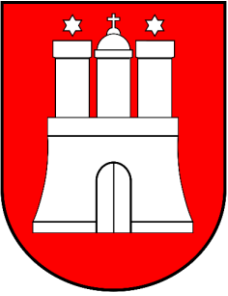




DESY Hamburg site intro



Summer student welcome Session 20th July 2021

Olaf Behnke, Friederike Januschek, Andreas Przystawik



How it all began – Research start with beams in 1964

First DESY particle accelerator: the DESY synchrotron



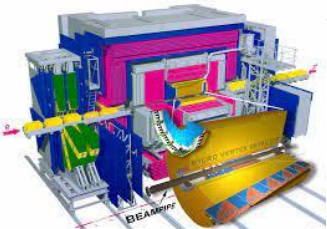
- The first particle accelerator was the **DESY synchrotron** with a diameter of 100 meter
- At **DESY**, electrons were accelerated to 7.4 GeV
- **DESY** was used for tests of QED
- In parallel: Start of DESY Photon science with synchrotron light, a by-product of the particle acceleration



Accelerators used for Particle Physics

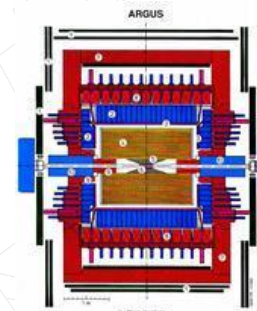
HERA ep
1992-2007

Example: ZEUS detector



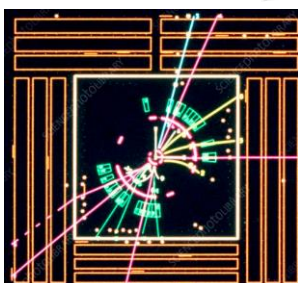
DORIS e+e-
1975-1992

Example: ARGUS detector

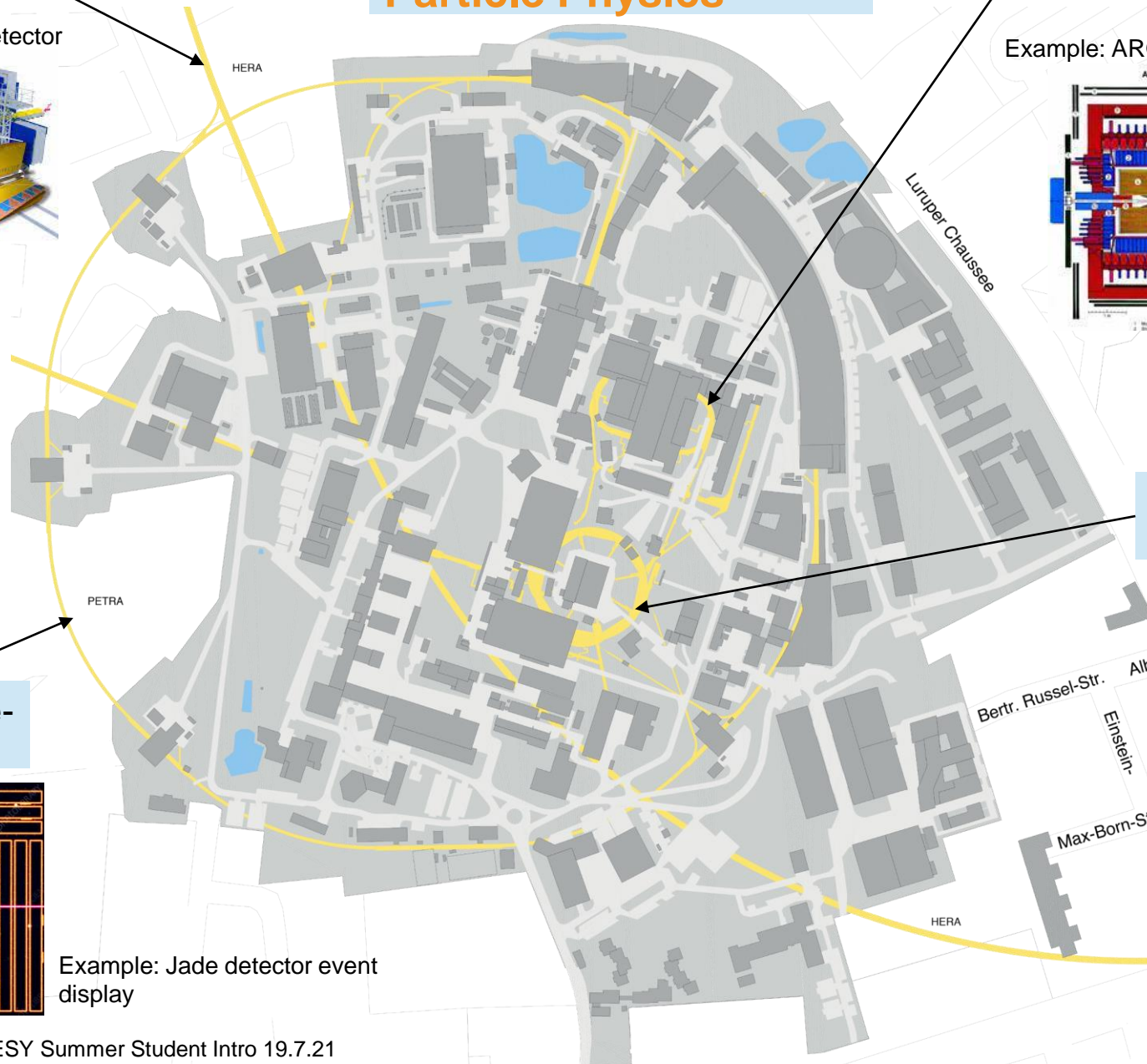


DESY e-
till today

PETRA e+e-
1978-1990

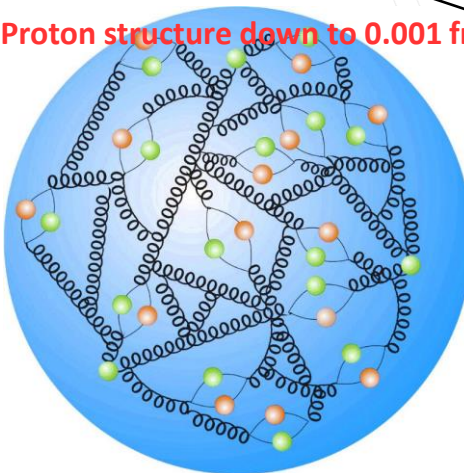


Example: Jade detector event
display



HERA ep
1992-2007

Proton structure down to 0.001 fm



Particle Physics: selected breakthroughs

DORIS e+e-
1975-1992

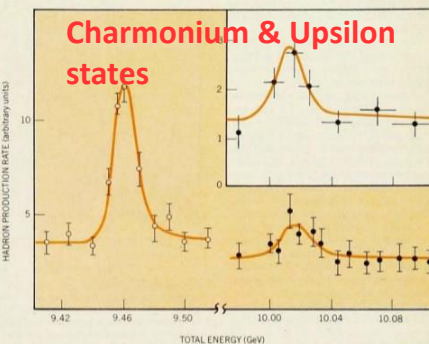
DESY verifies two upsilon states; evidence for fifth quark

By stretching the energy limits of the DORIS storage ring to its fullest, experimenters at DESY in Hamburg have observed the upsilon and upsilon prime at roughly the masses reported in 1977 by Leon Lederman and his collaborators (PHYSICS TODAY, October 1977, page 17)—9.46 and 10.02 GeV/c². But the new experiments have 20 times better energy resolution, primarily because they are done in an e⁺e⁻ storage ring.

The new observations are generally taken as further evidence for the existence of a fifth quark, known as "bottom" whose charge is $-\frac{1}{3}e$. Knowing the exact mass difference between the Υ and Υ' gives further clues as to the nature of the force between quarks. The popular theory, quantum chromodynamics, assumes that the underlying force is the same for all quarks, regardless of their flavor (up, down, strange, charm, bottom, the predicted top, ...).

The DORIS experiments provide an added fillip: Observations with PLUTO, DASP-2 and the NaI Lead-Glass Detector all show that outside the narrow energy region of the upsilon resonances, jets are

continued on page 19



Hadron production rate at DORIS versus total energy as observed by the NaI Lead-Glass Detector (bottom curves) and DASP-2 Detector (inset). The Υ yield measured by the NaI Lead-Glass Detector is included with the same scale and acceptance. Note the Υ' at 10.02 GeV from both experiments.

Argus experiment: discovery of B⁰-B⁰bar mixing

PETRA e+e-
1978-1990

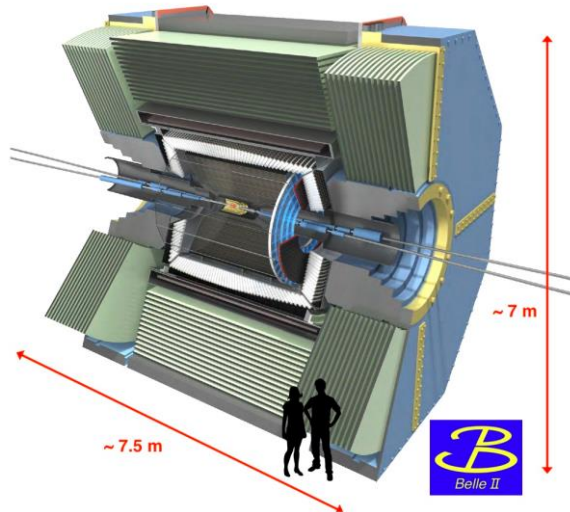
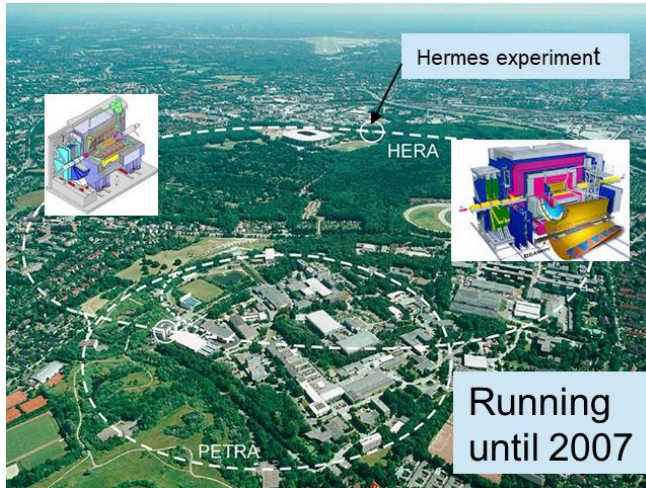
Gluon
discovery



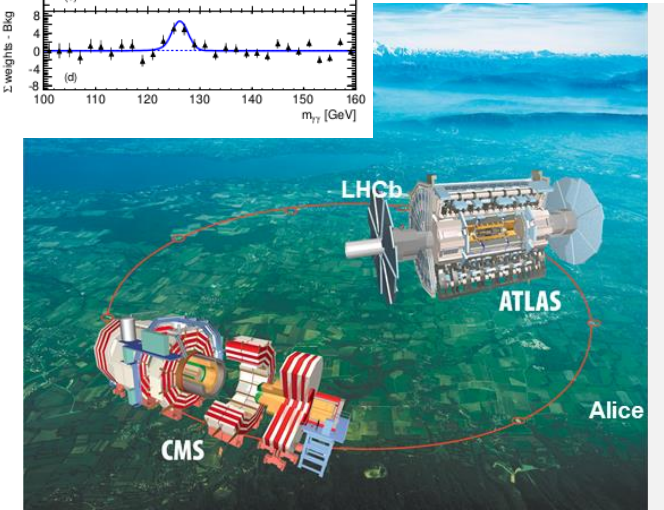
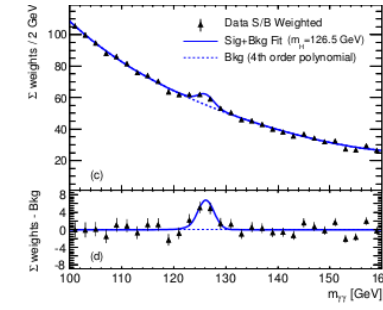
The observation of the gluon at the TASSO detector in 1979

DESY e-
till today

DESY particle physics: From past to present



- HERA running ended in 2007, data analysis continued
- DESY joined LHC experiments ATLAS and CMS in ~2008
 - Amongst many other things:
Contributed to discovery of H(125) boson
- DESY joined BELLE in ~2014
 - Amongst many other things:
Contributed to first physics publications: search for $B^+ \rightarrow K^+ \nu \bar{\nu}$
- Onsite program, searches for axions, ALPS experiment start in 2022



DESY PARTICLE PHYSICS in 2021

ATLAS group:

- Physics analysis: H, top, SM & BSM
- Detector operation
- Tracker upgrade



CMS group:

- Physics analysis: H, top, SM & BSM
- Detector operation
- Tracker upgrade

Theory:

- Collider phenomenology
- Cosmology
- String theory

IT:

- high tech computing infrastructure

FTX group

- Prepare future experiments
- e+e- collider program
- Science, software, detector, test beam and accelerators

BELLE:

- Physics analysis
- Software, Alignment
- Vertex detector



ALPS:

- Axion searches
- Light shining through wall experiment
- Optics, (cryogenic) detectors



DESY PARTICLE PHYSICS in 2021

Summer student work projects:

ATLAS group:

- Physics analysis: H, top, **B1-B4**
- Detector operation
- Tracker upgrade



CMS group:

- Physics analysis: H, top, **B5-B12**
- Detector operation
- Tracker upgrade

Theory:

- Collider phenomenology **B13**
- Cosmology
- String theory

IT:

- high energy computing infrastructure **B14**

FTX group

- Preparation of experiments **B15-B19**
- e+e- collider program
- Science, software, detector, test beam and accelerators

BELLE:

- Physics analysis
- Software **B20-B21** ment
- Vertex detector



ALPS:

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DESY PARTICLE PHYSICS in 2021

Summer student work projects:

ATLAS group:

- Physics analysis: H, top, **B1-B4**
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CMS group:

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IT:

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FTX group

- Preparation of experiments **B15-B19**
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BELLE:

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- Software development **B20-B21**
- Vertex detector



ALPS:

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- Light shining through wall experiment
- Optics, (cryogenic) detectors



*HEP summies: enjoy
your work in the
DESY Particle Physics
groups!*