IBA Accelerator Group R&D projects overview

Thomas Servais – Accelerator Group Engineering Mgr

… on behalf of the team

OUTLINE

- Once upon a time… and now !
- Projects overview
- How it impacts the organization ?
- What’s next ?

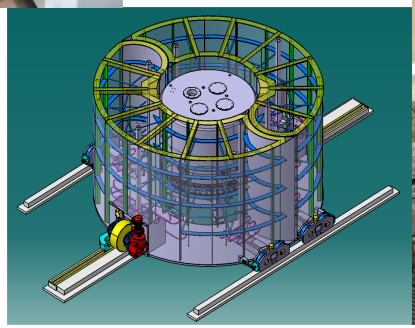
CYCLOS… A FAMOUS BELGIAN STORY

A WHOLE TEAM @ IBA

3 « HARD » YEARS…

3 years !

Many projects…
… and a lot of
Efforts
Process
Challenges
Issues
And… BENEFITS !!!



CYCLONE 3 – OSAKA HOSPITAL

Purpose

- O_{15} production (4.5^{e}6 Bq/min) for cardiac diagnosis

Tech. Spec.

Energy & current:
3,4 MeV
55µA D^- on target

Metrics:
1m*1m*1.6M, 5 tons

RF:
28.8 MHz, 17 kV, H2
Auto-oscillator

Magnetism:
AVG 1.9T
3 spiraled sectors
Low flutter

Extraction:
ESD (+cooled pre-septum)
Target bolted on VC

CYCLONE 3 (2)

Challenges

- 12 months from T0 to delivery on site => Project mgt + standardisation + PARTNERSHIP
- Beam dynamics & Energy upgrade => Spiraled sectors + yoke design optimisation + mapping improvement
- « High » current extraction => accurate extraction simulations

Issues

- RF stabilisation (thermo-mechanical effects) => Measures, mechanics and expertise !
- Septum lifetime & set-up => cooled pre-septum
- Fukushima earthquake ! => Just wait…

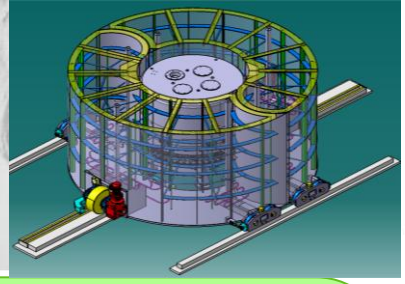
Benefits for future

- « High » current extraction by ESD
- How to handle with compact systems
- How to « design to cost » with a prefered partner !

CYCLONE 3 – STATUS

December 2011 – machine accepted, under warranty !

CYCLONE 11 – HTA, TIANJIN(CHINA)



Purpose

- **FDG production adapted to Chinese market (=> Self shielded)**

Tech. Spec.

Energy & current:
11 MeV
2*50µA H^- dual beam
on target

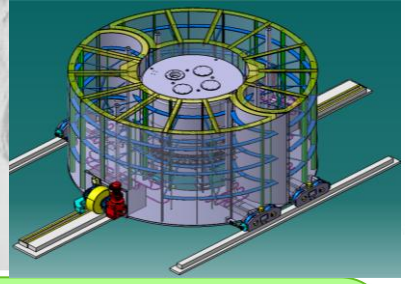
Metrics:
OD 1.55m, 13 tons

RF:
43 MHz, 35 kV, H2
Standard Cyclone18
RFchain

Magnetism:
2.1T hills, 1T valleys
4 sectors
Deep valley, high flutter

Extraction:
Stripping – 8 ports
Target bolted on VC

CYCLONE 11(2)



Challenges

- 12 months from T0 to delivery on site => Project mgt + standardisation
- Self shielding cost reduction (50%)=> Concurrent engineering with chinese supplier
- Start from existing Cyclone10/5 yoke => Valleys filling plates
- Low margin project => cost driven decisions

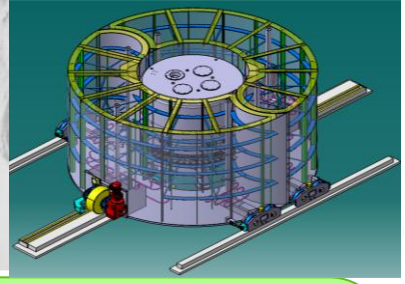
Issues

- Site installation in China – langague, skills, goals, … => R&D OPS organisation
- Vacuum is critical => simulations + bigger pumps
- Beam centering => mapping accuracy & sectors positioning improvement

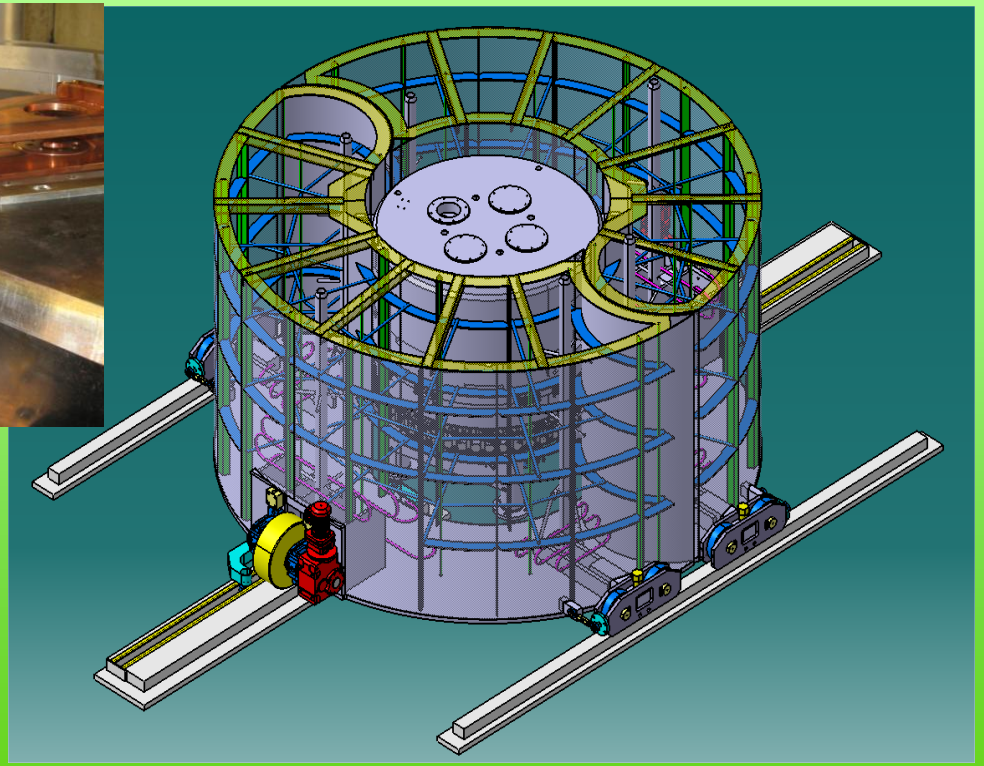
Benefits for future

- Use of « fleet leader » assets, standardisation
- New Self shielding materials
- R&D OPS organisation
- 3 other sales, access to chinese market !

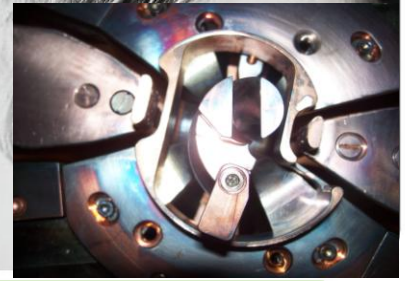
CYCLONE 11 – STATUS



October 2011 – machine accepted, under warranty !



CYCLONE 30HC – TAEK, ANKARA



Purpose

- Isotope production (Ta, Ga, I, F18) + Fusion material applications + Targetry dev.

Tech. Spec.

Energy & current:
30 MeV
2*500µA H^- dual beam on target
1.2 mA H- on BTL beam dump

Metrics:
OD 2.7m, 47 tons

RF:
66 MHz, 50 kV, H4
Dehnel external IS, axial injection, improved inflector

Magnetism:
~1T field
4 sectors
Deep valley, high flutter

Extraction:
Stripping, variable energy from 15 to 30 MeV
BTL

CYCLONE 30HC(2)

Challenges

- Starting from existing Yoke => Project mgt + Simulation
- 16 months from T0 to FTPR => Project mgt, dedicated team, standardisation
- High current injection => Space charge (PSI collab ?), new inflector, bunching optimisation, injection line as short as possible

Issues

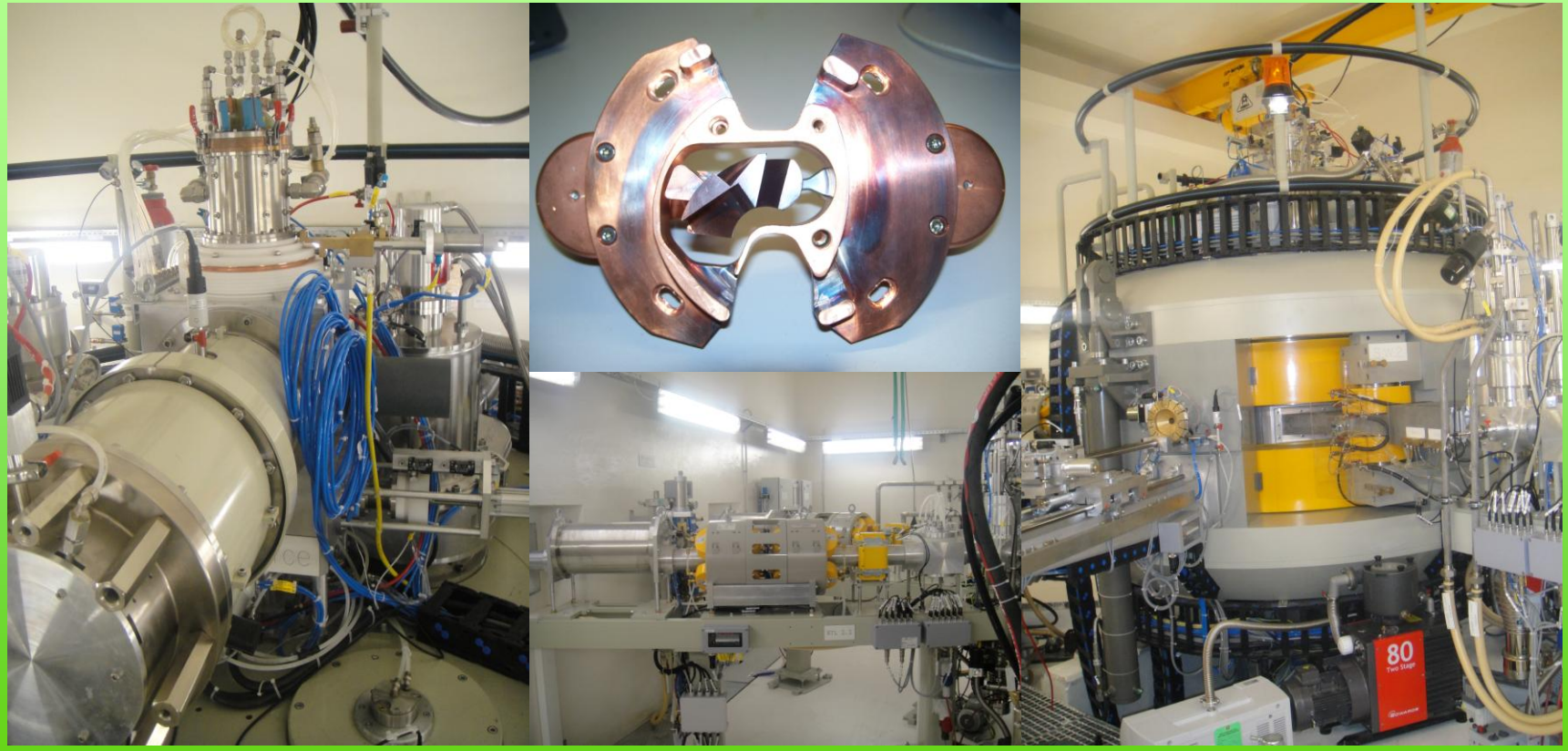
- Source vacuum=> Tests , simulations and optimisation
- Electrical instabilities due to ISPSU bad H5 filtering (between converter and PSU) => Trouble shooting + filtering

Benefits for future

- High current injection & transport
- Axial injection optimisation
- Stripping & vacuum simulation for axial injection

CYCLONE 30HC – STATUS

April 2012– machine accepted, under warranty !



CYCLONE 30XP – JULICH (GERMANY)

Purpose

- R&D on targetry + Astatine 211 production + other « classical » isotopes

Tech. Spec.

Energy & tgt current:

15-30 MeV H^-, 350µA

7.5-15 MeV D^-, 50µA

30 MeV He^{++}, 50µA

Metrics:

OD 2.7m, 47 tons

RF:

33-66 MHz, 50 kV, H4&2

Culham + PanTechnik

external IS, bottom-up axial injection

Magnetism:

4 sectors, azim. variation

Deep valley, high flutter,

Additionnal gradiant correctors

Extraction:

Stripping, variable energy from 7.5/15 to 15/30 MeV

Easy removable ESD

Flaps & HC

BTL

CYCLONE 30XP(2)

Challenges

- 3 particles starting from existing Yoke => Simulation, simulation & simulation…
- RF dual frequency system => Michel Abs expertise + strong supplier involvement
- Easy removal ESD => Cyclone 70&230 experience
- Source bench under the machine => 3D Cad analysis

Issues

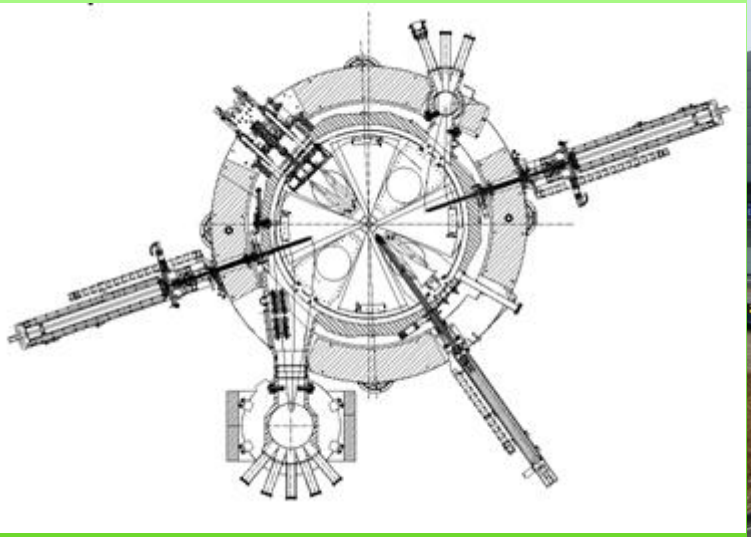
- Resonnance crossing => Simulation for azimuthal sectors variation, additionnal gradient correctors & flaps design
- ESD, high voltage insulator sparks => Redesign ongoing… based on ES simulations

Benefits for future

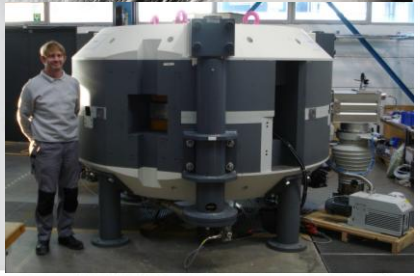
- One more RF challenge… prior to S2C2
- Resonnance crossing management… prior to mapping.
- Multi-particles « design methodology »
- Safer ESD systems design

CYCLONE 30XP – STATUS

April 2012– machine factory tested & rigged !



S2C2P



Purpose

- To become the « source of protons » of the new IBA Proteus1®ProtonTherapy System

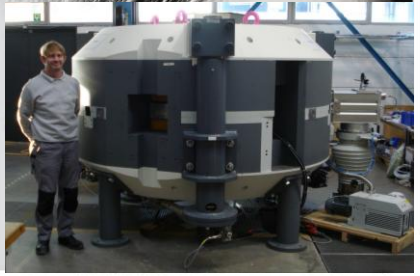
Tech. Spec.

Energy & current:
230-250 MeV H^+
20 nA avg @nozzle,
1kHz pulsed beam
Metrics:
OD 2.5m, 48 tons

RF:
90 to 60 MHz, 11kV
IBA internal IS radially inserted
Magnetism:
5.6T avg, 7.2T peak field,
NbTi, Dry cooled
No sectors

Extraction:
Self extracted, passive elements

S2C2P (2)



Challenges

- First IBA real superconducting magnet => ASG as partner, expert training (MIT), …
- First S2C2 => **AIMA partnership**, dedicated PhDs to adapt internal tools
- RF: variable f and ROTCO => M.Abs again, AIMA & Aero experts in rotating machines
- Self-extracted => just to lock one ww expert in-house
- IS compatible with PBS requirements => AIMA + test bench&campaign + expert
- First IBA Search Coil mapping system => « Hot » tests, expert dedicated, redundancy…
- Cost divided by a factor … *censored* ! => Concurrent engineering with suppliers

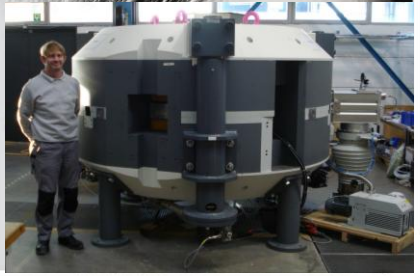
Issues

- Cold mass vs magnetic/shielding structure => Tests, ASG expertise, simulation… ongoing
- Physics underestimated => AIMA sponsoring + internal sponsorhip

Benefits for future

- To become the rationnaly one of the most performant light PT system.
- To definitively enter the SC magnet world !!!

S2C2^{P}– STATUS



May 2012– magnet cooled, magnetization optimization!

A DEDICATED & ORGANIZED TEAM !

Team & Project Mgt

Physicists

Develop& compute numerical/physics models

Field support

System Owners

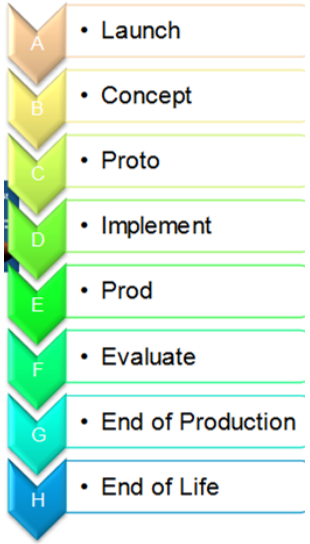
Manage technologies through an accelarator

Tech. Owners

Manage a technology through several accelerators

DEDICATED & ORGANIZED PROCESS !

- Stage gate
- Monthly review & dashboards with all stakeholders
- Roadmaps, Product release plan & maintenance release



TRY TO STAY « LIGHT AND FOCUSED »

R&D projects symptoms

- *Risky*
- *Intense*
- *Innovative*
- *Shorter and shorter*
- *Numbers of uncertainty*
- *Erratic (back & for)*

R&D Operations

Senior R&D Engineer
Assistant
Skilled FE
Skilled Fitter
Sourcing
…

R&D projects needs

- *Close follow-up*
- *Needs of experts*
- *Enthousiasm & creativity*
- *REACTIVITY*
- *Specific « light rules » to quote, supply, check, assemble & test*
- *Involved people from beginning to the end*

- **Fast tracked RFQ (one quote !, light spec, …)**
- **Place orders**
- **Visit & check material with the supplier (local)**
- **Order for complete subsystems**
- **Assemble with minimum support**
- **Test with limited support**
- **« doesn't count his hours »**
- **…**

ALONE…NOTHING IS POSSIBLE !

From Design to Manufacture : C3

Flexibility

Scope
- Design update + drawings
- Manuf. + assembly (magnetism, Vacuum & RF)

Schedule
- Design +drawings : 2 months
- Manuf : 5 weeks

Costs savings

Quality
- IBA CAD system not directly supported

From Design to Manufacture : Self Shielding

Productivity Innovation

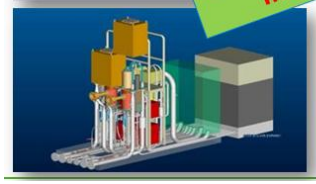
Scope
- Physics computation achievable
- Strong concurrent engineering (from mechanics to 'concrete 'job)
- Manuf. + assembly

Schedule
- Design +drawings : 2 months
- Manuf : 6 months (4 easily achievable)

Costs savings

Quality
- Nothing major up to now (final comissioning on site soon planned)
- Strong involvement from SQE team in China

From Design to Manufacture,Test & Indus : IFMIF



Flexibility Productivity Manufacturing Indus

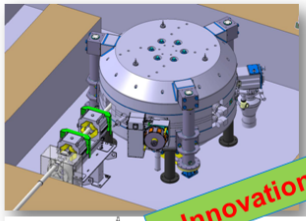
Scope
- Strong concurrent engineering (dimension change, material change, …)
- Design modif in CATIA
- Manuf. + assembly + mechanical tests

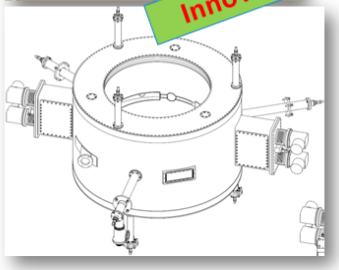
Schedule
- Proto in 5 months, 4 per quarter for serial production
- Not strategic for our manuf

Costs savings

Quality
- Nothing up to now

From Zero to $S_2C_2^p$: ASG & AIMA





Innovation

Scope
- Design + drawings for superconducting coils
- Physics computation for SC
- Concurrent engineering
- Manuf. + assembly + final test

Schedule
- 2.5 years for proto acceptance

Costs savings

Quality
- Strong Project Management required

WHAT'S NEXT ?

- S2C2 tuning and industrialization ?
- Drastic improvement of existing product line ?
- New super-conducting applications ?
- New Research projects with academic partners ?
- Open Innovation paths welcomed…

PAUL SCHERRER INSTITUT PSI

Université catholique de Louvain UCL

Massachusetts Institute of Technology

SCK·CEN STUDIECENTRUM VOOR KERNENERGIE CENTRE D'ETUDE DE L'ENERGIE NUCLEAIRE

CONCLUSION

We have a team !

We adapt R&D process !

We deliver !

We share !

WHAT ABOUT INNOVATING TOGETHER?

INTERNAL USE ONLY

iba