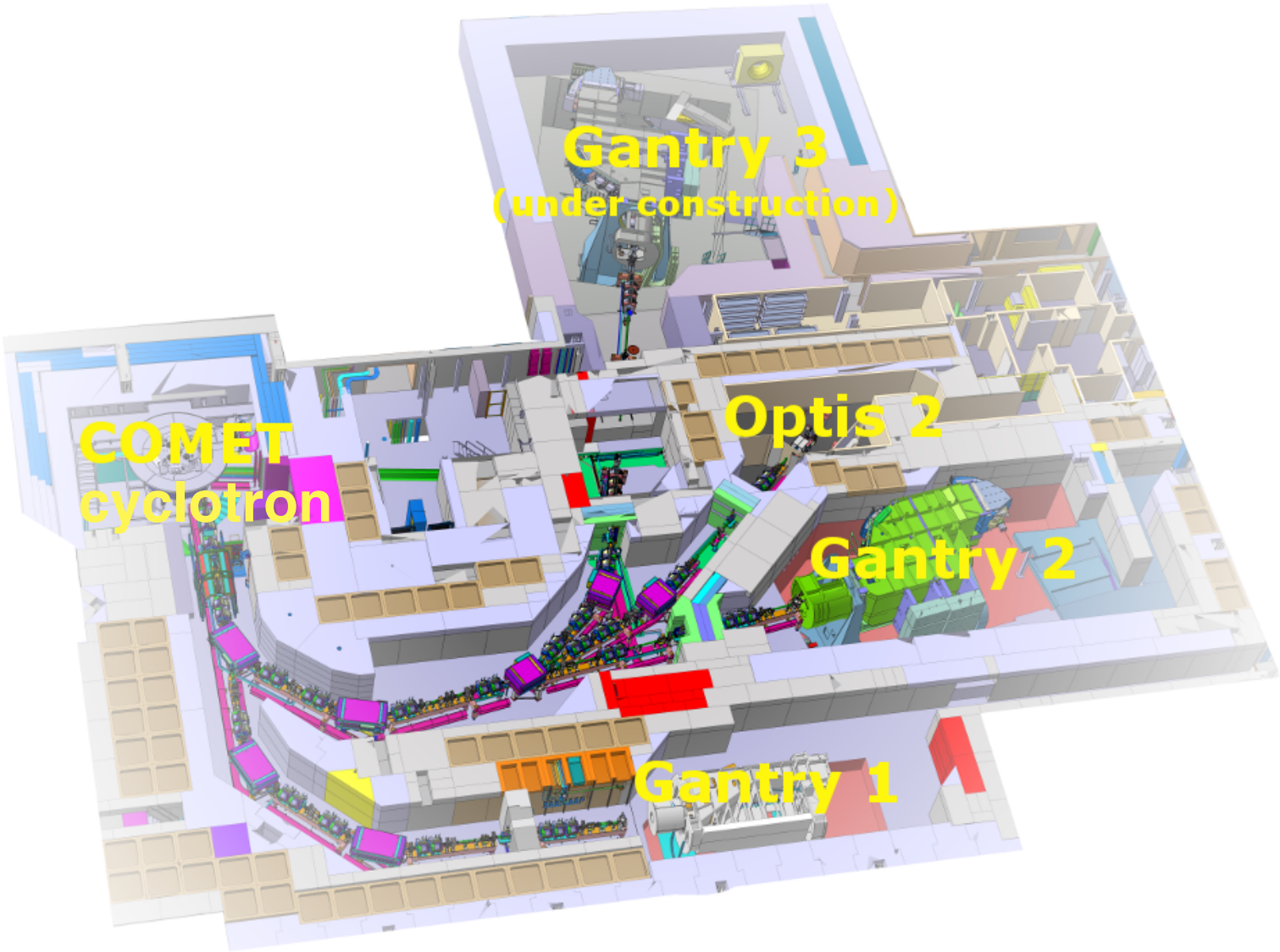
Konrad P. Nesteruk :: Paul Scherrer Institut

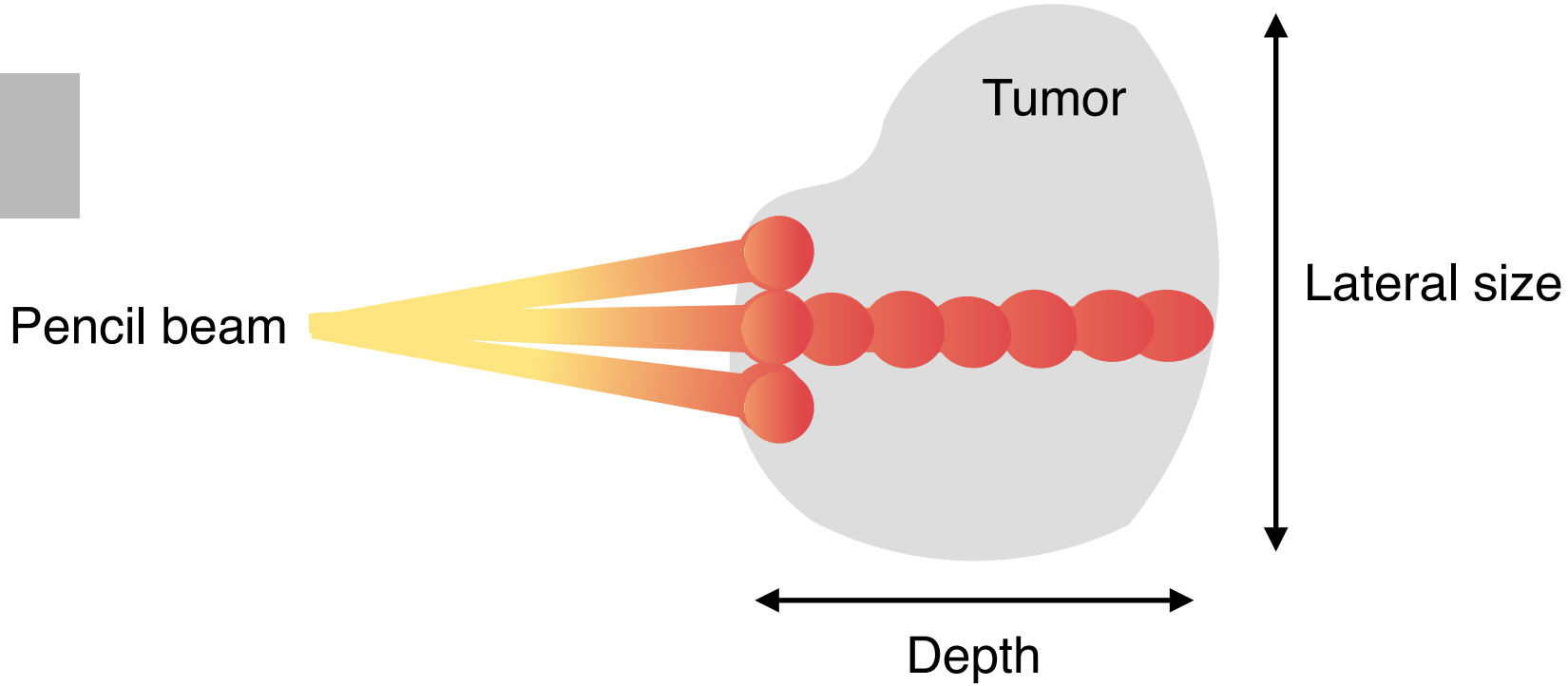
Gantry design and experience at PSI

Ions 2018, ESI, Archamps, 20.06.2018

Gantries at PSI



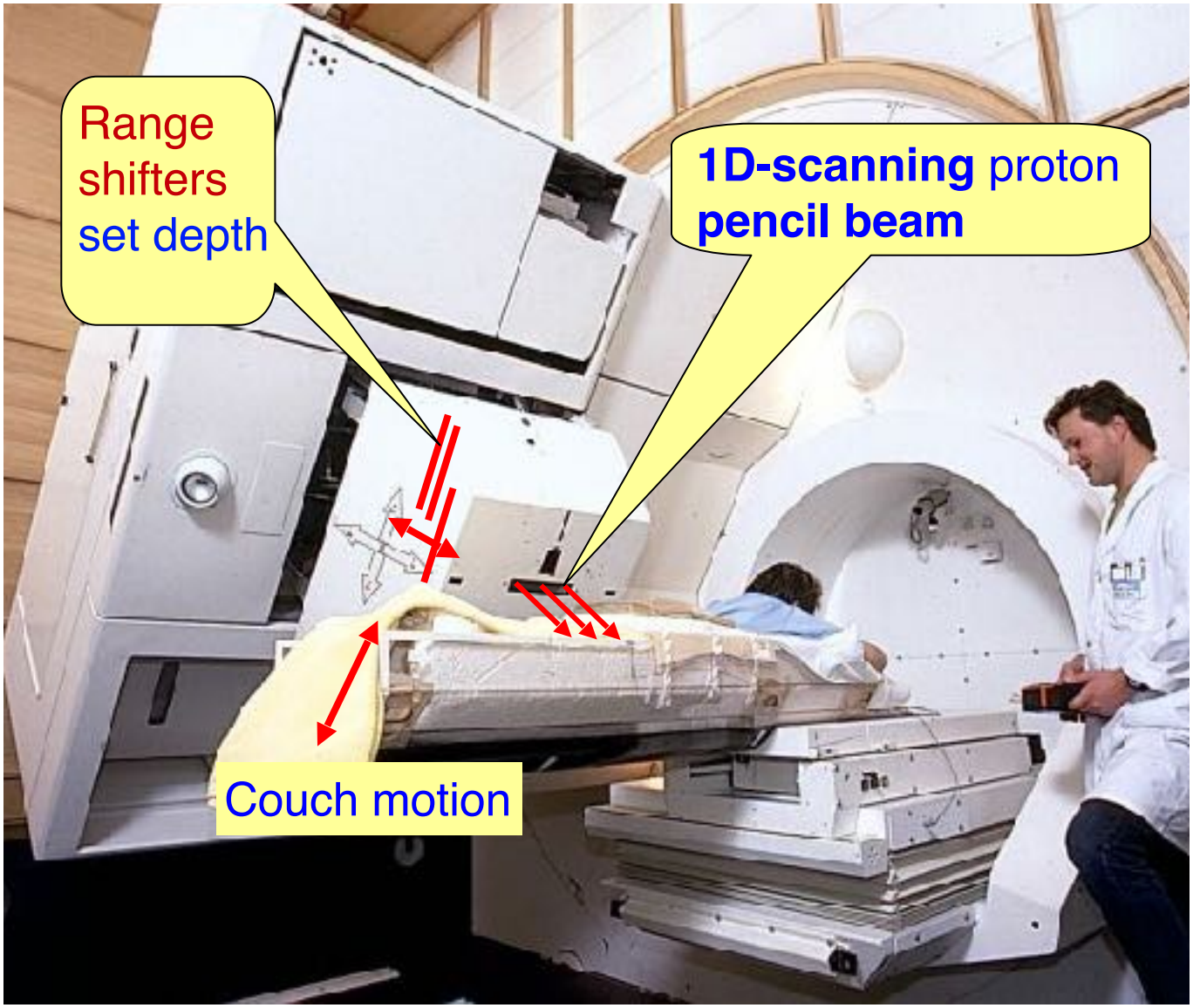
Pencil beam scanning



3rd dimension

- Couch movement
- 2D scanning

Gantry 1 - pioneer of pencil beam scanning



R=2 m

E. Pedroni

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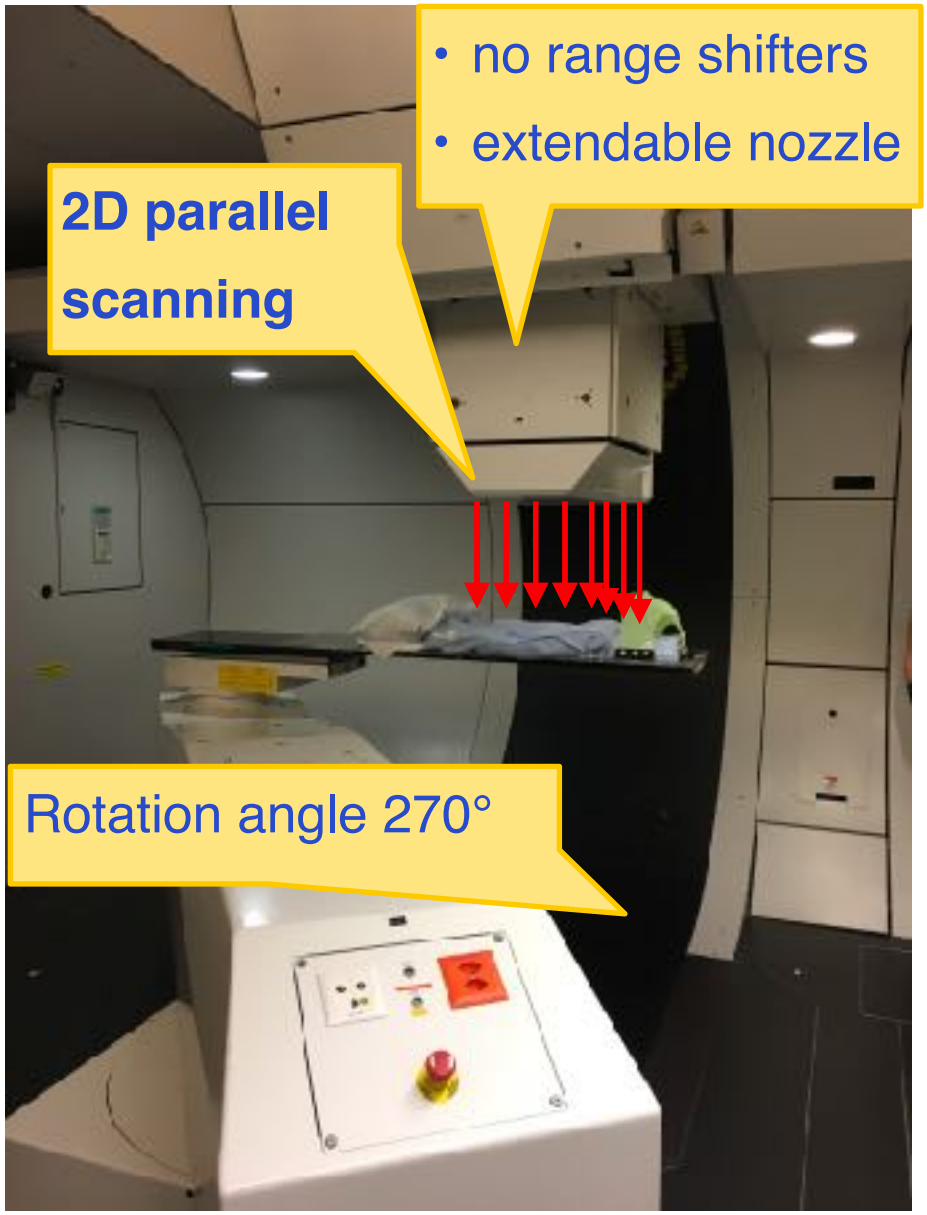
Gantry 2 - state-of-the-art gantry for PT



Radius = 3.2 m

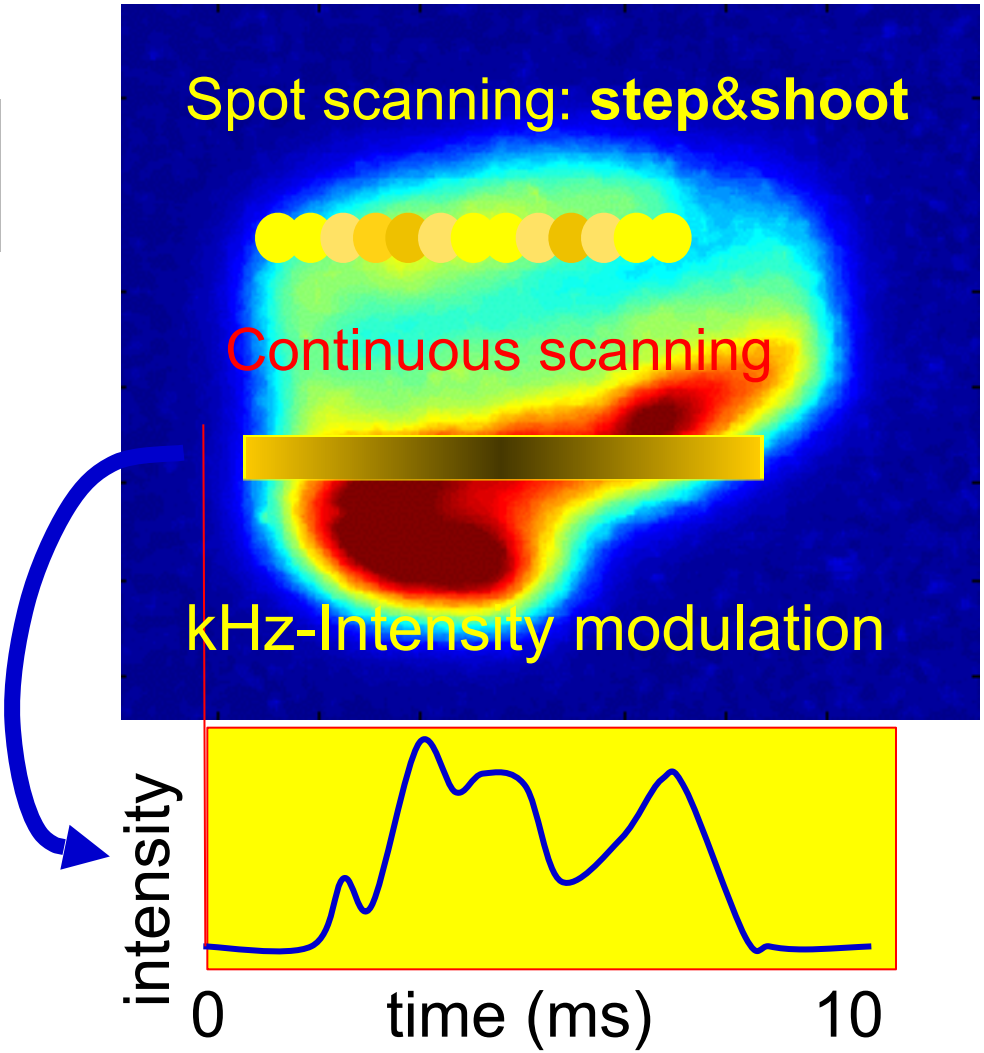
Length = 8.9 m

Weight = 200 t

Scanning field: 12 x 20 cm2

medicalphysicsweb.org

Pencil beam scanning at Gantry 2

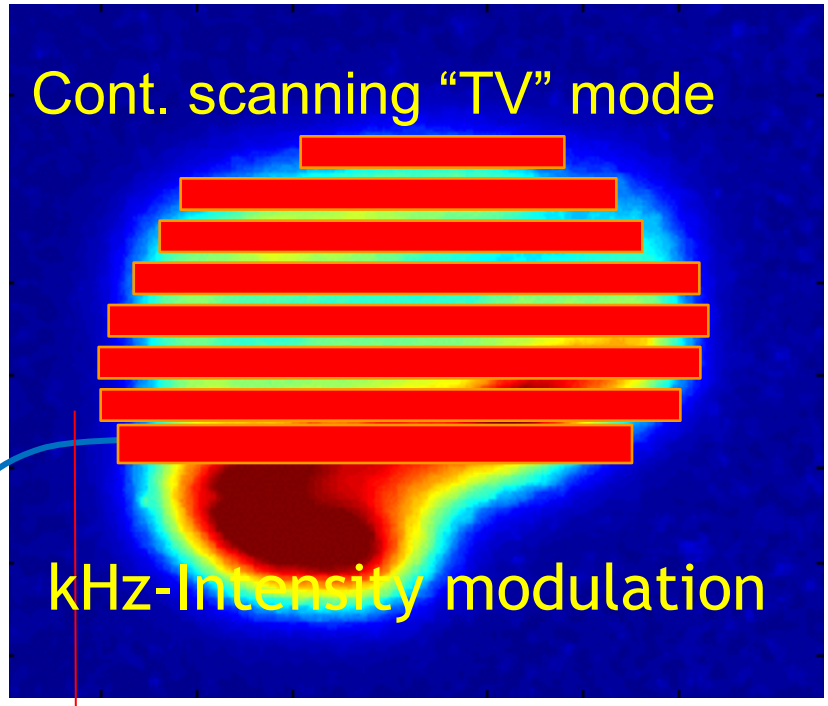


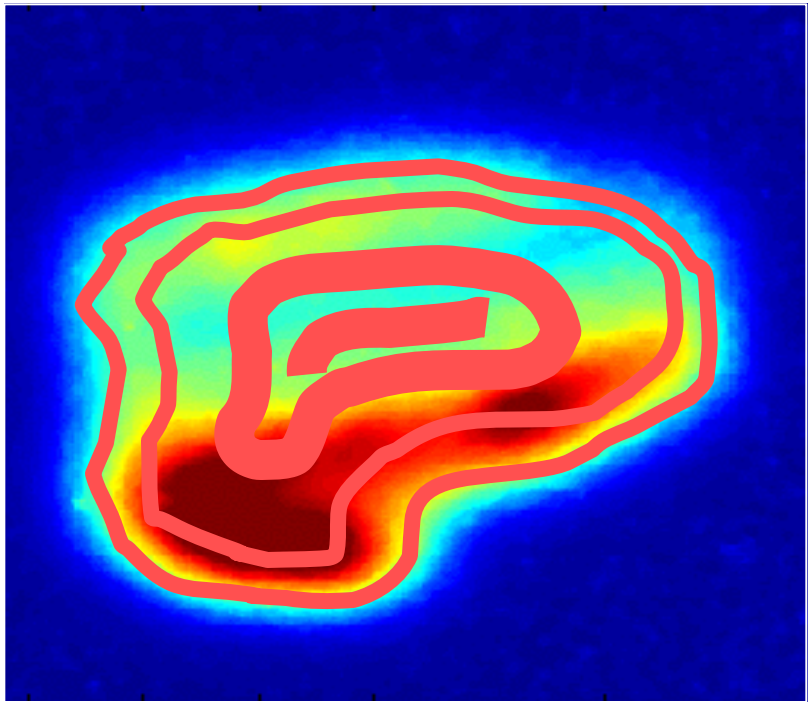
Credit: M. Schippers

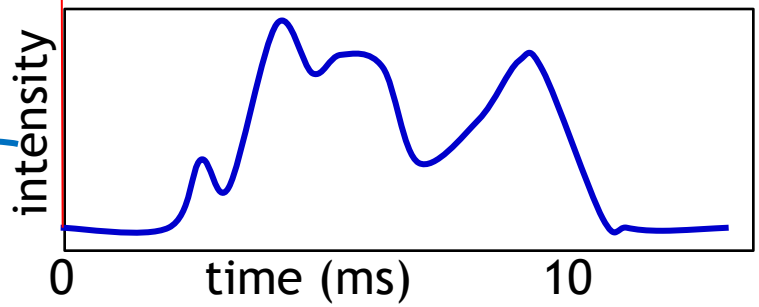
Continuous beam scanning:

- almost ready to be implemented
- **fast** volume **repainting** (up to **15/min**)

Fast pencil beam scanning







- Ultimate goal at Gantry 2
- **Combined** intensity control
  - vertical deflector at the cyclotron
  - varied scanning speed

Credit: M. Schippers

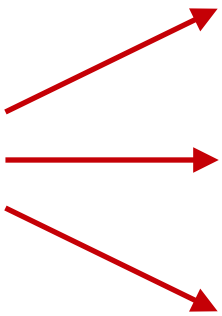
What's next?

Essential parameters to be improved:

- weight
- size
- treatment time

Possible solution:

Superconductivity



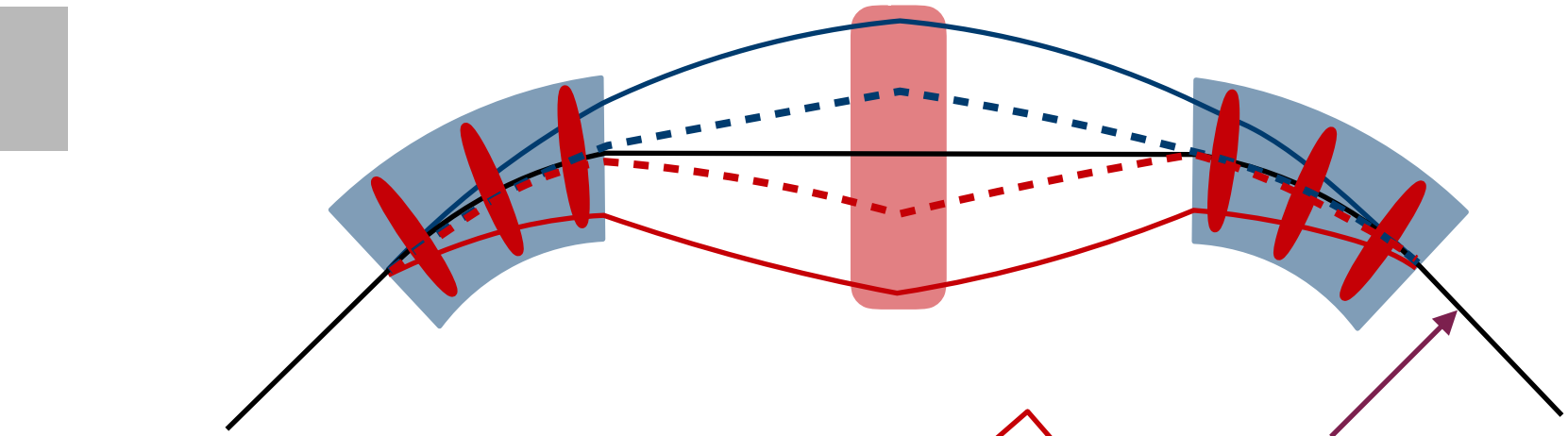
Significant reduction of weight

Certain reduction of size

Large energy acceptance

→ **ultra-fast dose delivery**

Energy/momentum acceptance



nominal momentum

achromatic bending

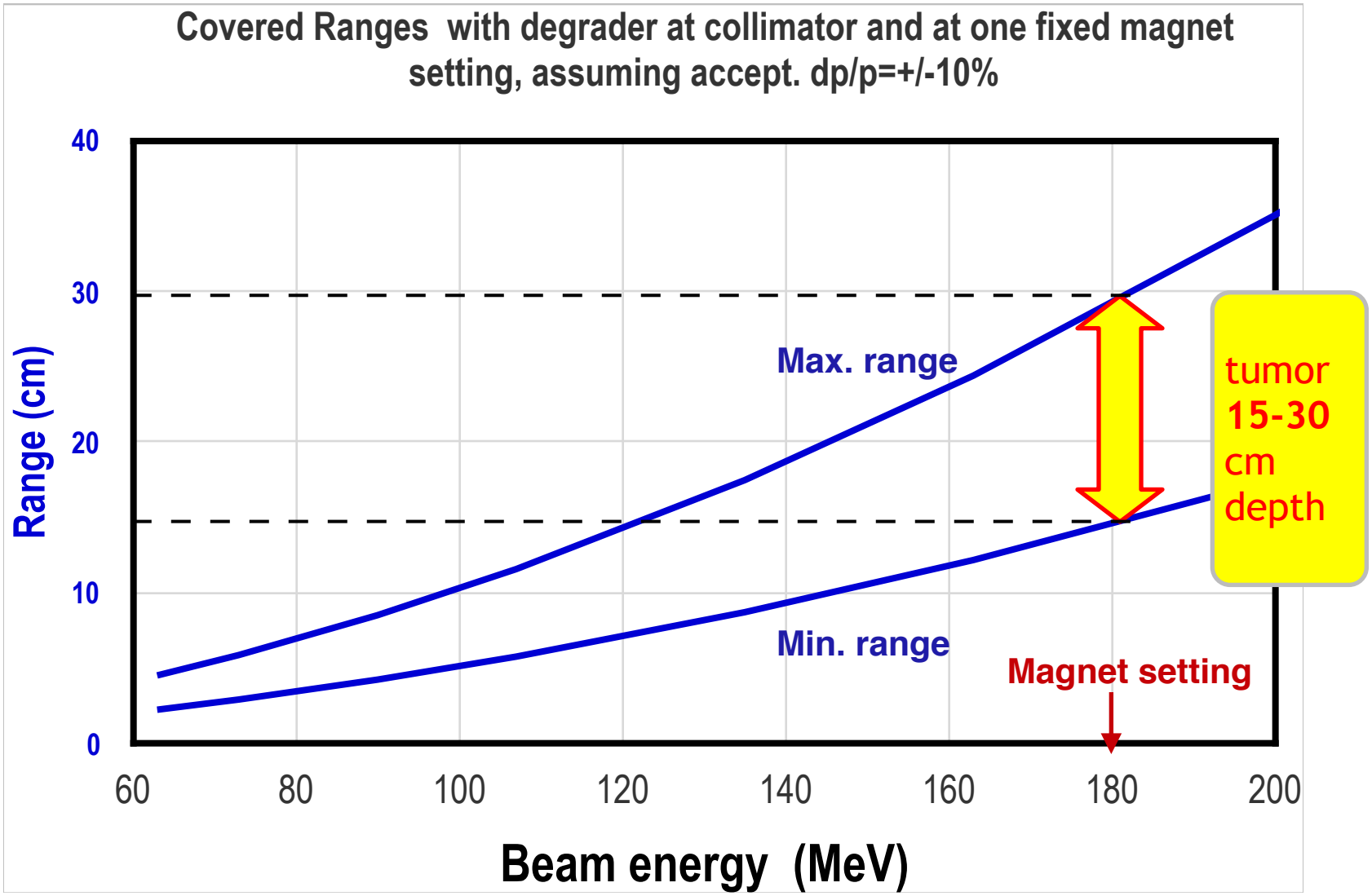
Combined function magnets + focusing)

Efficient di suppression

10 times la omentum/energy acceptance

Our goal at PSI

Why is the large momentum acceptance so important?



Courtesy of M. Schippers

PSI objectives

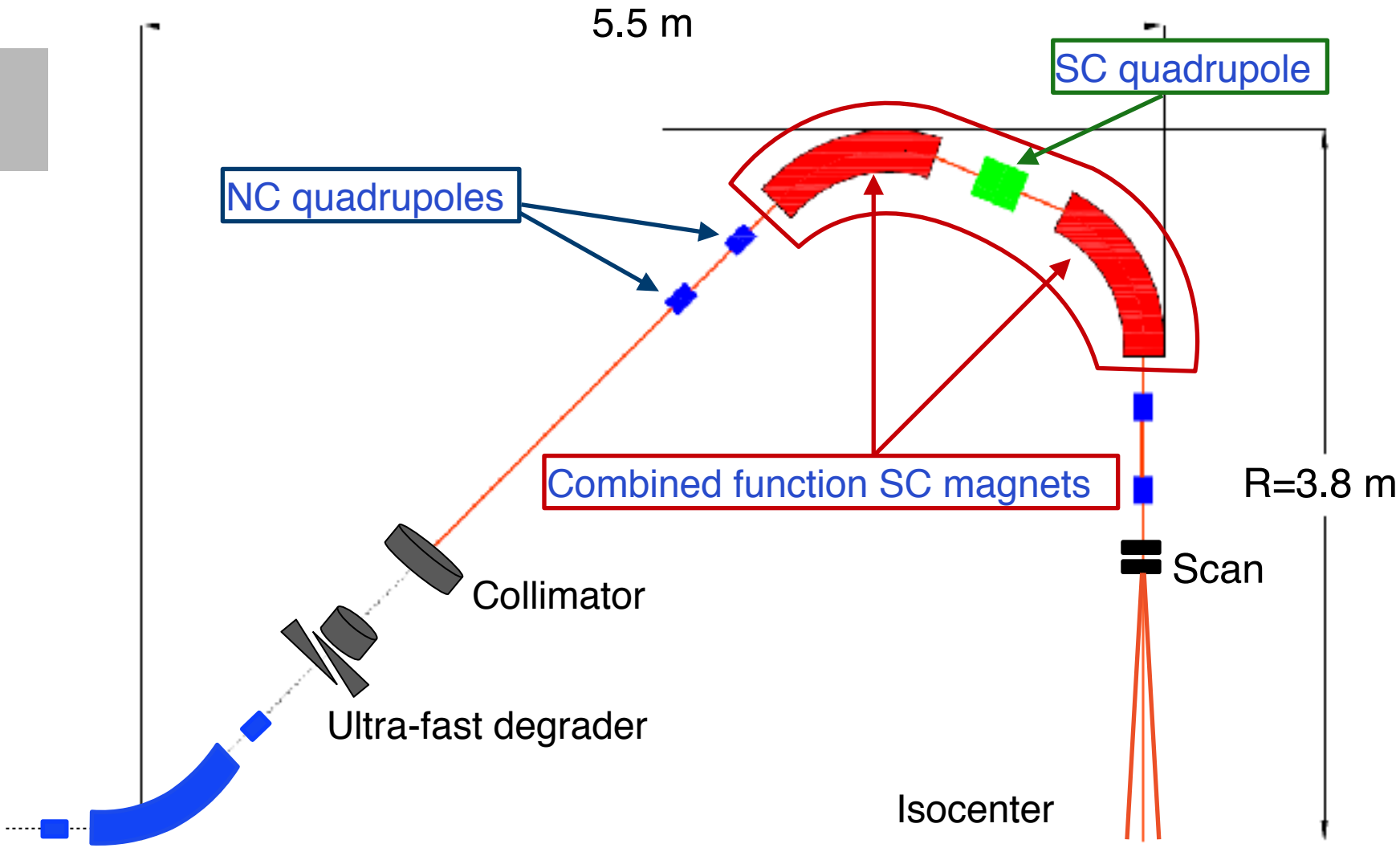
Benefits of a very large energy acceptance:

- ultra-fast 3D dose delivery
- reduction of the treatment time to a fraction of a minute

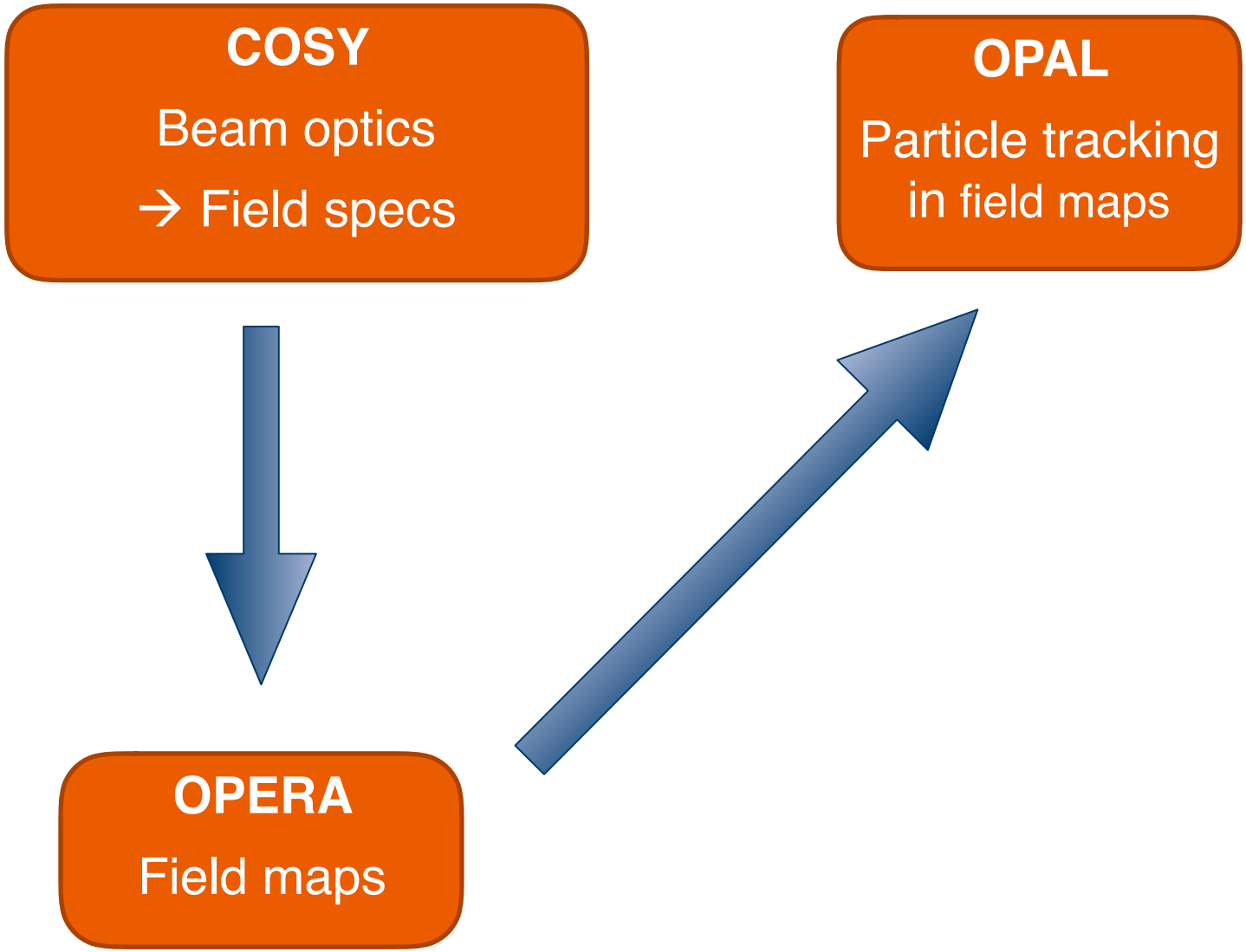
Application for moving organs:

- easier breath-hold technique
- more efficient gating
- new indications ?

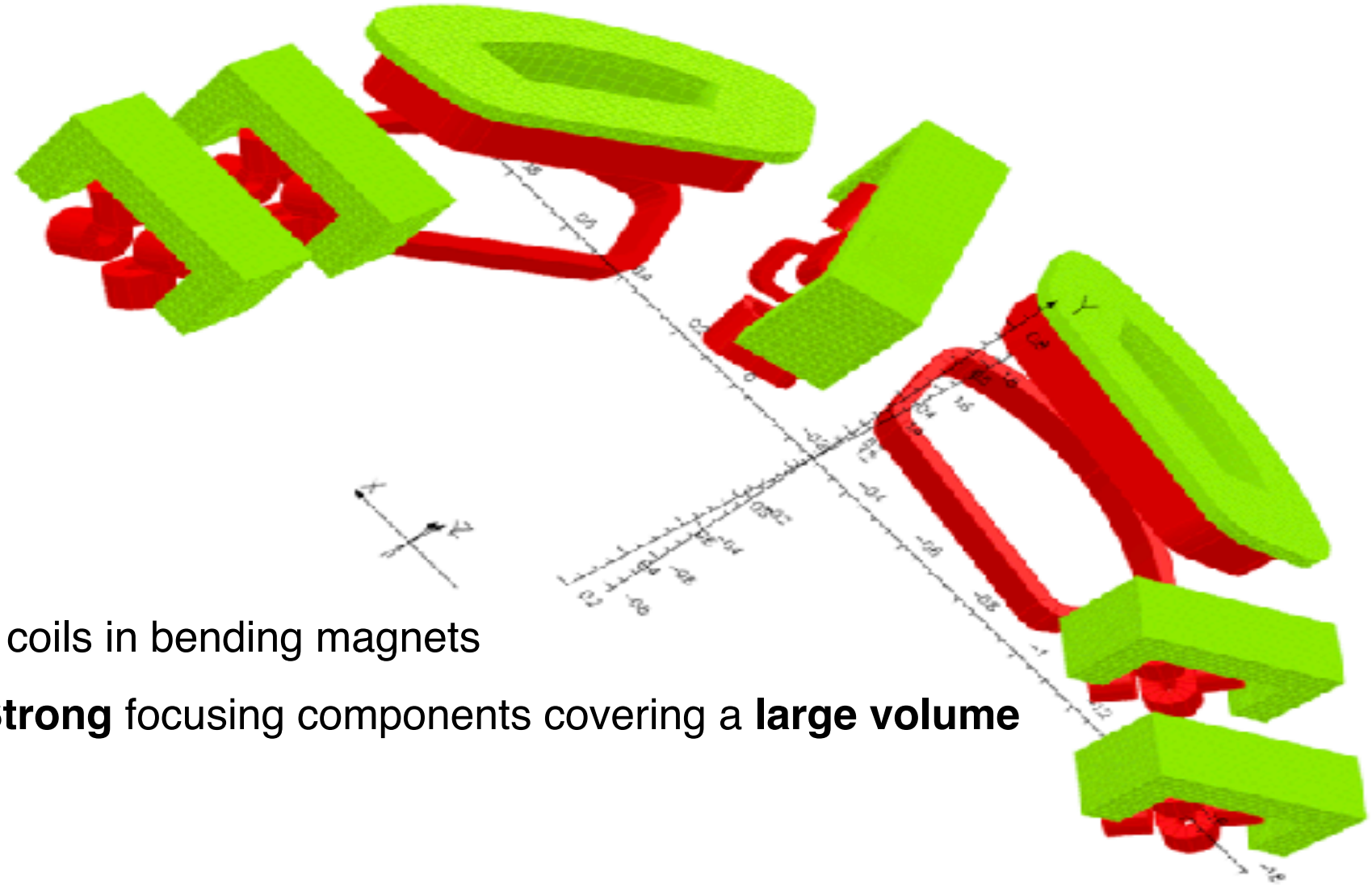
Scheme of the PSI SC Gantry



Use of different kinds of software and workflow



Magnet design



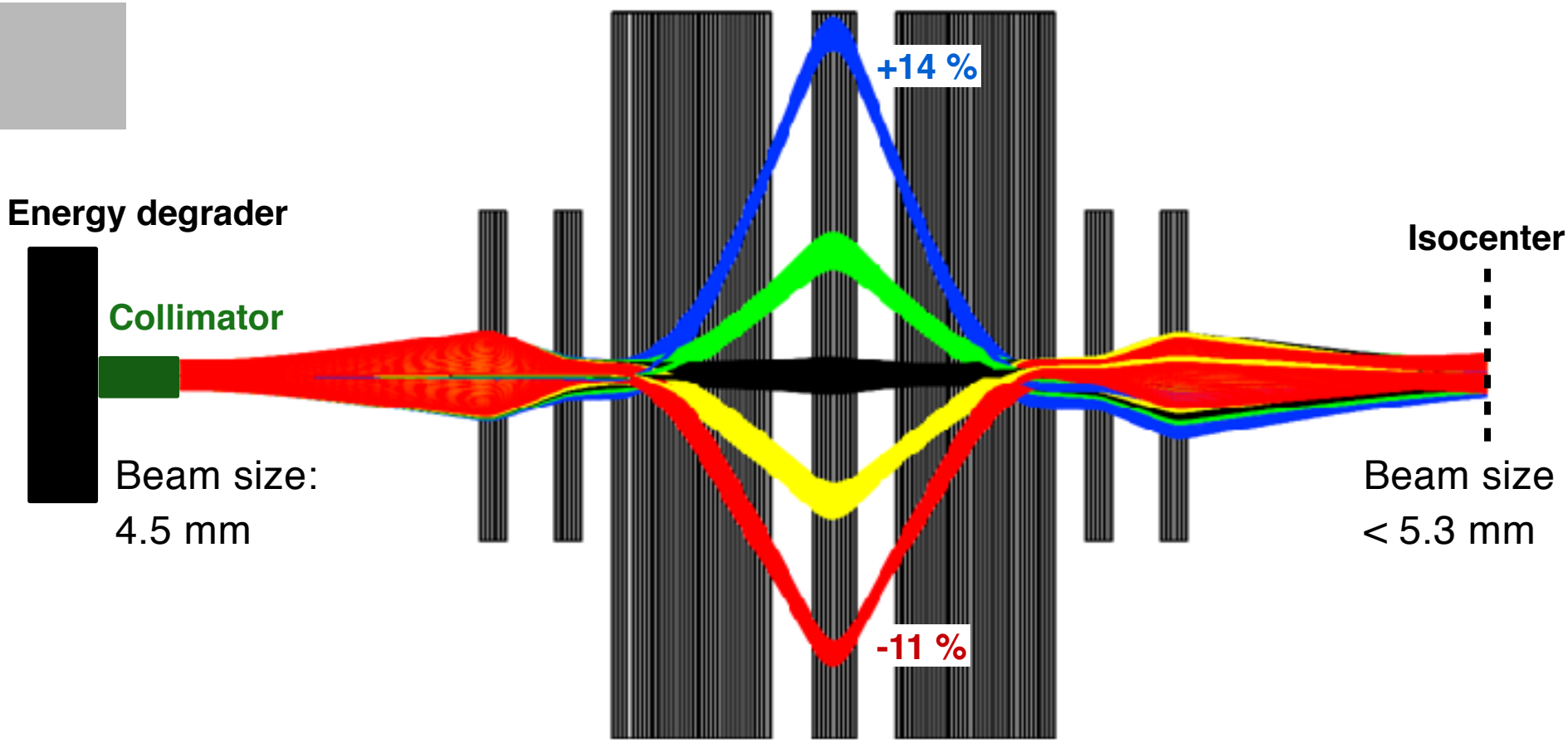
Tilted coils in bending magnets

→ **Strong** focusing components covering a **large volume**

OPERA

C. Calzolaio

Beam optics (dp/p= -11%...+14%)



COSY

Conclusions

Gantry 2:

1. State of the art in PT
2. Future: fast continuous scanning

PSI SC gantry design:

1. Reduced weight and footprint
2. **10 times bigger energy acceptance**
3. Ultra-fast energy change
4. Treatment time - fraction of a minute
5. Present status
   - Optics and magnet design - almost done
   - Looking for possibilities to proceed…

Thank you!

Special thanks to:
Marco Schippers
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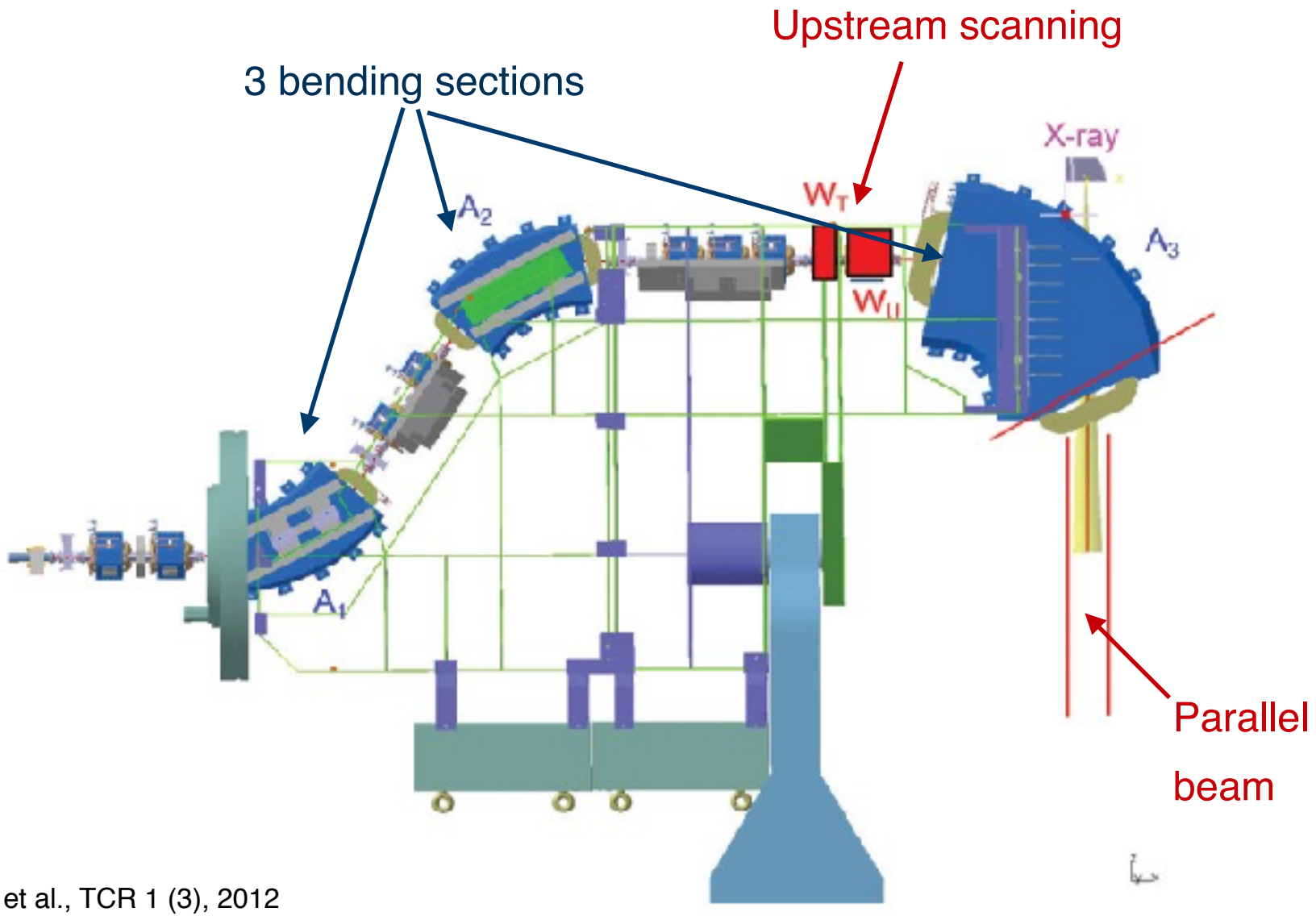
Stephane Sanfilippo
Valeria Rizzoglio
Mike Seidel

Beam optics of Gantry 2



S. Safai et al., TCR 1 (3), 2012

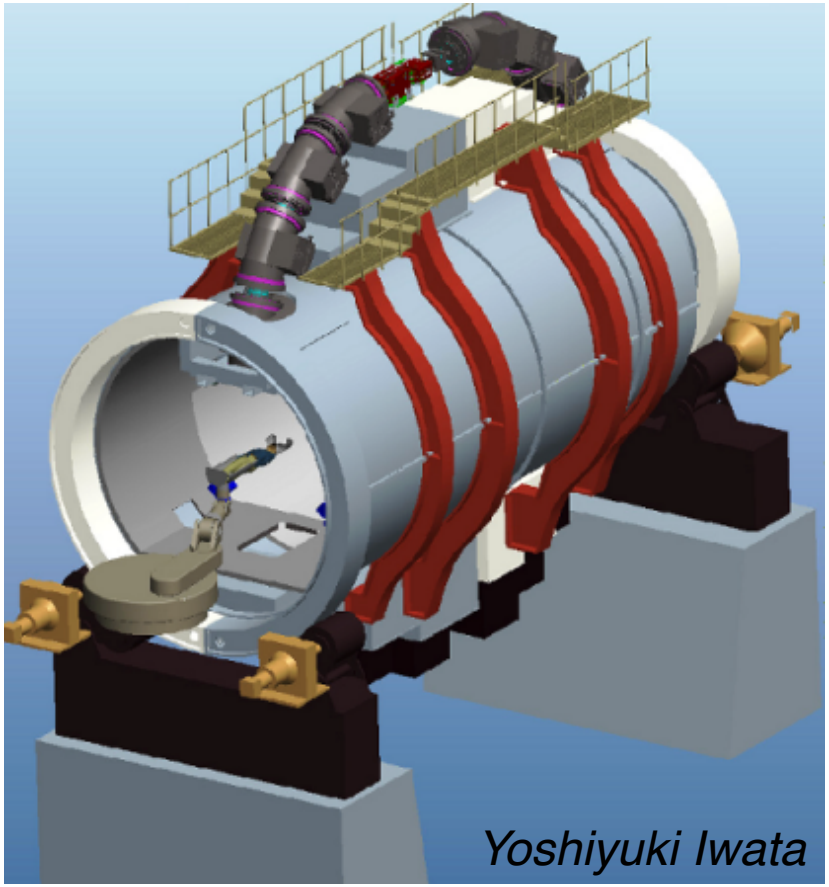
Why superconductivity for gantries?

HIT, Heidelberg, Germany

Radius: 6.5 m

Length: 25 m

Weight: 670 t



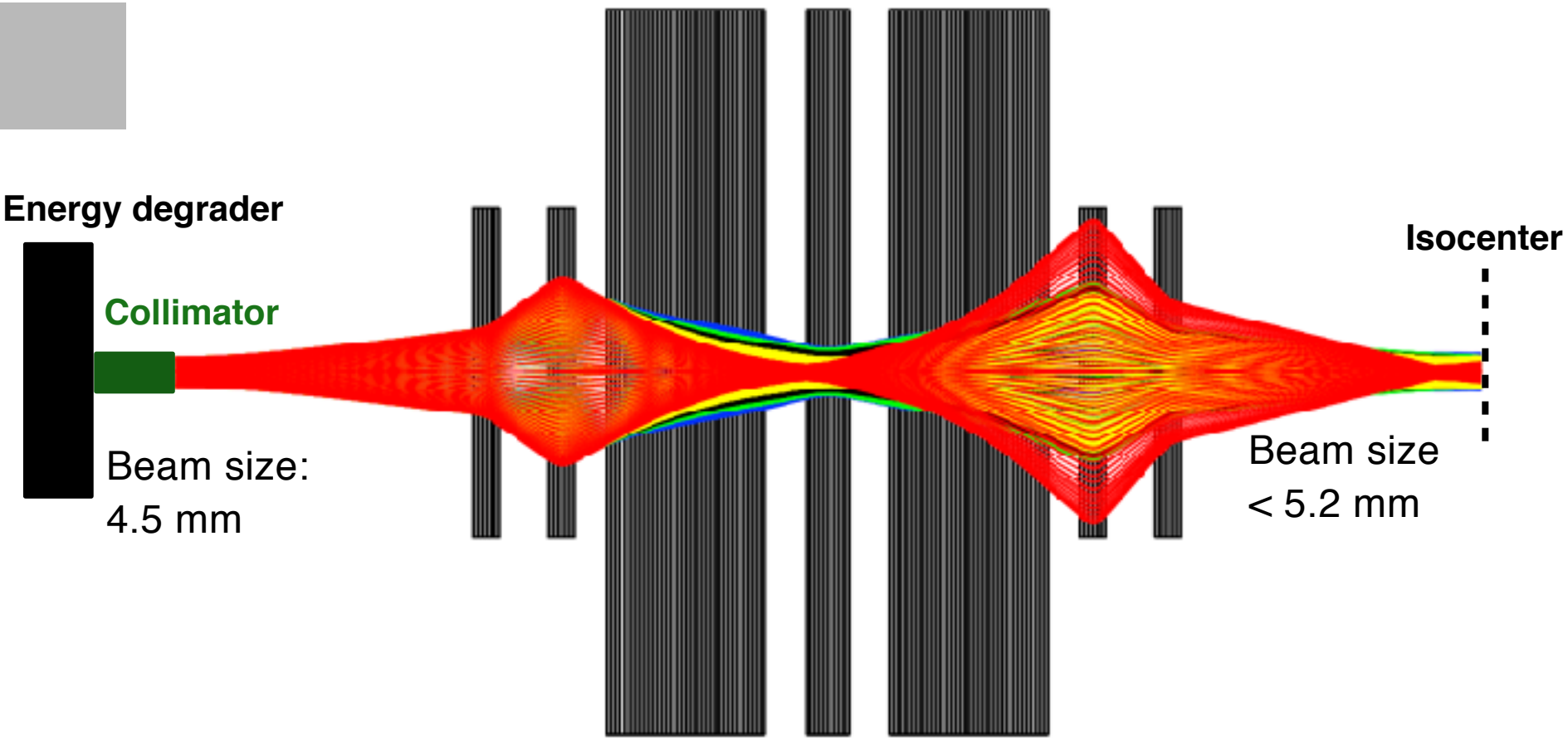
NIRS, Chiba, Japan

Radius: 5.45 m

Length: 13 m

Weight: 300 t

Non-bending plane (-11% - +14%)



COSY Infinity