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# Сценарий сборки вершинного детектора  установки SPD

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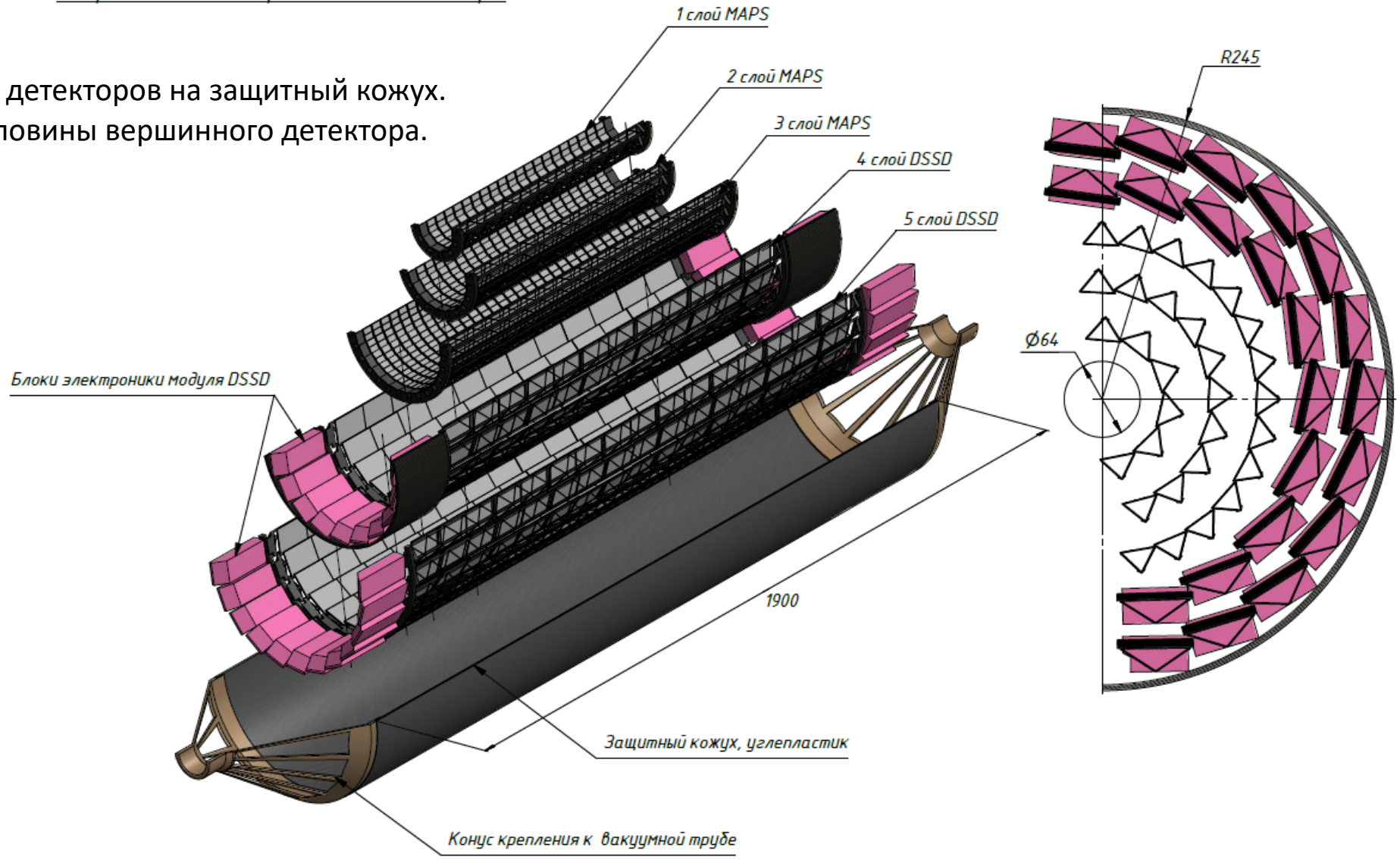
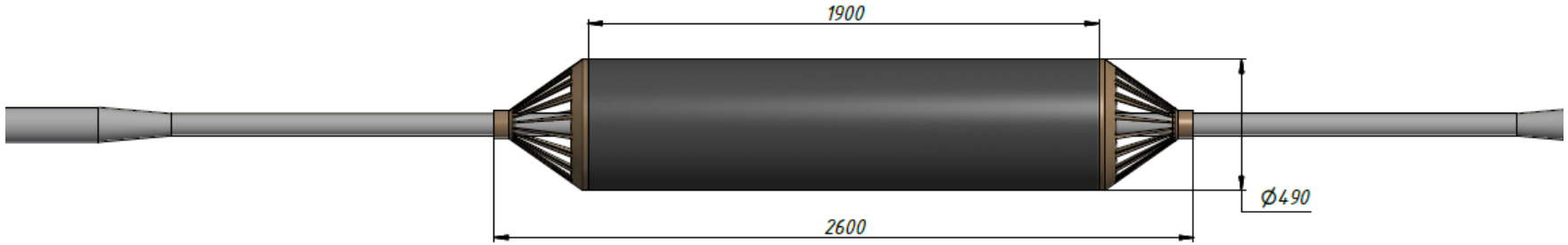
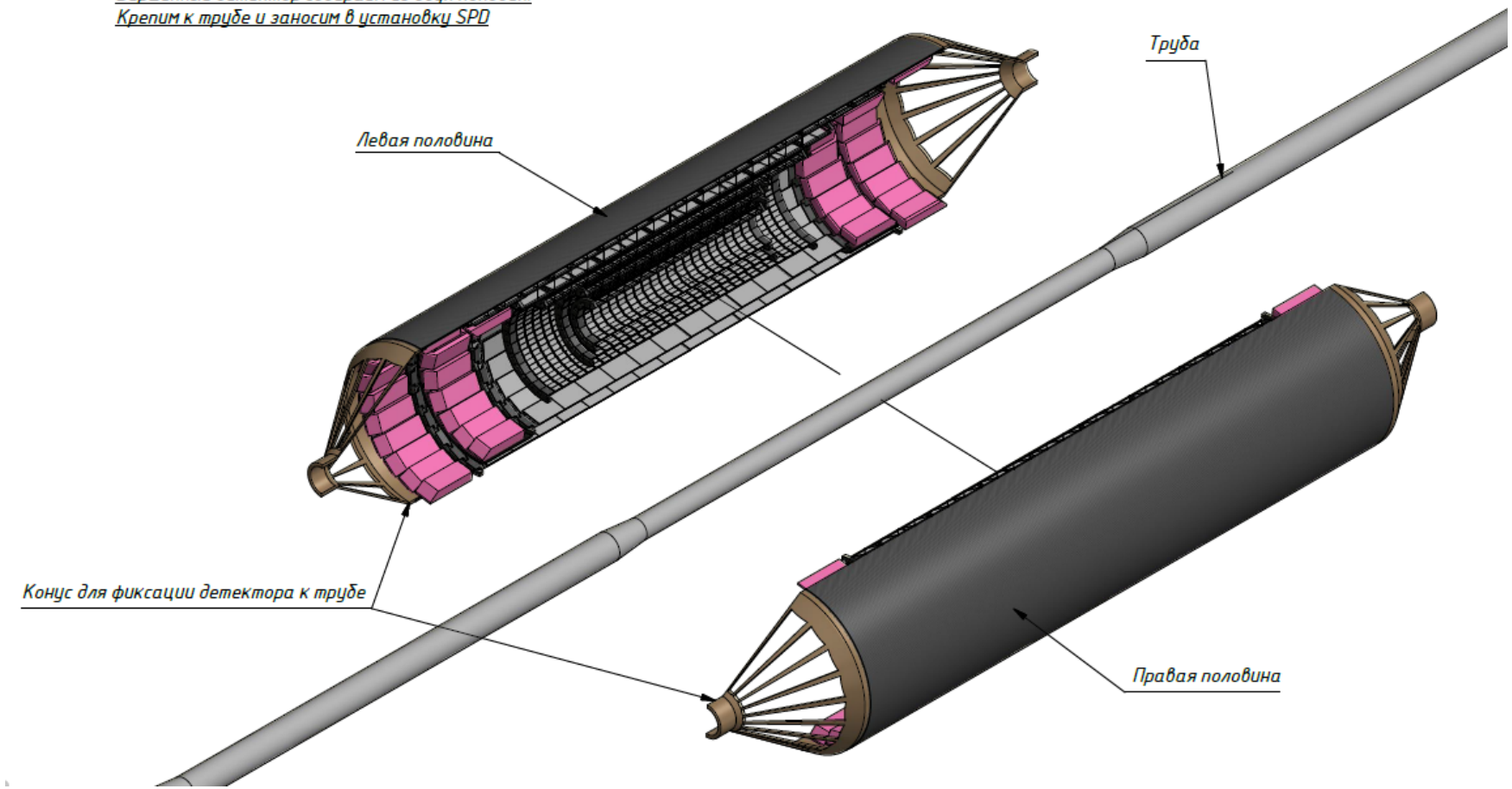
## Сборка половины вершинного детектора

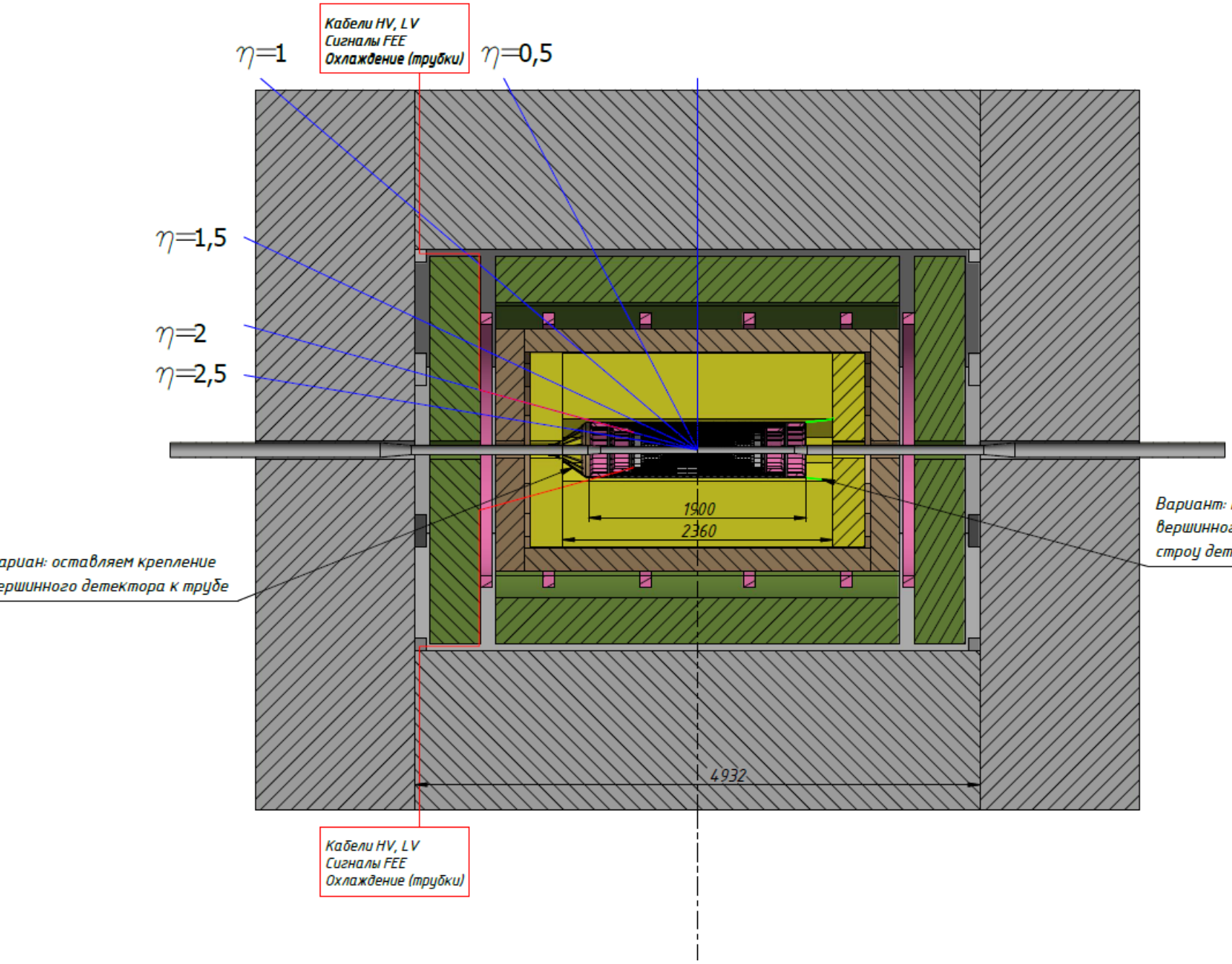
Укладываем слои детекторов на защитный кожух.
Собираем две половины вершинного детектора.






Вершинный детектор собираем из двух половин.
Крепим к трубе и заносим в установку SPD






**Основные принципы конструкции и сборки/ разборки VD+beam pipe:**

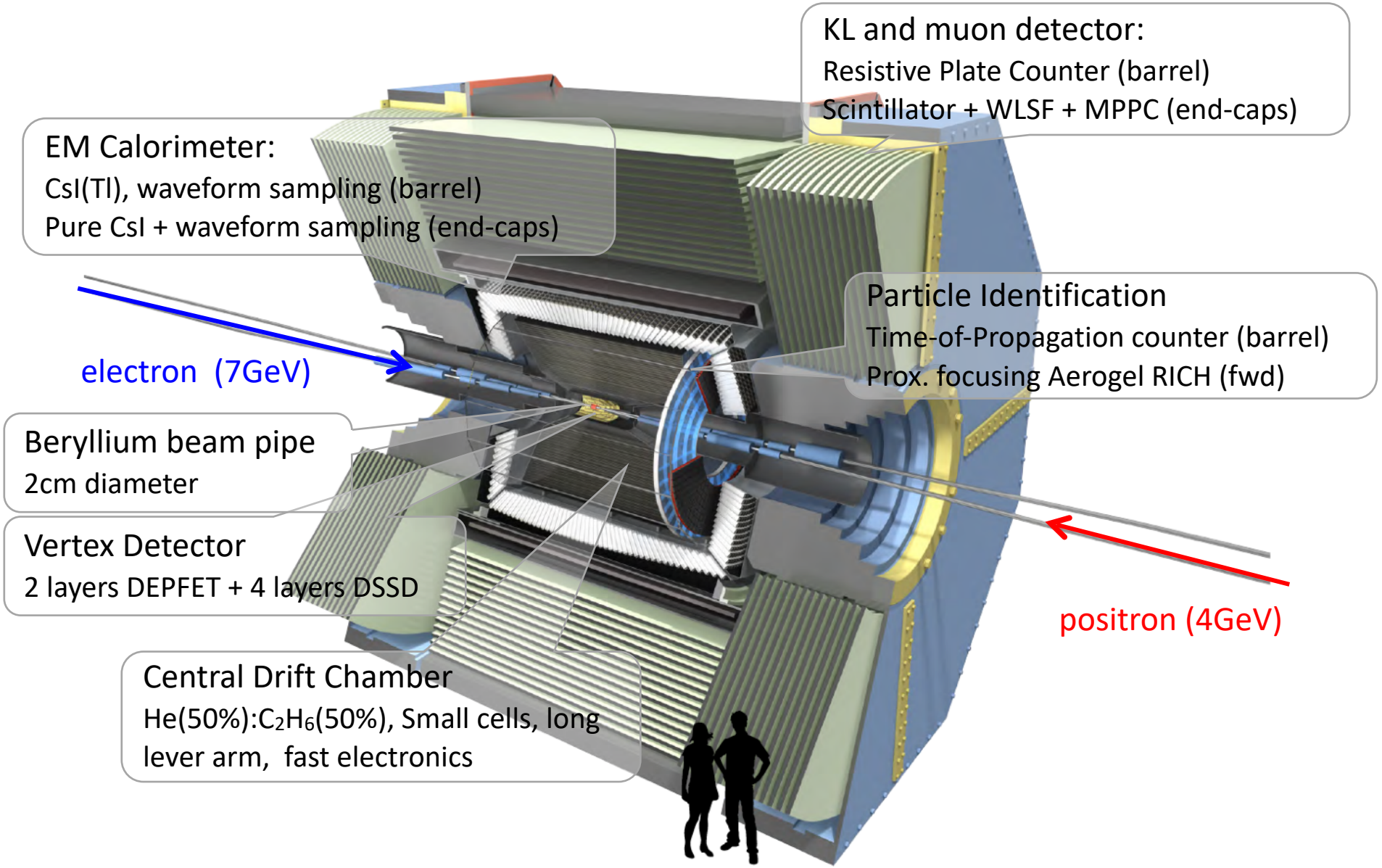
- **предлагаем трубу фиксировать (поддерживать) в 2-х точках на предусмотренных кольцах-опорах в ажурной конструкции VD;**
- **Сборка VD+труба происходит в сборочном зале с возможностью тестирования VD;**
- **Собранная конструкция VD+труба (в защитном экране вставляется в центр детектора СПД;**

- **После установки/юстировки VD+труба в СПД трекер точно фиксируется на специальном крепежном узле механики ST;**
- **Для обсуждения вопрос: надо-ли после установки поддерживать трубу на механике VD?** *(это плохо или хорошо?)*

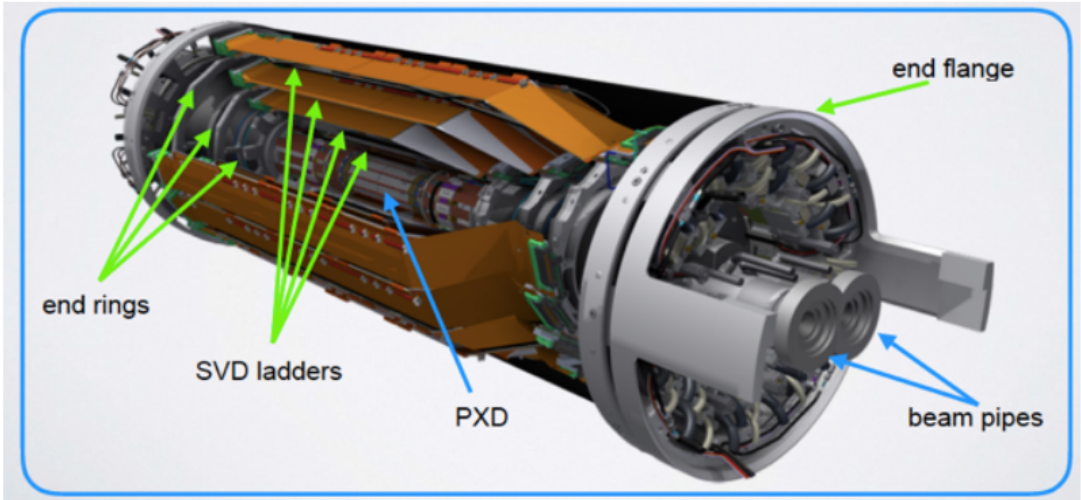
# Silicon Vertex Detector Assembling

Обзор конструкции трекеров некоторых экспериментов

# Belle II Detector



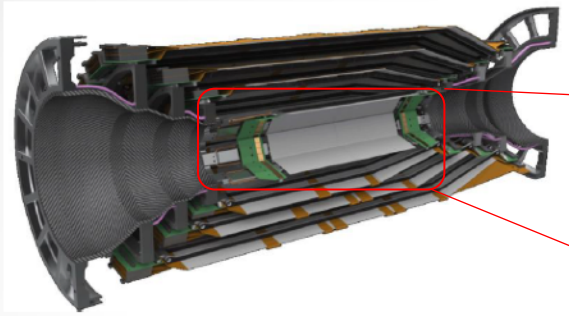
# Belle II Vertex Detector (VXD)

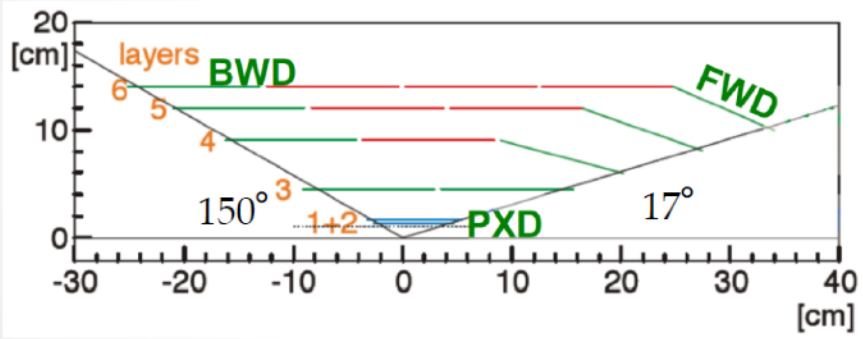


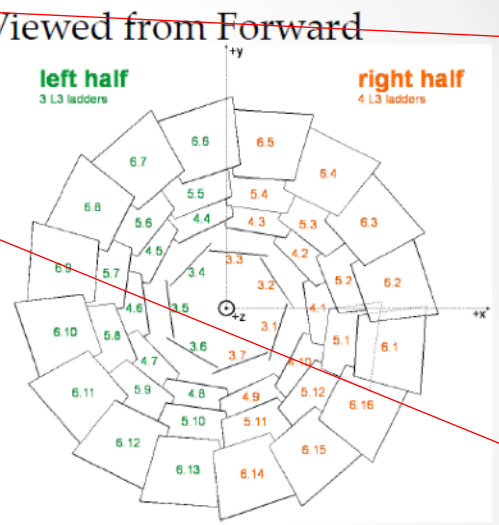

- PiXel Detector (PXD): Two layers of Depleted p-channel FET (DEPFET) pixels
- Silicon Vertex Detector (SVD): Four layers of Double sided Silicon Strip Detectors (DSSDs)

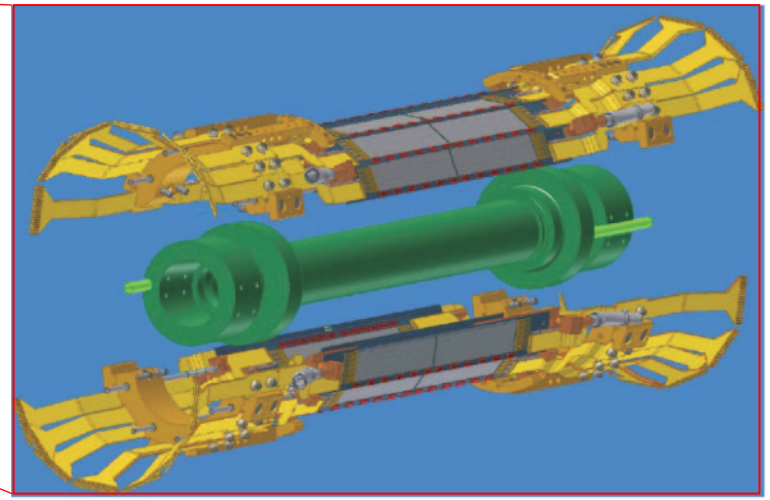
- Design optimized for precise vertex reconstruction of short-lived meson decays
  - reduced boost ($\beta\gamma$ = 0.28) & high luminosity/background: thin pixel detector at small radius & silicon strip detector with fast readout electronics
  - bigger radius and acceptance extended in the forward region (polar angle coverage up to 17 deg.)

# Belle II SVD Overview





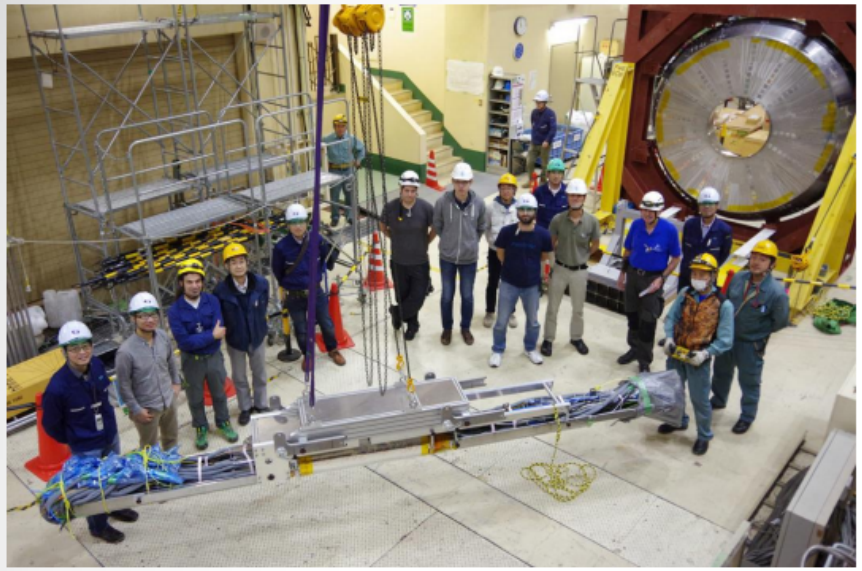



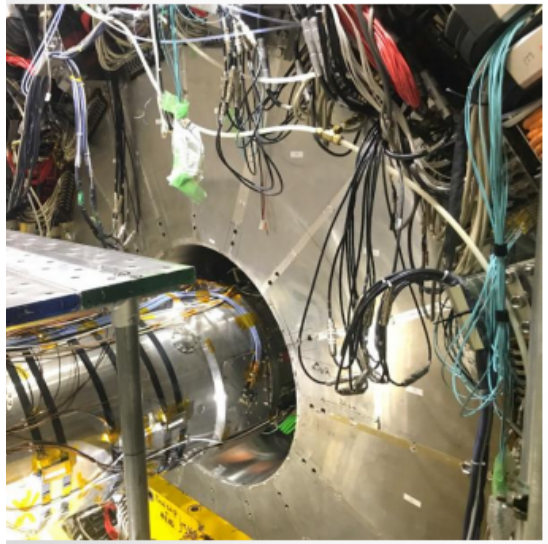
| Layer | Ladder /Layer | Sensor/l adder | Origami | Length | Radius | Slant angle |
|---|---|---|---|---|---|---|
| 3 | 7 | 2 | 0 | 262 mm | 39 mm | 0° |
| 4 | 10 | 3 | 1 | 390 mm | 80 mm | 11.9° |
| 5 | 12 | 4 | 2 | 515 mm | 104 mm | 17.2° |
| 6 | 16 | 5 | 3 | 645 mm | 135 mm | 21.1° |

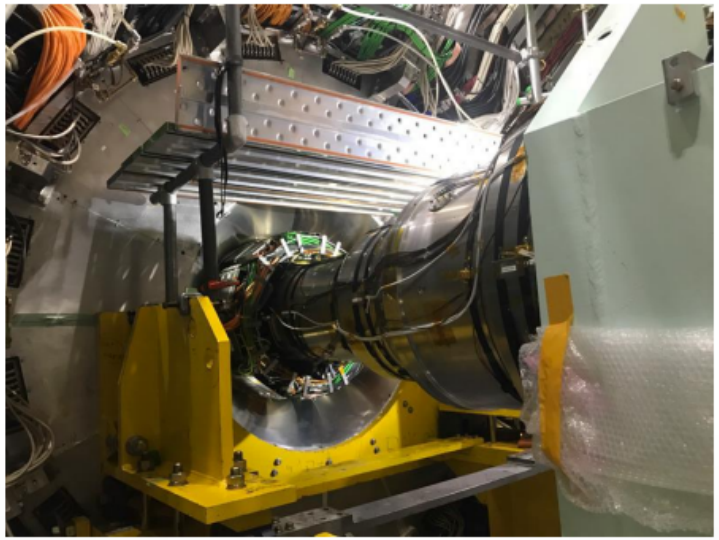
- 4 layers consists of ladders
- Large outer radius for vertexing with Ks decaying in VXD volume
- Arranged in windmill shape with overlaps for alignment
- Slant shapes in FWD region for the material budget reduction.
- Average material budget: 0.7%$X_0$ per layer

*Figure 4.2: Layout of the complete support structure with mounted sensor ladders and servic to the outside. The two half-shells are supported on the beampipe (shown in green). They a displaced from their mounting positions in the picture for clarity.*

# Phase3 VXD Installation







**2018 Nov. VXD installed in Belle II**

2019 Jan.
**Endcap and QCS has been inserted**

→ Preparing for SuperKEKB Phase3 Operation in March

# BaBar Detector

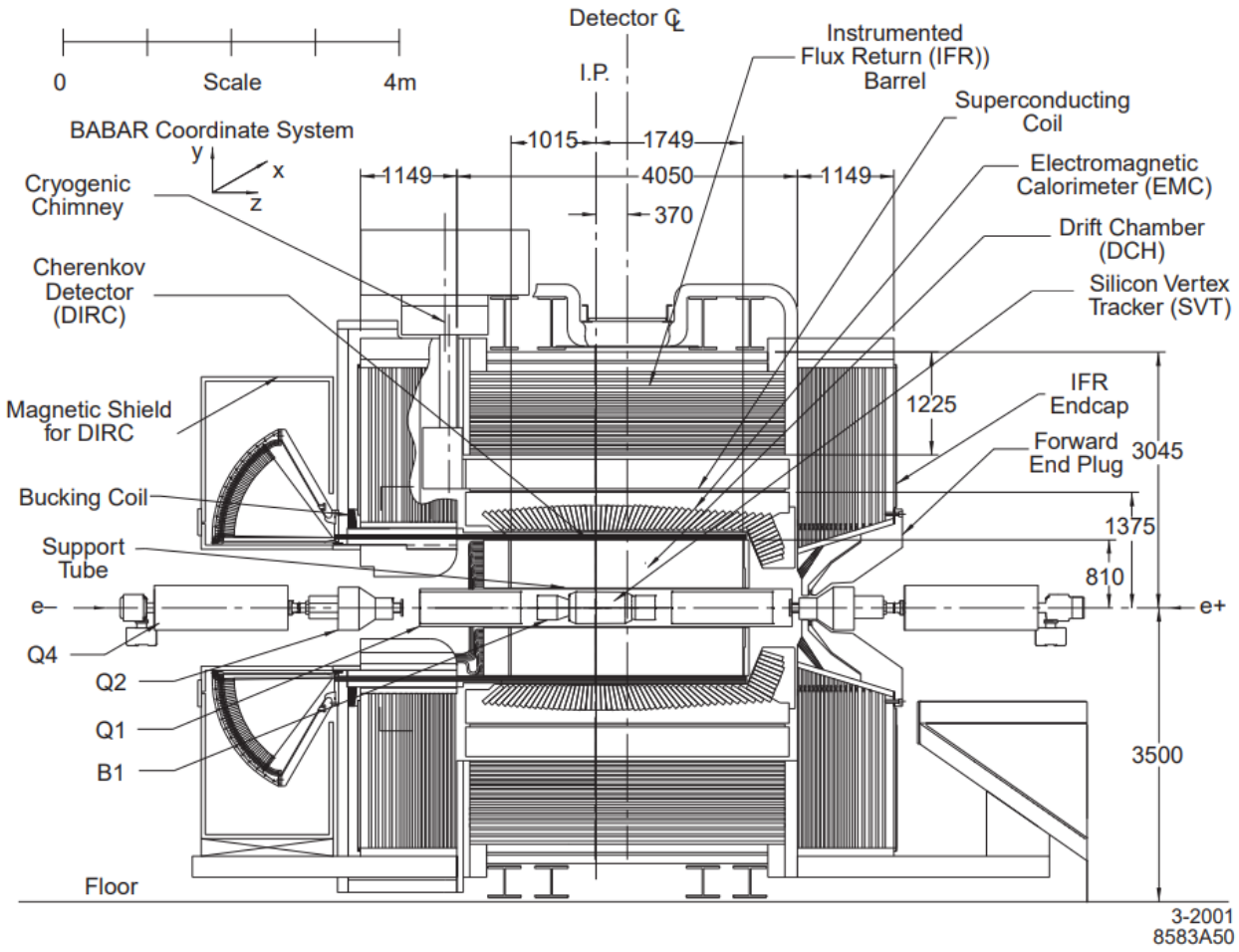
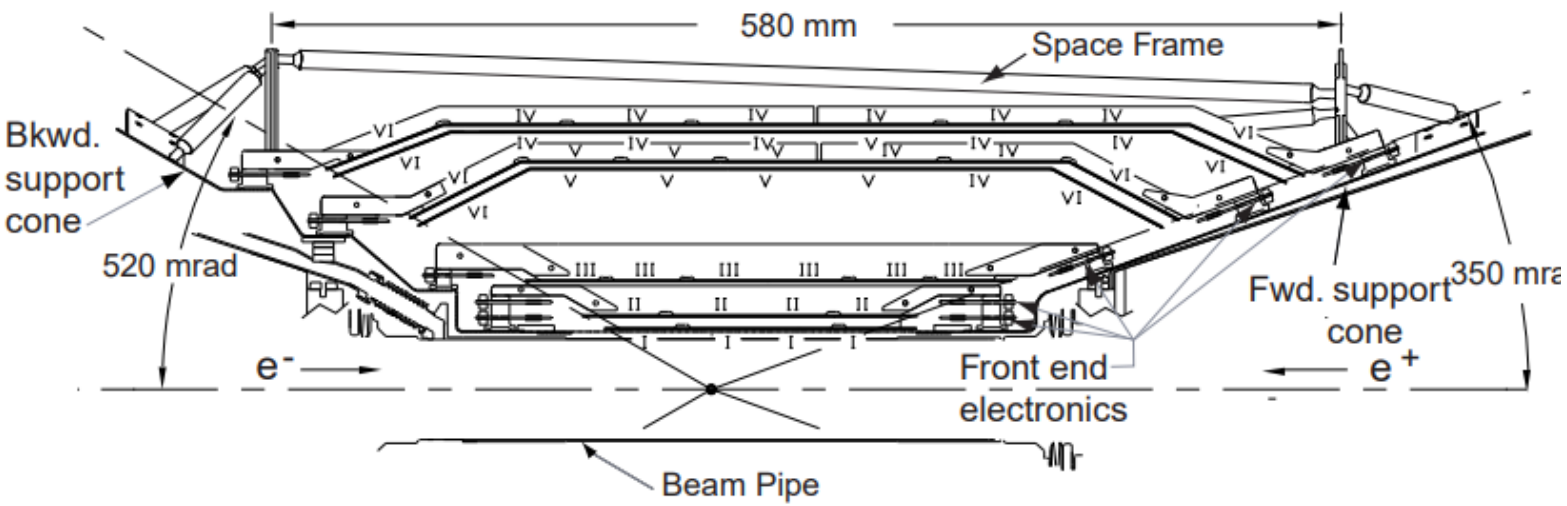



Figure 1. *BABAR* detector longitudinal section.

# Silicon Vertex Tracker



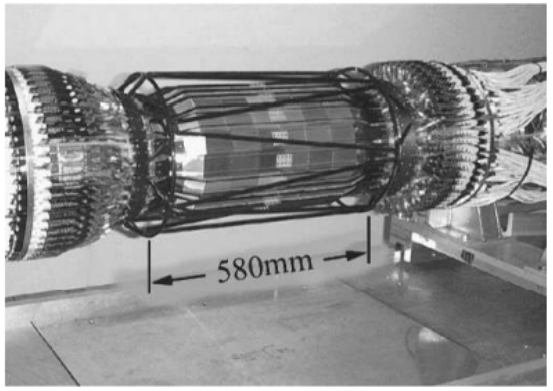
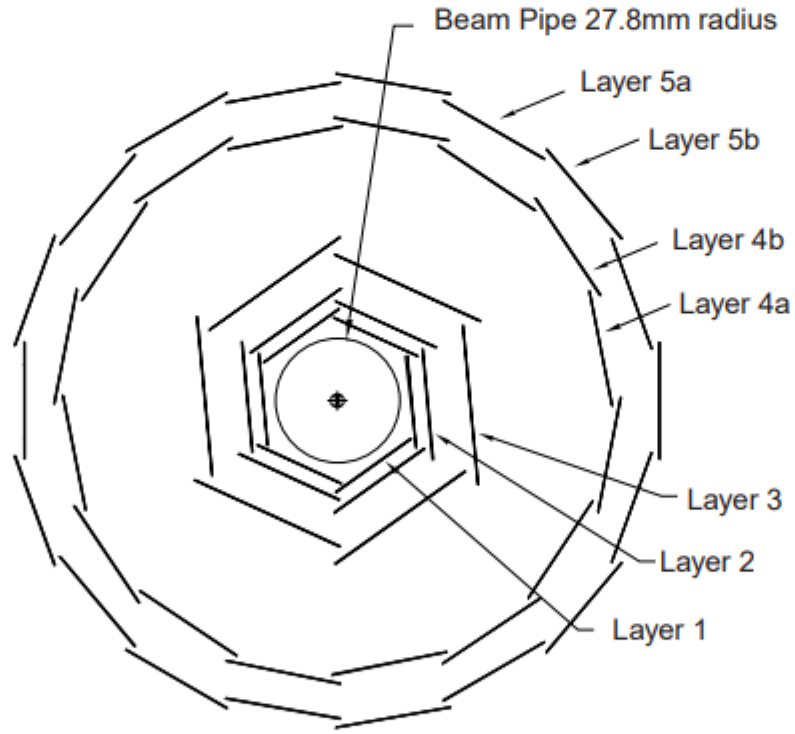
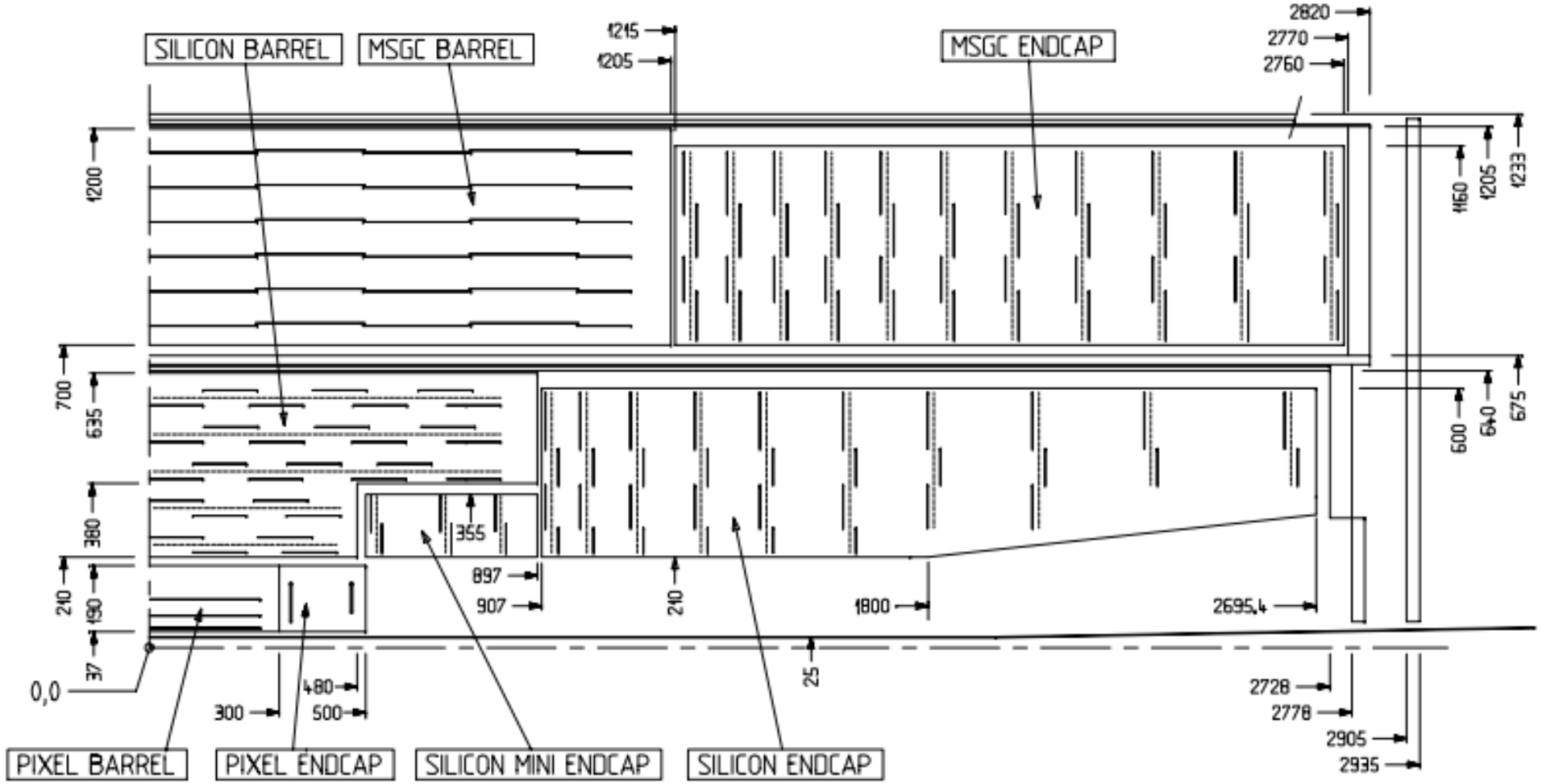




Figure 16. Fully assembled SVT. The silicon sensors of the outer layer are visible, as is the carbon-fiber space frame (black structure) that surrounds the silicon.



# CMS Inner Tracker



# CMS Inner Tracker

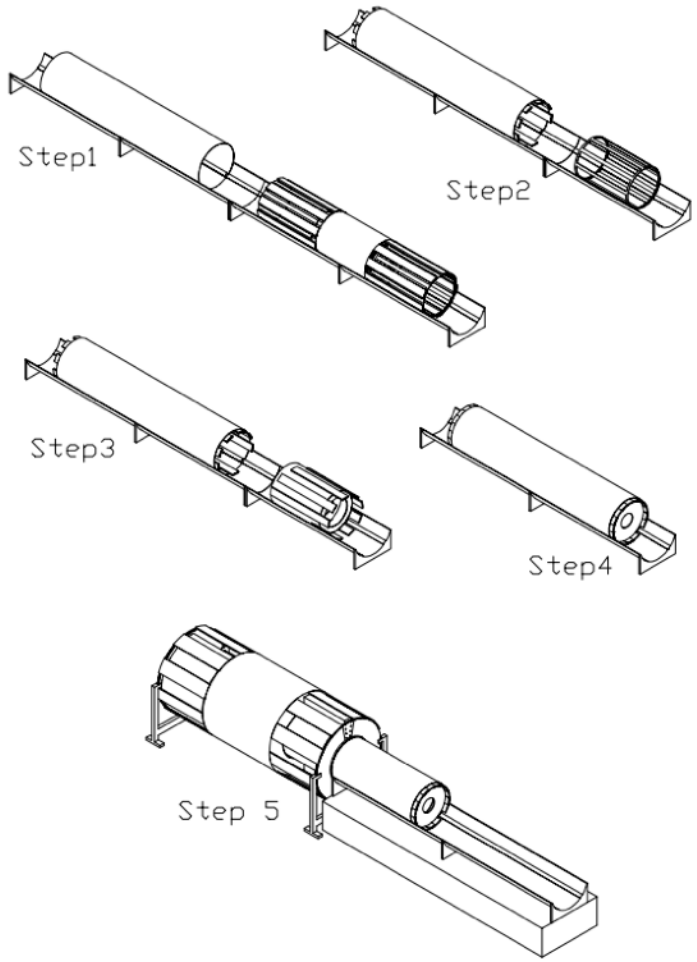



**Fig. 6.48:** Silicon assembly sequence.

1. The thermal screen is positioned onto the Silicon installation cradle, the Silicon barrel is positioned onto the assembly cradle and the two cradles are joined: a continuous sliding guide from the assembly cradle to the internal face of the thermal screen is obtained. The barrel service tails are supported on both ends by temporary supporting frames, sliding on the assembly cradle together with the detector (step 1).
2. The barrel detector is tested for final acceptance.
3. The barrel is slid into its central position inside the thermal screen. All of its services are attached to the allocated spaces on the internal surface of the thermal screen, and the temporary supporting frames are extracted (step 2).
4. The endcap blocks are positioned onto the assembly cradle and are prepared for installation, with the service tails held by the detector structures (step 3).
5. The endcap detectors are tested for final acceptance.
6. The endcap blocks are slid into their final position.
7. All the operations related to the assembly of the two endcap blocks can be performed simultaneously from both ends by two teams, if required.
8. A combined test is performed, including powering, cooling and position monitoring. For this the detector volume must be temporarily closed by the Silicon endflanges (step 4).
9. The Silicon installation cradle is aligned with the CST (Central Support Tube) and the completed Silicon Tracker is moved into its  final position inside the tube (step 5).
10. The general Silicon installation procedure is completed.

# CMS Inner Tracker

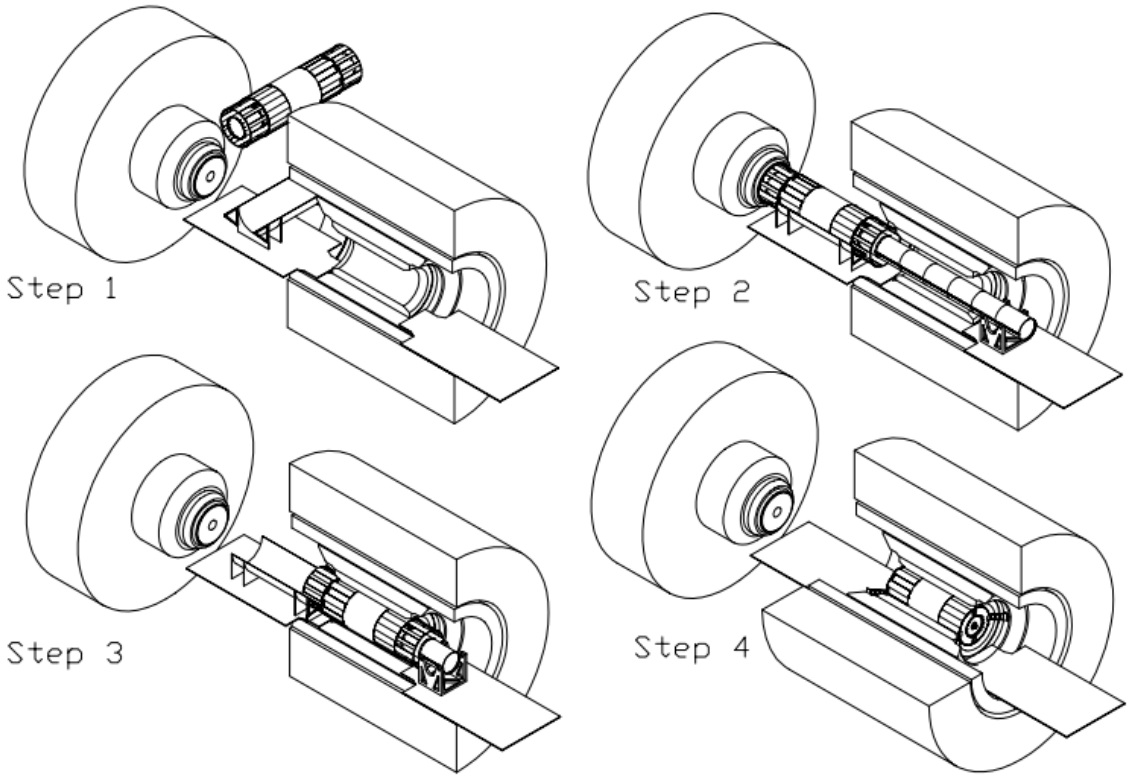



**Fig. 6.49:** Tracker installation sequence.

1. The assembled Tracker is moved to point 5 and lowered with the crane down PX 56 to arrive in the underground cavern UXC 55. Both the CMS endcaps are in the fully opened position. The CMS integration team prepares on both ends of the magnet solid installation platforms, providing a reference plane at a level of 1.7 m below the LHC beam height. The Tracker installation cradle stands on the reference plane below PX 56. The manoeuvre for the insertion of the Tracker inside the ECAL barrel starts from a position which is perpendicular to the beam line (step 1).
2. Once the Tracker is lowered onto the reference plane, it can be easily moved by the Tracker installation cradle, which sits on airpads. The consecutive execution of two translations and two rotations aligns the Tracker to the beam line. Meanwhile, on the opposite side installation platform, a supporting portal is positioned: the remaining part of the extension tube slides on it to reach the Tracker on the other side of the experiment. In order to avoid excessive space consumption, each element of the extension tube is connected to the following just before engagement on the supporting portal. The extension tube travels inside the ECAL barrel in a cantilevered conguration, but the large dierence in radial dimensions ensures the absence of any possible impacts. Once the end of the extension tube has reached the element fixed on the Tracker CST, they are connected and the whole structure is again supported on both sides (step 2).
3. The Tracker can now slide into its final position inside the ECAL barrel. During this phase, each element of the extension tube is removed just after its disengagement from the supporting portal (step 3).
4. The support brackets, attaching the Tracker endflanges to the HCAL barrel are installed. The MSGC cables and pipes are installed in their cable trays and connected to the patch panels. The last extension tube elements can now be dismounted on both Tracker sides. After removal of the cable support, the Silicon services are also unrolled and attached to the patch panels (step 4).