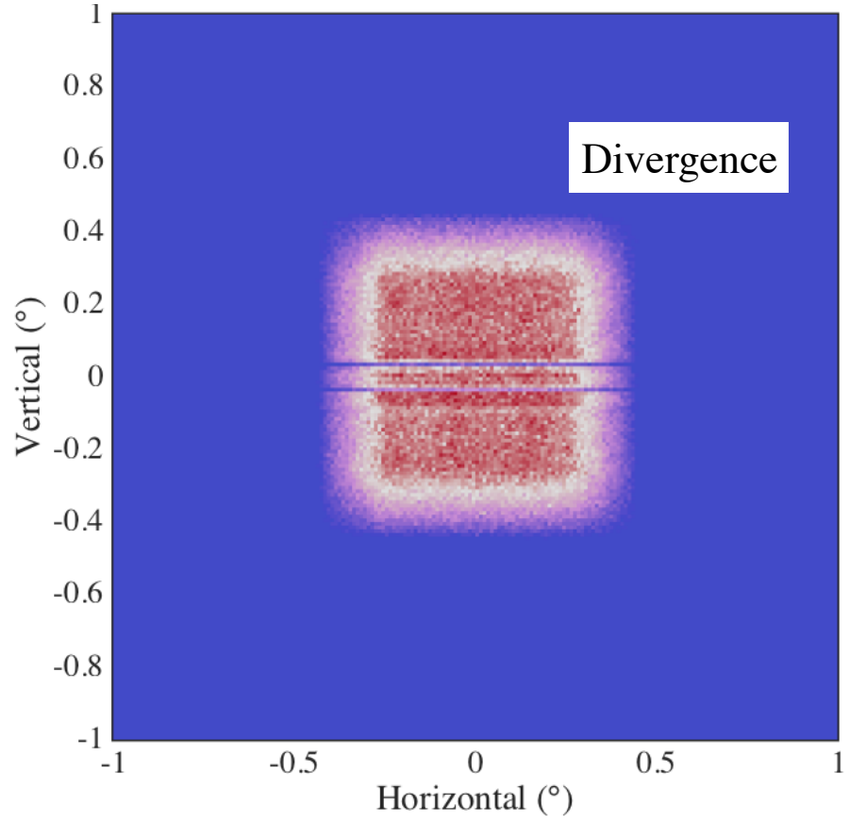


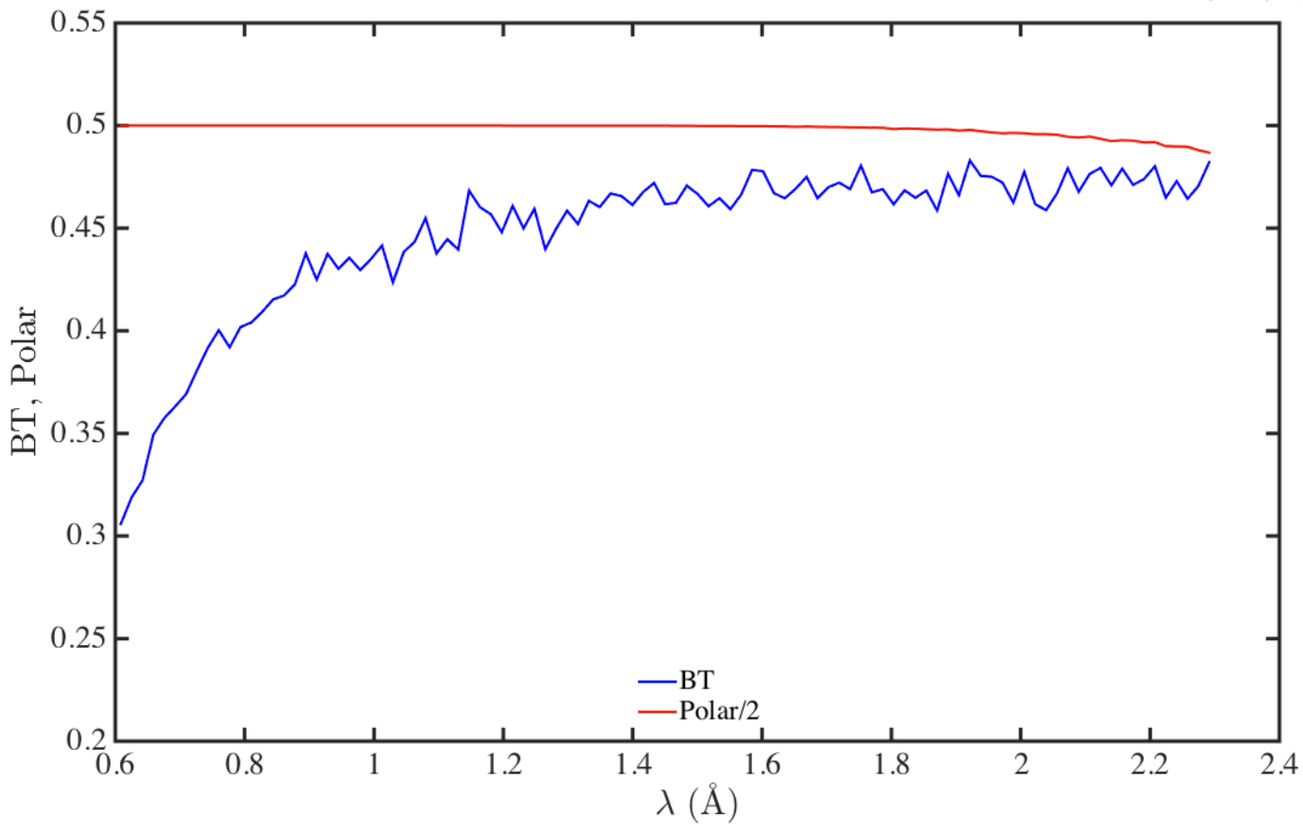
m-coating optimization



Expected performances







Optics costs

Super-mirrors:	2 100 000 €
Vacuum Housing:	520 000 € (including positioning)
Guide field:	82 700 €
SSB:	62 000 €
Saturation field:	100 000 €
Total:	**2 870 000 €**

Optics shielding: U. Filges estimate

Bunker:

- Boron carbide: 1cm thick
- Heavy shutter in bunker wall

First ellipse:

- Boron carbide: 1cm thick
- Heavy concrete (5g/cm3)

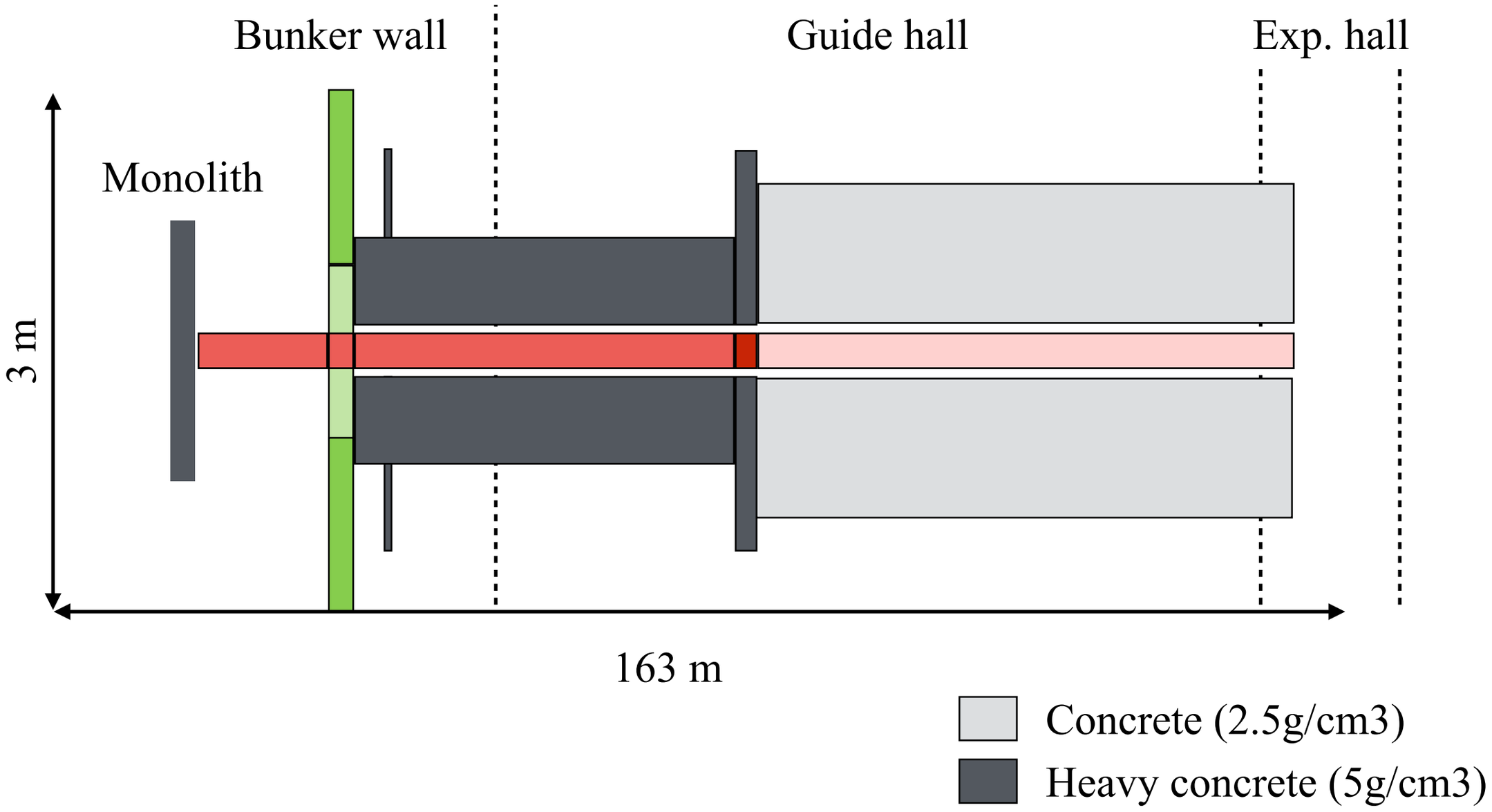
Polarizer:

- Heavy concrete (5g/cm3)
- Extra steel blocks at ellipse extremities

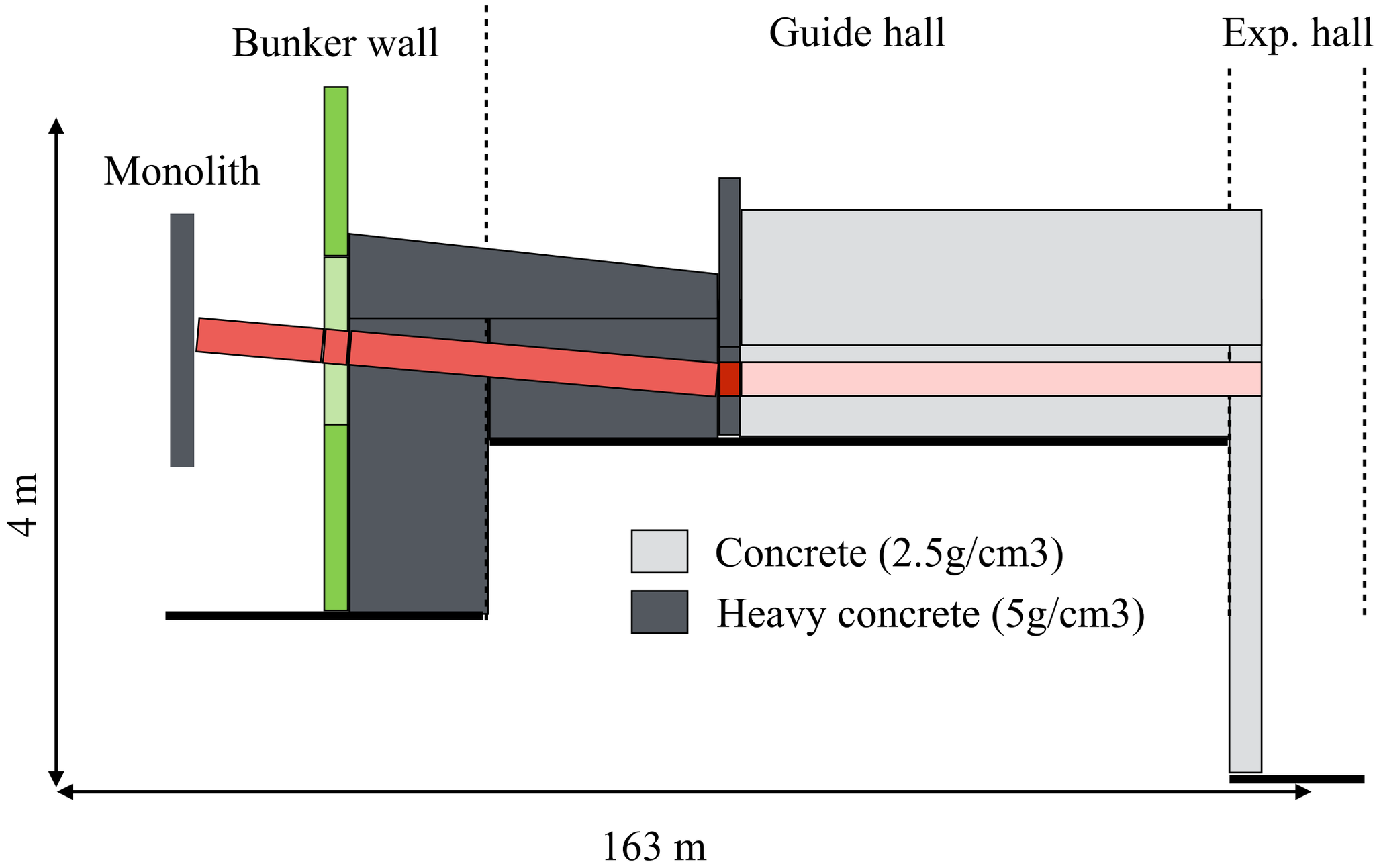
Second ellipse:

- Concrete (density = 2.4)

Top view


Bunker wall
Guide hall
Exp. hall
Monolith
3 m
163 m
Concrete (2.5g/cm3)
Heavy concrete (5g/cm3)

Side view


Bunker wall
Guide hall
Exp. hall
Monolith
4 m
Concrete (2.5g/cm3)
Heavy concrete (5g/cm3)
163 m

Heavy shutter

Heavy concrete
Steel
Tungsten

Expected cost: 200 000 €

Rotating ?
Vertical translation ?

Has to carry guide field !

First ellipse

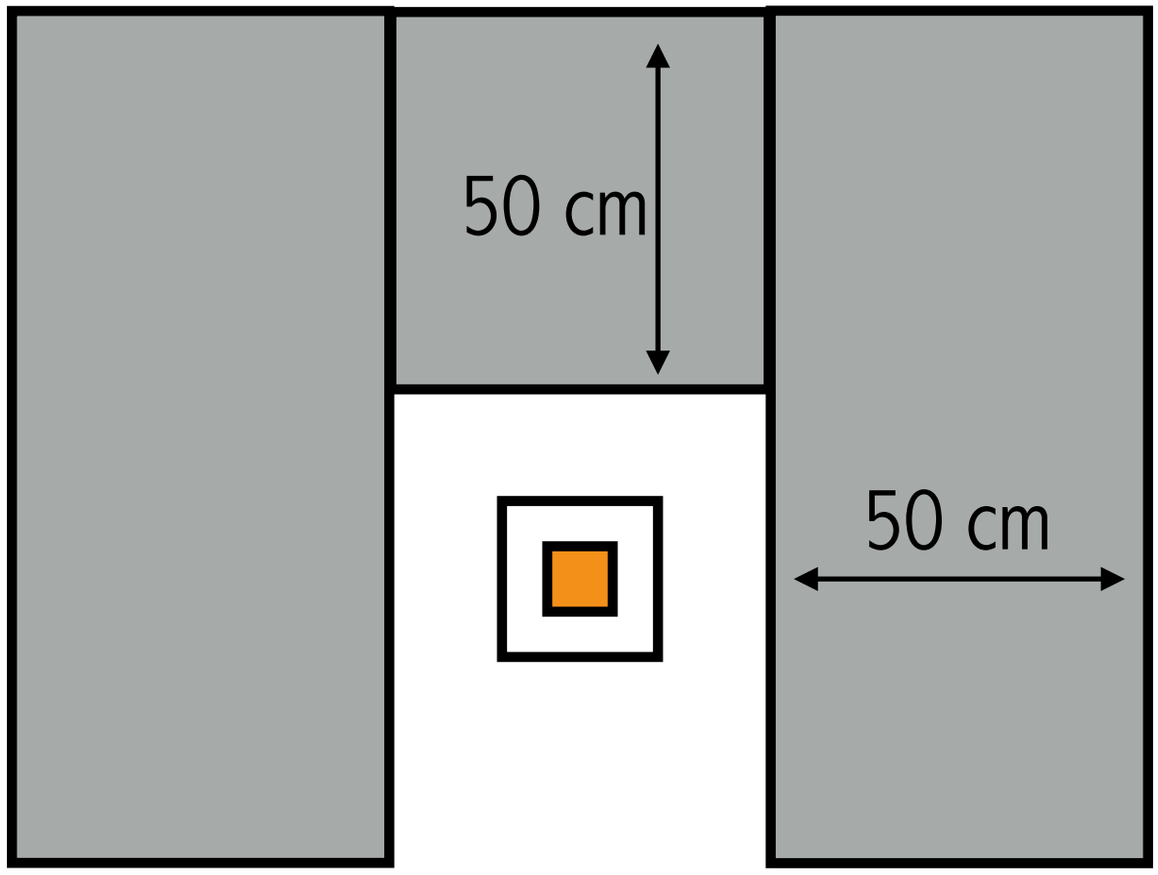
Heavy concrete:

Density = 5.2 g/cm3

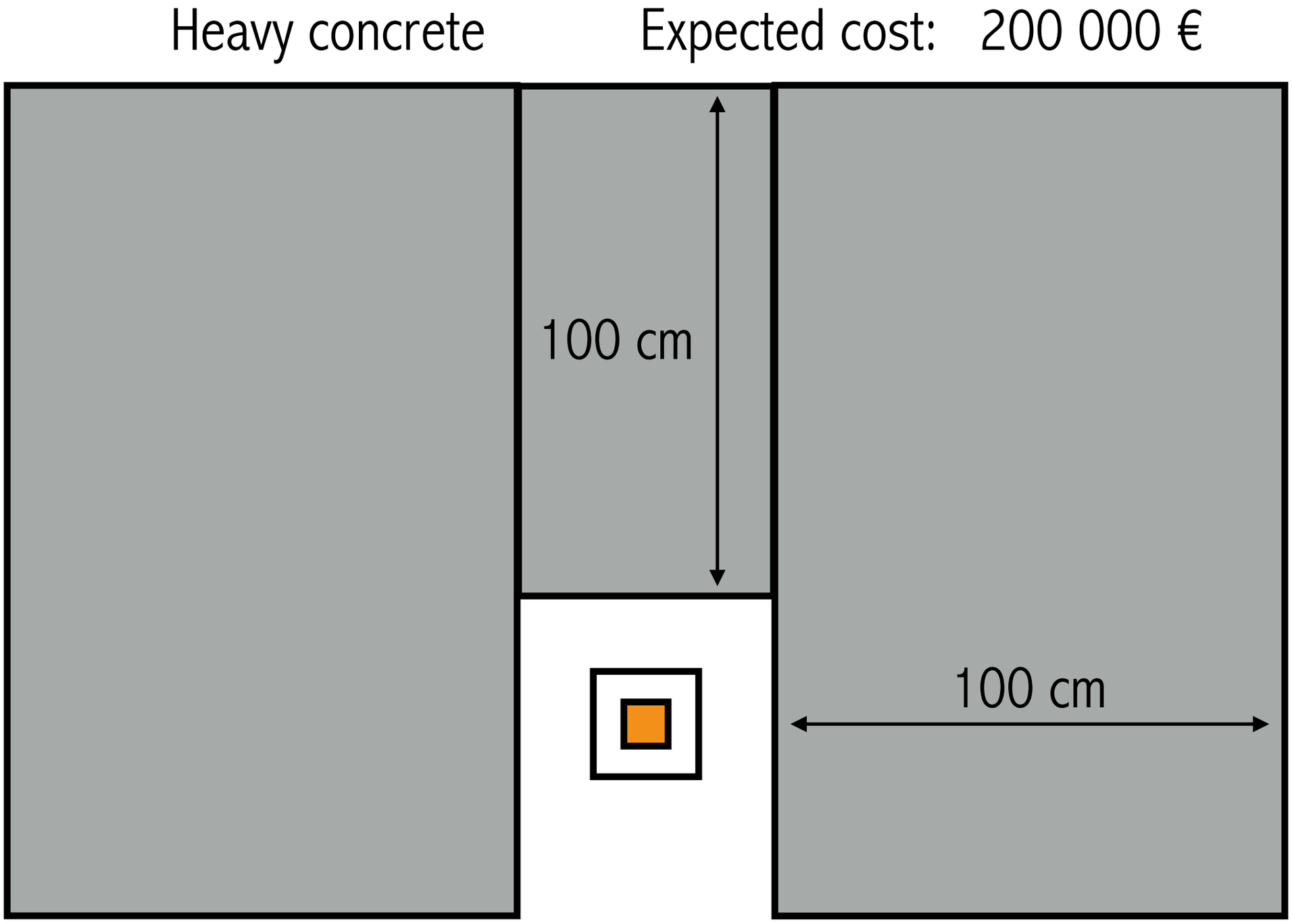
Stainless steel 1.4301

5% boron carbide

Expected cost: 1 600 000 €



Polarizer



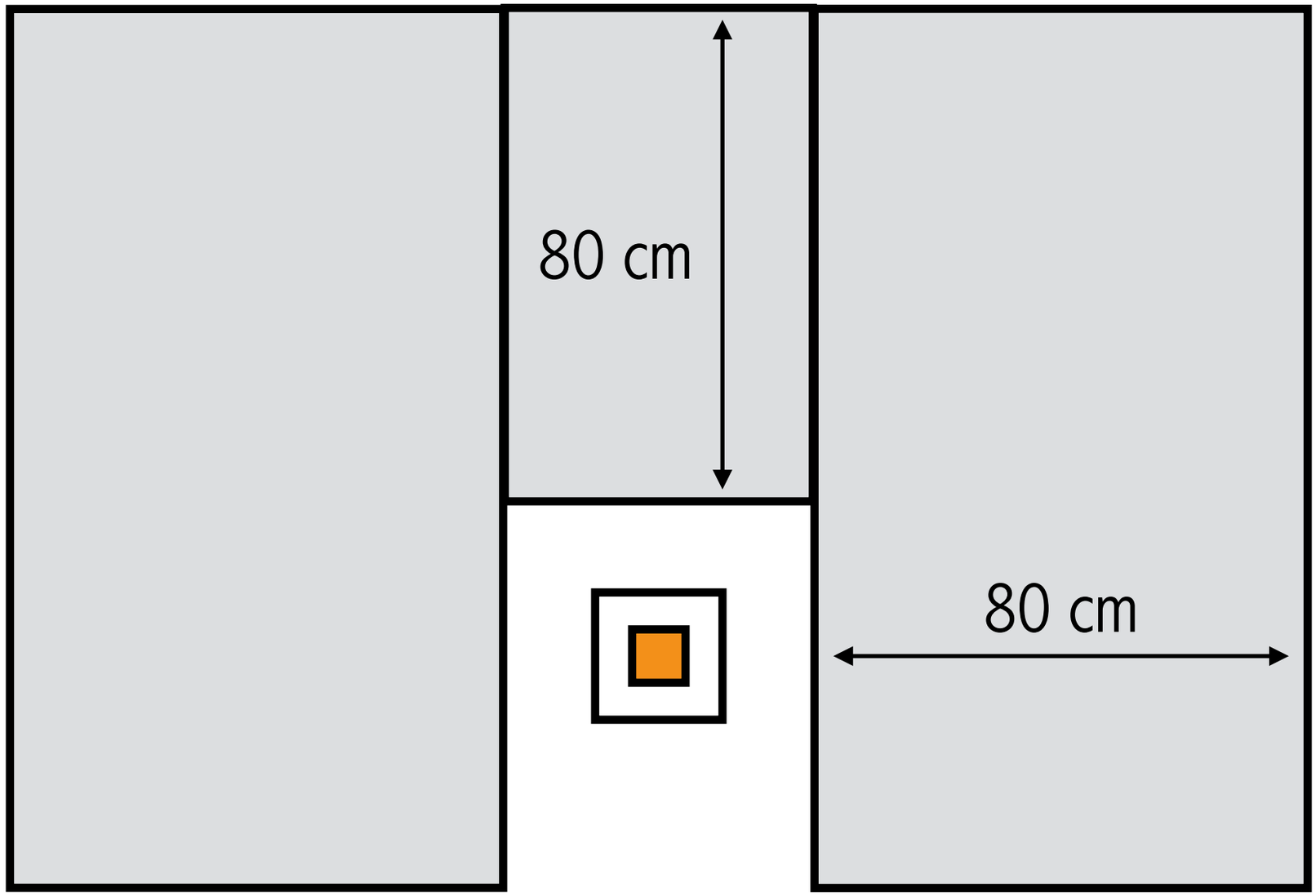
Second ellipse

Concrete:

Density = 2.4 g/cm3

5% boron carbide

Expected cost: 150 000 €



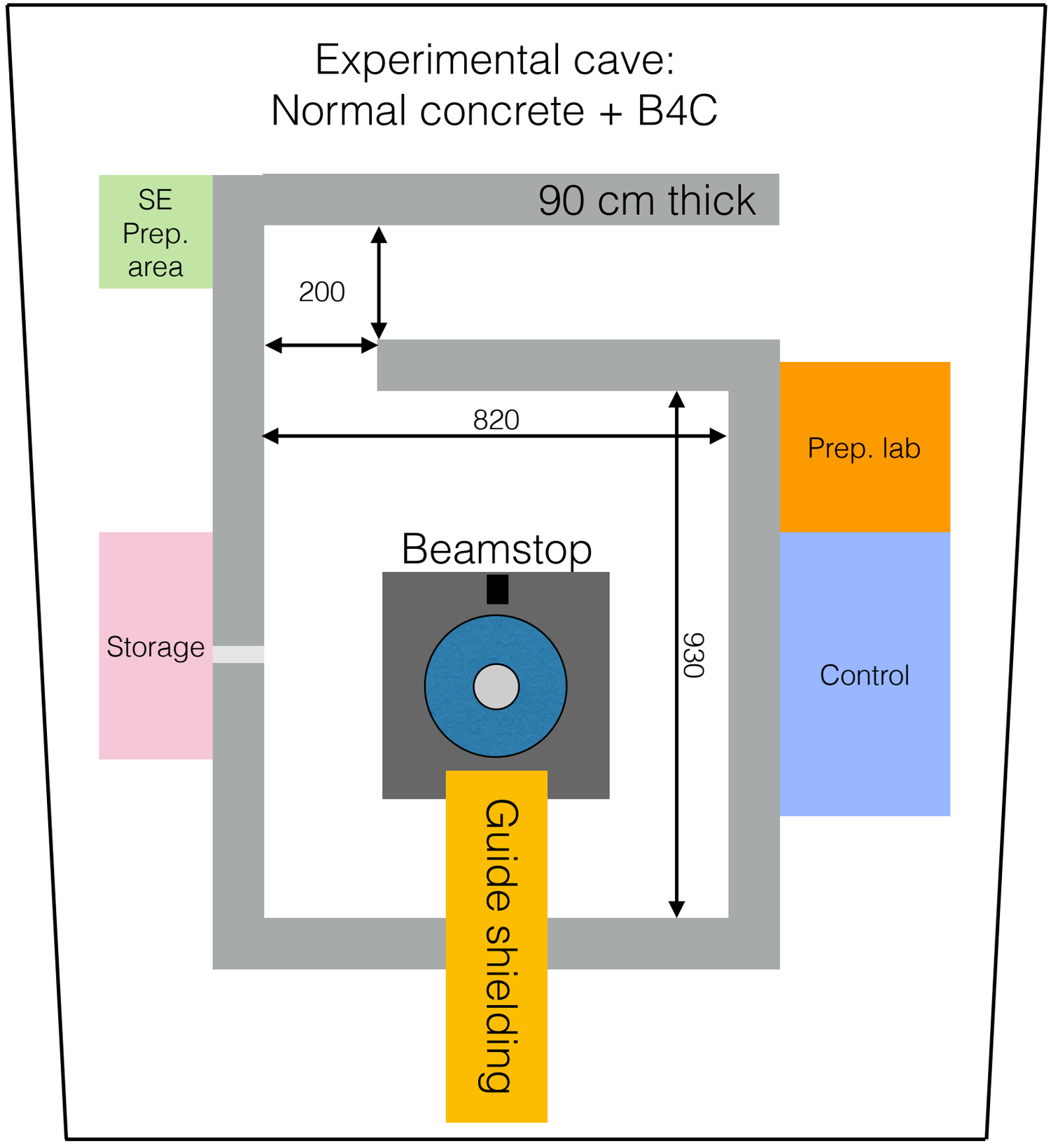
Experimental cave

- 1.5 μSv/hr
- No direct view

- 5 mm B4C
- 90 cm concrete

- 7 m height walls
- **Load = 18 T/m2**

- + roof
- **Load = 22 T/m2**



Shielding cost

Optics:

- B4C: 40 000 €
- Heavy shutter: 200 000 €
- Concrete + steel:
  - 85 m3 @ 18 000 €/m3
  - 1 500 000 €
- Normal concrete:
  - 170 m3 @ 700 €/m3
  - 120 000 €
- 1 860 000 €

Experimental cave:

- B4C : 40 000 €
- Light shutter: 20 000 €
- Beam stop: 5 000 €
- Normal concrete:
  - 400 m3 @ 700 €/m3
  - 280 000 €
- 345 000 €

Total: 2 205 000 €

Possible cost reduction ?

- Optics design (kink position):
  - Inside bunker = maintenance risk !
  - Optimal position to be defined
  - Closest position: 30 m

Possible gain: > 500 000 €
Performances hit ?

- Coordination between instruments
  - All 160 m long instruments will have similar shielding requirements
  - MIRACLES and T-REX are MAGiC neighbors
  - One "bunker" to shield them all ?

Possible gain: 1/3 of first section cost