Particle Physics at DESY

Joachim Mnich

DESY

Kharkiv
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DESY: Deutsches Elektronen-Synchrotron

- **One of the largest German research centres**
  - **Founded in 1959**

- **Two sites:**
  - **Hamburg**
  - **Zeuthen (since 1992)**

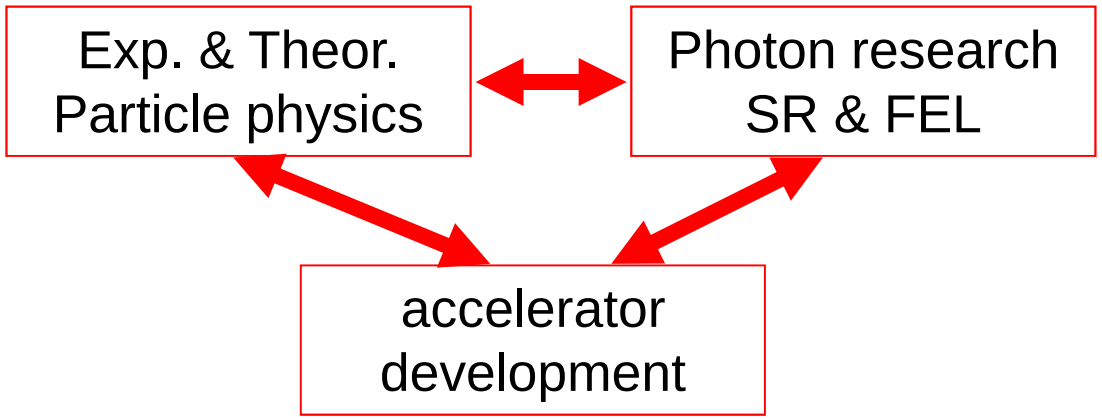
Elementary Particle Physics at DESY

> **DESY has a long successful history in three areas of basic science and high technology:**

- **Particle physics (one of 5 major laboratories world wide),**
- **Research with X-rays (synchrotron radiation, FEL) and**
- **Accelerator development.**

Particle Physics at DESY Highlights:

- **DORIS: discovery of B-mixing**
- **PETRA: discovery of the gluon**
- **HERA: precise studies of the proton and the strong force**



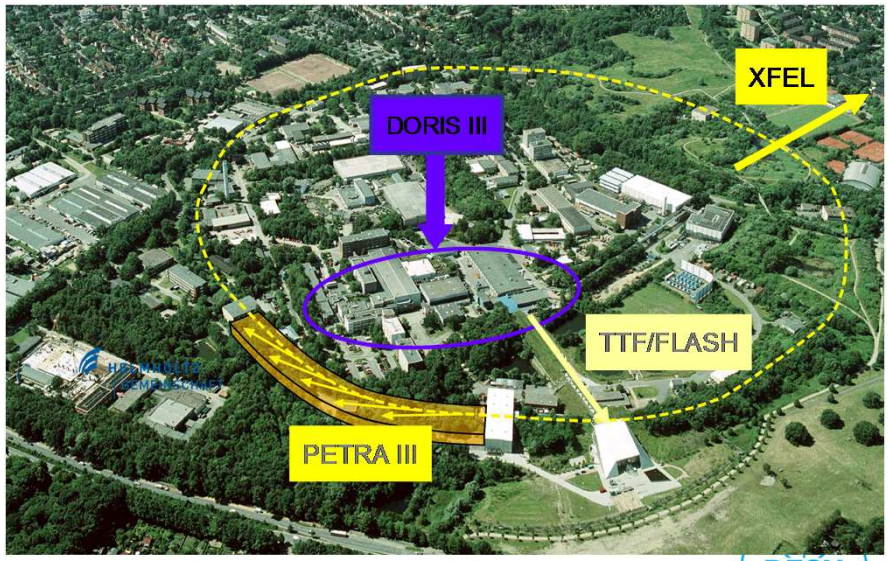
Accelerators at DESY

Circular:

- **DESY**
  - completed in 1964
  - electrons of 7.4 GeV
  - still used as pre-accelerator and testbeam facility (DESY III)
- **DORIS**
  - e^+e^- collider (2*3.5 GeV, upgraded to 2*5 GeV)
  - completed 1974, particle physics until 1992
  - since 1980: synchrotron light source (end 2012)
- **PETRA**
  - e^+e^- collider, 2*23 GeV
  - particle physics: 1978 – 1986
    pre-accelerator for HERA until 2007
  - as of 2009: synchrotron light source (PETRA III)
- **HERA**
  - electron-proton collider 27/920 GeV
  - particle physics 1991 - 2007

Linear:

- **TTF/FLASH**
  - completed 1997 as TESLA Test Facility
  - supra-conducting linear accelerator
  - since 2005 Free –Electron Laser at Hamburg (FLASH)
  - first soft X-ray FELworld-wide
- **European XFEL**
  - construction 2009-15



DESY: Long-term Strategy in Particle Physics

Structure of the proton **Explore the Terascale** **Precision physics**

Contributions to

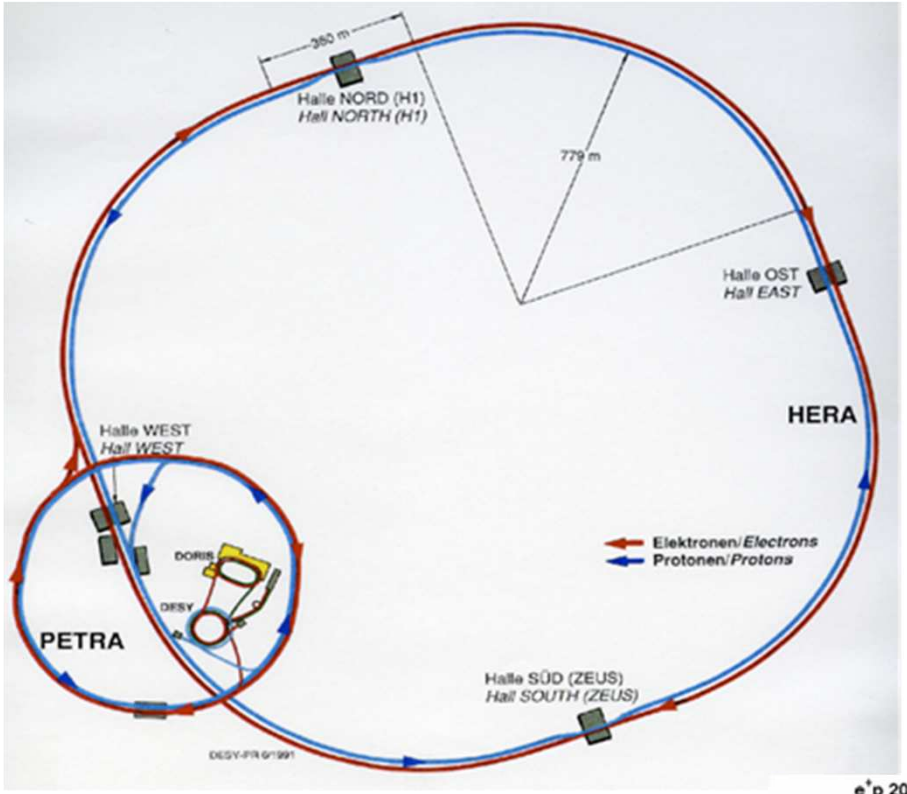
- **Accelerators**
- **Detectors**
- **Physics**

on an international scale

Supported by

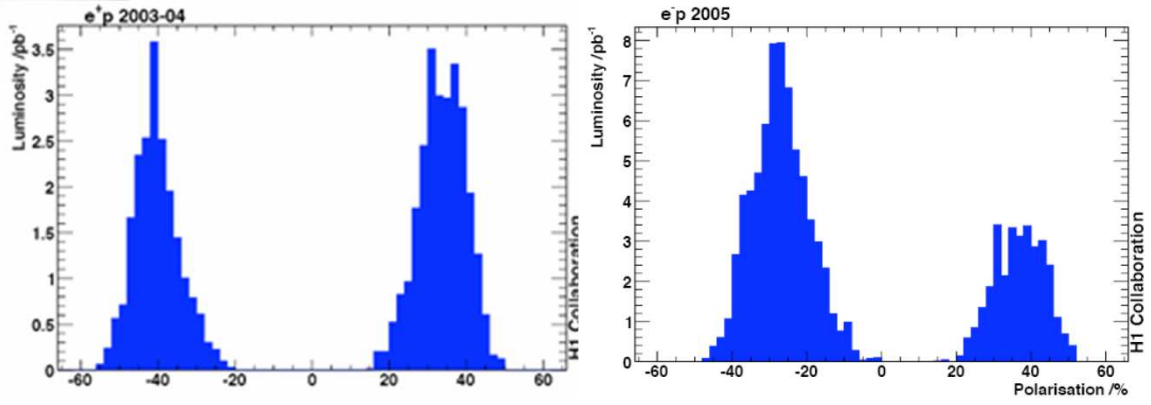
- **Strong and broad theory group**
- **Computing infrastructure (KIT and DESY)**
- **Testbeam & other infrastructures**

HERA: Electron-Proton Collider

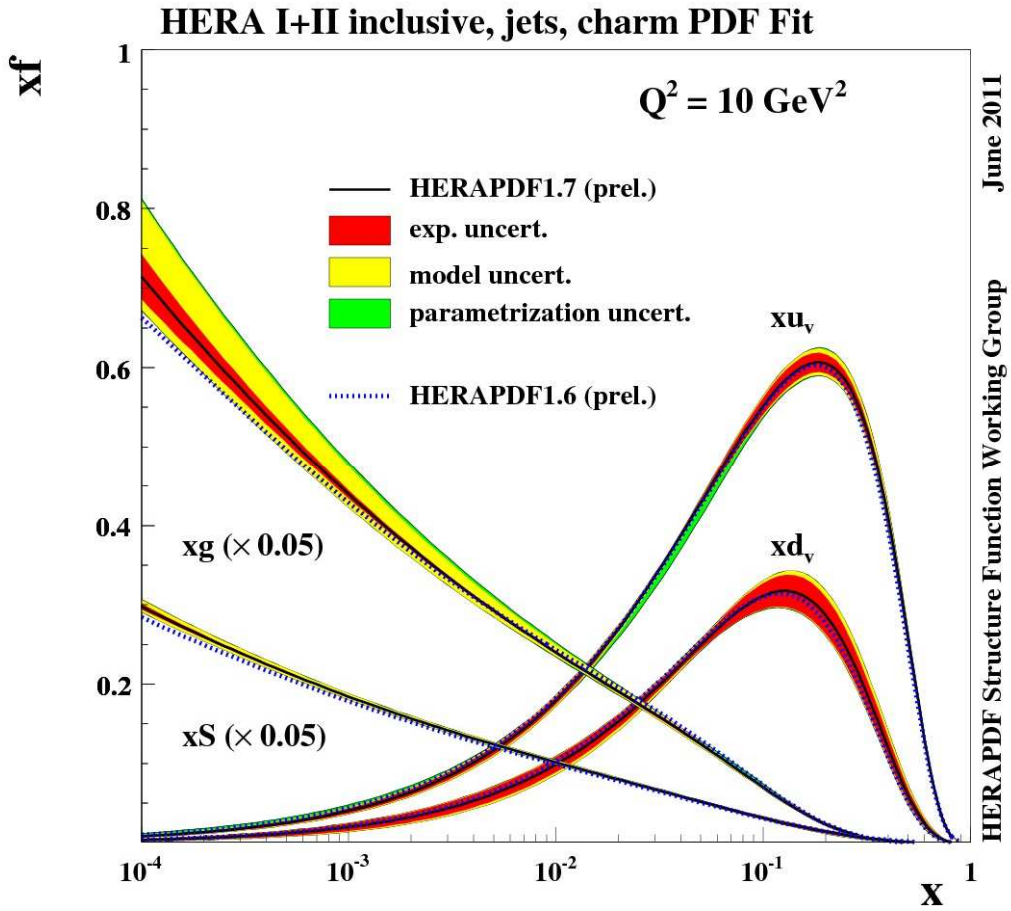


	e^+/e^-	Protons
Energy nominal (GeV)	27.6	920
Energy range (GeV)	10 – 35	460-920
Luminosity	$5 \times 10^{31} cm^{-2} s^{-1}$	
Circumference	6.3 km	
Magn. Field (T)	0.165	4.7
Beam current (mA)	58	160
Bunches	200	
e^+/e^- polarized		
Petra Injection (GeV)	12	40

Polarisation:



Parton Distribution Functions (PDF)



- **Large improvement wrt previous results**
- **In particular low-x gluons**
- **Important input for LHC**

LHC

- **DESY joined ATLAS and CMS in 2006**
- **Contributions to**
  - **Physics Analysis**
  - **Technical coordination**
  - **Trigger & DAQ**
  - **Software & computing**
  - **Tier-2 for ATLAS, CMS & LHC-b**
  - **Smaller detector components ATLAS: ALFA, CMS: CASTOR**
- **will not go into detail here…**

CMS centre @ DESY

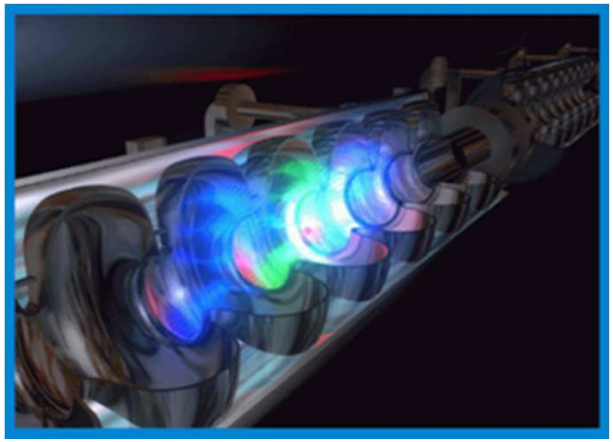
Electron-Positron Linear Collider

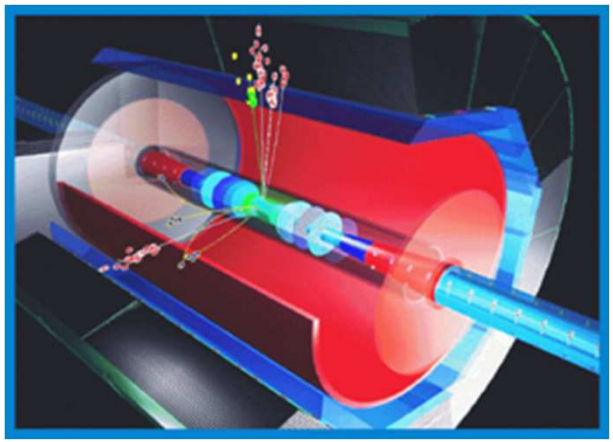
- **DESY pursues for > 15 years development of electron-positron linear collider**

  → TESLA TDR in 2001

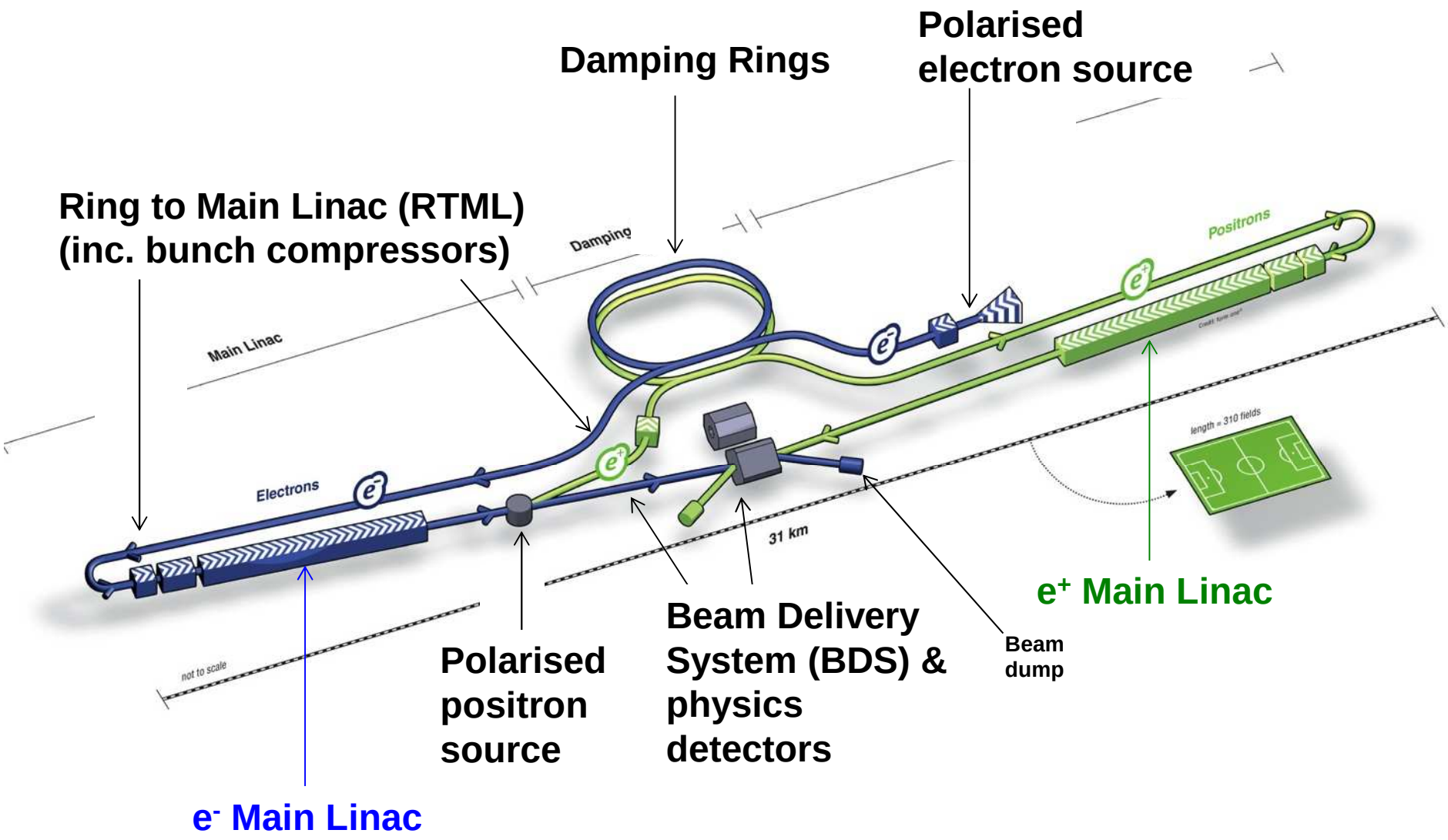
- **Supra-conducting RF technology**
  - **2004: Selected technology for the International Linear Collider (ILC)**

- **Global effort involving all major laboratories from all regions**





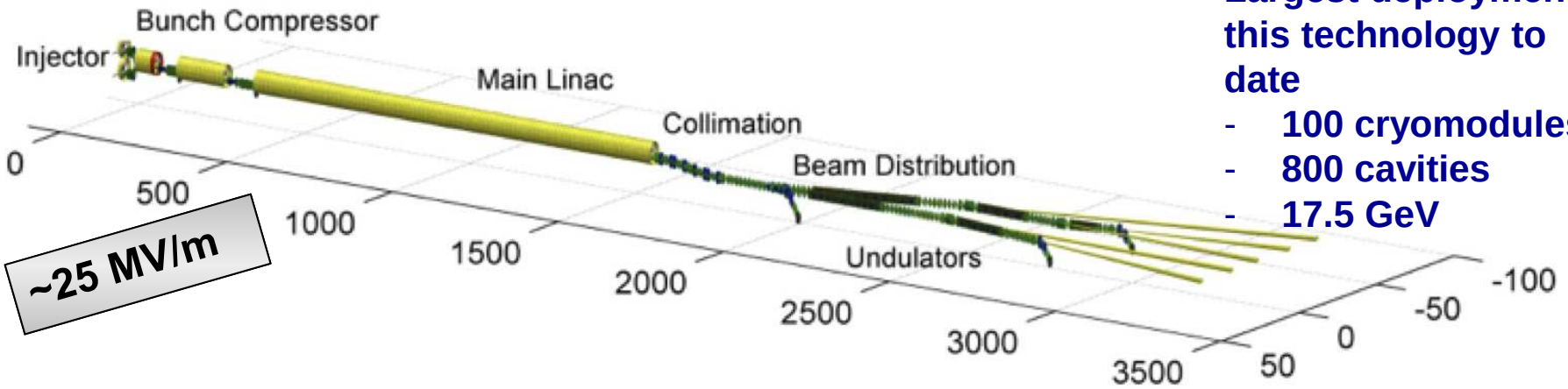
ILC Overview



not to scale

ILC Scheme | © www.form-one.de

European XFEL @ DESY



Largest deployment of this technology to date

- **100 cryomodules**
- **800 cavities**
- **17.5 GeV**

Institute	Component Task
CEA Saclay / IRFU, France	Cavity string and module assembly; cold beam position monitors
CNRS / LAL Orsay, France	RF main input coupler incl. RF conditioning
DESY, Germany	Cavities & cryostats; contributions to string & module assembly; coupler interlock; frequency tuner; cold-vacuum system; integration of superconducting magnets; cold beam-position monitors
INFN Milano, Italy	Cavities & cryostats
Soltan Inst., Poland	Higher-order-mode coupler & absorber
CIEMAT, Spain	Superconducting magnets
IFJ PAN Cracow, Poland	RF cavity and cryomodule testing
BINP, Russia	Cold vacuum components

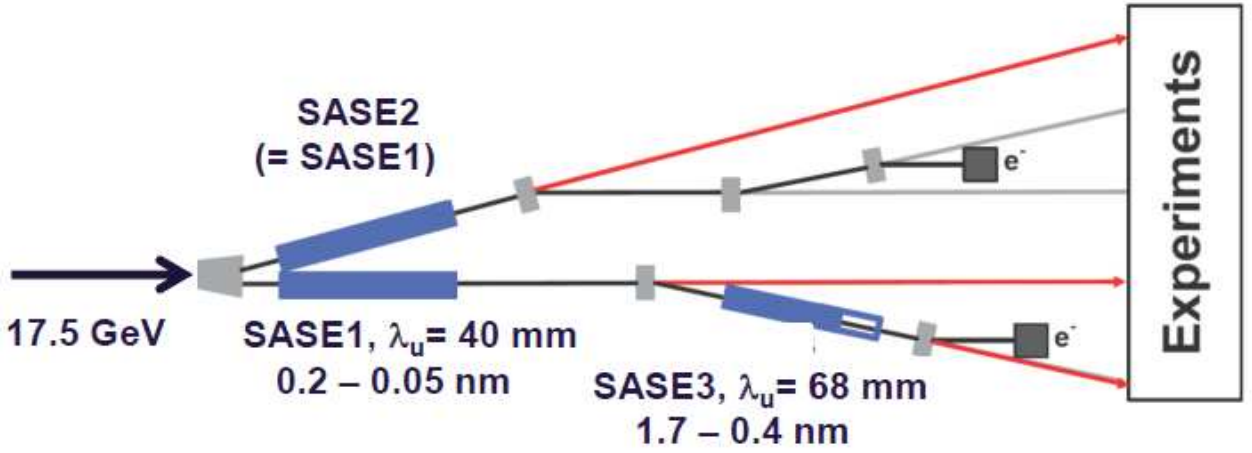
The ultimate 'integrated systems test' for ILC. Commissioning with beam 2nd half 2015

European XFEL

Some specifications

- Photon energy 0.3-24 keV
- Pulse duration ~ 10-100 fs
- Pulse energy few mJ
- Superconducting linac. 17.5 GeV
- 10 Hz (27 000 b/s)
- 5 beamlines / 10 instruments
  - Start version with 3 beamlines and 6 instruments
- Several extensions possible:
  - More undulators
  - More instruments
  - .....
  - Variable polarization
  - Self-Seeding
  - CW operation

First beam late 2015



Tunnel completed

Cryomodule Production: Cold Mass

XFEL Cavity Production

courtesy Zanon

>> 50 cavities produced

(out of 800)

All very good quality

European XFEL in 2016