HTS insert magnet design:
Stack Cable

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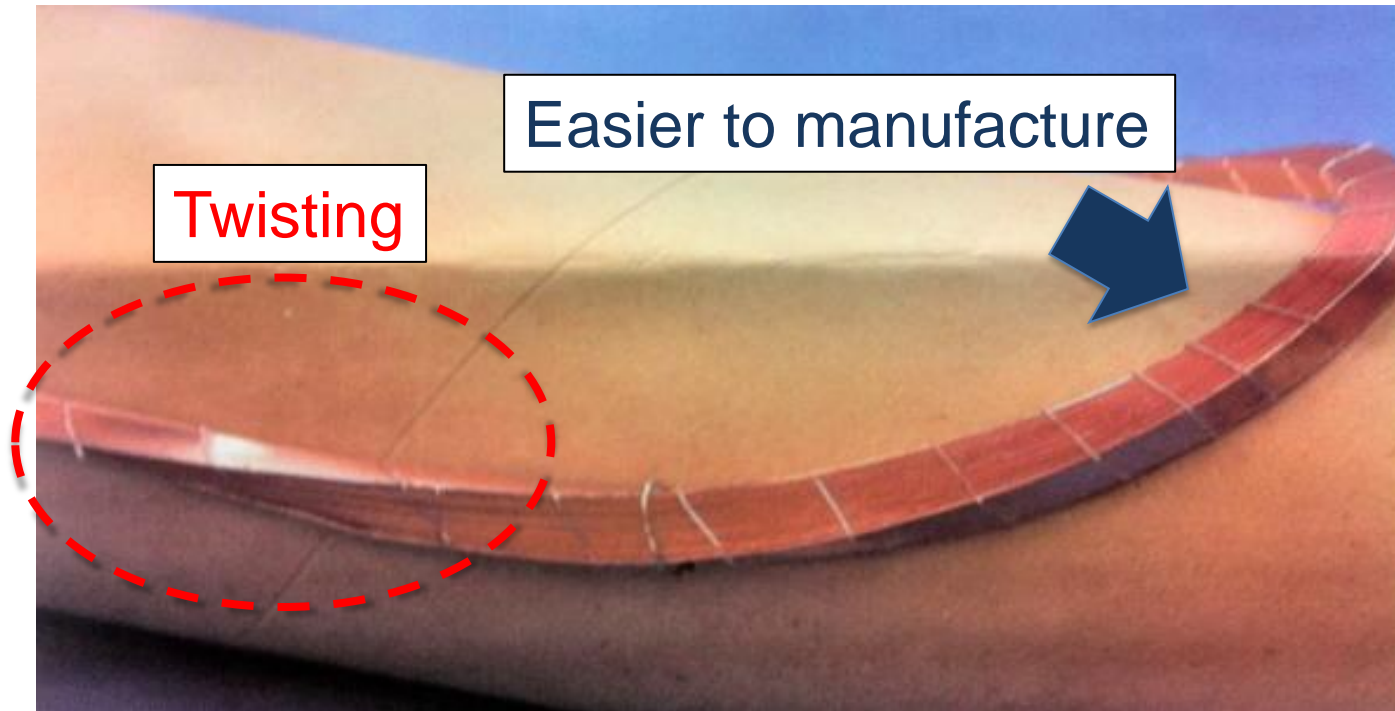
Outline

- Stack cable - Advantage/ Drawback -

- Specification

- Preliminary HTS insert magnet design

- Next steps

Stack cable - Advantage -

Simple structure, Effective cost and Mechanical performance
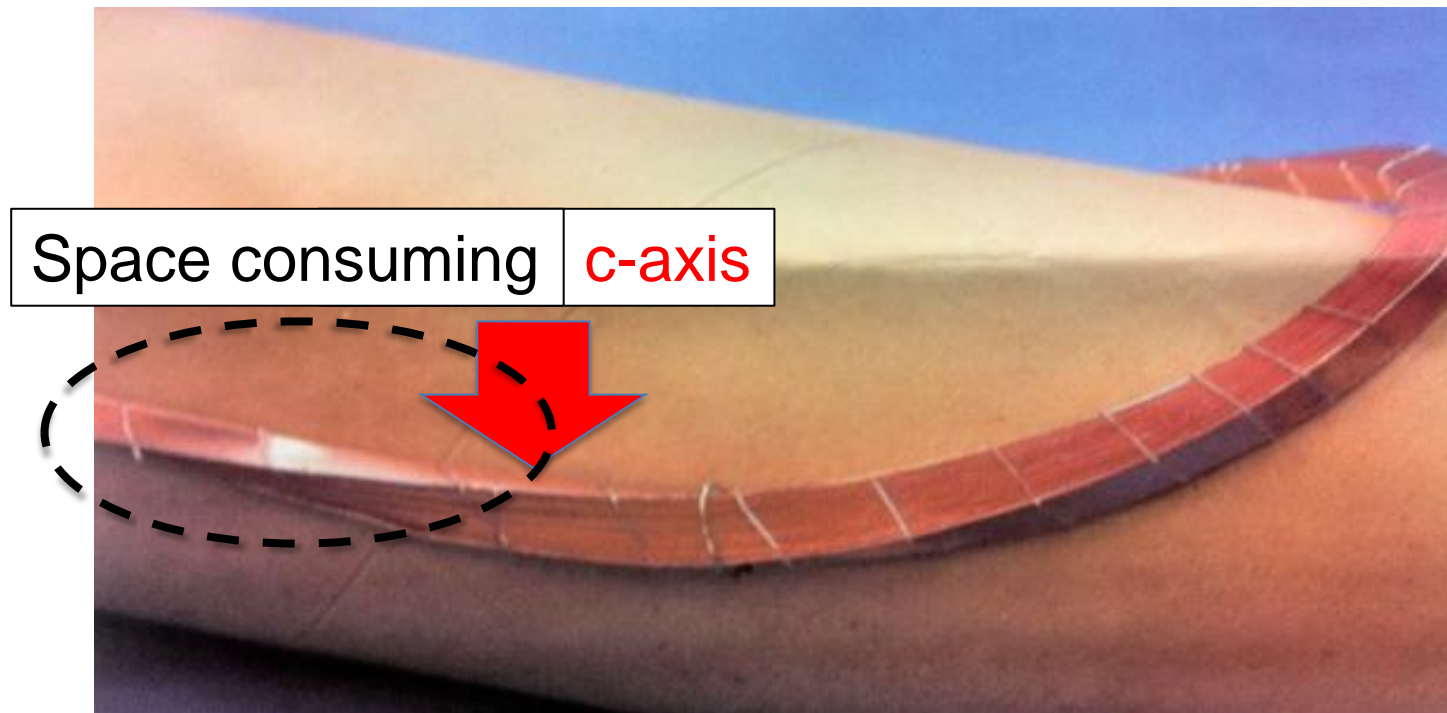

Easier to manufacture

Twisting

50-tapes of YBCO stack cable for 50mm dipole

M.Takayasu (MIT), IEEE vol.23 No.3 2013

Stack cable - Drawback -

I_c distribution, Bending radius, Current sharing and Spatial issue
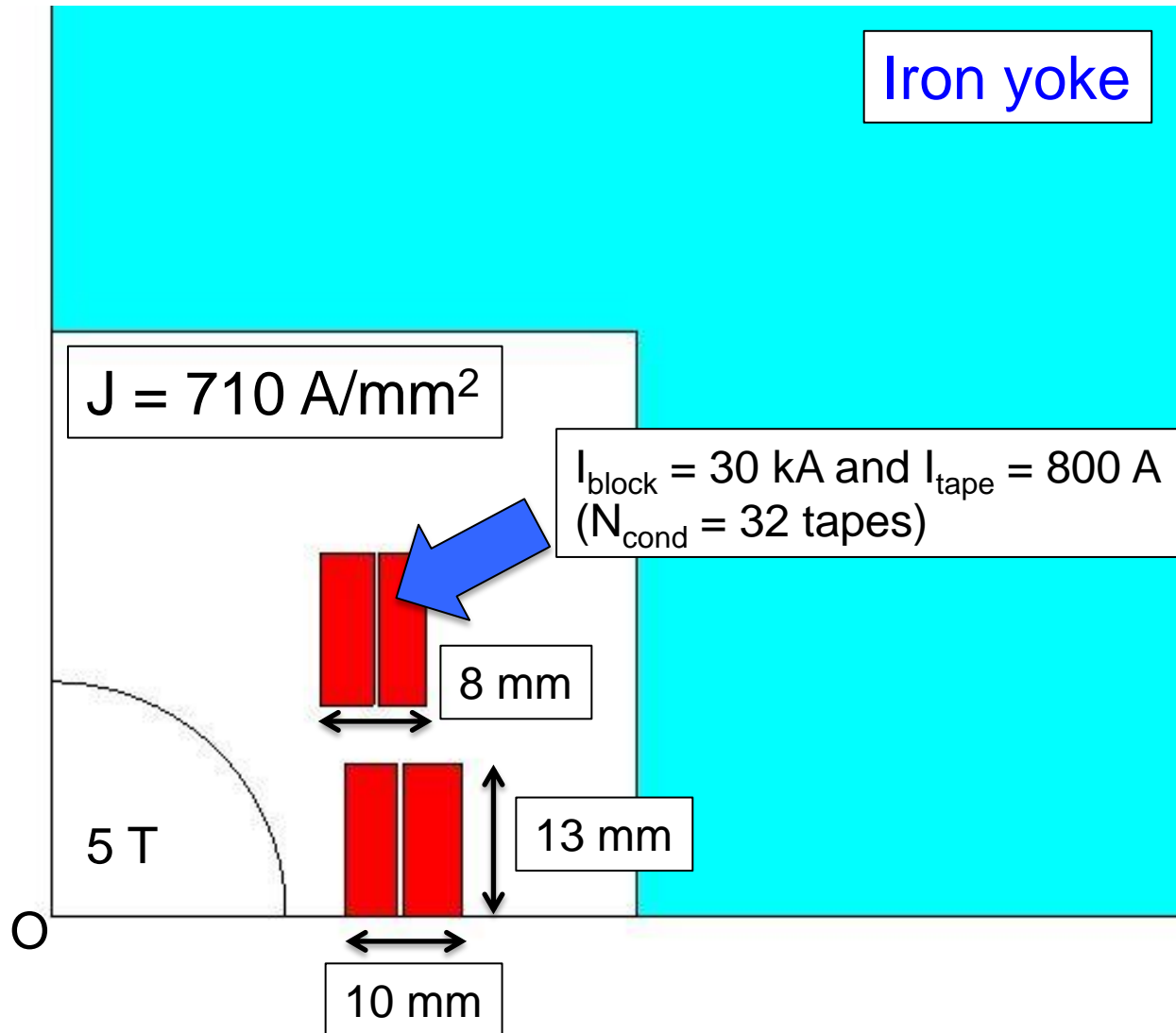

Space consuming | c-axis

50-tapes of YBCO stack cable for 50mm dipole

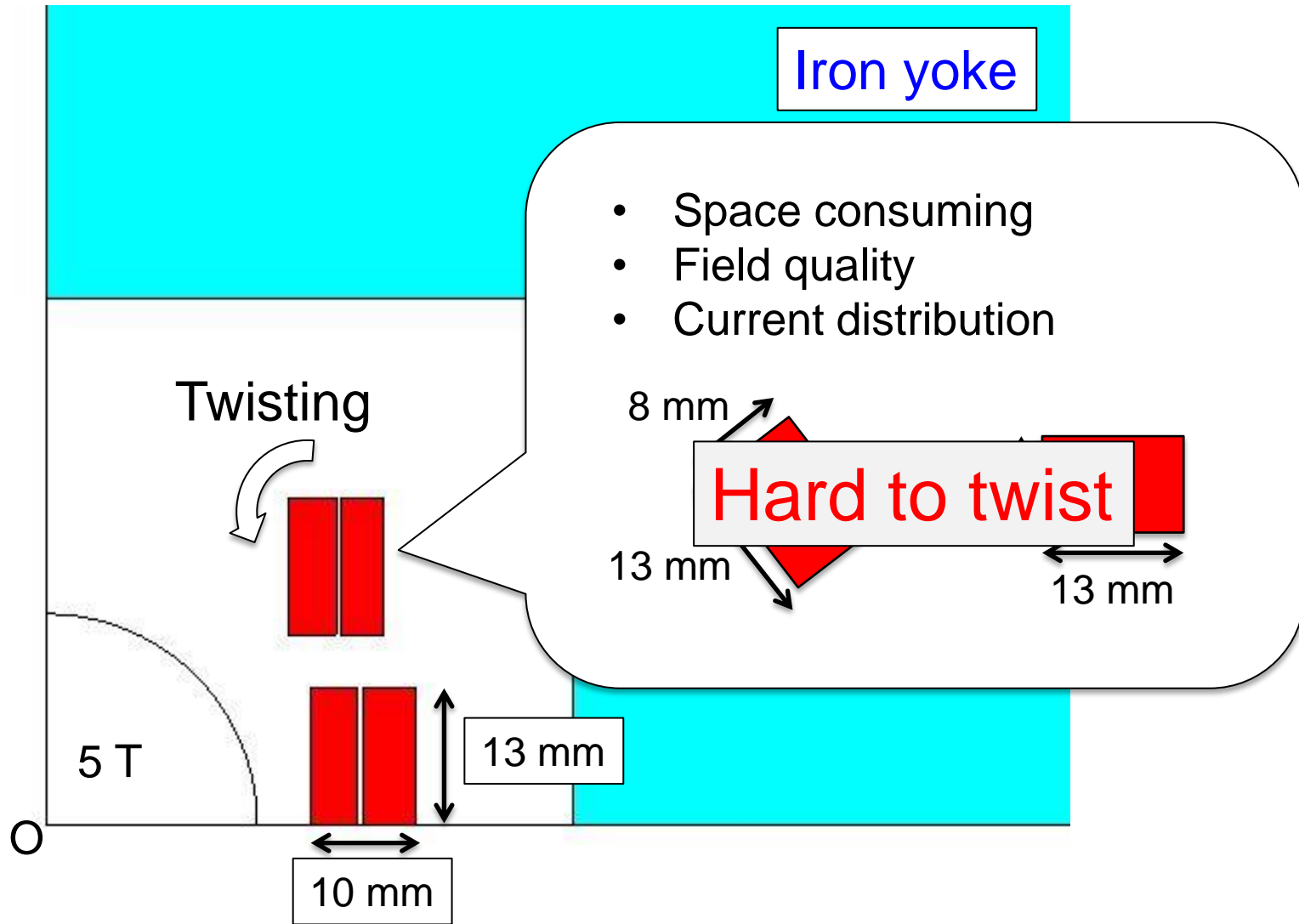M.Takayasu (MIT), IEEE vol.23 No.3 2013

Specification

- Clear bore aperture   40 mm

- Flux density B_1 5 T

- Field quality $5*10^{-4}$ B_1

- Current density   400 – 600 A/mm^2 (20 T, 4,2K)

- Mechanical stress   100 MPa

- Operating current   5 – 10 kA

- Cable transposition   Twisted stacked & Roebel cable

- Homogeneous current distribution

Preliminary HTS insert magnet design

Iron yoke

$J = 710$ A/mm^2

$I_{block} = 30$ kA and $I_{tape} = 800$ A
($N_{cond} = 32$ tapes)

8 mm

13 mm

5 T

O

10 mm

Preliminary HTS insert magnet design

Iron yoke

- Space consuming
- Field quality
- Current distribution

Twisting

Hard to twist

8 mm

13 mm

13 mm

13 mm

5 T

O

10 mm

Preliminary HTS insert magnet design

Iron yoke

Square block-coil

Twisting

- Less space consuming
- Less current in a block
- Less field quality disturbance in coil head

4 - 5 mm

5 T

13 mm

O

10 mm
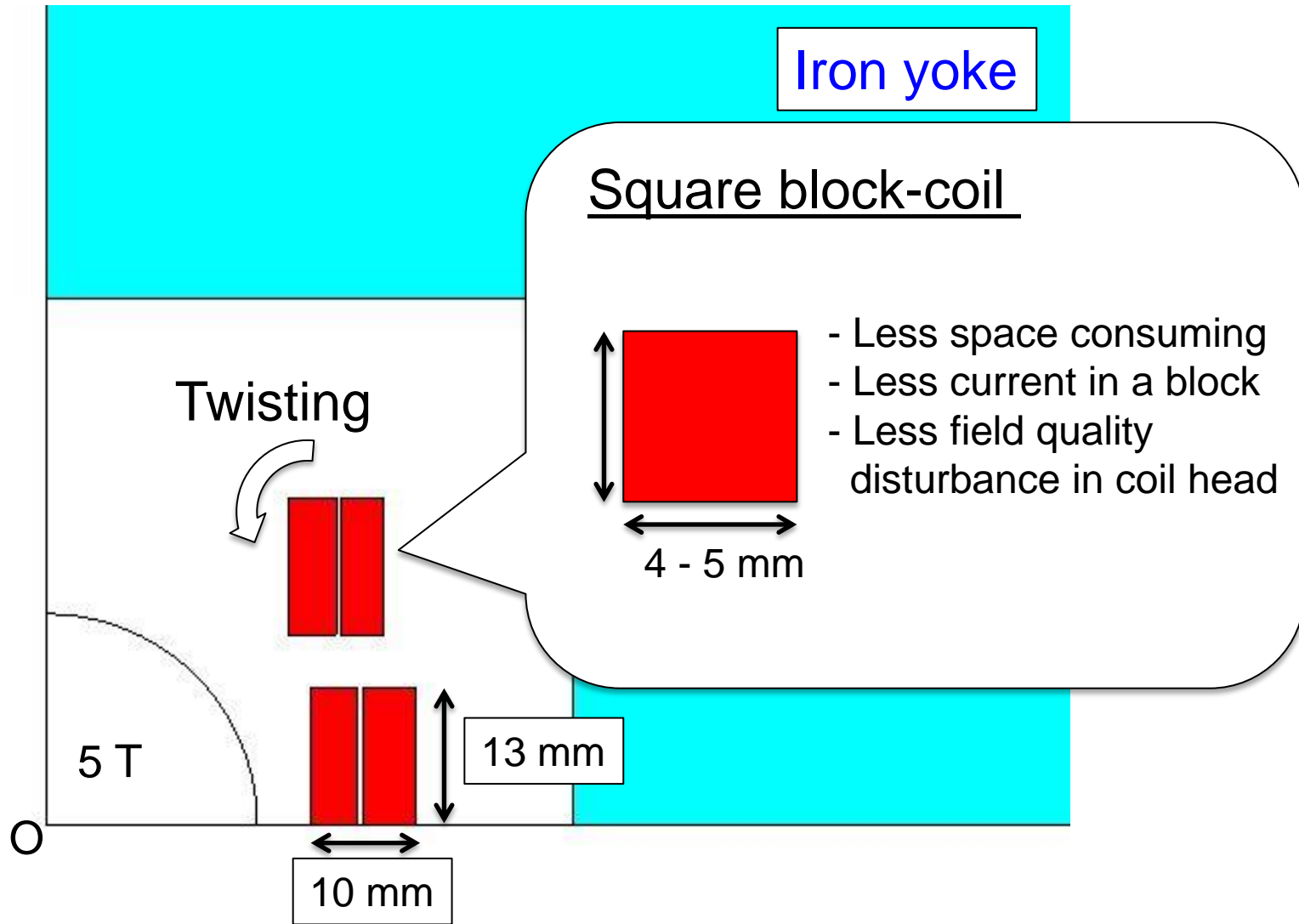
Preliminary HTS insert magnet design

Hypothesis

Iron yoke

$J = 710 \text{ A/mm}^2$

$I_{block} = 5$ kA and $I_{tape} = 300$ A
($N_{cond} = 16$ tapes)

Easy to twist

5 T

O

4 mm

4 mm
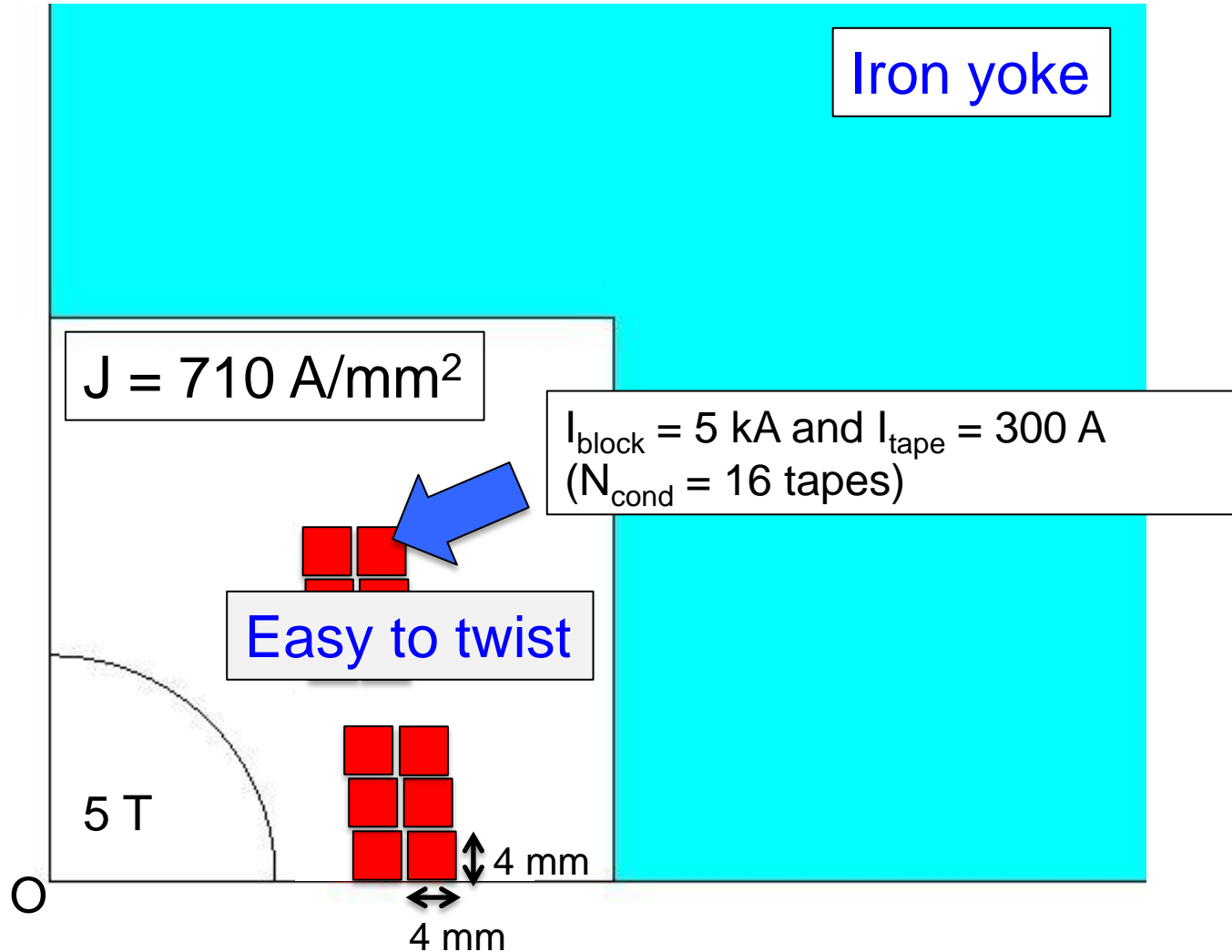
Next steps

FOR BETTER HTS INSERT MAGNET DESIGN

- <u>Cable design</u>: Cable width and thickness need to be same length (4 - 5 mm) to maintain a good field quality, to twist much easily and to have an effective space consuming at twisting part. The inhomogeneous I_c distribution is caused by twisting, therefore the twisting pitch is necessary to study.

- <u>Detection and protection</u>: Find the reasonable operating current regarding protection scheme and additional materials.