Cyclone® KIUBE : Development of a New Cyclotron for PET production

21st International Conference on Cyclotrons and their Applications

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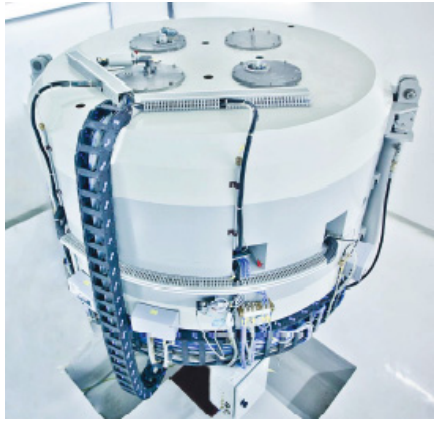
Main purpose

Design of a new PET cyclotron at 18 MeV



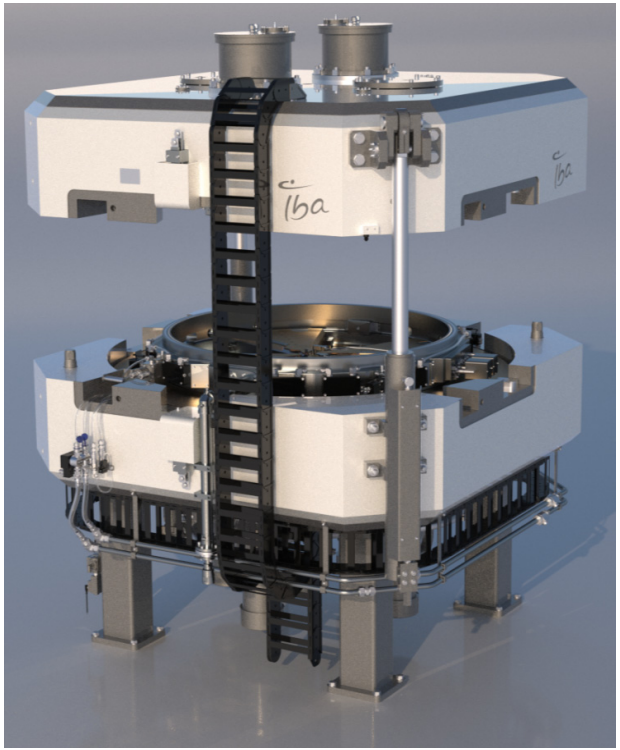
For detail design:

- **TUP03** : Extraction System Design for the new IBA Cyclotron for PET Radioisotope production : W Kleeven
- **TUP04** : Magnet Design of the new IBA Cyclotron for PET Radioisotope production : S Zaremba

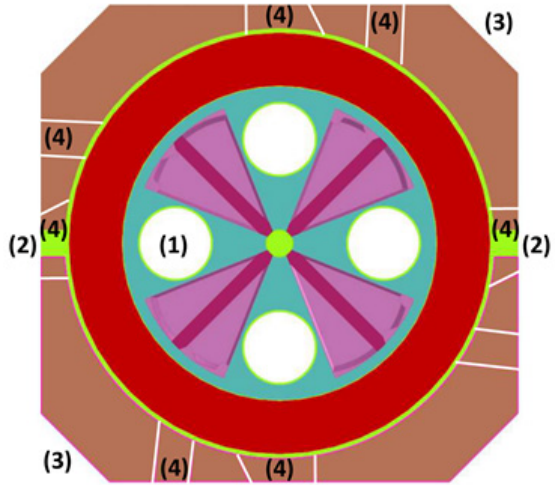
What are the goals ?

- PET cyclotron optimized for high current
  >200 µA extracted
- Smaller machine + self shielding option
- Easier Maintenance / Less activation
- Clean & high speed vacuum
- External tuning of Source position
- Uptime: twin proton ion sources
- Keep 8 exits (flexibility)

- Development planning : 15 months proto
- 1 machine/month out of factory

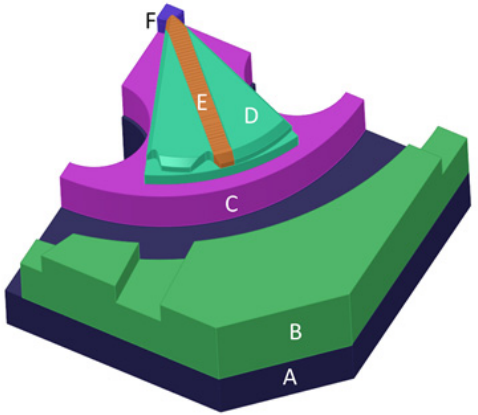


Magnet system



- Deep valley reinvented (keeping <11kw magnet need)
- Optimized size : 1740 x 1740 x 860 mm
- 8 identical target ports
- Pole insert for mapping adjustment
- Gradient corrector on each output

More information on poster session

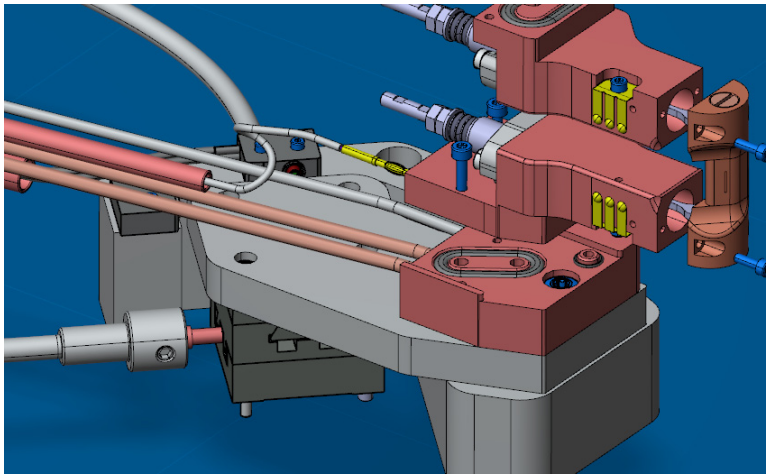


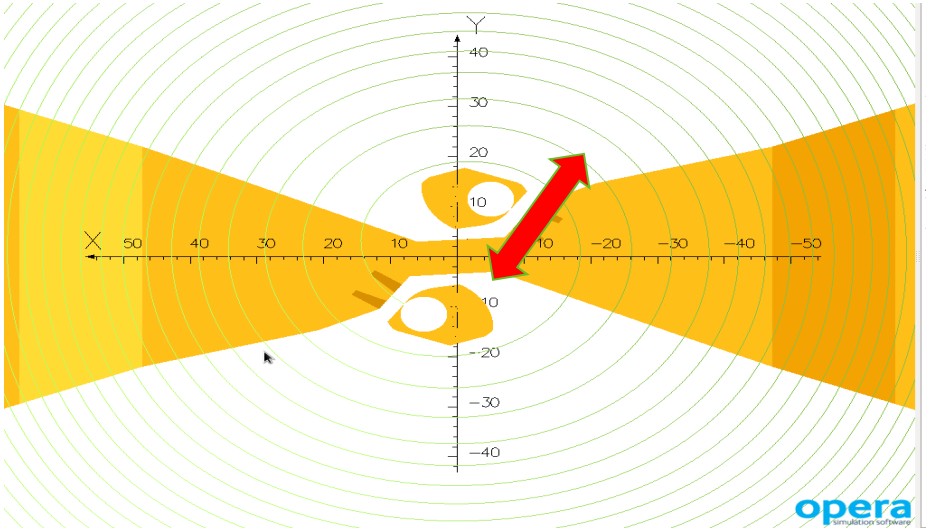
4 patent applications:

- [pole insert] EP16169489
- [pole contour] EP16169490
- [gradient] EP16169494
- [geometry] EP16169497

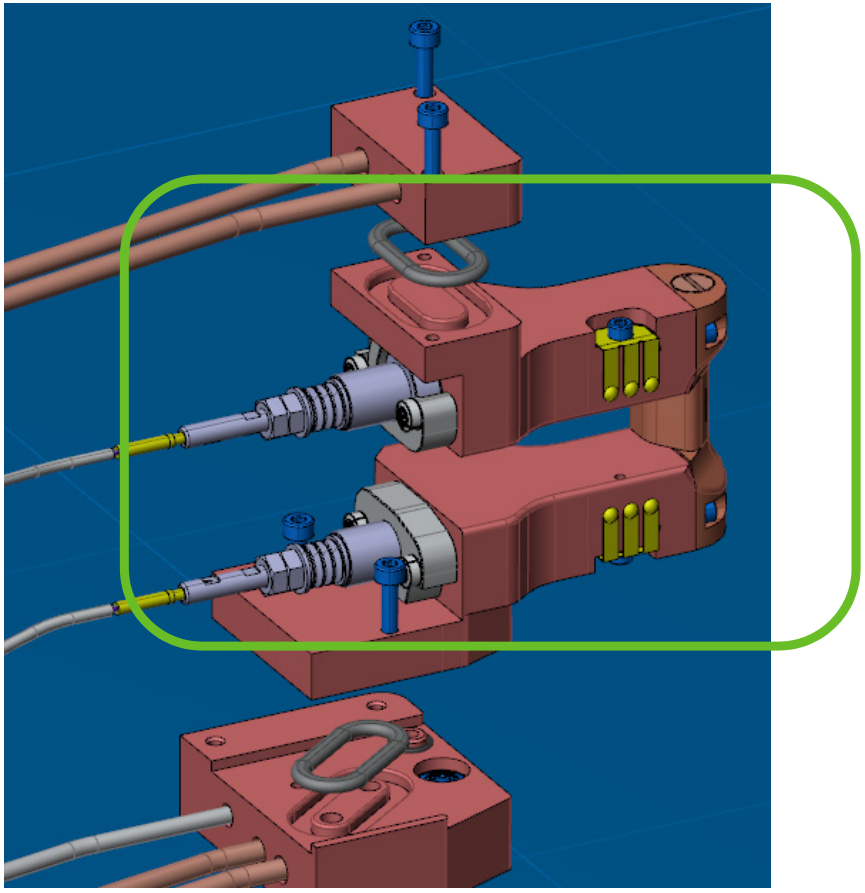
Proton sources

- Uptime -> twin proton source (IBA patent)
- Motorized source (azimuth & radial) movements (from outside)





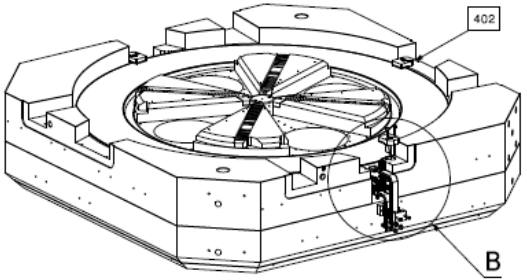
Maintenance - Easy access to source/cathodes body



Median Plan at 1,1m → easy access

High vacuum system

- High performance pumps
- Smaller valley / less surfaces
- High conductance
  - Large diameter holes in yoke



To	15 min	30 min	45 min
Full open	1.9 E-5 mbar	3.6 E-6	< 2.4 E-6

Vacuum speed with 4 VHS-6 after 2 h opening , no N2 venting

Transmission performances

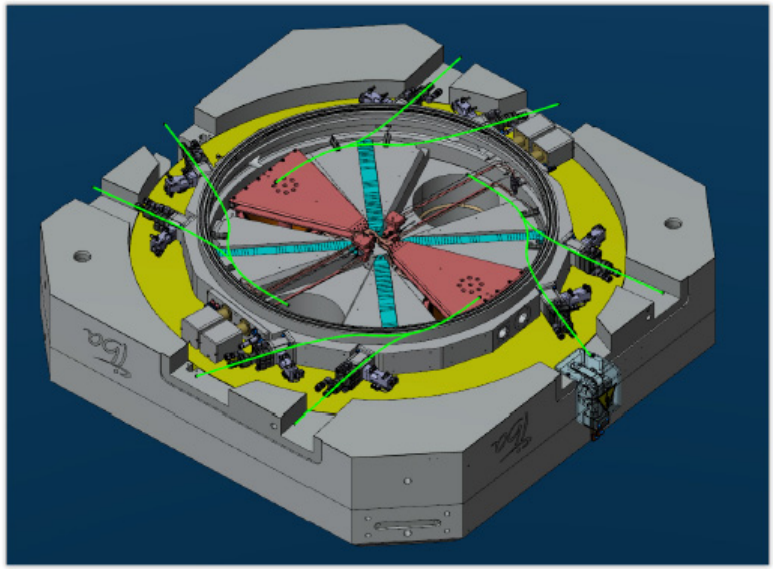
- Base 2.7 E-7 mbar, 40 kV, 40.65 MHz, 4 odp

Porter valve H2 flow	Transmission 4 ODP	2 ODP
4 T – 150µA	81 %	
6 T – 180 µA	**> 77 %**	**63 %**

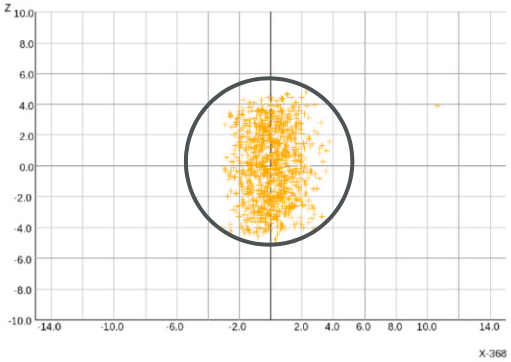
- Cyclone KIUBE : H+ (95 %) – H- (80 %)
- Cyclone 18/9 : H+ (95 %) – H- (55 %)

REDUCTION IN BEAM LOSSES

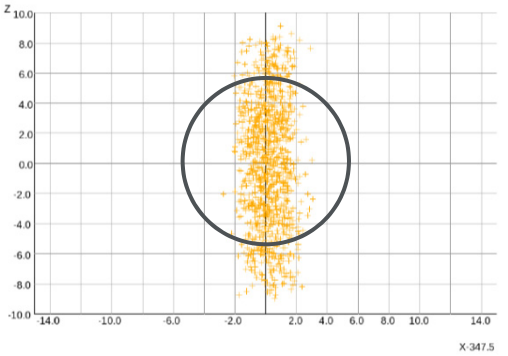
Beam optics on target = 100% symmetrical



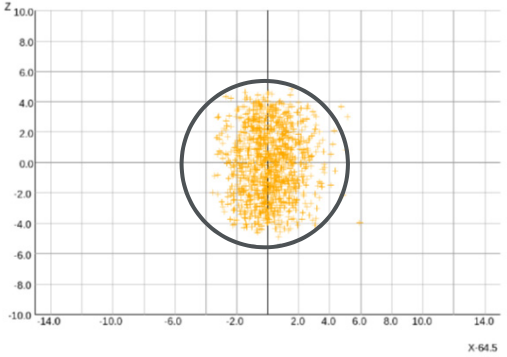
More information on poster session

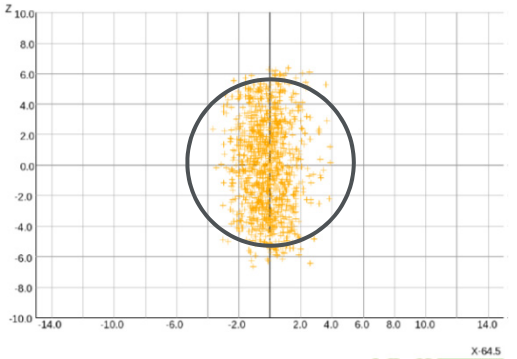


NOW

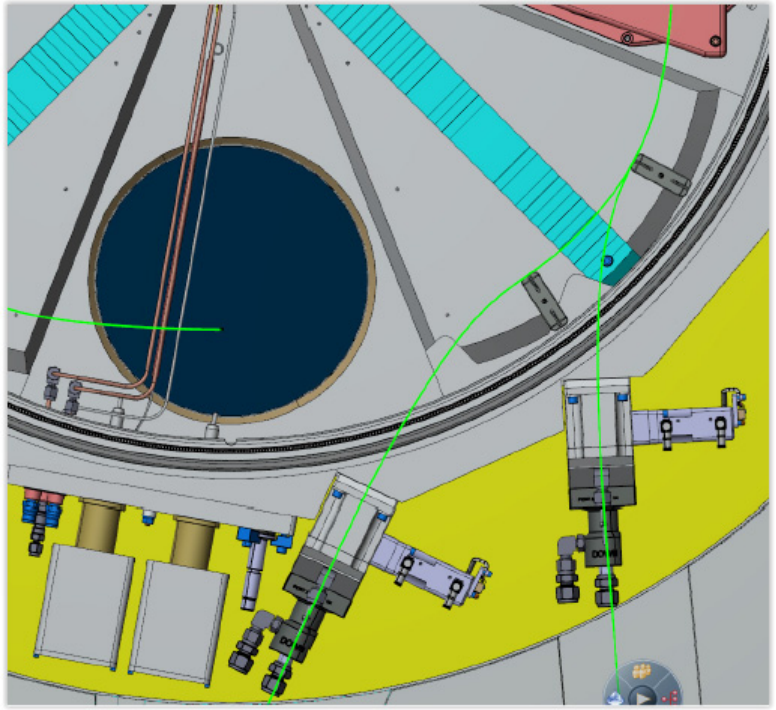


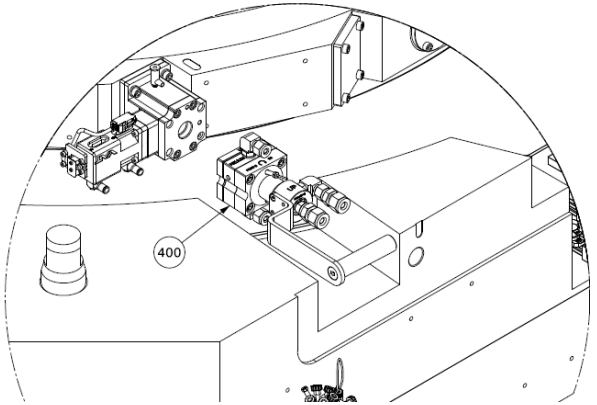
Previous

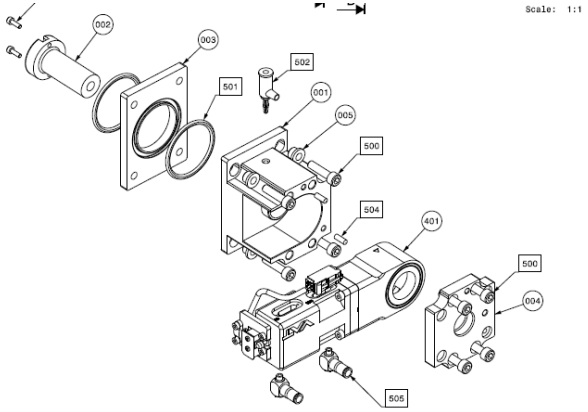




Target and vacuum box interface







FDG
& other $^{18}F^-$

$^{13}NH_3$

^{11}C- methionine,
raclopride, choline, acetate, …

^{15}O- H_2O,
CO, CO_2

Beam Line
Shielded doors

64Cu, 89Zr,
123I, 124I
…

^{99m}Tc

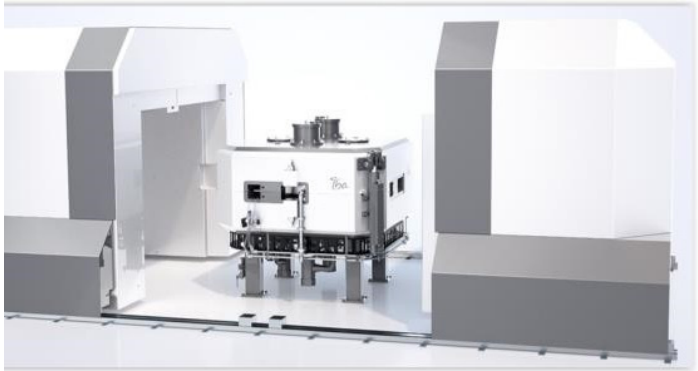
^{68}Ga- PSMA,
dotanoc, dotatate

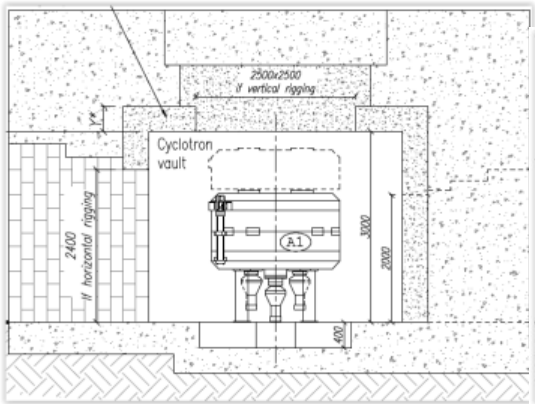
More COMPACT – less constraints on building

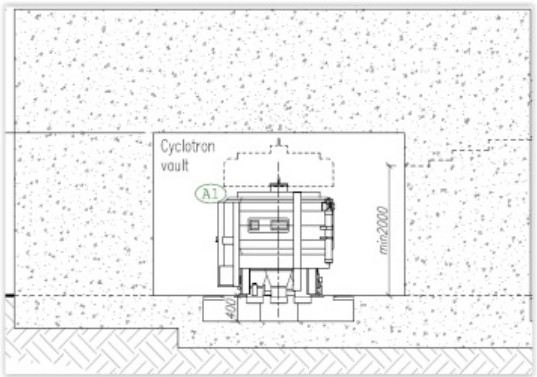
- Top of yoke: 1.6m (vs 2.2m)
- Vault height: 2.5m (vs 3m)

- Self-shield available

RadioPharmacy <100m²

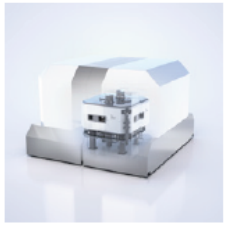






EVOLUTIVE CYCLOTRON

CYCLONE® KIUBE WITH SELF-SHIELDING OPTION



10Ci* 100 µA | **16Ci*** 150 µA

UPGRADABLE

CYCLONE® KIUBE WITHOUT SELF-SHIELDING OPTION

10Ci* 100 µA | **16Ci*** 150 µA | **20Ci*** 180 µA

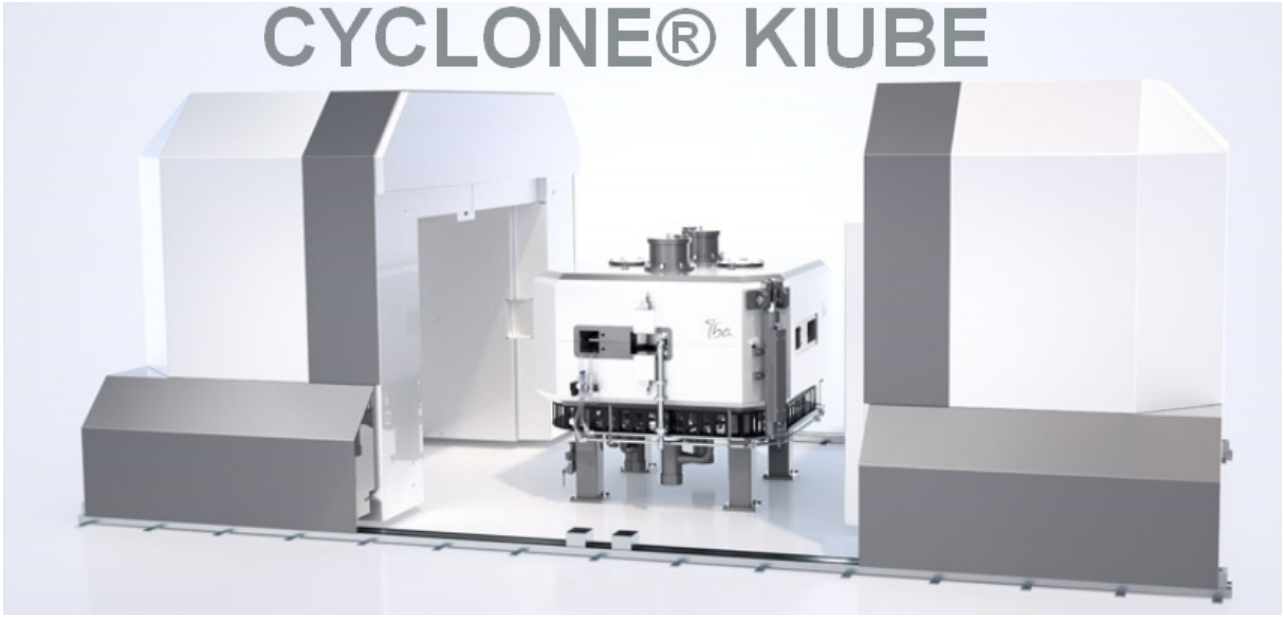
UPGRADABLE

*Curies of $^{18}F^-$ in 2 hours run

Production status

- Prototype in installation in customer vault in Belgium for full beam validation (customer beam license – few weeks)
- 2nd unit in assembly hall for test
- 3rd machine in assembly
- Next units in production (one/month delivery schedule)

CONCLUSIONS



SHIELDING	SIZE	MAINTENANCE	ACTIVITY
yes	smaller	less	more

Thank you ! Questions?