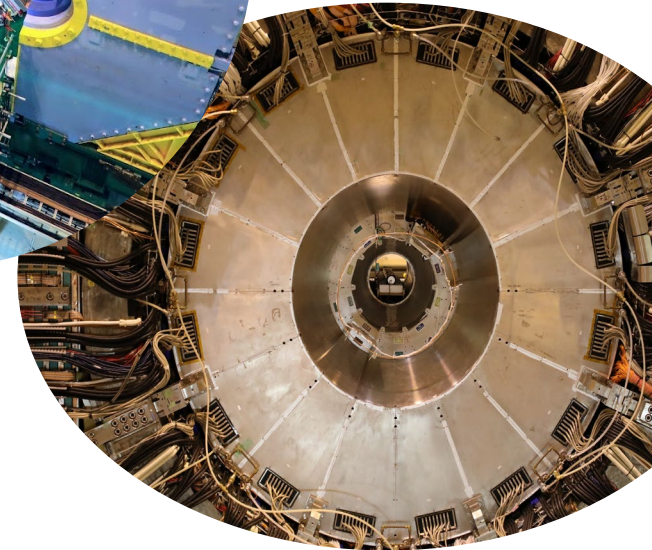
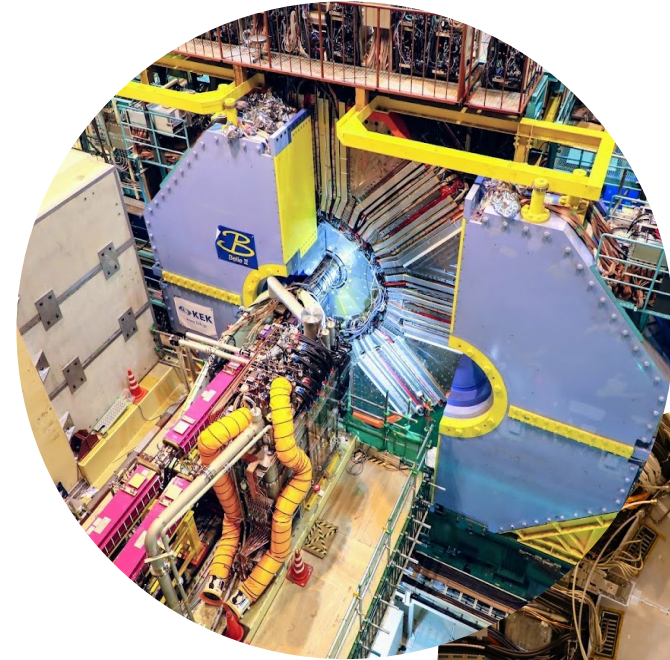


ErUM FSP T09



Belle II Germany
ErUM-FSP T09



Development of an interactive 3D detector representation

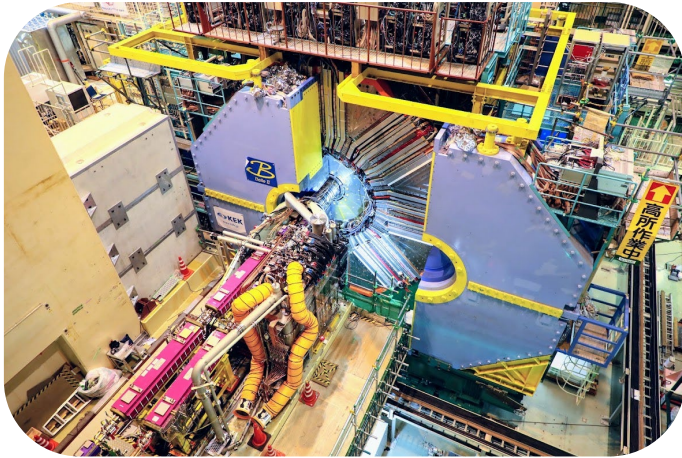
Johanna Häusler, M.Sc. M.A.

GEFÖRDERT VOM

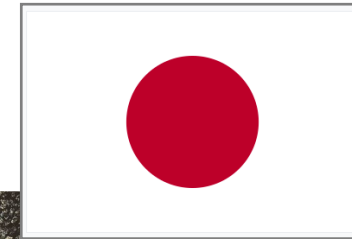


Particle Physics Adventure in Japan

The SuperKEKB / Belle II experiment is an electron-positron collider/detector



Its home base is here:

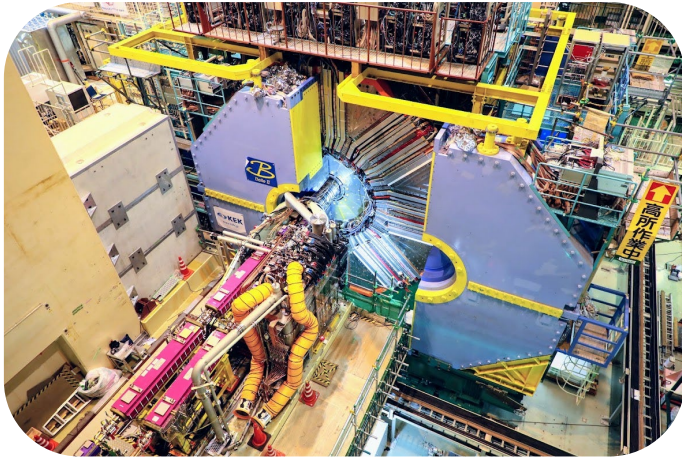


The KEK in Japan:

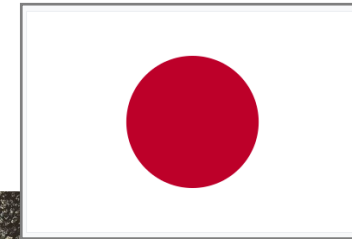


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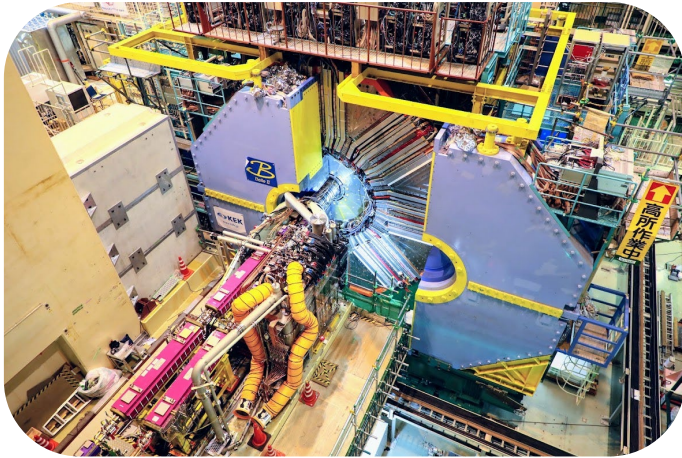
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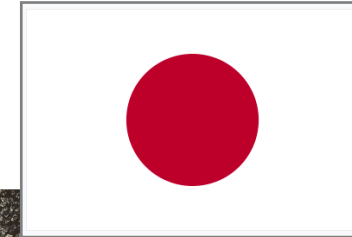
SuperKEKB holds the world record
in instantaneous **luminosity**

Particle Physics Adventure in Japan

The SuperKEKB / Belle II experiment is an electron-positron collider



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The KEK in Japan:

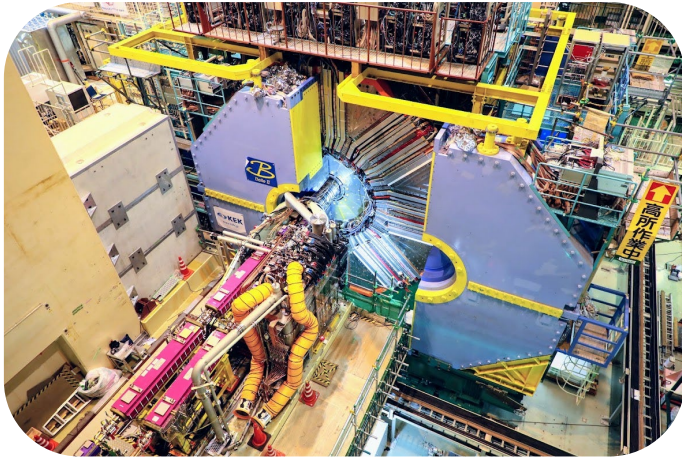


Is optimized for **high precision** measurements

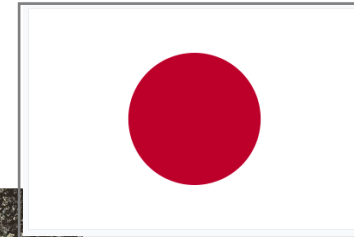
- important player in particle physics
- complementary to LHC experiments (CERN)

Particle Physics Adventure in Japan

The SuperKEKB / Belle II experiment is an electron-positron collider



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The KEK in Japan:

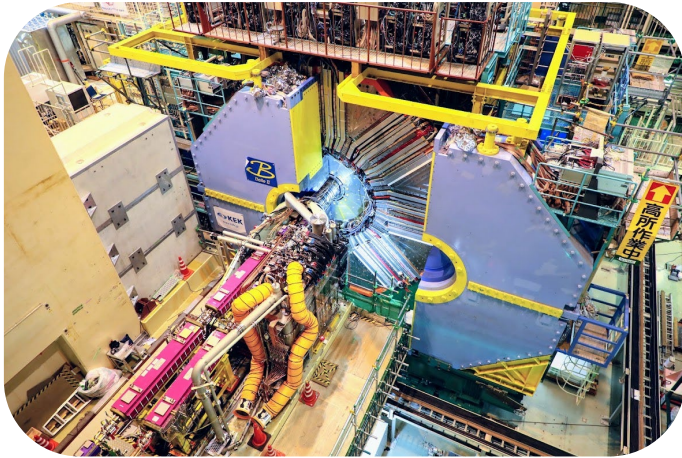


Belle II focuses on breakthrough topics:

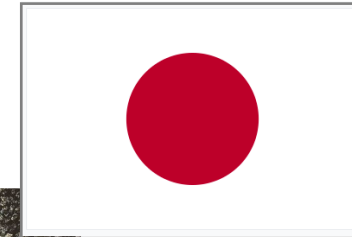
- CP-asymmetry
- Dark matter
- New physics beyond the Standard Model ...

Particle Physics Adventure in Japan

The SuperKEKB / Belle II experiment is an electron-positron collider



Its home base is here:



The KEK in Japan:



Belle II focuses on breakthrough topics

- Allready have exciting results
- New results are expected in the coming years!

Belle II Germany

Belle II
Institutes
Germany



Belle II Germany
Institutes



DESY

UNIVERSITÄT BONN

JOHANNES GUTENBERG
UNIVERSITÄT MAINZ

LMU LUDWIG-
MAXIMILIANS-
UNIVERSITÄT
MÜNCHEN

JUSTUS-LIEBIG-
UNIVERSITÄT
GIESSEN

TUM

MAX PLANCK
HALBLEITERLABOR

MAX-PLANCK-INSTITUT
FÜR PHYSIK

KIT
Karlsruher Institut für Technologie

GEORG-AUGUST-UNIVERSITÄT
GÖTTINGEN

Outreach Belle II

Structure of FSP-Belle II office

GEFÖRDERT VOM



Bundesministerium
für Bildung
und Forschung

Internal networking and
support:

- Annual meeting
- Belle II academy
- Workshops

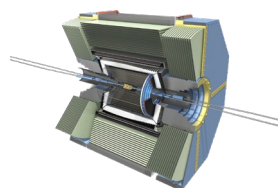


Belle II FSP office



Outreach:

- Belle II homepage
- Social media
- Corporate design
- Masterclasses
- School project
- Information material...



Industry transfer:

- Alumni network and lectures
- Hanover Fair



GEFÖRDERT VOM

Structure of FSP-Belle II office

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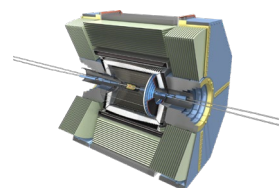
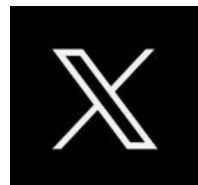


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GEFÖRDERT VOM

Getting in touch with particle physics

Models are useful tools to make particle physics more accessible:

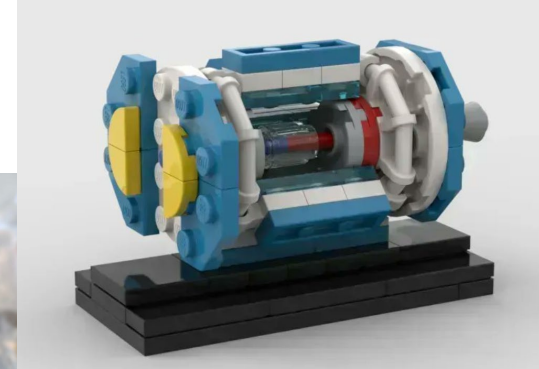
I. Interacting with detector components

- Understanding the overall design and principles of a detector

Hardware Models:

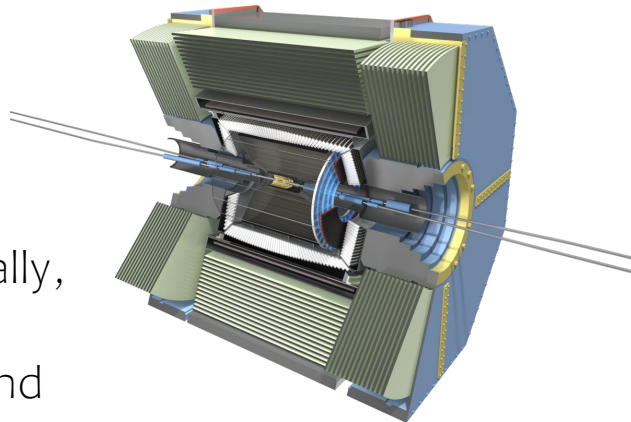
Playful learning with LEGO

- Suited for every age
- Developed at KIT



3D Print Model

- Very suitable for high-school level teaching
- Can be printed individually, once data is available
- In construction (LMU and origins-cluster)

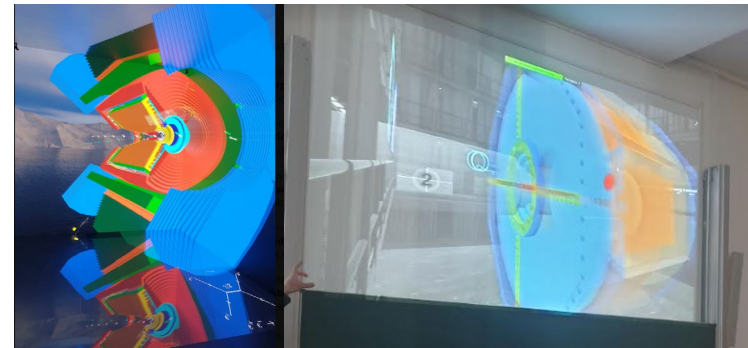


Getting in touch with particle physics

Models are useful tools to make particle physics more accessible:

- I. Interacting with detector components
- II. Interacting with physics data
 - Understanding particle decays and physics principles

Virtual reality (VR-) applications



We have different VR-Applications available at Belle II

Original Belle II VR

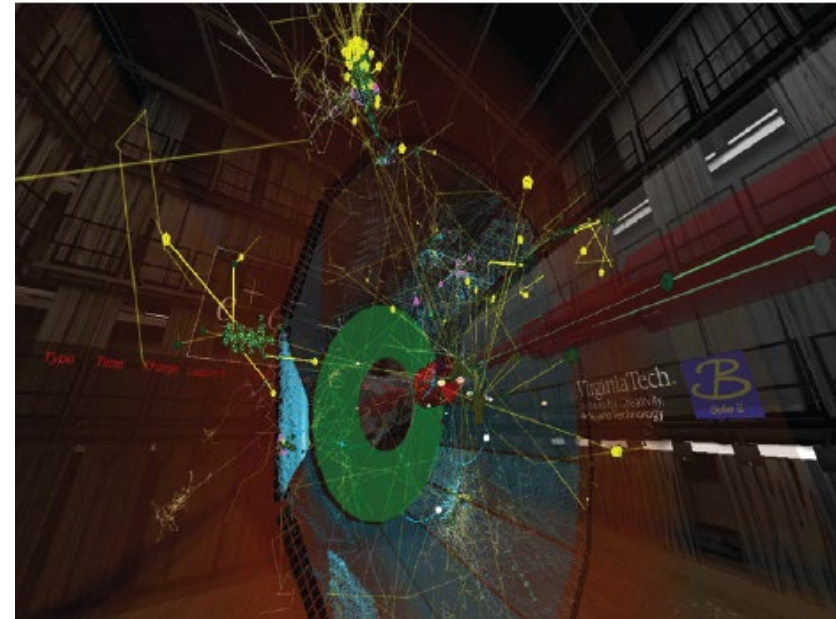
- Has been developed as a **pedagogical tool** for high school and undergraduate students.
- It displays a 3D model of the Belle II detector together with simulated electron-positron collisions.
- Allows users to investigate the detector and the evolution of the particle collisions itself.



Belle II VR by Virginia Polytechnic Institute

Original Belle II VR

- **Realistic model:** The displayed events are created with the full Belle II event simulation and detector reconstruction
- Full event information is accessible, e.g. the underlying physics process and the correct particle properties, like type, energy and momentum.
- Allows users to investigate the detector and the evolution of the particle collisions itself.

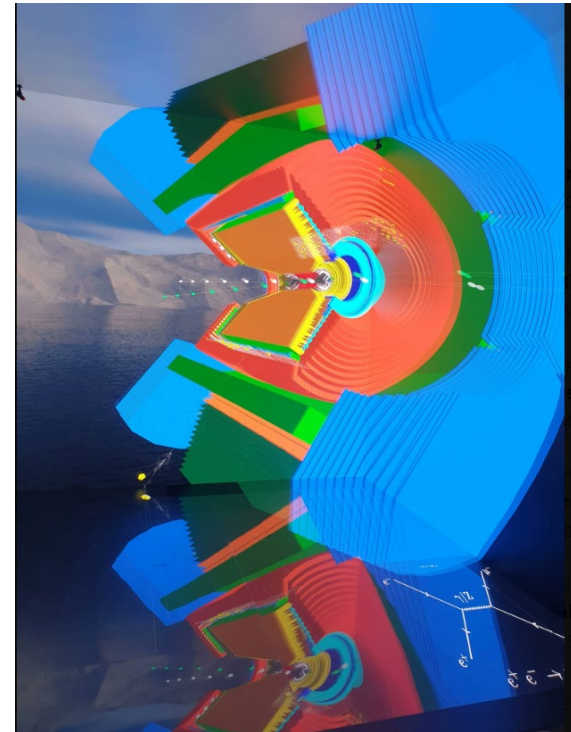
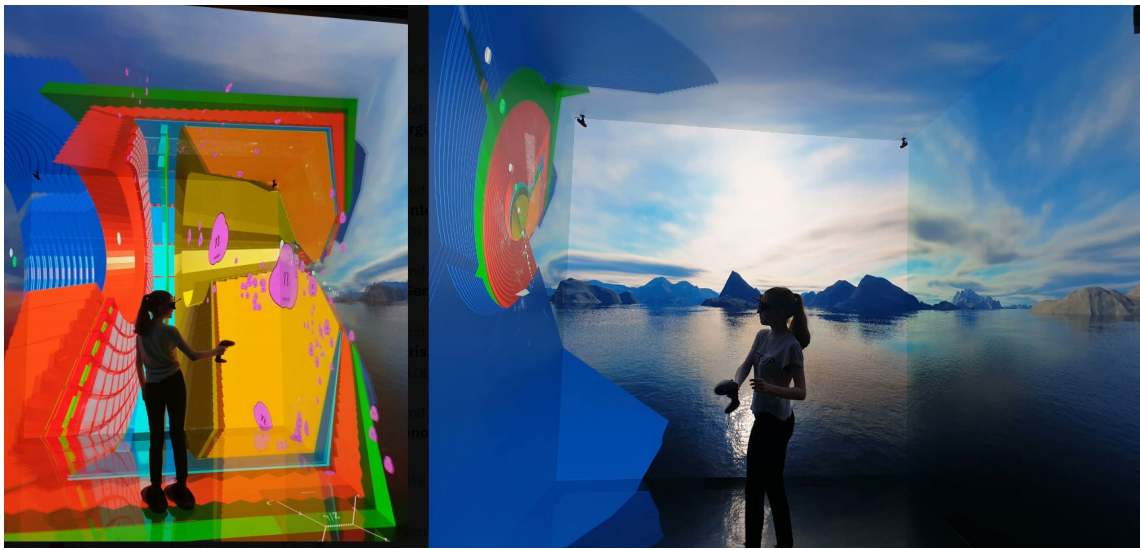


For general outreach, this model is too complex...

A CAVE Model for Belle II

For outreach purposes, a simplified version was developed:

- Graphical education tool for CAVE environments
- The cave automated virtual reality (CAVE) is a cube (2,7m wall length), with a 3D projection on the walls, generating an immersive 3D environment with a robust 3D experience.
- At Leibniz-Rechenzentrum (LRZ)

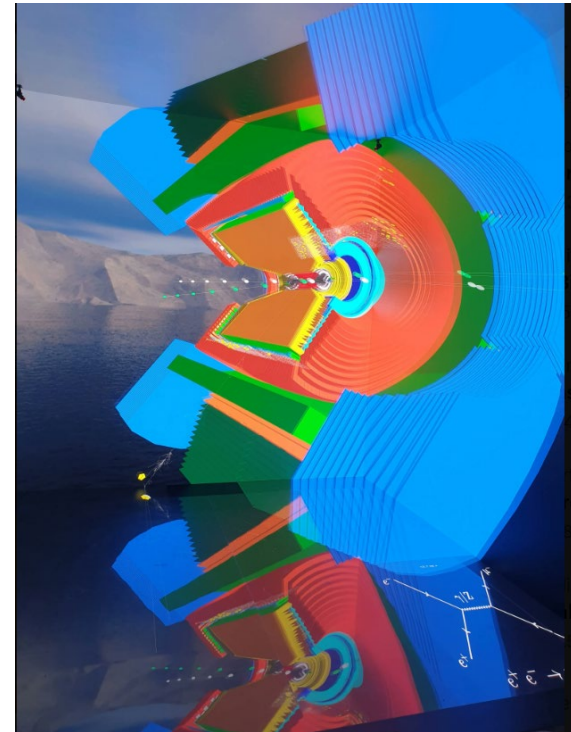


Michael Bender and Thomas Kuhr (LMU)
Leo Pilonen (Virginia Polytechnic Institute)

A CAVE Model for Belle II

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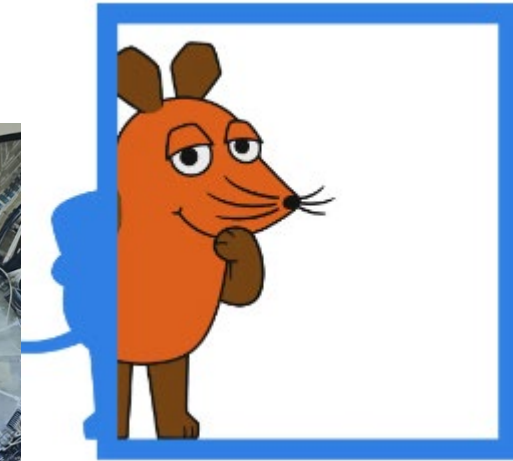
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 - At Leibniz-Rechenzentrum (LRZ)
- The CAVE is obviously **stationary** and thus not appropriate for a broader use.



Michael Bender and Thomas Kuhr (LMU)
Leo Pilonen (Virginia Polytechnic Institute)

Belle II VR-applications

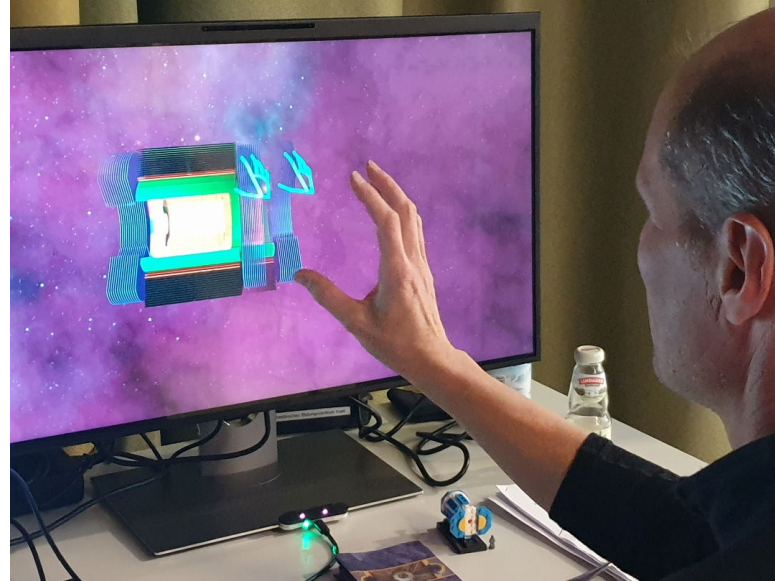
VR-Glasses



- There is a VR-Glass Version of the CAVE Model
- But this shields the user from the environment, thus creating a restricted experience, particularly in group settings!

Belle II VR-applications

VR-Display



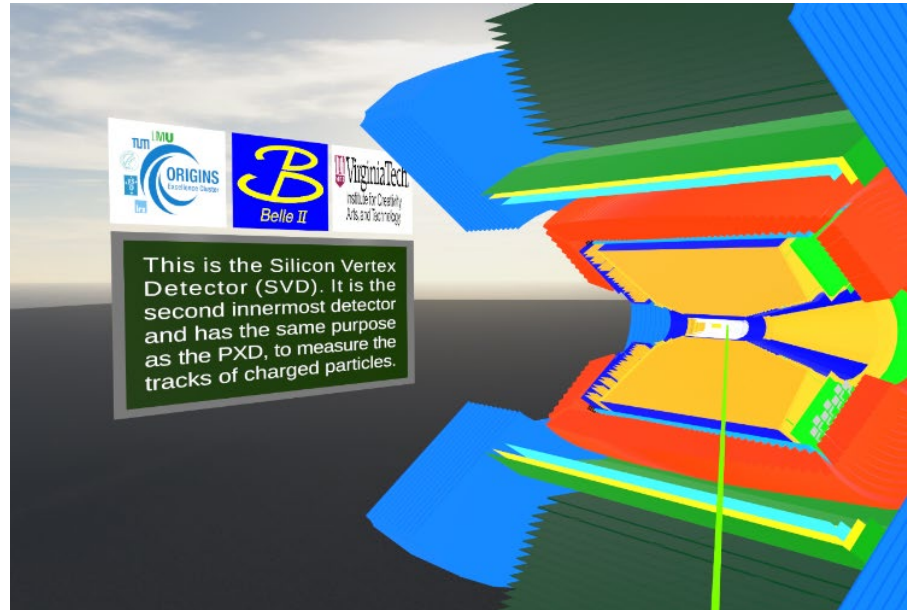
- **Eye tracking** display that generates a 3D Environment for the user
- Display is openly accessible: Physics and detector principles can be explained easily in group settings.
- Less equipment, direct interaction by hand-tracking (novel degree of freedom)



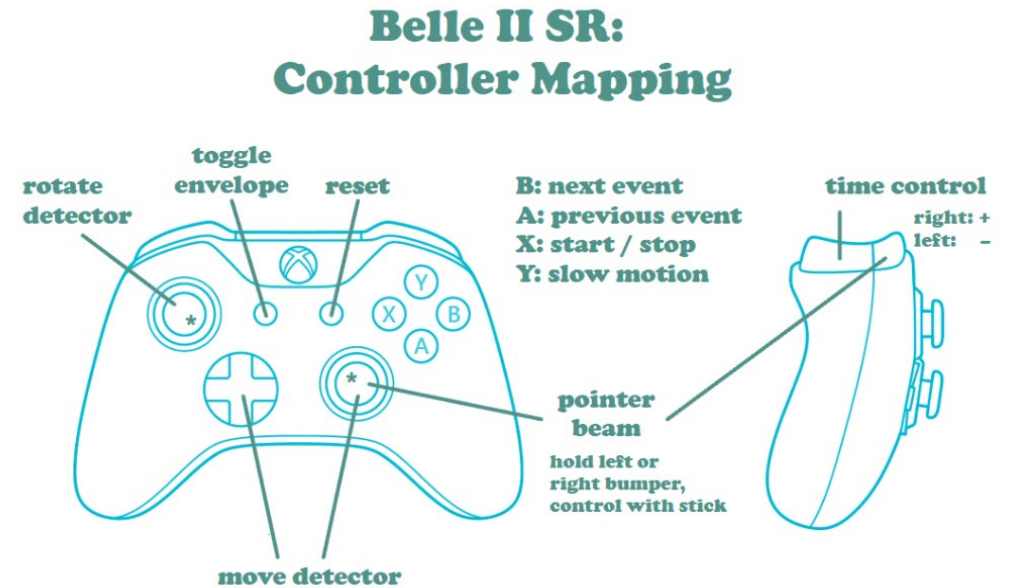
Origins cluster science week (Kloster Irsee)

Belle II VR-applications

VR-Display



Thanks to Maximillian Gewald (our HIWI, working on the project)



*press down to reset rotation / position

Adapting the CAVE Model:

- Intermediate between the LEGO Model and the precise original Belle II VR application
- Simplified representation of detector and particle decays
- Runs on the game engine UNITY

Thank you for your attention!