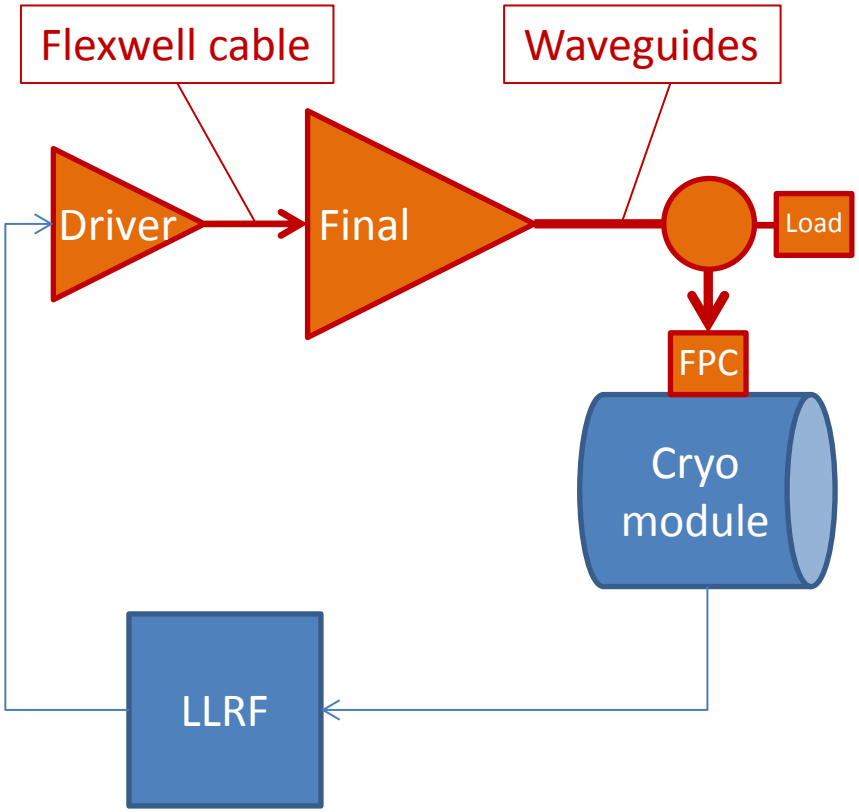
RF power & FPC status

20150216

Eric Montesinos, CERN BE-RF

on behalf of all people involved, great thanks to all of them !

RF Power system & FPC



RF power systems including :

- SSPA Driver surface building
- Flexwell cable
- Tetrode Final (from 1996)
- WR2300 Waveguide
- Circulator & Load
- Fundamental Power Coupler (FPC)

Two complete systems operating:

- 400 MHz
- 45 kW CW
- 1 MHz maximum BW

RF Amplifiers

Drivers

- New SSPA driver to be built
- 10 European companies already contacted
- First prototype by June 2015

Finals

- One old SPS amplifier (1996-2000) has been successfully tested at 400 MHz up to 45 kW CW
- Five amplifiers to be modified from 352 MHz to 400 MHz
- Characteristics have been checked by Philippe in January, but driver (tube) was not ok
- Tests to be repeated in June

Power supplies

All present HVPS are out of date

Will be one HVPS per two amplifiers to reduce the cost

First new system by June 2015

Two additional new systems for SM18 & SPS

WG & Coaxial

Waveguides

- Regarding frequency only WR2300 & WR2100
- WR2300 LHC standard

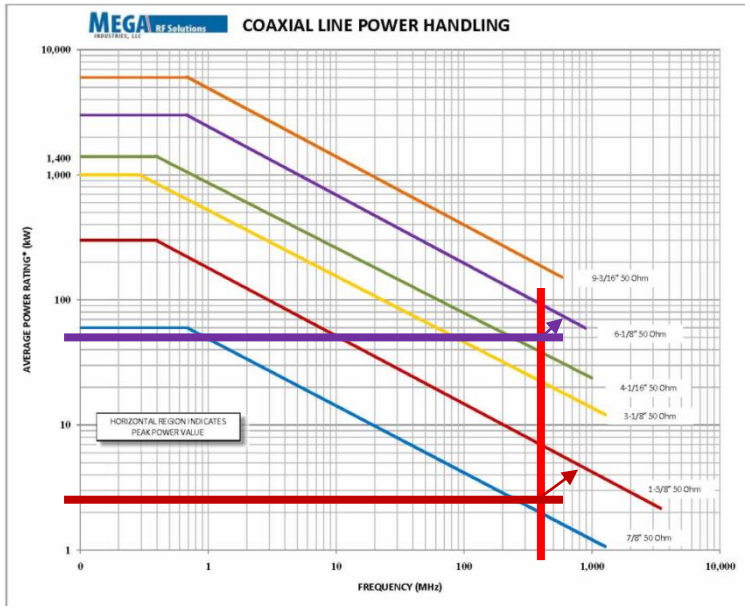
WR	Fmin MHz	Fmax MHz	a inch	b inch	Flange mm
2300	320	490	23.0	11.5	677 385
2100	350	530	21.0	10.5	626 359

Coaxial lines from SSPA Driver to Final

- Pfwd = 2.5 kW
- 1-5/8 EIA line

Coaxial lines from Final to Circulator

- Pfwd = 50 kW
- 6-1/8 EIA line



Circulators & Loads

We decided to buy LHC circulators and Loads

- 330 kW power capability
- Re-usable with LHC main RF system

Loads have already been delivered (to be modified from 4 sections to 2 sections)

Circulators will be delivered by March 2015

FPC 1.0 (x 3 - 2013)

400 MHz 50 kW CW FPC
full reflection all phases

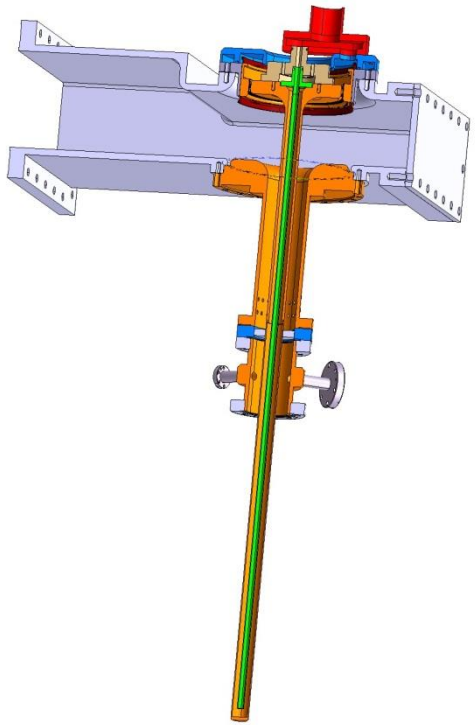
Agreed coaxial line
OD 62 mm - ID 27 mm

Coaxial disk window

- Outer titanium flange
- Al2O3 97.6% ceramic
- Inner copper tube

Coupler body

- Massive copper
- 316 LN Stainless Steel flanges on both sides



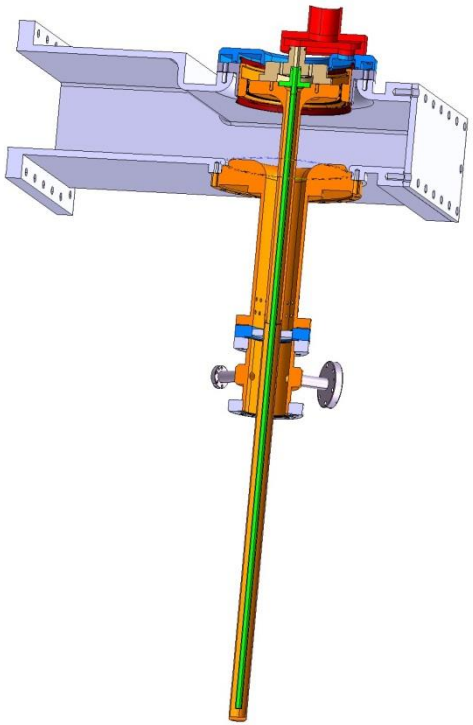
FPC 1.0 (x 3 - 2013)

Monitoring ports

- 1 port for vacuum gauge
- 1 port for e- monitoring
- 1 port for arc detector

Coaxial to WG WR2300½H transition without doorknob

DC capacitor included for DC polarization



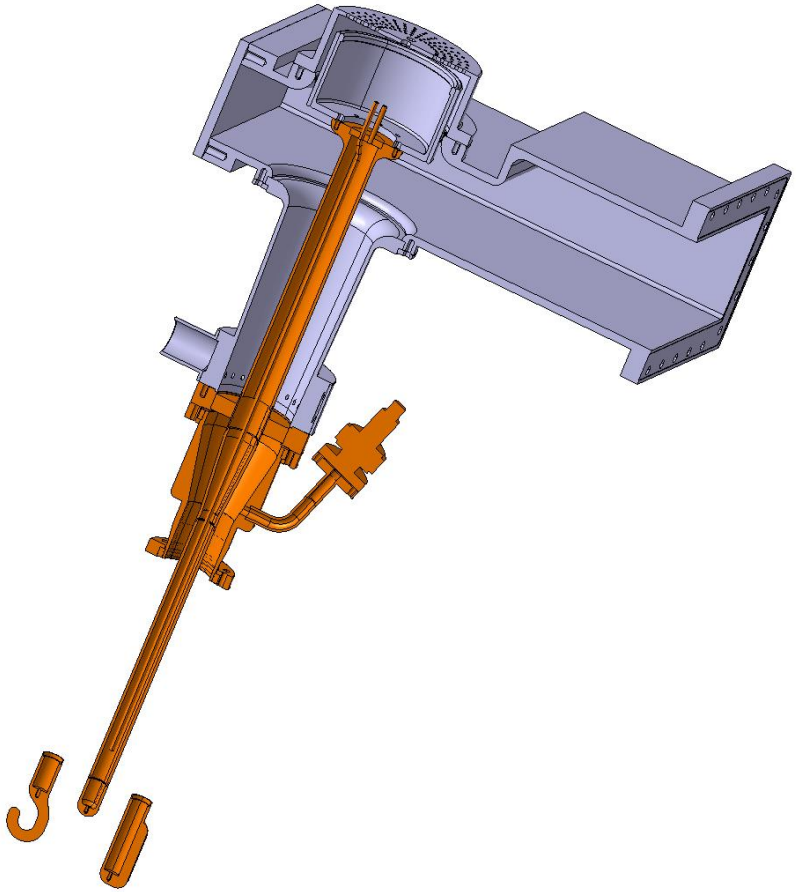
FPC 2.0 (x 3 - 2014)

Still agreed sizes on cavity side
OD 62 mm - ID 27 mm

Conical vacuum line to increase the diameter of the ceramic in order to avoid arcing on the air side

Ceramic & Air coaxial line increased
OD 100 mm – ID 43.5 mm

Robust ceramic
Thickness 20 mm



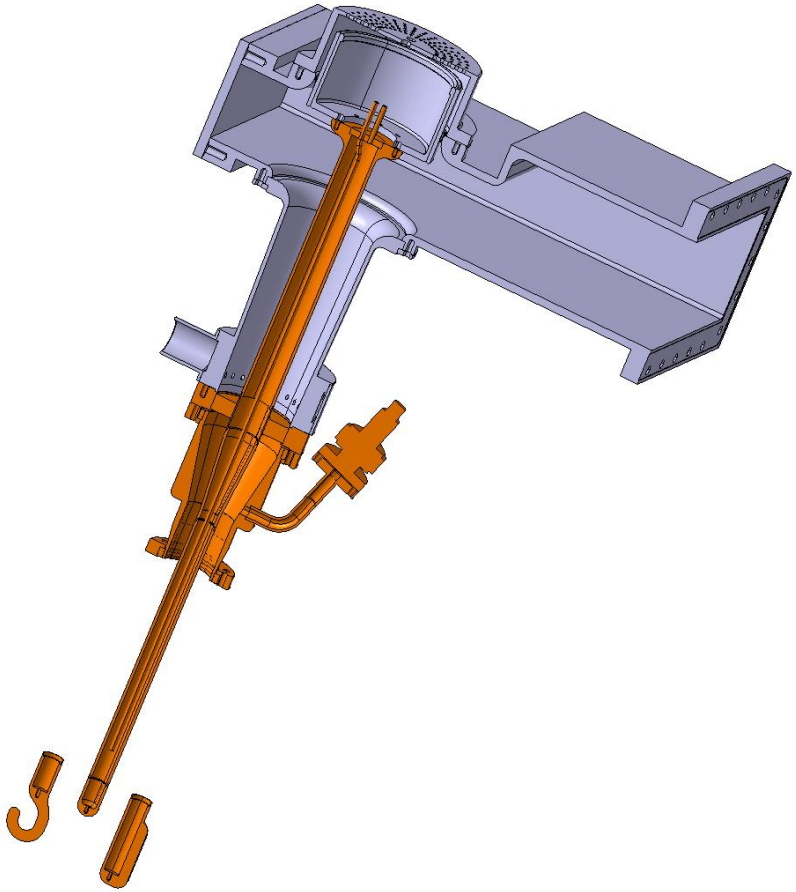
FPC 2.0

Pseudo-conical air extension cooled with forced air

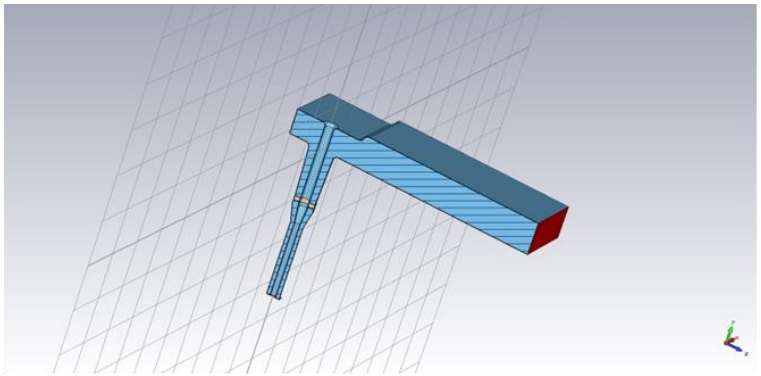
Even if against CERN's rules regarding joining, as no other way to do it, water cooled antenna

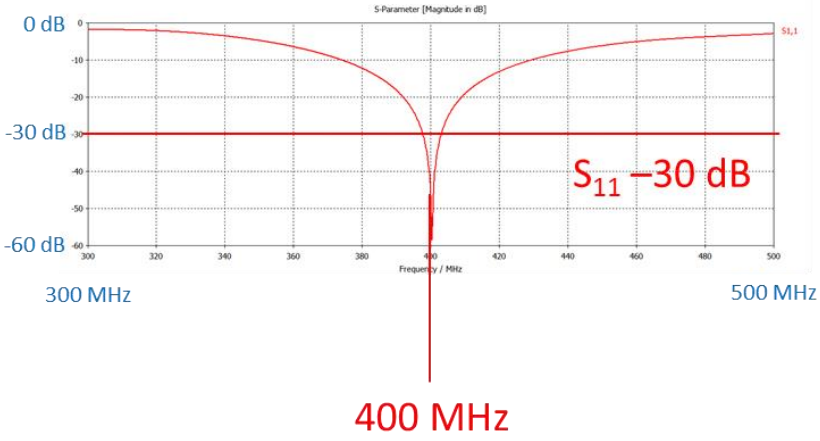
Mandatory vacuum gauge for coupler protection

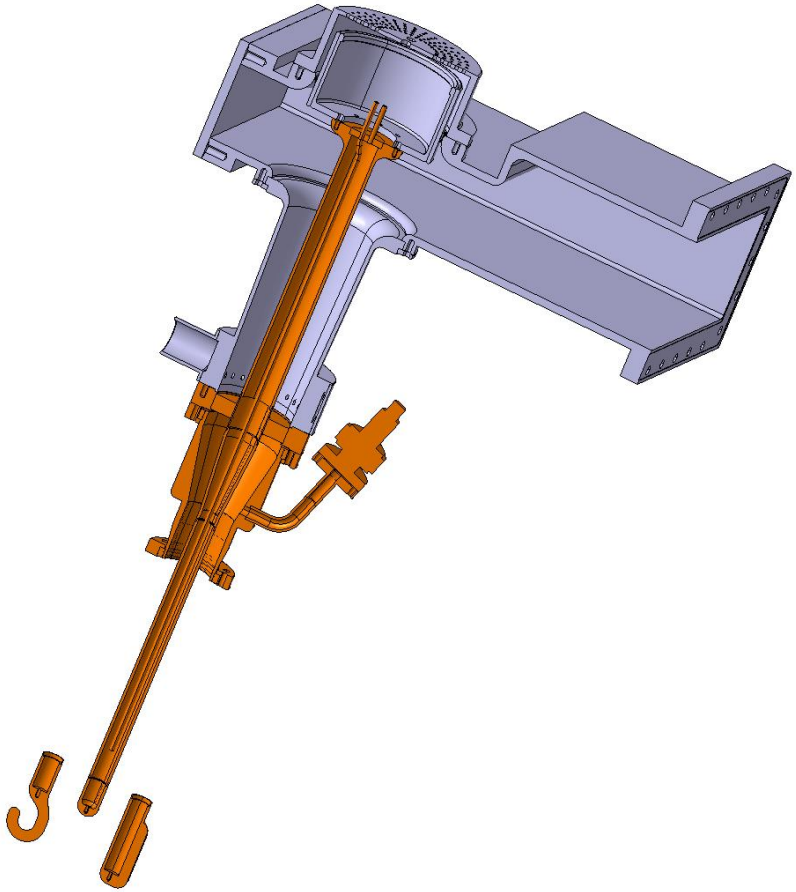
No more arc detector window neither e- antenna to ease integration



FPC 2.0 (x 3 - 2014)





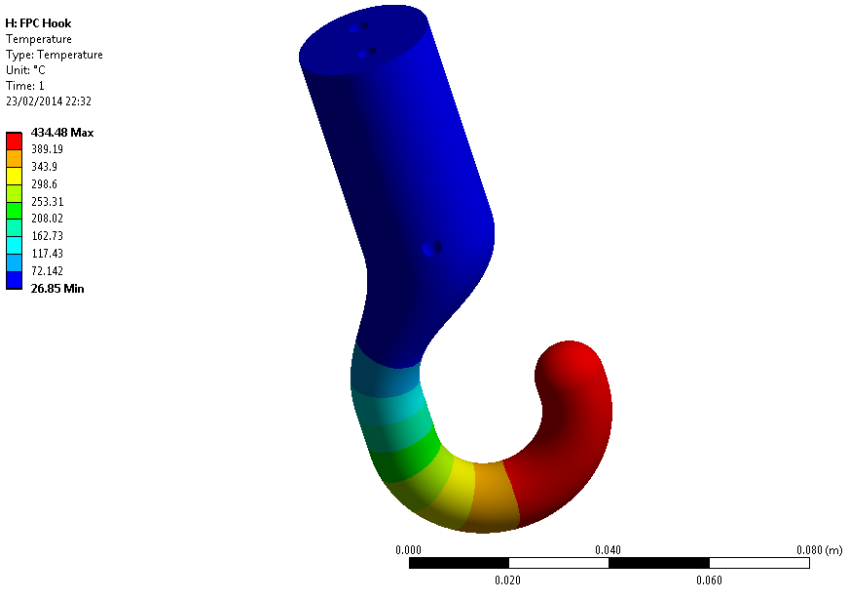


Antenna overheating

Looking at the size of the hook, no way to design a cooling circuit which also cools down the curved part of the hook

Initial design of coupling elements (BNL-ODU) shown overheating up to an unacceptable temperature

New coupling element shapes have been designed allowing acceptable temperature for the three couplers



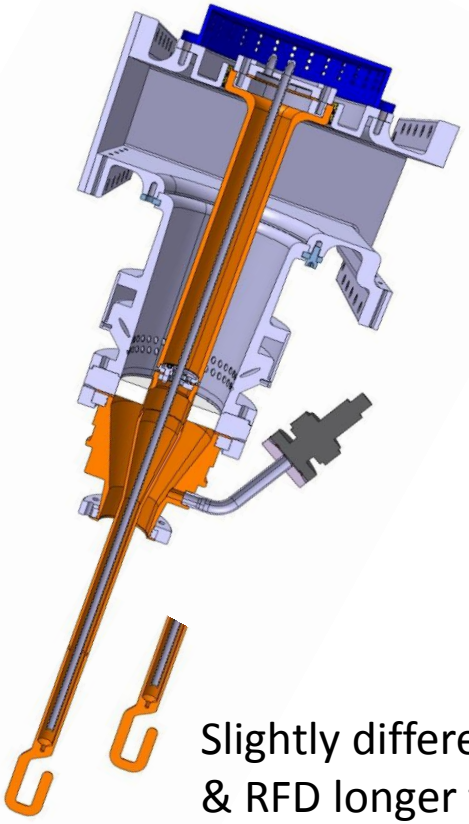
FPC 3.0 (x 2 - Fall 2014)

Two versions only

Pseudo-conical air extension cooled with forced air

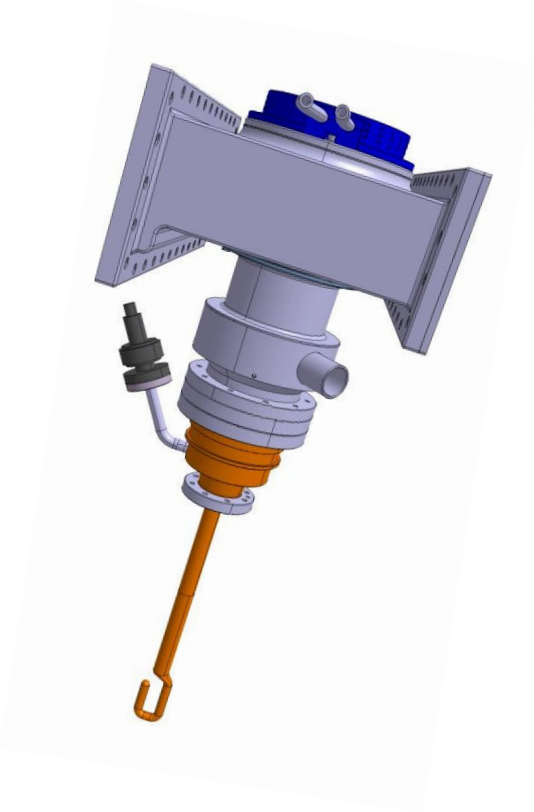
Water cooled antenna

Mandatory vacuum gauge for coupler protection



Slightly different hook & RFD longer than DQW

FPC 3.0 (x 2 - Fall 2014)



June 2015

December 2015

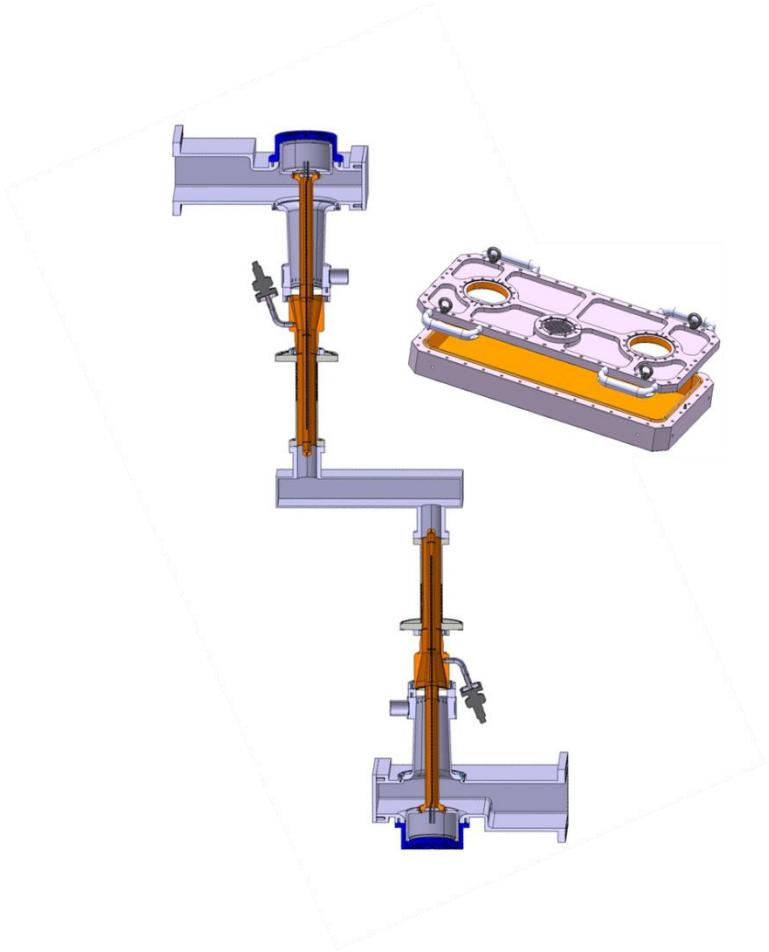
Test boxes

Two test boxes will be built allowing the preparation of pair of couplers

They have to be customized regarding the coupling element for each cavity design

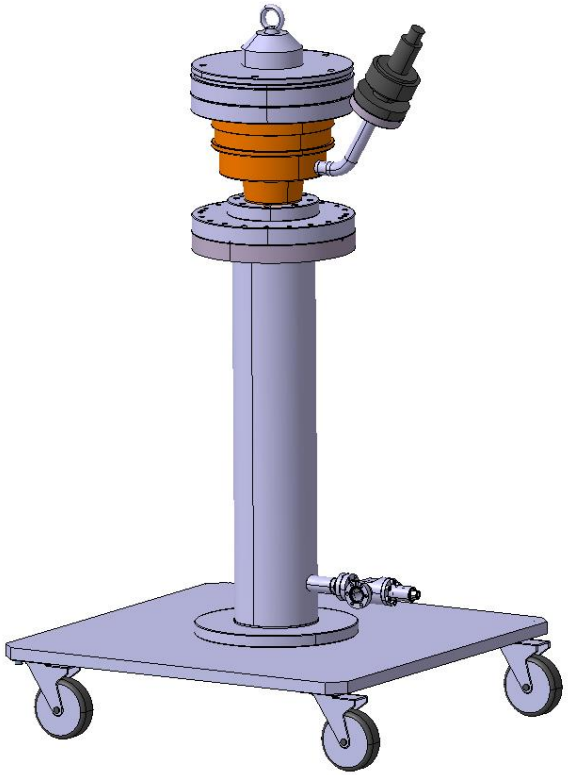
Coupling element has been defined very late (November 2014)

Need 12 months to build these test boxes, <u>ready by beginning 2016</u>

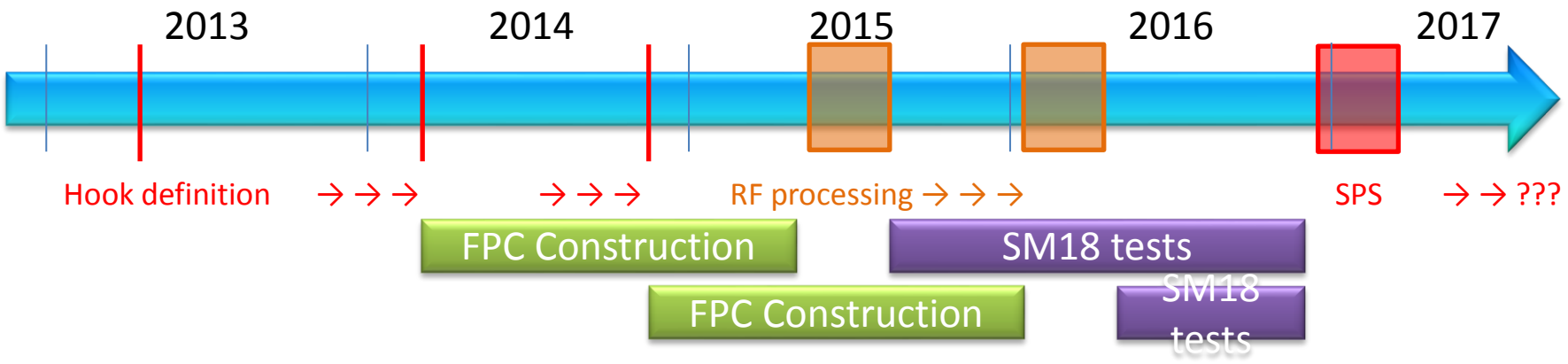


FPC 3.0

FPC 3.0 as delivered to clean room Q2-2016



Schedule February 2015



- FPC design was missing **coupling element definition until November 2014** (Test cavity impossible to be designed)
- Couplers processed 40 kW SW CW all phases Q2-2016
- Cavities to be installed in the SPS in December 2016 ???

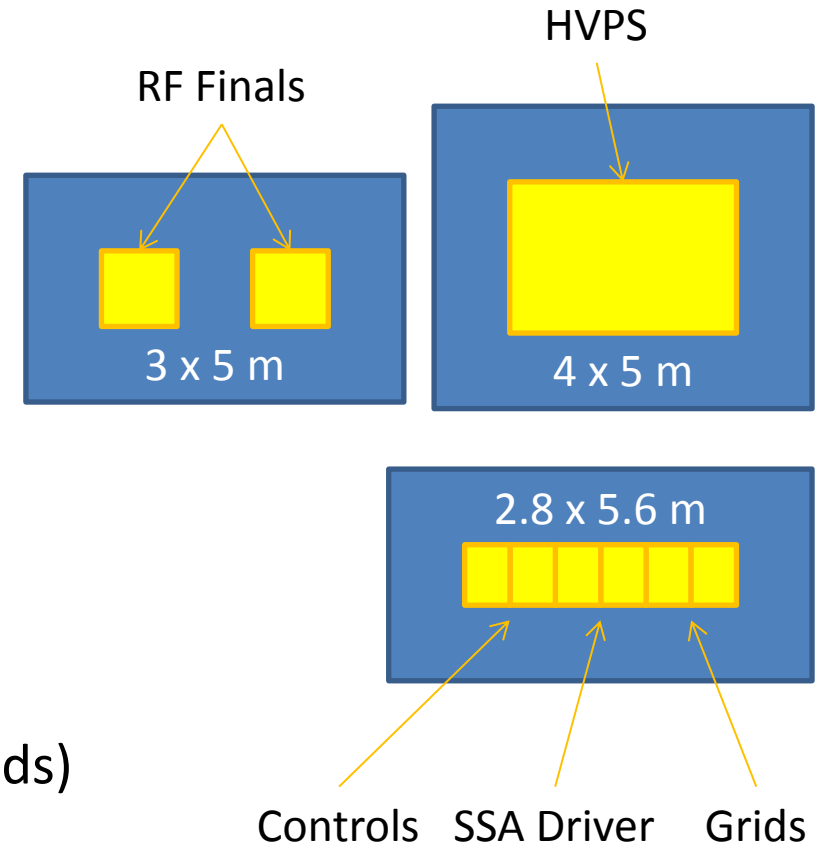
Space request

Surface building

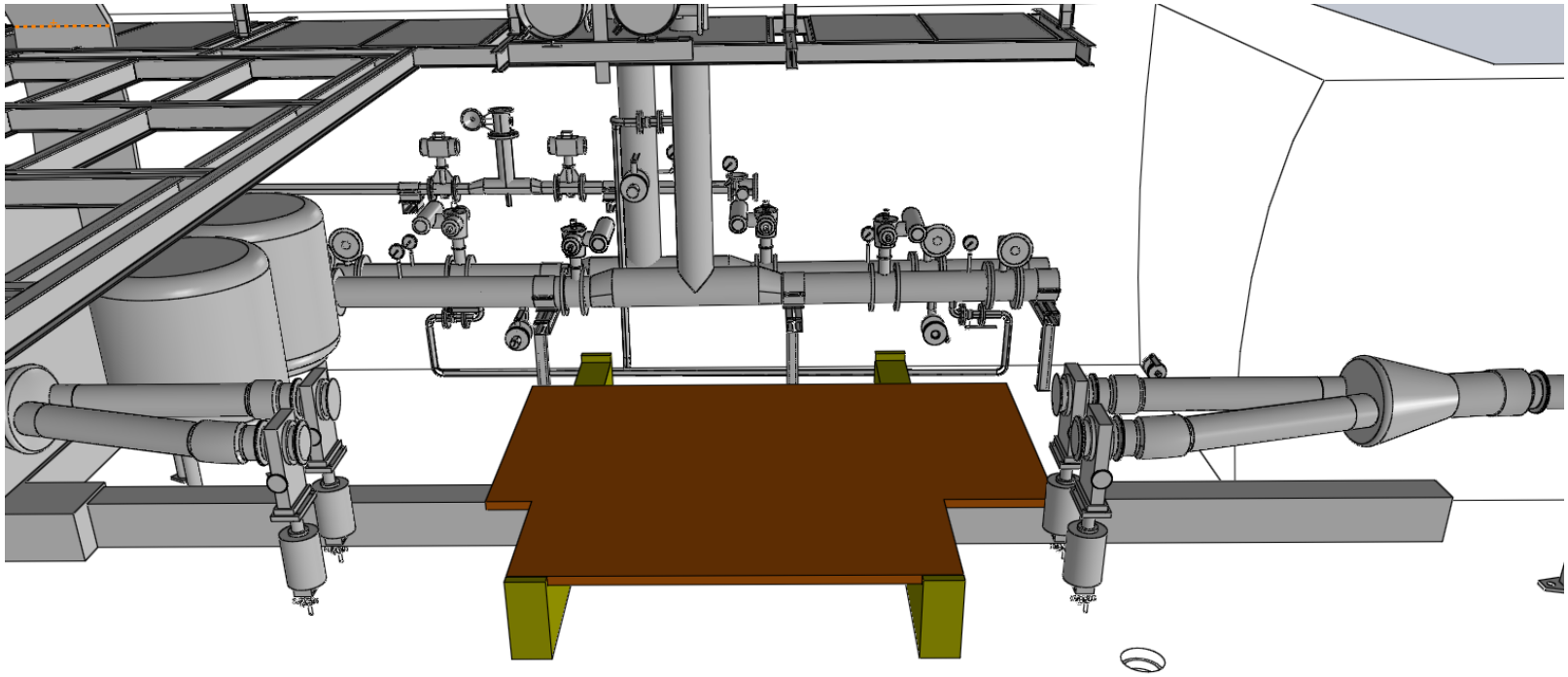
- 10 racks equivalent Ua
- (8 racks equivalent RF amplifiers)
- 2 racks Grids
- 2 racks SSPA Drivers
- 2 racks Controls & Monitoring

Machine

- (Space on moveable platform)
  (2 amplifiers + 2 circulators + 2 loads)
- Water pump
- Blowers
- HV filtering box

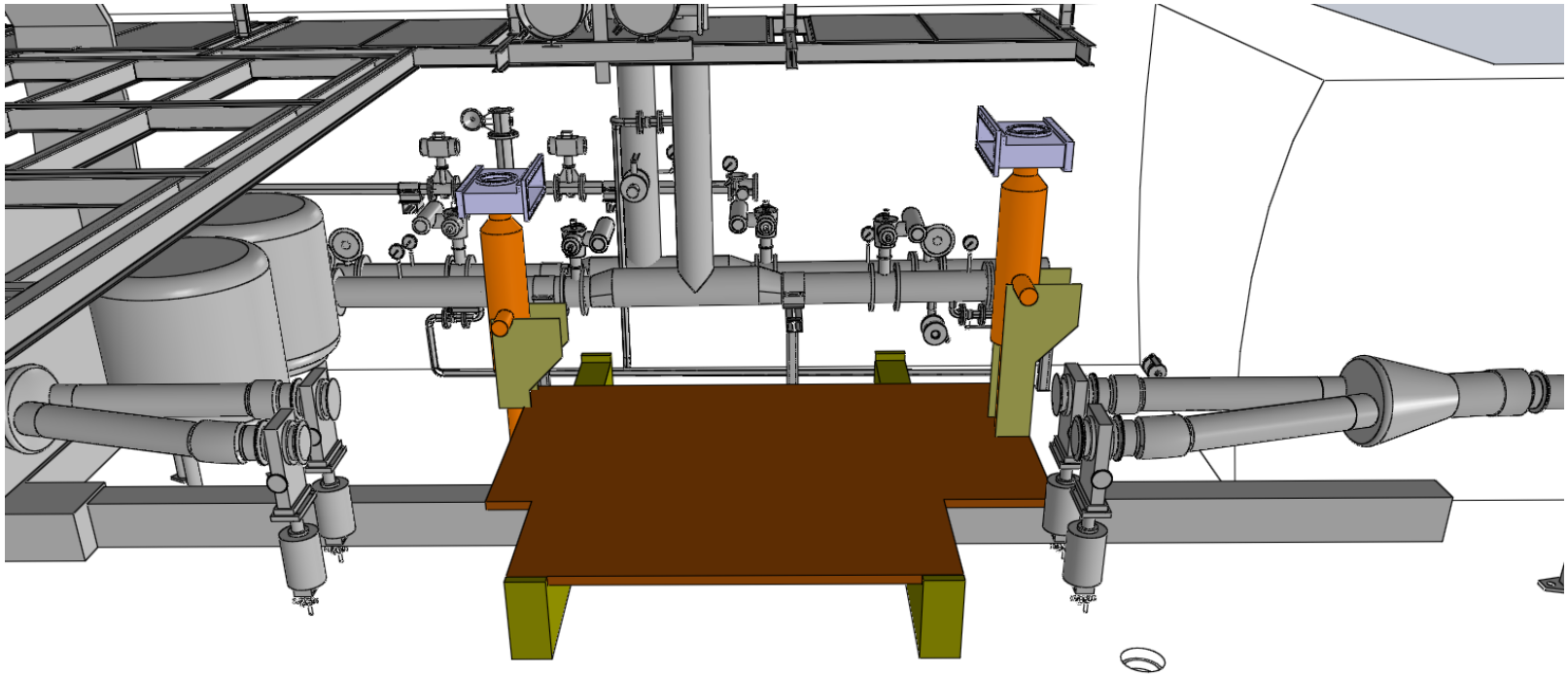


Movable table



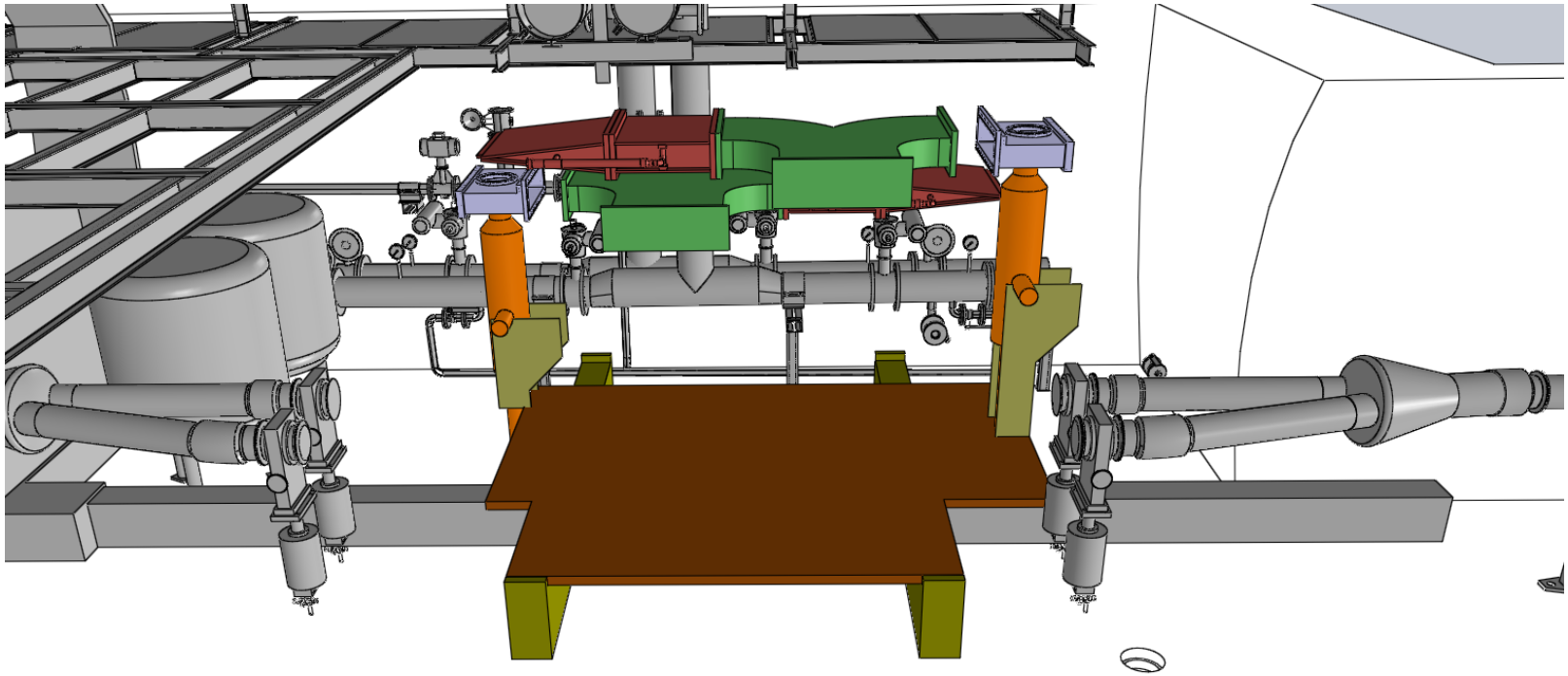
Phoevos Kardasopoulos

Two Tetrodes Amplifiers onto the table



Phoevos Kardasopoulos

Circulators & power Loads (with adjustable supporting system for integration of all three designs)



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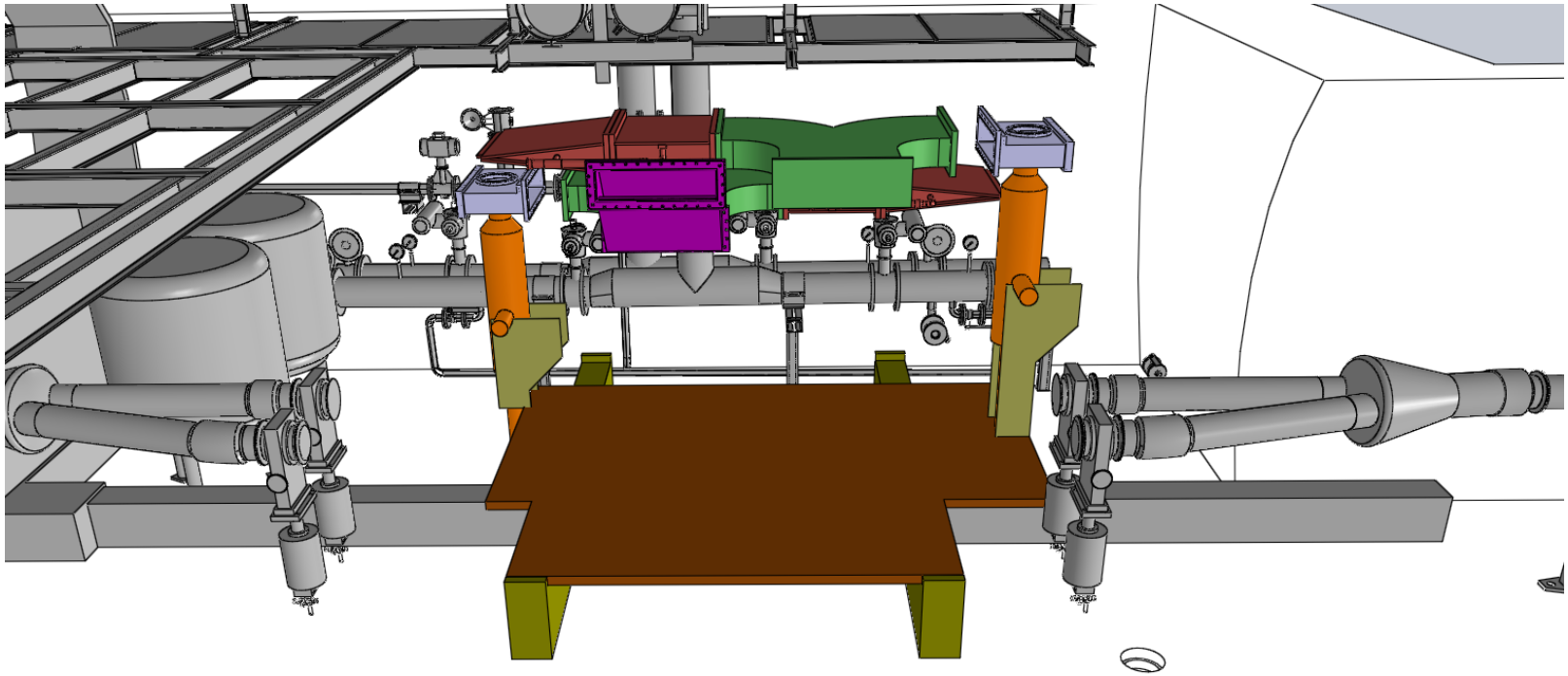
Waveguides to FPC



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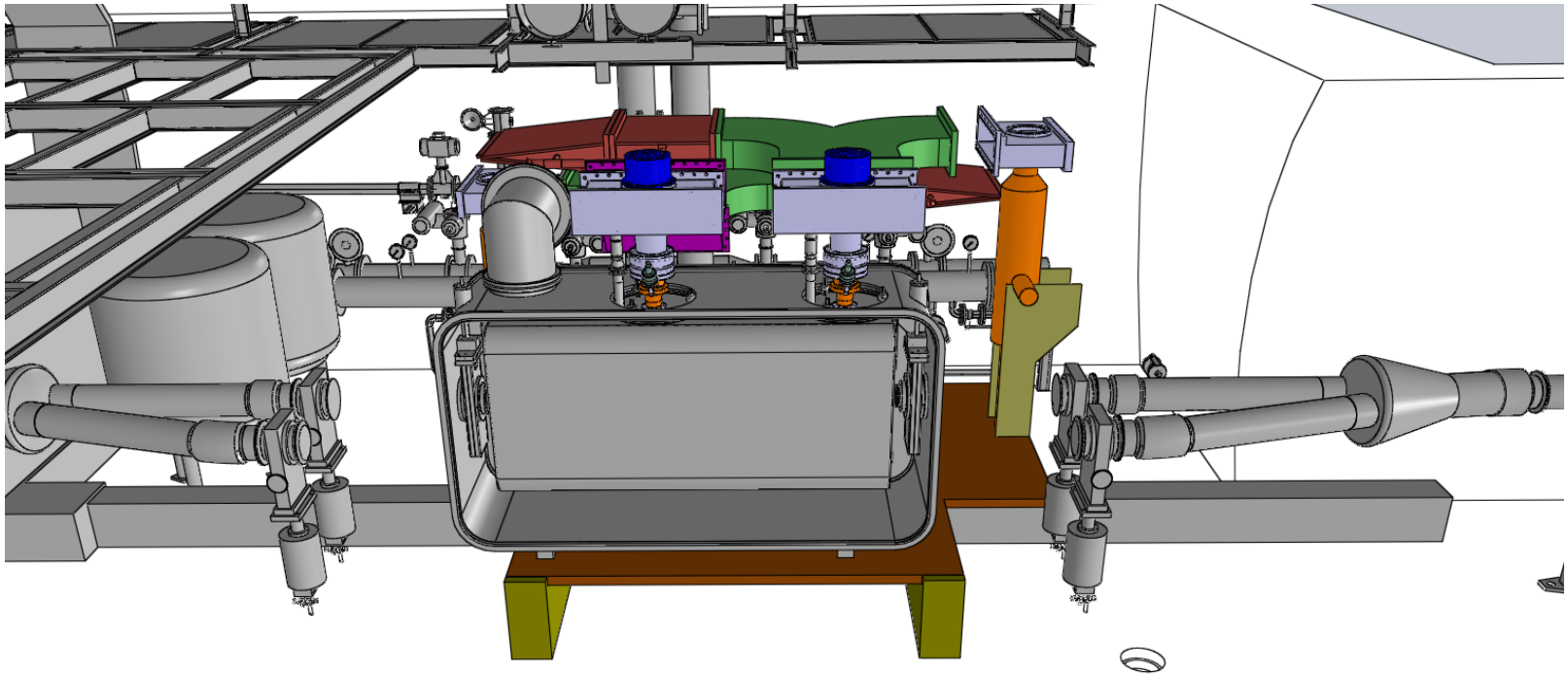
Cryomodule with FPC



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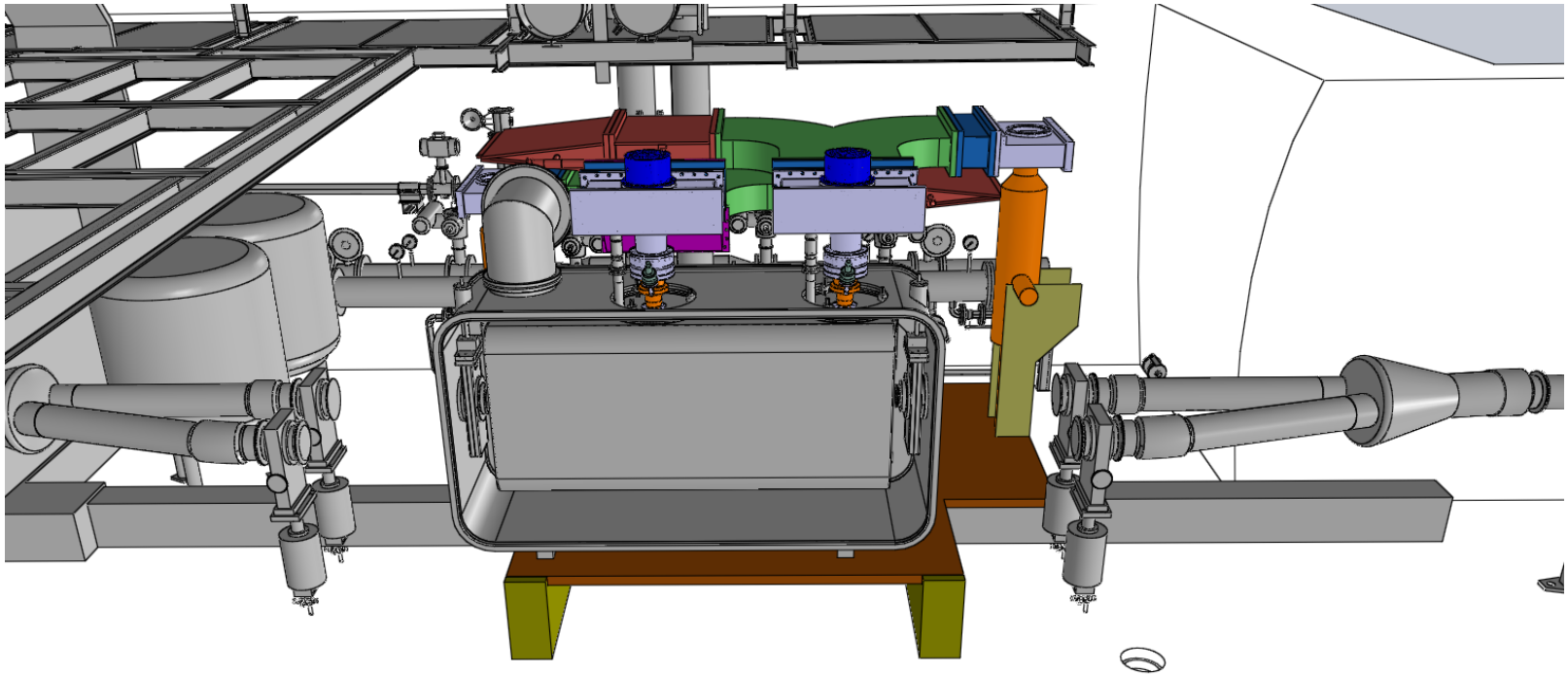
Flexible WG

(allowing integration of all three designs)



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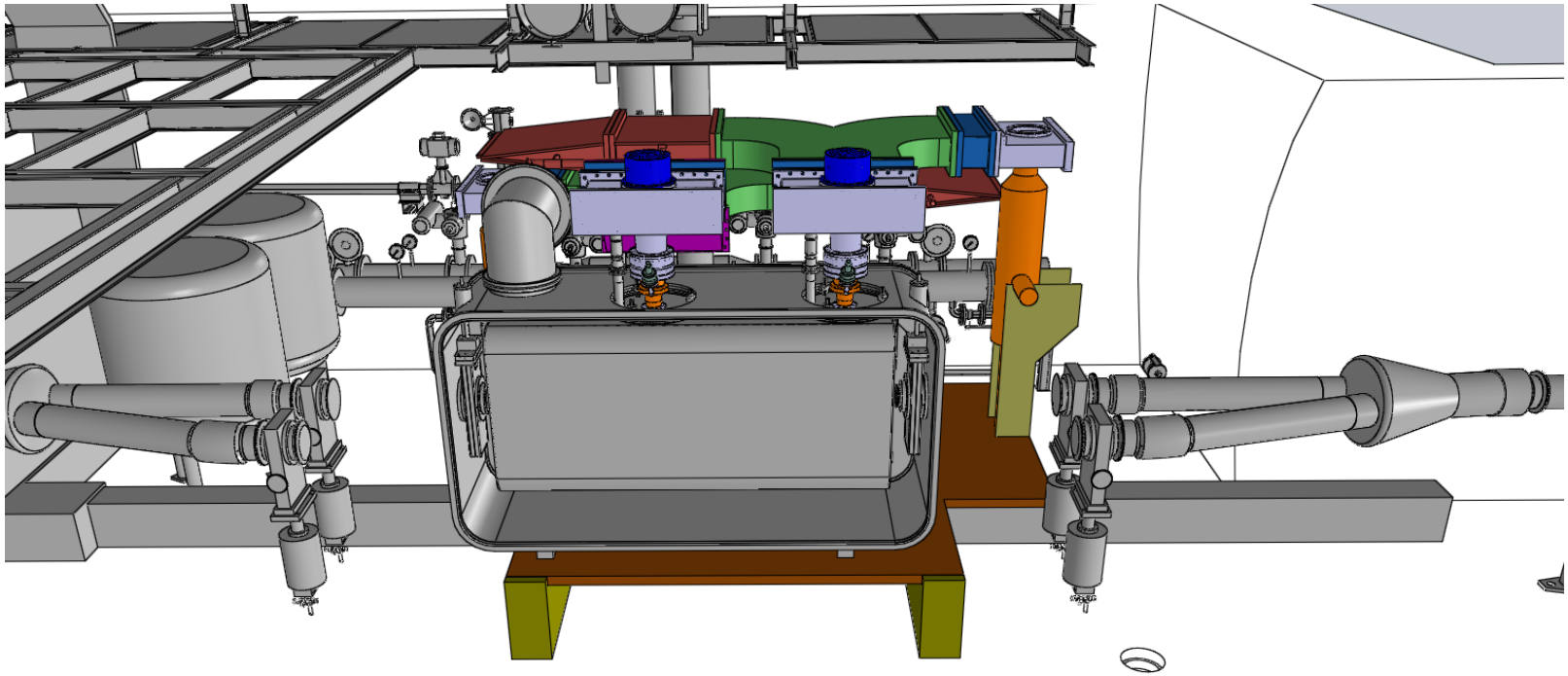
Flexible WG

(allowing integration of all three designs)



Phoevos Kardasopoulos

Services

Electrical network

- Power: 250 kVA
- UPS: 10 kVA

Cooling & Ventilation

- Water: 100 kW
- Air: 20 kW

HVPS + SSPA Drivers accessible with beam

Finals accessible with RF on short at the output of the circulator

Control room for Controls and Monitoring & LLRF

Thank you