# MIRACLES, an update for the IKON19 meeting

Félix J. Villacorta and Jorge R. González,

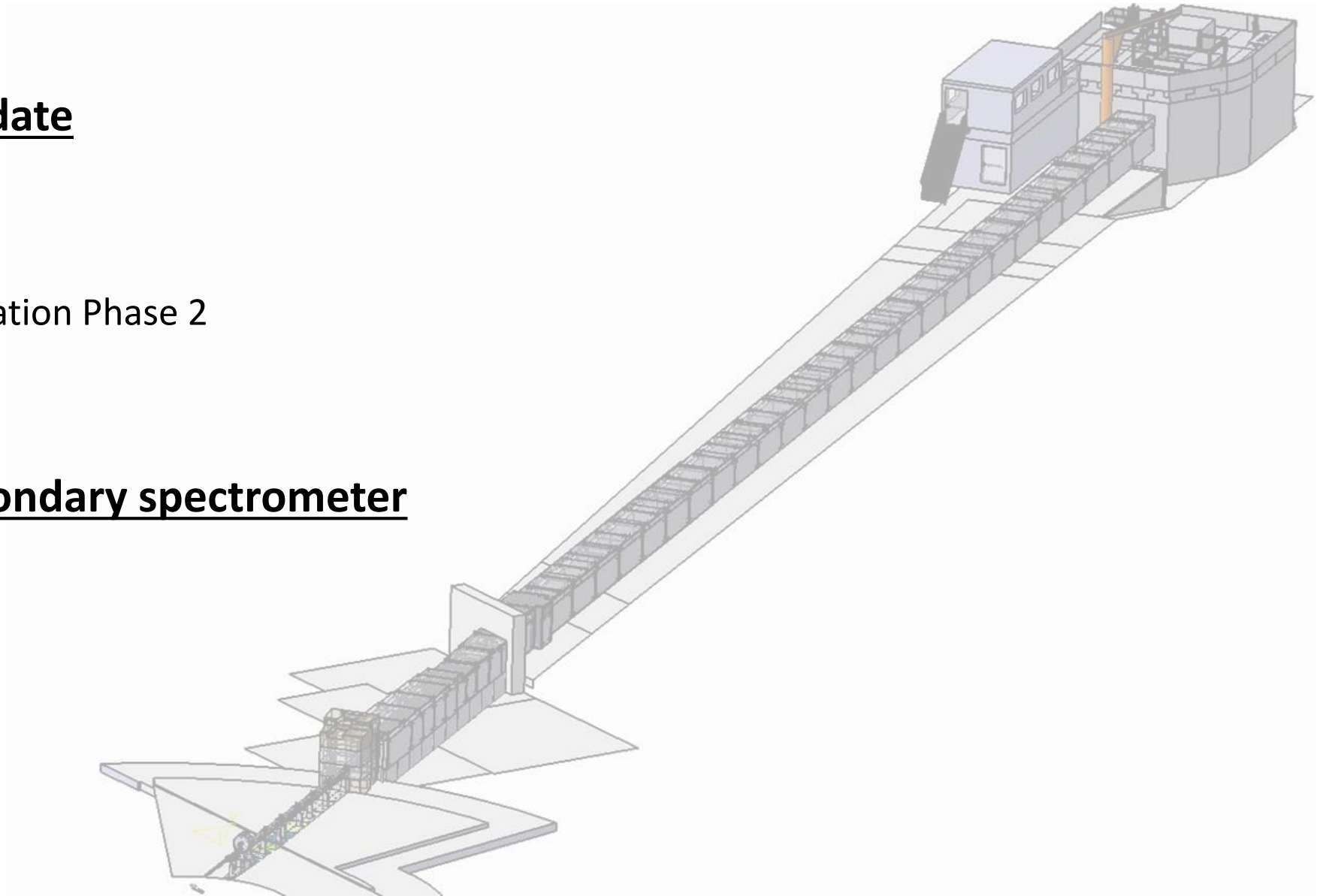
on behalf the MIRACLES team

# Outline

## General update

- ❑ Resources
- ❑ Schedule
- ❑ Documentation Phase 2

## Update secondary spectrometer



# Update on HHRR

- New Lead Engineer: Jorge R. González (July)

- MIRACLES Team for the Detailed Design phase

Panel

Editar

## MIRACLES - The ToF-Backscattering spectrometer at the ESS

Creado por Zsuzsa Helyes, modificado por última vez por Felix Villacorta hace un momento

This is the collaboration area for the MIRACLES Project.

The project is in Phase 2. The main responsible of the delivery of the instrument is ESS-Bilbao. The main workforce constituents are:

@Felix Villacorta is the Lead Instrument Scientist

@Jorge Rafael Gonzalez Teodoro is the Lead Instrument Engineer

@Idoia Mazkiaran is the Control Engineer

Giles Harper is the Electrical Engineer

Roberto Martínez is the Data Scientist

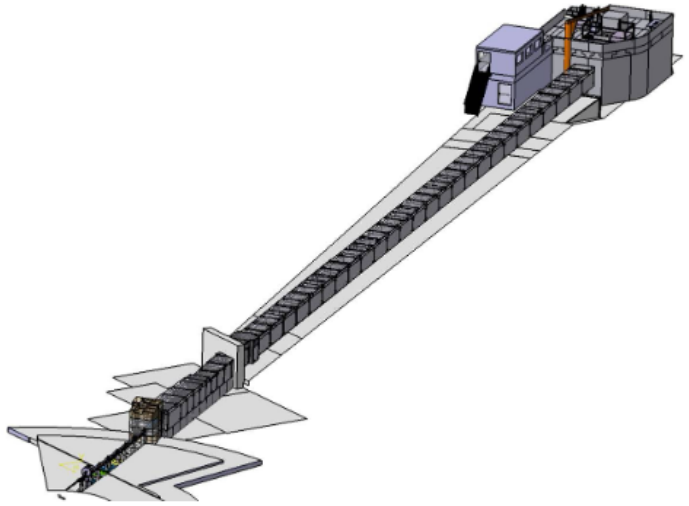
@Octavio Gonzalez and @Miguel Magan are the Neutronic Engineers

@Alexander Conde Estebanez, @Aitor Zugazaga and Gorka Bakedano are the Mechanical Engineers

Heloisa N Bordallo is the Science Advisor (Spectroscopy)

In construction

**MIRACLES Instrument Proposal**



# Update on schedule

- Effects of COVID are remarkable, but we are recovering

## CTVs 2020

- CTV BWI  *More expensive than expected: ~90 mm-thick housing*
- CTV Choppers  *Longer procedure process, because > 600 k€*
- CTV Vessel & In-vessel components → October-November 2020
- CTV out-of-bunker guide → December 2020

## Manufacturing

- NBOA: delayed (Apr-21)

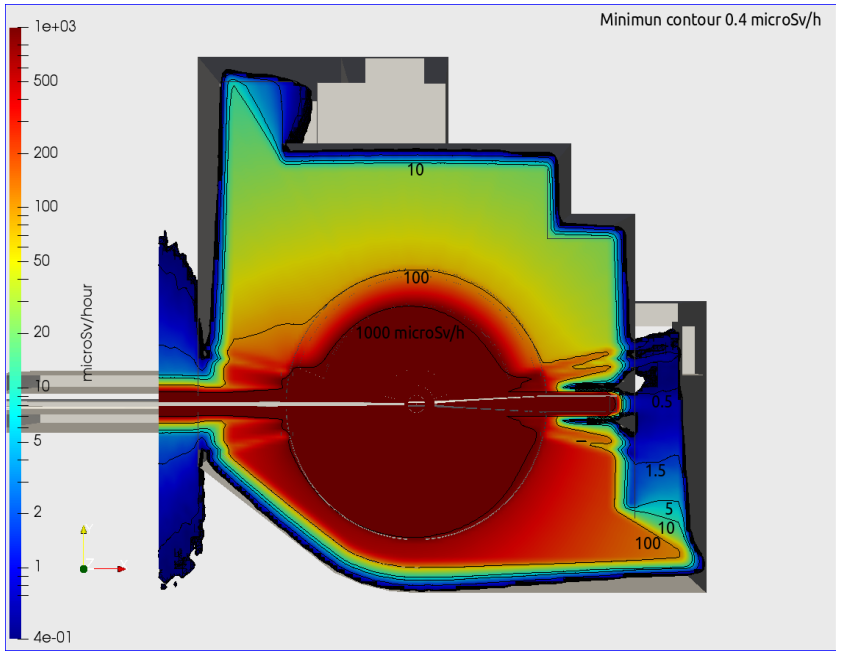
# Documentation: Operation & safety

**H1-H2 scenarios**. Status now…

- ➢ Third round (hopefully last)
- ✓ It seems that we can move ahead with hazard analysis
- ➢ Feedback from PSS is ok as well

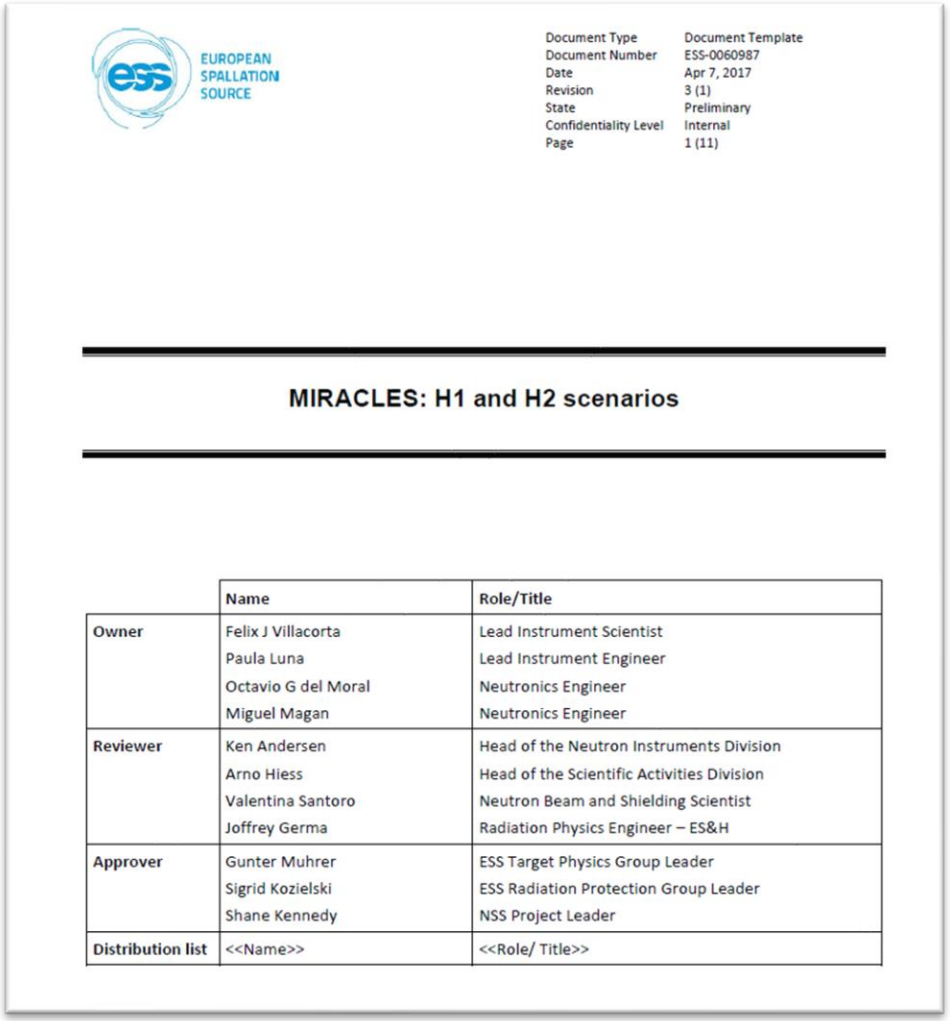
Next steps (2020):

- ➢ IHA
- ➢ Shielding Analysis




Lesson learned:

- ➢ CHESS not good



EUROPEAN SPALLATION SOURCE

| | |
|---|---|
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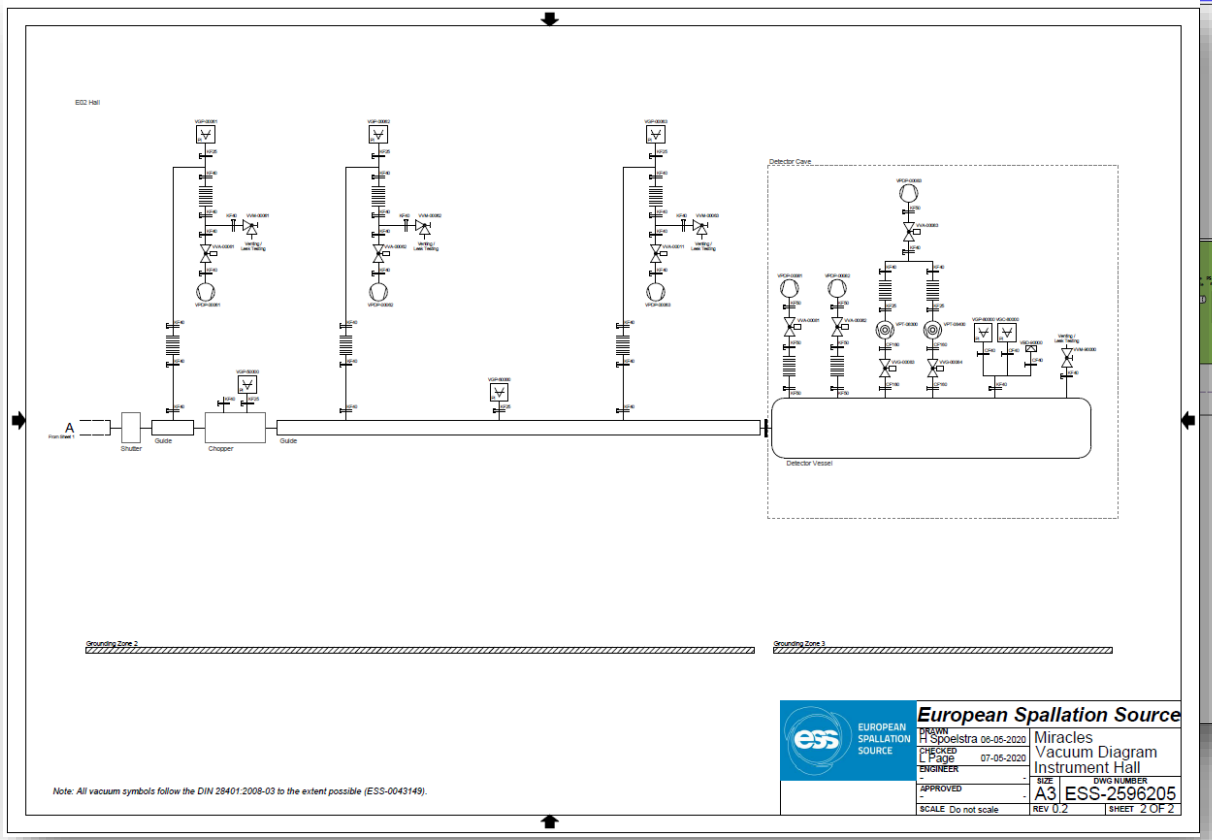
| State | Preliminary |
| Confidentiality Level | Internal |
| Page | 1 (11) |

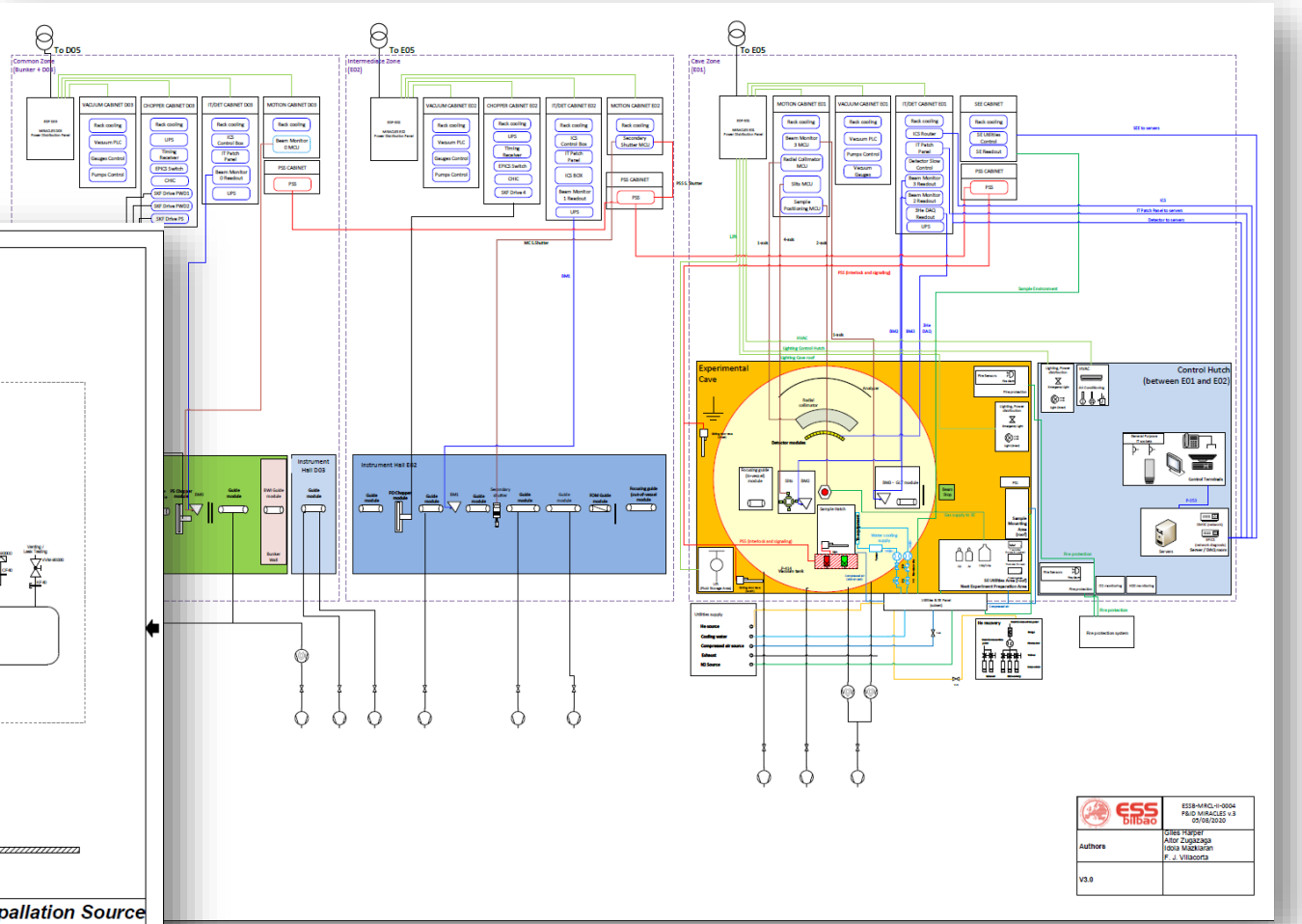
**MIRACLES: H1 and H2 scenarios**

| | Name | Role/Title |
|---|---|---|
| **Owner** | Felix J Villacorta | Lead Instrument Scientist |
| | Paula Luna | Lead Instrument Engineer |
| | Octavio G del Moral | Neutronics Engineer |
| | Miguel Magan | Neutronics Engineer |
| **Reviewer** | Ken Andersen | Head of the Neutron Instruments Division |
| | Arno Hiess | Head of the Scientific Activities Division |
| | Valentina Santoro | Neutron Beam and Shielding Scientist |
| | Joffrey Germa | Radiation Physics Engineer – ES&H |
| **Approver** | Gunter Muhrer | ESS Target Physics Group Leader |
| | Sigrid Kozielski | ESS Radiation Protection Group Leader |
| | Shane Kennedy | NSS Project Leader |
| **Distribution list** | <<Name>> | <<Role/ Title>> |

# Documentation: Diagrams

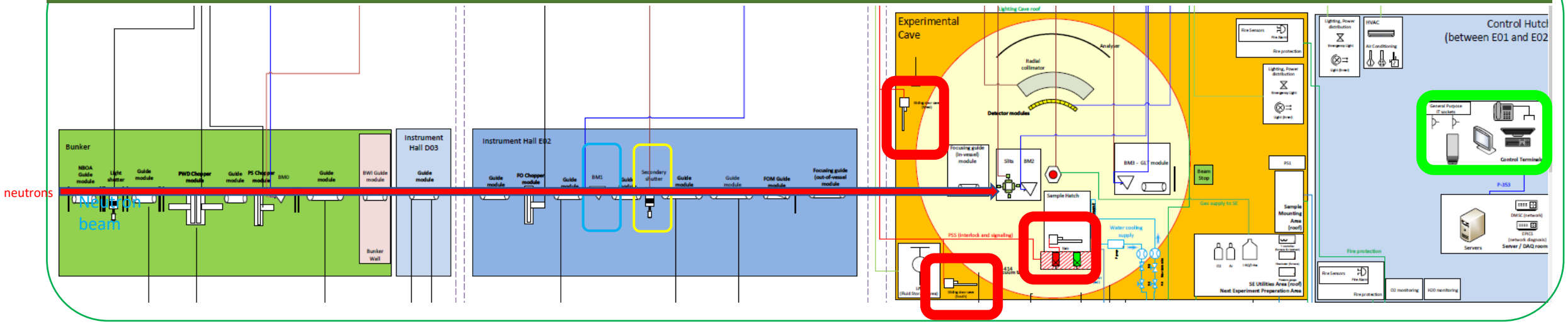
- ✓ Vacuum diagram (Laurence, ESS-2596205 )
- ✓ Power and racks distribution (v2)
- ✓ P&ID (v3)
- ✓ PSS (KOM today)



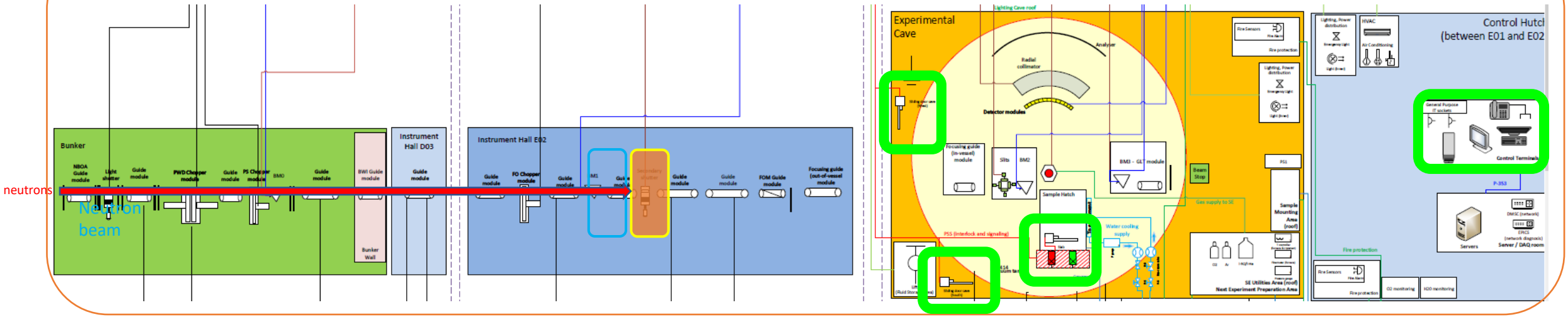



# MIRACLES Operation Secondary shutter as Access shutter

During measurement: experiment *running* → *S*hutter OPEN (Beam ON).




Changing sample *(access to hatch)*, maintenance in the cave,etc,…) → Shutter CLOSE (Beam OFF).

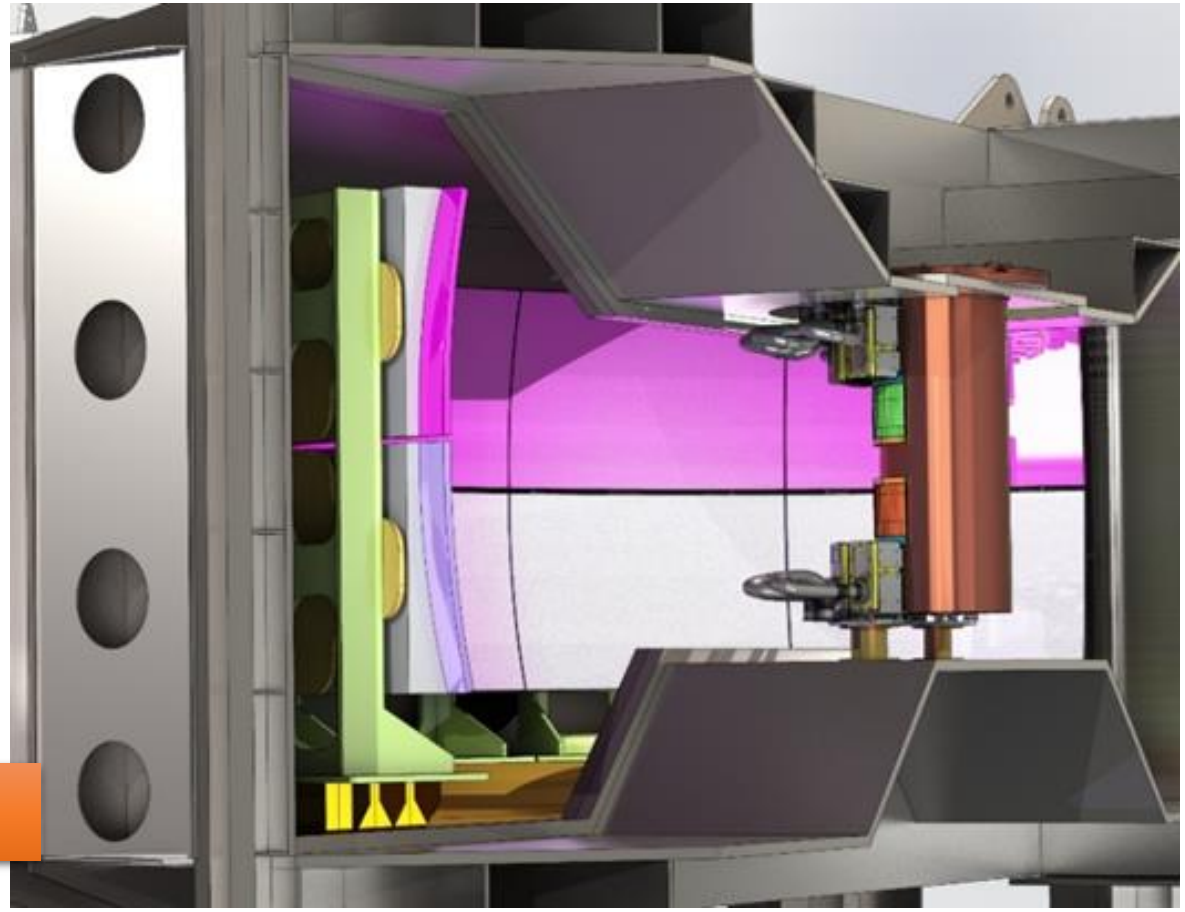


# MIRACLES secondary spectrometer: input in the last 6 months

PDR secondary spectrometer (March 2020)

Engineering team (July 2020)

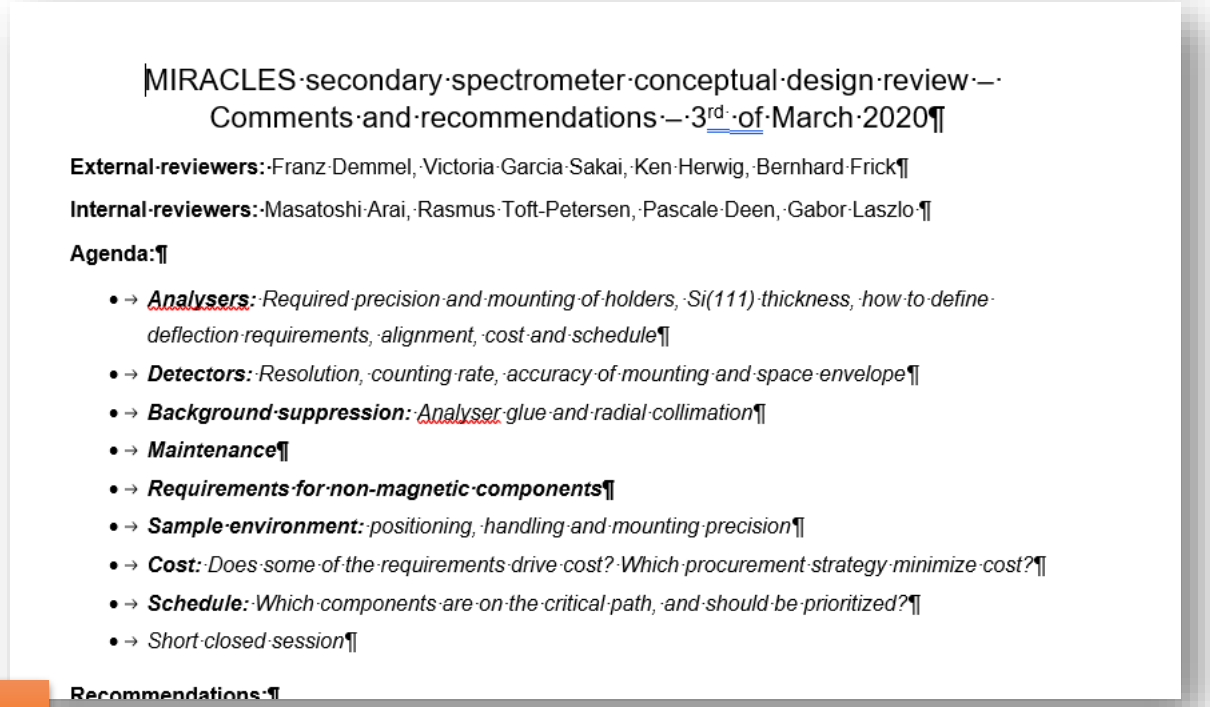
ESS Polarization Workshop (September 2020)



# MIRACLES secondary spectrometer: input in the last 6 months

## PDR secondary spectrometer (March 2020)

- Vessel: dimensions, access points, vacuum
- Analyzer: alignment features, crystal thickness
- Preamps: access and distances ~40 cm



MIRACLES secondary spectrometer conceptual design review – Comments and recommendations – 3rd of March 2020

**External reviewers:** Franz Demmel, Victoria Garcia Sakai, Ken Herwig, Bernhard Frick

**Internal reviewers:** Masatoshi Arai, Rasmus Toft-Petersen, Pascale Deen, Gabor Laszlo

**Agenda:**

- ***Analysers:*** *Required precision and mounting of holders, Si(111) thickness, how to define deflection requirements, alignment, cost and schedule*
- ***Detectors:*** *Resolution, counting rate, accuracy of mounting and space envelope*
- ***Background suppression:*** *Analyser glue and radial collimation*
- ***Maintenance***
- ***Requirements for non-magnetic components***
- ***Sample environment:*** *positioning, handling and mounting precision*
- ***Cost:*** *Does some of the requirements drive cost? Which procurement strategy minimize cost?*
- ***Schedule:*** *Which components are on the critical path, and should be prioritized?*
- *Short closed session*

**Recommendations:**

## Engineering team (July 2020)

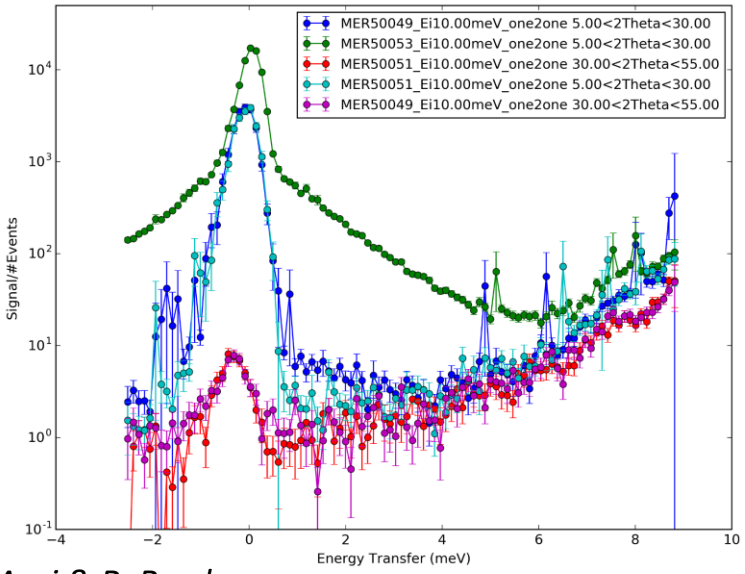
- Jorge: Background design vessels (ITER)
- Aitor & Alex: alignment & fixations (ESS MEBT)

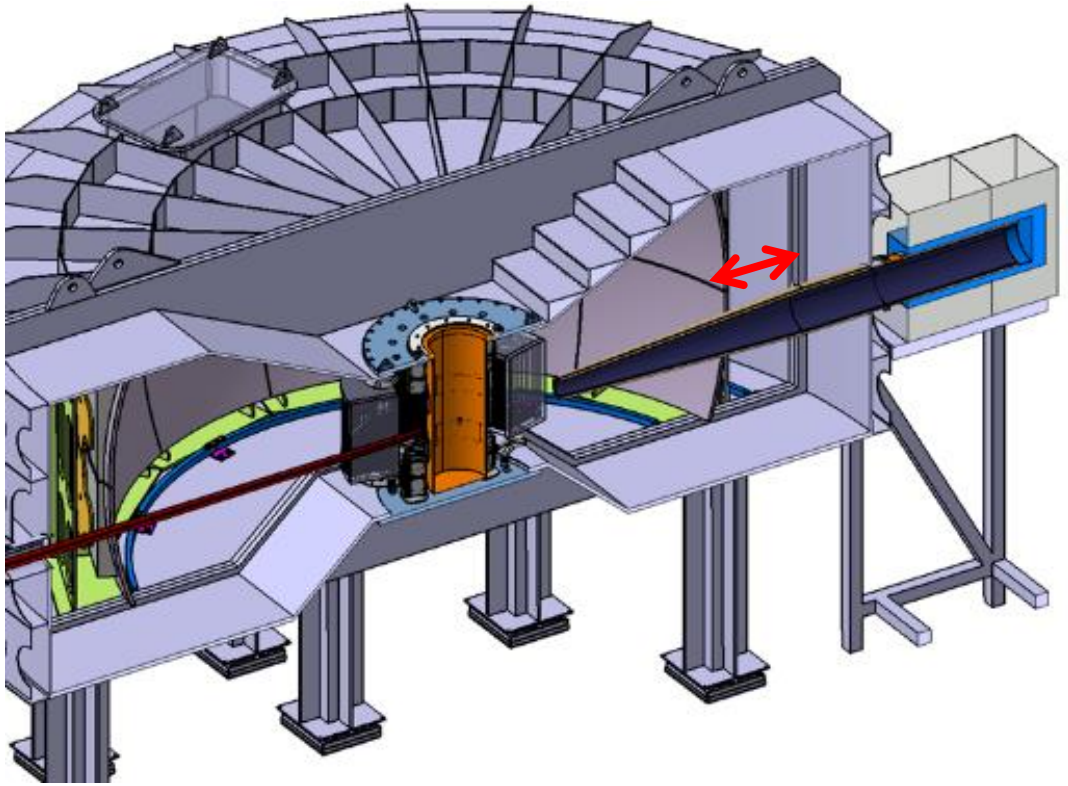
## ESS Polarization Workshop (September 2020)

- Implementing new capability (first thoughts)
- Redimensioning in-vessel components (radial collimator) and vessel

# Vacuum vessel

- Vessel diameter reduction:
  - No need for lateral access (analyzer alignment from the front). Bottom access (in progress)
  - Better mechanical properties anticipated
- Strategy for dealing with tank deformation considered beforehand:
  - Preliminary mechanical analysis (October)
- Air scattering:
  - ✓ Improve vacuum level down to ~E-4 mbar



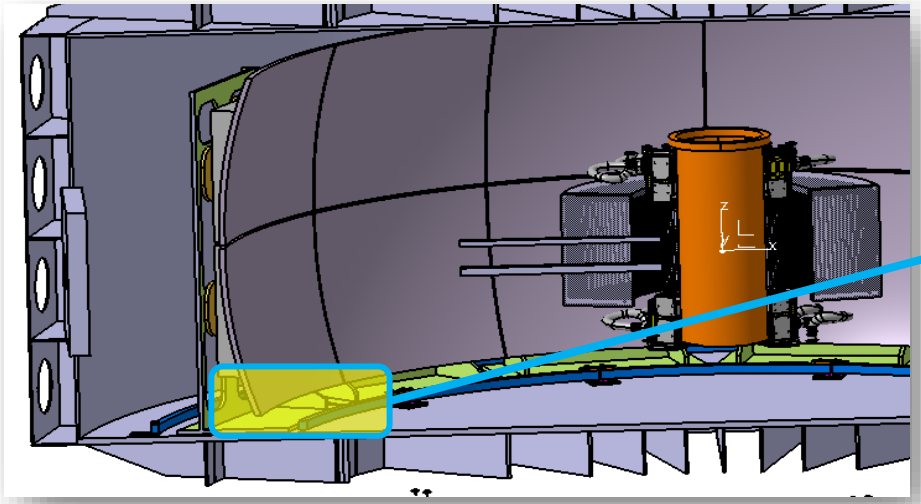



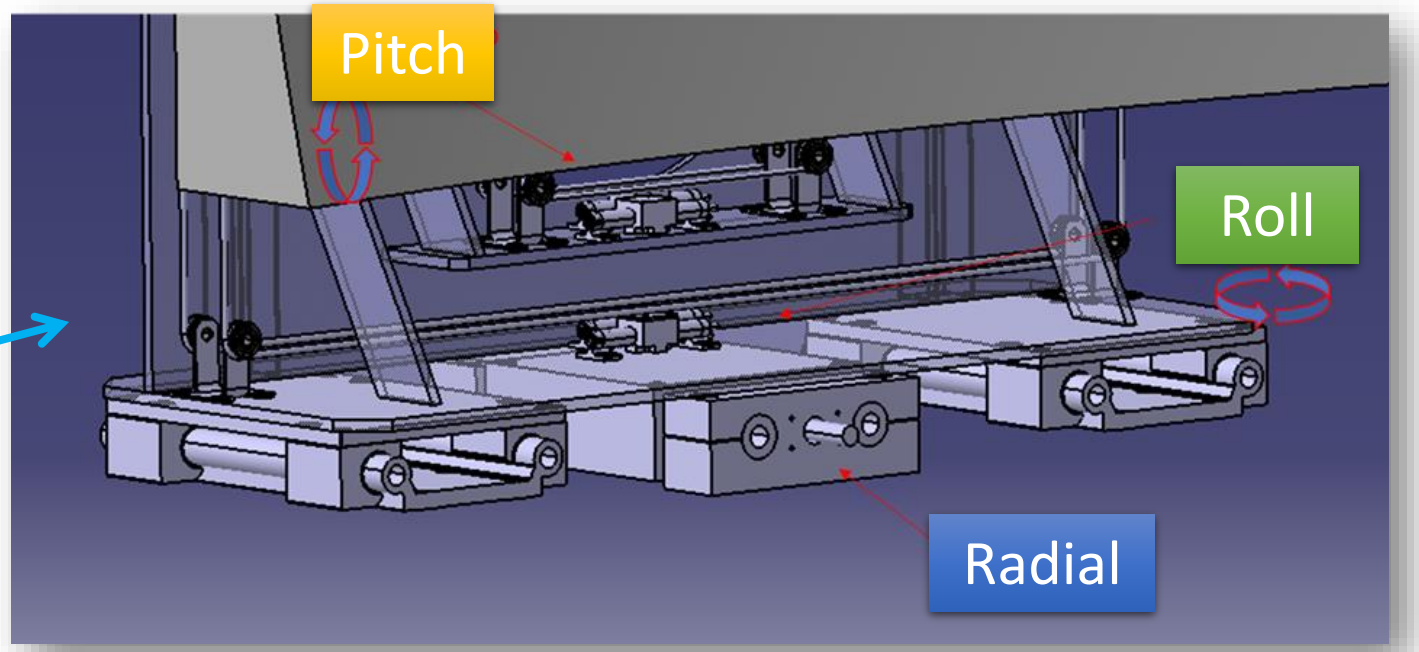
*Courtesy: M. Arai & R. Bewley*

# Analyzer: frame

- Panel alignment from the front:
  - ✓ Positioning system: transmission from the back, handling from the front
  - ✓ Independent angular motion for panels
  - ✓ Translation, every set of top-bottom panels
  - ✓ Angular tilting, every panel independently

- Translation:
  - Vertical alignment.
  - Horizontal alignment (radial).
  - Accuracy < 0.5 mm.
- Angular tilting:
  - Pitch: to focus center vertically.
  - Roll: to focus center horizontally.
  - Yaw: not needed.
  - Rotation range: ±3º.
  - Angular spread: ±0.15º.



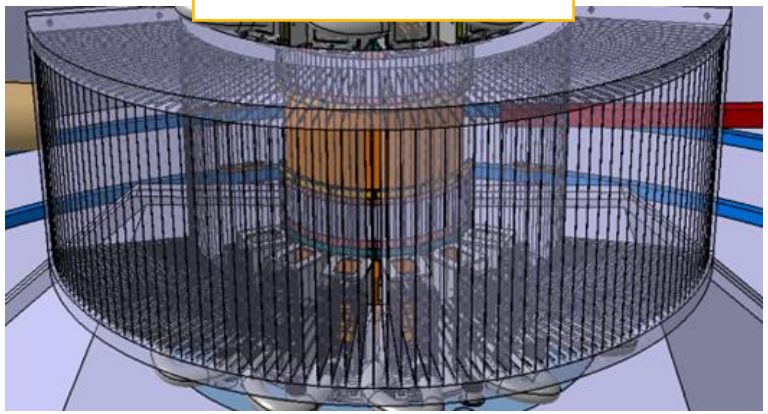


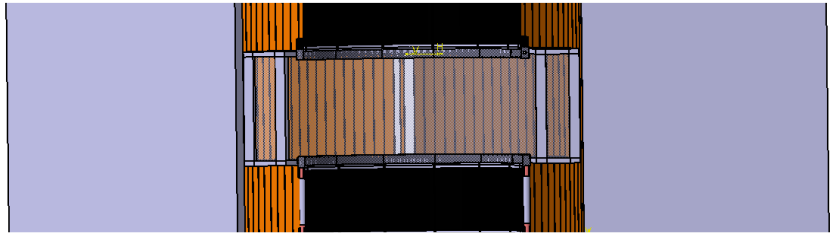
# Radial collimator

## Polarization analyzer ($^3$He cell) into the MIRACLES design

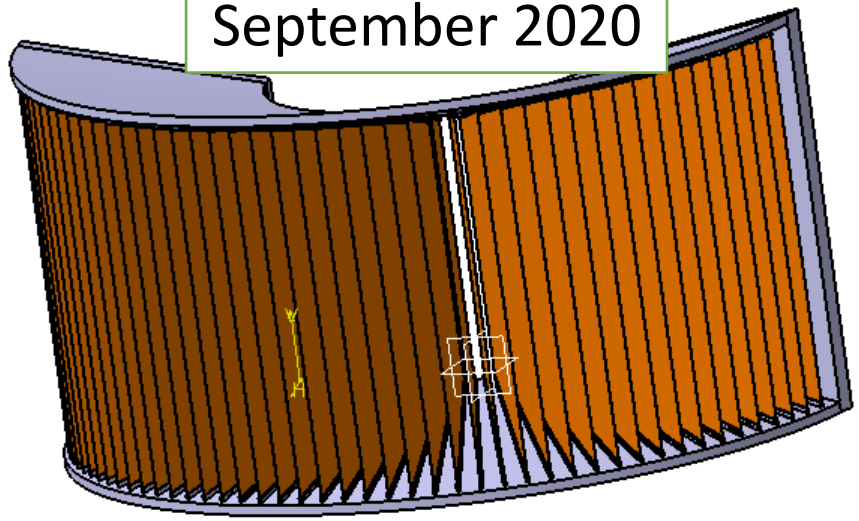
- Wide angle $^3$He cell
  - ✓ Horizontal angular coverage: 9,5-165º
  - ✓ Thickness: 90 mm (R=250-340 mm)
- Revision of the inner radius of the radial collimator (from $r_m$=300 mm to $r_m$ =350 mm).
- To maintain focal/gauge width of 70 mm (cryostat bore), the outer radius should be increased ($R_M$=805 mm).

March 2020





September 2020



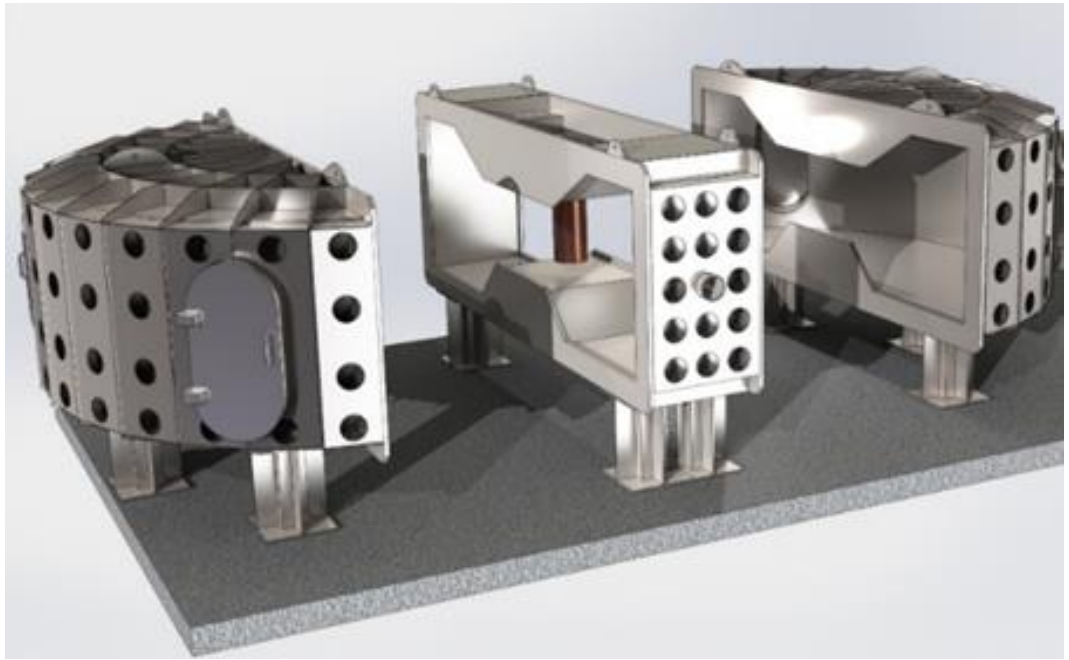
***Analytical calculations***

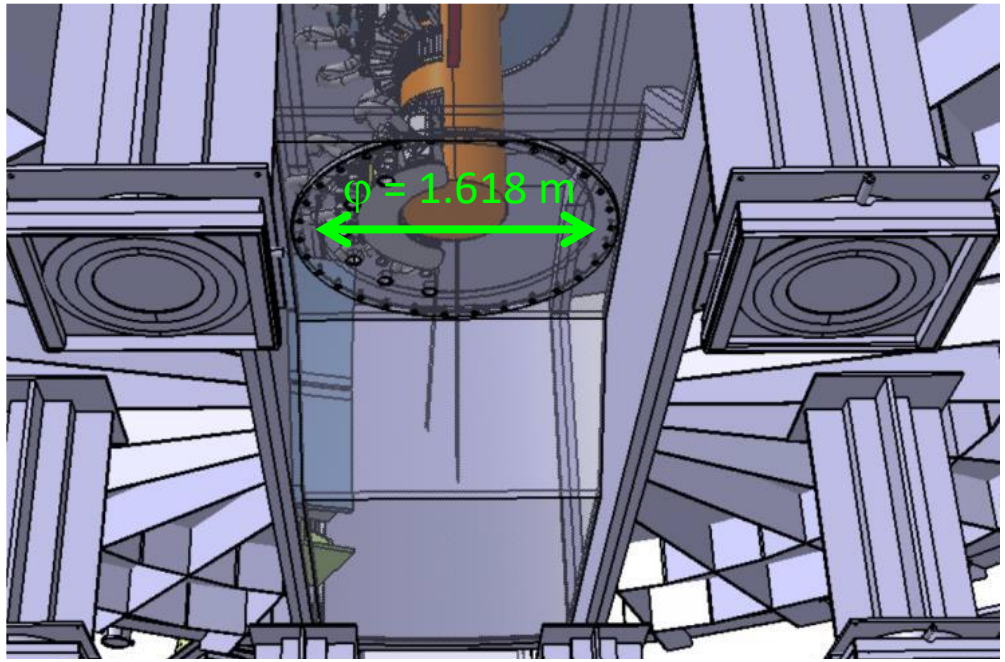
| | | | | | Backwards pathway | | |
|---|---|---|---|---|---|---|---|
| $r_m$ (mm) | $R_M$ (mm) | T | 2Y | R | $a_m$ (mm) | γ/2 (º) | Detectors bathed |
| 300 | 931 | 0.70 | 50 | 0.076 | 8.48 | 0.21 | 1.3 |
| 300 | 582 | 0.79 | 70 | 0.106 | 8.48 | 0.21 | 1.3 |
| 350 | 805 | 0.79 | 70 | 0.106 | 9.90 | 0.25 | 1.6 |
| 350 | 692 | 0.81 | 80 | 0.121 | 9.90 | 0.25 | 1.6 |
| 400 | 920 | 0.81 | 80 | 0.121 | 11.31 | 0.29 | 1.8 |

# Vessel: lower lid and vessel segments

## Design efforts to accommodate PA capability into the MIRACLES design

- This conveys a final increase of the lower lid diameter, since this flange is used for installation and maintenance of the radial collimator.
- Re-dimensioning the lower flange leads to a re-evaluation of the dimensions for the 3 segments that comprise the vessel (the central segment becomes larger).



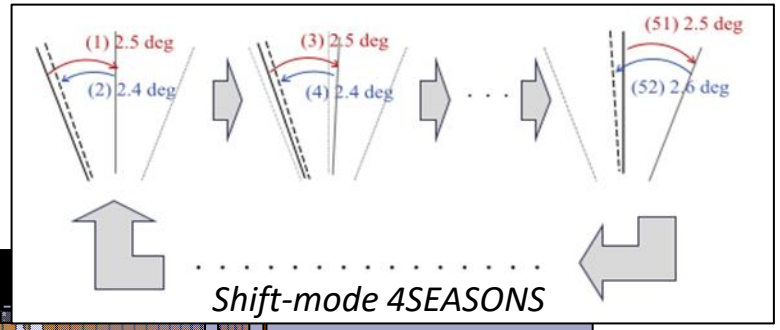


# Radial collimator: motion control

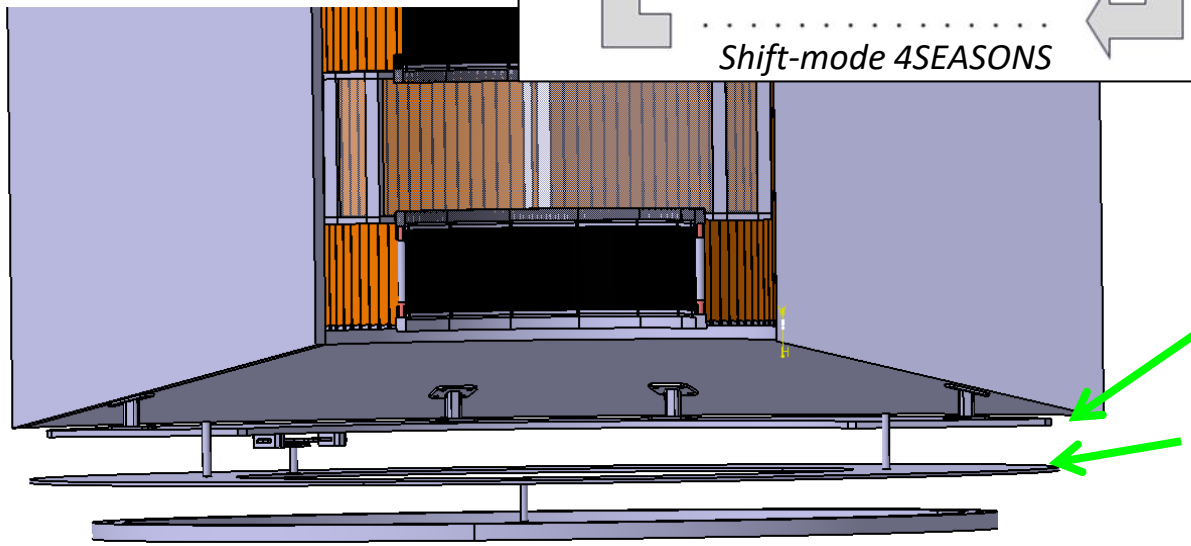
- ✓ Oscillation, 3 options:
- Static (PDR)
- Standard oscillation (3.24º)
- Shift-mode oscillation (4SEASONS @ J-PARC)

- ✓ Removal: 180º

| Horizontal Movement | Motion range (º) | Precision (º) | Use |
|---|---|---|---|
| 1. Oscillation | 3.24 | ±0.1 | Operation |
| 2. Removal | 180 | ±0.1 | Maintenance |

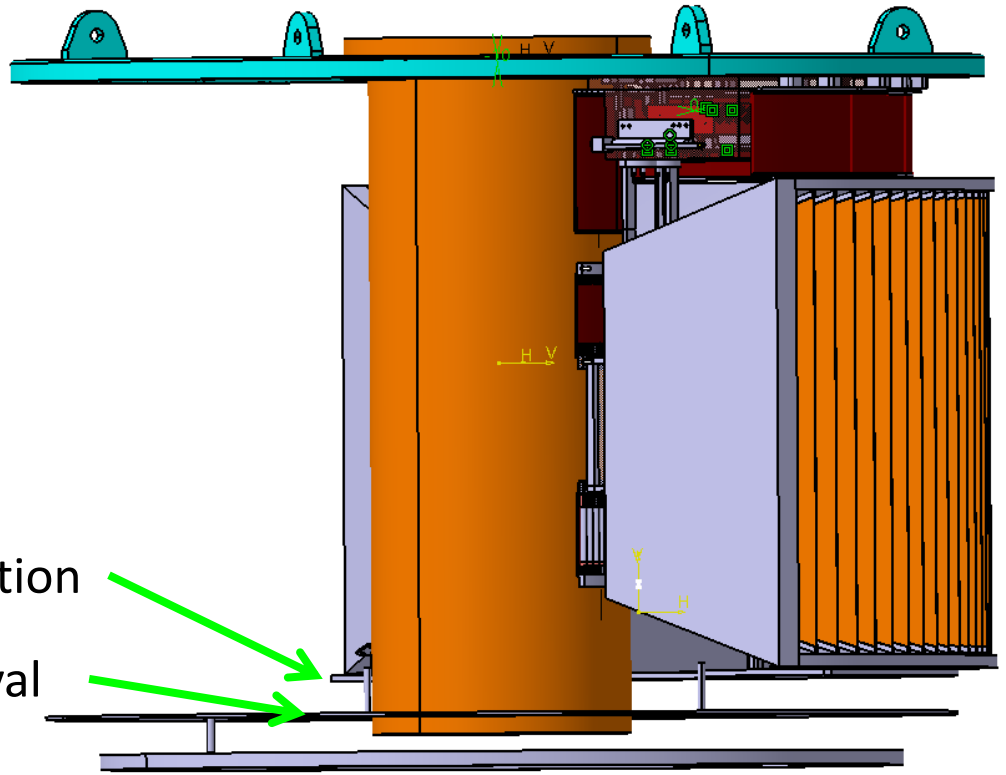


*Shift-mode 4SEASONS*



Oscillation

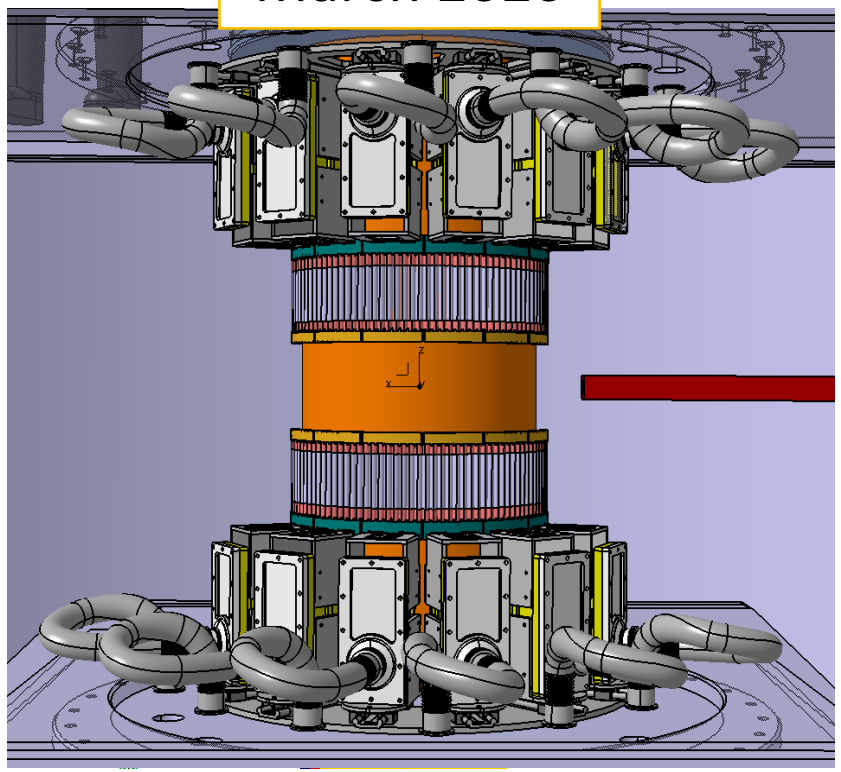
Removal



# Pre-amps

- ✓ Preamps can be located at >20 cm from the $^{3}He$ tubes
- ✓ More compact design of PA air boxes
- ✓ Direct access from top (where the scientist is) and air conditions
- ✓ Also the upper lid diameter was increased

March 2020



September 2020