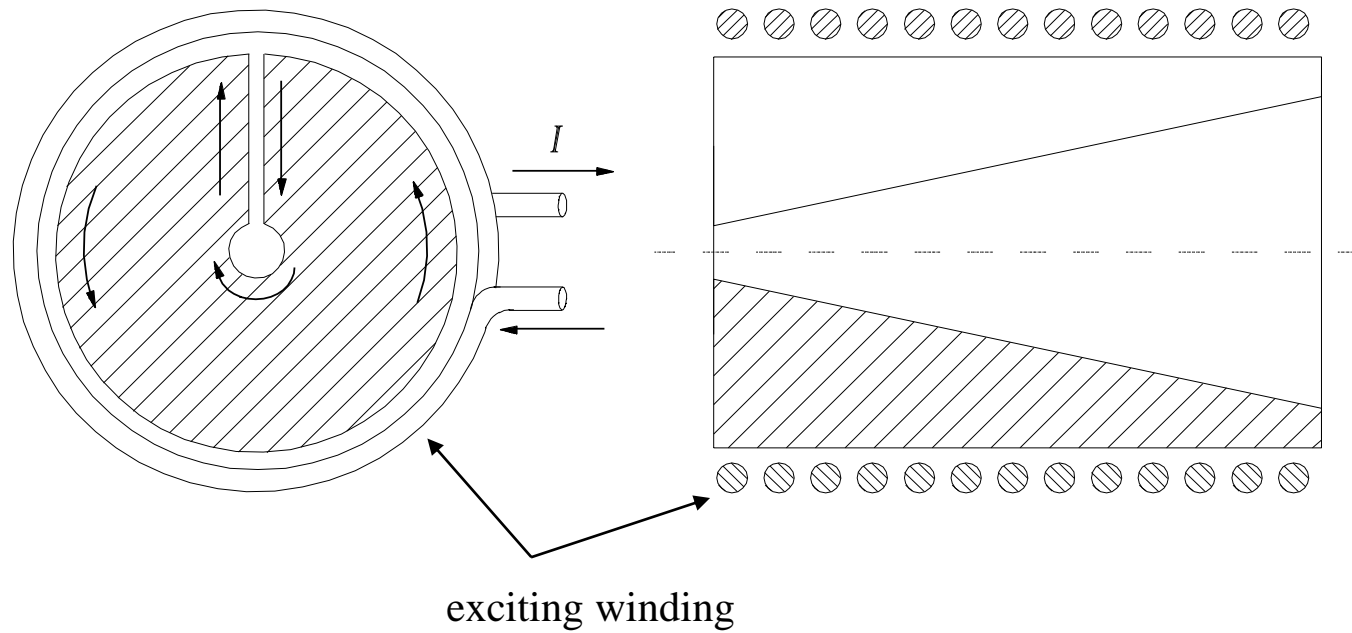


# *FCC – ee Flux Concentrator computer models*

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Budker Institute of Nuclear Physics,  
Novosibirsk*

## Classical Flux Concentrator



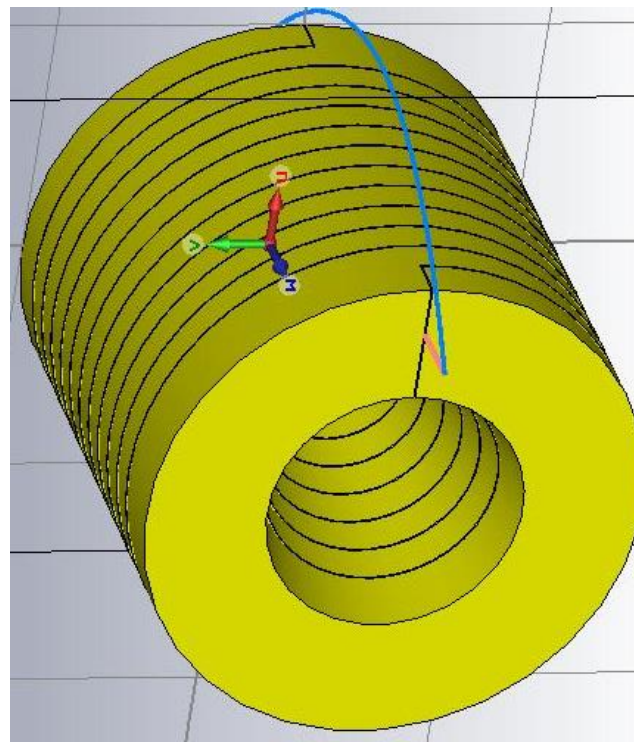
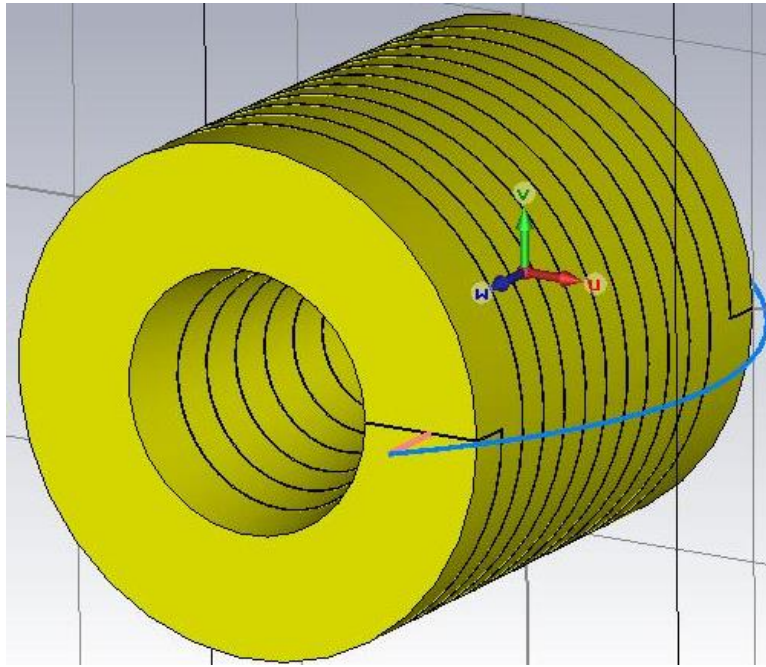
The small cone diameter defines the peak magnetic field .

The angle of conical cavity defines tapering parameter of magnetic field.

**Mechanical structural strength of FC body is not enough.**

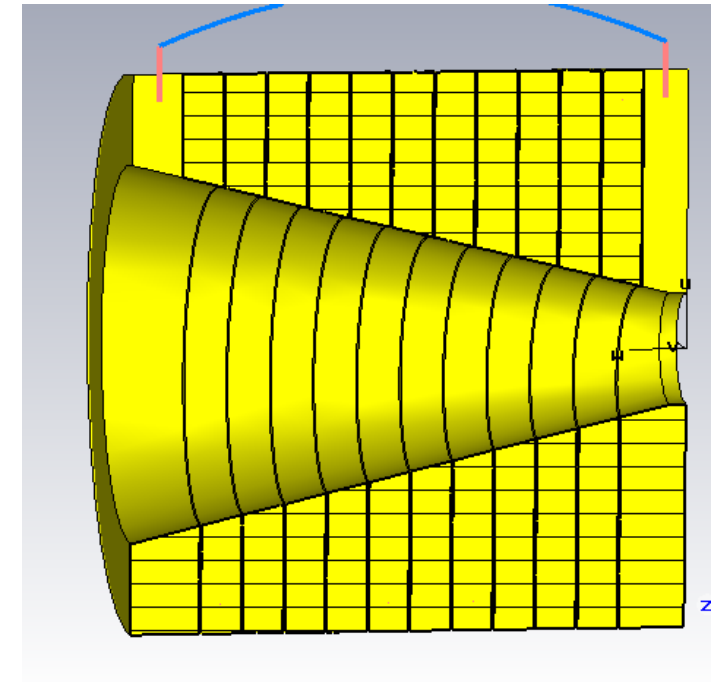
**Fastening of exciting winding is not reliable**

**Life time of device is less of  $10^9$  pulses.**

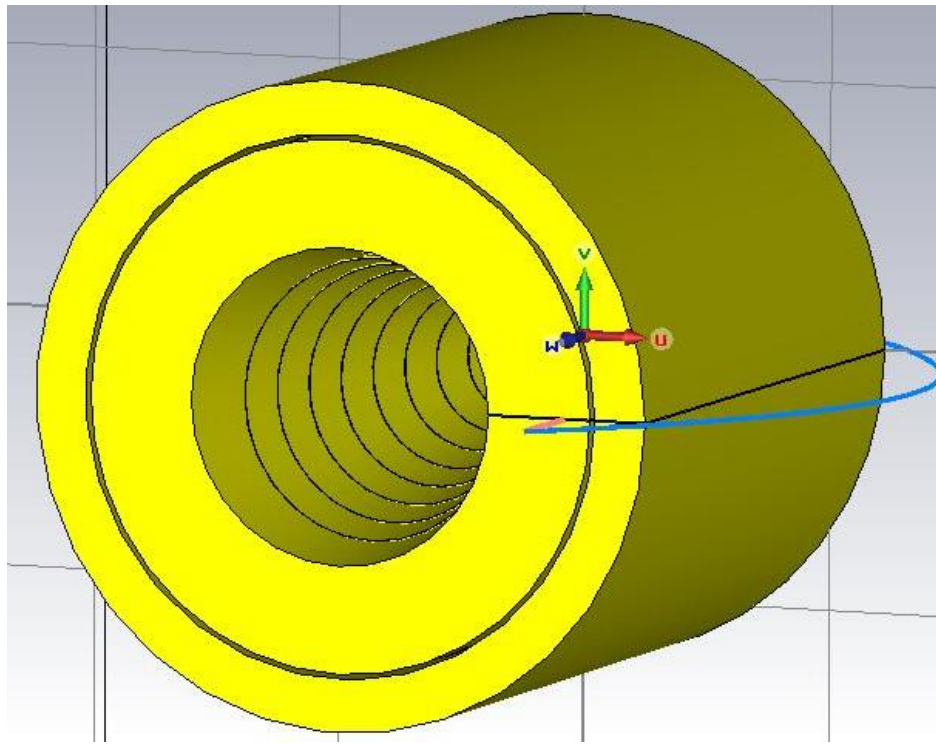


*Spiral Flux Concentrator (SFC)  
computer model*

- SFC diameter is 100mm
- SFC length is 100mm
- Min cone diameter is 7mm
- Max cone diameter is 52 mm
- 12 turns
- Current profile is a half of sine with a pulse length of  $6 \mu\text{s}$
- Peak field is not higher of 5 Tesla

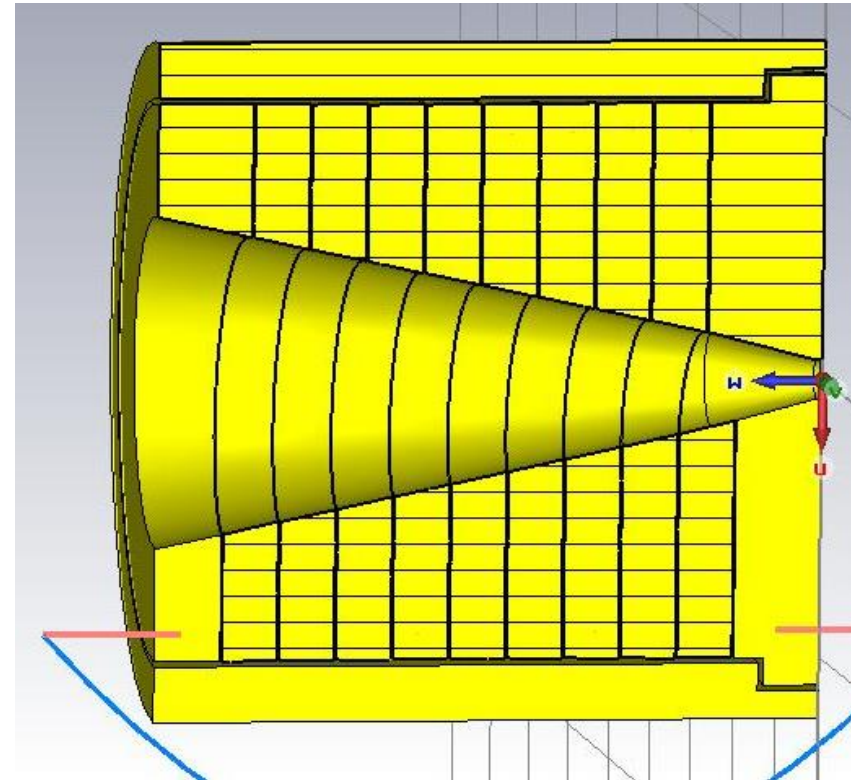


## *SFC with shielding computer model*

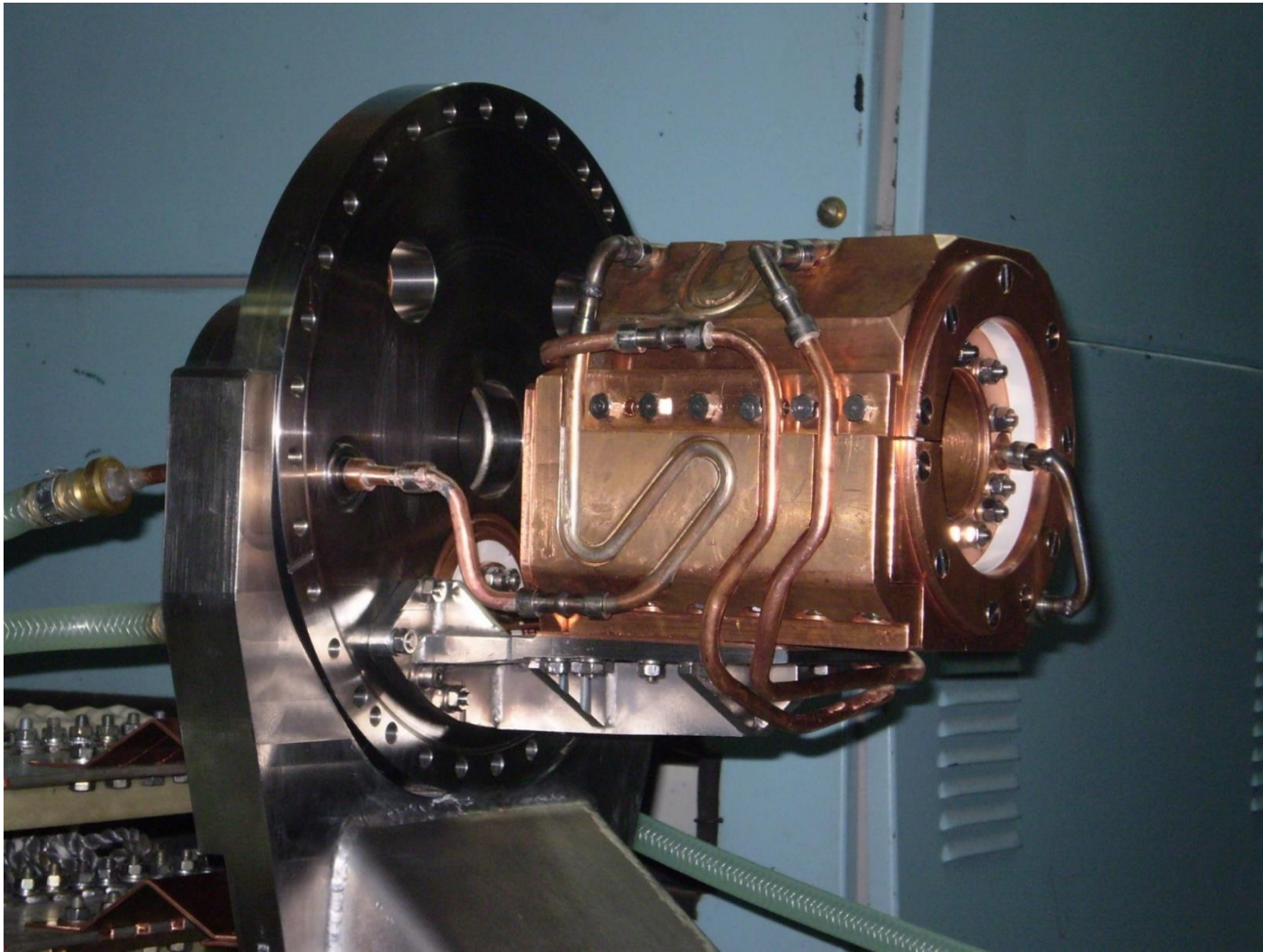


- Coil has 10 turns
- Current profile is a half of sine with a pulse length of 25  $\mu$ s
- Gap between turns is 0.3mm
- Gap between coil and shield is 1 mm
- Gap between spiral and shield is 1mm
- Width of first turn is 15.4 mm
- Turns width is 11.4 mm
- **Peak field is not higher of 7 Tesla (breakdowns)**

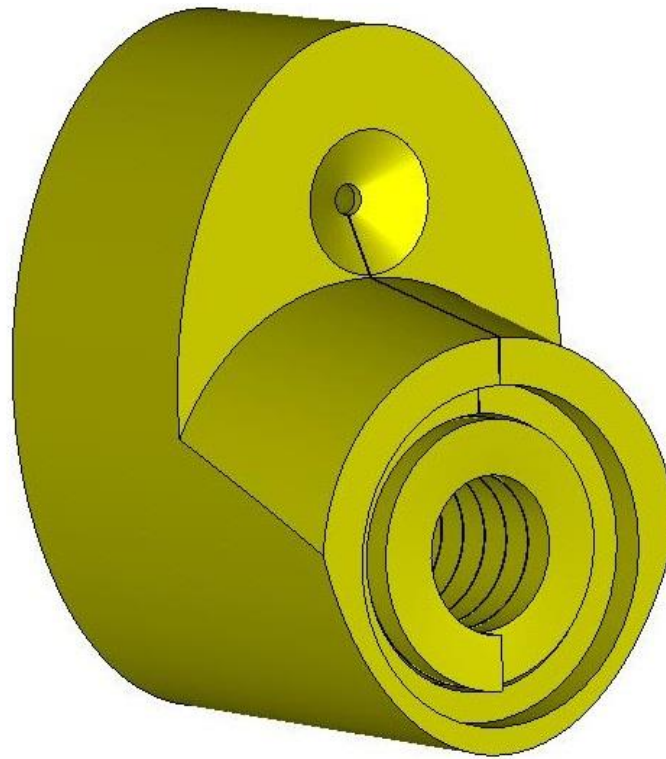
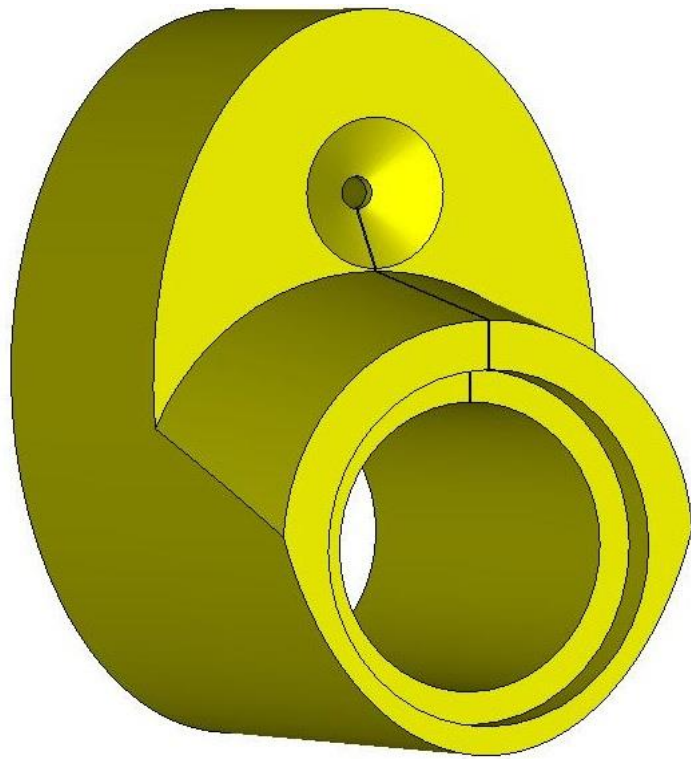
- SFC spiral diameter is 100mm
- SFC length is 120mm
- Min cone diameter is 7mm
- Max cone diameter is 52 mm







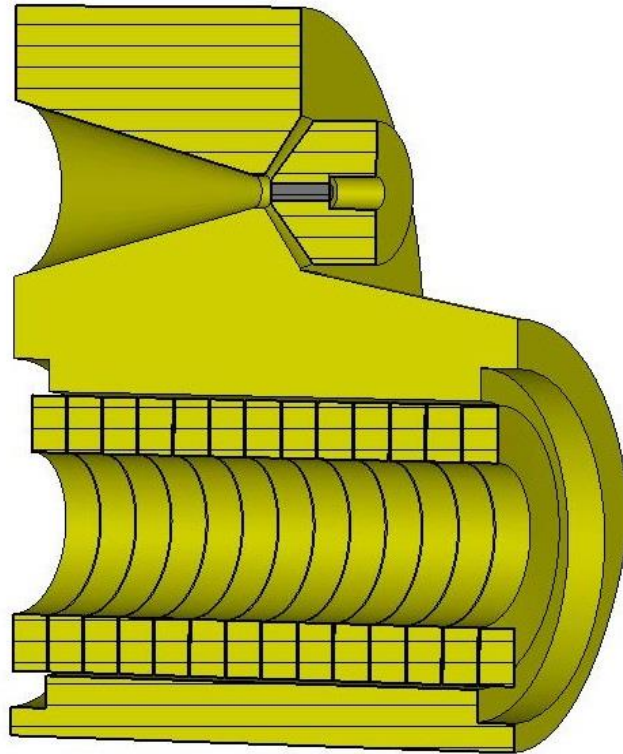
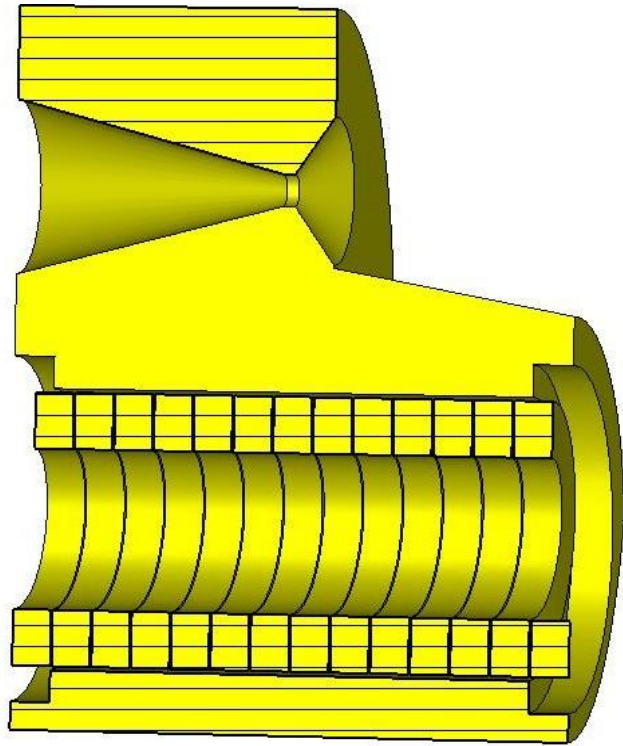
*SFC with shielding prototype BINP*



*FCC-ee Flux Concentrator (FC)  
computer model*

- Current profile is a half of sine with a pulse length of  $25 \mu\text{s}$
- Gap between coil turns is 0.4 mm
- Gap between coil and FC body is 1 mm
- Turns size is 9.6x14 mm

- Elliptical cylinder 120x180 mm
- Total length is 140 mm
- Conical part length is 70 mm
- Min cone diameter is 8 mm
- Max cone diameter is 44 mm
- Cone angle is  $\approx 30$  degrees
- Cylindrical hole diameter is 70 mm
- Coil has 13 turns

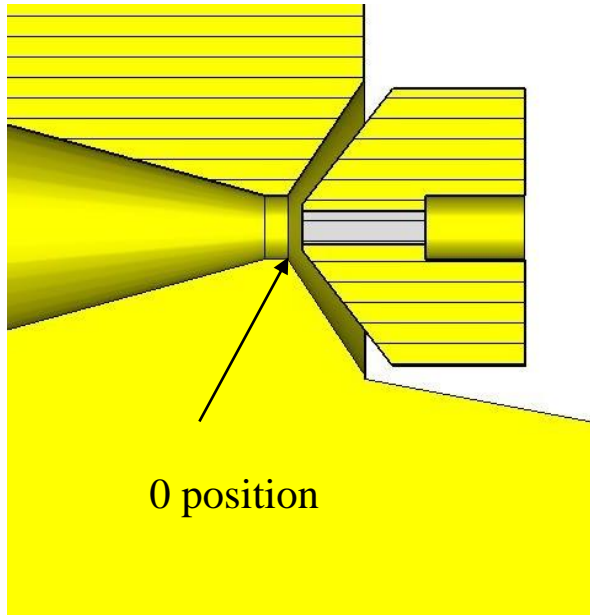


- Elliptical cylinder 120x180 mm
- Total length is 140 mm
- Conical part length is 70 mm
- Min cone diameter is 8 mm
- Max cone diameter is 44 mm
- Cone angle is  $\approx 30$  degrees
- Cylindrical hole diameter is 70 mm
- Coil has 13 turns

- Current profile is a half of sine with a pulse length of  $25 \mu\text{s}$
- Gap between coil turns is 0.4 mm
- Gap between coil and FC body is 1 mm
- Turns size is 9.6x14 mm

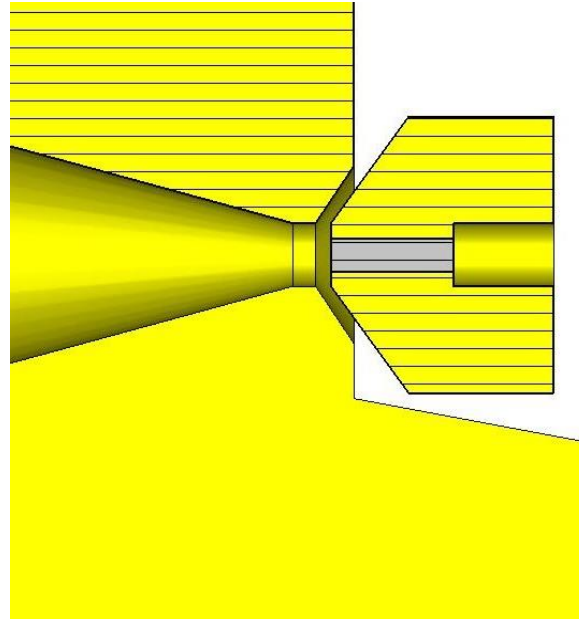
- Target rod (W74Re26) diameter is 4 mm, length is 16 mm
- External target unit diameter is 35 mm

## *Modifications of target position and FC front face*

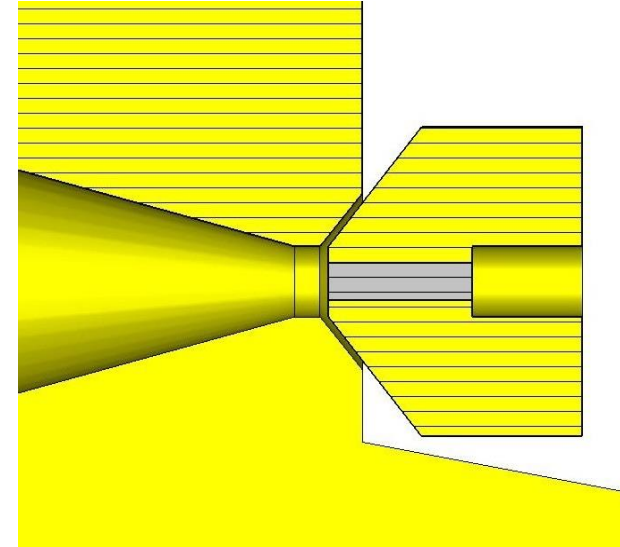


Model 1.

Target position of end face  
is -2mm



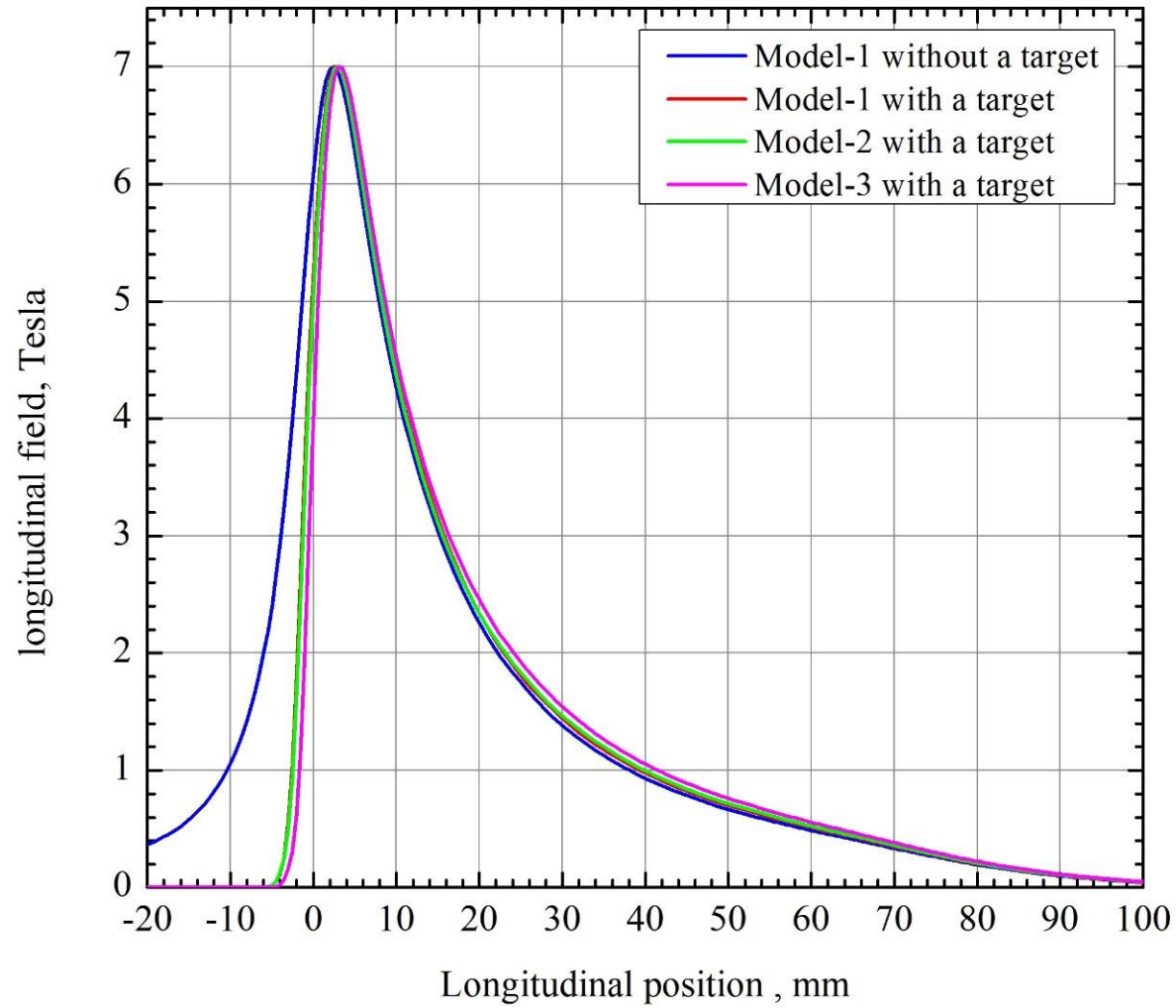
Model 2. Modification of FC  
front face around of a target



Model 3. Modification of gap between  
FC front face and target  
Target position of end face is -1mm

Min cone diameter is 8 mm

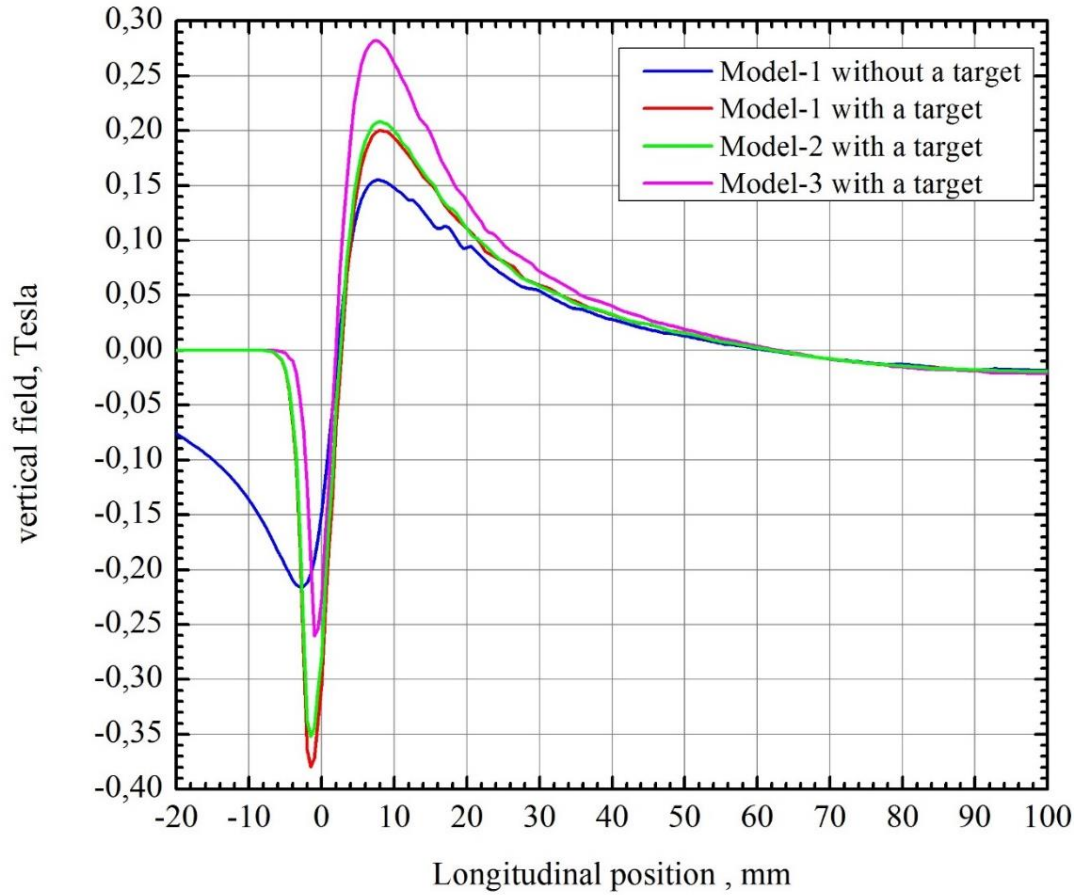




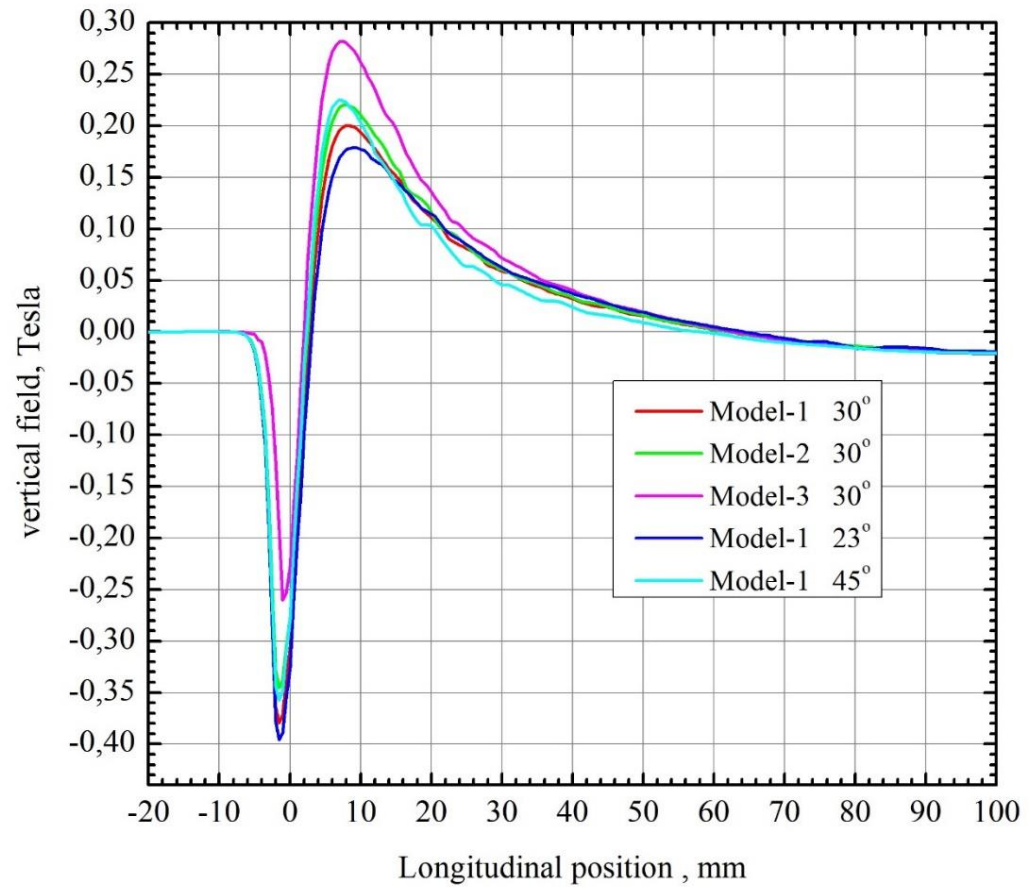
*Longitudinal magnetic field component  
on axis of Flux Concentrator*

Peak field position is 3 mm

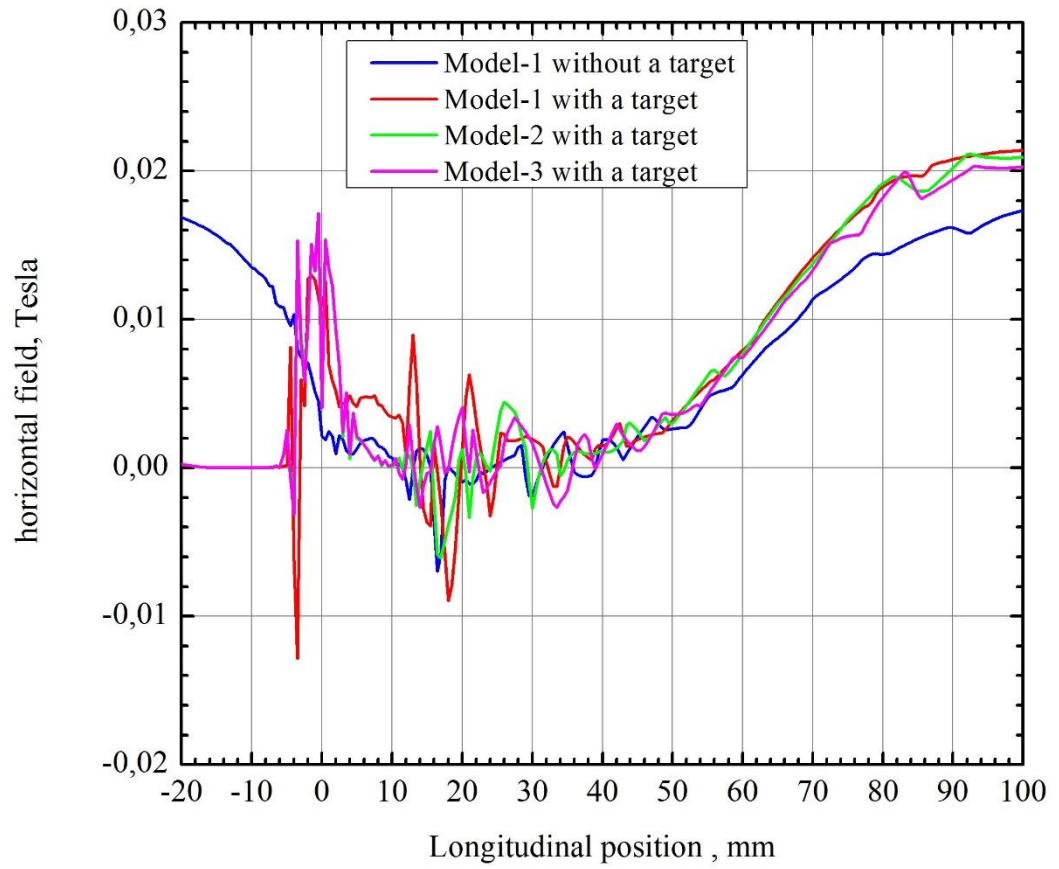
## Transverse magnetic field components on axis of Flux Concentrator

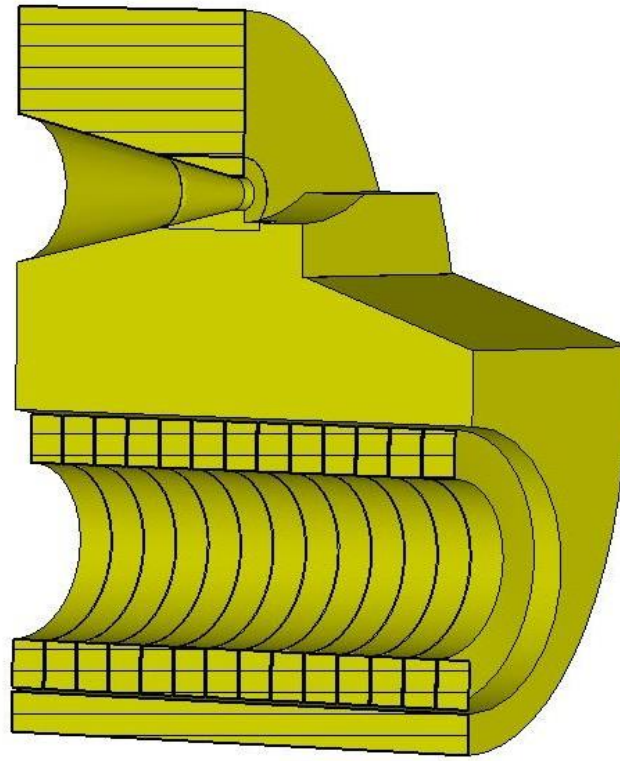
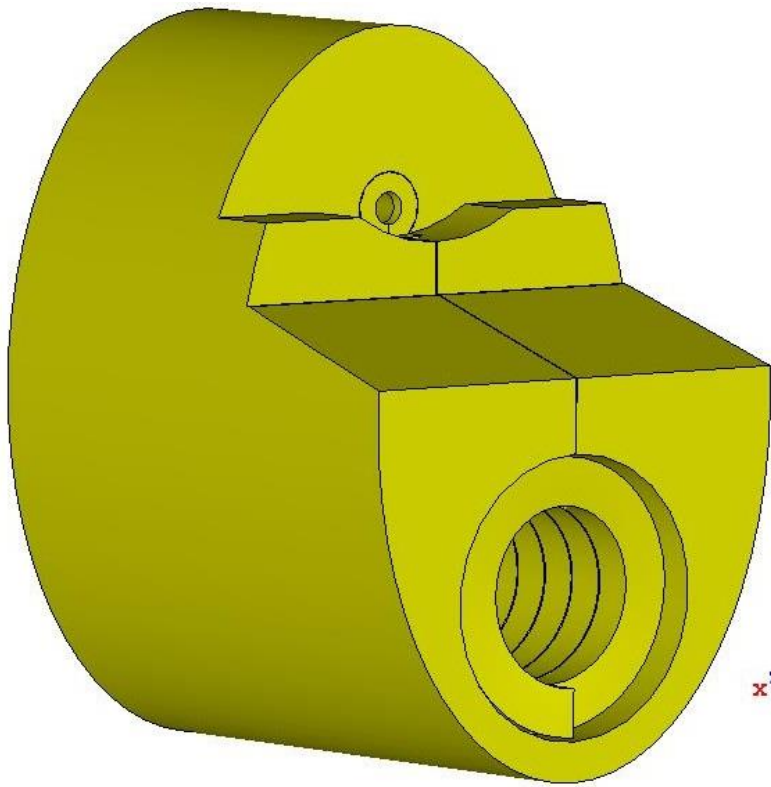


Peak field position is 8 mm  
Cone angle is  $30^\circ$



Cone angle modification with  $23^\circ$  and  $45^\circ$



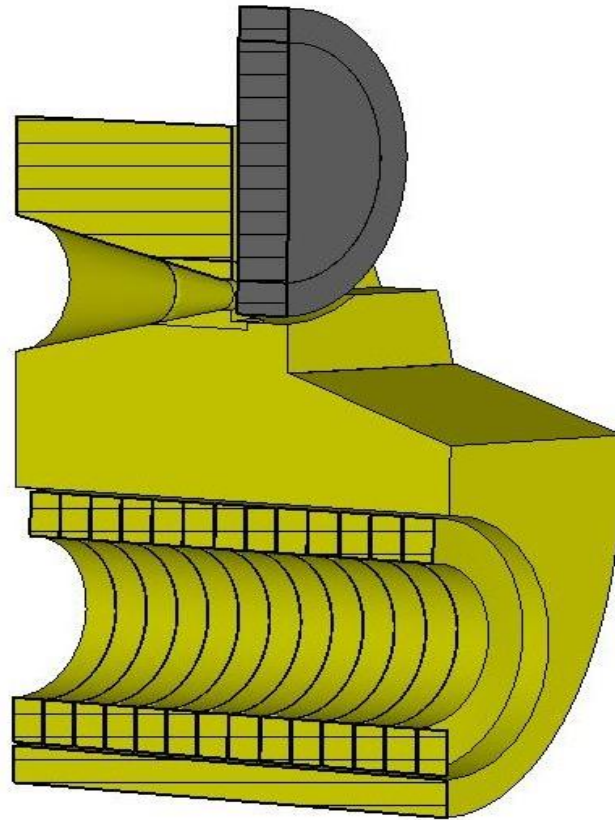
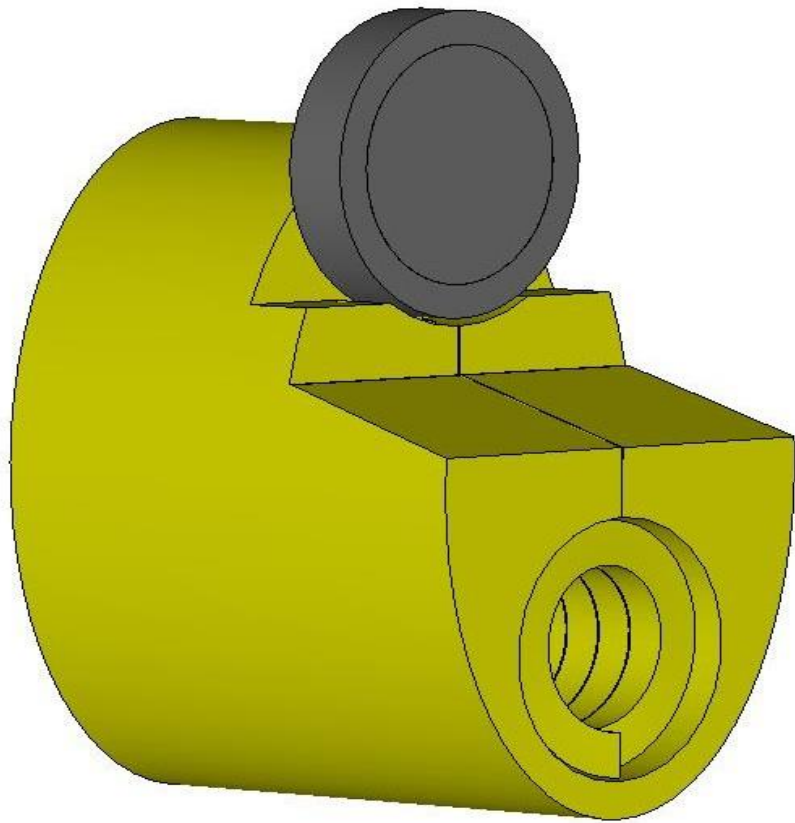


- Elliptical cylinder 120x180 mm
- Total length is 140 mm
- Conical part length is 70 mm
- Min cone diameter is 8 mm
- Max cone diameter is 44 mm
- Cone angle is  $\approx 25$  degrees
- Cylindrical hole diameter is 70 mm
- Coil has 13 turns

- Current profile is a half of sine with a pulse length of  $25 \mu\text{s}$
- Gap between coil turns is 0.4 mm
- Gap between coil and FC body is 1 mm
- Turns size is 9.6x14 mm

- Target (W74Re26) diameter is 88 mm, length is 16 mm
- Gap between target and FC front face is 2mm

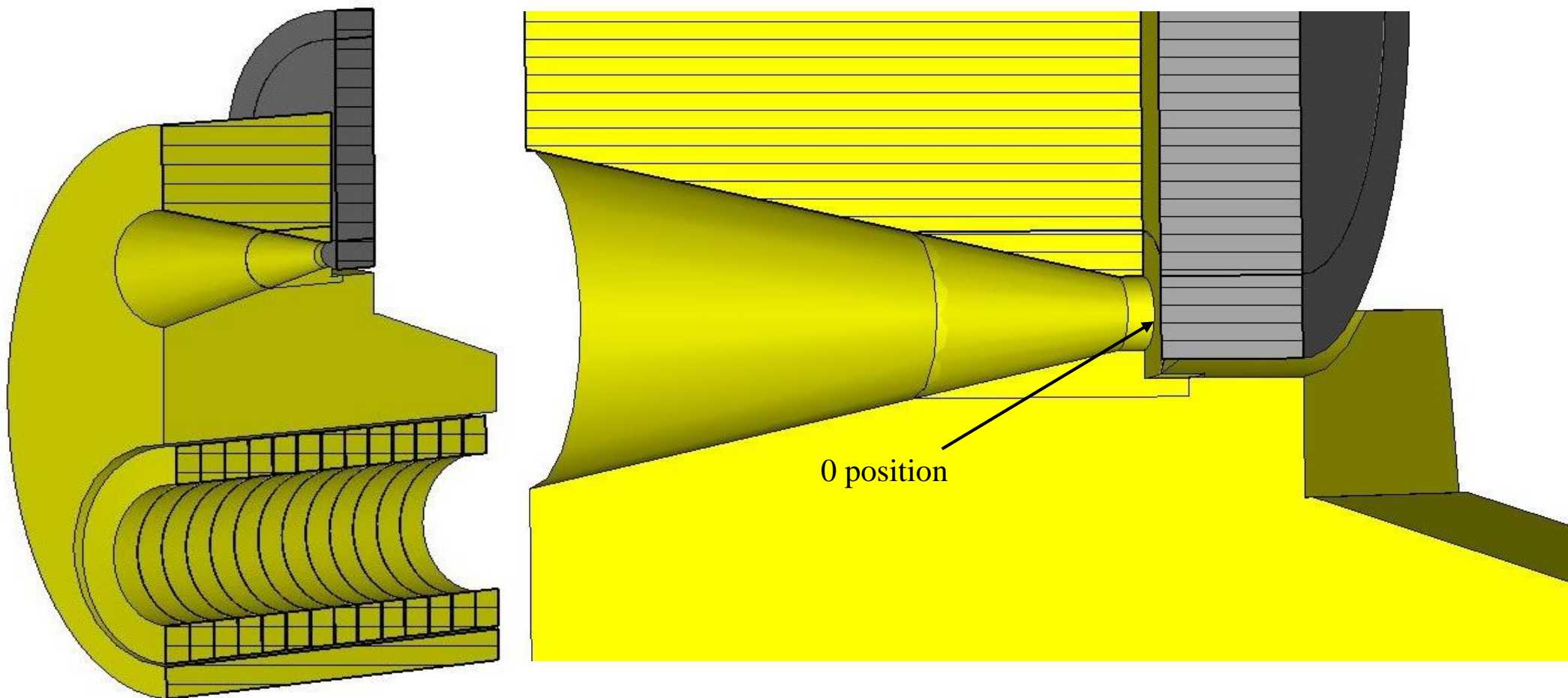




- Elliptical cylinder 120x180 mm
- Total length is 140 mm
- Conical part length is 70 mm
- Min cone diameter is 8 mm
- Max cone diameter is 44 mm
- Cone angle is  $\approx 25$  degrees
- Cylindrical hole diameter is 70 mm
- Coil has 13 turns

- Current profile is a half of sine with a pulse length of  $25 \mu\text{s}$
- Gap between coil turns is 0.4 mm
- Gap between coil and FC body is 1 mm
- Turns size is 9.6x14 mm

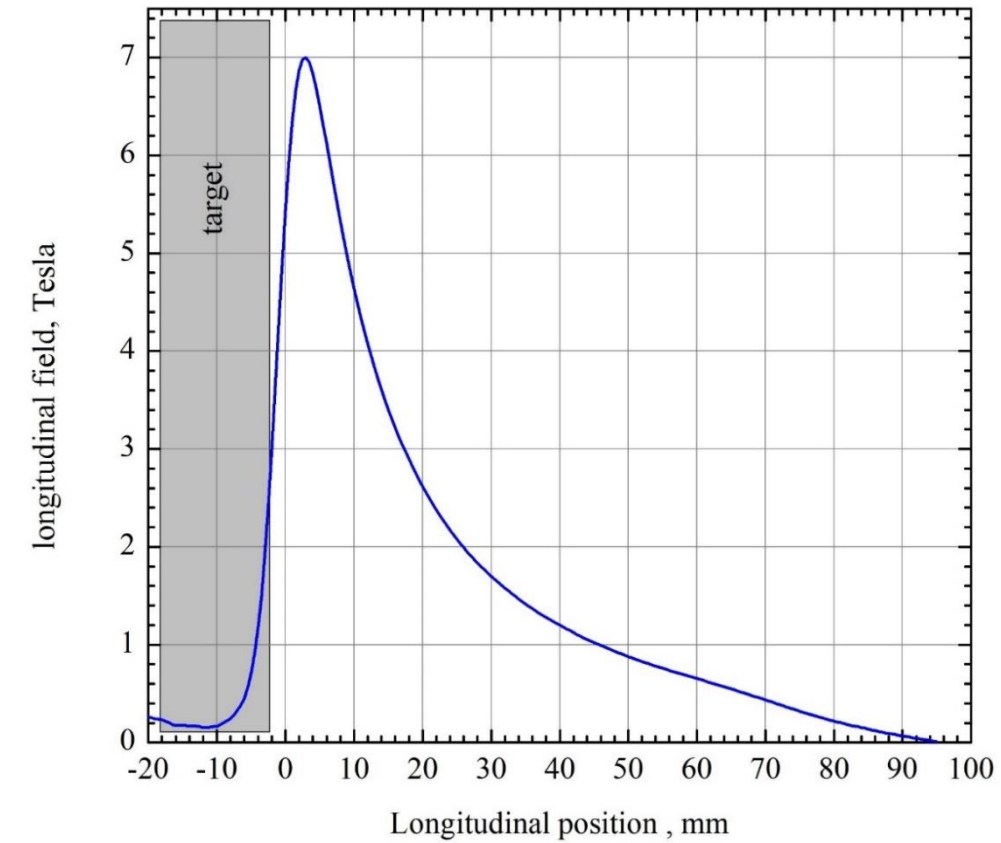
- Target (W74Re26) diameter is 88 mm, length is 16 mm
- Gap between target and FC front face is 2mm



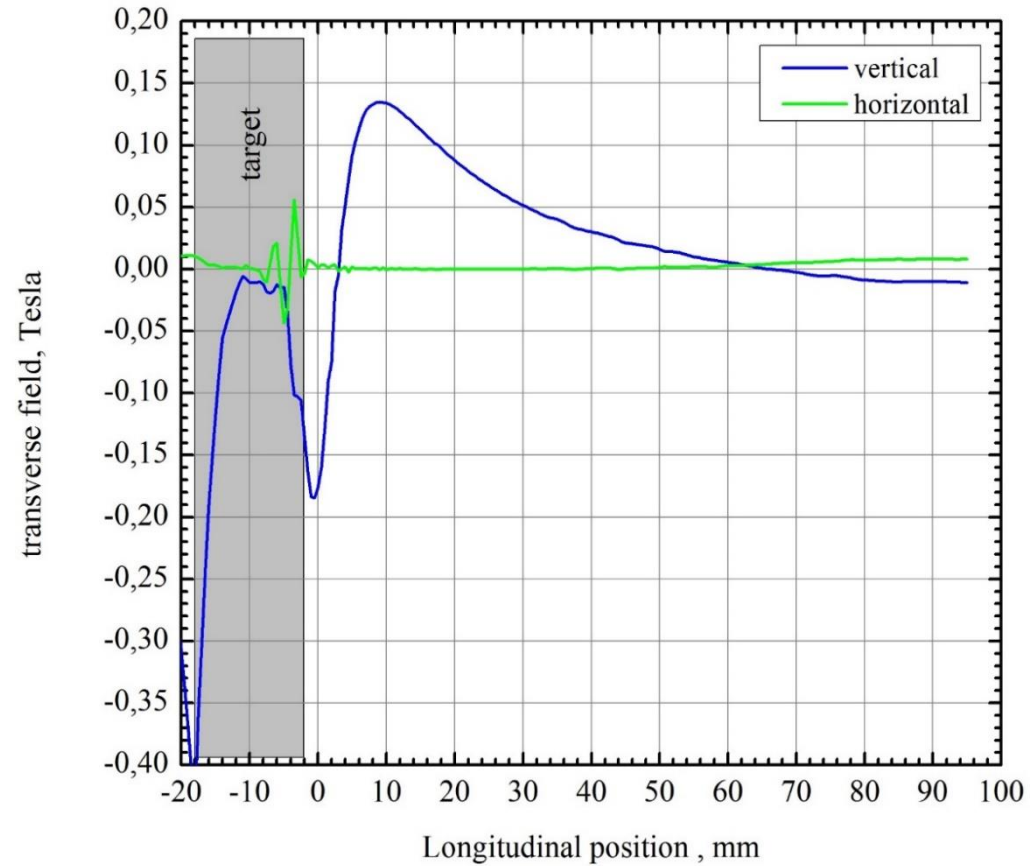
- Current profile is a half of sine with a pulse length of  $25 \mu\text{s}$
- Gap between coil turns is 0.4 mm
- Gap between coil and FC body is 1 mm
- Turns size is 9.6x14 mm
- Target (W74Re26) diameter is 88 mm, length is 16 mm
- Gap between target and FC front face is 2mm

- Elliptical cylinder 120x180 mm
- Total length is 140 mm
- Conical part length is 70 mm
- Min cone diameter is 8 mm
- Max cone diameter is 44 mm
- Cone angle is  $\approx 25$  degrees
- Cylindrical hole diameter is 70 mm
- Coil has 13 turns

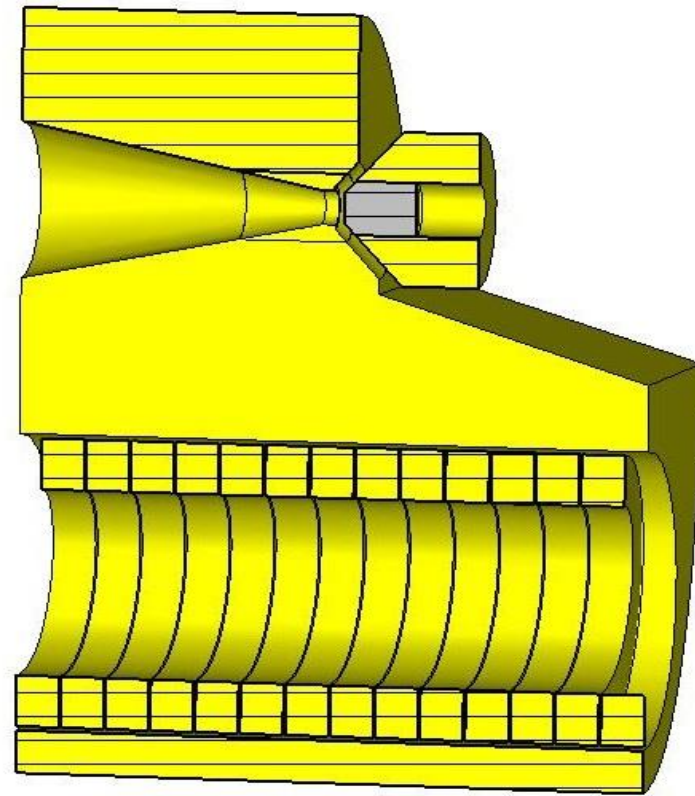
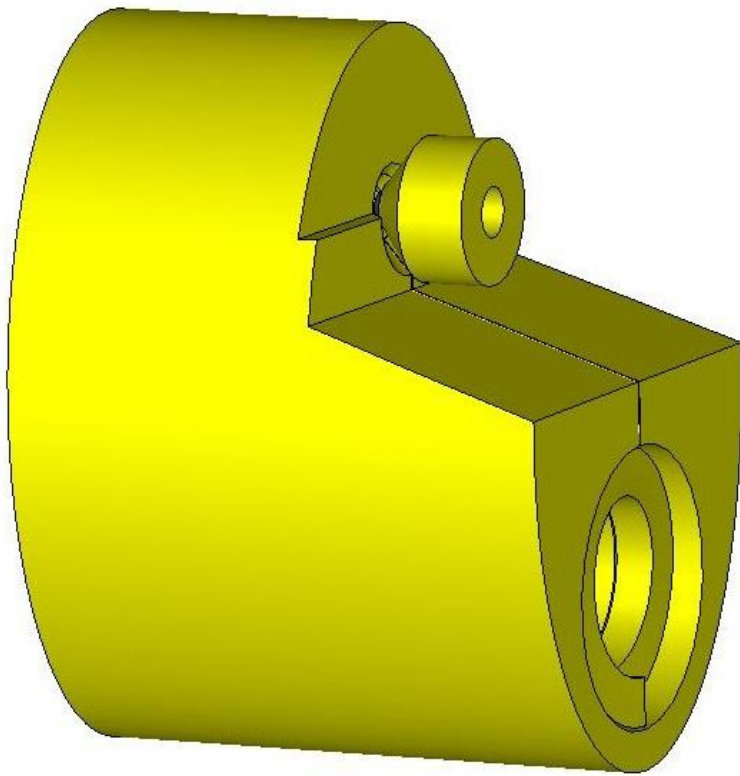
## Magnetic fields on axis of Flux Concentrator



- Target position end face is -2 mm
- Peak field position is 3 mm



- Target position end face is -2 mm
- Peak field position is 9 mm



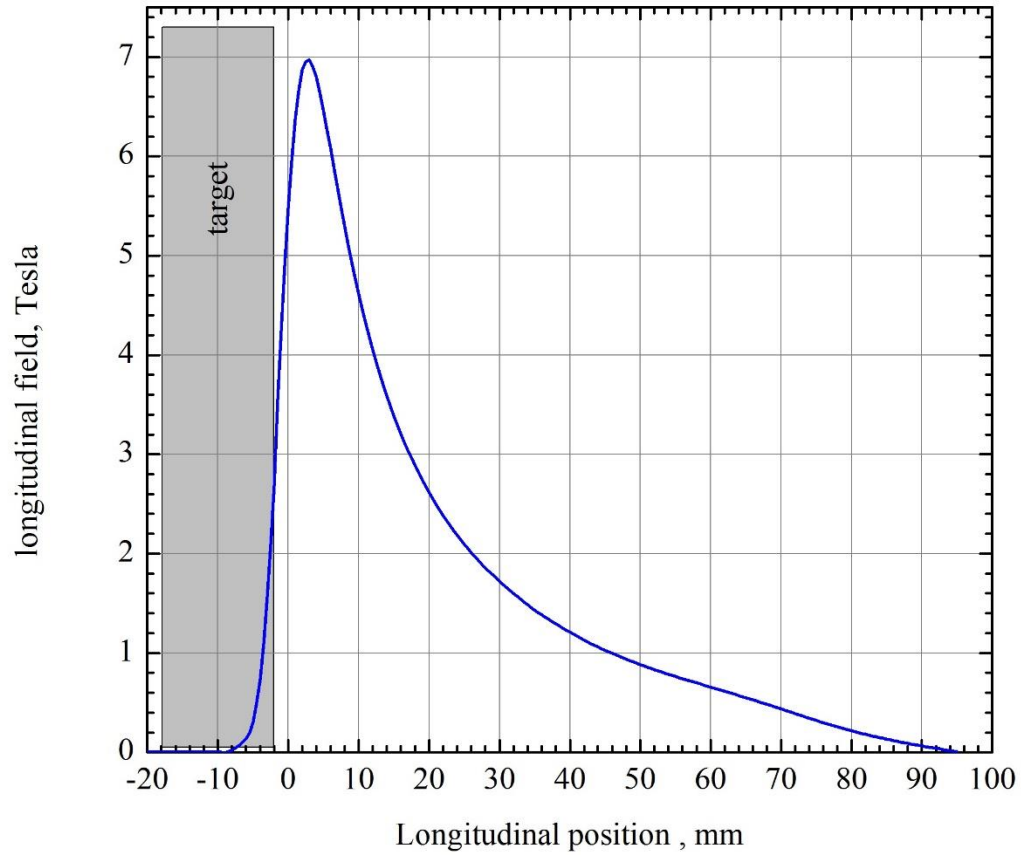
- Elliptical cylinder 120x180 mm
- Total length is 140 mm
- Conical part length is 70 mm
- Min cone diameter is 8 mm
- Max cone diameter is 44 mm
- Cone angle is  $\approx 25$  degrees
- Cylindrical hole diameter is 70 mm
- Coil has 13 turns

- Current profile is a half of sine with a pulse length of  $25 \mu\text{s}$
- Gap between coil turns is 0.4 mm
- Gap between coil and FC body is 1 mm
- Turns size is 9.6x14 mm

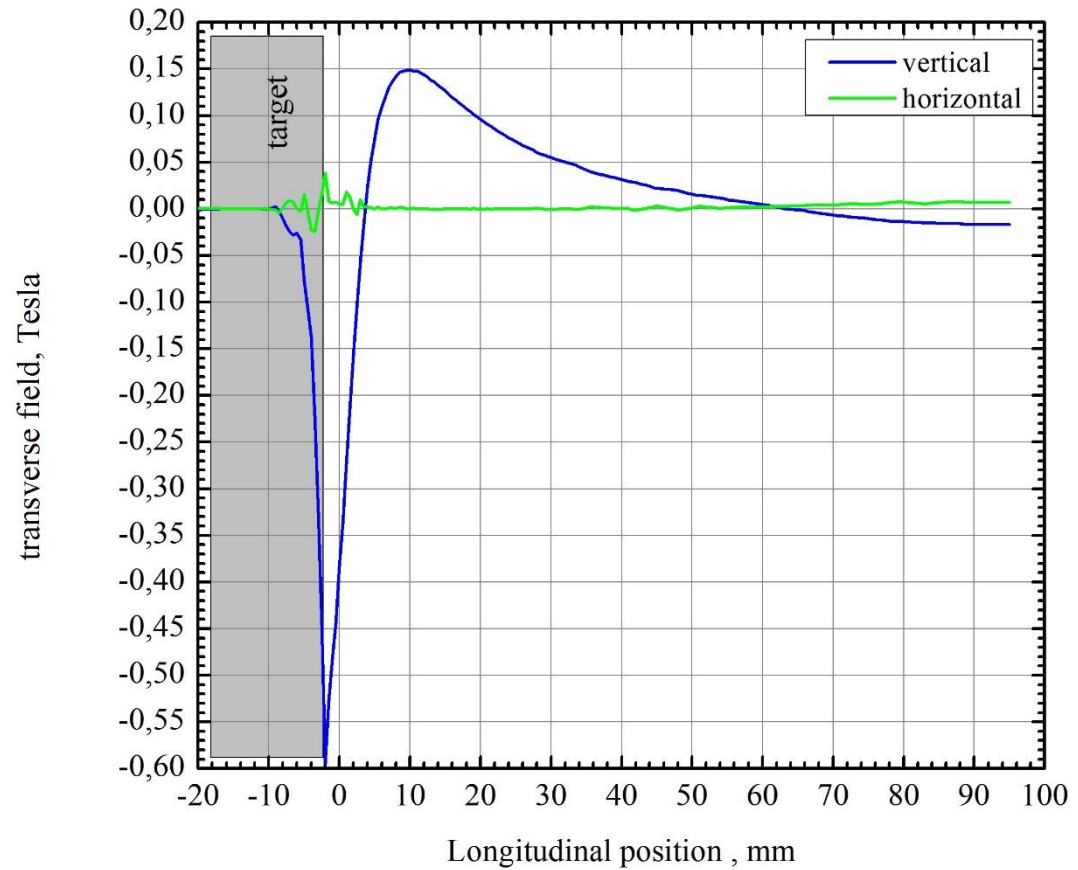
- Target (W74Re26) diameter is 10 mm, length is 16 mm
- External target unit diameter is 36 mm
- Gap between target and FC front face is 2mm



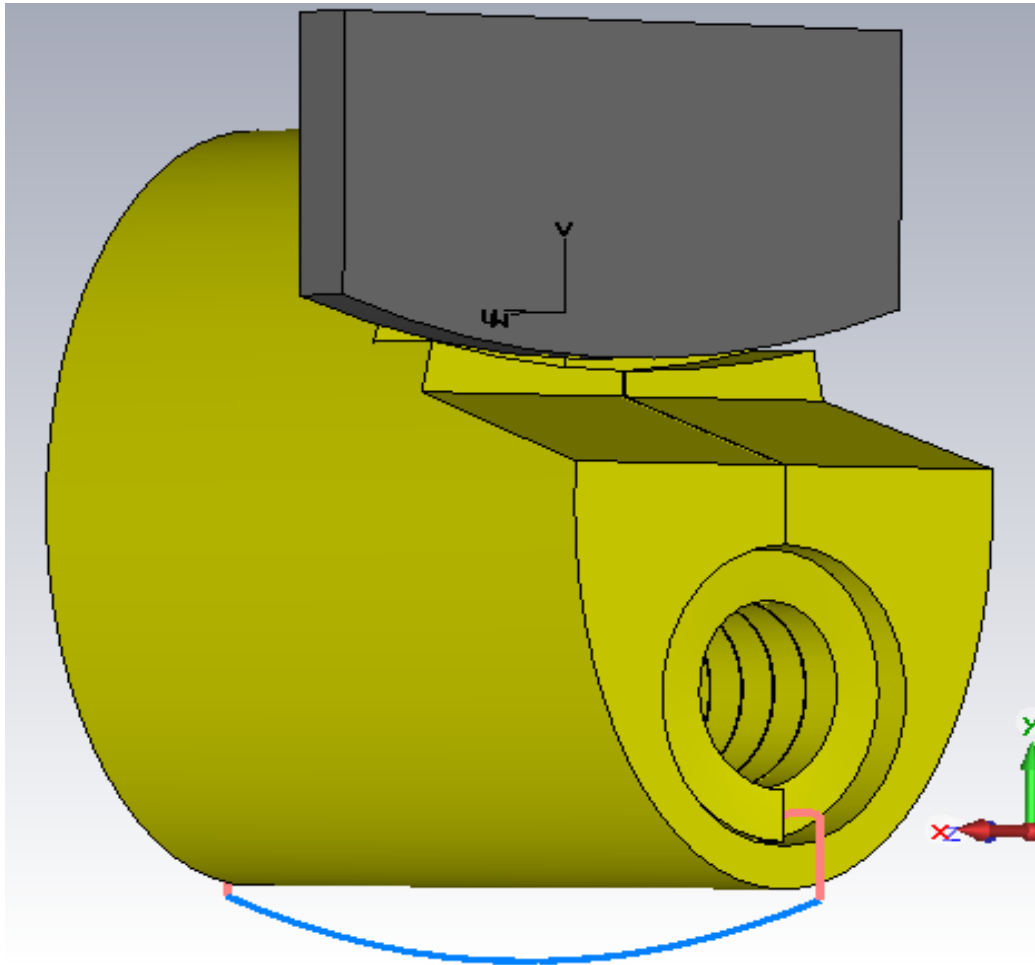
## Magnetic fields on axis of Flux Concentrator



- Target position end face is -2 mm
- Peak field position is 3 mm



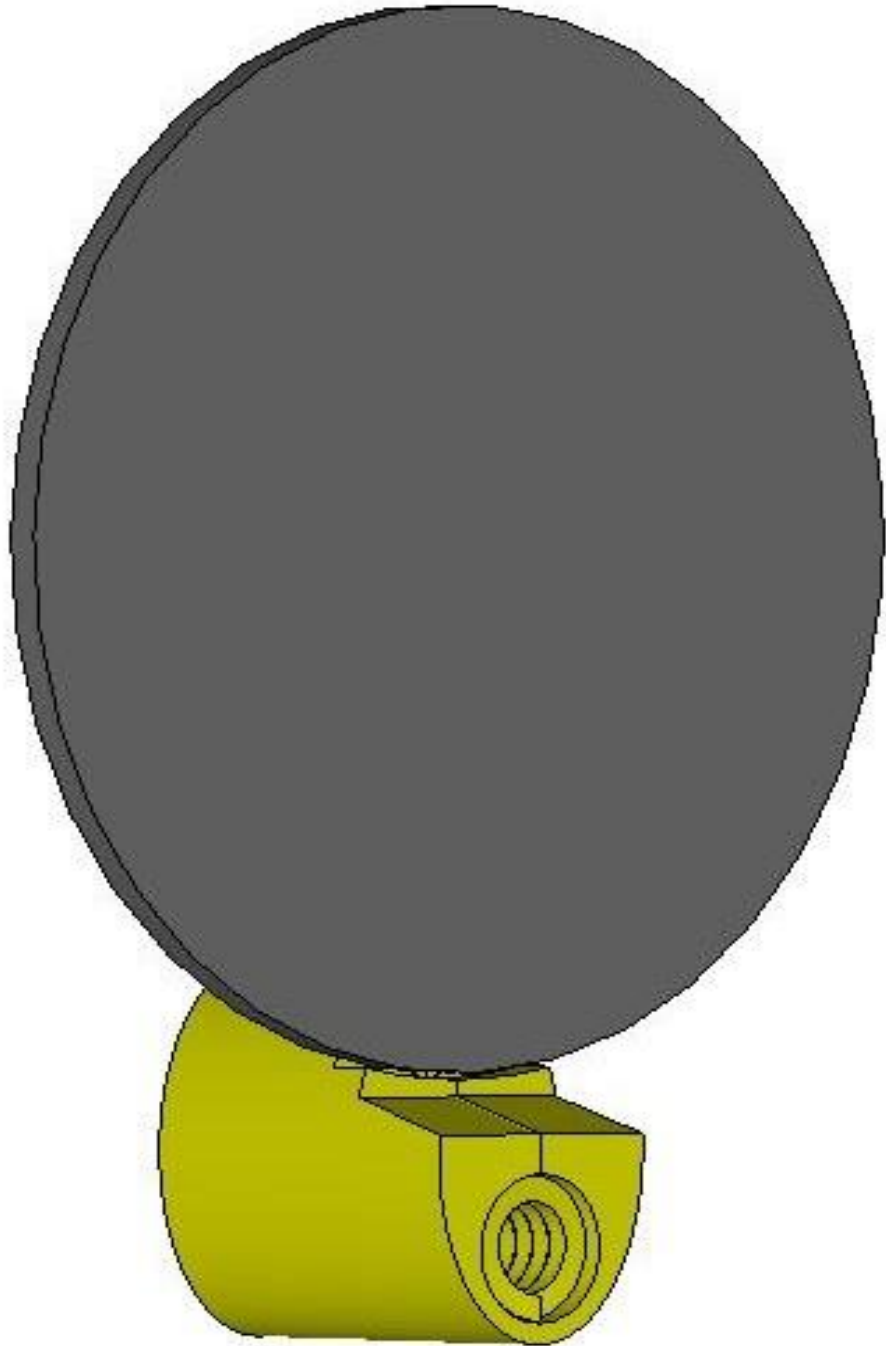
- Target position end face is -2 mm
- Peak field position is 10 mm

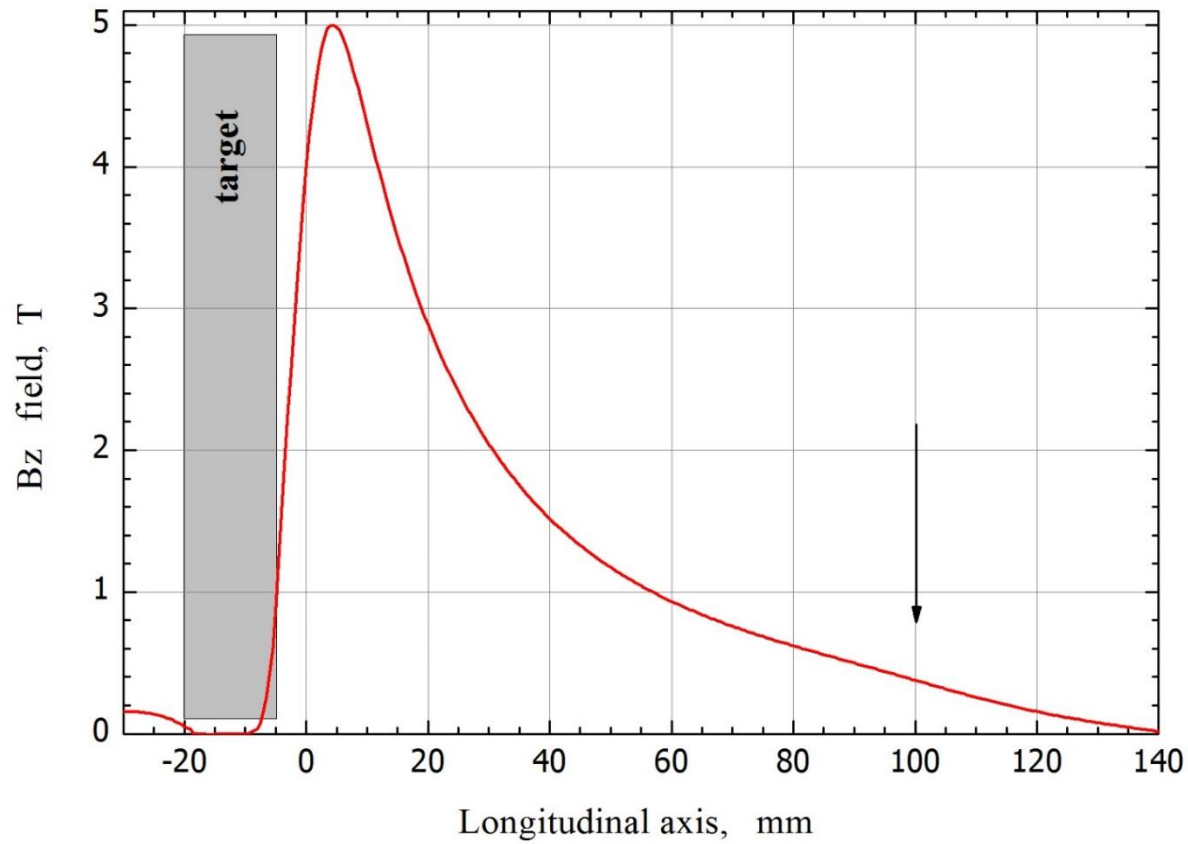


*ILC FC Computer model with part of positron production target*

Size	Elliptical cylinder 120x180 mm
Total length	170 mm
Conical part length	100 mm
Min cone diameter	16 mm
Max cone diameter	63 mm
Cone angle	24 degrees
Turns number	16 (9,6x12 mm)
Cylindrical hole diameter	70 mm

*ILC FC Computer model with a  
positron production target*



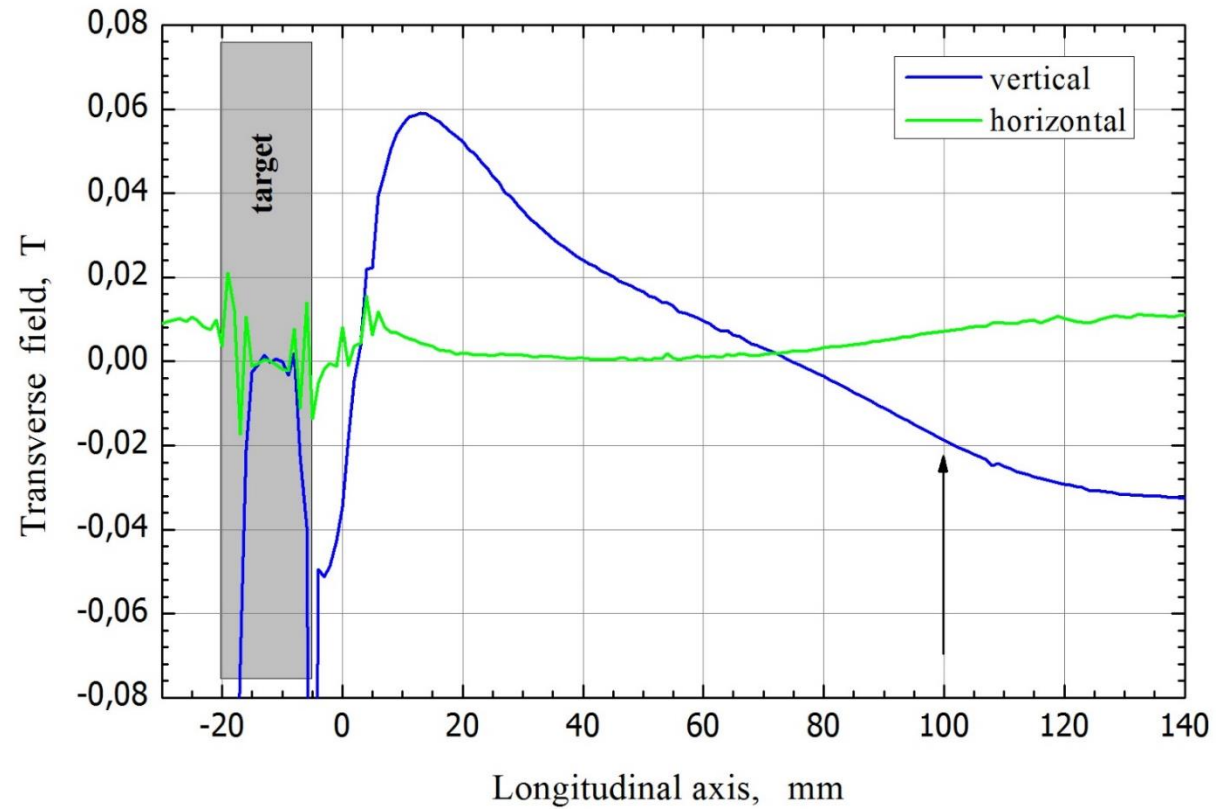


Longitudinal magnetic field component  
on axis of Flux Concentrator (top)

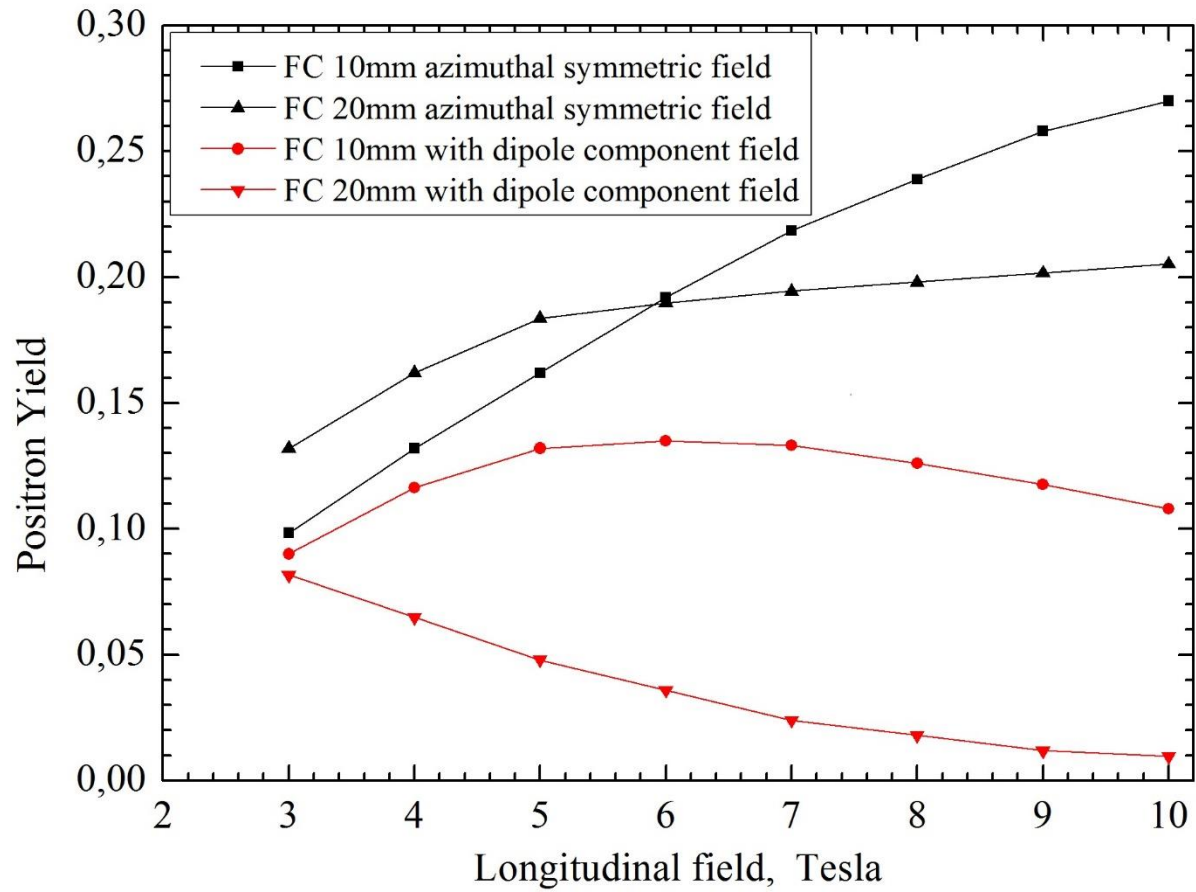
Peak current is 25 kA  
Pulse length is 25  $\mu$ s  
Target ohmic losses is 10 J/pulse  
FC ohmic losses is 140 J/pulse

*ILC FC magnetic field (on axis)*

Transverse magnetic field components  
on axis of Flux Concentrator (bottom)









*VEPP-5 complex Flux Concentrator*

