



# RESEARCH CENTRE: DESY

**HELMHOLTZ**  
SPITZENFORSCHUNG FÜR  
GROSSE HERAUSFORDERUNGEN

**DEUTSCHES ELEKTRONEN SYNCHROTRON**

Research centre of Helmholtz Association

**One of Germany's largest laboratories for basic research with large-scale facilities**

Founded 1959,  
located in Hamburg and Zeuthen

650 staff scientists, 700 young scientists  
3000 guest scientists from 40 countries

## **Fundamental & Applied Science:**

- accelerator development & operation
- photon science
- particle and astroparticle physics



**Leading the Helmholtz Research Programs in the Field “Matter”:** *“Matter and the Universe”*  
and *“Matter and Technology”*



# DESY INVOLVEMENT IN THE LHC PHYSICS



## Analysis of the LHC data

- **DESY-CMS: top-quark and Higgs physics**  
leading role in the CMS TOP group,  
focus on measurement of  $t\bar{t}$ ,  $t\bar{t}+H$ ,  $t\bar{t}+\text{jets}$ ,
- **DESY-CMS: properties of jets**  
leading CMS analyses of inclusive  
jet, jet+EW bosons, W+charm,

Interpretation: extraction of PDFs, top mass,  
strong coupling, EFT, new physics

**Grid Computing: Tier-2 center**

**LHC Detector upgrade** DESY-CMS provides major contribution in building the new  
silicon outer tracker (R&D, maintenance and integration in CMS)

**Collider Physics Theory in Hamburg**

**Scientific exchange programs with phenomenology-groups in USA and Europe**

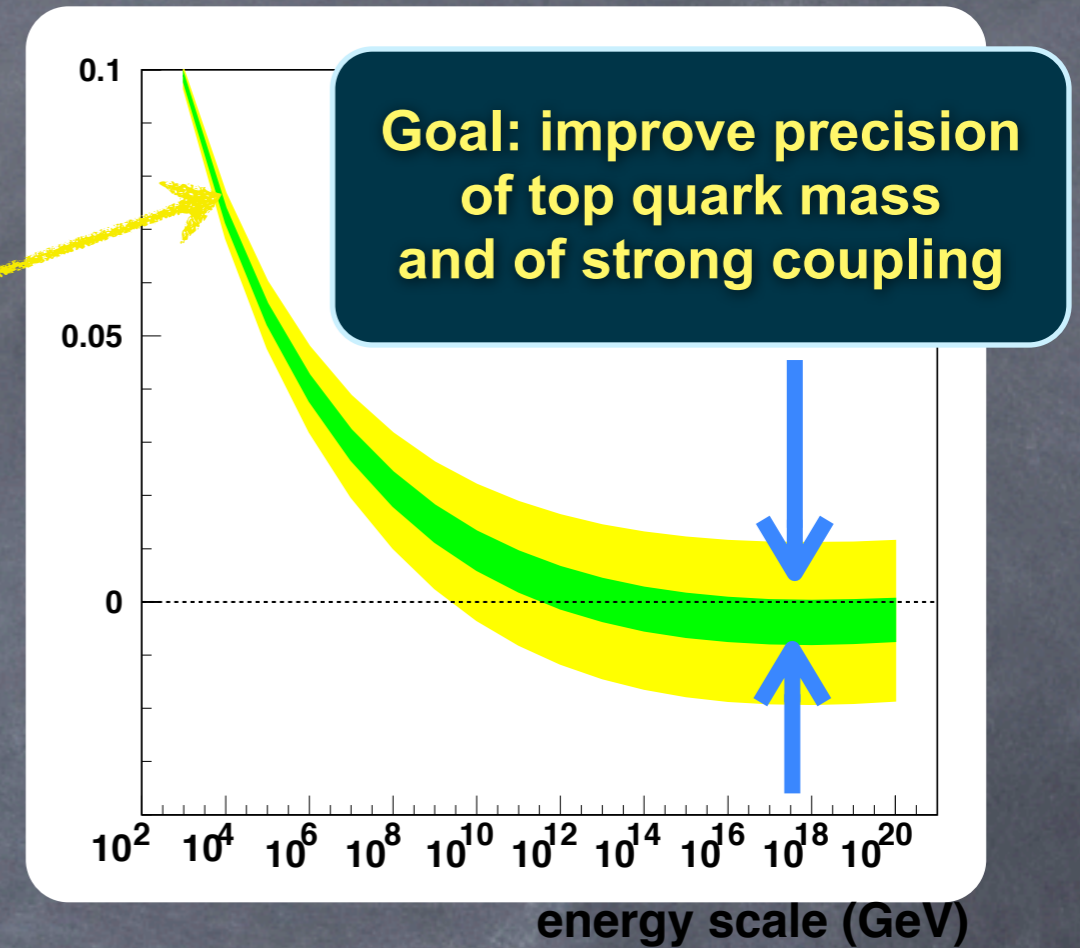
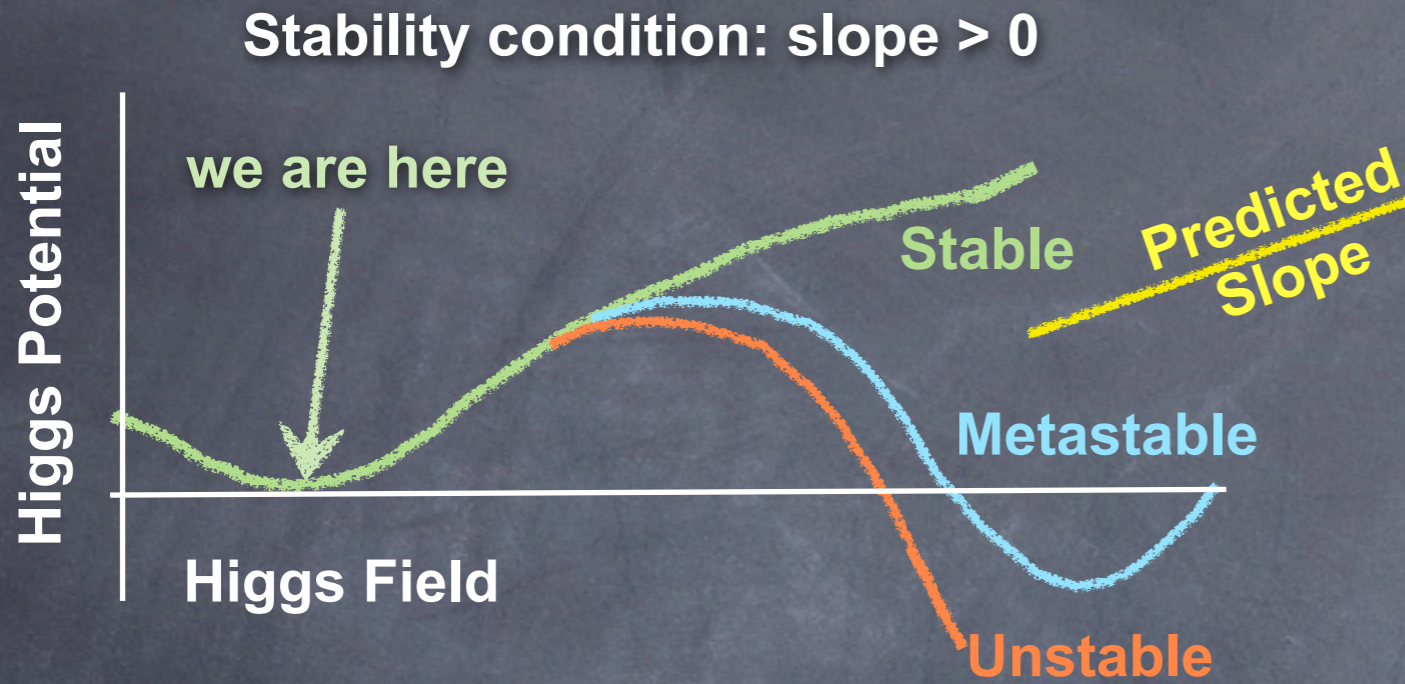






# DESY CMS PHYSICS TOPICS TO BE COVERED

- Ultimate tests of the Standard Model with top quarks: stability of the Universe



- Ultimate test of QCD: running of the top quark mass : first measurement by DESY-CMS

CERN COURIER | Reporting on international high-energy physics

11 May 2020

Physics ▾ Technology ▾ Community ▾ In focus Magazine

STRONG INTERACTIONS | NEWS

**First sight of the running of the top-quark mass**

11 May 2020

A report from the CMS experiment

CMS 35.9 fb<sup>-1</sup> (13 TeV)

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CMS NEWS

WATCHING THE TOP QUARK MASS RUN

For the first time, CMS physicists have investigated an effect called the "running" of the top quark mass, a fundamental quantum effect predicted by the Standard Model.

<https://cms.cern/news/watching-top-quark-mass-run>

Goal: run for precision (full RunII), test new physics models

<https://cerncourier.com/a/first-sight-of-the-running-of-the-top-quark-mass/>



# 2. POWERFUL PROBE OF NEW PHYSICS

families

quarks

2.3 M u up 2/3 1/2	1.27 G c charm 2/3 1/2	173.1 G t top 2/3 1/2
4.8 M d down -1/3 1/2	95 M s strange -1/3 1/2	4.2 G b bottom -1/3 1/2
strong force		g gluon

Standard Model: 3 “families” of elementary particles

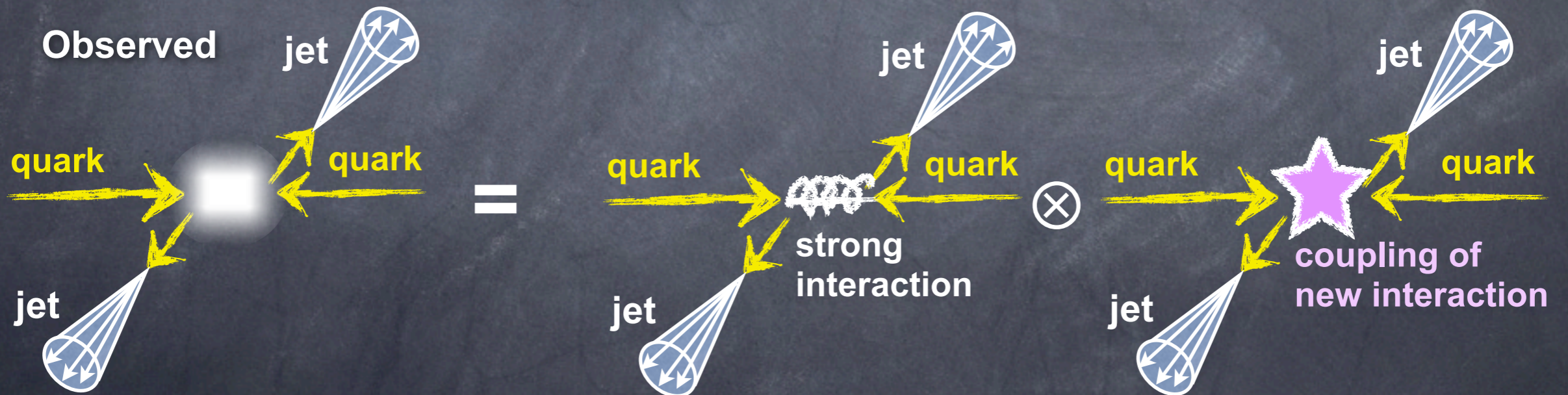
But only 1<sup>st</sup> makes up stable matter → Hint to New Physics?

Idea: quarks could be composed of more fundamental objects  
→ fundamentally new interaction of quarks at very high energy

Free quarks can't be observed, form collimated bundles of stable particles (jets)

Experiment: measure rates of jets produced in proton collisions

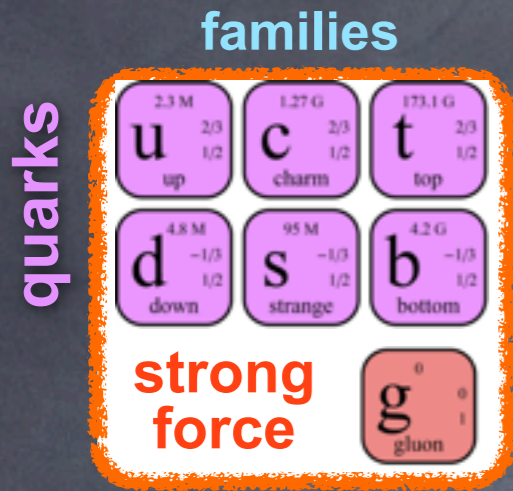
Signature of new physics: deviation from Standard Model expectation



Problem: the observed cross section is a mixture of SM + New Physics!



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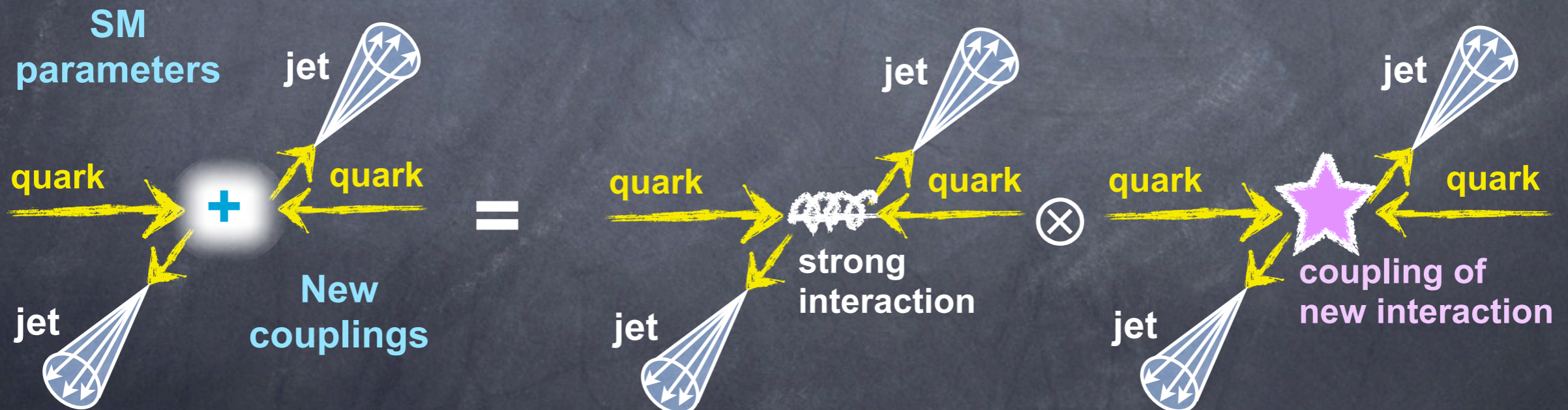
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New idea and developments at DESY-CMS: unbiased interpretation as SM+BSM parameters!  
Task: measure inclusive jet x-sections (full Run II), perform SMEFT fit

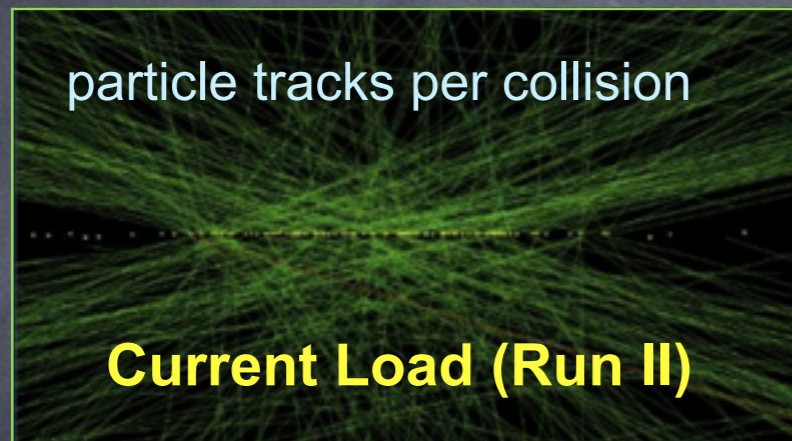


# 3. TECHNOLOGY CHALLENGE OF PRECISION

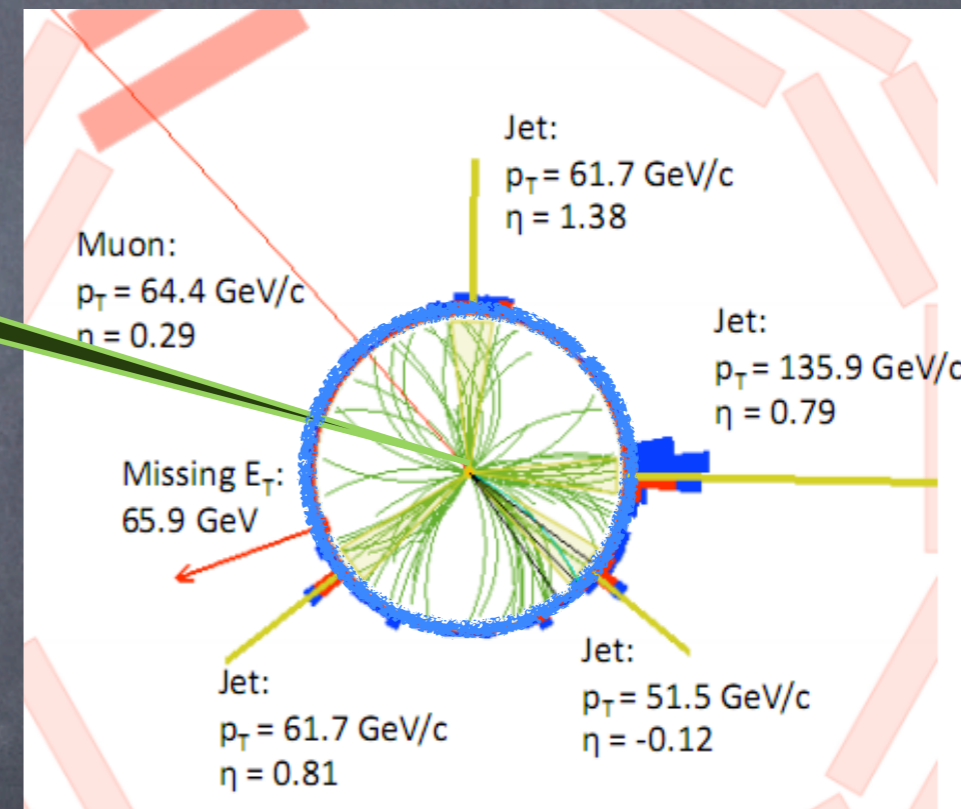
LHC: collider at frontiers of collision energy & rates → the facility for precision

2026 → High-Luminosity LHC: increase of the detector load **~ 7 x higher rates**

Technological challenge for the experiment: unprecedented radiation level, extreme hit rates, huge data volumes



side view



top quark decay seen in the  
CMS tracking detector

**DESY-CMS in collaboration with KIT and Aachen builds endcap of outer tracker  
~1500 PS modules have to be tested and integrated, thermic tests, cooling, tests  
of the disc efficiency, preparation of burn-in setup ...**



# FEW POSITIONS TO BE OPENED IN OCTOBER 2020

PhD positions for physics topics (full RUN II data):

- measure inclusive cross section of top quark pair production, extract of  $m_t$
- measure multi-differential top quark pair cross sections, interpretation in QCD, EFT
- measure inclusive jet production, interpretation in SMEFT
- joined SMEFT interpretation of jet and top quark measurements

Positions based in Hamburg, hired by DESY, position 50% of regular scientist (public service E13/2).

Duration: 3 years. Enrolment in a german university (Dr. rer. nat.)

Social insurance+unemployment, retirement, health care taken care of.

Graduate program PIER (language, soft-skills etc.)

Regular schools at DESY in the framework of Terascale Alliance

Stays at CERN possible

Exchange programs with IFIC Valencia, KSU Georgia, SMU Dallas



# FEW POSITIONS TO BE OPENED IN OCTOBER 2020

2 junior-faculty positions (after 1st postdoc), 5 year positions  
possibility of habilitation (includes low load in university teaching)

- for coordination and contribution to analyses in TOP and QCD groups at DESY CMS,  
collaboration with ATLAS and theory groups

- for taking responsibilities in outer tracker assembly and testing, possibility to join  
R&D activities of novel CMOS sensor

Positions are based in Hamburg with usual possibility to stays at CERN and  
participation in the exchange programs



# CONTACTS

[Katerina.Lipka@desy.de](mailto:Katerina.Lipka@desy.de) (details on positions)

[Maria.Aldaya@desy.de](mailto:Maria.Aldaya@desy.de) (DESY CMS top quark group)

[Doris.Eckstein@desy.de](mailto:Doris.Eckstein@desy.de) (DESY CMS outer tracker upgrade)

## ADDITIONAL INFORMATION

**In case you are interested but not yet eligible to apply for 5-year position (right after PhD)  
further possibilities to join our projects are:**

**DESY Fellowship (deadline 30. September / 31. May each year)**

[https://www.desy.de/career/career\\_programs/fellowships/experimental\\_particle\\_physics/index\\_eng.html](https://www.desy.de/career/career_programs/fellowships/experimental_particle_physics/index_eng.html)

**Humboldt Fellowship (contact K. Lipka)**

<https://www.research-in-germany.org/en/research-funding/funding-programmes/avh-humboldt-research-fellowship-for-postdoctoral-researchers.html>