IBA Carbon therapy system

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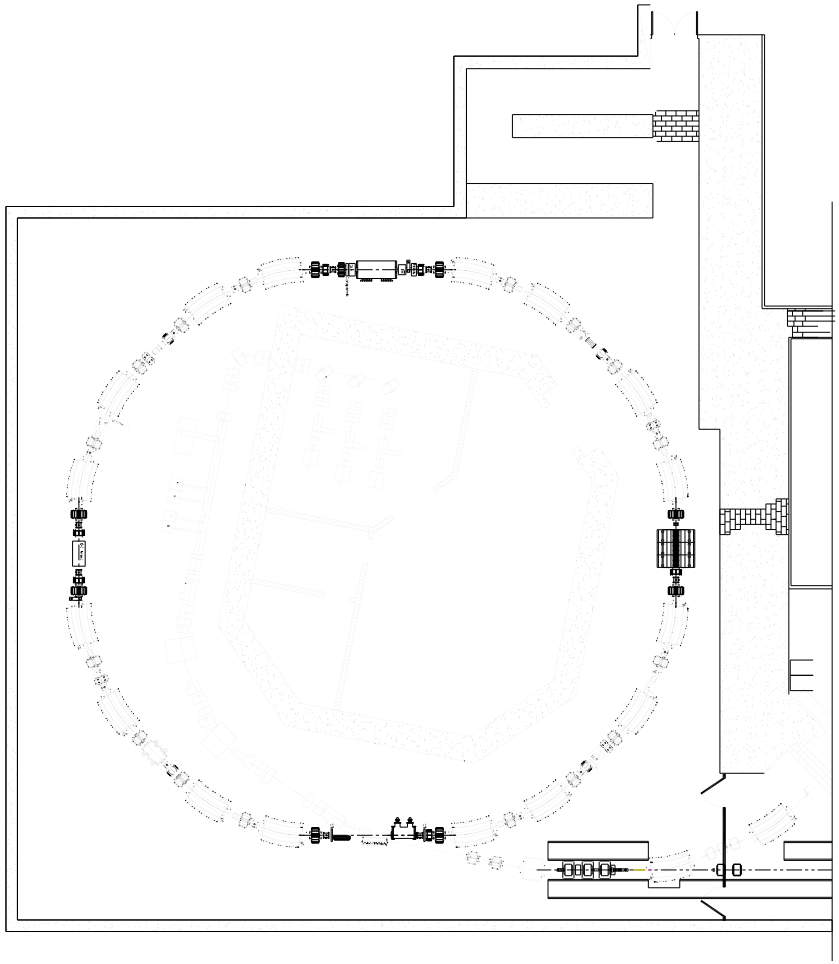
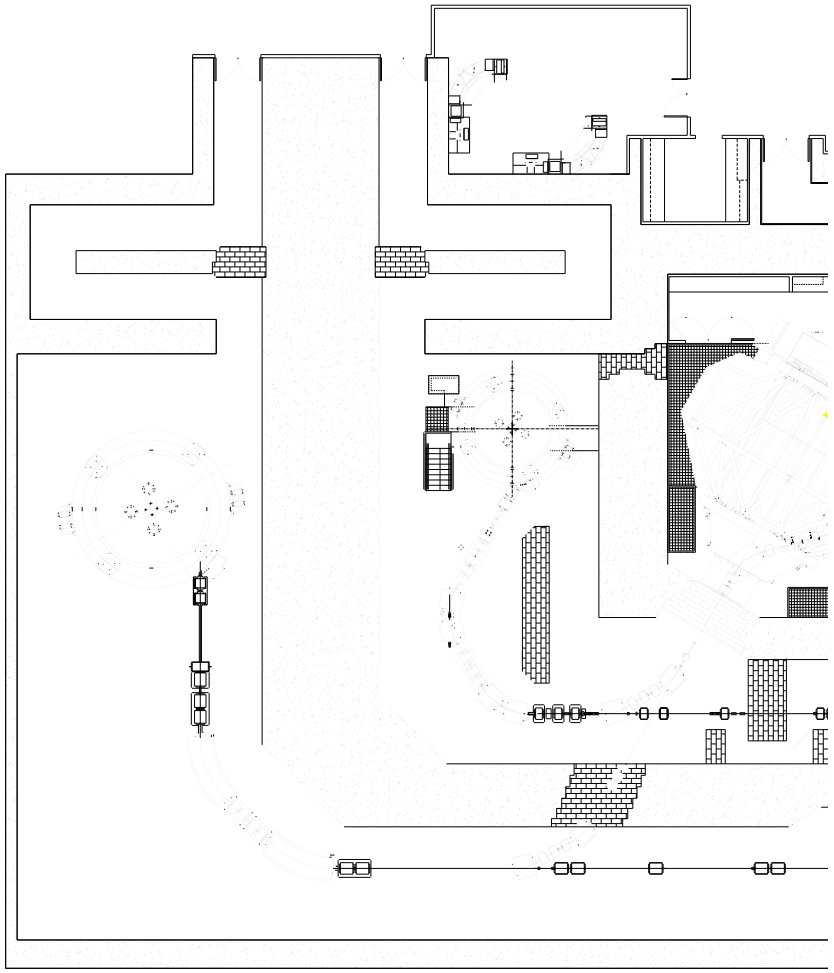
IBA sa

A cyclotron for Carbon therapy? Are you crazy?

- In 1991, when IBA entered in PT, the consensus was that the best accelerator for PT was a synchrotron
- IBA introduced a very effective cyclotron design, and today the majority of PT centers use the cyclotron technology (Not only IBA but Accel/Varian, Still Rivers)
- Over these 15 years, users came to appreciate the advantages of cyclotrons:
  - Simplicity & reliability
  - Intense, continuous (non pulsed) beam current
  - Lowest cost and size
  - But, most importantly, the ability to modulate rapidly and accurately the proton beam current

In less space and cost than a synchrotron: a two cyclotrons phased approach





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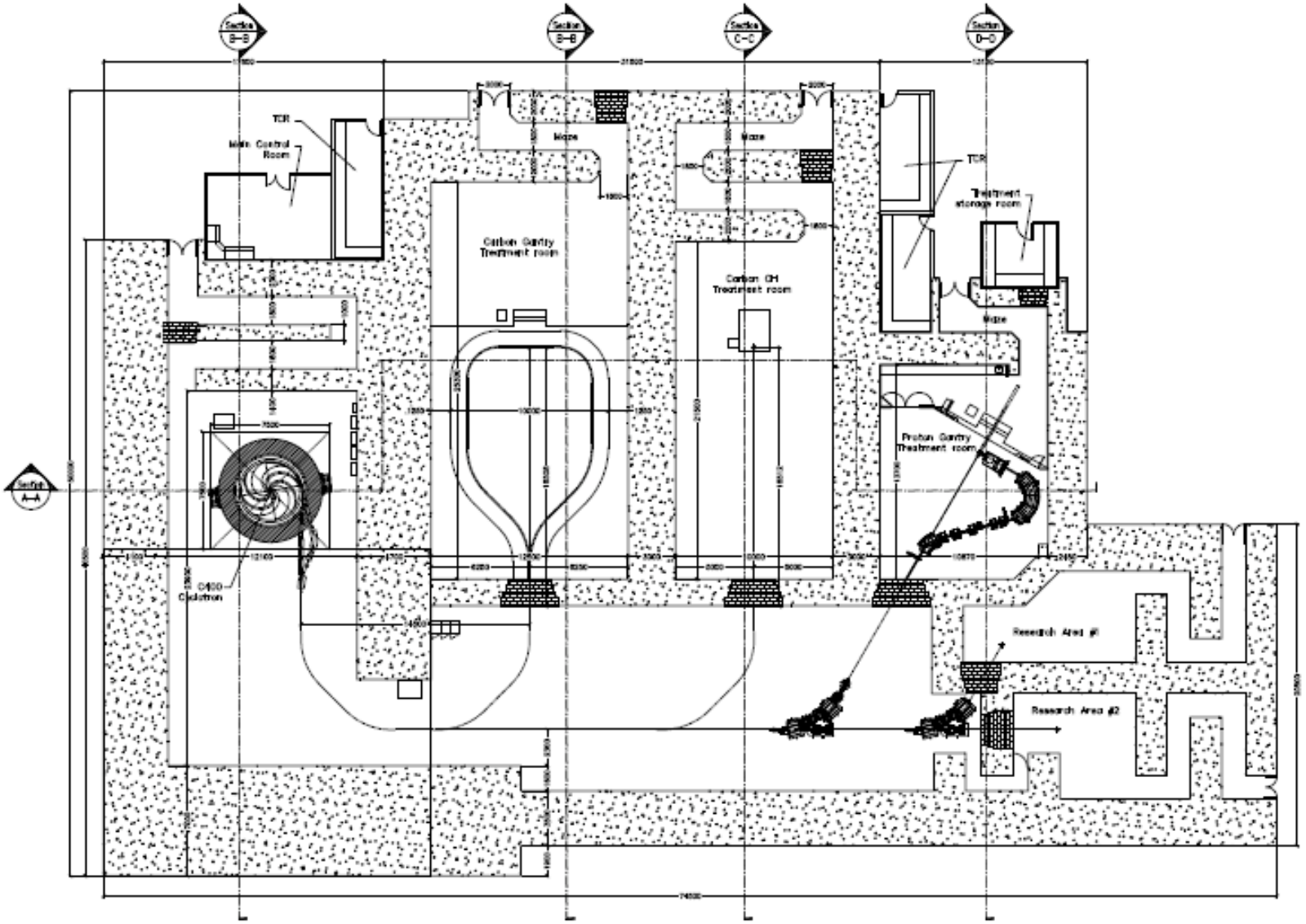
One cyclotron IBA proton-carbon therapy system



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The IBA Carbon cyclotron design

- Superconducting isochronous cyclotron, accelerating all Q/M = 1/2 ions to 400 MeV/U (Alphas, Lithium, Boron, Carbon, but also Nitrogen, 0xygen, Neon and Argon 36 for research)
- Accelerates also protons as H2+. Protons are extracted by stripping around 270 MeV
- Design similar to IBA PT cyclotron, but with higher magnetic field thanks to superconducting coils, and increased diameter (6.3 m vs. 4.7 m)
- Treatment field 20 x 20 cm. Scanning beam only.

Change of energy?

- Cyclotrons are simpler at fixed energy
- Energy change by graphite degrader at waist after cyclotron exit, followed by divergence slits and energy analyzer
- Fragmentation products are effectively eliminated in slits and ESS
- Yes, neutrons are produced, but ESS is well shielded and the average beam current in PT or CT is very low > little activation
- How fast? 5 mm step in energy in 100 msec at PSI (vs. 5 msec for Cyclinac). But respiration cycle is 2…4 seconds, so 100 msec is fine

Status of the cyclotron

- During the last three years, a team of accelerator physicists at the JINR in Dubna has completed the physical design of the cyclotron. This study has been summarized into a comprehensive design report.
- On January 8th 2007, an international design review was organized by IBA, with worlds key superconducting cyclotron experts. The outcome of the review was completely positive.
- Construction of the prototype has started
- A design contest has just been organized between the SC coils suppliers. Results were reviewed. Contract negotiated with Sigmaphi + CERN consultants.

Status of the IBA carbon system in April 08

- In the competition for contracts, the lack of a carbon cyclotron prototype is a significant weakness
- For this reason, the board of IBA decided the construction of a prototype on IBA budget, and the installation of the prototype at a scientific partner to validate the system by the end of 2011
- The scientific partner is now selected. It is the scientific laboratories association Archade associated with the GANIL national laboratory (Caen, France)

The agreement signed in February 2008

- IBA will, at his own cost, install the C400 prototype in Caen, close to the GANIL laboratory, within the frame of a research project with ARCHADE.
- Within the frame of this research project, the region will, at his own cost, finance the building and electricity.
- Archade will hire, and IBA will pay 9 to12 scientists to work on radiobiology and hadron therapy related physics issues to contribute to a carbon TPS.
- The goal is to establish a center of resources and knowledge in hadron therapy, and to validate the IBA system, treating a first patient in 2011.
- The goal is not to create a clinical therapy center (Lyon's Etoile project comes first)

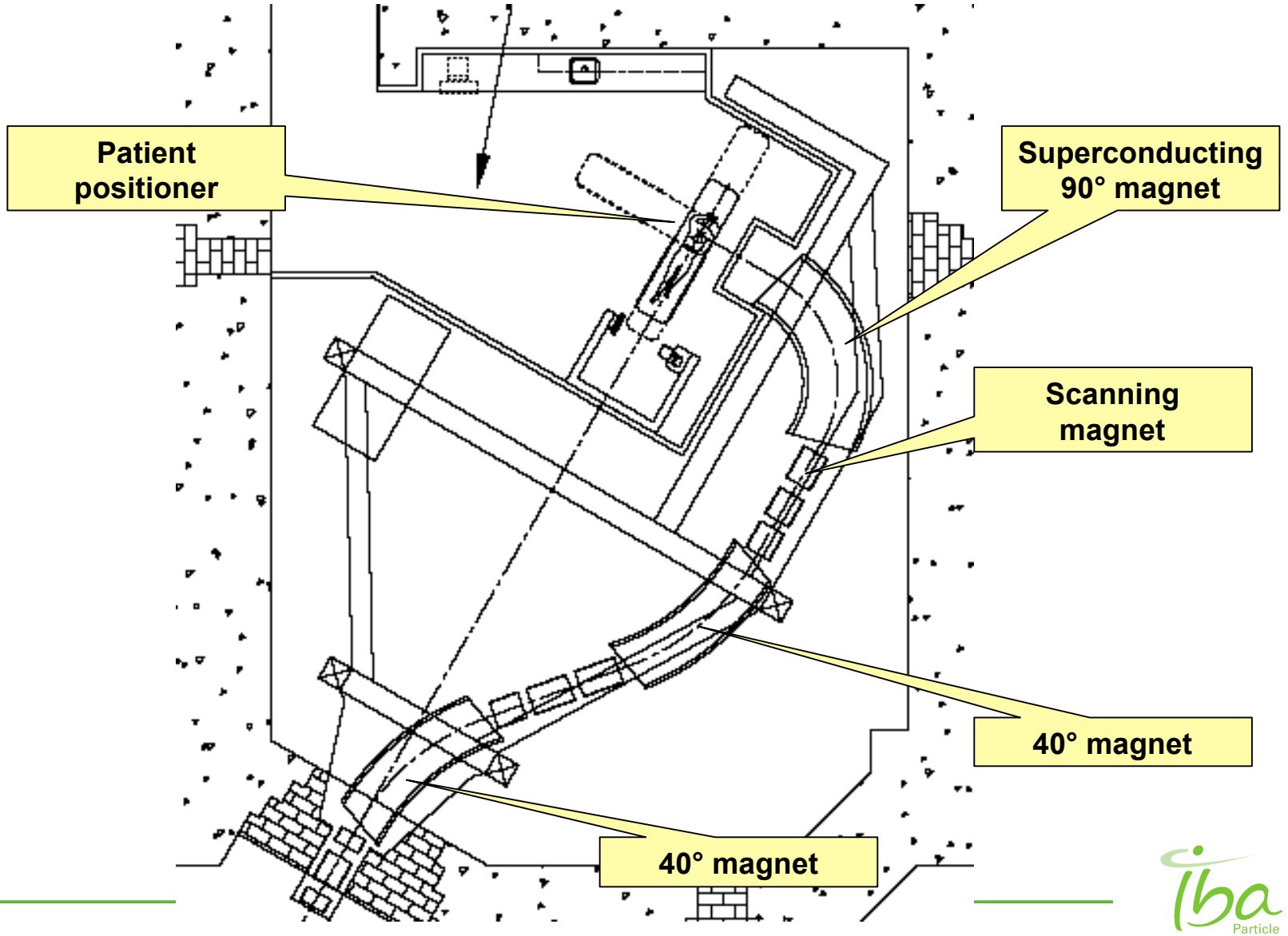
A Proton/Carbon therapy TPS

- IBA has launched an international collaboration for the development of a better, biologically optimized treatment planning system for carbon beams, to be included into an existing, commercial TPS
- Participants to the collaboration include:
  - The INFN (Italy)
  - Dresden University/ Oncoray (Prof. M. Bauman)
  - The ARCHADE collaboration (Prof. J. Bourhis)
  - Industrial partners (IBA, CMS-Elekta)

Compact isocentric gantry for Carbon beams

- MD's want a true isocentric gantry
- The gantry of Heidelberg (20 m long, 12 m diameter, 600 Tons) is often seen as too large, heavy and expensive to be selected as a solution
- Is it possible to build a Carbon gantry of the size and (more or less) the cost of a proton gantry?
- Yes, if the last dipole magnet is superconductive (3.2 T) and if scanning is done upstream of this last dipole

The compact carbon gantry



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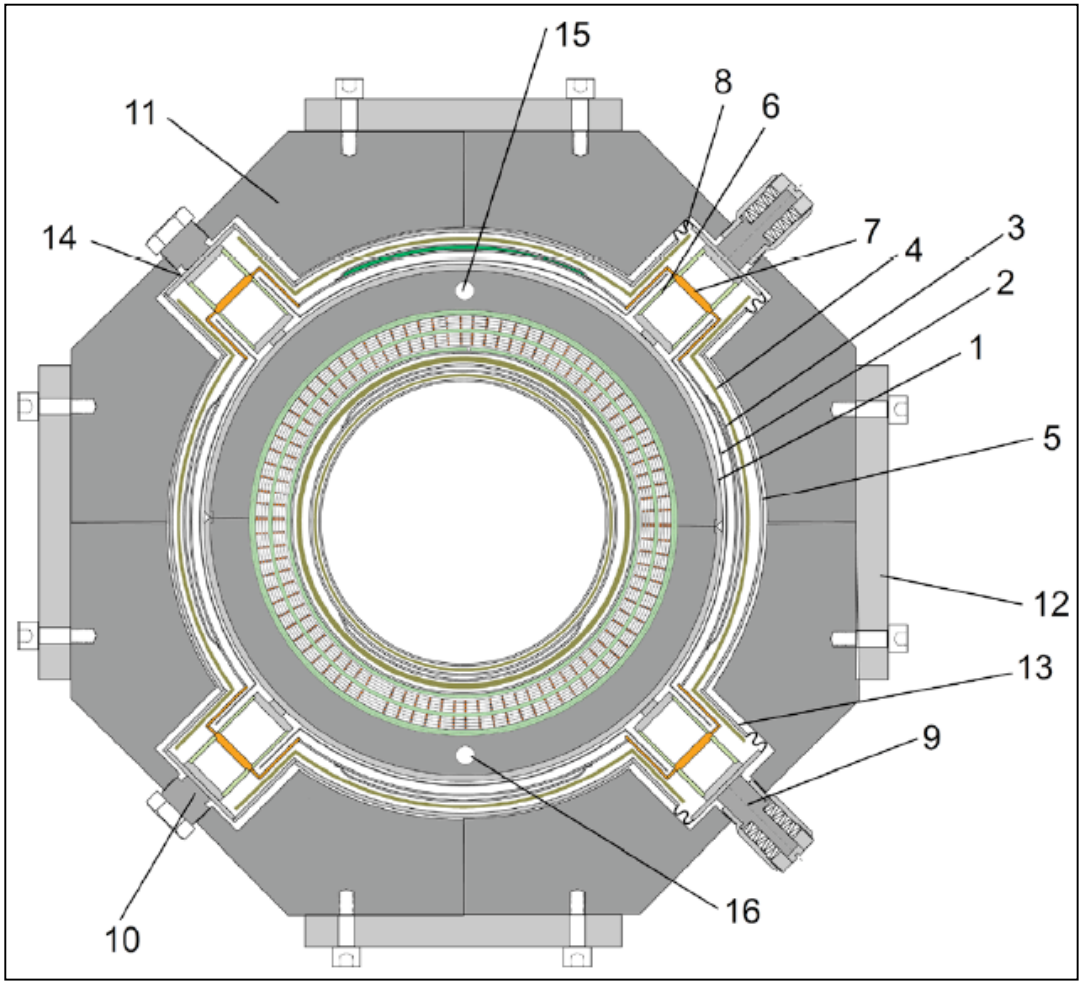
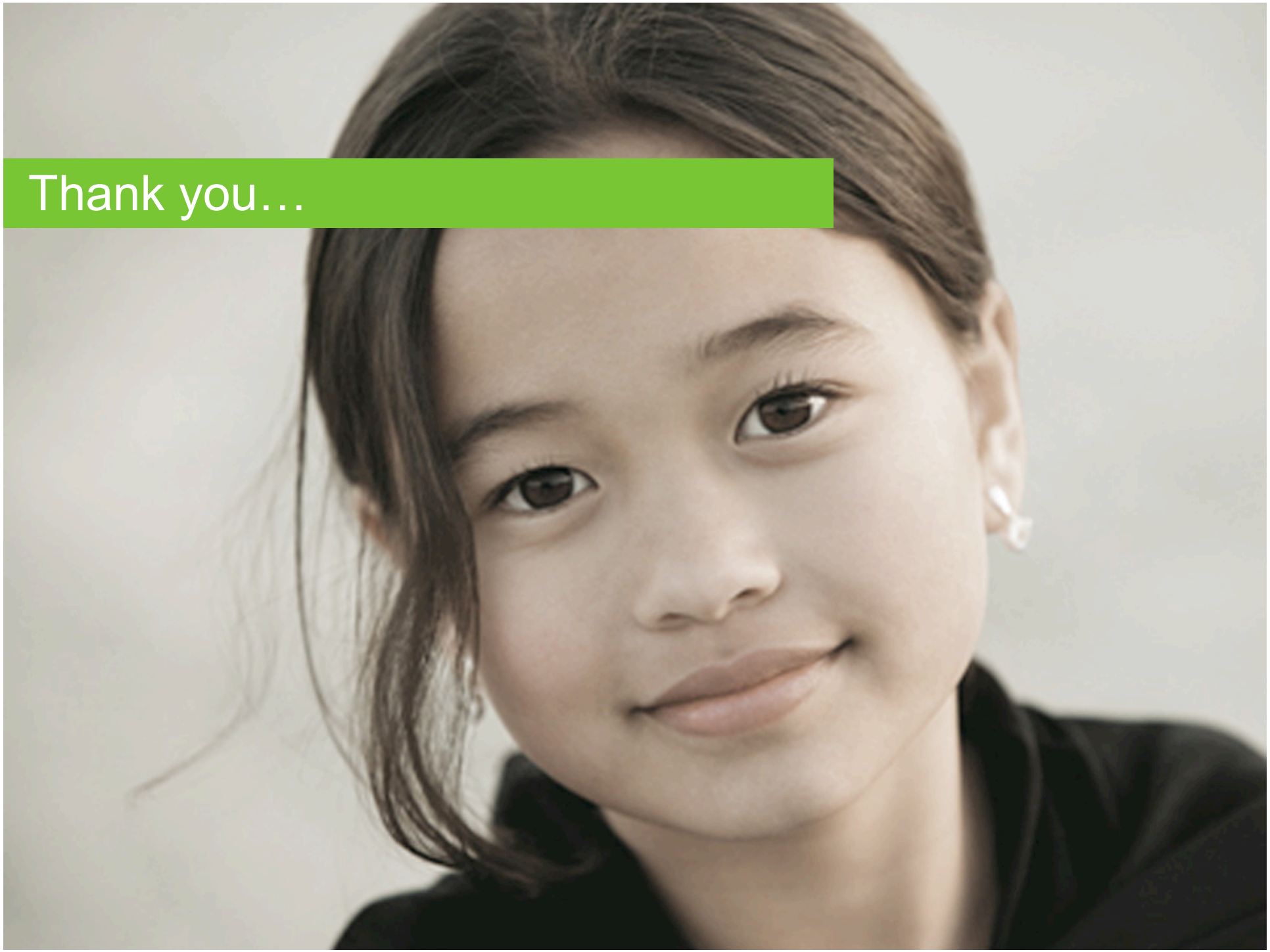
Superconducting dipole magnet cross section



1 - Coldmass assembly
2 - Mulitlayer insulation
3 - Liquid N2 cooled shield
4 - Mulitlayer insulation
5 - Coldmass vacuum tank
6 - G10 support tube assembly
7 - 80 K heat sink (copper)
8 - Bellows
9 - Preload cartridge
10 - Anchor cartridge
11 - Magnet support quadrant
12 - Magnet support tie plate
13 - Vacuum tank preload protuberance
14 - Vacuum tank anchor protuberance
15 - Liquid He supply tube
16 - He vapor return tube


Thank you…