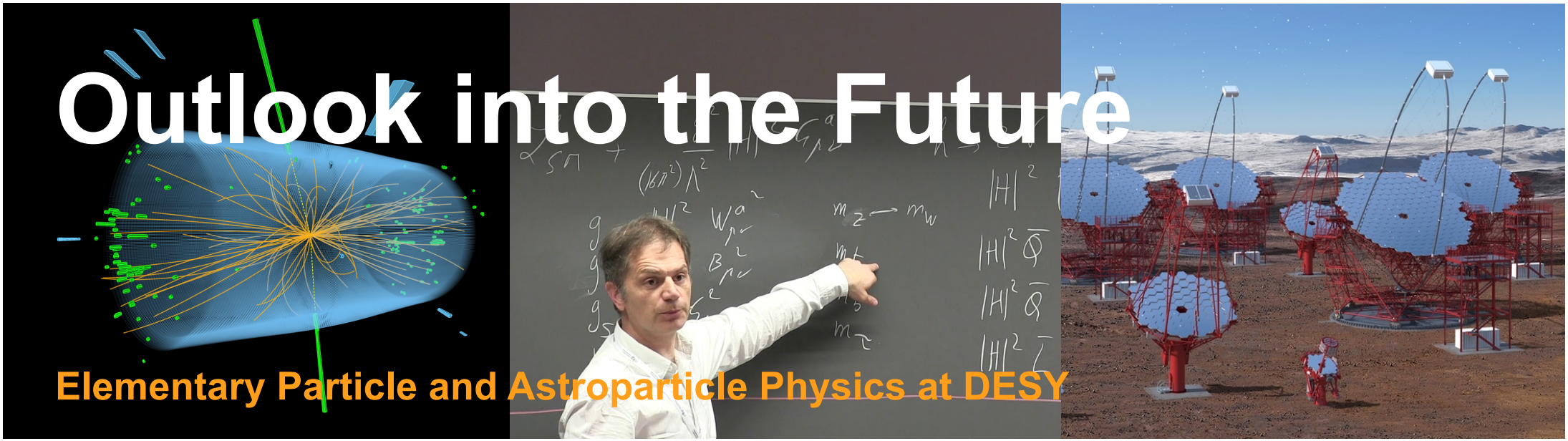


Outlook into the Future

Elementary Particle and Astroparticle Physics at DESY

Helmholtz Program: Matter and the Universe (MU)

PoF III Topics: Fundamental Particles and Forces, Matter and Radiation from the Universe

DESY Research Units: Experimental Particle Physics, Theoretical Particle Physics, Astroparticle Physics

Joachim Mnich
Center Evaluation DESY, 5 – 9 February 2018

HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

DESY

The Program *Matter and the Universe*

At the Helmholtz Center DESY

Experimental Particle Physics

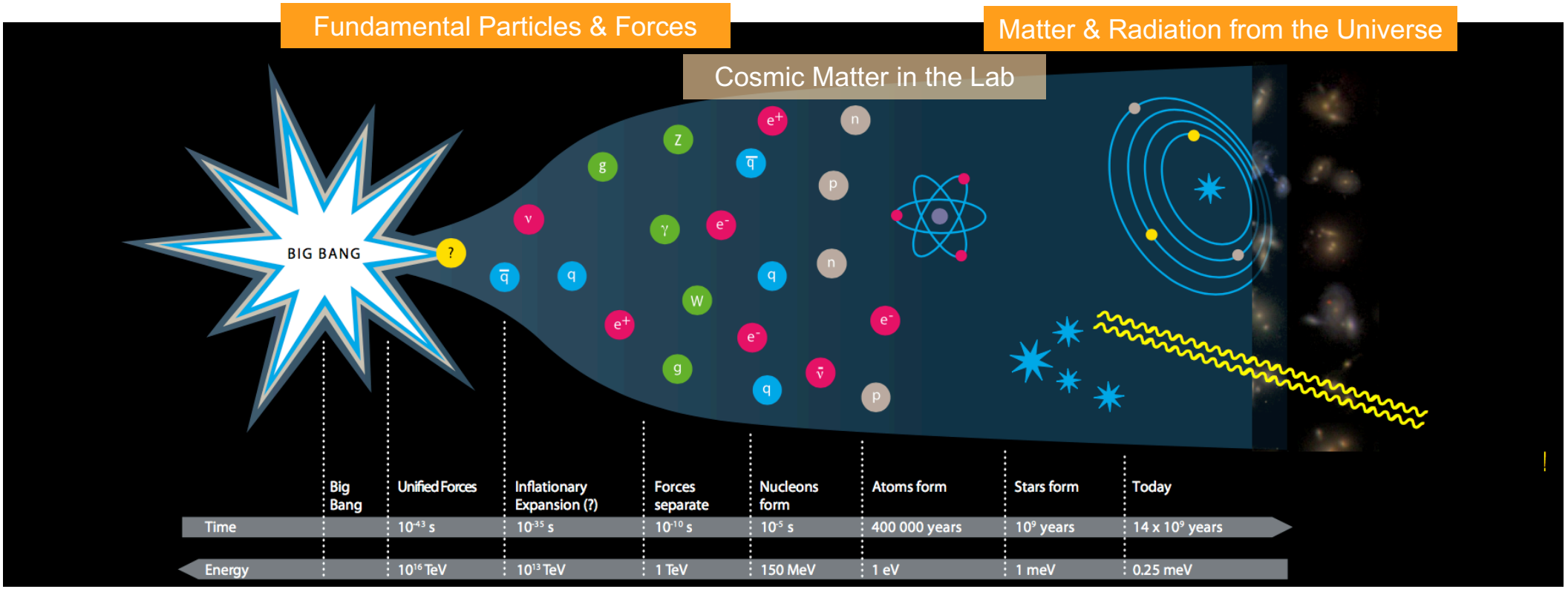
Theoretical Particle Physics

Astroparticle Physics

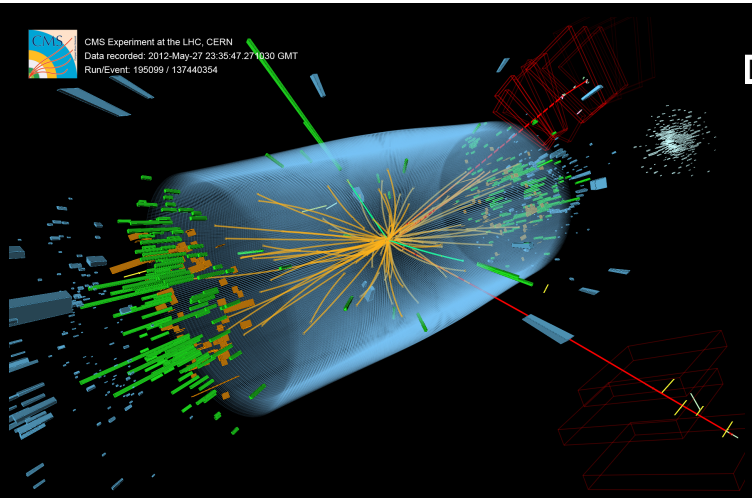
Research Unit	Matter		POF III
	Matter and the Universe	**From Matter to Materials and Life**	**Matter and Technologies**
Experimental Particle Physics	Fundamental Particles and Forces	Research on Matter at LSF	Accelerator Research and Development
Theoretical Particle Physics	Cosmic Matter in the Laboratory	Facility Topic: Photon Sources	Detector Technologies and Systems
Astroparticle Physics	Matter and Radiation from the Universe	Facility Topic: Neutron Sources	
	TIER-2 Center	Facility Topic: Ion Sources	
		Facility Topic: Highest Magnetic Fields	

The Mission of the Program *Matter and the Universe*

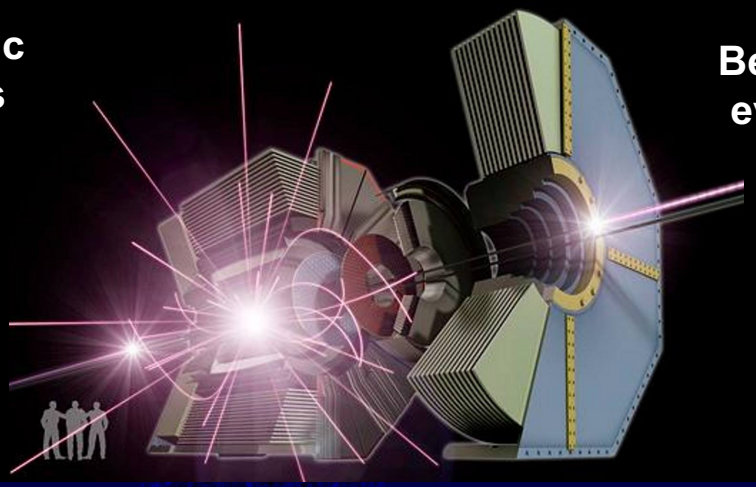
Understanding fundamental constituents and laws governing the development of the universe



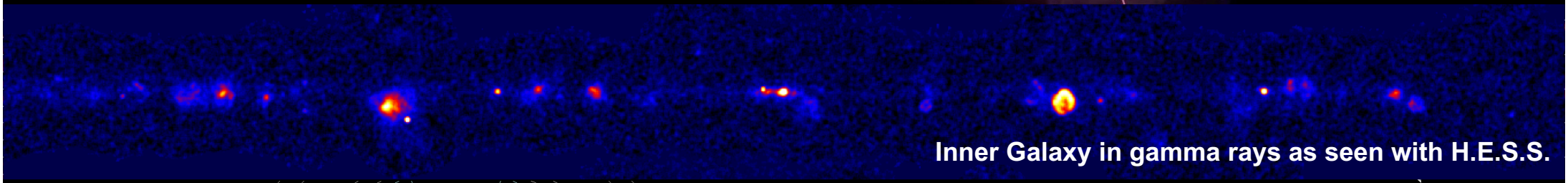
LHC: event in CMS



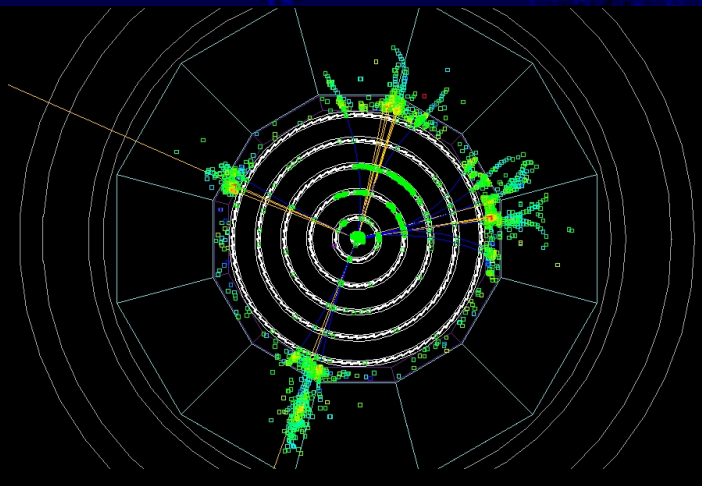
DESY: Scientific Achievements



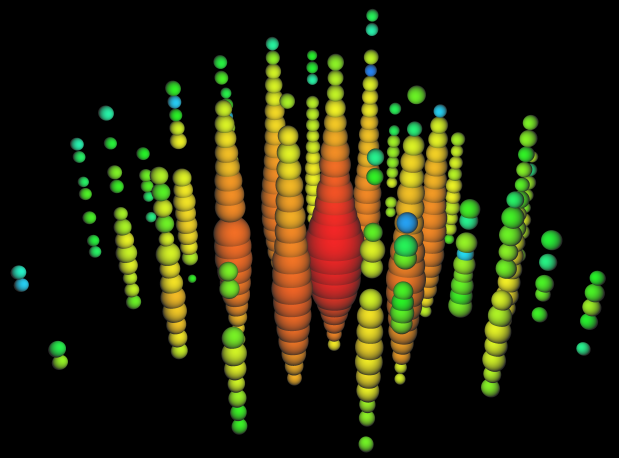
Belle II event



Inner Galaxy in gamma rays as seen with H.E.S.S.



ILC: simulated event

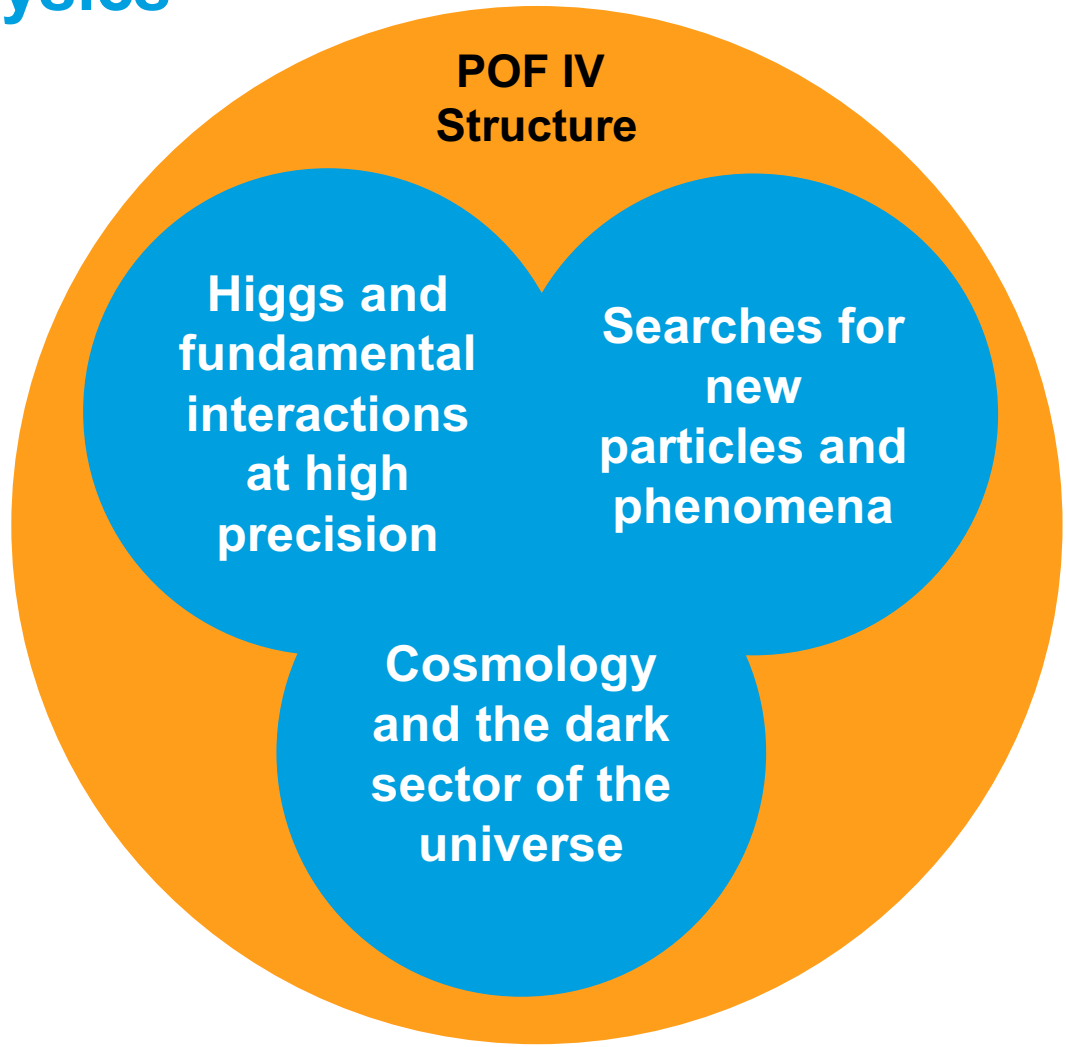


IceCube neutrino event

The Future of Particle Physics

Addressing fundamental questions

- Structure of the vacuum
- Nature of the Higgs
- Theory beyond SM
- Dark matter
- (Anti)Matter asymmetry
- Neutrino properties



ATLAS EXPERIMENT

CMS Compact Muon Solenoid

Belle II

ALPS Any Light Particle Search

T DESY Theory

+

Future Expe-riments

The Future of Particle Physics

Results of DESY-2030 strategy process

Explore the LHC and beyond

- Upgrade ATLAS and CMS for HL-LHC
- Prepare leading participation in future global collider project

Harvest at Belle II

- Data taking and analysis until ~2027

On-site experiment

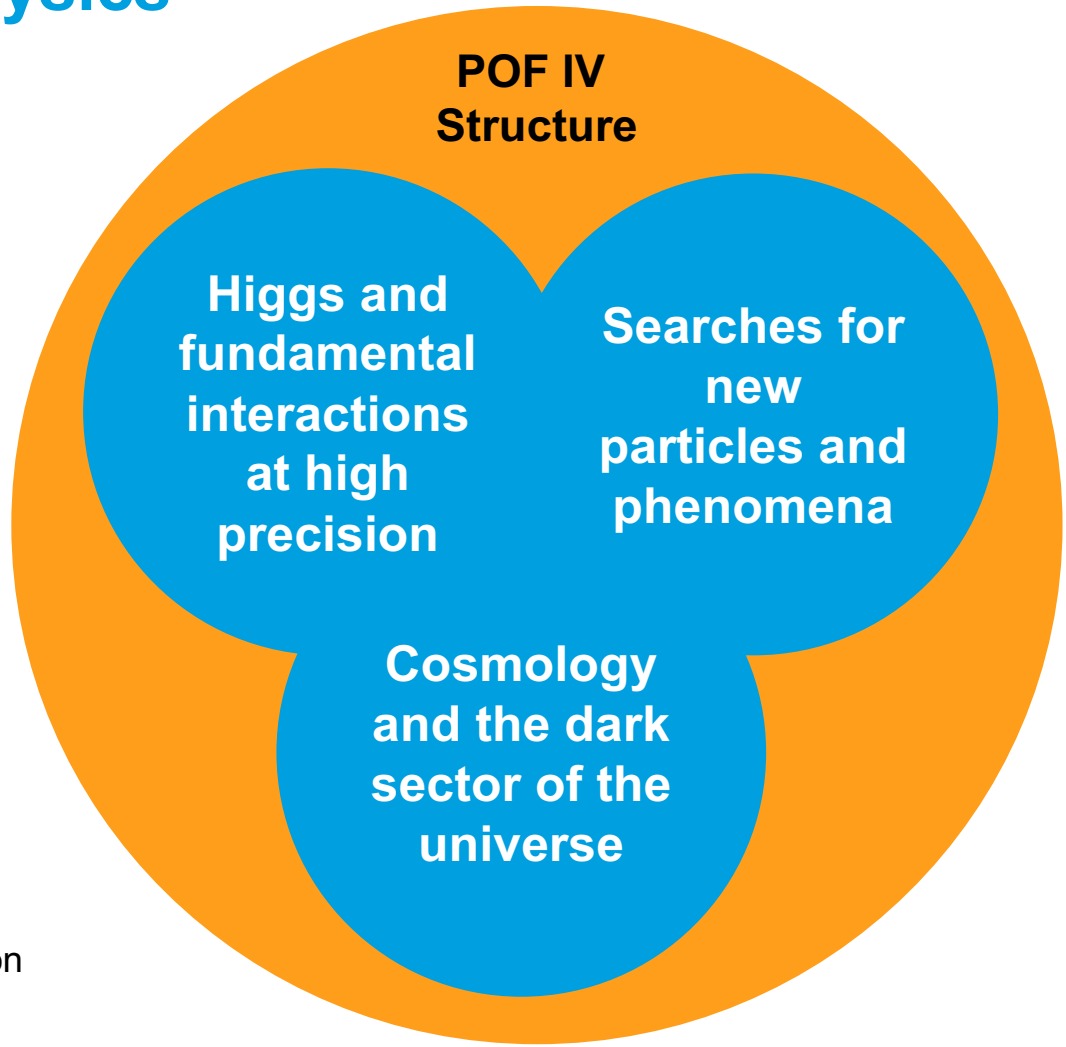
- Prepare future on-site experiment after ALPS-II
- Detector R&D & testbeam operation

Theory:

- Maintain broad spectrum of research topics and world-leading expertise

DESY as a "hub":

- Support projects with large German participation



ATLAS EXPERIMENT

CMS

Belle II

ALPS Any Light Particle Search

T DESY Theory

+

Future Expe-riments

Particle Physics beyond 2020

Preparing for future large-scale opportunities

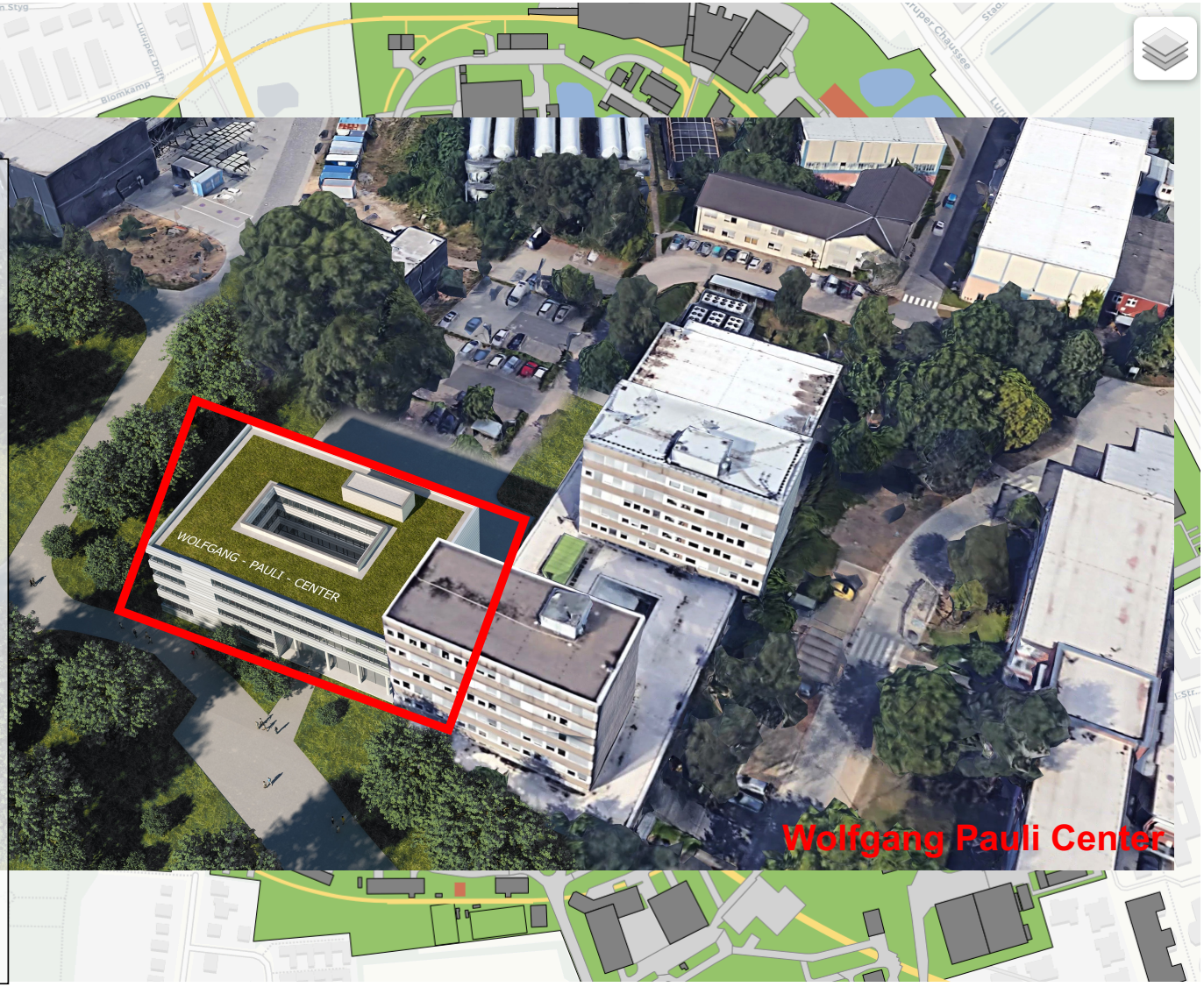
and HE-LHC

… and also MADMAX or LUXE on-site!

Campus Hamburg

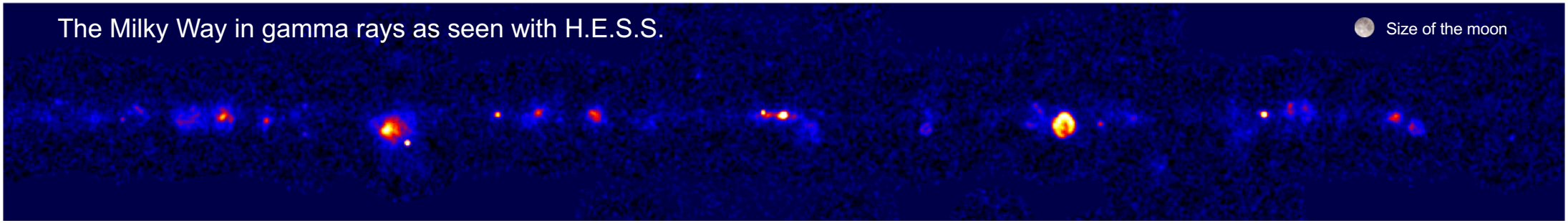
Plans for the future

Detector Assembly Facility DAF for LHC tracker end-cap construction



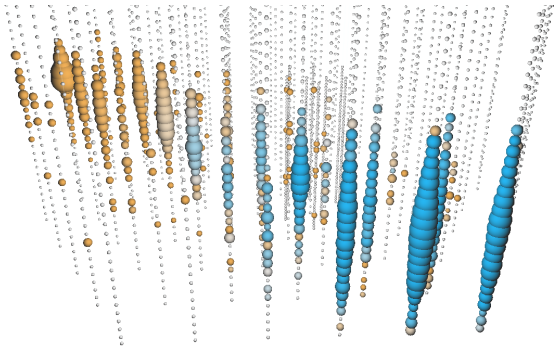
Astroparticle Physics

Our way to POF IV



- DESY developed into a **center for astroparticle physics** with a clear scientific focus
  - Gamma-ray astronomy towards CTA
  - Neutrino astronomy with IceCube and beyond
  - Multi-messenger and real-time astronomy
  - Theoretical astroparticle physics

- A key partner to study the key questions of high-energy astroparticle physics



Discovery of high-energy cosmic neutrinos with IceCube

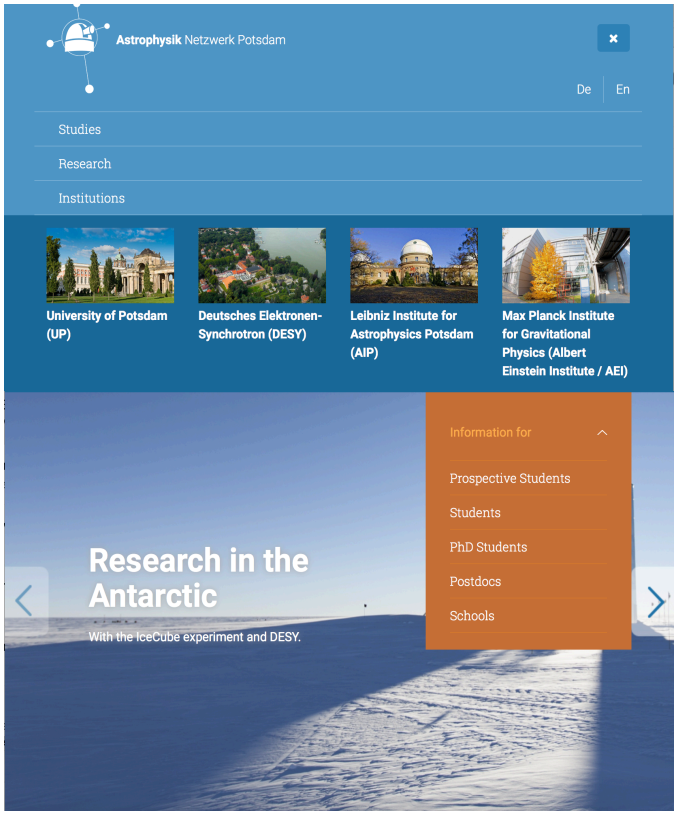
Strategy in Astroparticle Physics

Further strengthening the scientific impact

- Gamma-ray astronomy
  - **Build, operate and use CTA**
  - Science exploitation of running experiments
  - Identify and and **drive prominent science topic(s)** with CTA: Galactic center and transient phenomena
- Neutrino astronomy
  - Science exploitation of IceCube (neutrino astronomy and neutrino physics)
  - **Drive the IceCube upgrade program** towards IceCube-Gen2
  - Advance and expand activities **towards radio detection of EHE cosmic neutrinos**
- Theoretical astroparticle physics
  - **In-depth studies of particle acceleration and transport processes**
  - Modeling of sources and their emission
- Multi-messenger astronomy and synergies
  - Key role in **real-time alert systems** and **optical follow-ups** for gamma-ray and neutrino observatories
  - Further develop **synergies with neighboring fields**: Dark Matter together with particle physics, neutrino physics, …

DESY Campus in Zeuthen 2020

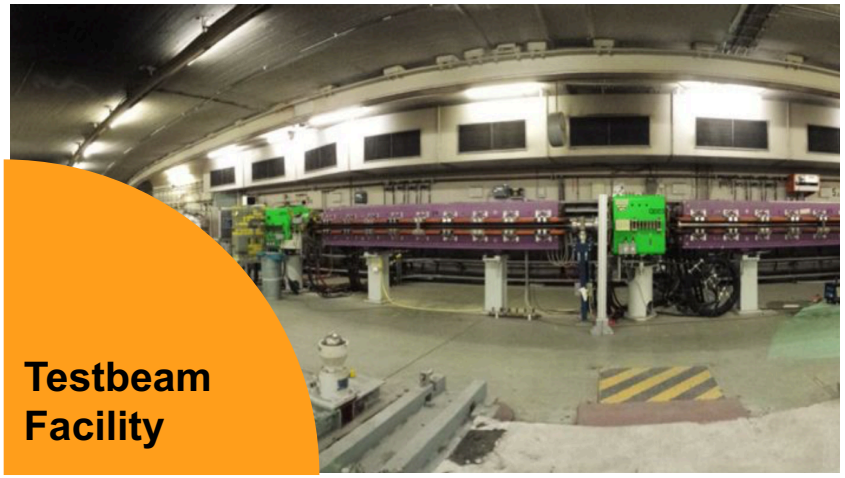
A key partner for CTA, international reference point for astroparticle physics and strong partner in the metropolitan region Berlin-Brandenburg



Talents and Infrastructure

Supporting excellent science

Attracting the best talents



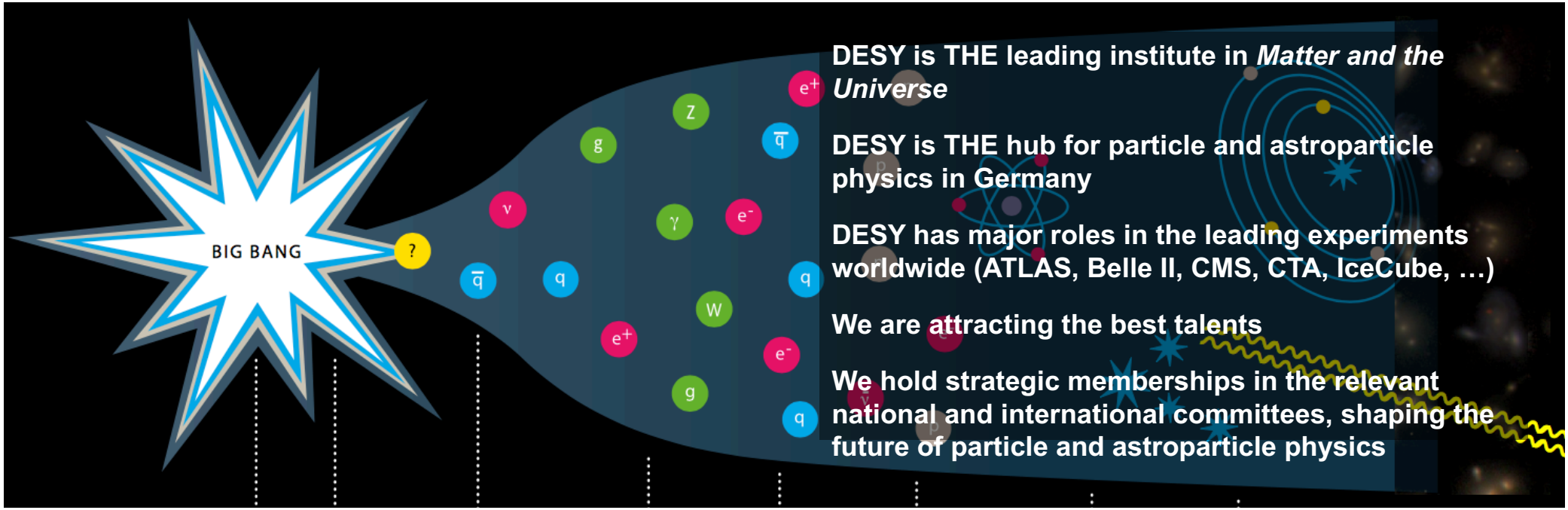
Testbeam Facility

Scientific computing

DAF and other services

The Program *Matter and the Universe*

At the Helmholtz center DESY



DESY is THE leading institute in *Matter and the Universe*

DESY is THE hub for particle and astroparticle physics in Germany

DESY has major roles in the leading experiments worldwide (ATLAS, Belle II, CMS, CTA, IceCube, …)

We are attracting the best talents

We hold strategic memberships in the relevant national and international committees, shaping the future of particle and astroparticle physics