



CYCLOTRON 2007

**CYCLONE® 70
Project Development**

**Giardini Naxos, Sicily
October 2007**



We protect, enhance and save lives

INTRODUCTION

p **ARRONAX Project in Nantes**

« Accélérateur Recherche Radiochimie Oncologie Nantes »

p **FIRST OF A KIND @ IBA**

- n 70 MeV Proton & Alpha Particles
- n 750 μ A Protons à > 50kW Beam Power
- n Alpha Pulsing system
- n Universal target system

p **AMBITIOUS GOAL à 34 MONTHS**

INTRODUCTION

p INDUSTRIAL PARTNERS:



SCOPE

p CYCLOTRON:

- n Multi Particle
- n Variable Energy
- n High Intensity Protons
- n Dual Beam

Accelerated Beam	Extracted Beam	Extracted Energy (MeV)	Beam Intensity (eμA)	Exit Ports
H ⁻	H ⁺	30 - 70	750	dual
D ⁻	D ⁺	15 - 35	50	dual
⁴ He ²⁺	⁴ He ²⁺	70	70	single
HH ⁺	HH ⁺	35	50	single

SCOPE

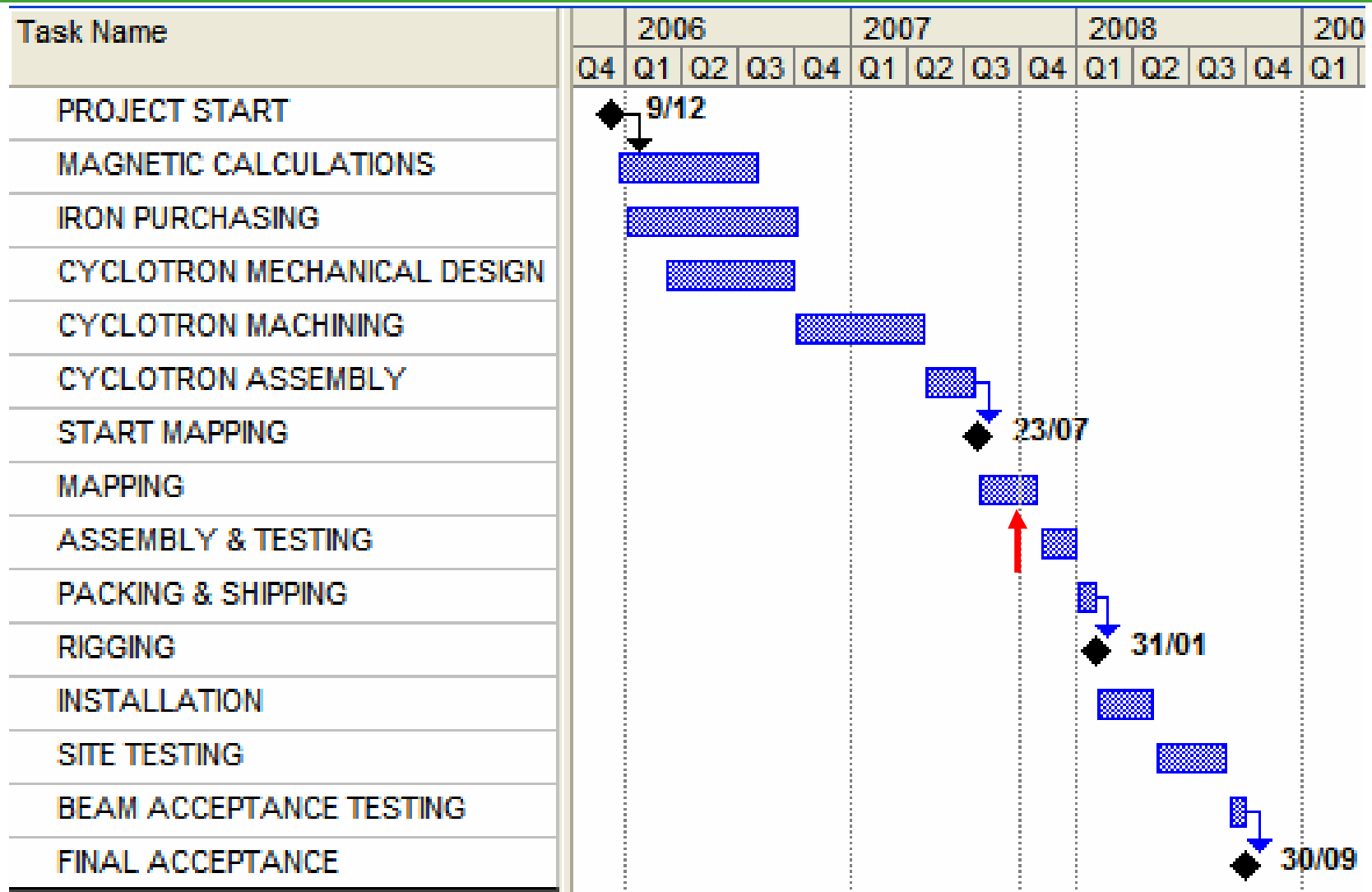
p BEAM TRANSPORT LINES:

- n 6 Lines**
- n 4 Solid targets**
- n Alpha pulsing device**

p CONTROL SYSTEM à SIEMENS S7 PLC

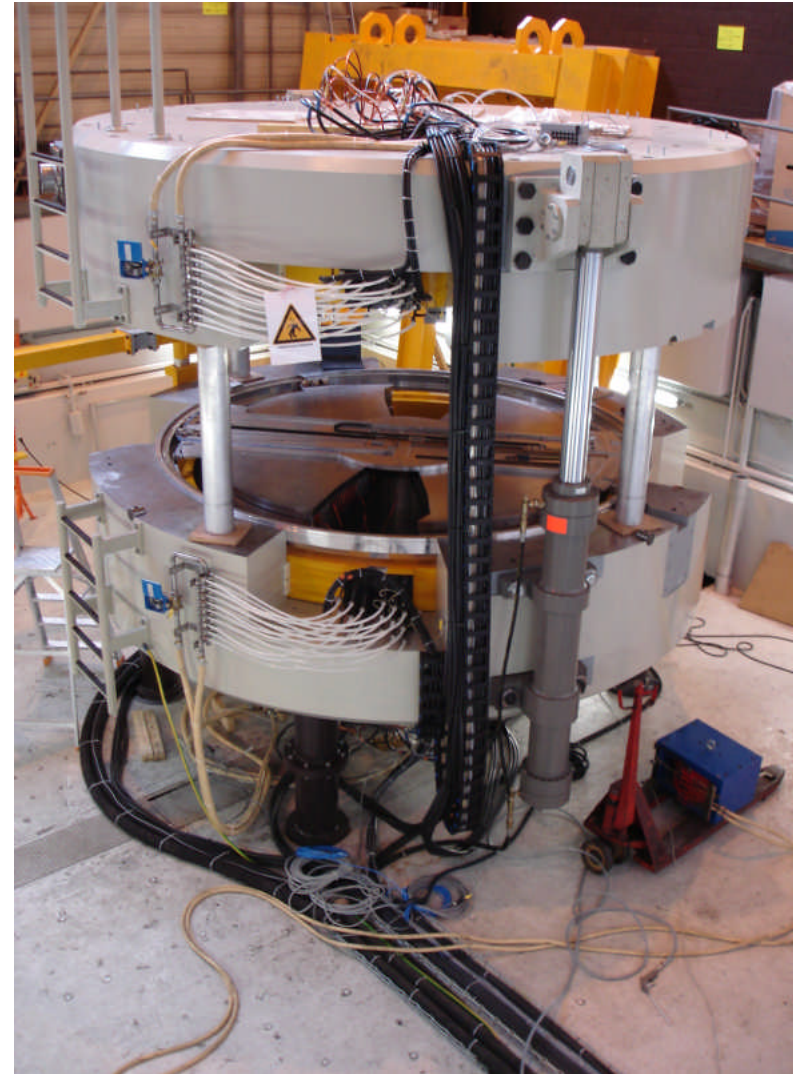
p USER INTERFACE à INTOUCH

PROJECT DEV. LIFE CYCLE



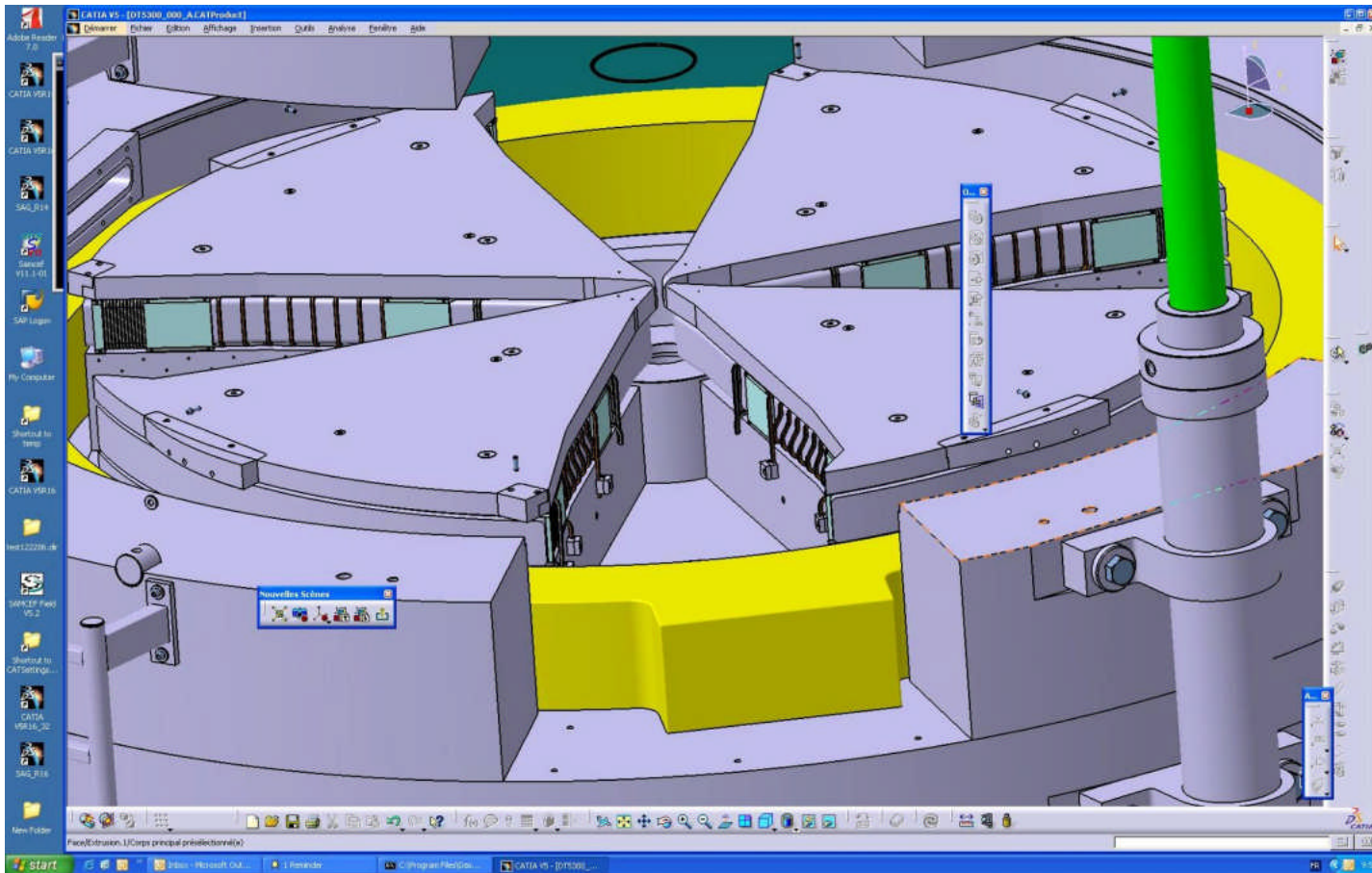
GENERAL DESCRIPTION

- ⌘ Diameter < 4m
- ⌘ Weight > 120t
- ⌘ Magnetic Gap:
 - ⌘ 30mm
- ⌘ Magnetic field:
 - ⌘ 1.55T
- ⌘ Extraction Radius:
 - ⌘ 1.2m

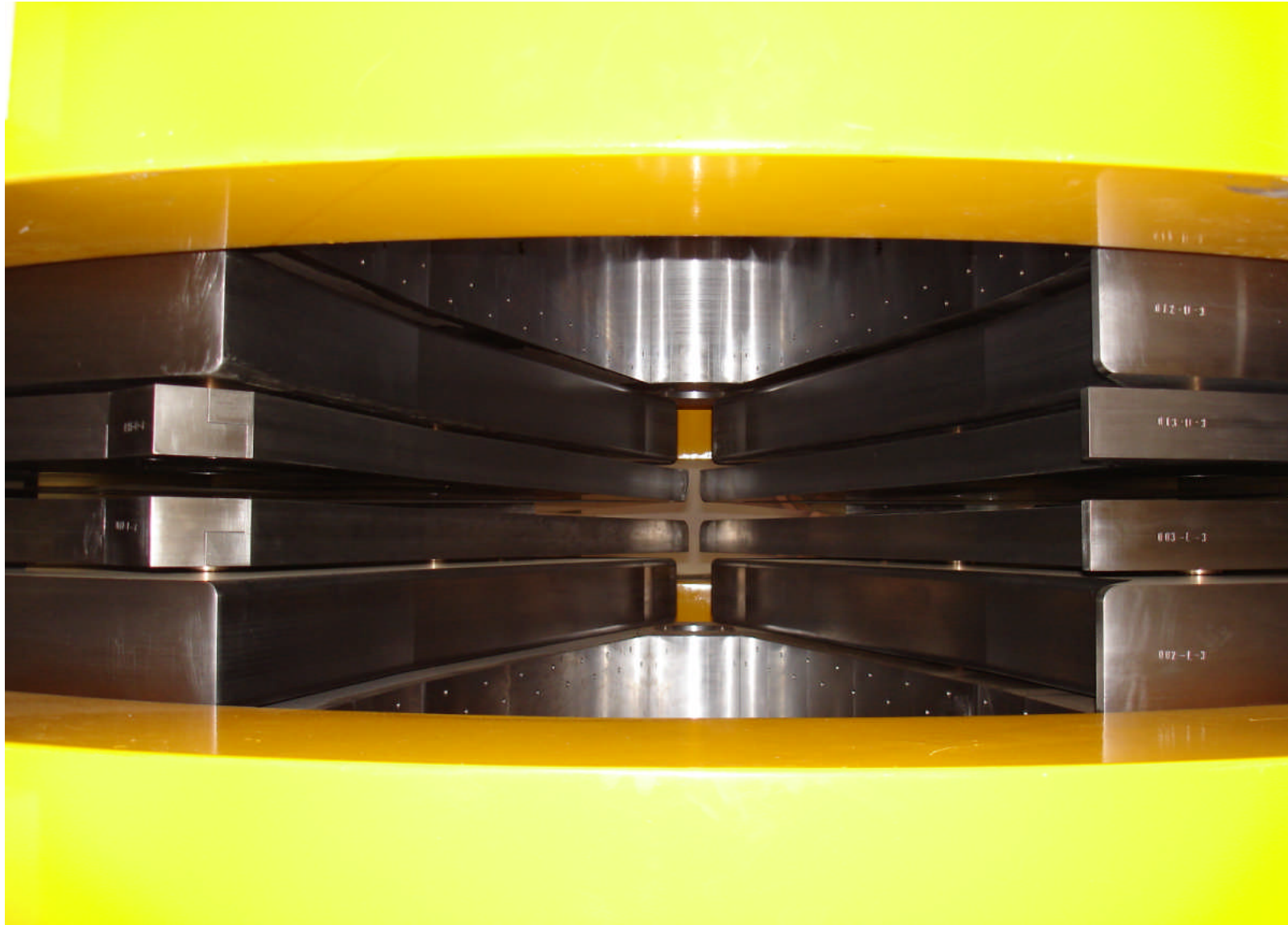


MAGNET STRUCTURE

- Unique 3 layer structure:
 - Sector / Pole / Cover

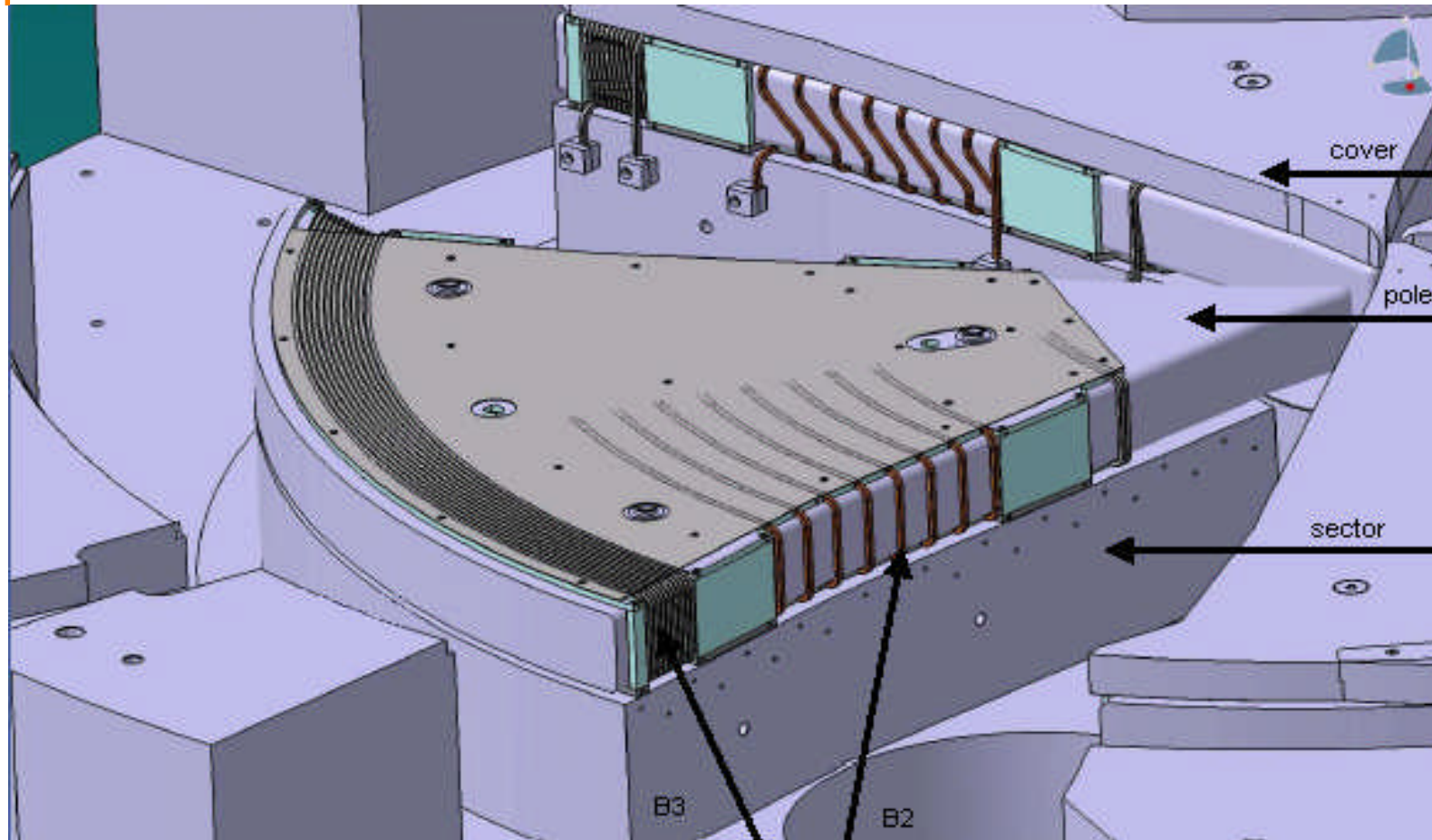


MAGNET STRUCTURE



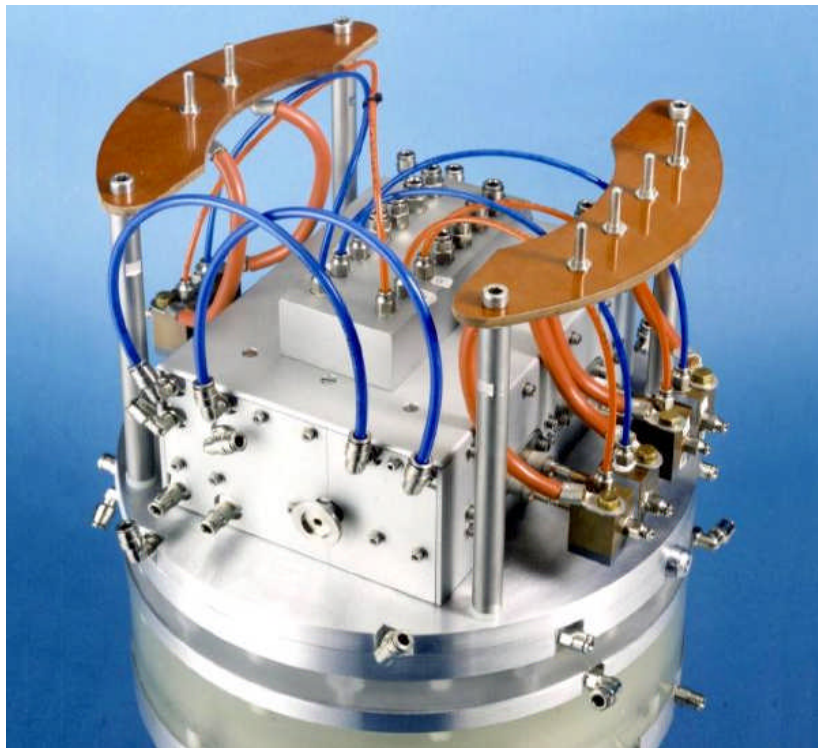
MAGNET STRUCTURE

⌘ CORRECTION COILS à ${}^4\text{He}^{2+}$

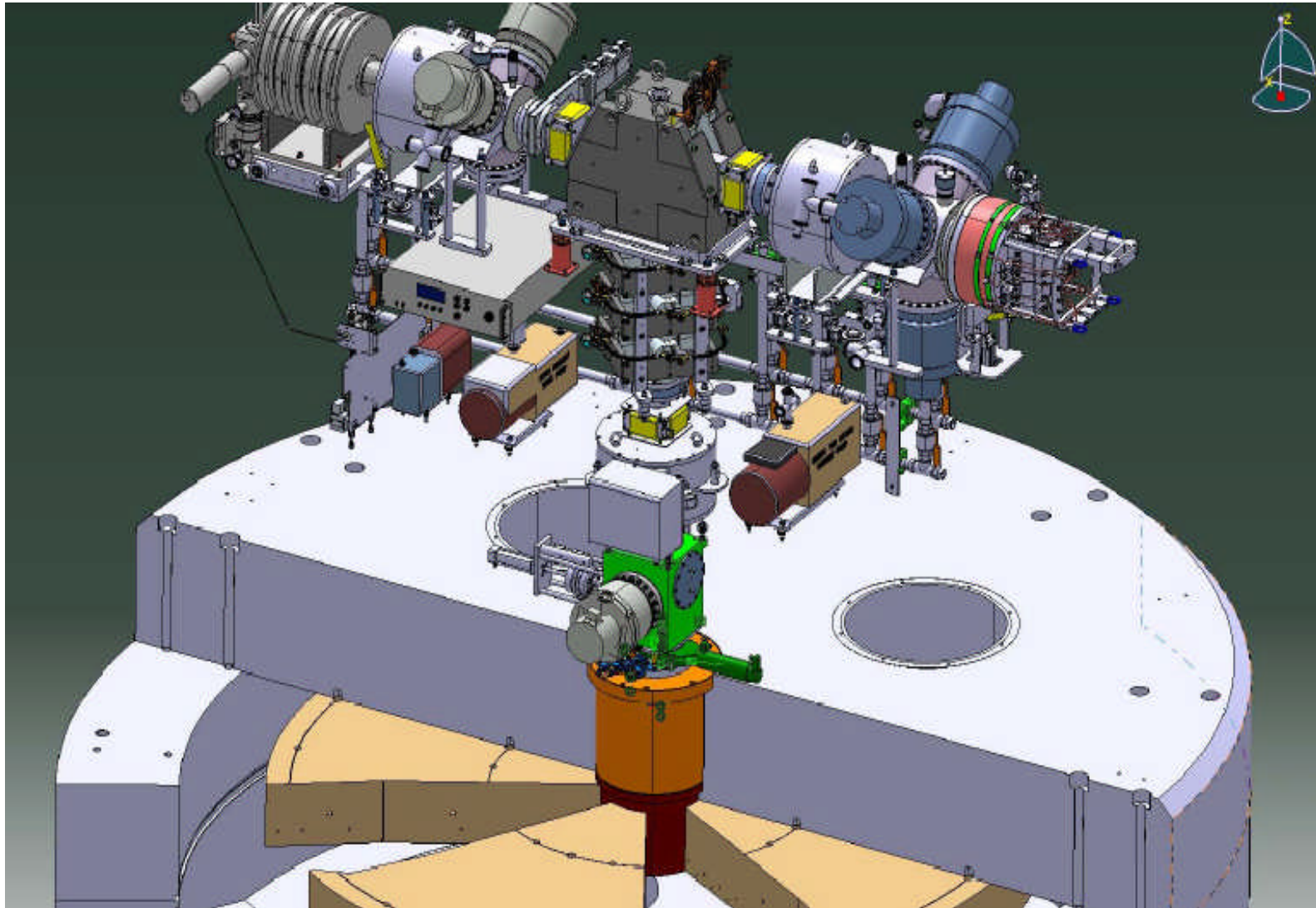


SOURCES

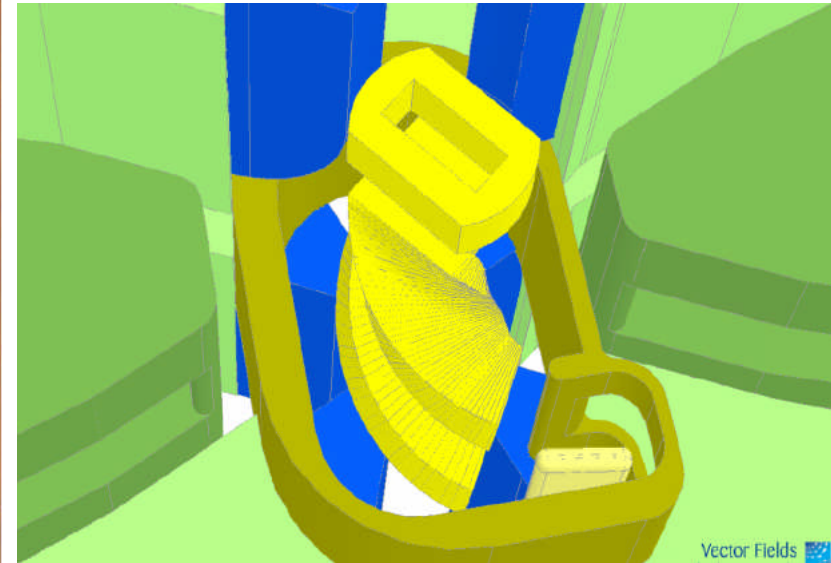
- ⌘ Multicusp Source à 8mA H⁻
- ⌘ ECR Source à 700µA ⁴He²⁺



INJECTION LINE



CENTRAL REGION

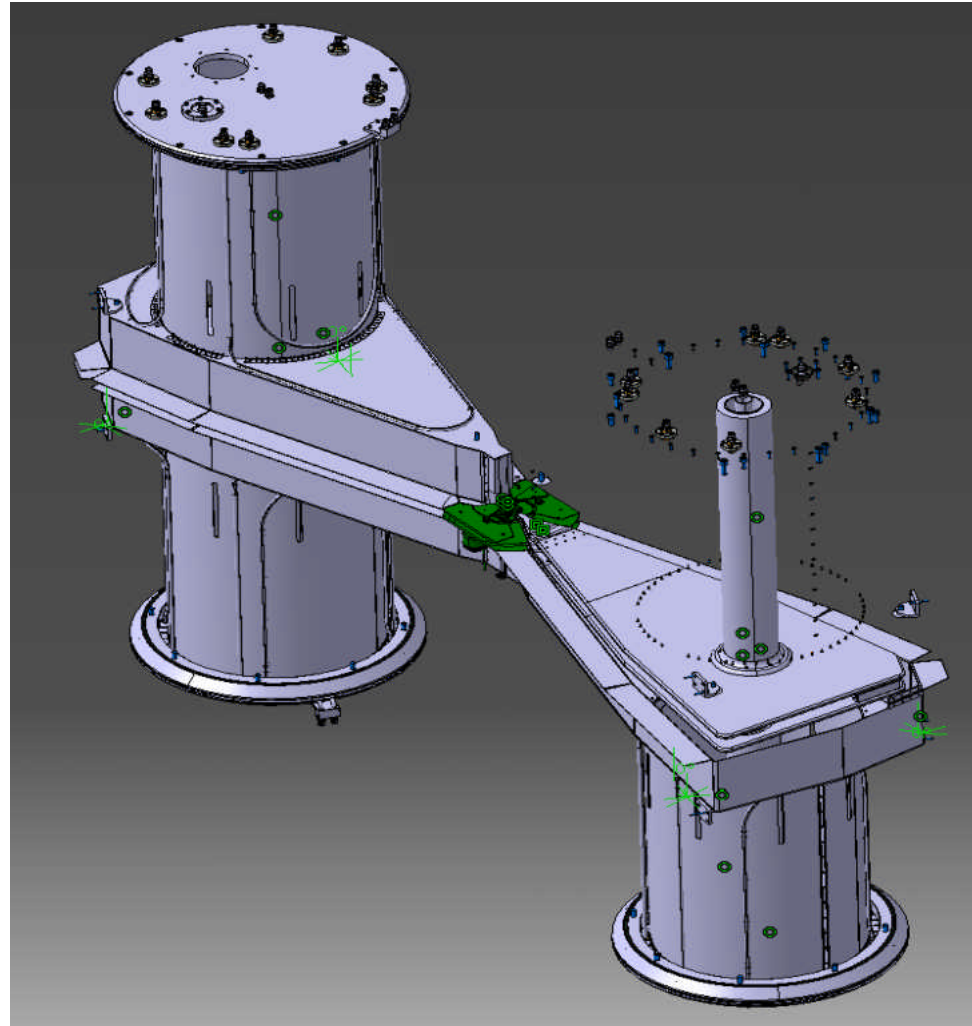


à **SPIRAL INFLECTOR**

à **COMMON FOR ALPHAS & PROTONS**

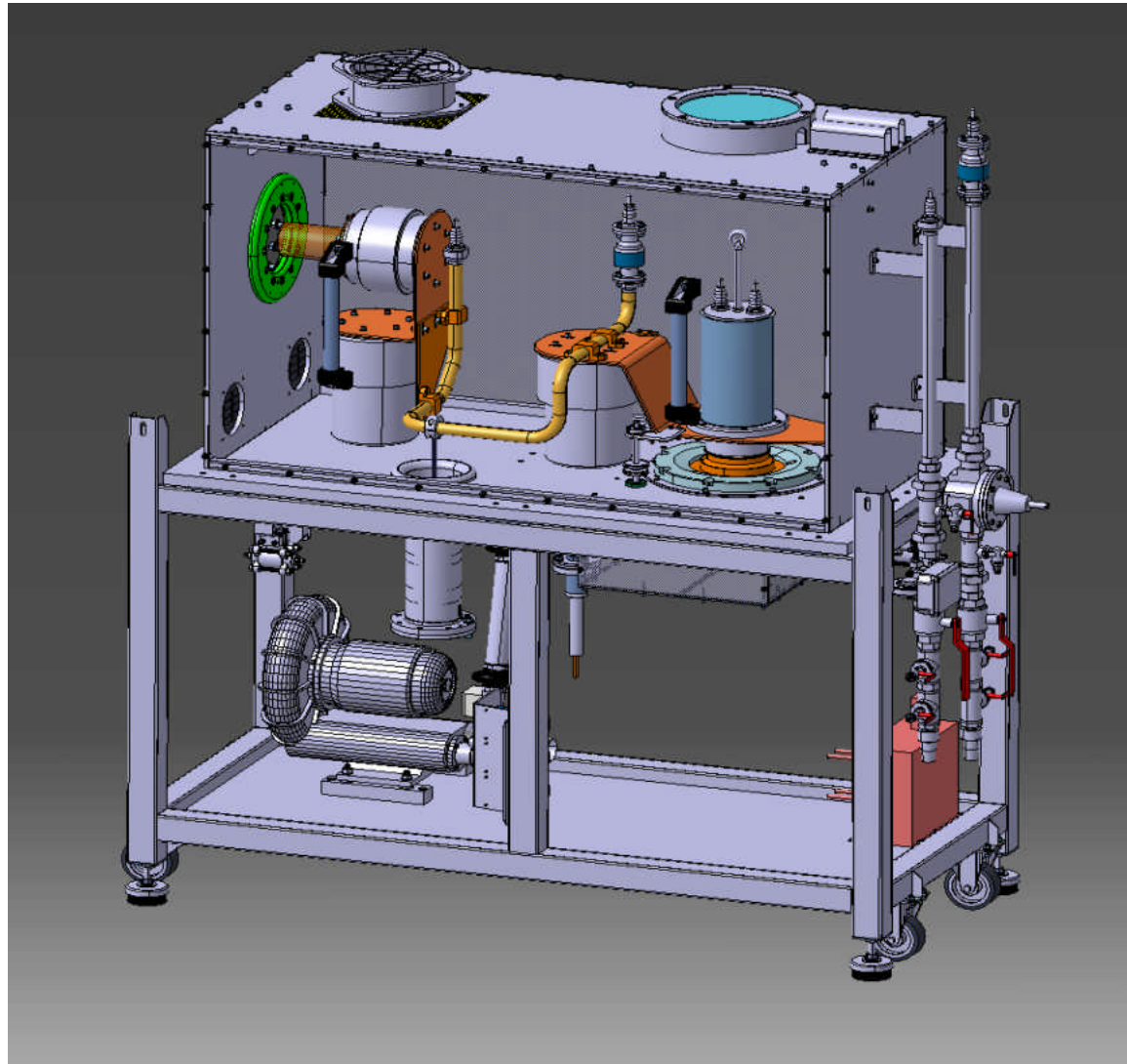
RF CAVITY

- ρ CST Model
- ρ 4 Pillars
- ρ 4 Accelerating gaps
- ρ DESIGN VALUES:
 - n $F \sim 30.4\text{MHz}$
 - n $V_{\text{dee}} \sim 65\text{kV}$
 - n $P_{V_{\text{dee}}} \sim 20\text{kW}$
 - n $Q \sim 8000$



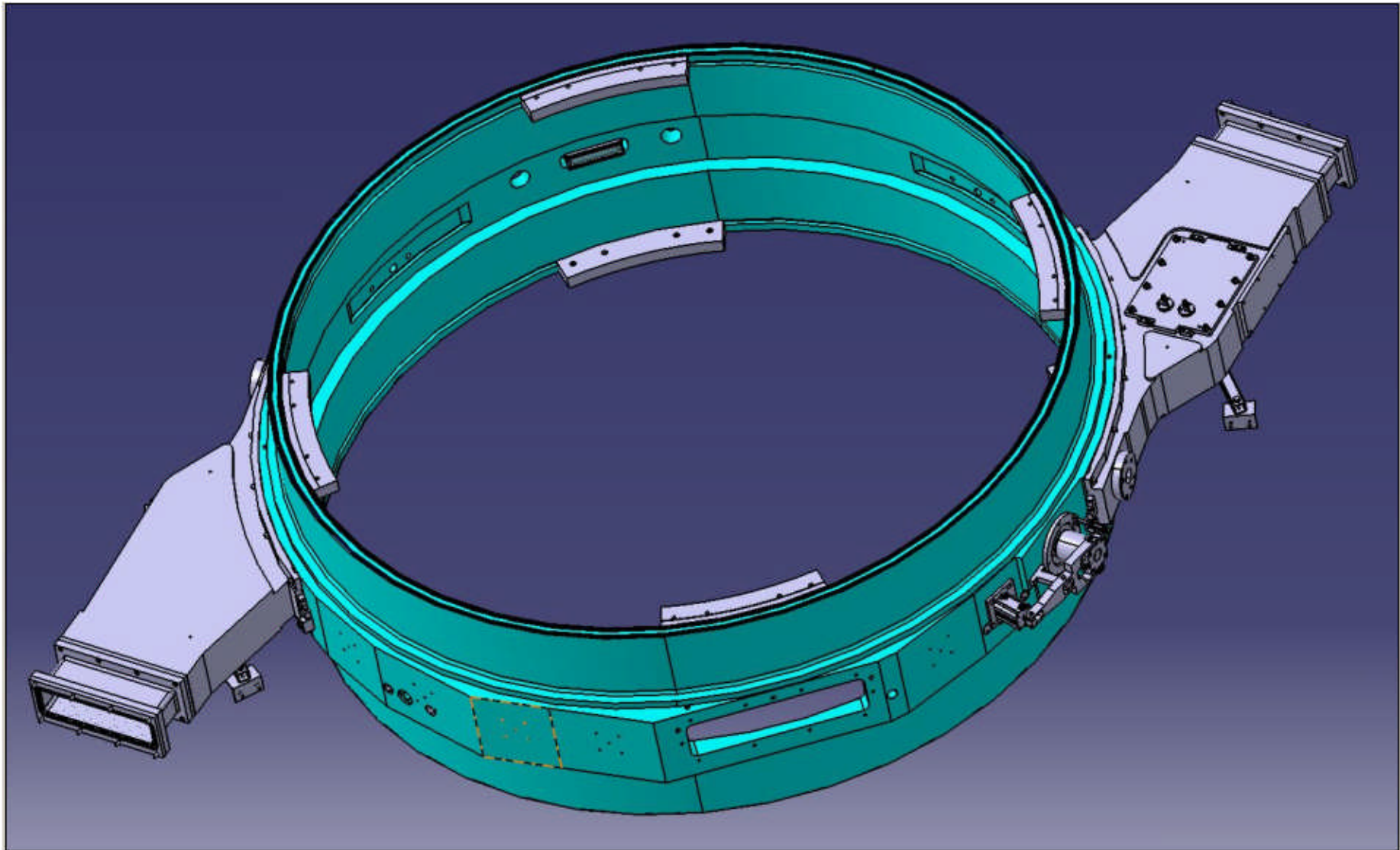
RF AMPLIFIER

- ⌘ 100kW
- ⌘ Thomson Tetrode

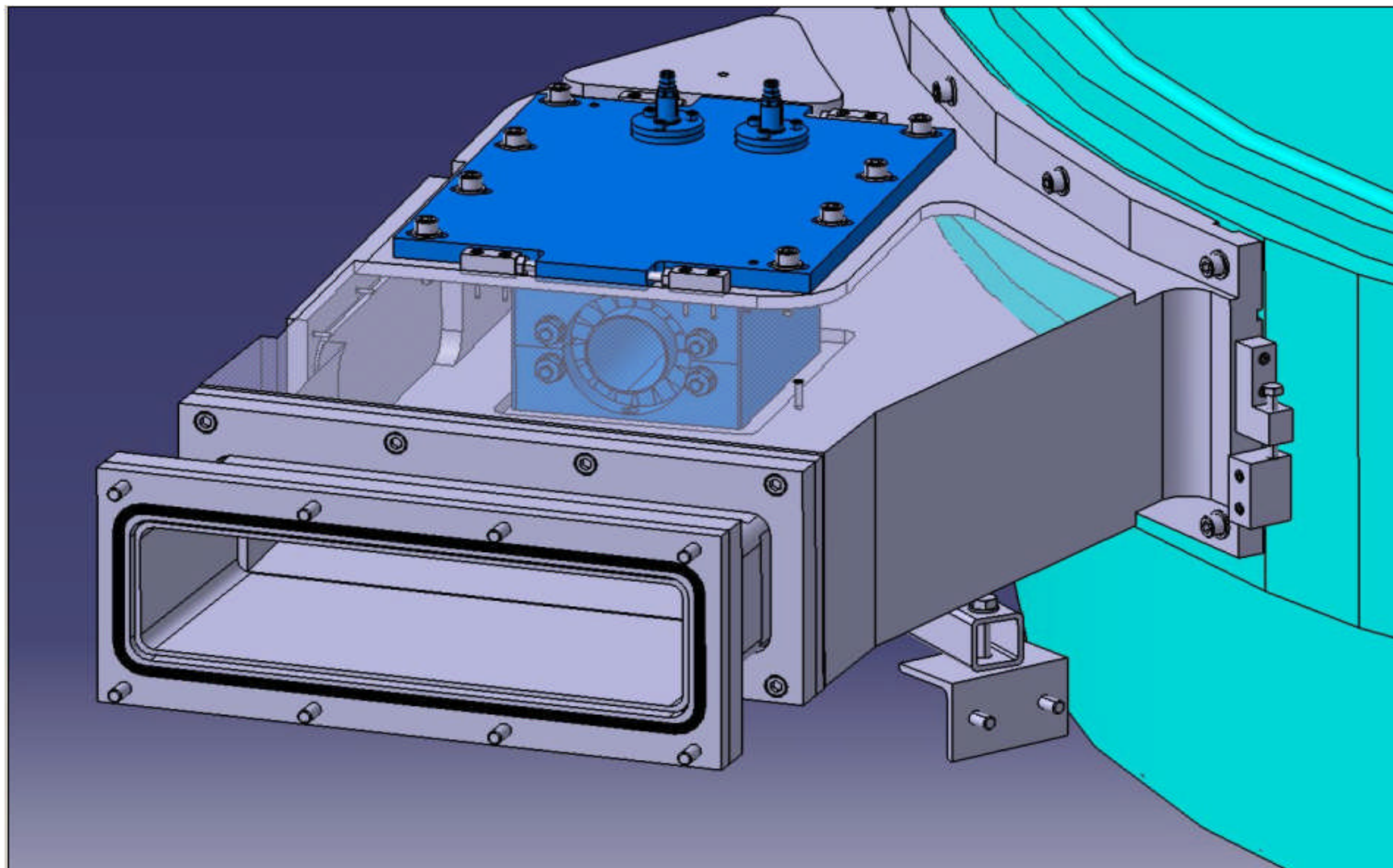


Iba

VACUUM CHAMBER

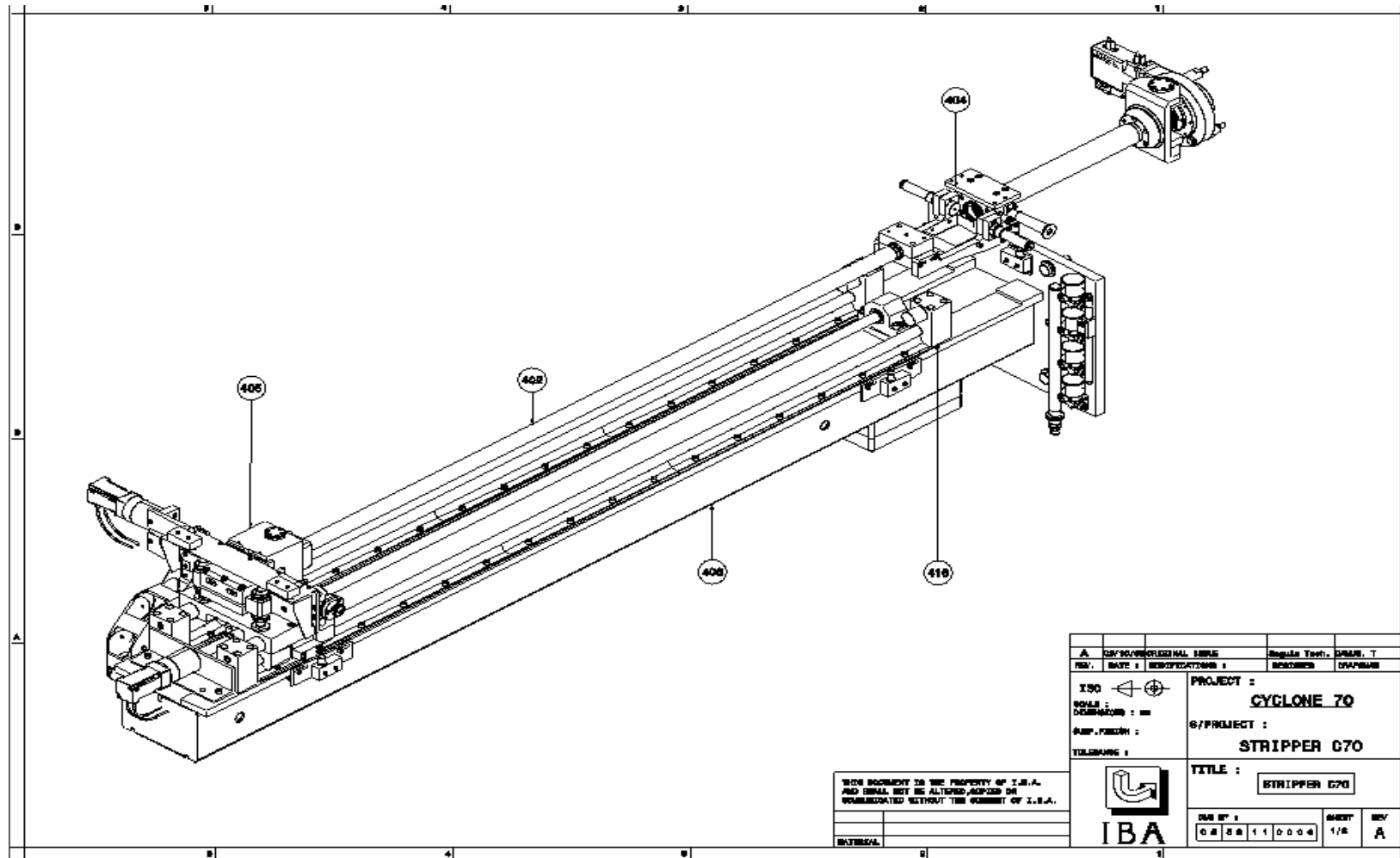


EXTRACTION CHAMBERS



EXTRACTION

p STRIPPING DEVICE à H- & D-



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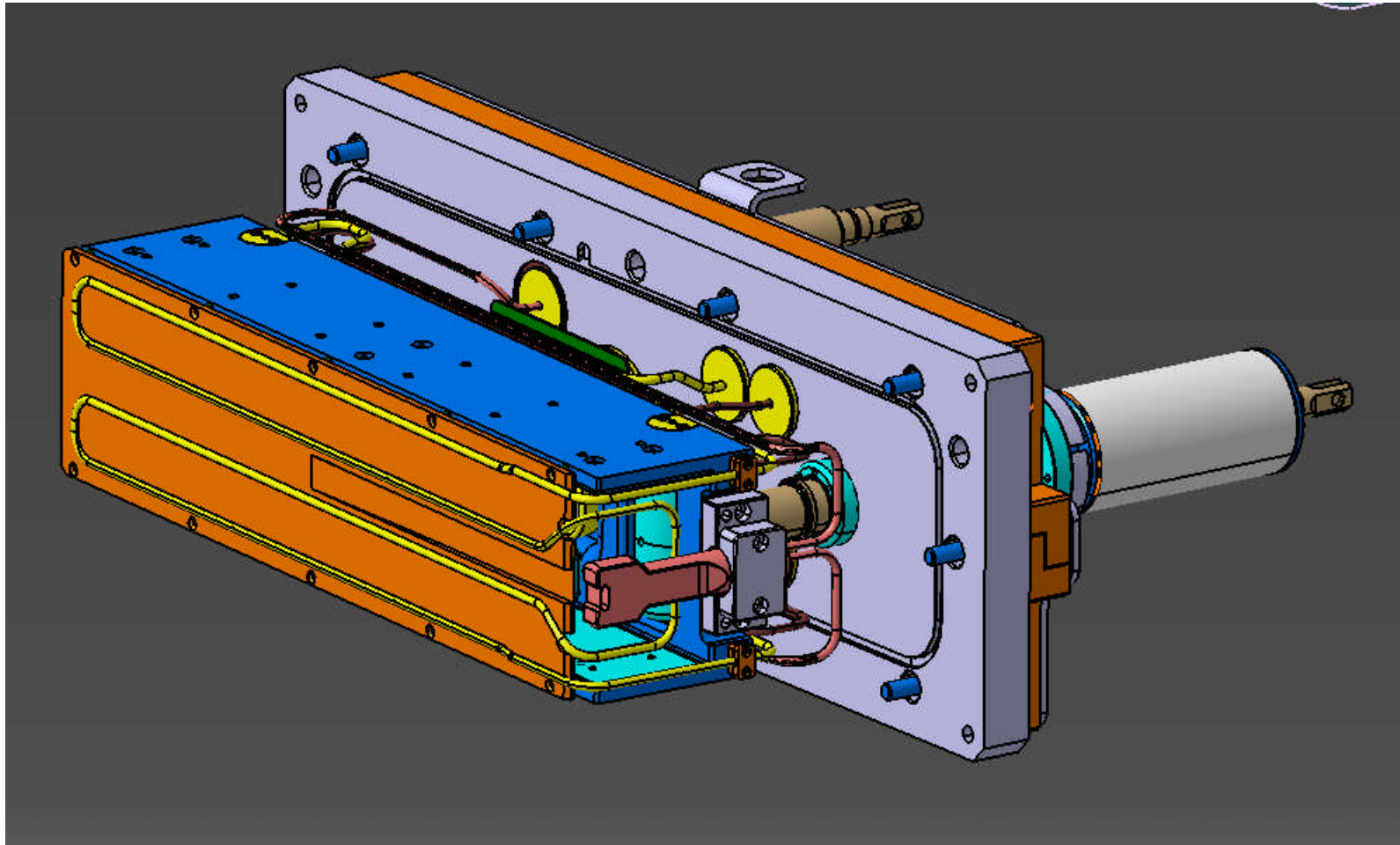
MATERIAL

A	DESIGN/PROFESSIONAL ENGINEER	Ingénieur Techn.	DRAGEN, T
REV.	DATE :	REVISÉ/REVISION :	DATE/REVISE
ISO		PROJECT :	CYCLONE 70
SCALE :	mm	G/PROJECCT :	STRIPPER G70
SUPP. FINISH :		TITLE :	STRIPPER G70
TELEPHONE :		DWG NO :	0000110000
		SHEET	REV
		1/8	A

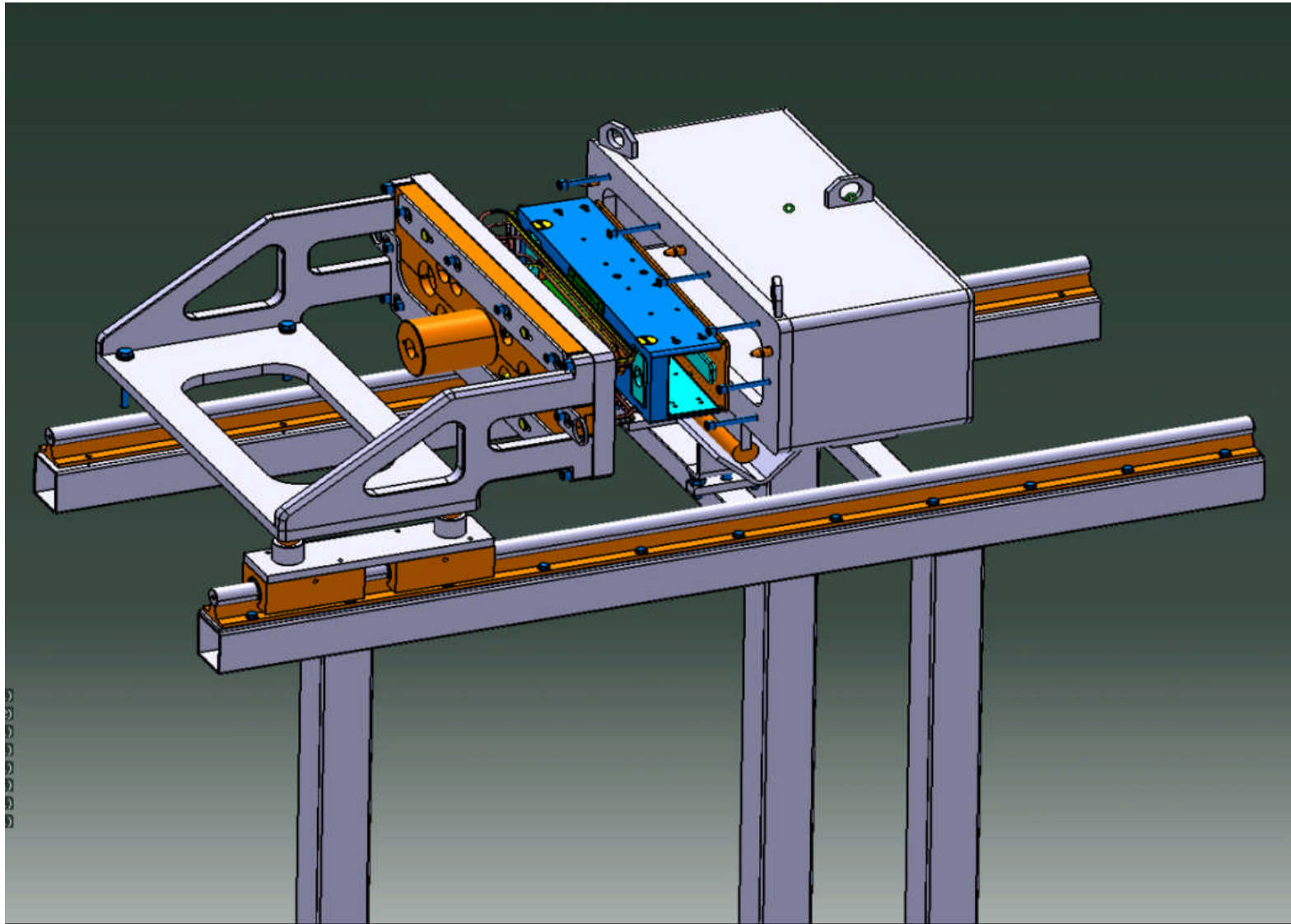


EXTRACTION

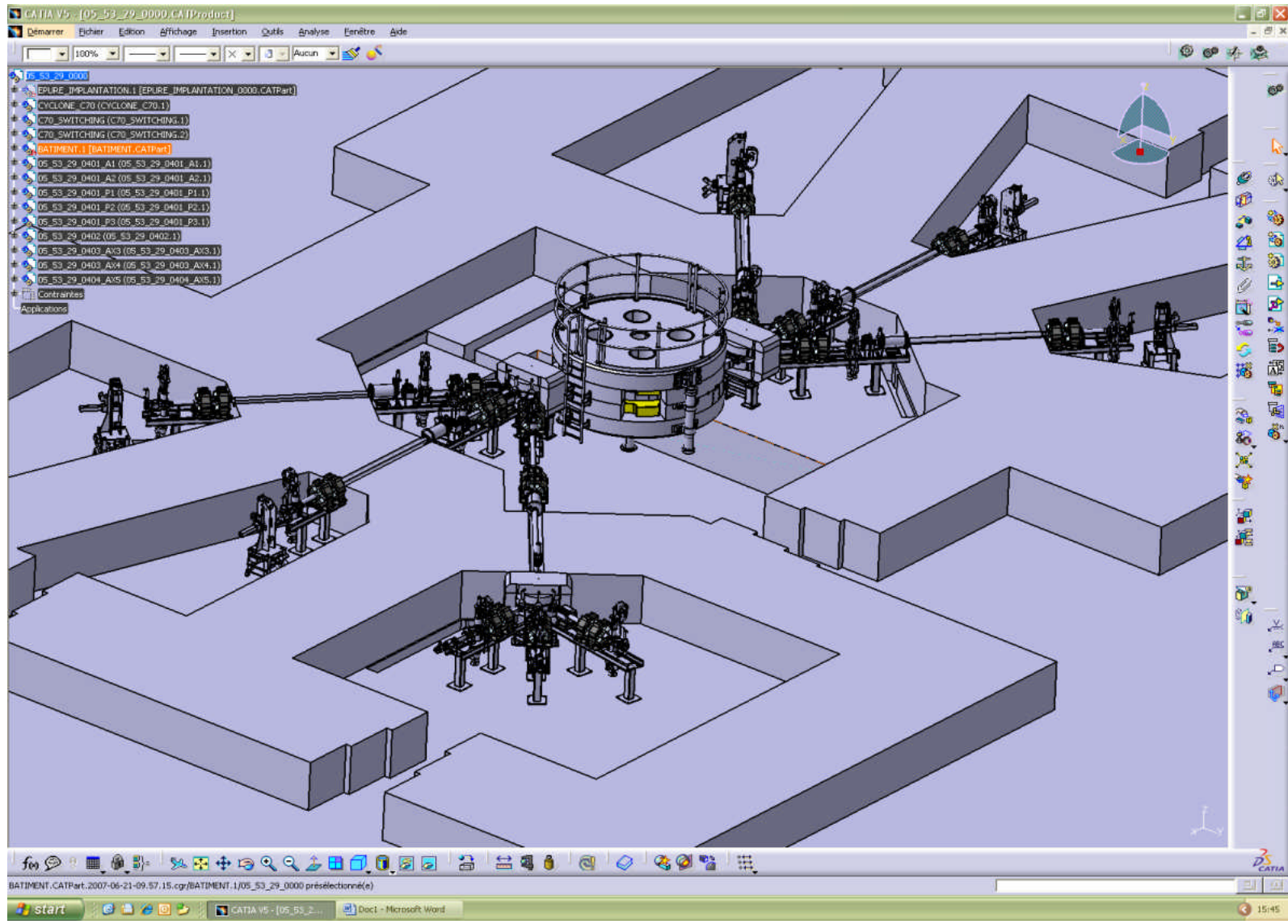
p ELECTROSTATIC DEFLECTOR à ${}^4\text{He}^{2+}$ / HH^+



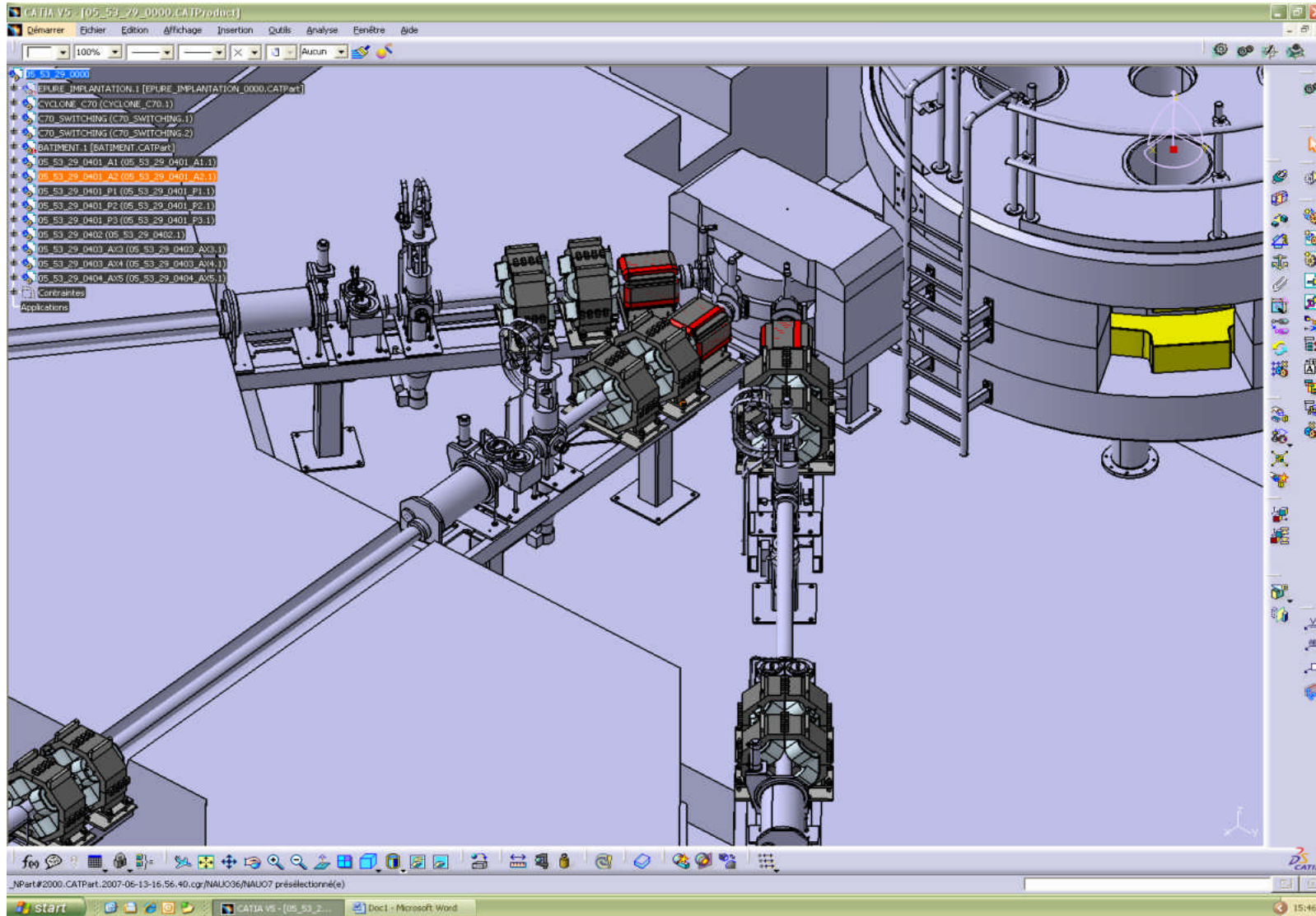
EXTRACTION



BEAM TRANSPORT LINES



BEAM TRANSPORT LINES

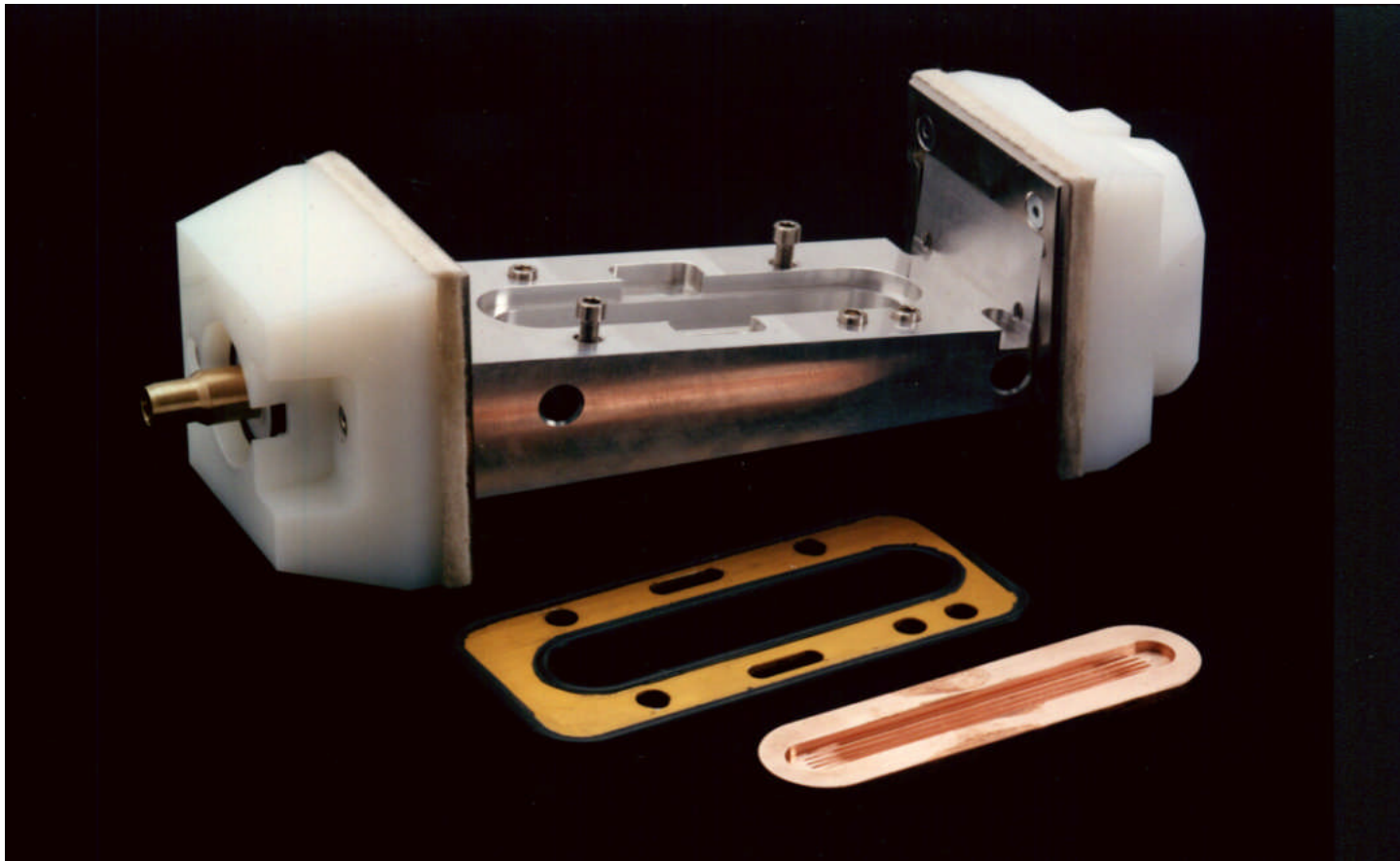


SOLID TARGETS

p RADIOISOTOPE PRODUCTION:

n SPECT à ^{201}Tl / ^{67}Ga / ^{111}In

n THERAPEUTIC à ^{211}At / ^{67}Cu



BUILDING

p BUILDING:

- n LENGTH: 40m
- n WIDTH: 28m
- n 10 000m³ concrete
- n 3 – 3.7m wide walls
- n 6 irradiation vaults
- n à DECEMBER 2007

BUILDING



BUILDING



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Thank-you...

