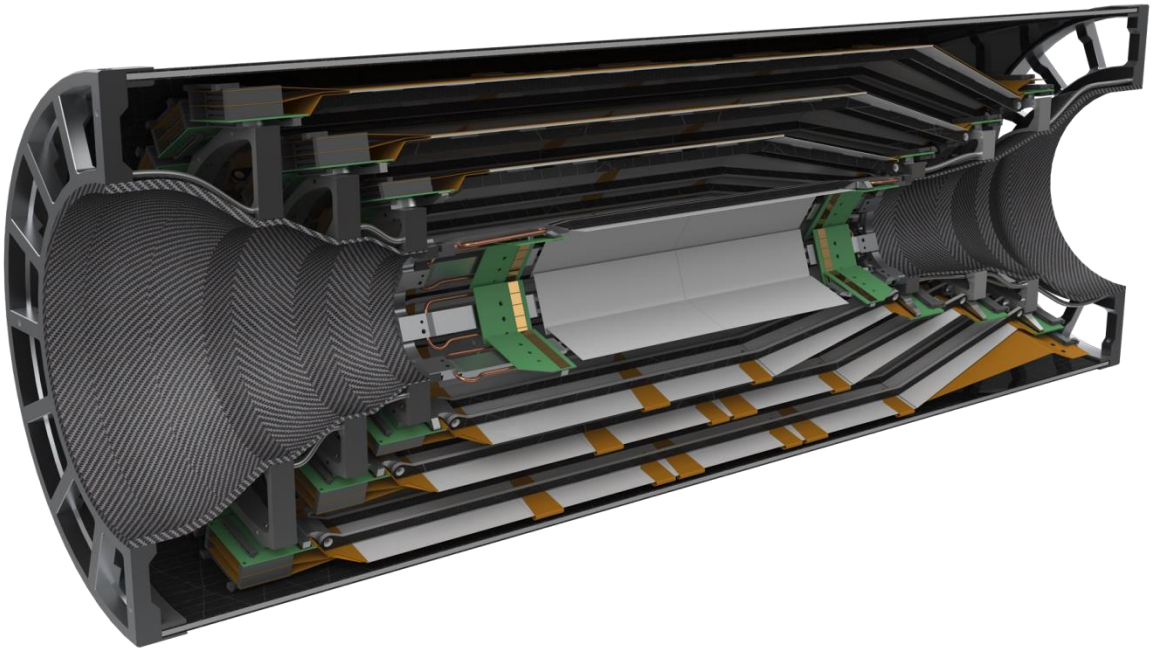


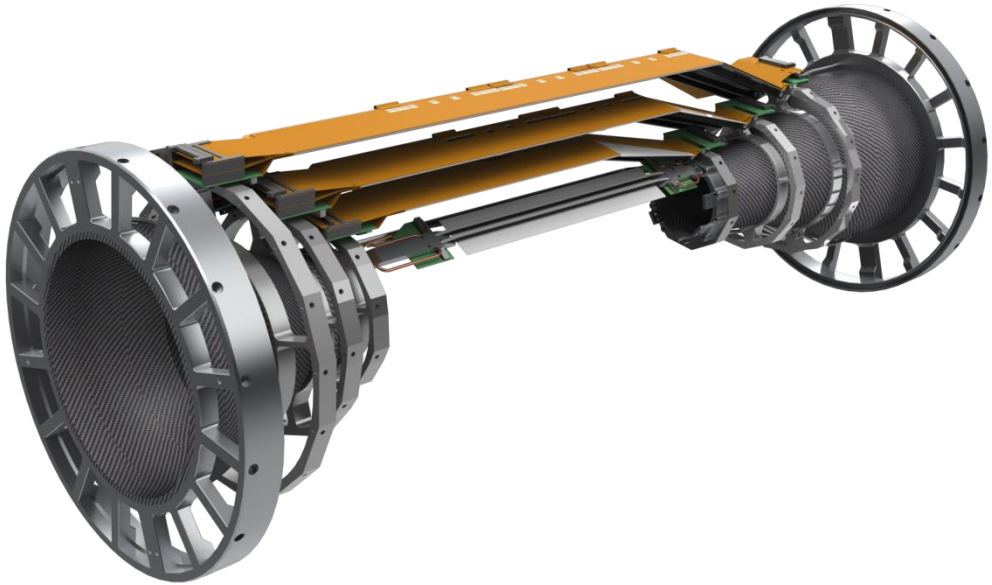
Belle II SVD Overview

Immanuel Gfall (HEPHY Vienna)

26 April 2013

Detector Overview

- The SVD consists of 4 Layers
- Each Layer is supported by end rings
- The end rings are supported by the support cones
- The support cones are connected with the CDC through the end flanges



General Dimensions

- Length: 925 mm
- Largest diameter: 313 mm
- Smallest diameter: 68.36 mm

Layer	Radius [mm]	Ladder #	Windmill °	Overlap %
6	135	16	7	10.8
5	104	12	5	5.1
4	80	10	6	17.6
3	38	7	6	5.9

Design Goals of the Mechanical Structure

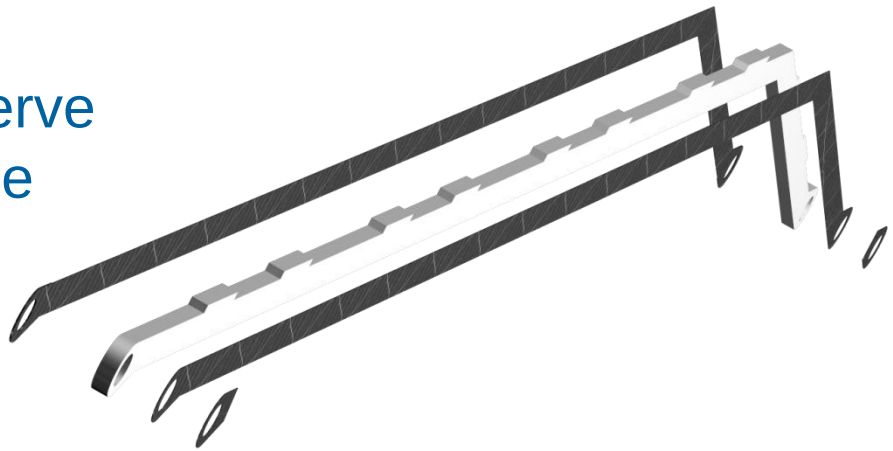
- Lowest possible material budget
- Maximum gravitational sag equal or lower than 100µm over a length of 700mm
- Minimum coefficient of thermal expansion (CTE)
- Match or compensation of CTE at joints
- Radiation hardness up to 10 Mrad
- Compliant with the Origami concept
- Reproducible production quality

Mechanical Component Groups

- Ribs
- Mount Blocks
- Ladder
- End rings
- Support Cone
- End flange
- Support shell

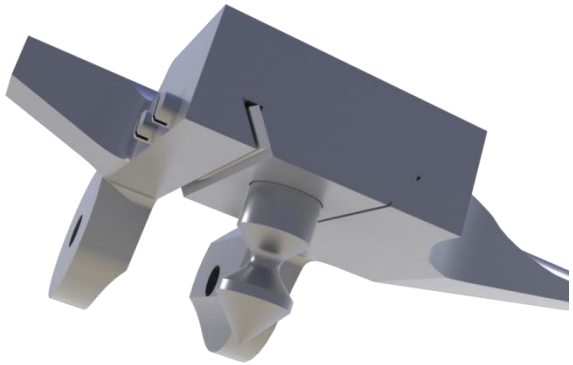
Ribs

- The ribs support the Origami Sensor Modules
- They are made from carbon fibers and Airex R82
- Due to their sandwich composite structure, they are extremely light, stiff and have a low material budget
- The contact surface between the ribs and the sensors are the “stand-offs”
- Those are pillars to separate the electrically conductive fiber from the sensor
- Inserts glued into each hole serve as the rib mount block interface



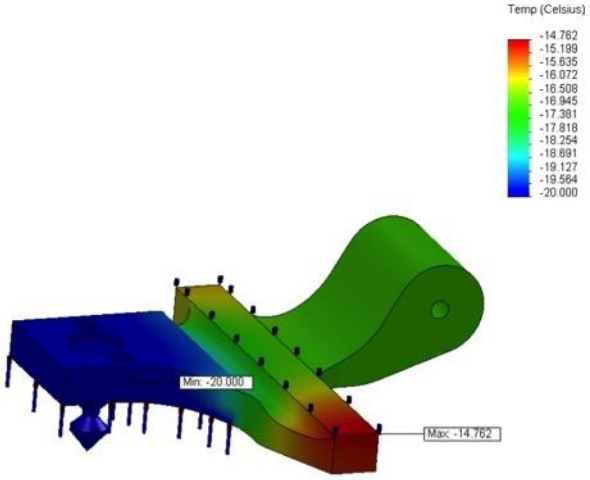
Mount blocks

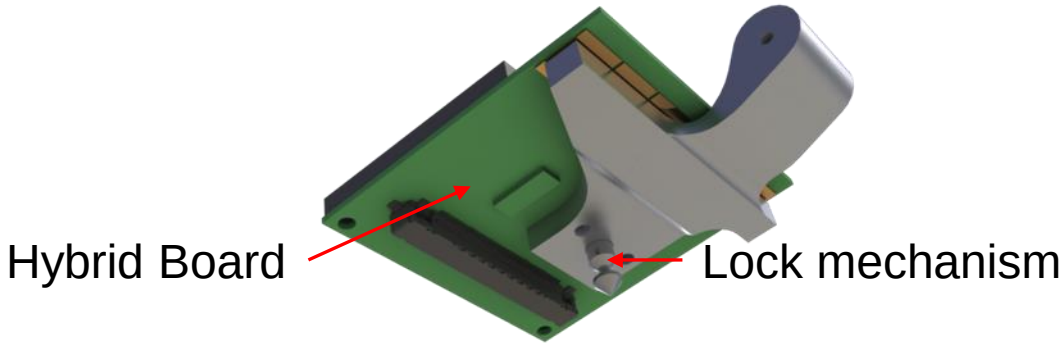
- The are the interface between the ribs and the main support structure
- They serve also as a cooling block that conducts the dissipated heat from the APV's to the actively cooled end rings
- They feature the a Simple Locking Mechanism (SLM) which can be tightened from the side and does not require top access



Mount Block

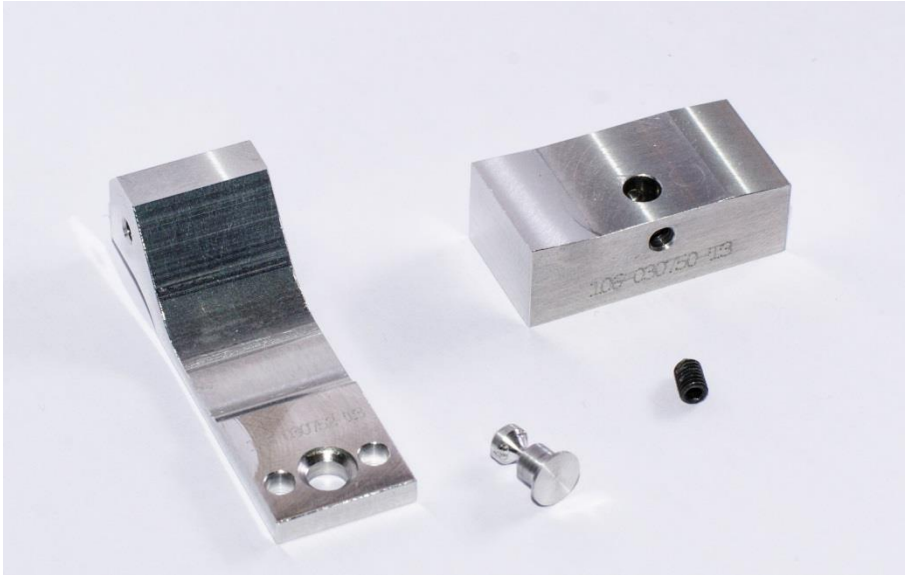
- The mount block has been thoroughly redesigned
- The new design is optimized for heat transport
- The backward SLM is overhauled and several mockups prove the concept
- Thermal simulations suggests a small thermal gradient on the APV cooling contact surface (~2.5 K)





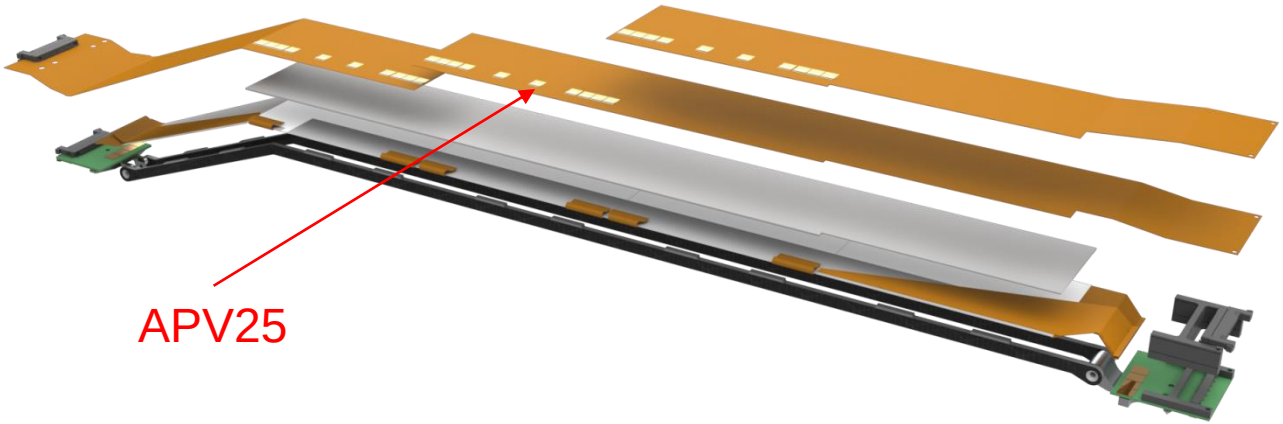
SLM

- Single precision pin with a groove
- The pin determines the position
- The groove is used to pull down and fix the pin in the end ring
- This locking mechanism is accessible during installation

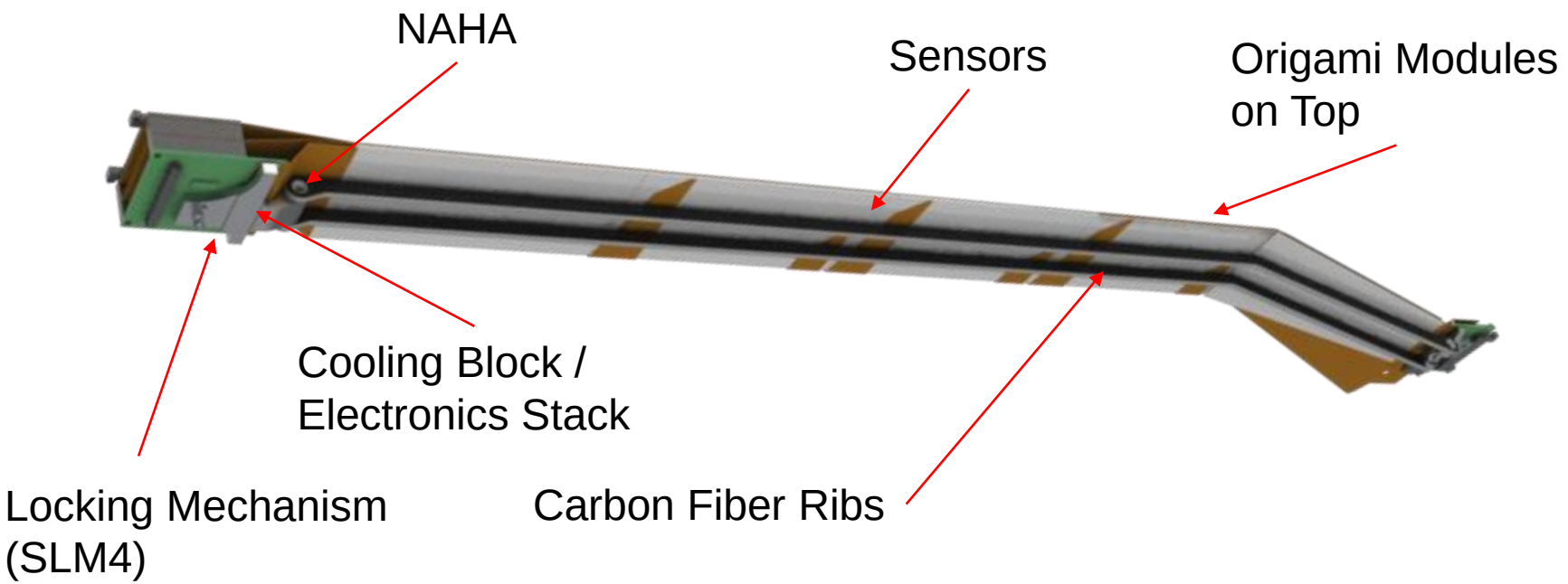


Ladder

- A ladder consists of sensors, and readout electronic
- Those components are carried by the carbon fiber sandwich ribs and connected to a rigid support structure (end rings) by the mount blocks
- A ladder is the smallest replaceable unit within the SVD

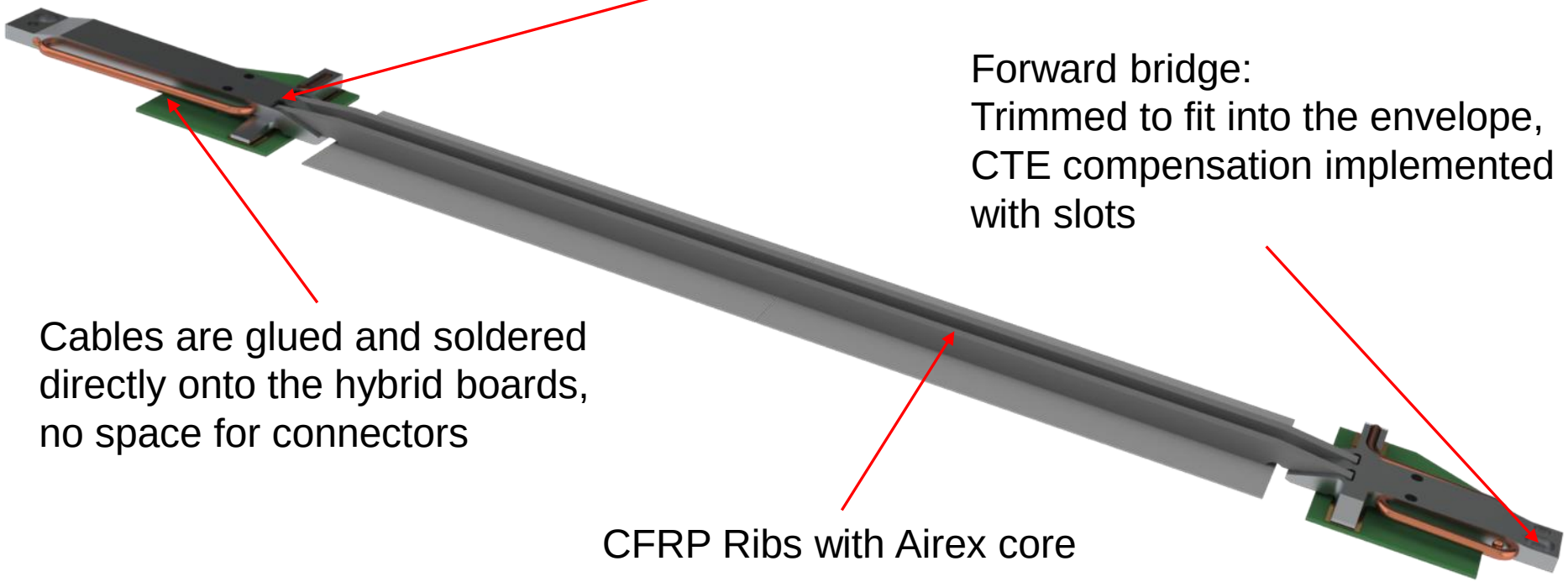


Composition of a Ladder



Ladder 3

Backward bridge:
longer than the forward bridge, has no CTE compensation (fixed position), heat transport optimized with heat pipes



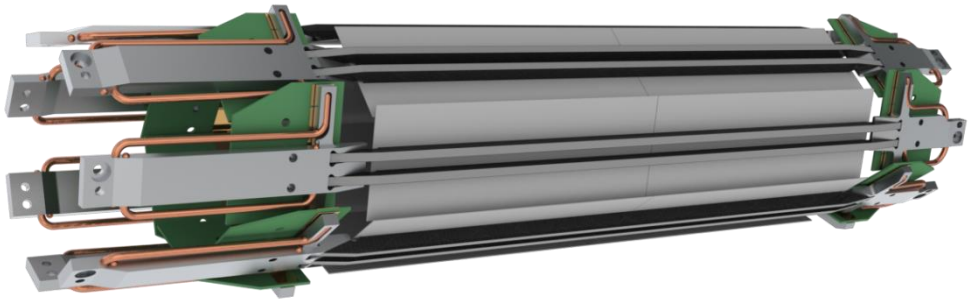
Forward bridge:
Trimmed to fit into the envelope, CTE compensation implemented with slots

Cables are glued and soldered directly onto the hybrid boards, no space for connectors

CFRP Ribs with Airex core

Layer 3

- Differs from the other layers in many aspects
- No slant angle but close proximity to the adjacent layers
- Sensor support is a carbon fiber / Airex sandwich
- The proximity to the layer 4 requires a mounting scheme different from the other layers

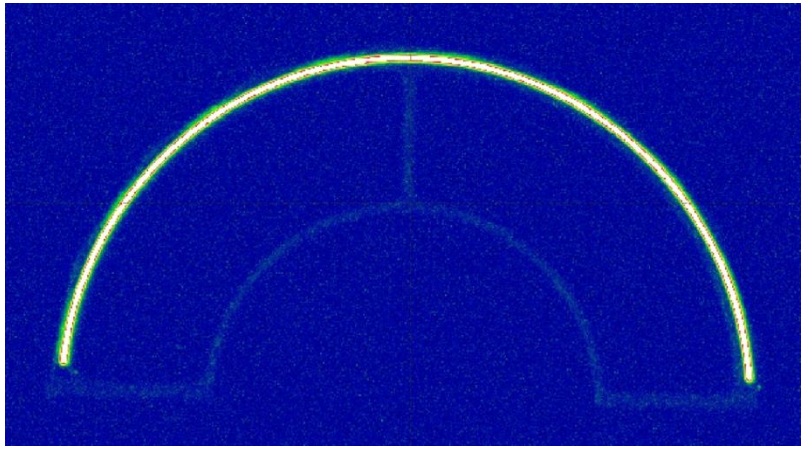


End Ring

- End rings provide the interface between the ladders and the support structure
- The feature internal cooling channels
- Each layer has two end rings that are split in half
- Layer 3+4 share one end ring

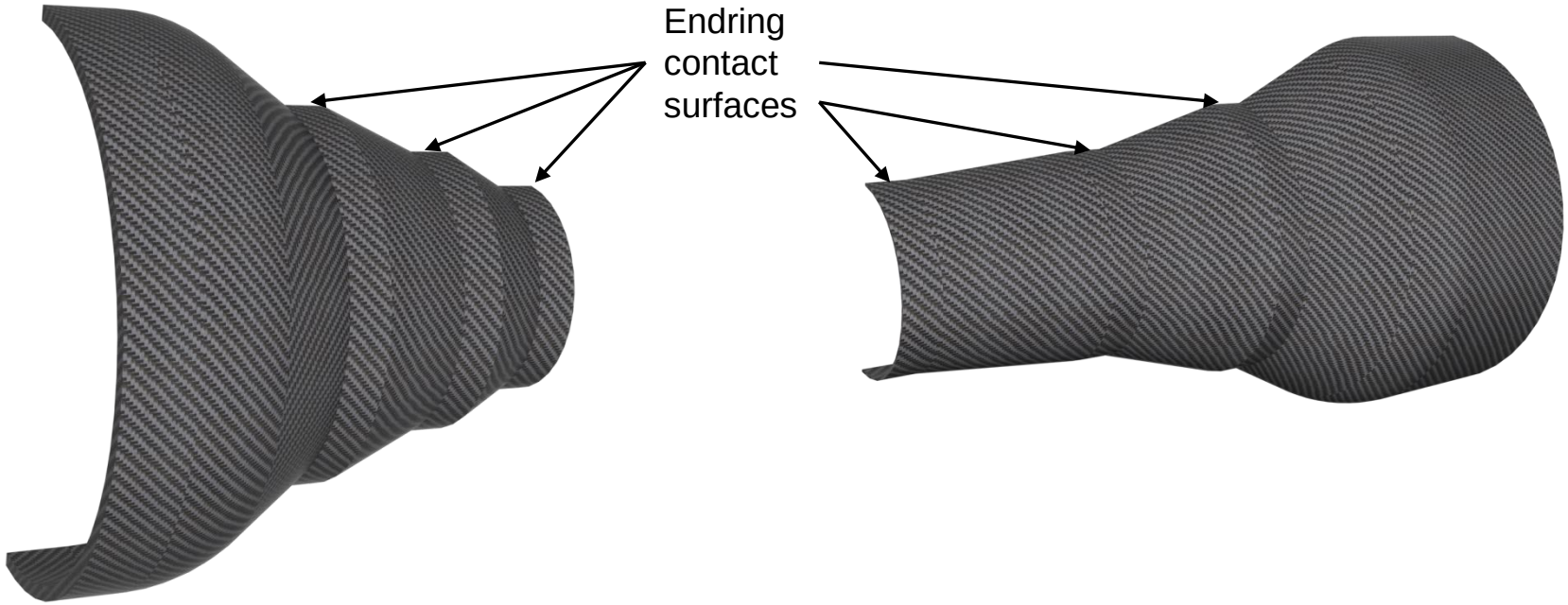
End Ring Cooling

- One half end ring consists of two pieces with a half circled groove
- The halves are then combined with diffusion welding
- This process leaves a circular channel inside of the end ring without a strength sacrifice
- Connecters are brazed into the stainless steel end rings



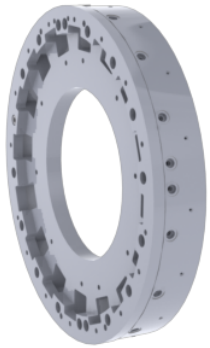
Support Cones

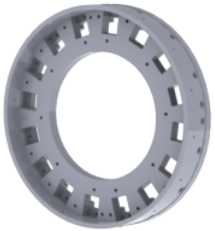
- Carbon fiber cones are used to position the end rings
- Lightweight thin shells that provide some degree of thermal insulation
- Separates PXD and SVD Volume



End Flanges

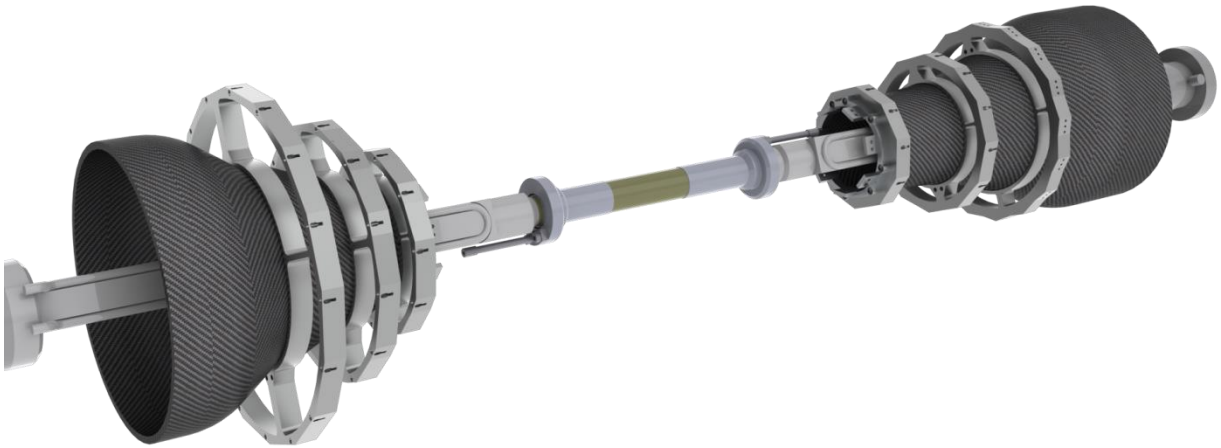
- The end flanges provide an interface between the SVD and the surrounding detector
- This part needs to carry the full SVD load including heavy metal shielding
- Slots need to provide space for services (cooling, cables)
- End flanges encapsulate the nitrogen volume of the SVD





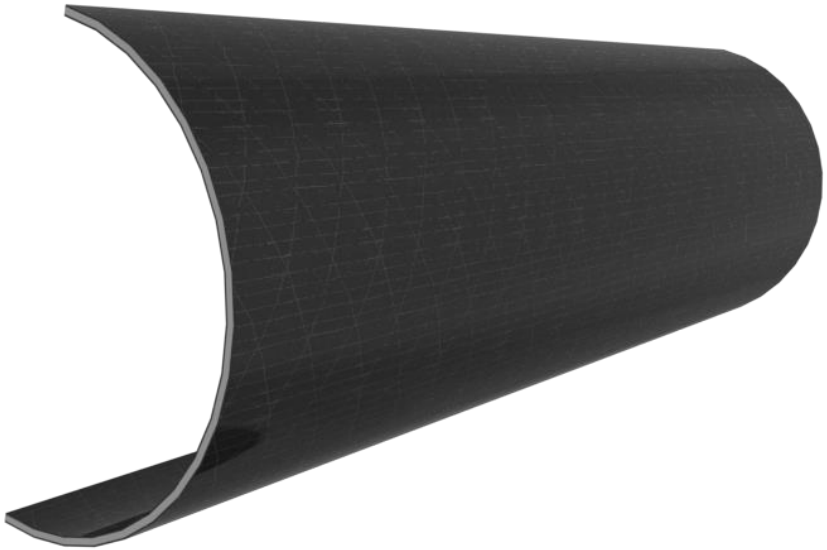
SVD Support Structure

- The support structure consists of all end rings, support cones and the end flanges
- This structure needs to be separable
- The support structure encloses the beam pipe



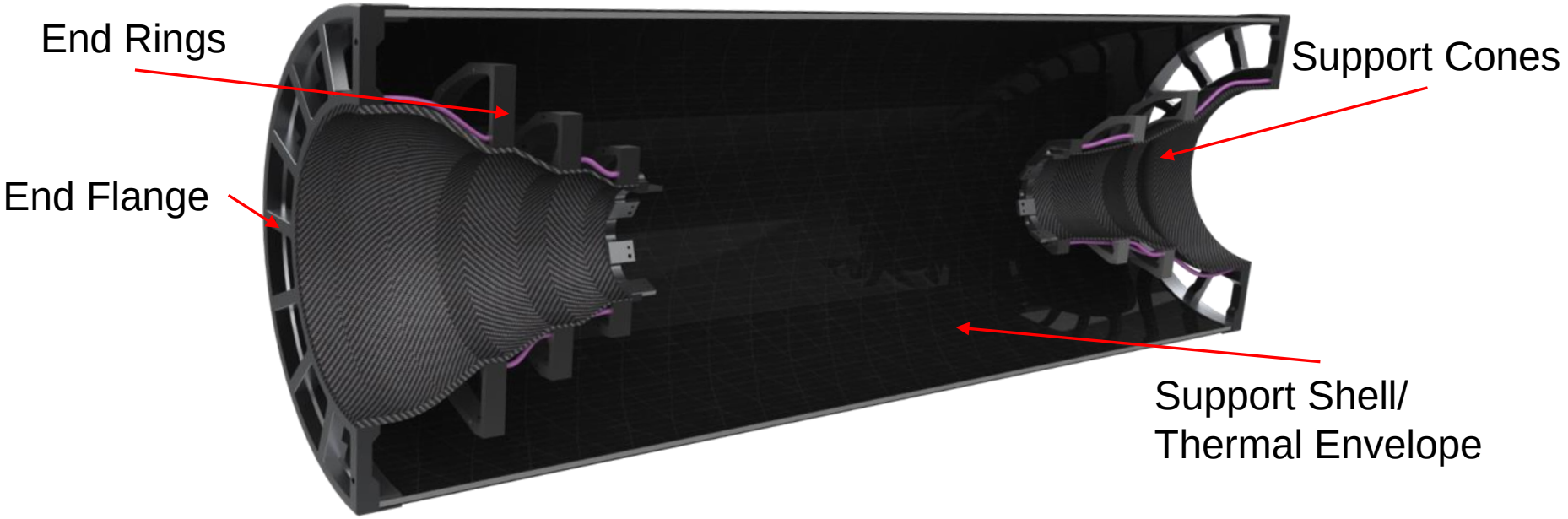
Support Shell

- The support shell couples the forward and backward end flanges
- Purpose is to provide mechanical stability, thermal insulation and a conductive path for grounding



SVD Support Structure

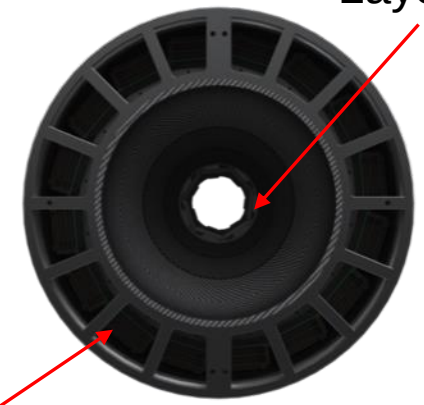
- The support structure consists of all end rings, support cones (end flanges provided by KEK)
- This structure needs to be separable
- The support structure encloses the beam pipe and masks



Support Shell / End Flange

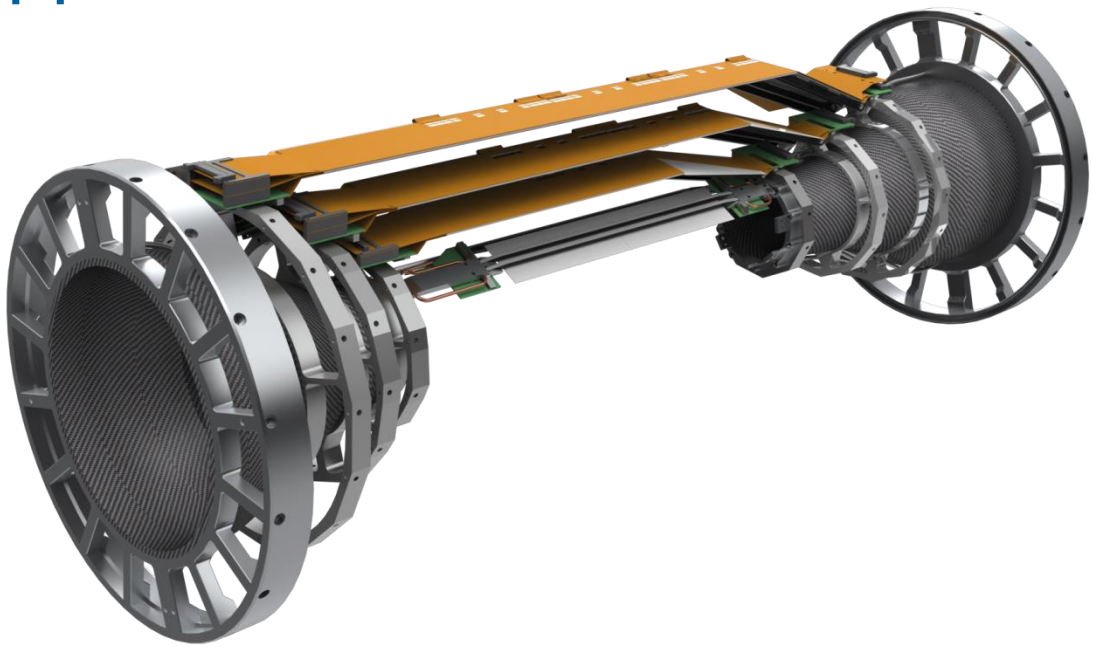
CFRP shell - end flange interface part

- Design is not fixed
- The shell is required to implement a compensation mechanism for mechanical imperfections during assembly and later serve as the rigid exoskeleton of the SVD



Belle II SVD

- Assembly of the detector
- Missing in the picture: cables, cooling tubes and support shell



Cooling

- A closed loop CO2 system is used
- Operation temperature: -20°C
- Pressure: ~56 bar (@startup), 20 bar in the evaporator
- Cooling tube serpentine for each half layer