



Alexander-von-Humboldt

Founded: 28. March 1919

but Gymnasium + Gelehrtenschule since 1529

- **Physikalisches Staatslaboratorium: 1885**
- **Observatory (Sternwarte): 1912**

Biggest University in Northern Germany

- **41 214 Students**
- **690 Professors**

6 Faculties

- **Education, Psychology and Sports**
- **Law**
- **Medicine (incl. hospital)**
- **Arts and Humanities**
- **Economics and Social Sciences**
- **Mathematics, Informatics and Natural Sciences**



Hamburg University - central building



Physikalisches Staatslaboratorium 1901

Bild 3: Gebäude des Physikalischen und des Chemischen Staatslaboratoriums an der Jungiusstraße um die Jahrhundertwende. Vorn links: das Direktoren-Wohnhaus, hinten links: das Hygienische Staatsinstitut Aus: Hamburg in naturwissenschaftlicher Beziehung, Hamburg 1901, S. 203

The golden 20^{ies}-30^{ies} ("Sternstunden"):

4 Nobel-prize winners at Hamburg

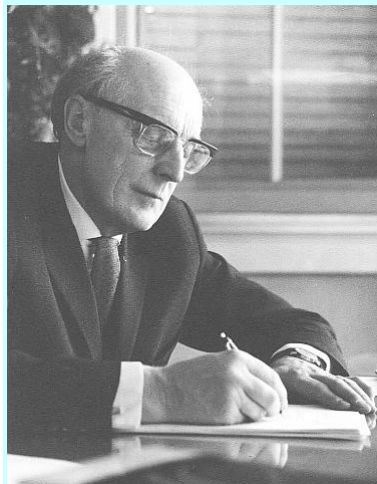
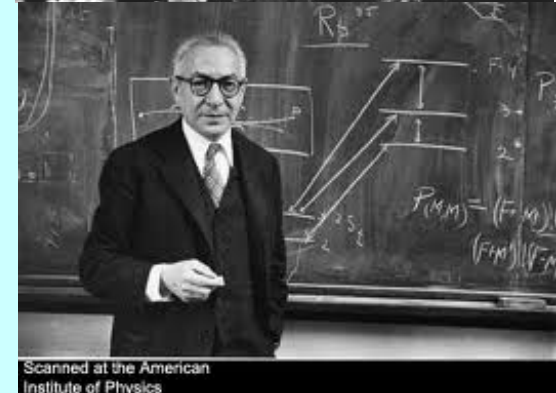
Wolfgang Pauli: Exclusion principle



Otto Stern: Molecular beams
(magnetic moment proton)



Isidor Rabi: Molecular beams
(nuclear magnetic resonance)



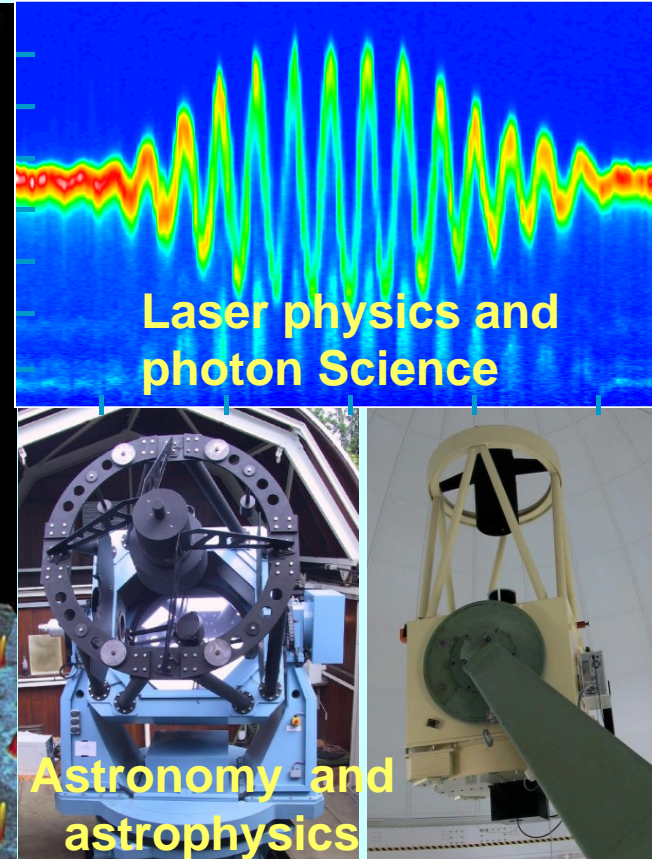
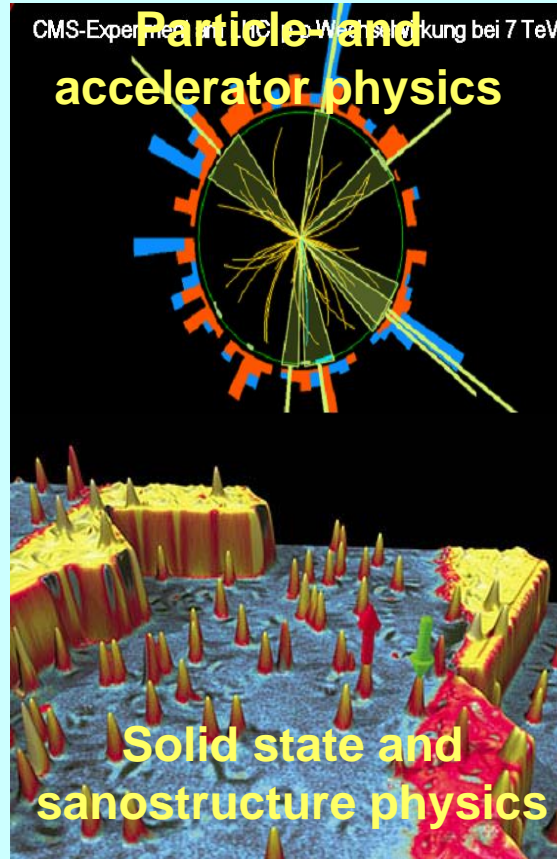
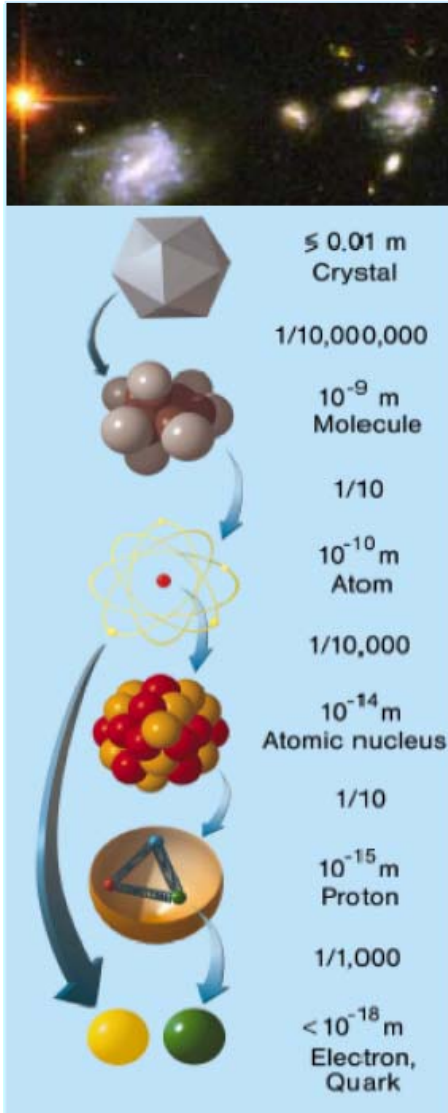
Hans Jensen: Nuclear shell model



Some numbers:

- 3 locations
- One of the largest physics departments in Germany
 - 38 professors and 7 junior professors
 - several joint professorships with non-university partners
 - 61 scientific staff
 - 148 non-scientific staff
- **Students in Physics**
 - Bachelor of Science: 503
 - Master of Science: 154
 - Diploma (program not continued): 69
 - PhD: 408
- **in Nanoscience**
 - Bachelor of Science: 149
 - Master of Science: 19
- **Total: 1302**

4 Research areas in 6 Institutes at 3 locations



In close collaboration with:

DESY, Max-Planck, Helmholtz-Centre Geesthacht

Founded: **18. December 1959**

2 locations: Hamburg and Zeuthen

Financing: 90% federal + 10% state

Personnel: ~1900 (690 scientists)

- ~ 700 students + junior researches
- ~ 120 apprentices
- ~ 3000 guest scientists from 40 nations

Mission:

Development + operation of accelerator for
the study of the Structure of Matter

Research in Particle- and Astro-Particle Physics

Research with Photons

Accelerators @ DESY:

DESY, DORIS, PETRA, HERA

PETRA III, FLASH

European XFEL (2016)



W. Jentschke



Dec. 18 1959



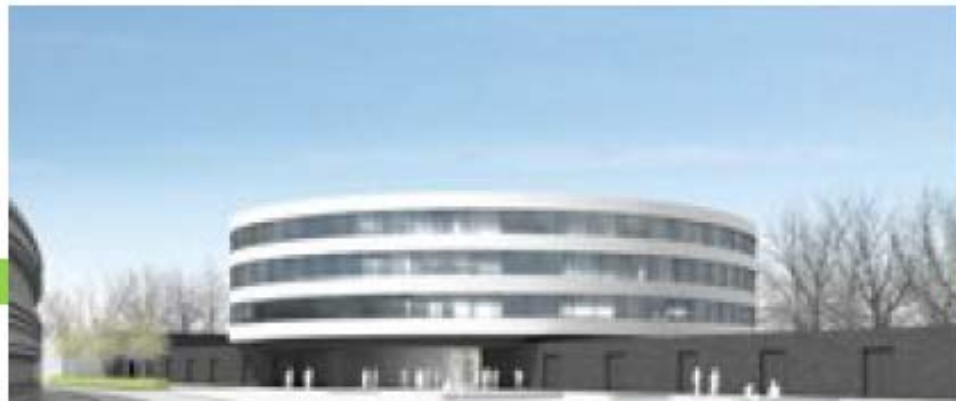
DESY 1964



we are here
→

Campus Bahrenfeld 25.7.2012

CFEL: Interdisciplinary research center focused on FELs



DESY - University HH - MPG



A. Cavalleri
 CFEL-MPG/UHH
 Matter with
 Strong Electron
 Correlations

Oxford



H. Chapman
 CFEL-DESY
 Nanocrystallography
 Ultrafast Imaging

Livermore Lab



D. Miller
 CFEL-MPG/UHH
 Single Molecule
 Diffraction
 Laser applications

Toronto



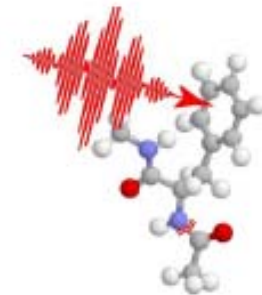
R. Santra
 CFEL-DESY
 Theory of
 Ultrafast
 Phenomena

Chicago



F.X. Kärtner
 CFEL-DESY
 Modern
 Lasertechnologies

MIT



ILC and high-gradient SC cavities:
(mainly DESY + B.Foster)

FLASH: > 5 years operating experience
(one cavity in FLASH @ 30 MV/m)

Eu-XFEL: $E_e = 17.5 \text{ GeV}$

→ 100 modules @ 25MV/m
(5 % of a 500 GeV ILC)

Main achievements of global effort:

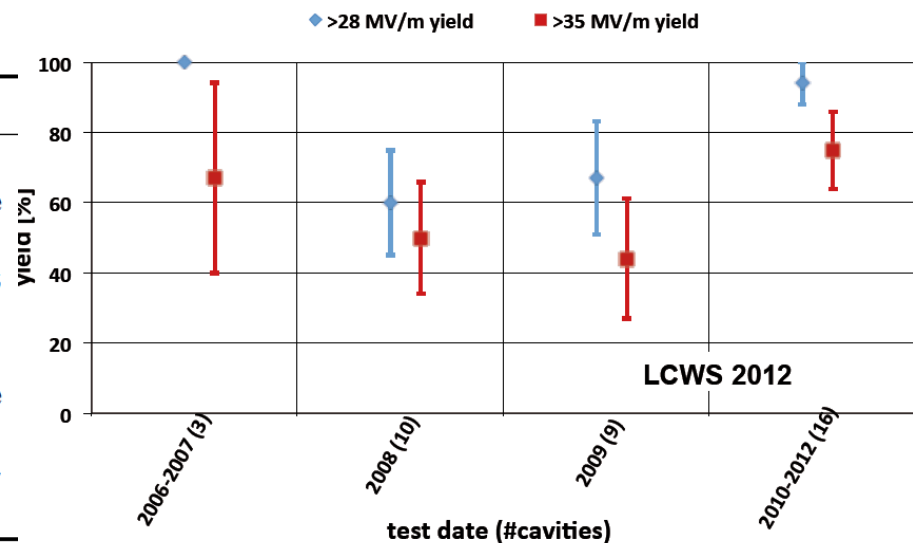
Table 2.2. Main achievements of the SCRF R&D effort.

Achievements
Understanding and mitigation of field emission at low gradient.
Establishment of a baseline sequence of cavity fabrication and surface preparation for ILC.
Achievement of a production yield of 94 % at 28 MV/m and of 75 % at 35 MV/m ± 20 %.
Achievement of an average gradient of 37.1 MV/m in the ensemble.
Achievement of an average field gradient of 32 MV/m in a prototype cryomodule for the European XFEL program.
Demonstration of the technical feasibility of assembling ILC cryomodules with global in-kind contributions.

Cavities @ Zanon

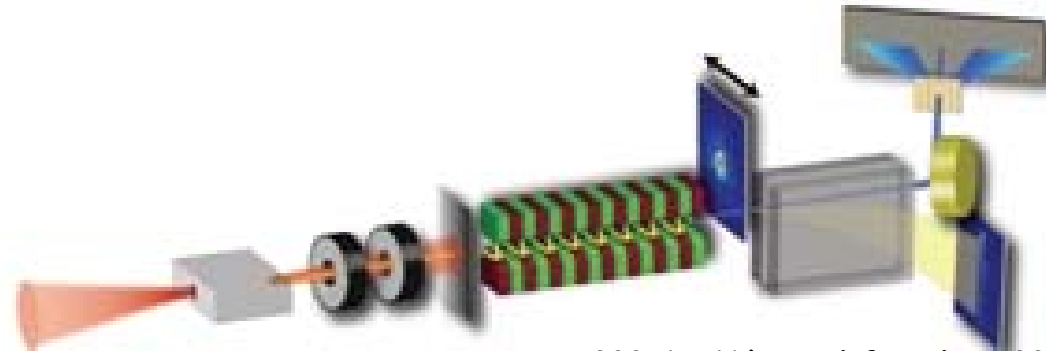


Second pass yield: >28 MV/m + 35 MV/m



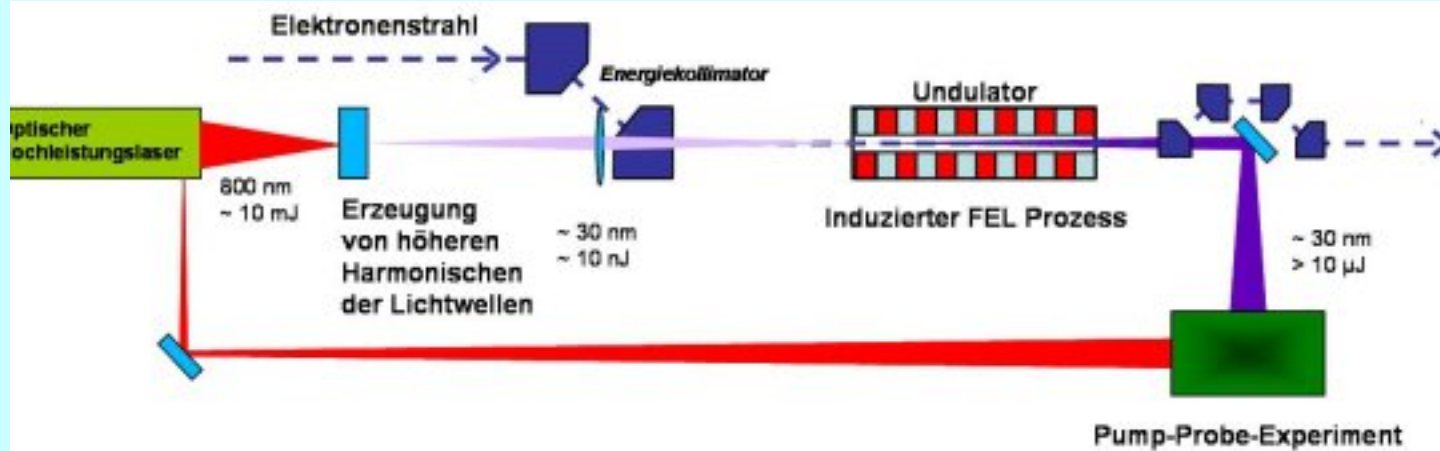
(b) Second-pass yield

Plasma wake-field acceleration



??? 1 TV/m and fs pulses ???

Seeding @ FLASH: for 17 - 35 nm X-rays

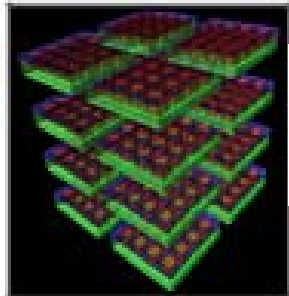


<http://beschleunigerphysik.desy.de/>

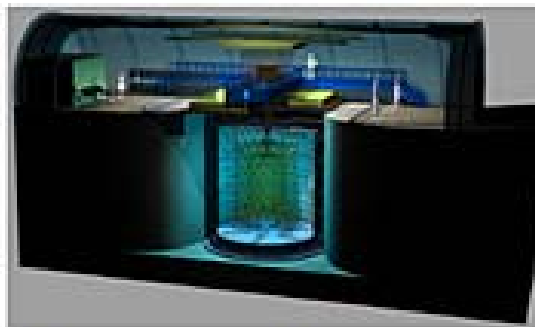
Selected Topics: Neutrino Physics



OPERA: Direct detection
 of $\nu_\mu \rightarrow \nu_\tau$ oscillations with
 ν_μ beam CERN \rightarrow Gd.Sasso



COBRA: ν -less $\beta\beta$ -decay
 $^{116}\text{Cd} \rightarrow ^{115}\text{Sn}$ using 64 000
 (400kg) CdZnTe-detectors

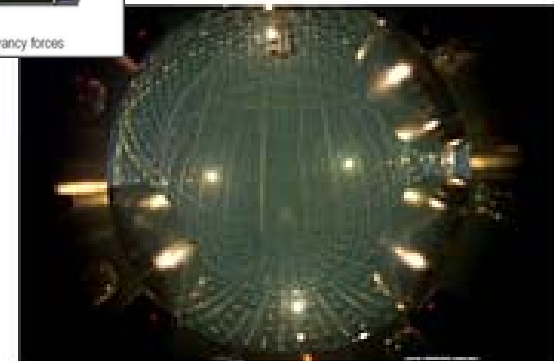


Double CHOOZ: Reactor experiment to measure θ_{13}

DETECTOR LAYOUT



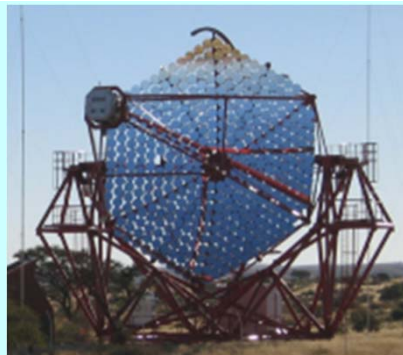
LENA:
 Low-energy ν -astronomy
 ν -oscillations: a 50 kton
 liquid scintillator calorim.



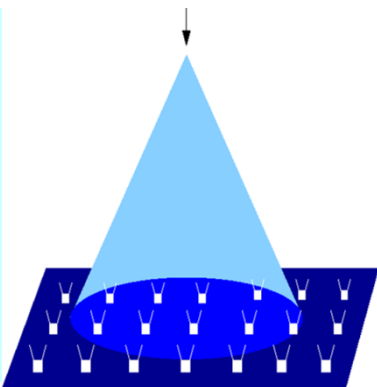
BOREXINO:
 Solar ν -flux, ν -oscillations
 (100 tons fiducial liquid sci.)

HESS:

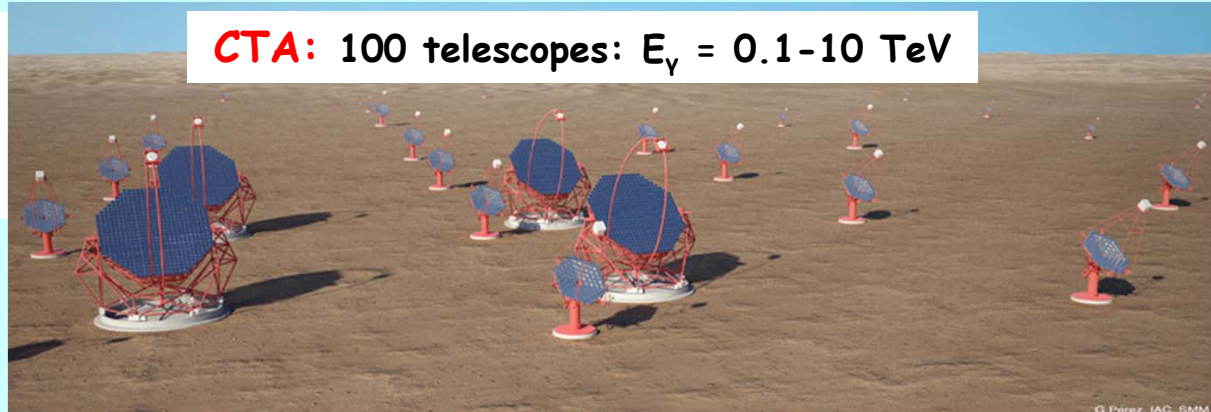
High-energy γ -astronomy -
 study non-thermal universe
 (UHH founding member HEGRA)



HISCORE: 100 km²
 $E_\gamma = 0.1-1\text{EeV}$
 Proto. in Tunka valley



CTA: 100 telescopes: $E_\gamma = 0.1-10\text{TeV}$



ROTSE:

Robotic telescopes
 around the world for
 optical transient for
 sec. - days time-scale
 → **Gamma Ray Bursts**



Exp. + theor. astro-particle physics:

- Dark matter
- Photon-photon oscillations
- Gamma emission from galactic centre
- Gamma Ray Bursts
- Origin of ultra-high cosmic rays
- Relics from the early universe
- Cosmological phase transitions
- Gravitational waves
- ...



Close Collaboration DESY + (Physics + Mathematics) @ Uni-HH (Wolfgang-Pauli-Centre)

Collider phenomenology

- Detailed predictions for signal and background processes at LHC and future colliders
- Identification of the nature of TeV-scale physics from collider data, flavour physics and other experimental constraints
- Development of new models, methods and algorithms

Particle cosmology

- Matter-antimatter asymmetry , dark matter, inflation and gravitational waves
- Axion-like particles, WISPs and the low energy frontier
- Grand unified theories in four and more dimensions

String theory

- Non-perturbative dualities between gauge theory and string theory
- String theory on curved space-times
- Non-perturbative dualities between string theory on different space-times

After HERA → CMS@LHC + preparation for ILC-experiment

Detector:

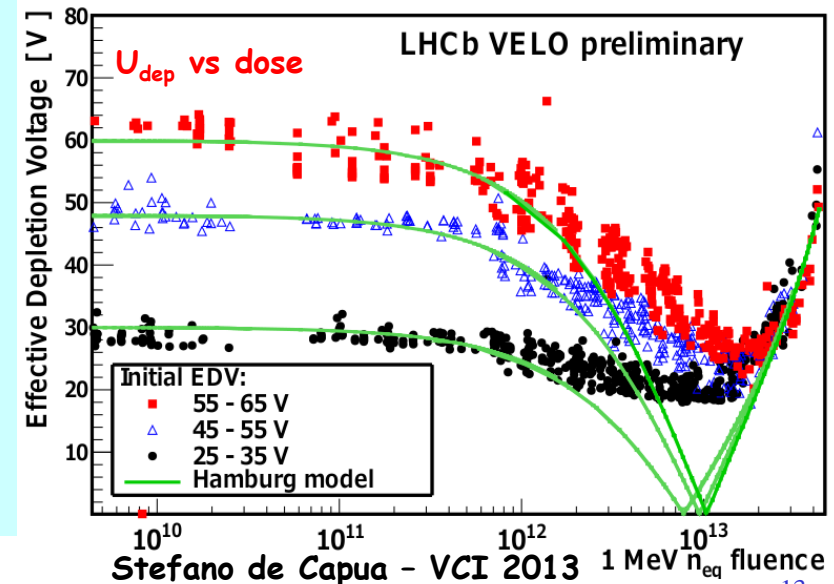
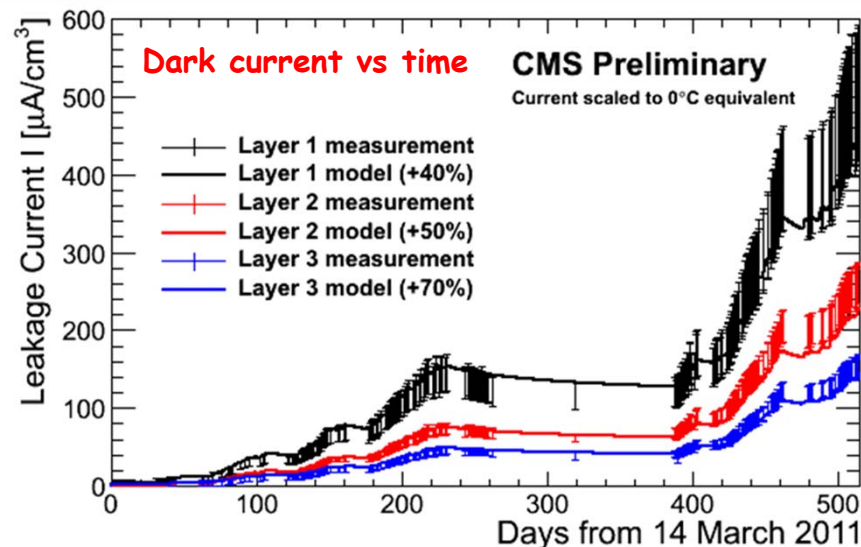
- Si tracker
- Alignment (Millipede)
- CAL calibration+understanding (JET- + missing-energy)
- Tracker upgrade
- Pixel upgrade



Physics:

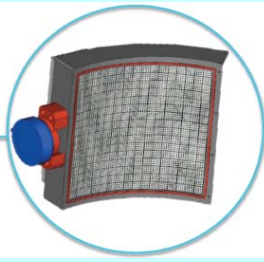
- SUSY
- Top production
- Dark matter
- 4-th generation quarks
- BSM

Radiation damage Si: Hamburg model: I_{dark} and U_{dep} vs dose + oxygenated Si

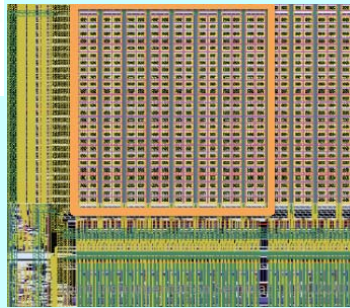




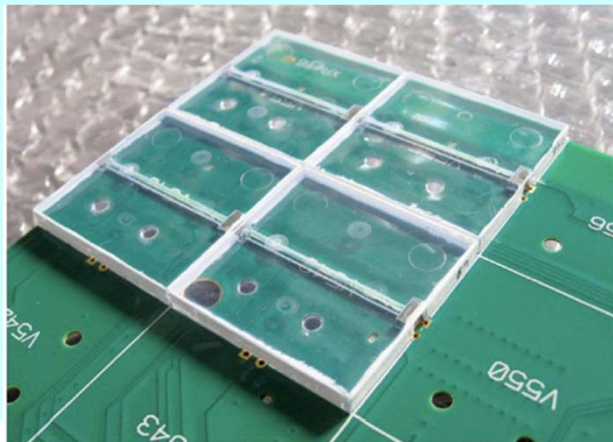
PET with on **external** + **internal** detector on ultra-sound endoscope



LYSO-crystals readout by SiPM digital SPAD



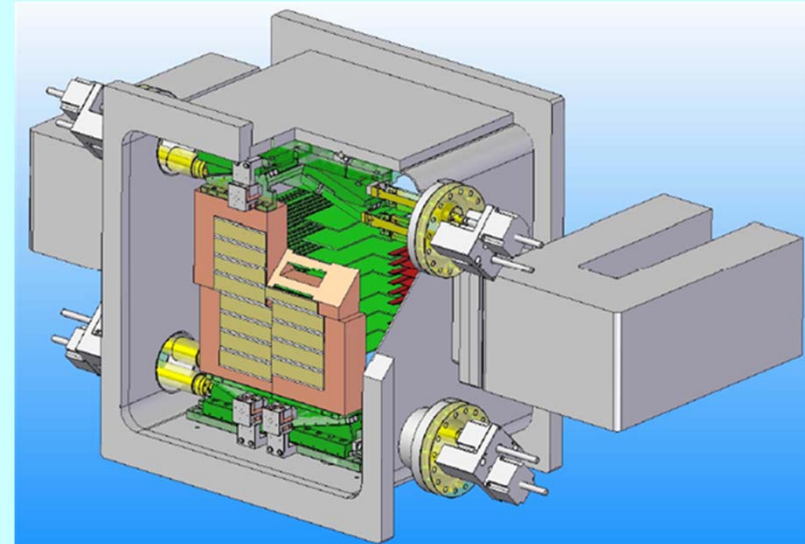
← Spin-off of **CALICE R&D**



AGIPD: 1M-pixel detect. for EuXFEL

- Dyn. range: 0, 1, $\sim 10^4$ X-rays of 12keV within ~ 10 fs
- 220 ns data rate (for 600 ns)
- 0-1GGy X-ray radiation damage

1 Mpixel detector assembly (16 single det. assemblies)



← Spin-off of **CMS-Pixelsensor**



Welcome to an exciting and pleasant meeting

Alexander-von-Humboldt