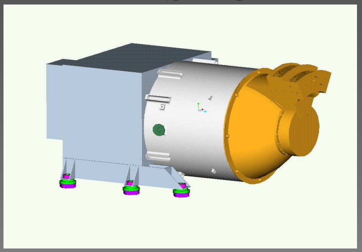


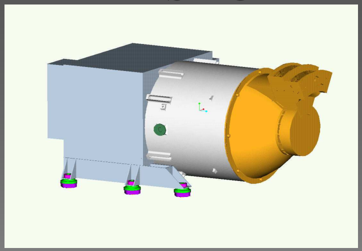
PLASTIC

PLASTIC Activities

Presented by A.B. Galvin
STEREO SWG
NOAA
Boulder, Co
22 March 2004

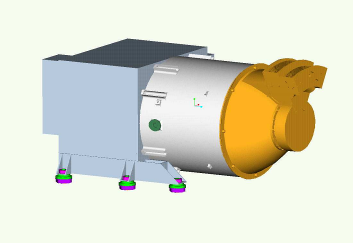
Data Plan Activities

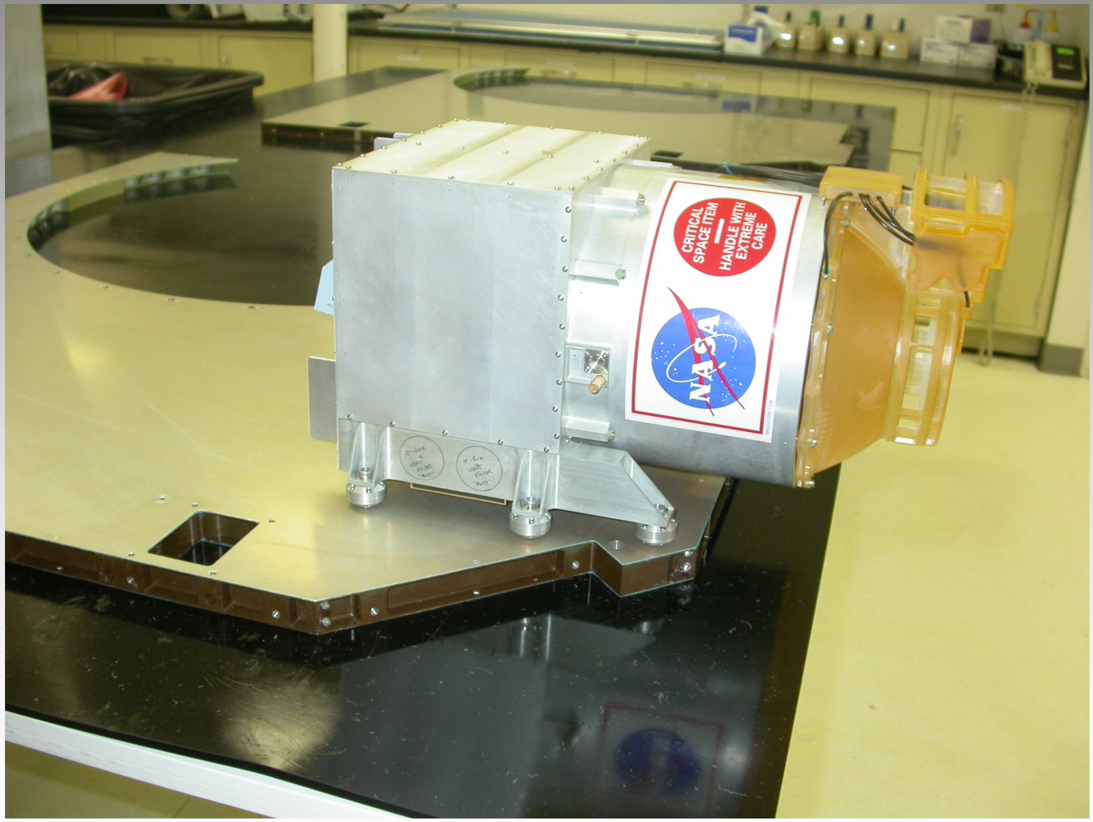
PLASTIC



- Data file naming and formatting conventions are being formulated (graduate student available until May 2004)
- VHO, SSC and IMPACT representatives have been contacted
- Expected Beacon Mode Data contribution is unchanged from previous submissions

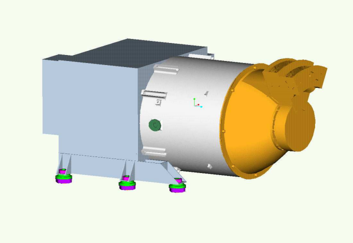
Structural Model

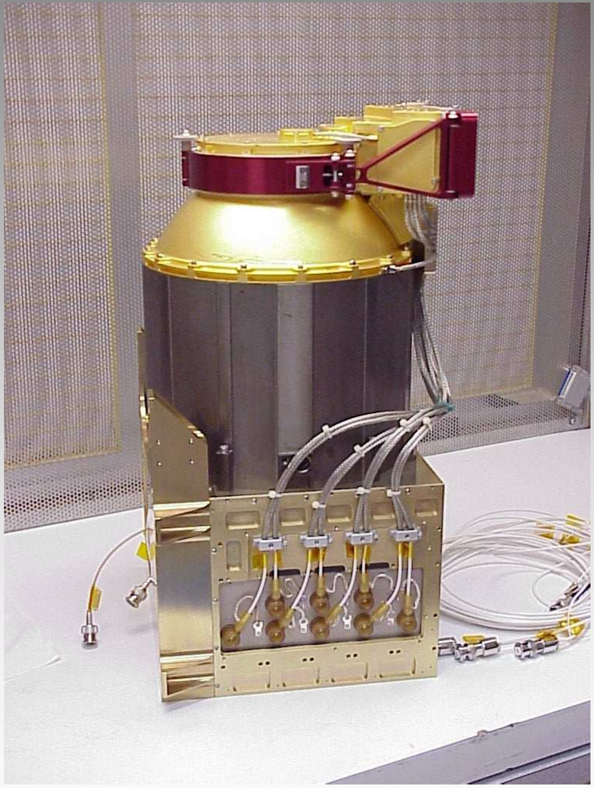



CRITICAL SPACE ITEM
HANDLE WITH EXTREME CARE
NASA

- Fit Check on S/C

PLASTIC SUBSYSTEMS

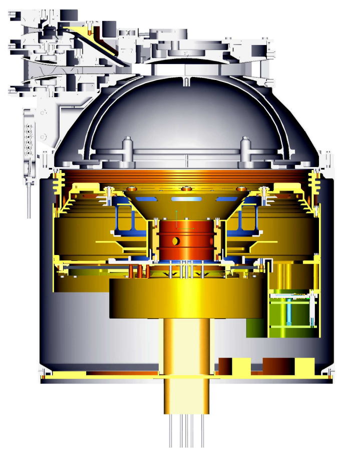




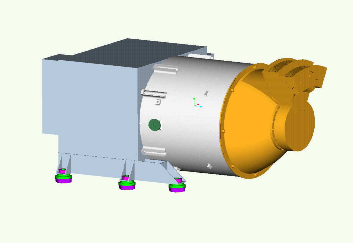
Entrance System

Time of Flight Chamber

Electronics Box



TOF Chamber and EBox



Flight Model TOF Chamber, EBox systems are still in fabrication.

Mechanical parts (UNH, MPE, U Kiel):

- **> 1200 machined parts required**
- **94% of parts have been fabricated/plated**
- **EM calibration results incorporated into ion optics**

Electrical Assembly (UNH, MPE):

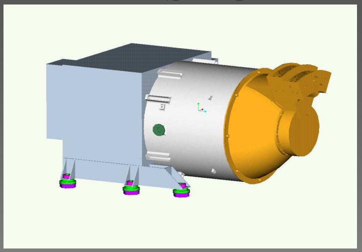
- **Continued population of PWBs**
- **ASIC packaging looking at alternative company**

ACTEL programming

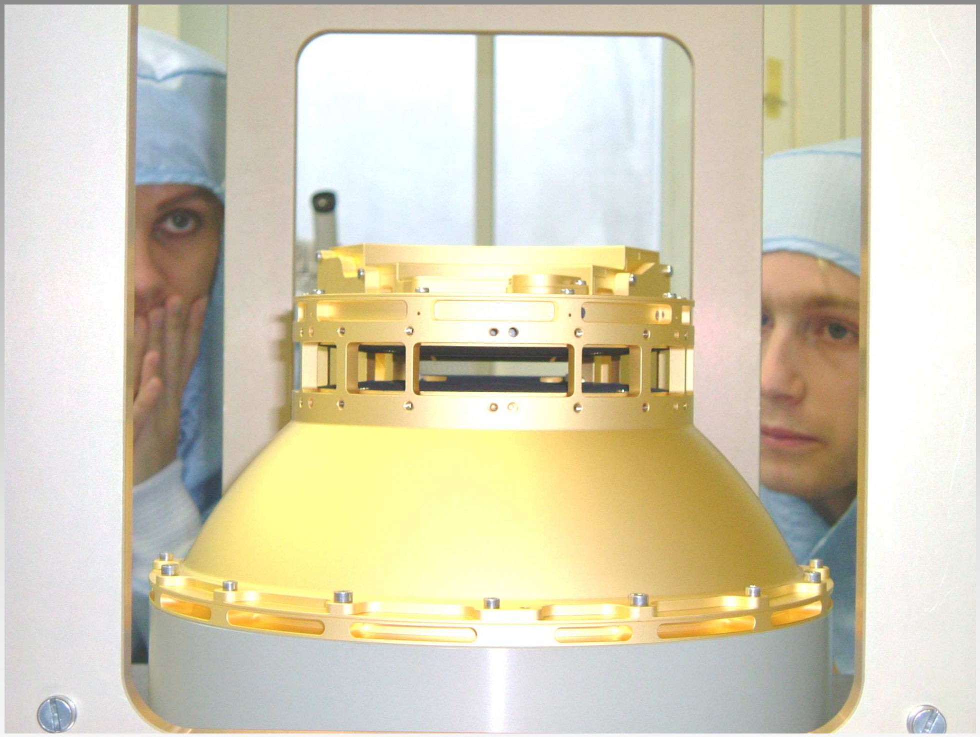
- **All updates from EM testing completed**
- **Currently checking SWEEP table implementation**

Entrance System

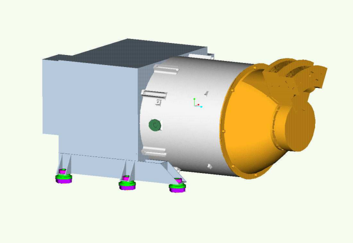
PLASTIC



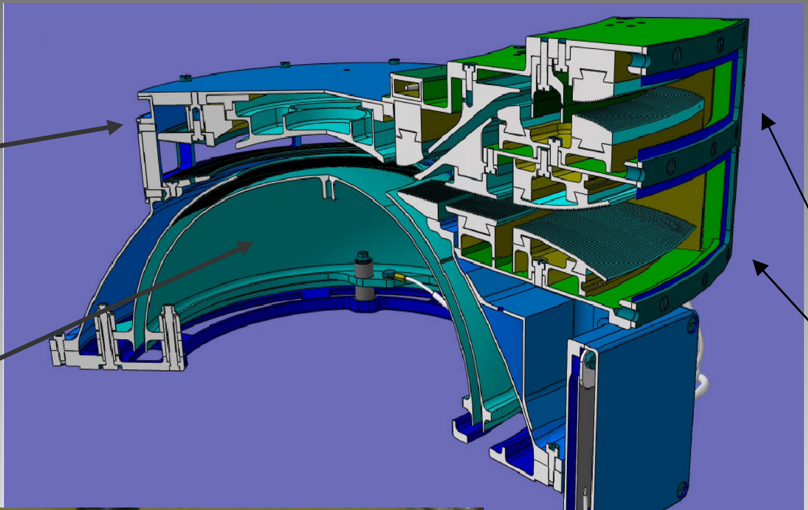
- Construction contract (Contraves Space) nearing completion
- FM1 & FM2 delivered to University of Bern (Nov 2003 & Jan 2004, respectively)
- Entrance System FM1 & FM2 testing underway at UBern



FM1 Entrance System Testing
University of Bern



Entrance System Sections



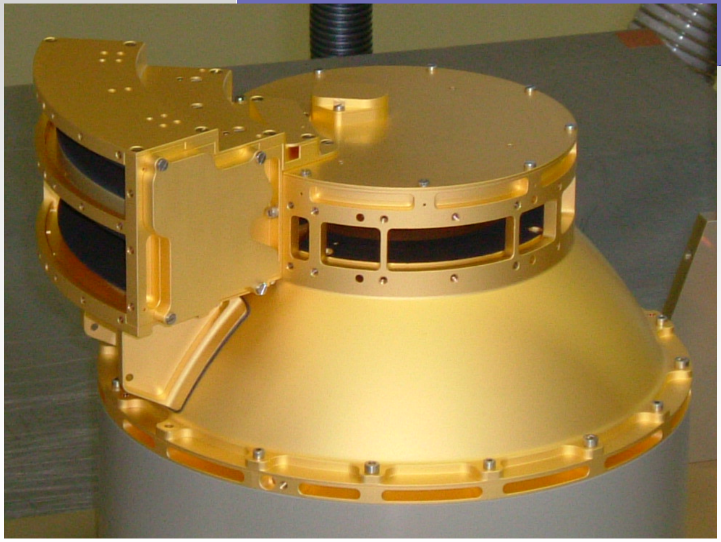
Wide Angle Partition (Suprathermal Ions)

Electrostatic Analyzer (E/Q selection, UV suppression)

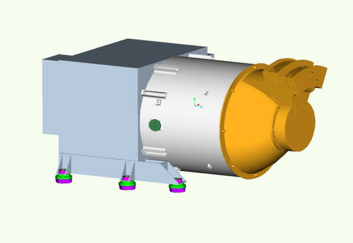
Solar Wind Sector:

Proton Channel

Main Channel (Polar Angle Deflectors)



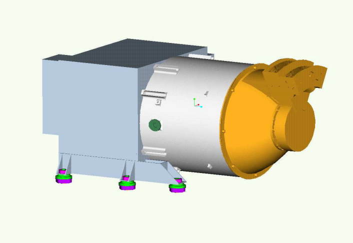
Entrance System Characterization



- Analyzer Constants:
  Main Channel
  WAP
  Proton (S-Channel)
- Deflection Constants
- UV Suppression
- Main Gating Capability
- HV Capacity

Entrance System FM 1

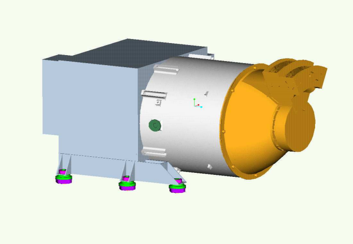
PLASTIC

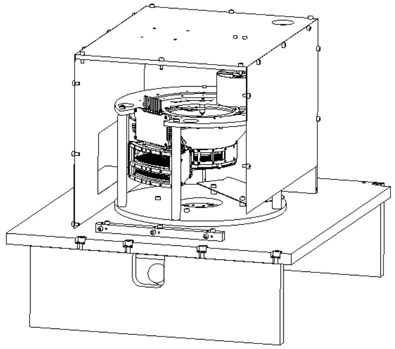


- UV Suppression verified
- Partial discharge tests successfully completed
- Thermal vacuum and vibration tests successfully completed
- Preliminary ion optics calibrations give expected results
- Cable harness rebuilt

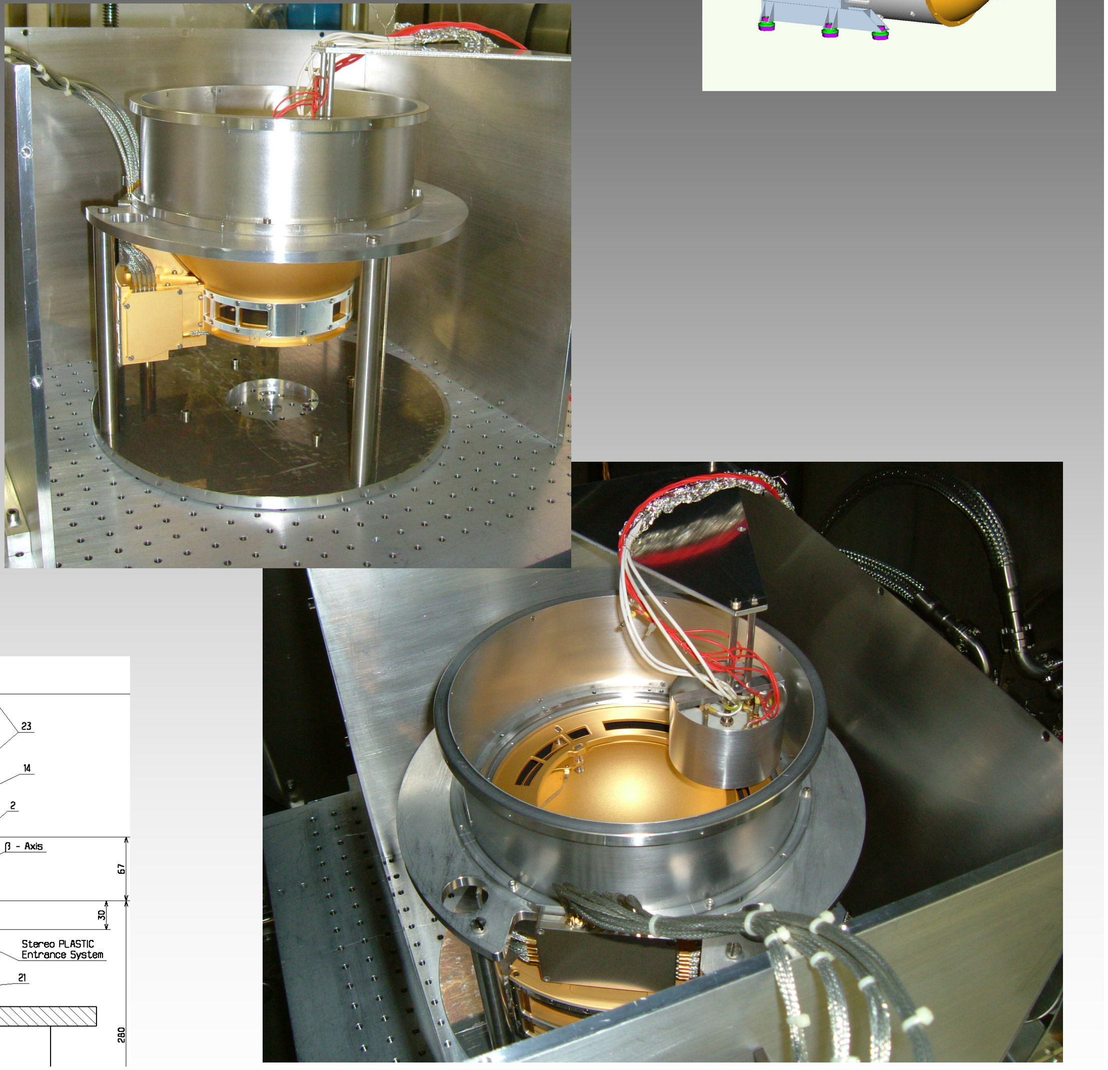
PLASTIC Entrance System
CASYMS Test Set-Up (UBern)

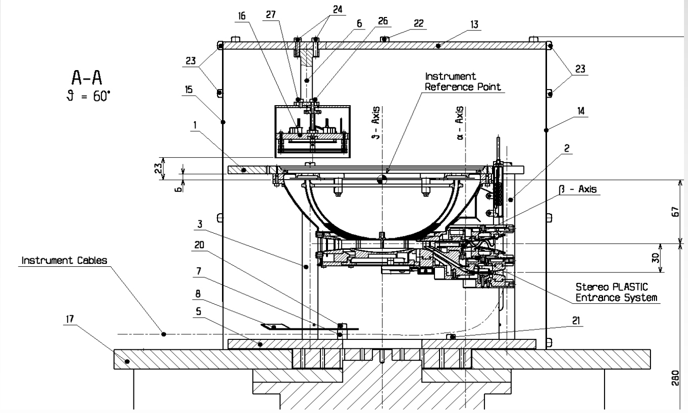
PLASTIC





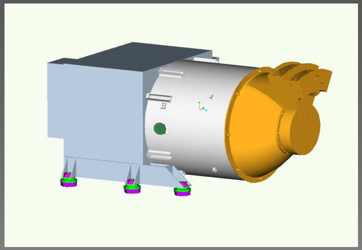
Isometric View
without Shield Sidewall
1 : 5

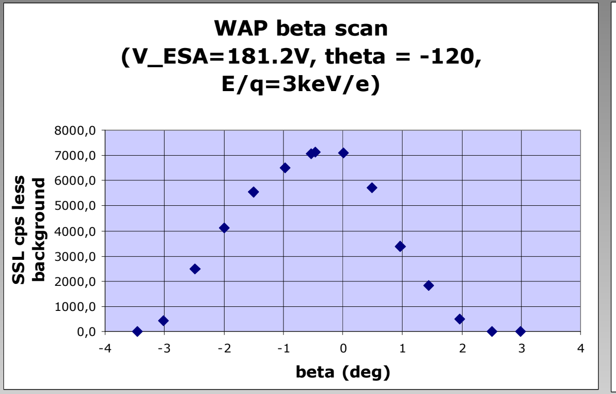



A-A
ϑ = 60°
16
27
24
6
26
22
13
23
15
1
23
14
2
Instrument Reference Point
ϑ - Axis
α - Axis
β - Axis
23
5
67
30
3
20
7
8
5
17
Instrument Cables
Stereo PLASTIC Entrance System
21
280

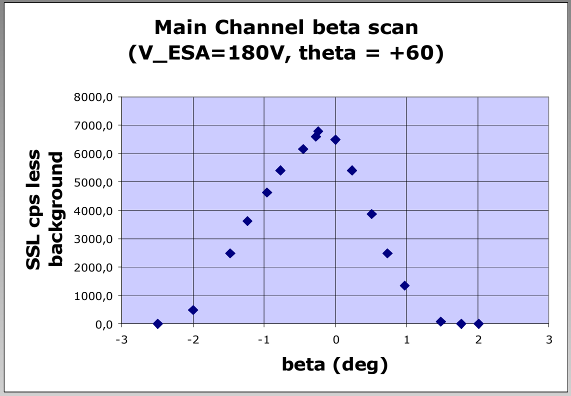
Polar Angle
WAP, Main and Proton-Channel

PLASTIC

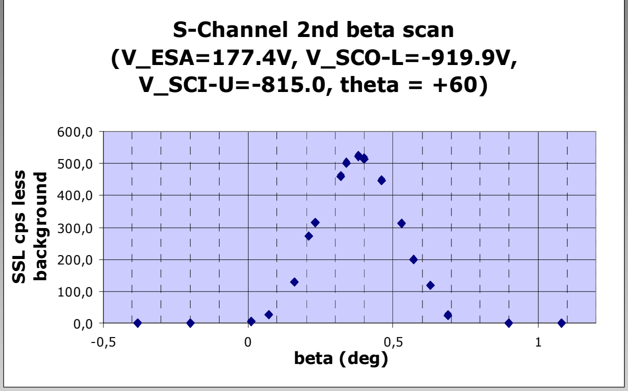




WAP beta scan
(V_ESA=181.2V, theta = -120,
E/q=3keV/e)

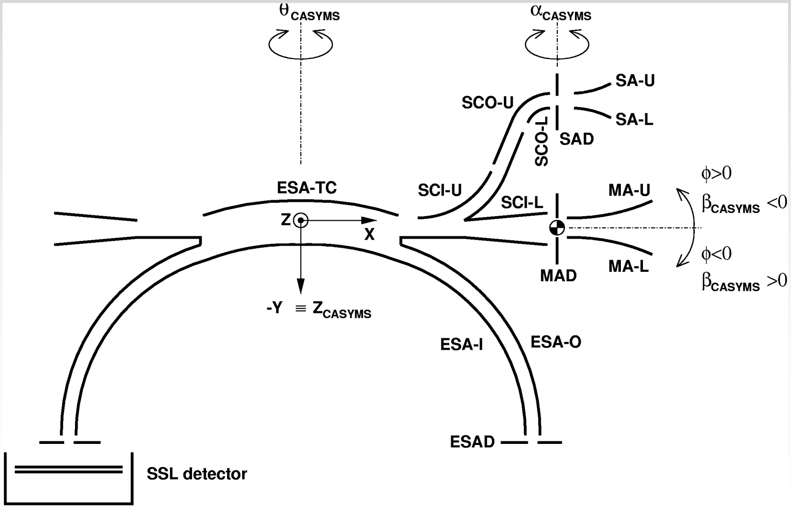


Main Channel beta scan
(V_ESA=180V, theta = +60)



S-Channel 2nd beta scan
(V_ESA=177.4V, V_SCO-L=-919.9V,
V_SCI-U=-815.0, theta = +60)

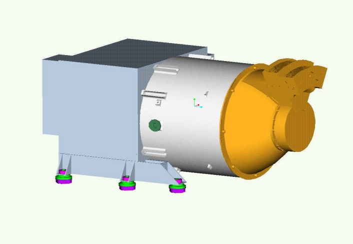
	Beta center (°)	Beta FWHM (°)
WAP	+0.5	3.2
Main Channel	-0.25	1.9
Proton - Channel	+0.37	0.37

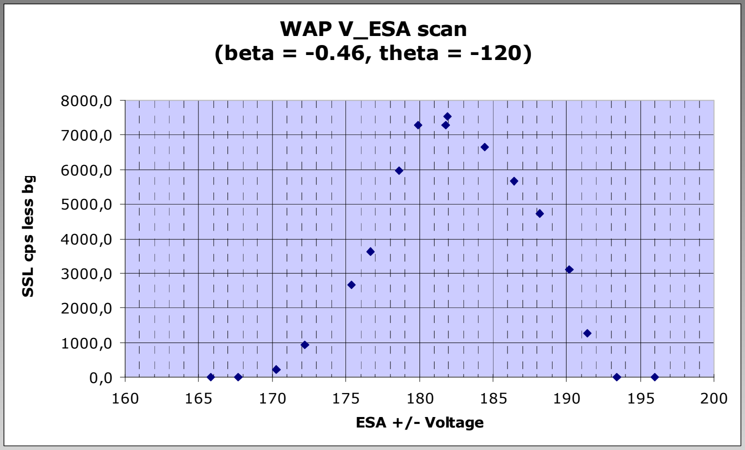


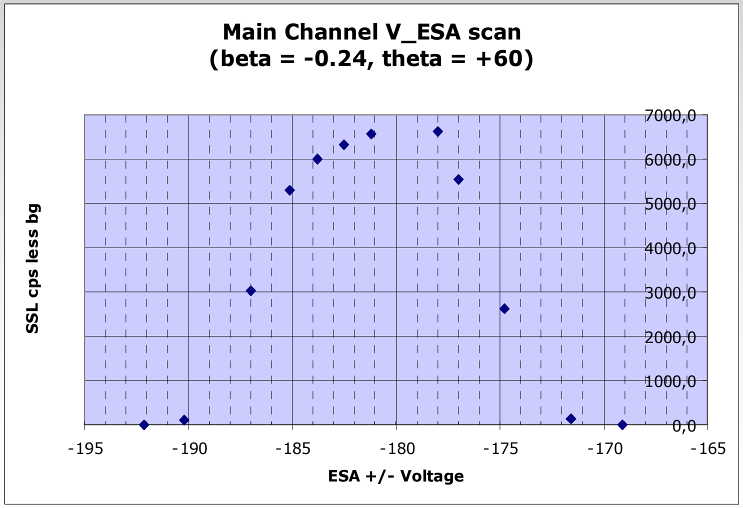
θ_{CASYMS}
α_{CASYMS}
SA-U
SCO-U
SA-L
SCO-L
SAD
$\phi>0$
$\beta_{CASYMS}<0$
ESA-TC
SCI-U
SCI-L
MA-U
Z
X
MAD
MA-L
$\phi<0$
$\beta_{CASYMS}>0$
-Y $\equiv Z_{CASYMS}$
ESA-I
ESA-O
ESAD
SSL detector

ESA Voltage Scan
WAP and Main Channel

PLASTIC




WAP V_ESA scan
(beta = -0.46, theta = -120)


Main Channel V_ESA scan
(beta = -0.24, theta = +60)

ESA Voltage	**Voltage 3keV/e** (Volts)	**Energy Res.** (FWHM)	**Analyzer constant** (eV/e V^{-1})	**Active Area** (cm^2)
WAP	182	7 %	8.24	0.891
Main Channel	180	6 %	8.33	0.548

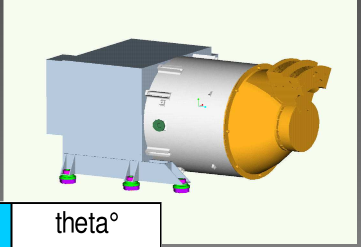
$$k_{electrode} = \frac{\textbf{Energy per Charge}}{\textbf{Voltage difference Electrodes}} = \frac{E_{kin}/q}{V_{electrodes}}$$

$$A_{active} = \frac{n}{\Phi t} = \frac{n_{SSL}}{\Phi t \varepsilon_{SSL}}$$

Φ: Beam Flux (Hz/cm^2)

Summary of Entrance FM1
ion beam measurements

PLASTIC

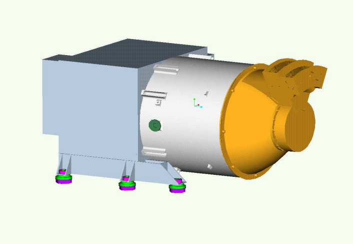


Energy Tuning		**Voltage for 3keV/e (Volts)**			**Energy Resolution (Voltage FWHM)**			theta°
	electrode	FM1 Measurement	EQM Measurement		FM1 Measurement	EQM Measurement	Simulations	
S-Channel	SCO-L	**-920**	**-870**	**N/A**	**10%**	**11%**		
	SCI-U	**-815**	**-815**		**13,5%**	**12%**		
	ESA ±	**177,4**	**177**		**6,2%**	**5,8%**	**9,8%**	
Main Channel	ESA ±	**180**	**179,7**	**N/A**	**6%**	**5,8%**	**6,5%**	**60**
WAP	ESA ±	**182**	**182,3**	**N/A**	**7% (-120°)**	**6.3% (-120° 6.7% (-30°)**	**7%**	**-120 -30**

		Analyzer Constant (eV/e V^{-1})			**Active Area (cm^2)**		
	electrode	FM1 Measurement	EQM Measurement	Simulations	FM1 Measurement	EQM Measurement	Simulations
S-Channel	SCO-L	**3,26**	**3,45**	**3,329**	**2,15E-03**	**3,07E-03**	
	SCI-U	**3,68**	**3,68**	**3,803**	**2,10E-03**	**4,05E-03**	
	ESA ±	**8,46**	**8,47**	**8,344**	**1,51E-03**	**3,27E-03**	**6,00E-04** estimation
Main Channel	ESA ±	**8,33**	**8,35**	**8,127**	**0,548**	**0,715**	**1,400**
WAP	ESA ±	**8,24**	**8,23**	**8,127**	**0,891**	**0,944**	**1,680**

Summary of Entrance FM1 ion beam measurements

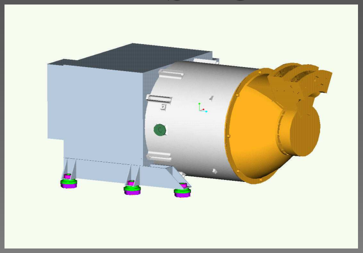
PLASTIC



Taken for Ar^+ beam 3 keV/e		beta center (°)			beta FWHM (°)		
		FM1 Measurement	EQM Measurement	Geometry	FM1 Measurement	EQM Measurement	Geometry
S-Channel		**+0.37°**	**+0.47°**	**-0.039 (FM1)** **0.0 (EQM)**	**+0.37°**	**0.4°**	**0.36° (FM1)** **Simulations 0.55°**
Main Channel		**-0.25°**	**+0.86°**	**N/A**	**1.9°**	**1-2 °**	**2.9°**
WAP		**0.5°**	**-0.4°**	**N/A**	**3.2°**	**3.5°**	**-5°/+6°**

		slope (V) (° V^{-1})			duckbill deflection constant (° keV/e V^{-1})		
		FM1 Measurement	EQM Measurement	Simulations	FM1 Measurement	EQM Measurement	Simulations
S-Channel		**0,0389**	**0,0384**	**-**	**0,1167**	**0,1152**	**0,0981**
Main Channel		**0,0426**	**0,0429**	**-**	**0,1278**	**0,127842**	**0,125**
WAP		**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

Note that beam position is known to ~1°



Ion Beam Test Summary

Analyzer constants according to simulations

E/q selection according to simulations

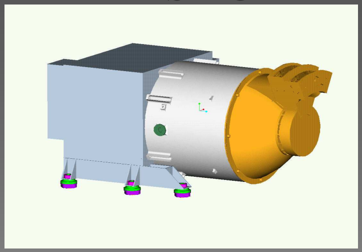
Angle selection according to simulations

Active Area according to simulations

Entrance System achieves the required values and constants

Entrance System Test - Partial Discharge

PLASTIC



Flight Model 1

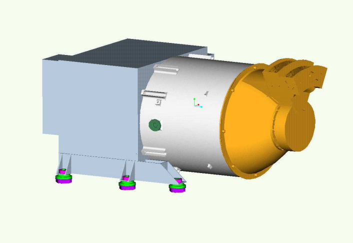
- All electrodes verified to 130% flight operational level
- Exception ESA-I to 125%
- Entrance System HV operation verified
- Remaining task to verify re-built and mounting cable harness

Flight Model 2

- All electrodes verified to 130% flight operational level!!
- Entrance System HV operation verified

Entrance System UV Suppression

PLASTIC

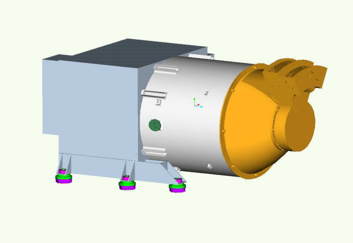


- Solar UV can generate spurious detector counts.
    - Carbon-foil
    - MCPs

F PLASTIC requires a suppression factor SF ~ 10^8-10^9 in order to limit the detector UV noise to ~ 1 count/s

UV Suppression

PLASTIC

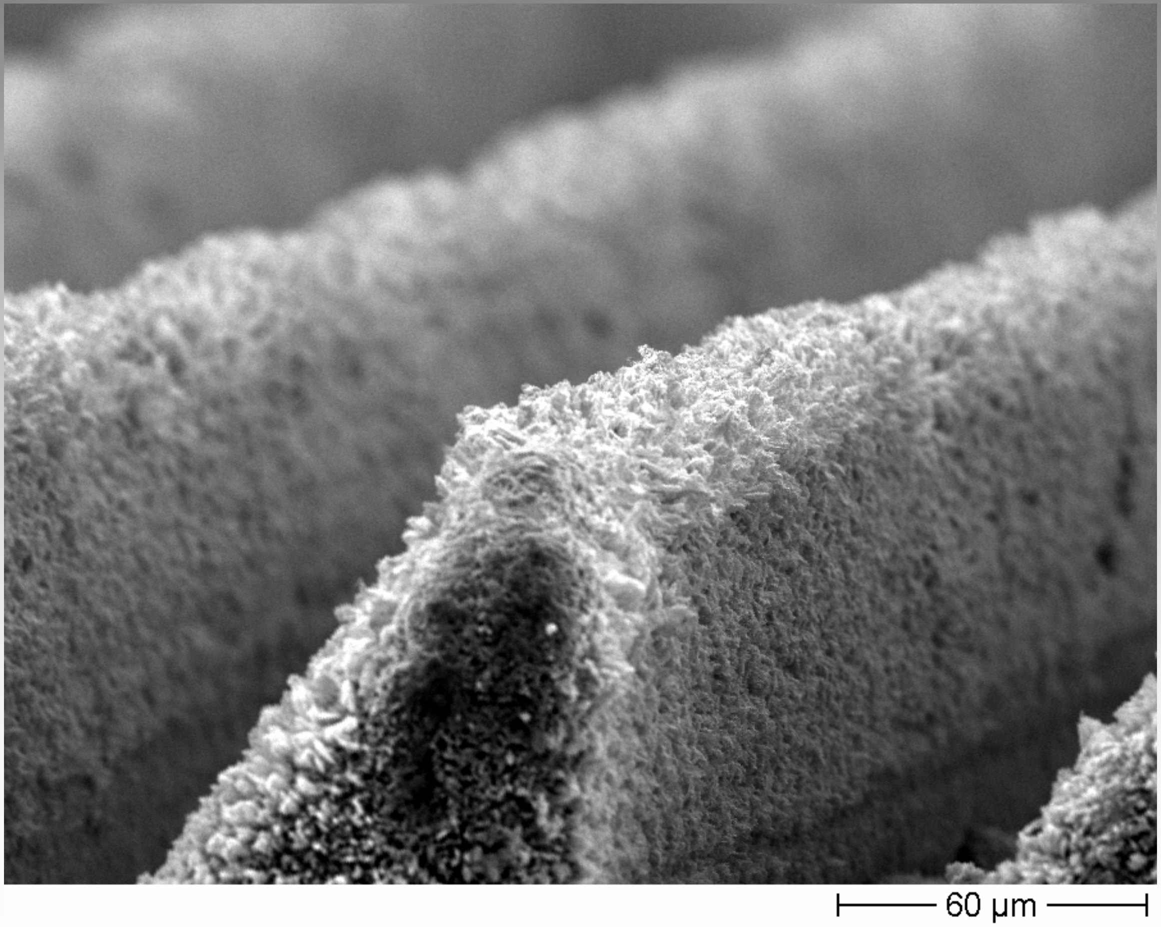


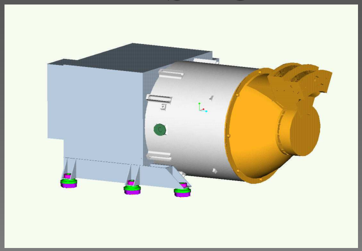
Serration

Multiple Bounce

CuS surface

- Isotropic scattering
- absorption





UV Suppression

Calibrations

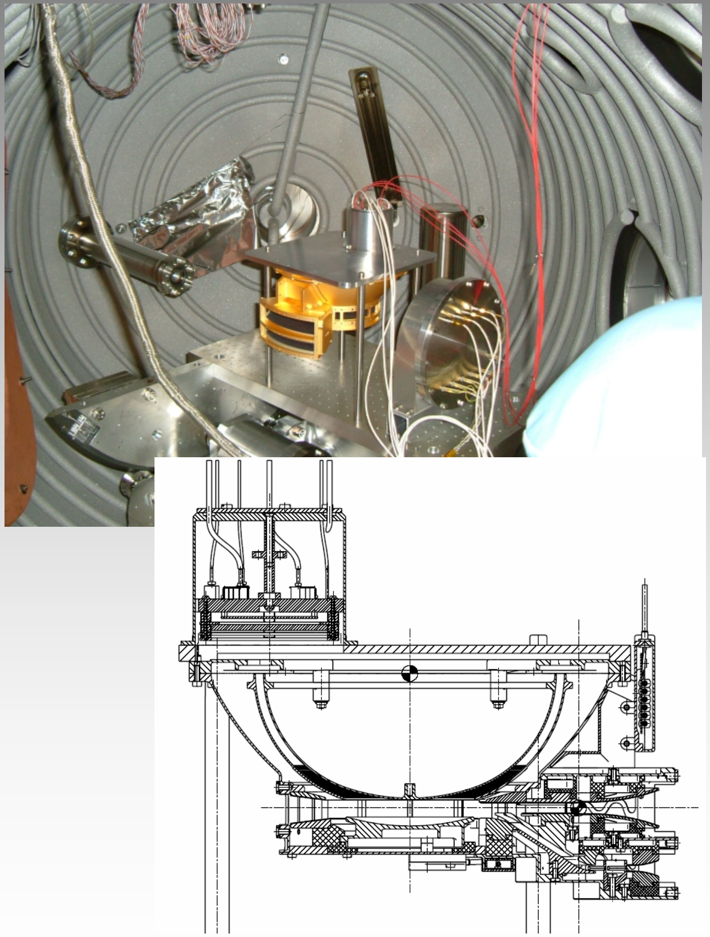
Mefisto laboratory (University of Bern)

9/9/2003 - 27/2/2004

UV source

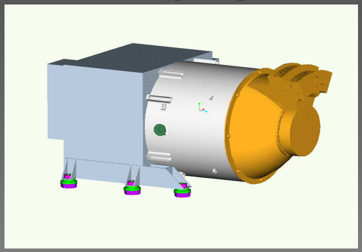
SSL detector: 3 MCPs

vacuum chamber



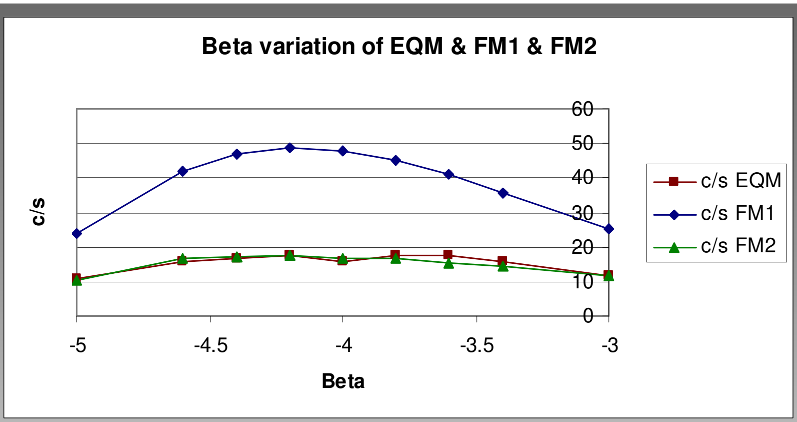
UV calibration results

PLASTIC



β-angle variation

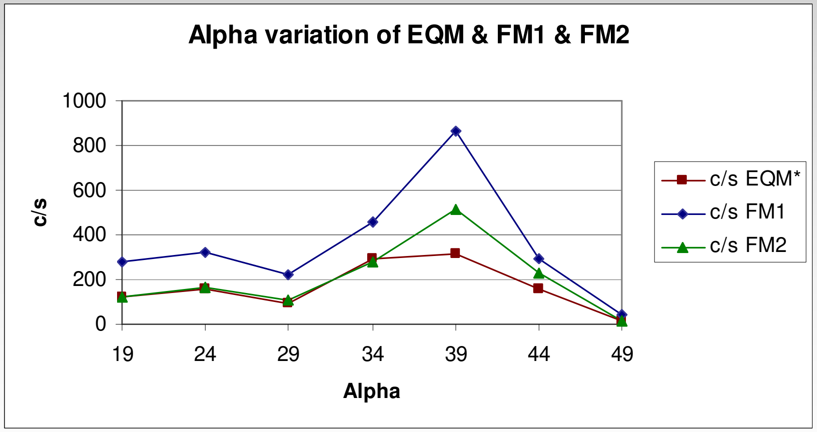
all at α = 49°



FM1 count rate higher by 2.1 – 3.0 than EQM count rate.
FM2 count rate is approx. the same as EQM count rate.

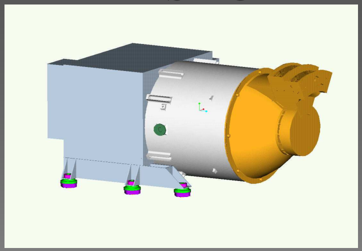
α-angle variation

EQM at β = -3.8°
FM1 at β = -4.0°
FM2 at β = -4.0°



FM1 count rate higher by 1.6-2.8 than EQM count rate.
FM2 count rate is approx. the same as EQM count rate.

UV Suppression Summary



Flight Model 1

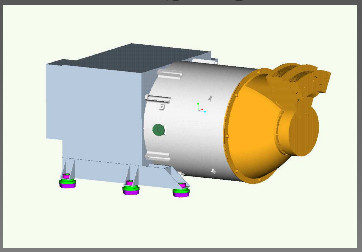
- CuS exhibited imperfections - accepted pending PD & UV tests
- Suppression factor $1.3\mathrm{x}10^9$ ($\mathrm{SF}_{\mathrm{EQM}}$ $4\mathrm{x}10^9$)

Flight Model 2

- High quality CuS coating
- Suppression factor $2.4\mathrm{x}10^9$

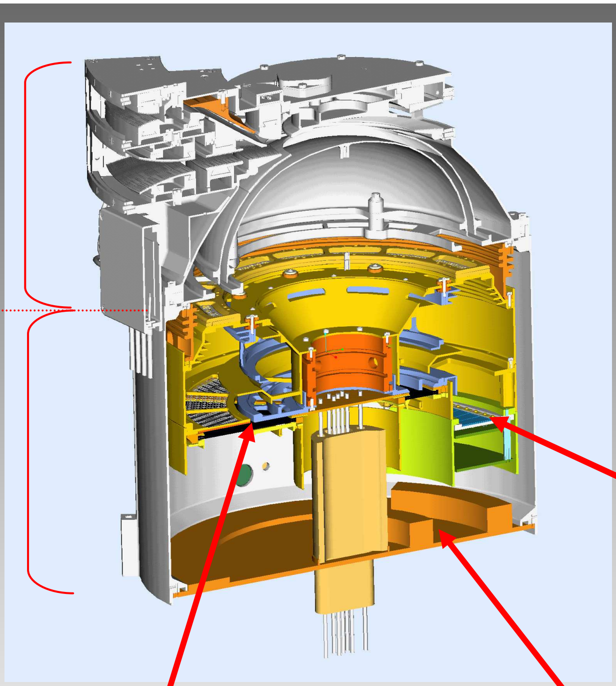
Detectors in the PLASTIC Instrument

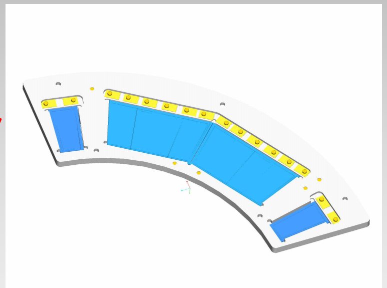
PLASTIC



Entrance System

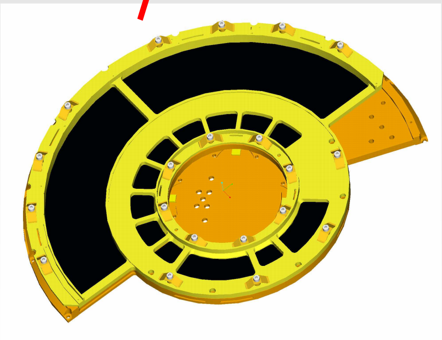
Time of Flight Section





SSD detector frame

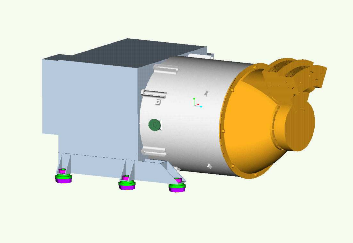
Signal Board (Anodes)

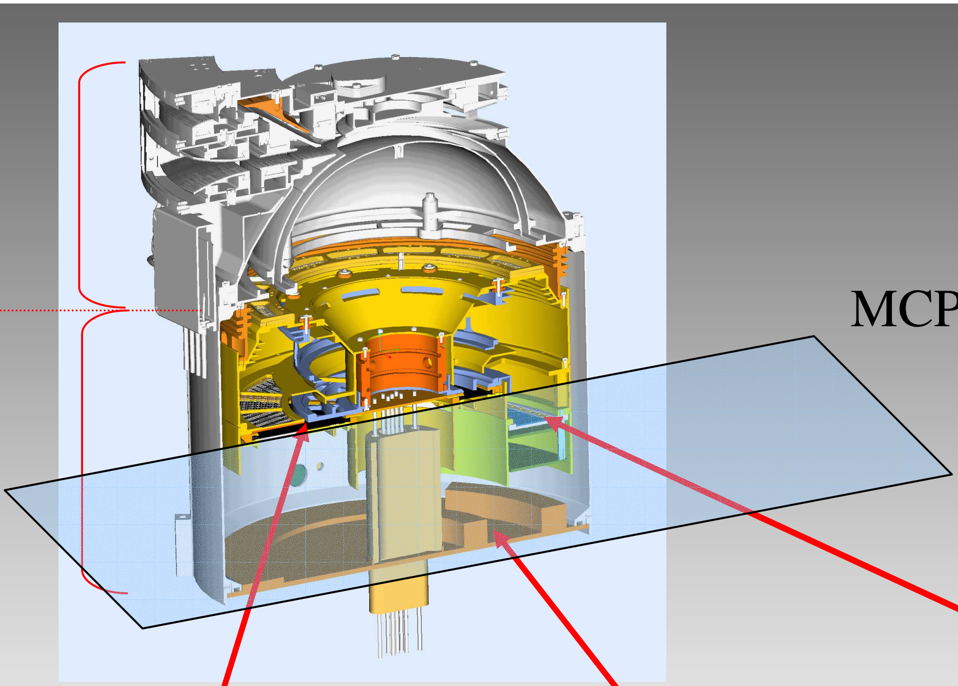


MCP detector mounting

Detectors in the PLASTIC Instrument

PLASTIC

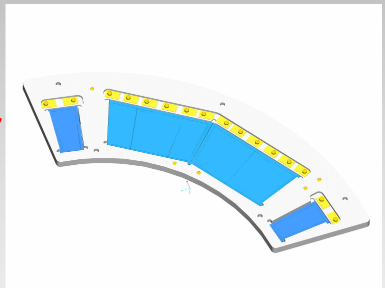




Entrance System

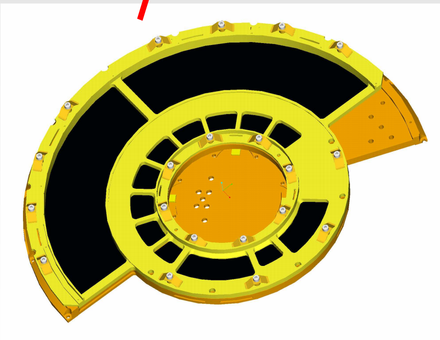
Time of Flight Section

MCP Detection Plane



SSD detector frame

Signal Board (Anodes)



MCP detector mounting