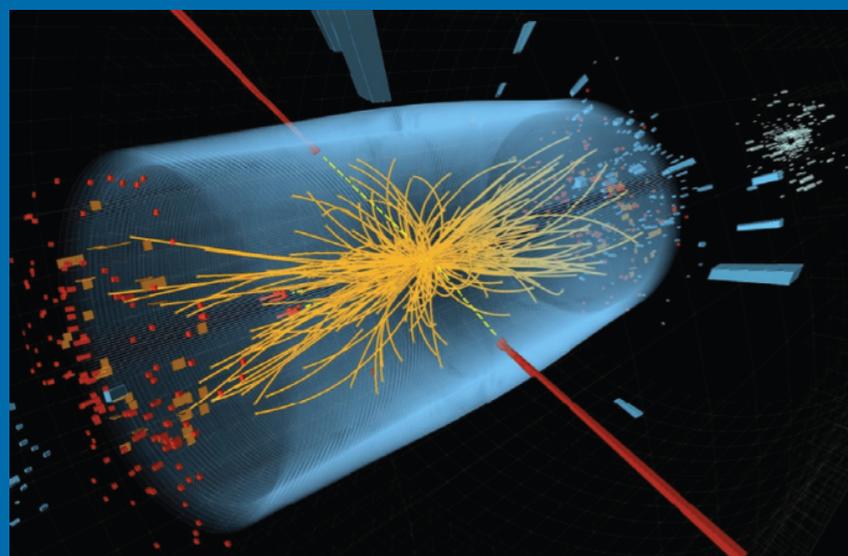


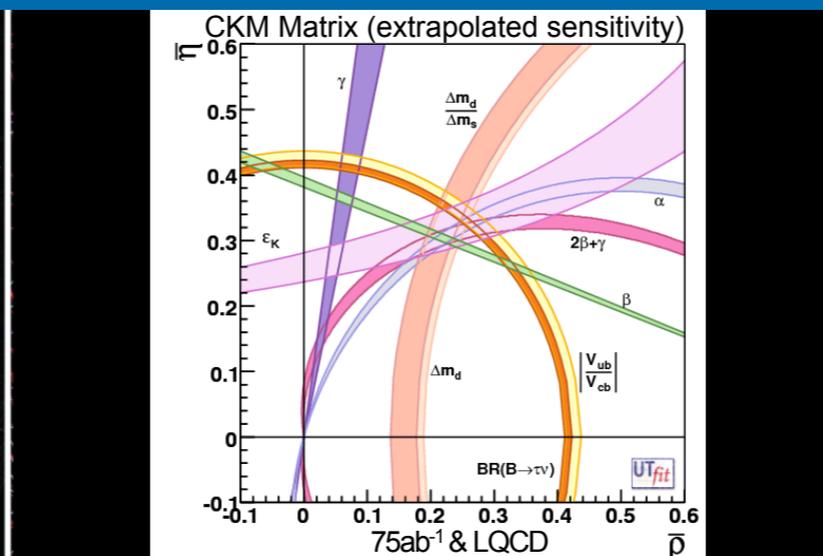
e^+e^- collider

Complementing the LHC physics programme by precision

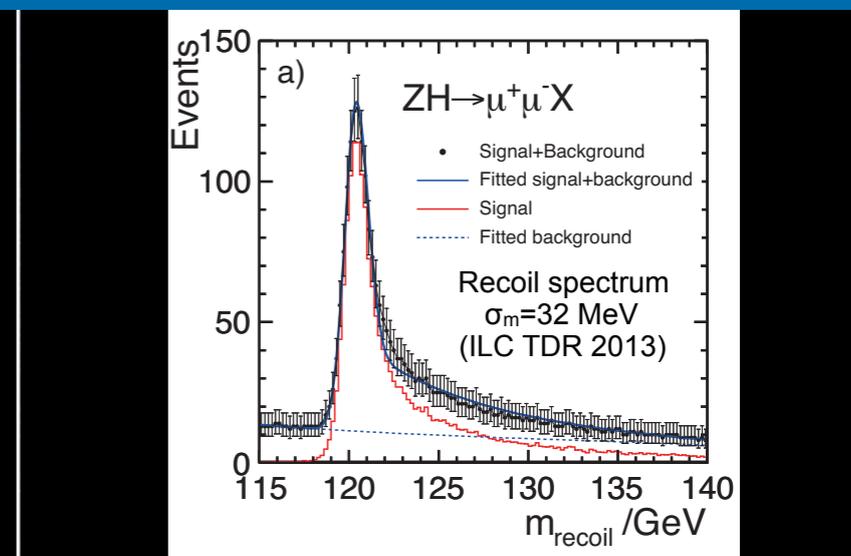
LHC



BELLE II/SuperKEKB



ILC



E.Elsen and C.Niebuhr – DESY

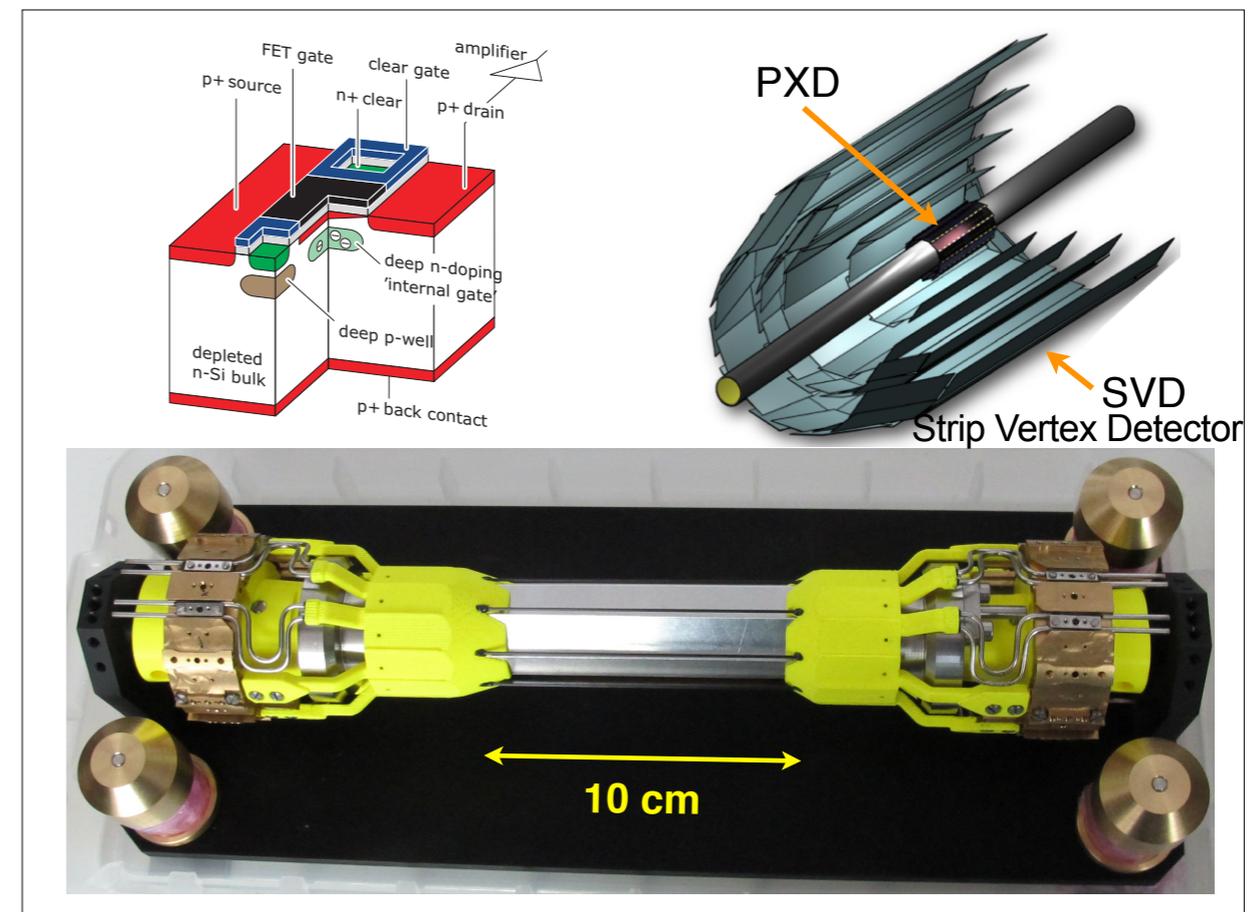
German Contribution to Belle II

Germany plays major role in Belle II upgrade

- 10 German institutes represent 2nd largest Belle II group after Japan
- DEPFET collaboration provides novel pixel vertex detector PXD
 - Technology developed for ILC at Semiconductor Lab (HLL, Munich)
 - PXD intimately linked to StripVertexDetector: **common VXD project**

DESY joined Belle II in 2011

- DESY's role as national lab:
 - Support German groups in building, installing and operating challenging pixel vertex detector
- Synergies with activities in program *Matter and Technology*

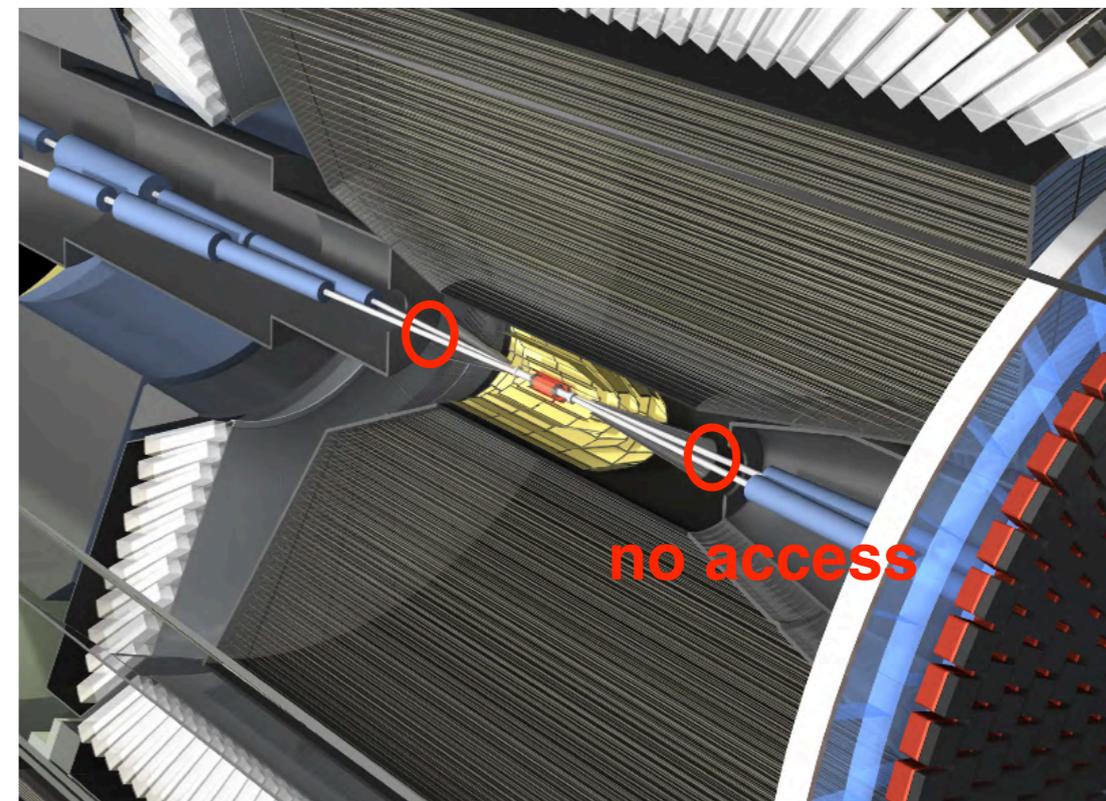
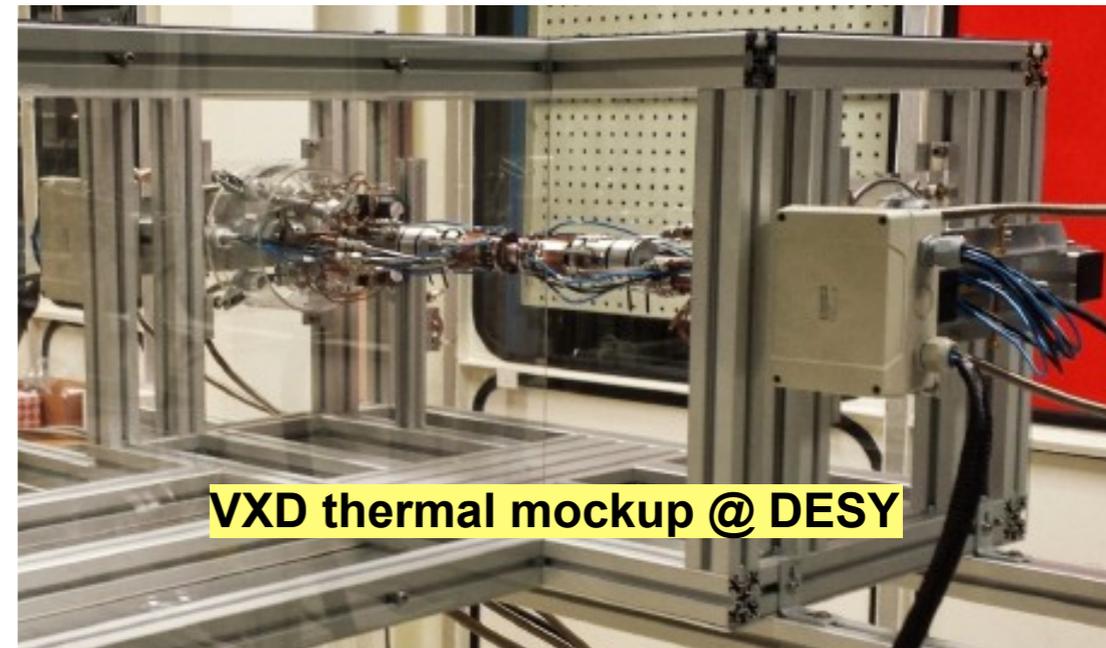


Exploiting Specific DESY Expertise

Extensive experience in integration & operation of complex detector systems

Examples for DESY responsibilities

- VXD heat management
 - Build realistic thermal mock-up including evaporative CO₂ cooling
- Intricate installation of VXD into Belle II
 - Hardly feasible without novel hydraulic remote vacuum connection system developed at DESY
 - Requires very close collaboration at machine-detector interface with SuperKEKB vacuum & magnet groups

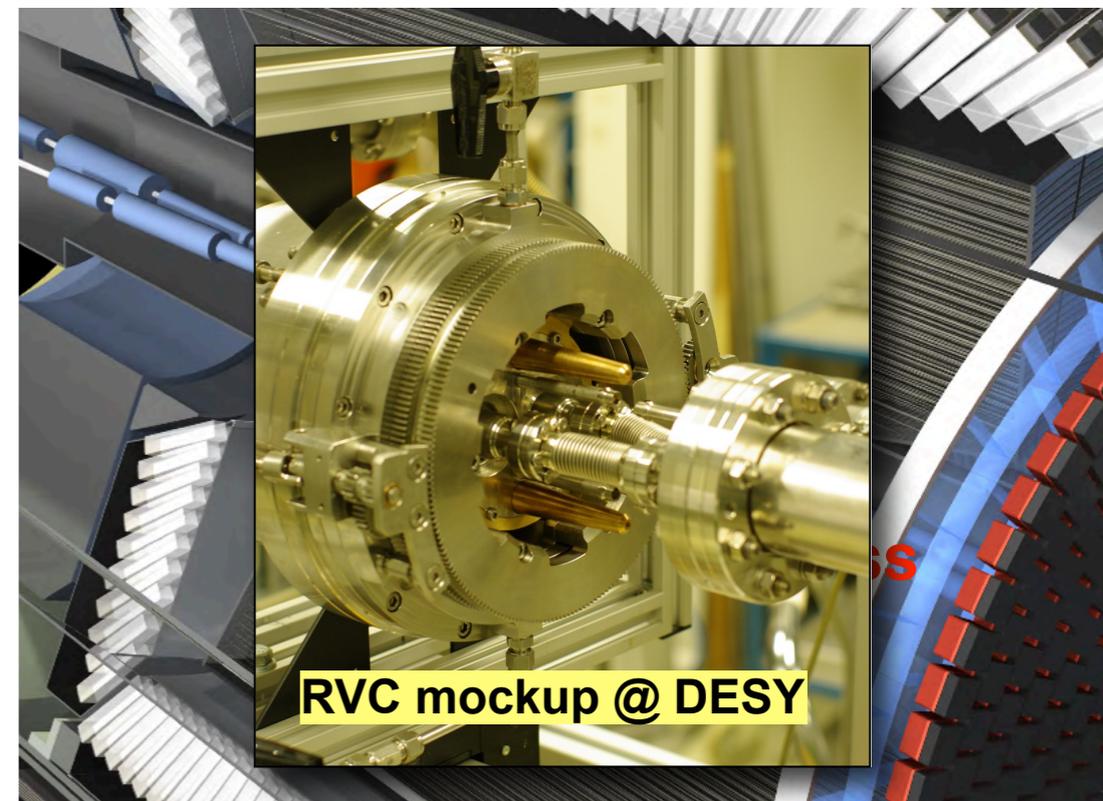
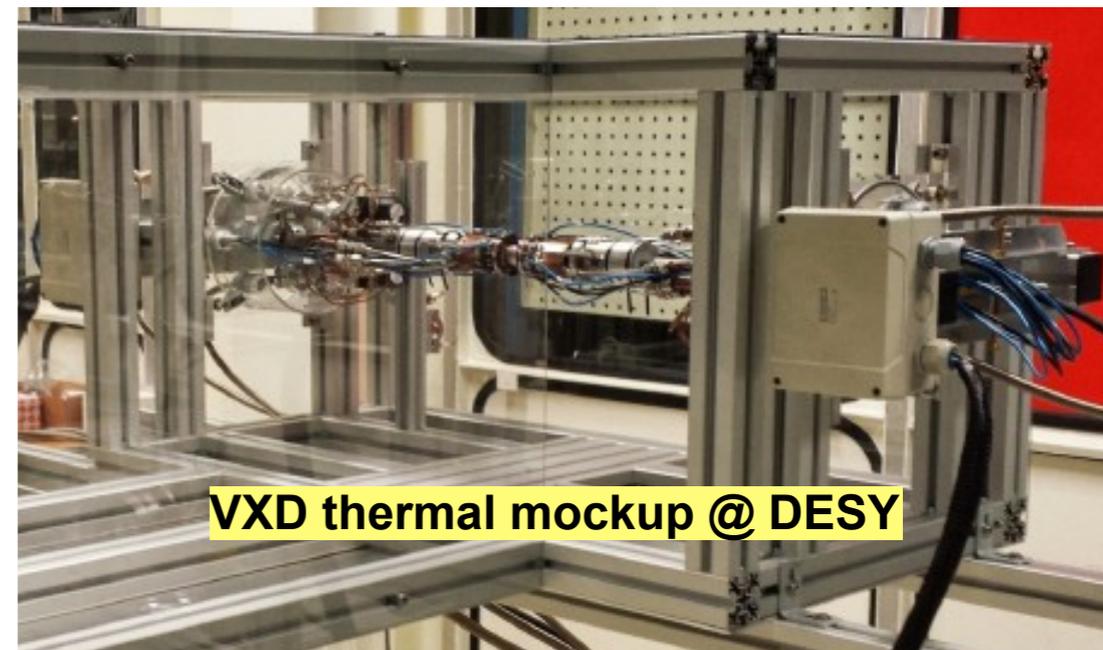


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Utilising Helmholtz Infrastructure

DESY test beam

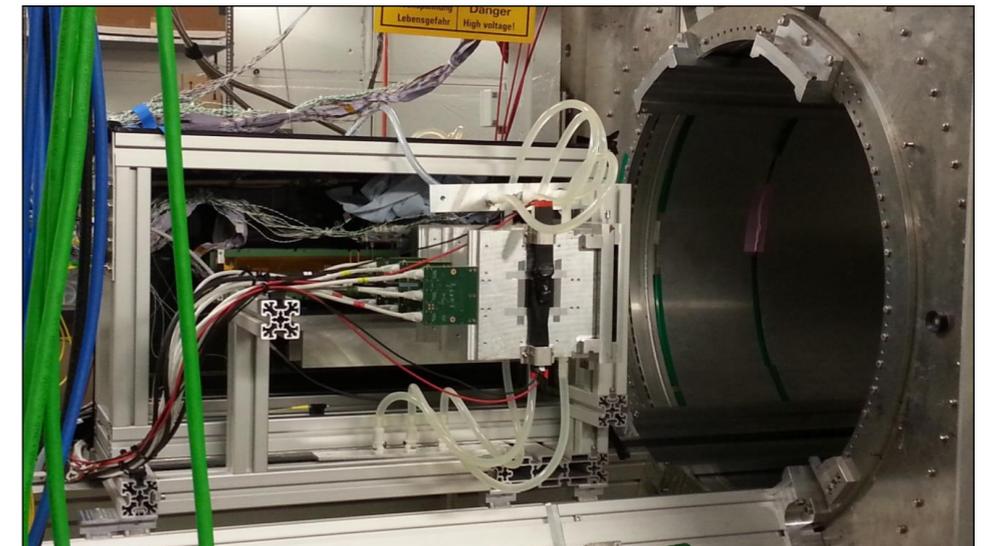
- Major Belle II milestone met in Jan 2014
 - First full VXD system test

Computing

- Data preservation for Belle
 - Full Belle mDST at DESY
- GridKa, Tier2 and NAF for Belle II

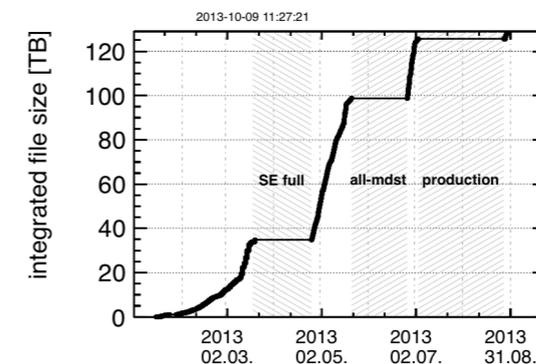
High-level software support

- Building on HERA & LHC experience
 - DESY leads tracker alignment effort
 - Underlying software framework supported by Terascale Alliance



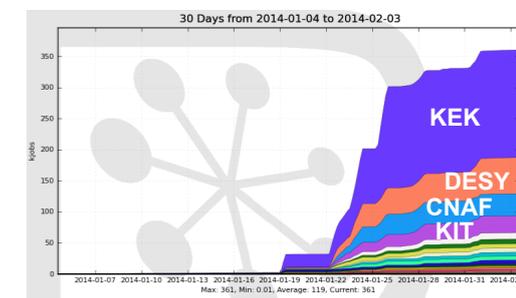
VXD Slice Test in PCMAG

Repository

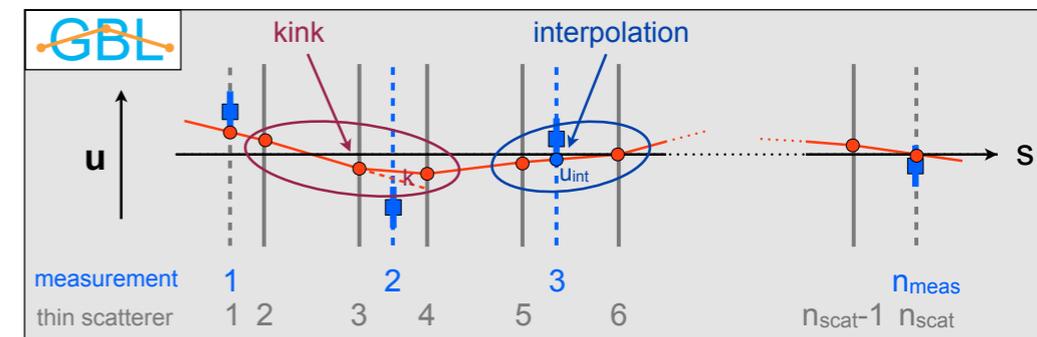


Full Belle Data @ DESY

MC Production



Cumulative MC Jobs per Site



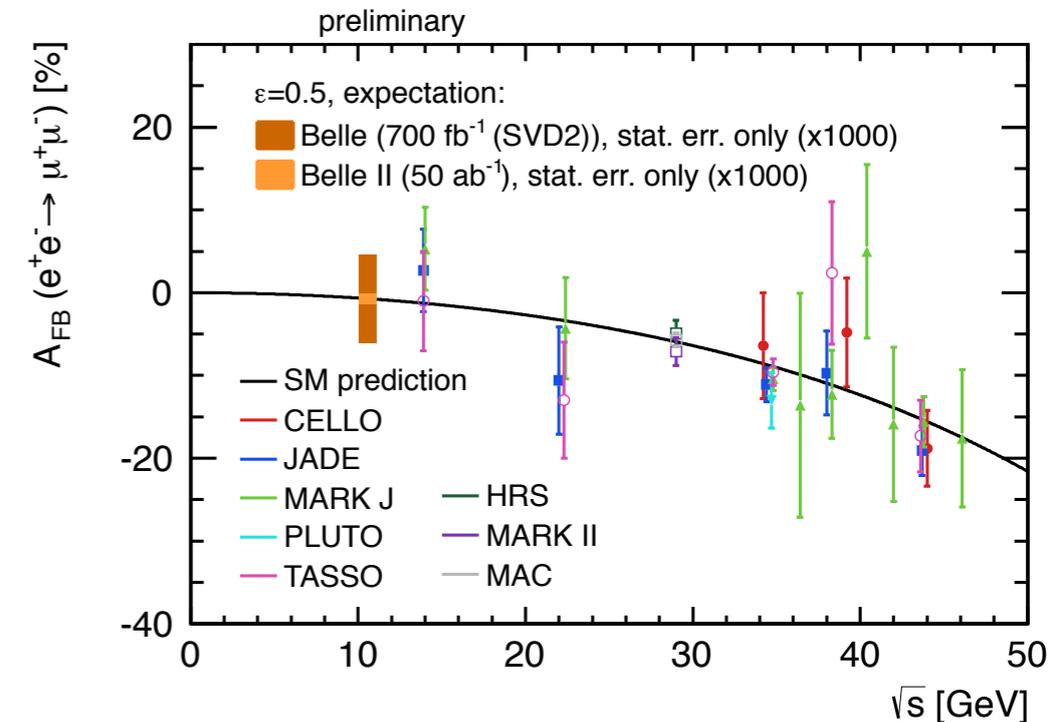
General Broken Lines for Alignment w/ Millepedell

Examples for Ongoing Belle Physics Analyses

Forward-backward asymmetry A_{FB} of muon pairs

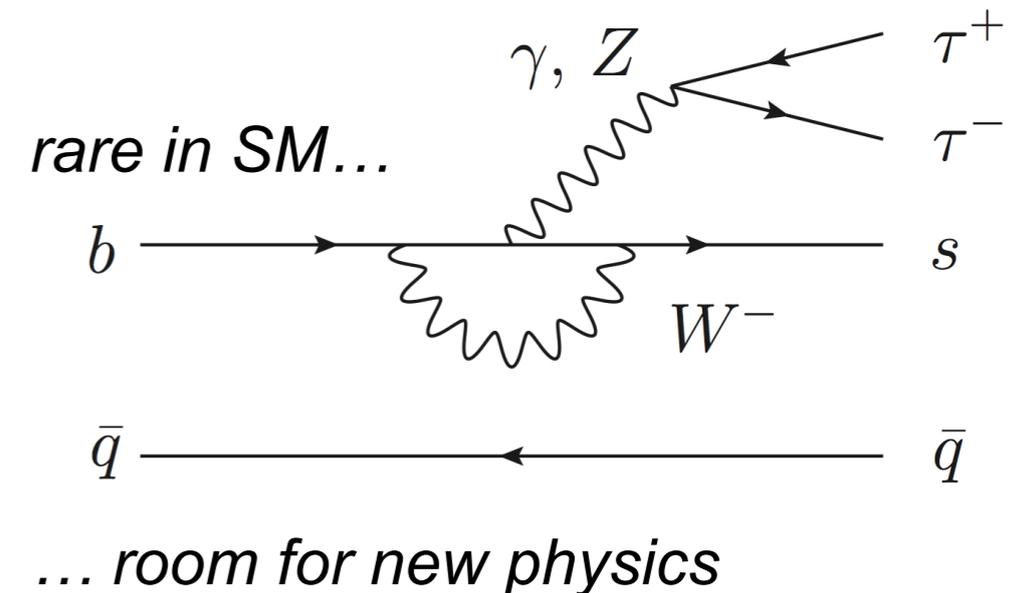
- Born level: $A_{FB}(\sqrt{s}=10.58\text{GeV}) \approx -0.75\%$
- Huge statistics of $\sim 7 \times 10^8$ muon pairs enables precision tests of SM
 - Belle sensitivity: $\sigma_{\text{stat}}(A_{FB})/A_{FB} \approx 1\%$
 - Expect $>50\times$ more data for Belle II

$$A_{FB} = \frac{N(\cos(\theta) \geq 0) - N(\cos(\theta) < 0)}{N(\cos(\theta) \geq 0) + N(\cos(\theta) < 0)}$$

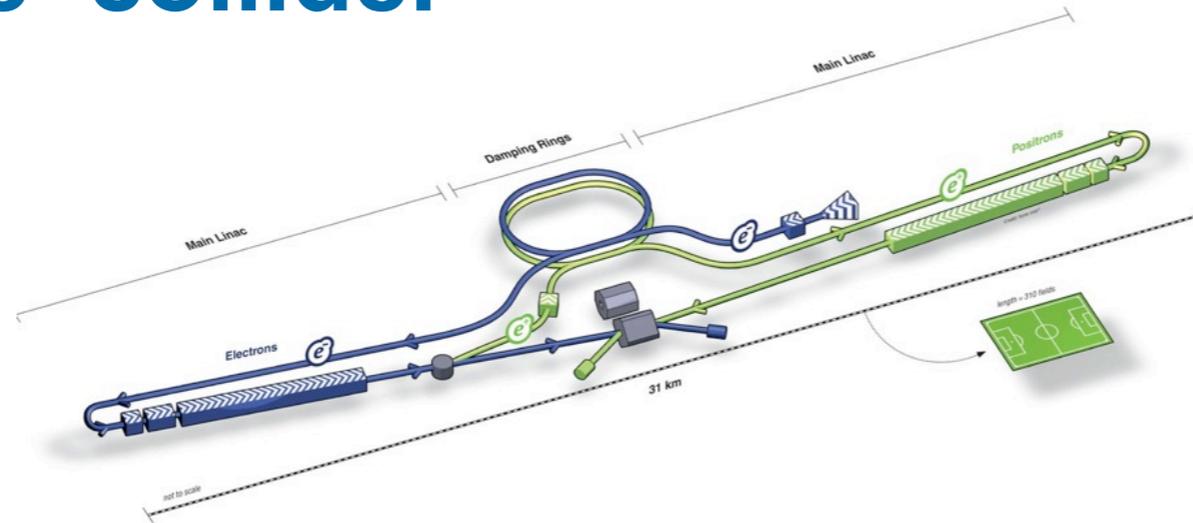


Rare processes, e.g. $B \rightarrow K^{(*)} \tau \tau$

- Heavy meson chiral perturbation theory predicts $BR \sim O(10^{-7})$
- Present upper limit (BaBar) $BR < 10^{-3}$



DESY key to development of a superconducting linear e^+e^- -collider

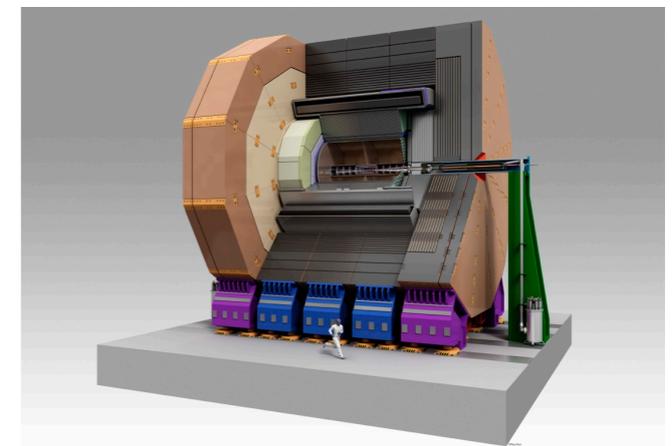


- TESLA collaboration, hosted at DESY, develops SRF technology (since the 1990ies); TESLA proposal in 2001 (collider & XFEL)
- European XFEL construction at DESY with SRF linac
- Key contributions to the 2013 GDE Technical Design Report (TDR) of an e^+e^- -collider
 - Accelerator
 - Detector
 - Physics case

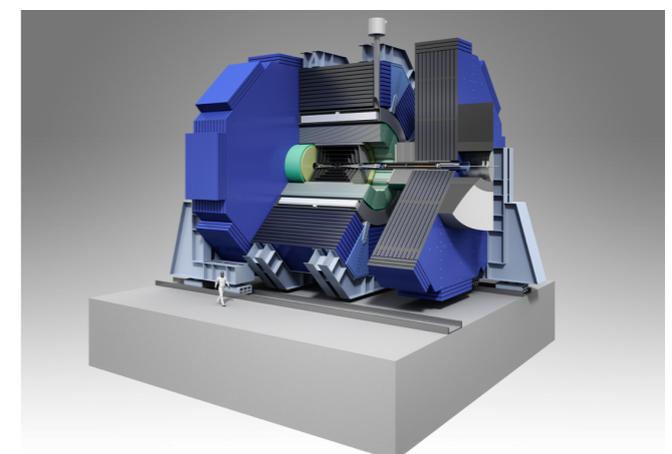
} TDR editors from DESY in all areas



ILC



ILD

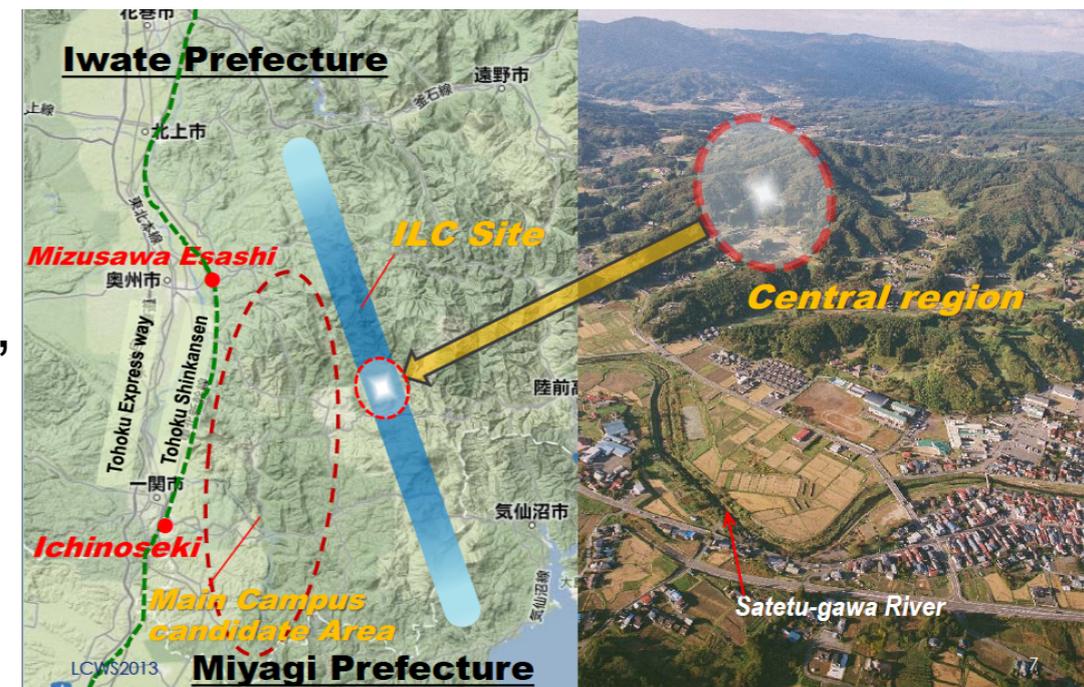
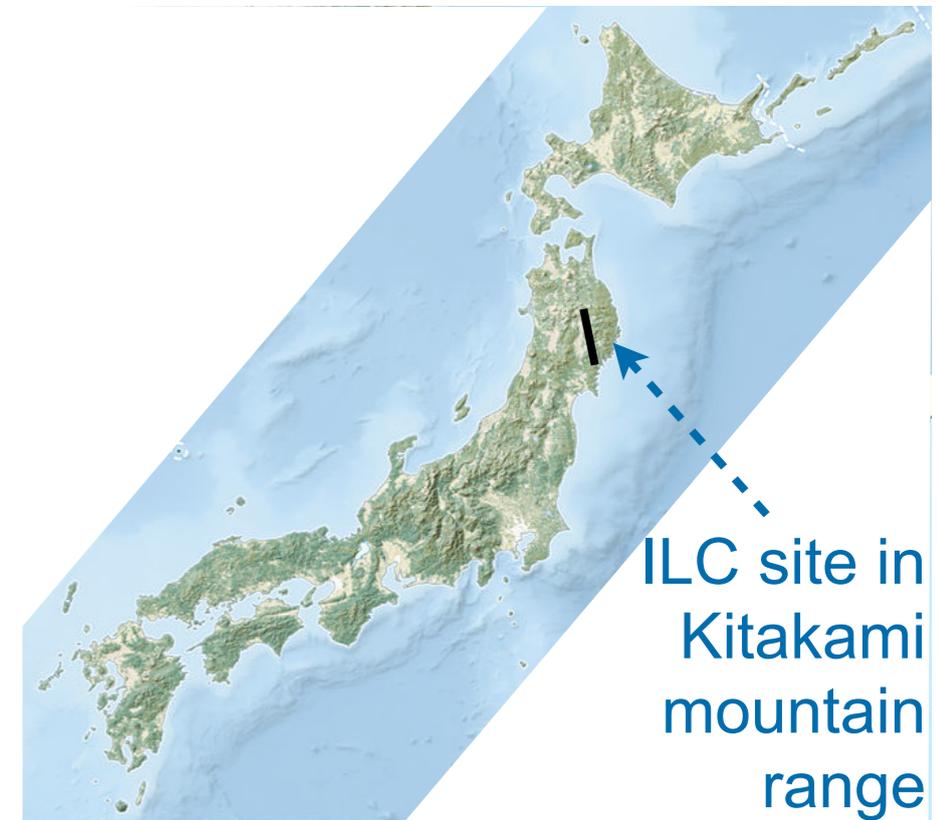


SiD

International Linear Collider (ILC)

ILC construction considered in Japan

- Strong support from industry and government for HEP initiative in Japan: Advanced Accelerator Association (AAA)
- **European Strategy for Particle Physics (2013) welcomes Japanese initiative**; awaits Japanese proposal
- **US Snowmass process** emphasises importance of ILC: input for HEPAP P5 panel recommendations
- Japan Policy Council (politicians and industry), recommend (2012) creation of science city with ILC at core; ILC site has been selected
- Science Council of Japan (SCJ) recommends physics – ok. Details of high energy option open; 2 year evaluation envisaged
- Prime minister includes ILC in political programme



L Evans of LCC visits PM S Abe

DESY contributes to ILC accelerator

Technology

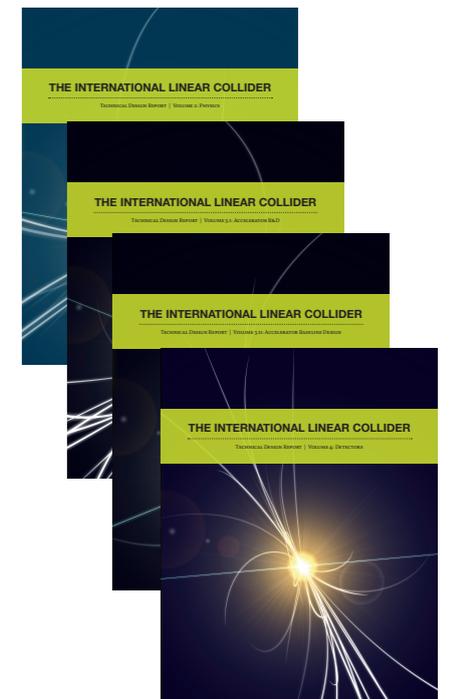
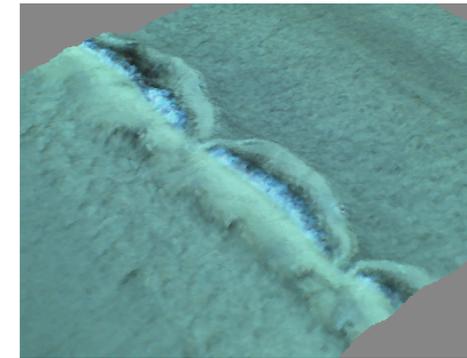
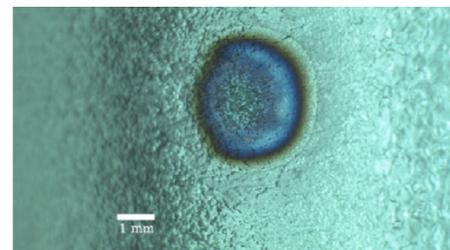
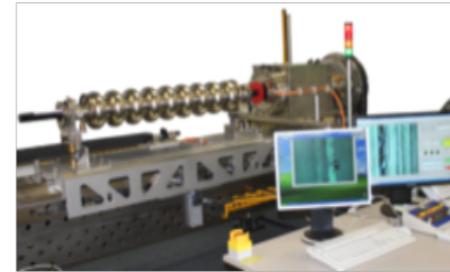
- European XFEL is a 5% prototype
- Explicit high-gradient research at DESY
 - Optical inspection
 - Surface treatment
 - Second sound for defect location
 - Centrifugal barrel polishing
- FLASH operation – 9 mA experiment

ILC Technical Design Report

- Several key editors from DESY

ILC Management, LCC

- European director, etc.



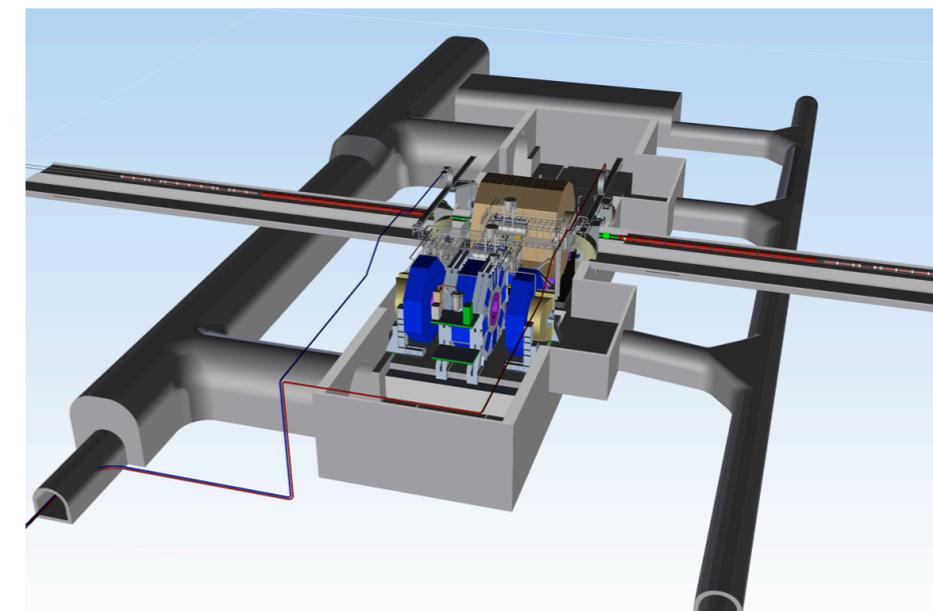
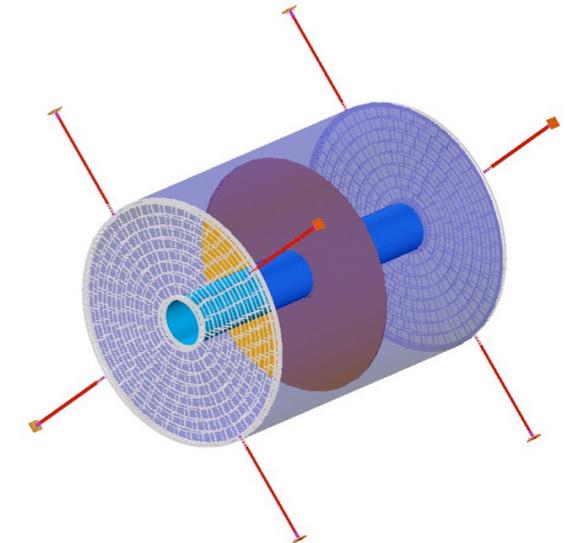
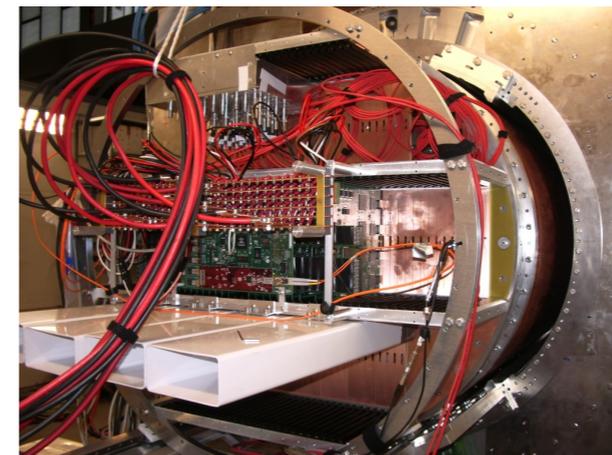
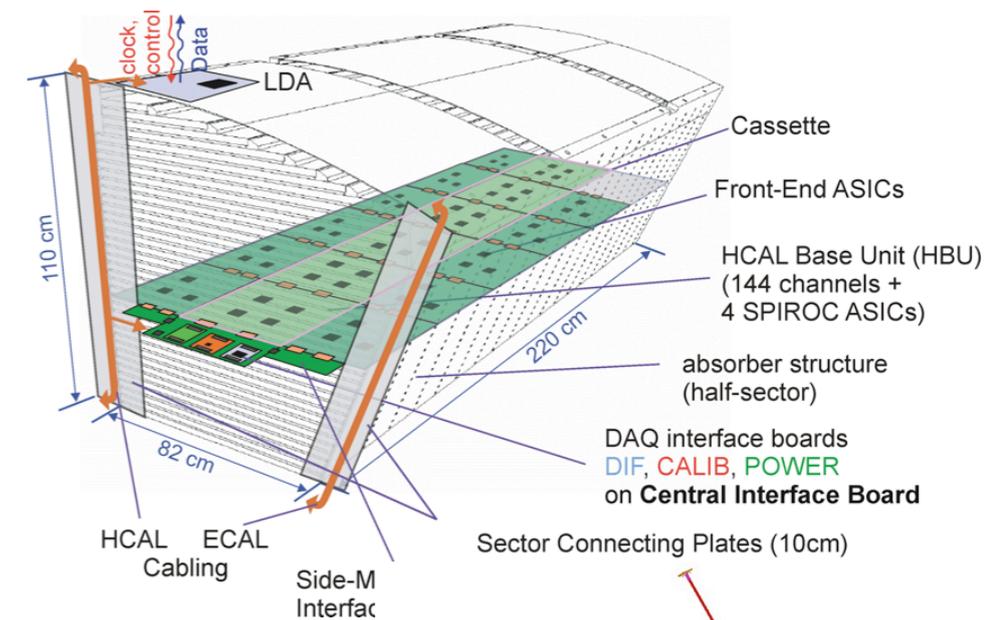
DESY contributes to ILC detector concepts

ILD and SiD detector concepts

- Calorimeter
 - CALICE collaboration to advance Particle Flow algorithms
- TPC
 - High-resolution readout
- Availability of test beams
- Coordination
 - Co-spokespersons in detector concepts

Integration laboratory for ILC detector

- Engineering expertise and support
- EDMS support for detector and accelerator



Physics viewed from a different angle with precision

e^+e^-

- Leptonic initial state; kinematics fully defined
- Precision detector development (vertex, tracking, calorimetry, ...)

Belle II

- High and complementary sensitivity to new physics in indirect signatures ($\sim 10 \text{ ab}^{-1}$ in PoF 3 period)

International Linear Collider

- Unravel the mechanism of Electroweak Symmetry Breaking with precise measurements
- ***DESY is striving to make the ILC become a reality***

Matter and the Universe

Backup slides

Belle II Detector

EM Calorimeter:
CsI(Tl), waveform sampling (barrel)
Pure CsI + waveform sampling (end-caps)

electrons (7GeV)

Beryllium beam pipe
2cm diameter

Vertex Detector
2 layers DEPFET + 4 layers DSSD

Central Drift Chamber
He(50%):C₂H₆(50%), small cells, long
lever arm, fast electronics

KL and muon detector:
Resistive Plate Counter (barrel)
Scintillator + WLSF + MPPC (end-caps)

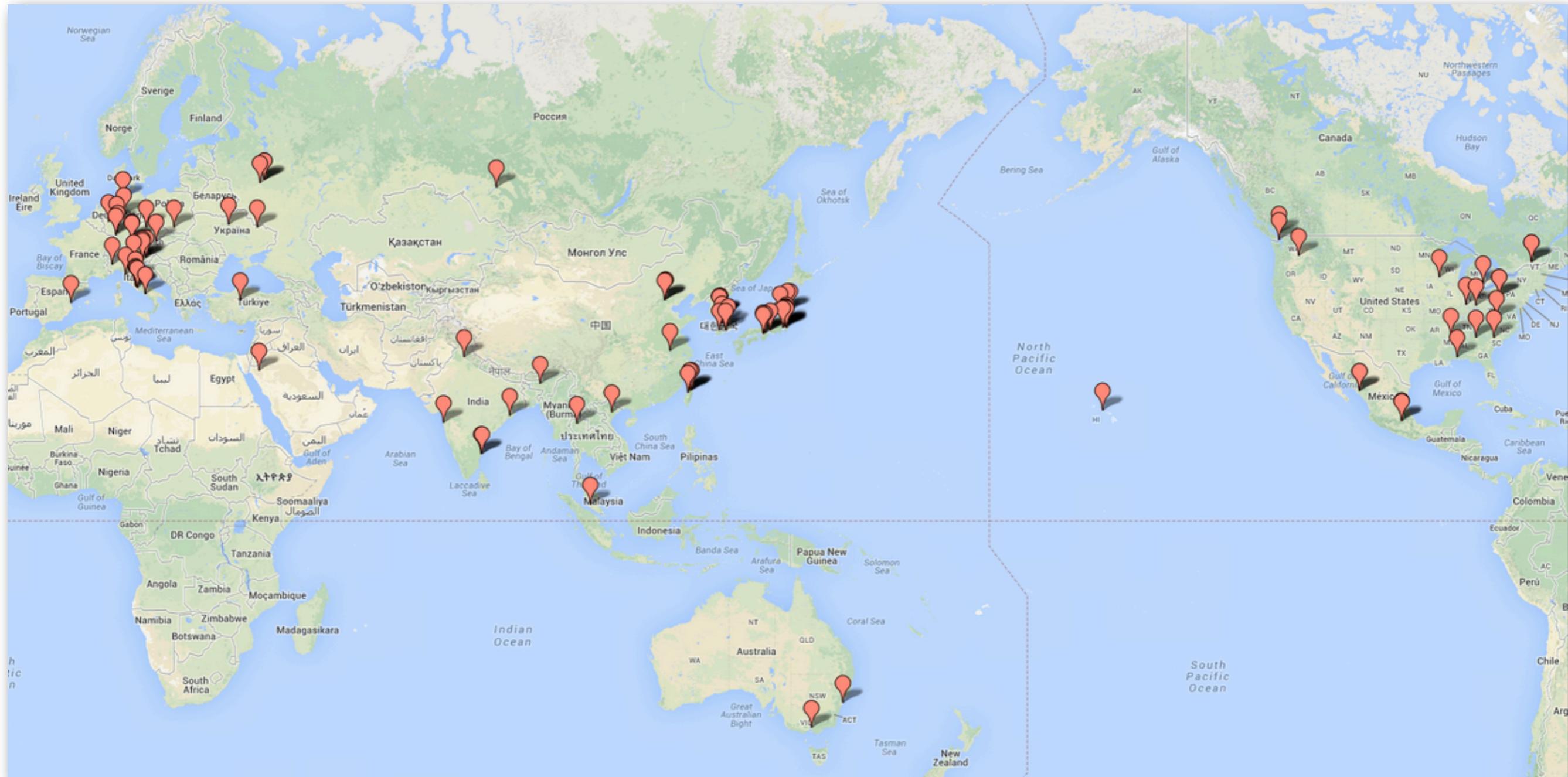
Particle Identification
Time-of-Propagation counter (barrel)
Prox. focusing Aerogel RICH (fwd)

positrons (4GeV)



Belle II Collaboration

- Recently significant influx from former SuperB members
- ~600 members from 96 institutions
- 23 countries



DEPFET Collaboration

China	Institute for High Energy Physics (CAS), Beijing	Zhen'An Liu
Czech Rep	Charles-University Prague	Zdenek Dolezal
Germany	University of Bonn	Norbert Wermes
	DESY Hamburg	Carsten Niebuhr
	University of Gießen	Sören Lange
	University of Göttingen	Ariane Frey
	University of Hamburg	Caren Hagner
	University of Heidelberg	Peter Fischer
	University of Karlsruhe	Thomas Müller
	Ludwig-Maximilians-University Munich	Dorothee Schaile
	Max-Planck-Institute for Physics, Munich	C.Kiesling / H.G.Moser
	HLL Semiconductor Laboratory Munich	Jelena Ninkovic
	Technical University of Munich	Stephan Paul
Poland	Institute of Nuclear Physics, Krakow	Maria Rozanska
Spain	Instituto de Fisica Corpuscular (IFIC), Valencia	Carlos Lacasta
	University of Barcelona	Angel Dieguez
	Centro Nacional de Microelectronica, Barcelona	Enric Cabruja
	Inst. de Fisica d'Altes Energies (IFAE), Barcelona	Mokhtar Chmeissani
	Inst. de Fisica de Cantabria (IFCA), Santander	Ivan Vila Alvarez

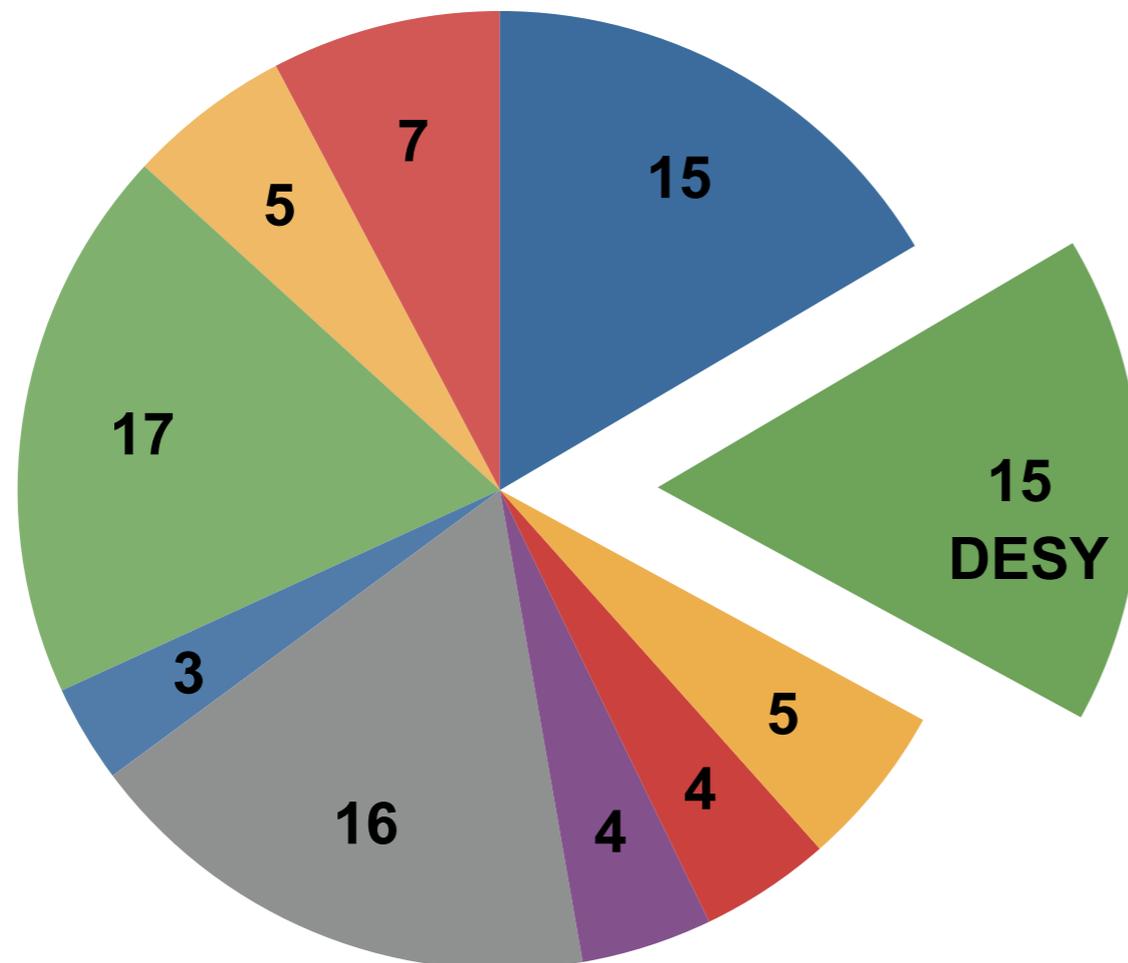
Belle II D SP

PL / TC

German Participation in Belle II

Germany 2nd largest country after Japan

- Belle II third largest particle physics project in Germany after ATLAS and CMS
- DESY among four largest German groups
- University of Hamburg (C. Hagner) intends to join in the near future



Collaboration members

- Bonn
- DESY
- Gießen
- Göttingen
- Heidelberg
- Karlsruhe
- LMU Munich
- MPI Munich
- HLL Munich
- TU Munich