



Mid-term report from the Netherlands

Nik**hef 22/11/2016 Stan Bentvelsen**





- Kingdom of the Netherlands

- ~17 million inhabitants

- 41.543 km² surface
 - 408 inhabitants/km² (27th in world)

- GDP

- 38.700 €/inhabitant
- rank 7 in EU

- Innovation and R&D

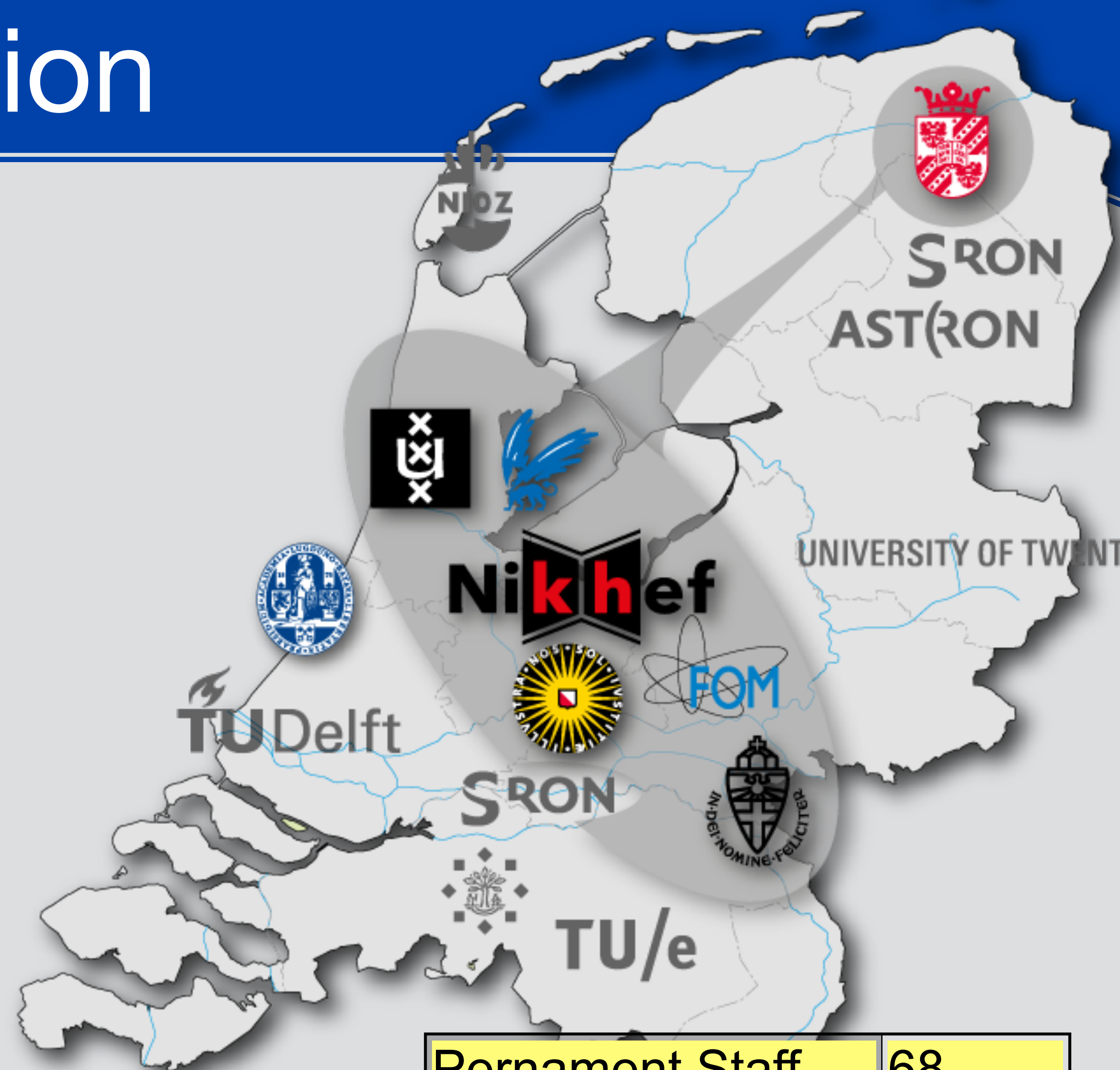
- 2.01% of GDP
- rank 12 in EU

- Founder of CERN

- Dutch contribution 4.7%
 - 52MCHF annual



- Particle physics in the Netherlands
 - Coordination by Nikhef institute with 5 University partners
 - close collaboration Leiden, Delft, Twente
 - University partners play key positions
 - leaders of the scientific programs
 - Added value Nikhef
 - Technical support
- Extension 2016: Groningen added
 - renewed partnership

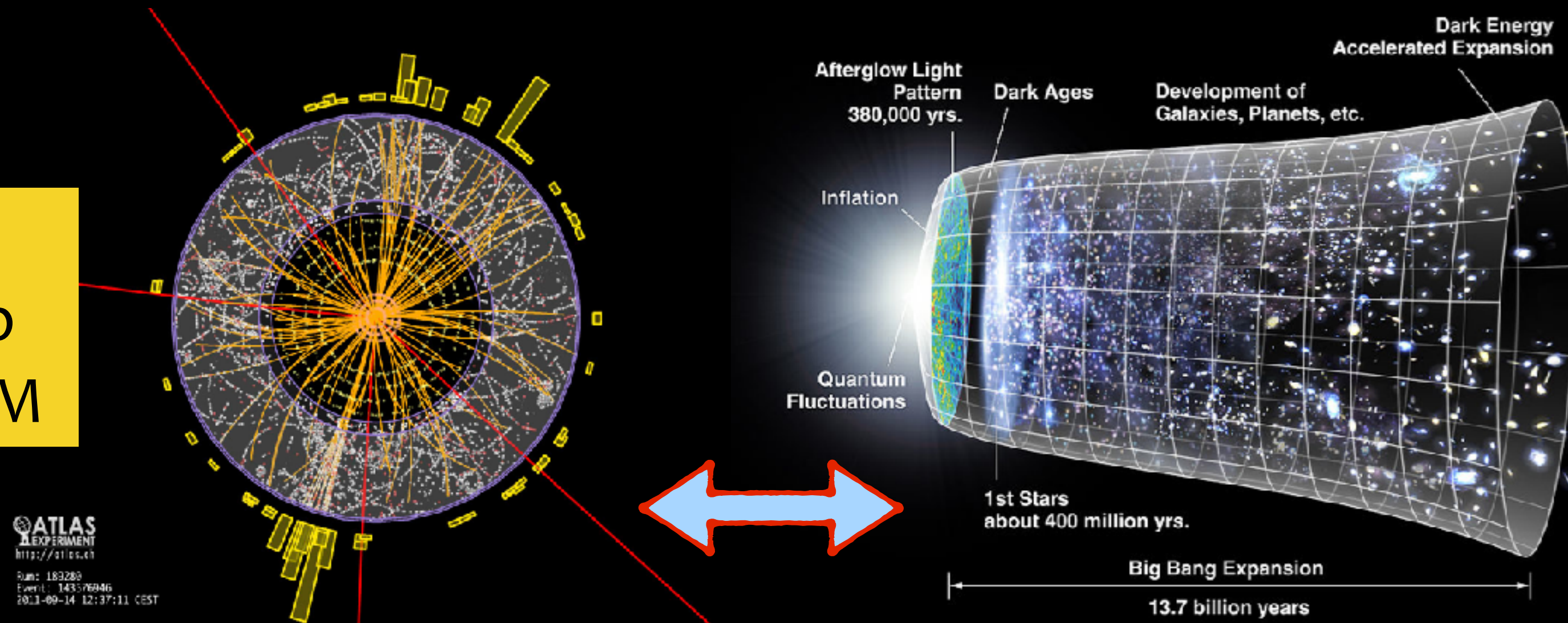


Permanent Staff	68
PhD+PD	125
Technical/engineer	75
Support	26









LHC experiments form 'backbone' of Nikhef
 Astroparticle physics is a central activity

LHC
 ALICE, ATLAS, LHCb
 High-precision eEDM



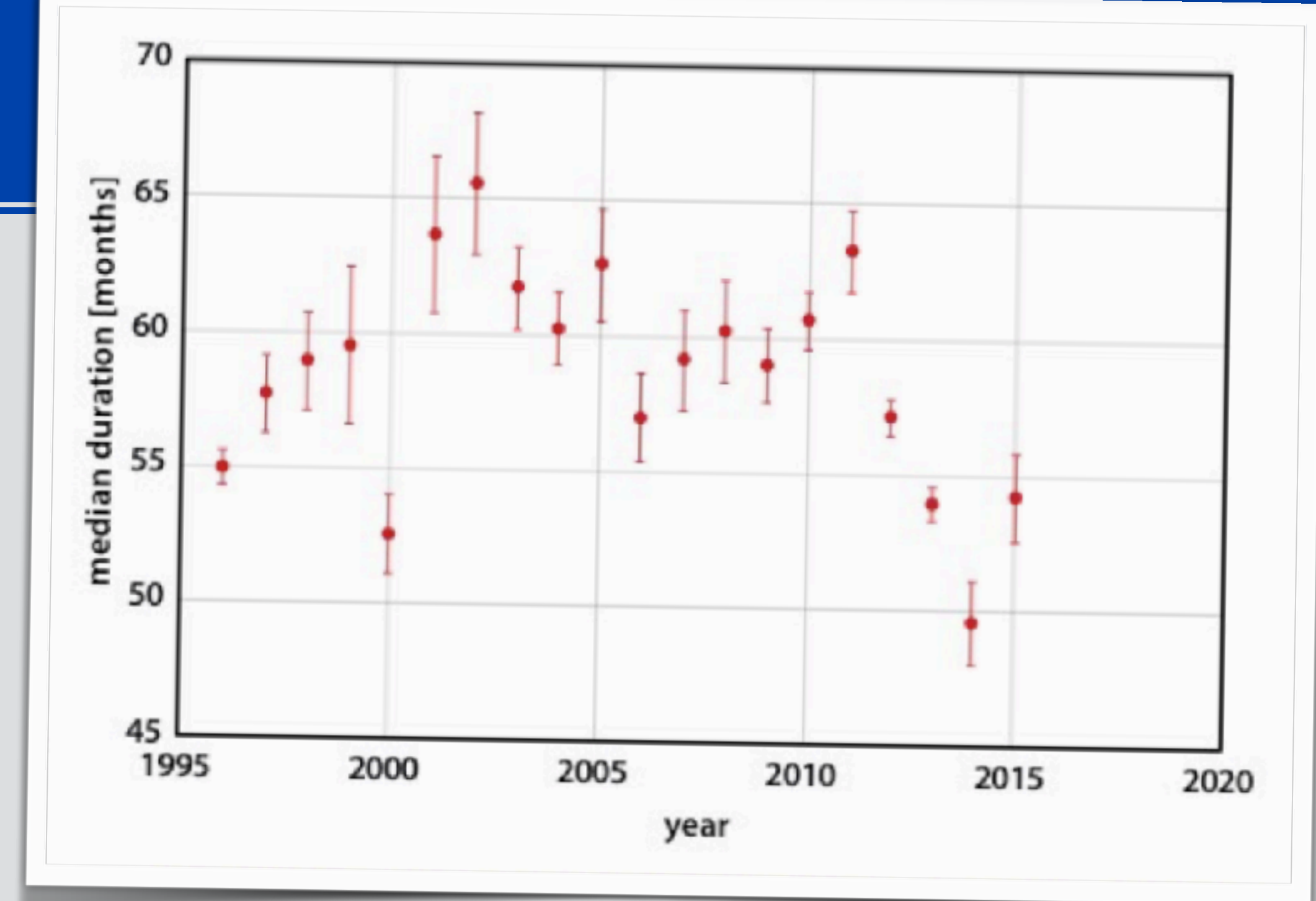
Astroparticles
 Auger, KM3NeT,
 Virgo, XENON

- Enablers
 - Detector R&D
 - Theory phenomenology
 - Physics Data Processing
- Technical support
 - Mechanical technology
 - Electronics
 - Computing

	 FOM	 UU	 RUG	 VU	 UvA	 RU
ATLAS	***				***	***
LHCb	***		**	***		
ALICE	***	***				
Neutrino Telescopes	**				***	
Cosmic Rays						***
Gravitational Waves	**			***		
Dark Matter	**	*			**	
Theoretical Physics	**	*	**	*	***	**
Electric Dipole Moments	***		***			

*** *lot of activity*
 ** *medium activity*
 * *small activity*

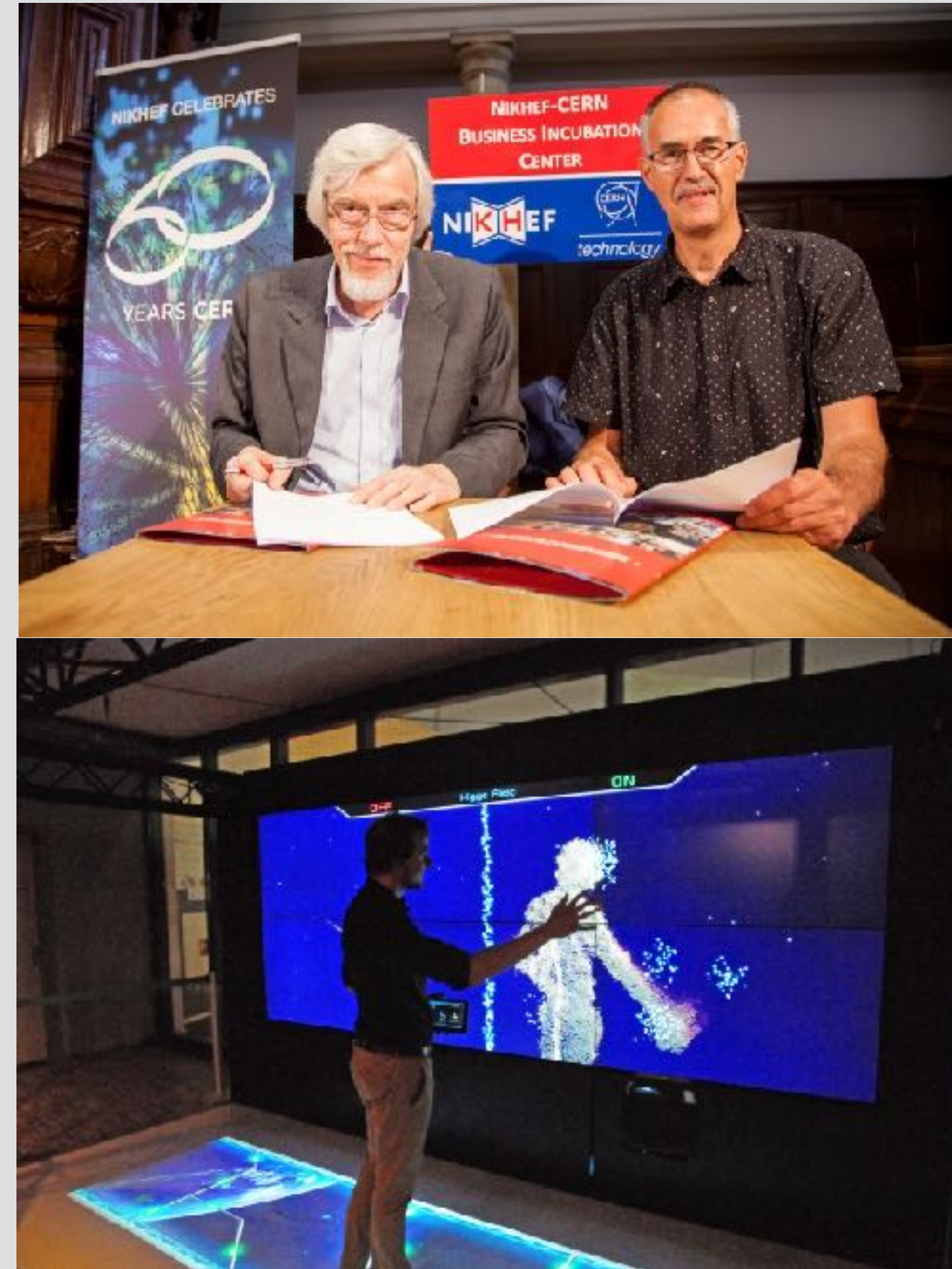
- PhD research school
 - PhD monitoring system
 - Topical lectures
 - Dedicated school joint with Belgium and Germany (BND)



***PhD duration nominally 48 months is exceeded
Challenge to keep the median under control***

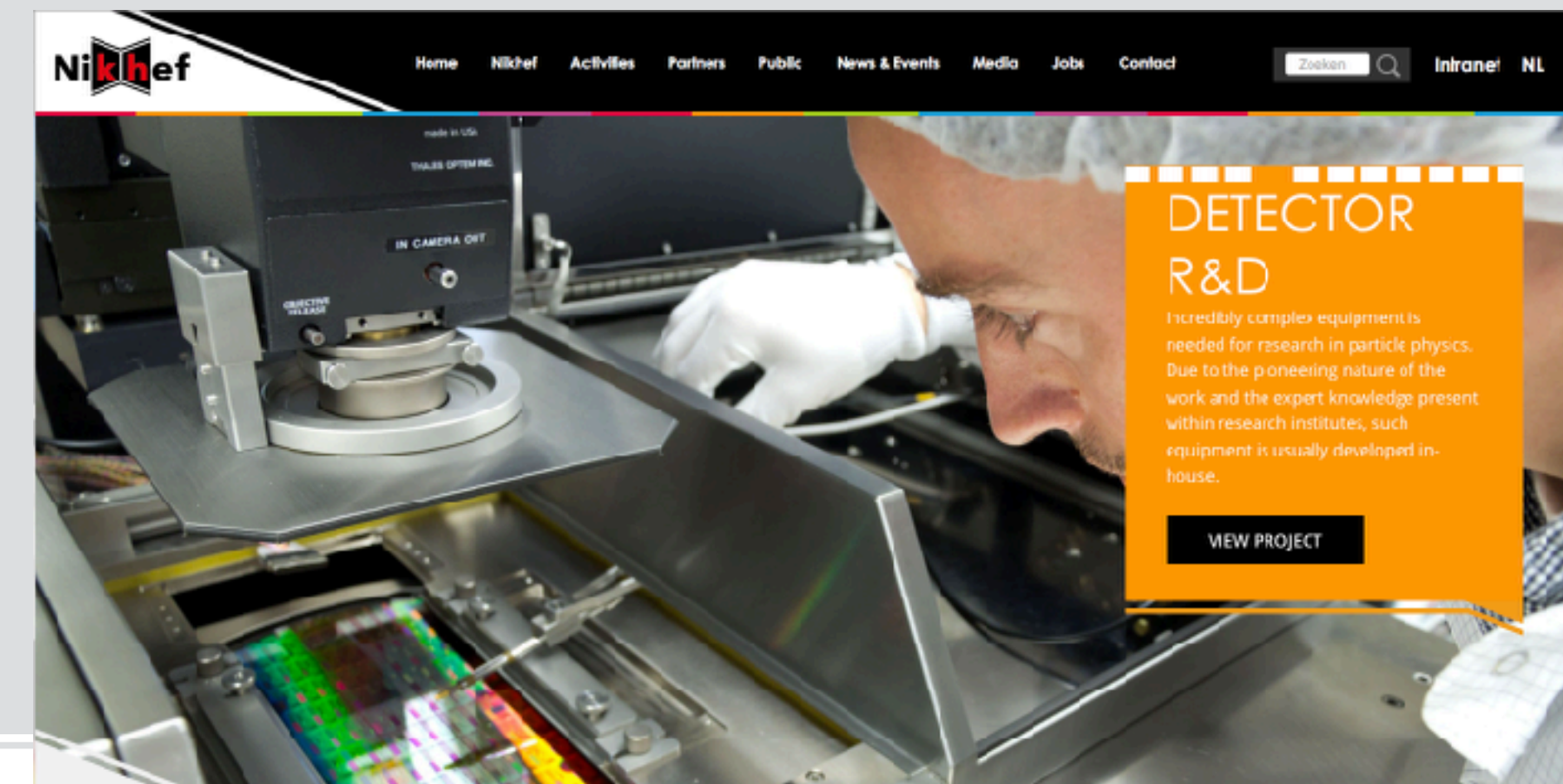


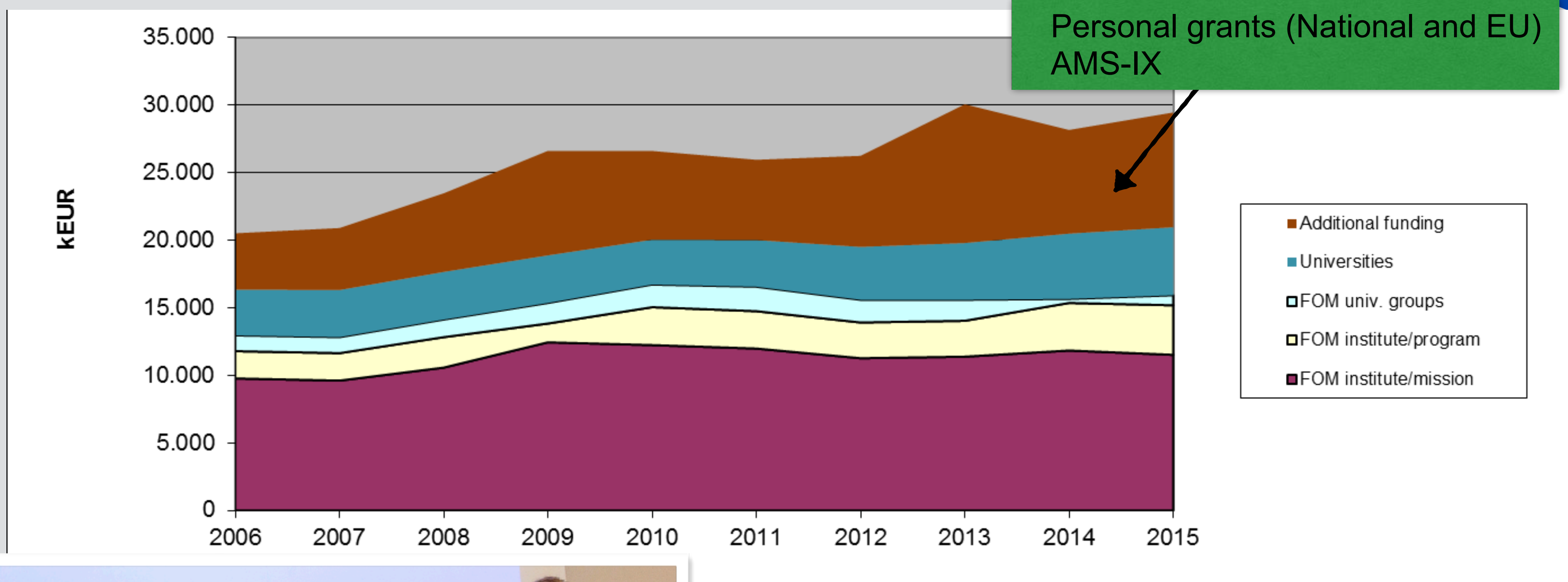
- Master student program
 - Lectures & projects at Nikhef and universities
- High school
 - Teachers program, HISPARC



- CERN & APP lab visits
 - State secretary
 - Journalists, Universities, Schools, Industries, IPPOG
- Nikhef
 - General audience, Open day
 - New web site

– E.g. CERN60 - Festive symposium with guests from science, politics and industry



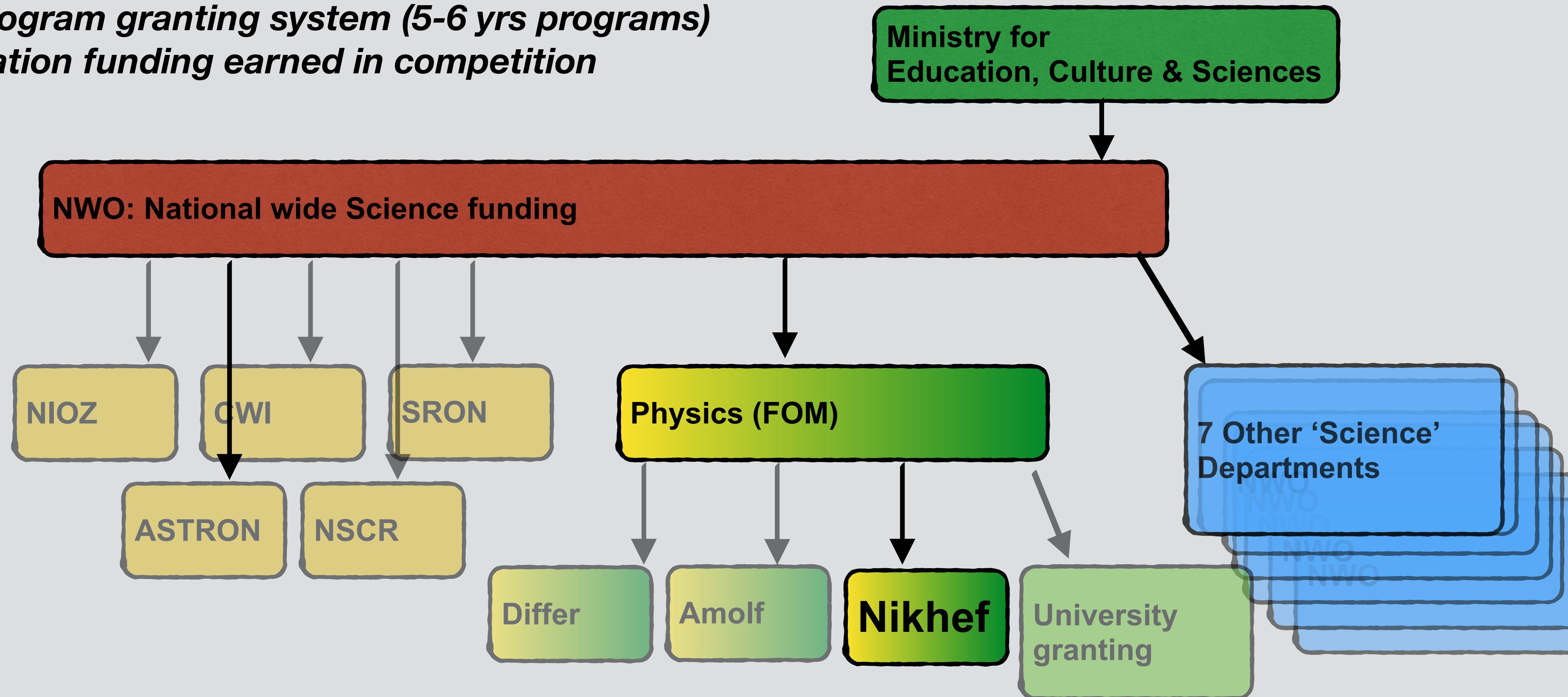


July 1st, 2014

Dutch roadmap funding: investment LHC upgrade phase1, phase2 and computing

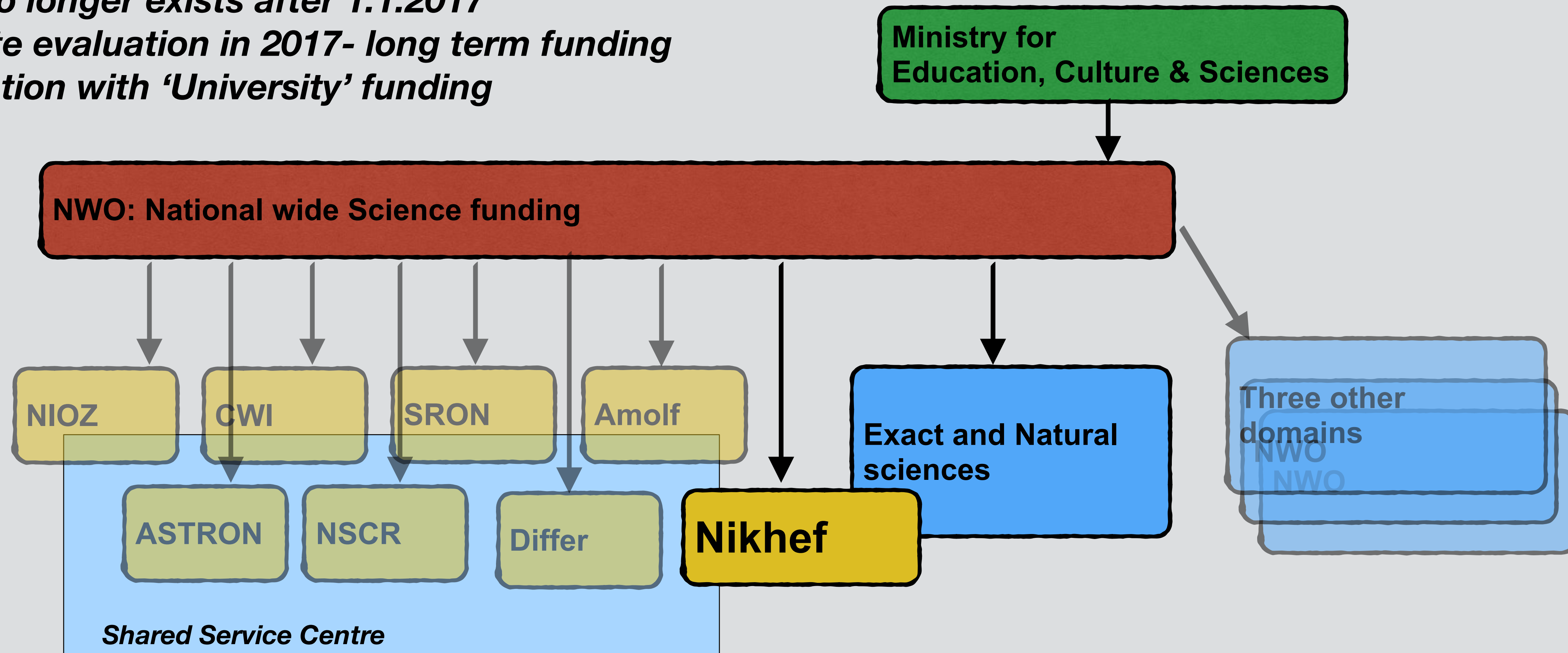
Keywords for Nikhef:

- FOM program granting system (5-6 yrs programs)
- Exploitation funding earned in competition

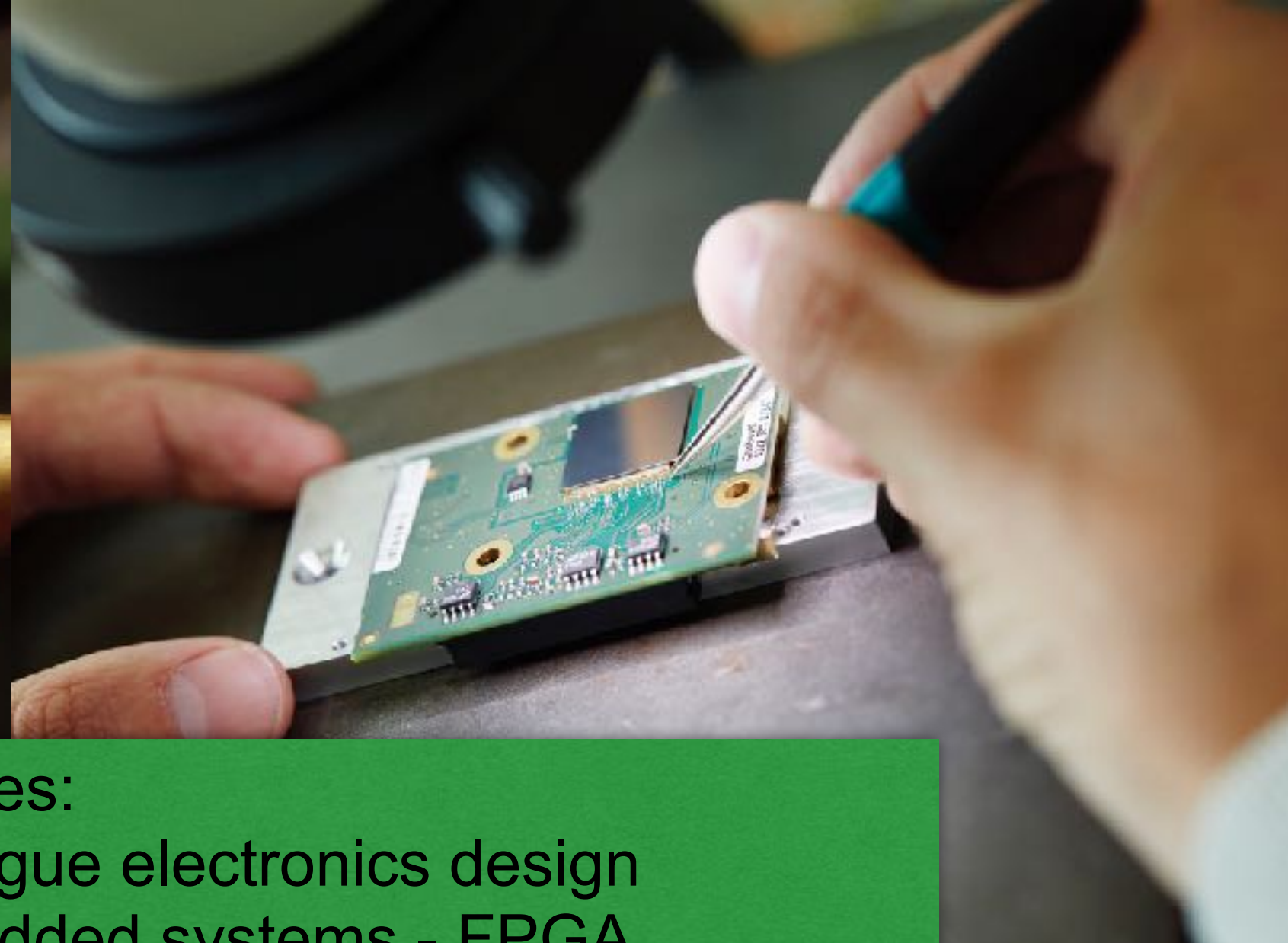
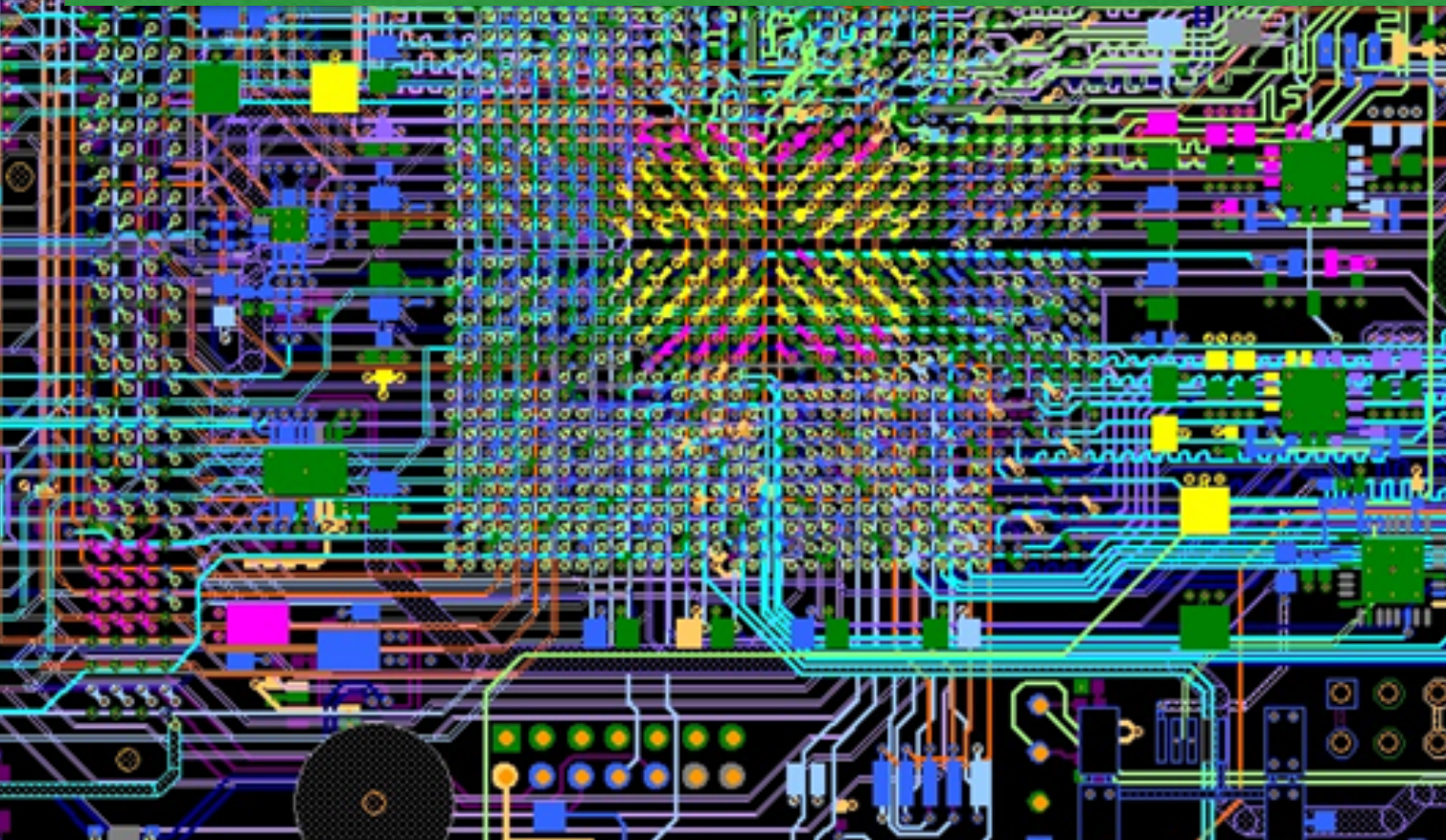


Keywords for Nikhef:

- FOM no longer exists after 1.1.2017
- Institute evaluation in 2017- long term funding
- Separation with 'University' funding



Nikhef technical groups



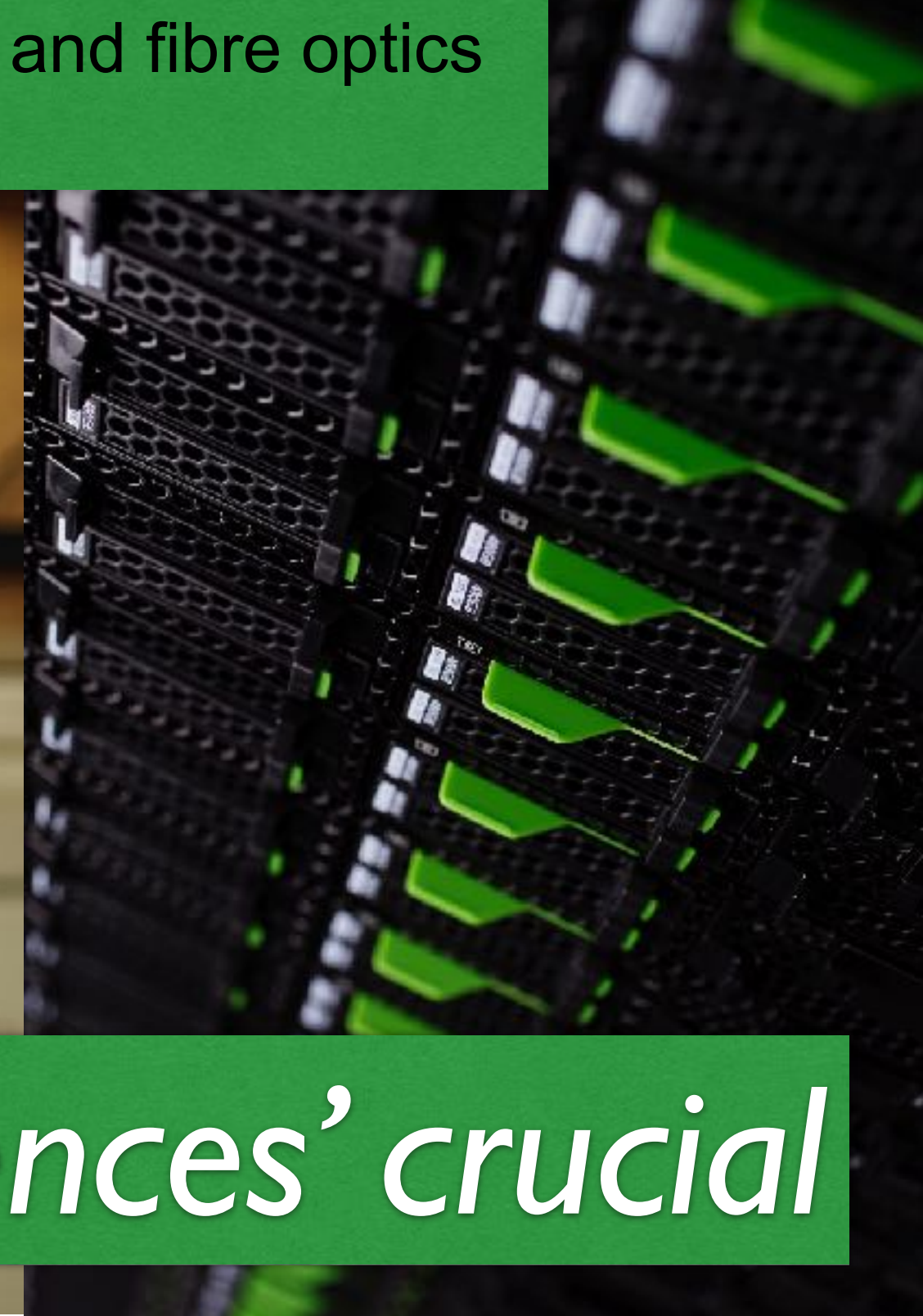
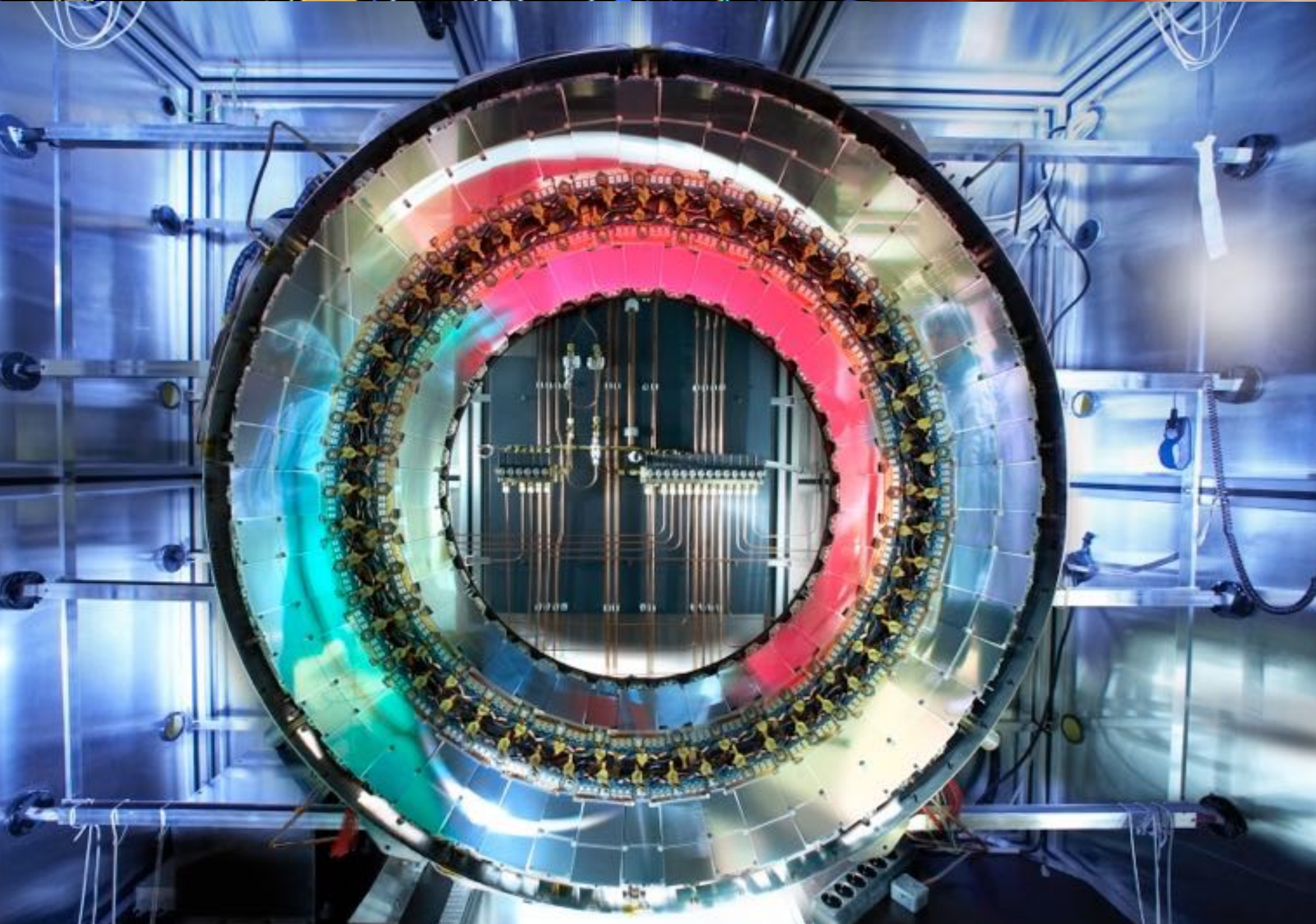
Examples:

Analogue electronics design

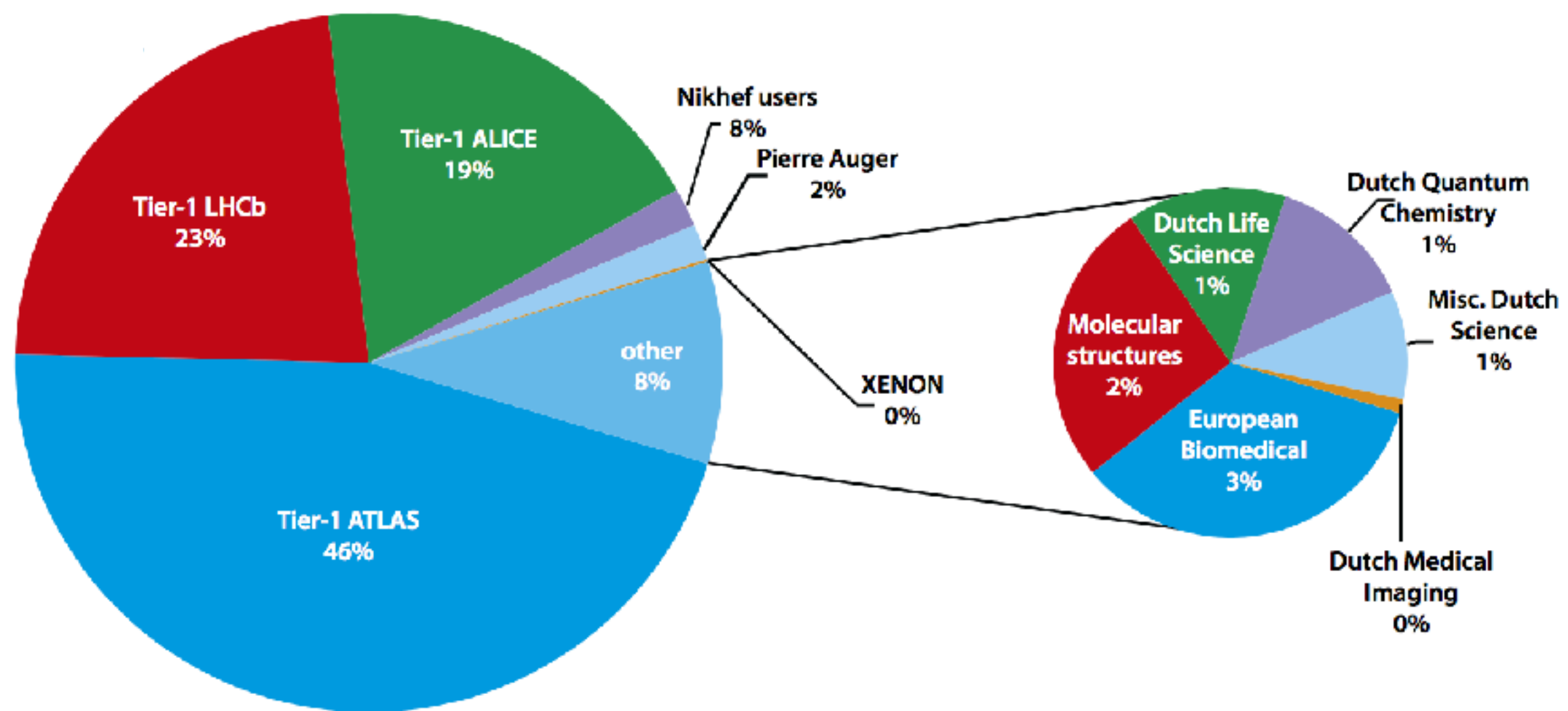
Embedded systems - FPGA

Data communication and fibre optics

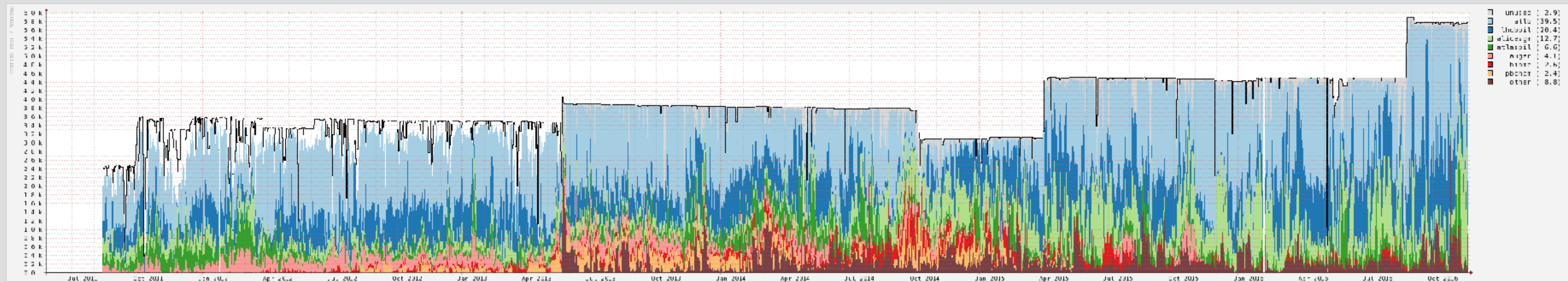
IC design



‘Core competences’ crucial

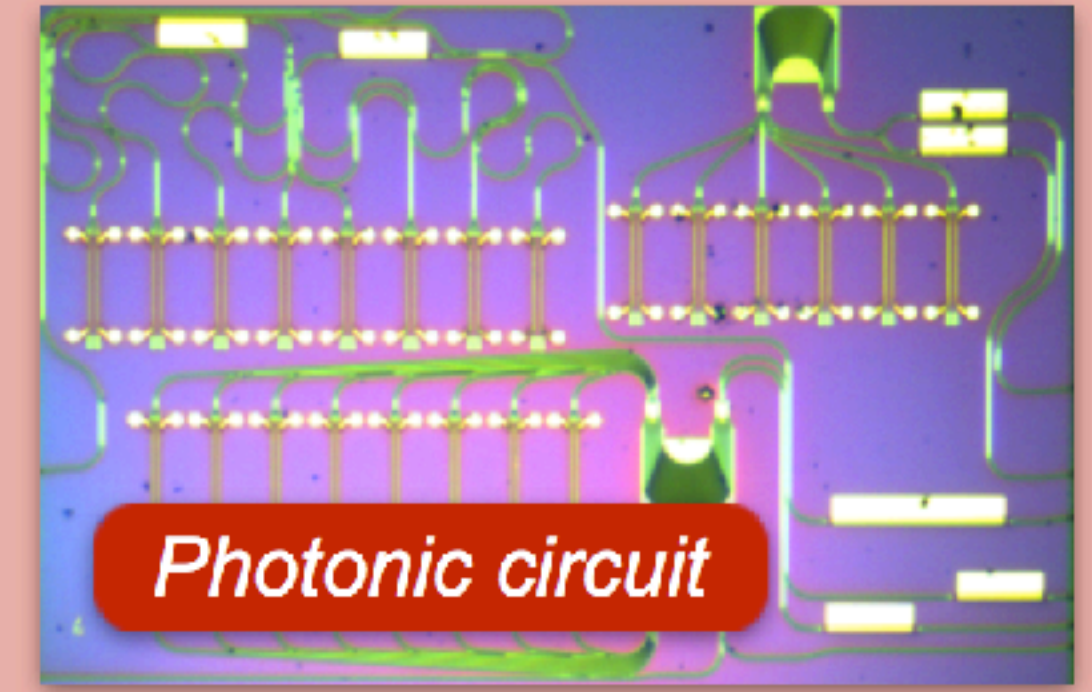
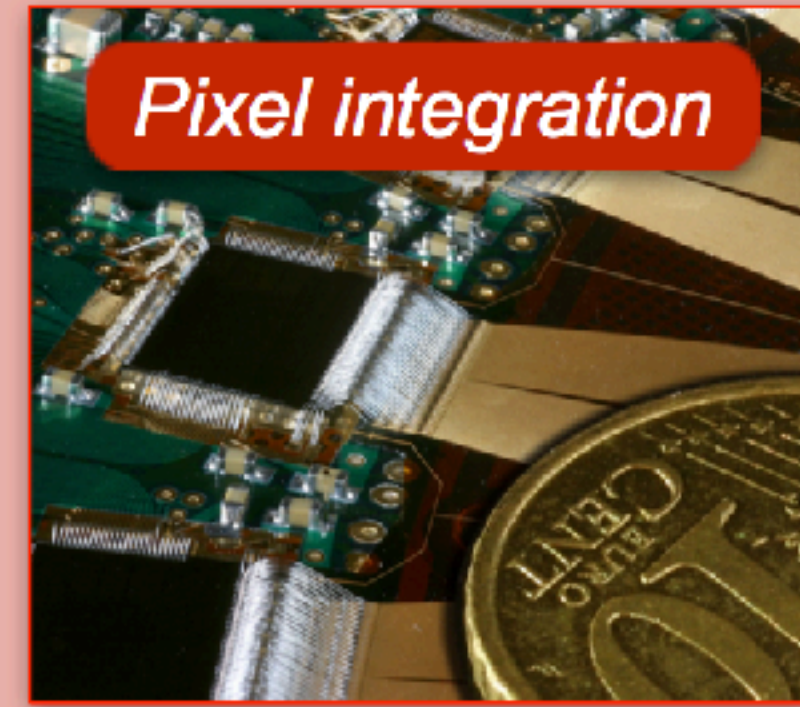
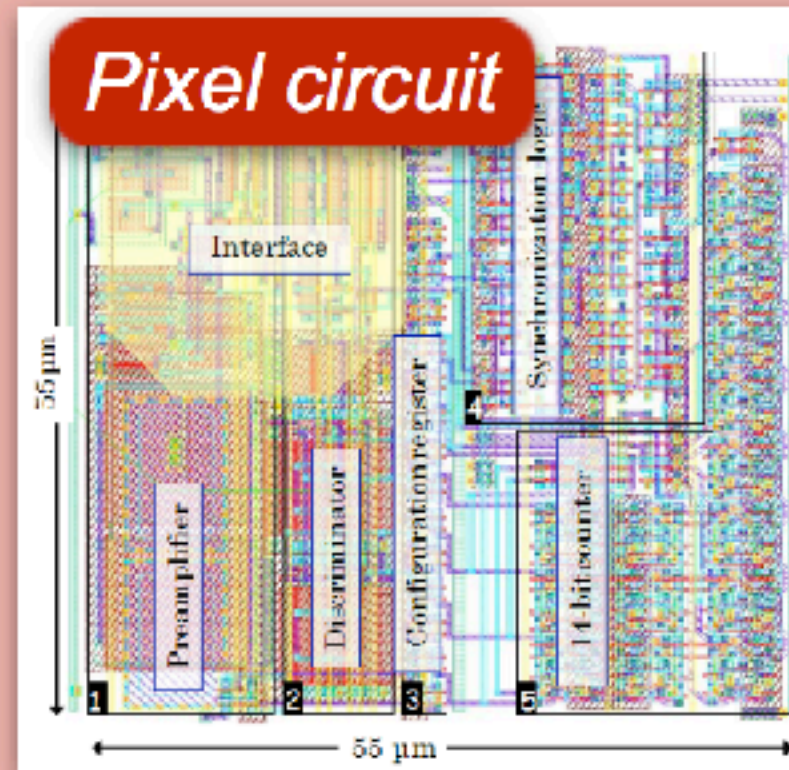


- Tier1 centre ATLAS
- Steadily growing GRID infrastructure -
 - reaching to almost 6000 cores recently
 - state-of-the-art networking reaching terabits/s bandwidth
- Available to non-HEP clients (~8%)

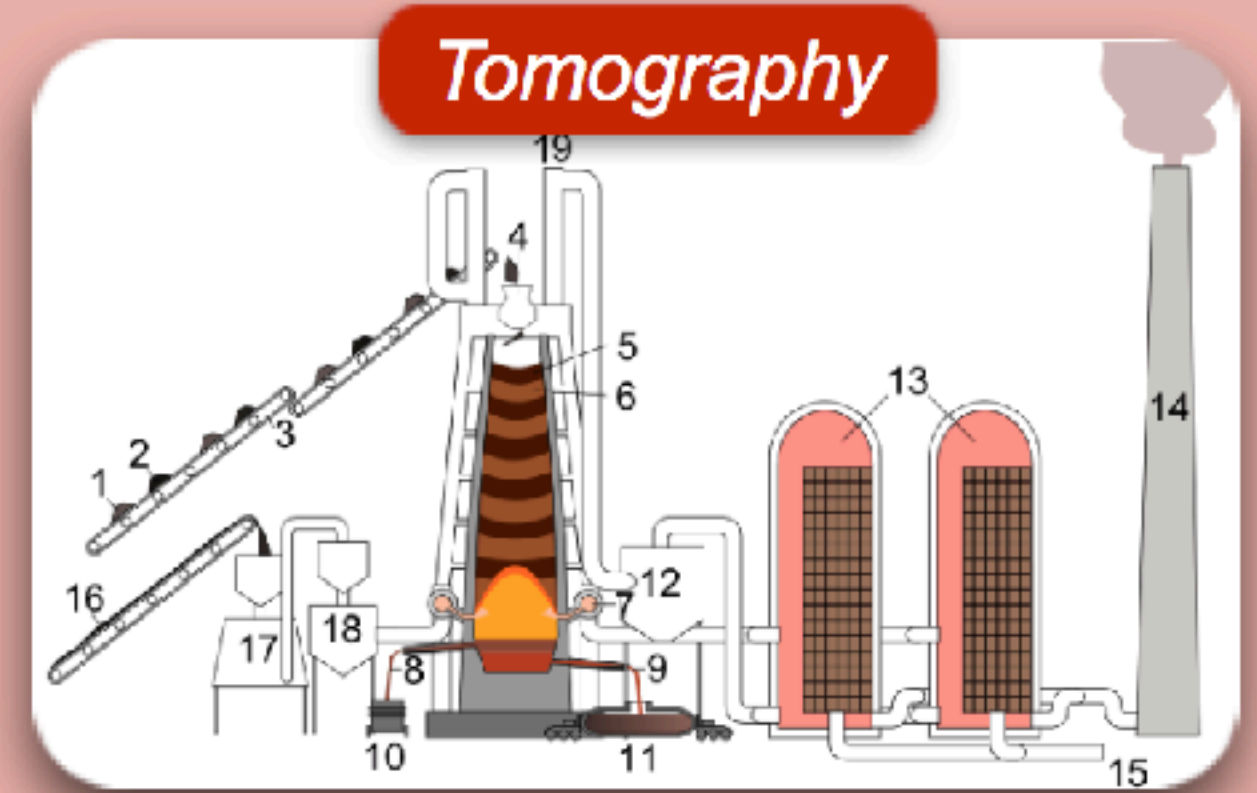


- Activities
 - invent new technologies
 - upgrade existing sci-tech
 - knowledge transfer
- Spin-off examples
 - Medipix applications

Chip design

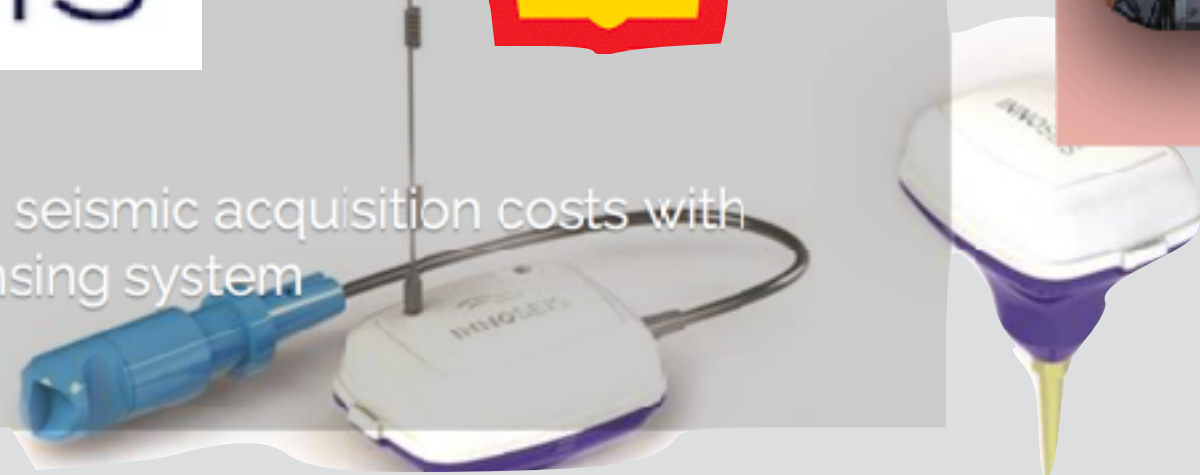


Detectors

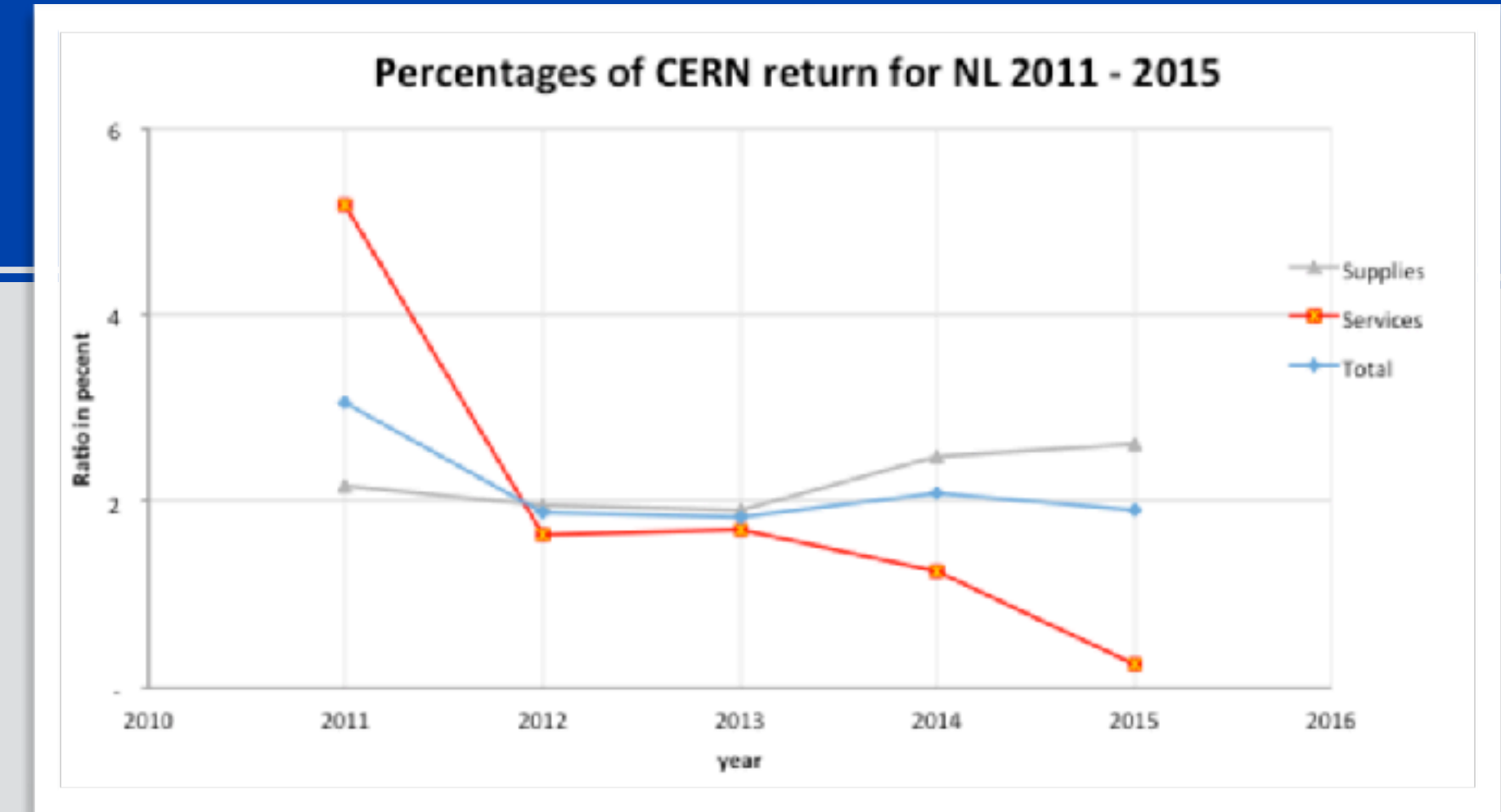


TremorNet

Dramatically reduce land seismic acquisition costs with the industry's lightest sensing system



- Industry return CERN non-optimal
 - Return figures “low balanced”
- Awareness opportunities of Small-Medium Enterprises
 - Holland@CERN (May 2016)
 - Company visits to CERN



Theory programme
Eric Laenen, Robert Fleischer
Amsterdam, Nijmegen, Groningen

9 staff, 12 postdoc, 15 PhD students
2x aERC, 4x projectruimte, 2x VENI,
Marie Curie, ITN network

- Very active in Phenomenology
 - Higgs as probe and portal
 - Observing the Big Bang
- FORM algebraic manipulation
 - Calculations 4 loop splitting functions
 - Development 5 loop calculations

JosFest 3 July 2015

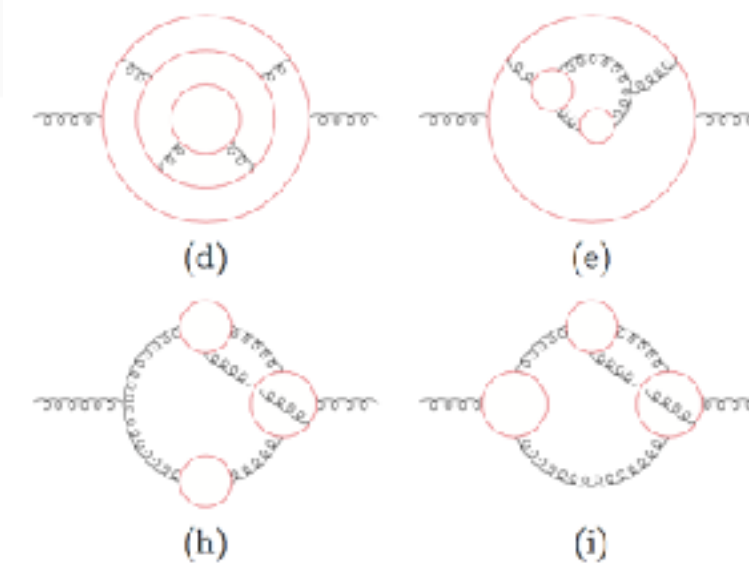
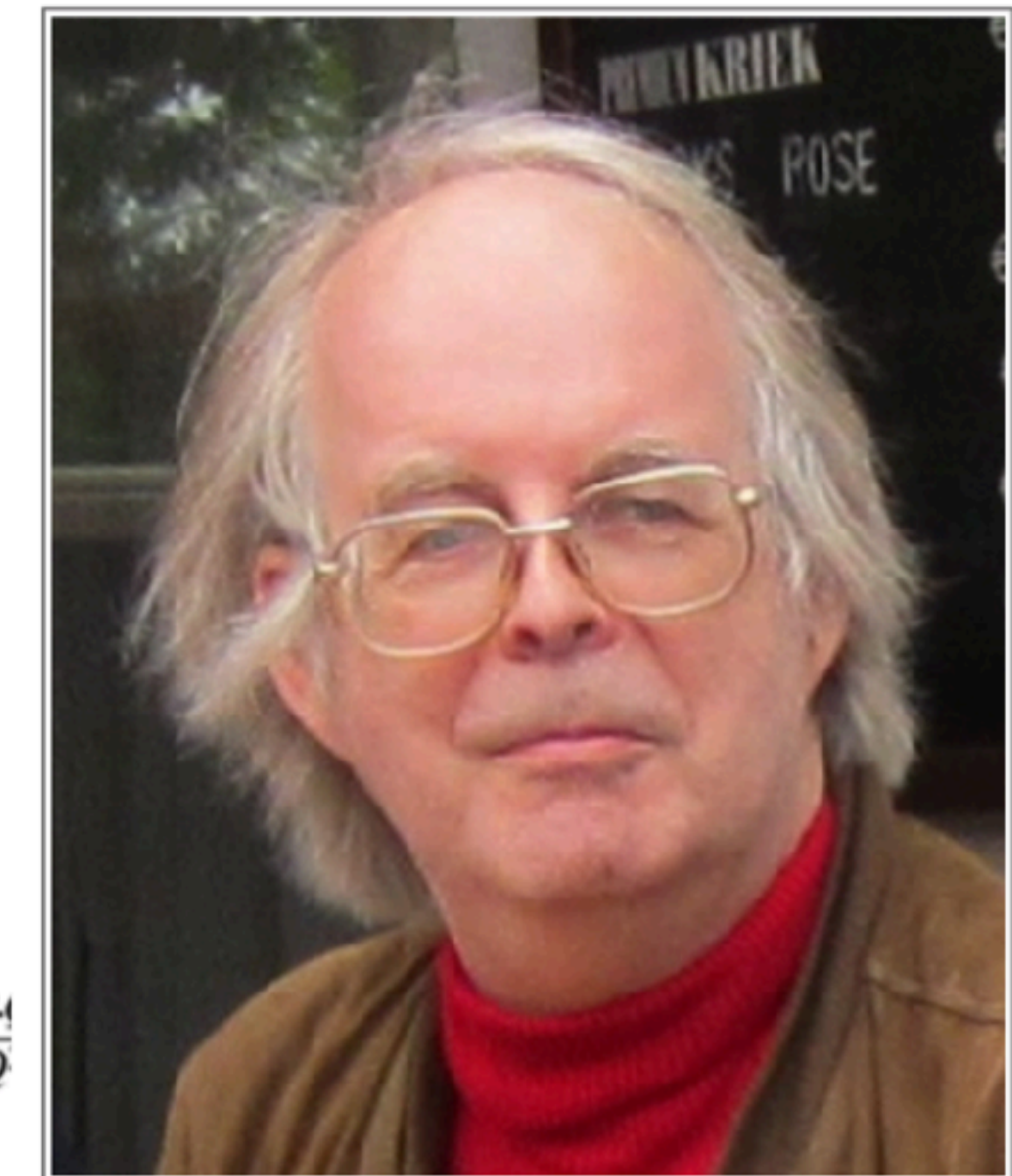
home programme location photos travel hotel tourism

Josfest

We organize a special meeting to celebrate Jos Vermaseren's 66th birthday at Nikhef in Amsterdam, on Friday 3 July 2015. Participation is by invitation.

Jos has spent a life in particle physics and at Nikhef working on the phenomenology and methodology of perturbative quantum field theory, and, of course, developing and being in charge of the FORM computer programme.

In this meeting we will celebrate his achievements, renew friendships and acquaintances. The meeting starts 3 July 2015 at 14:00.



$$\left(\frac{P \cdot Q}{Q^2}\right)^n \int \frac{1}{1 - \frac{P \cdot Q}{Q^2}} = \frac{1}{N-n+2} \left(\frac{P \cdot Q}{Q^2}\right)^{n-1}$$

We enjoy the high quality large data sets of LHC!

ATLAS

*Wouter Verkerke & Nicolo de Groot
University of Amsterdam and Nijmegen*

*19 staff, 8 postdoc, 23 PhD students
1 VICI, 1 projectruimte, 2x ASDI (eScience)*

LHCb

*Marcel Merk
Free University Amsterdam*

*8 staff, 2 postdoc, 7 PhD students
1 VIDI, 1 Infieri*

ALICE

*Raimond Snellings
Utrecht University*

*7 staff, 3 postdoc, 14 PhD students
Two VICI's, 1 VIDI, projectruimte*

ALICE

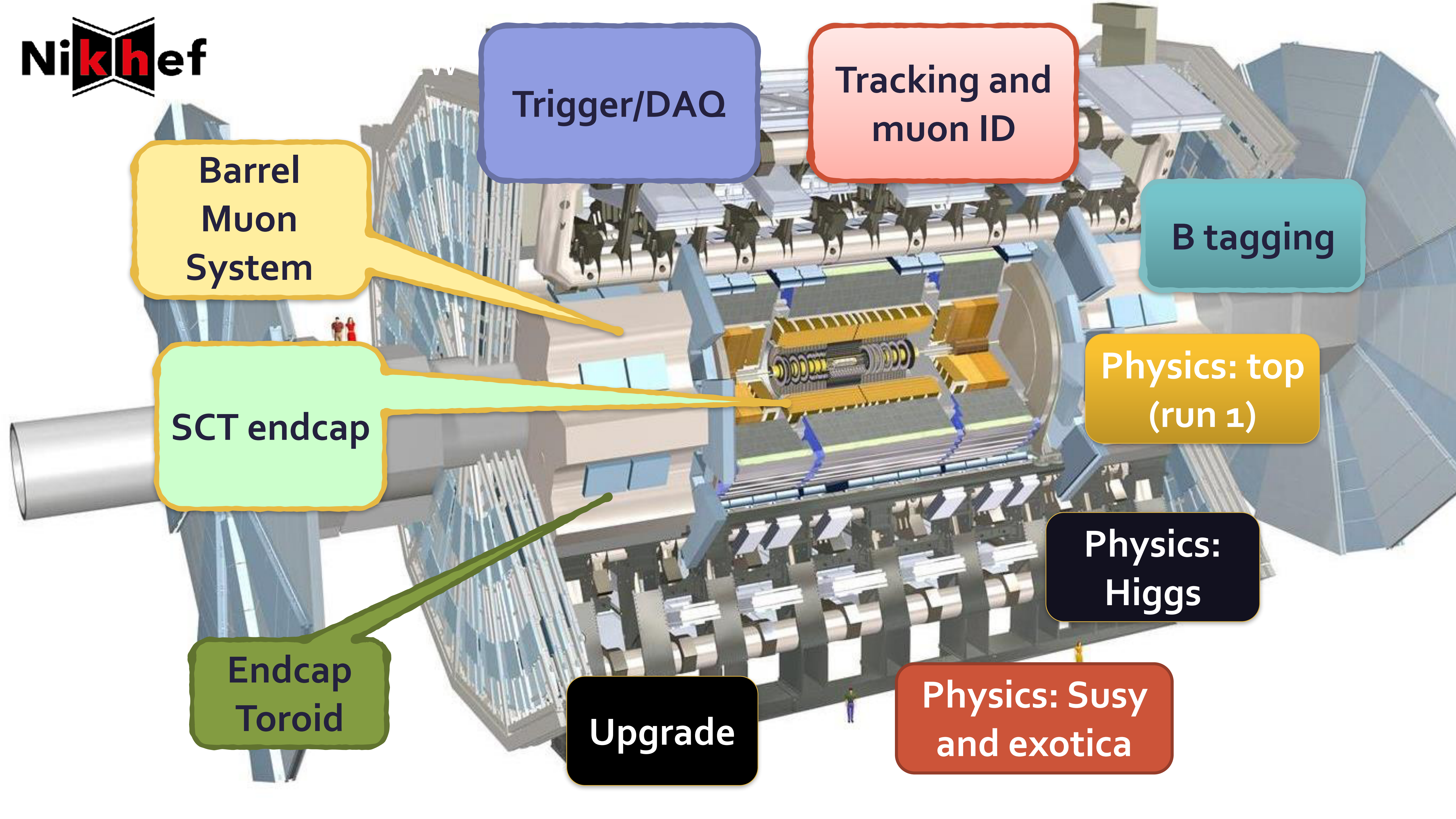


ATLAS



LHCb





Trigger/DAQ

Tracking and
muon ID

Barrel
Muon
System

B tagging

SCT endcap

Physics: top
(run 1)

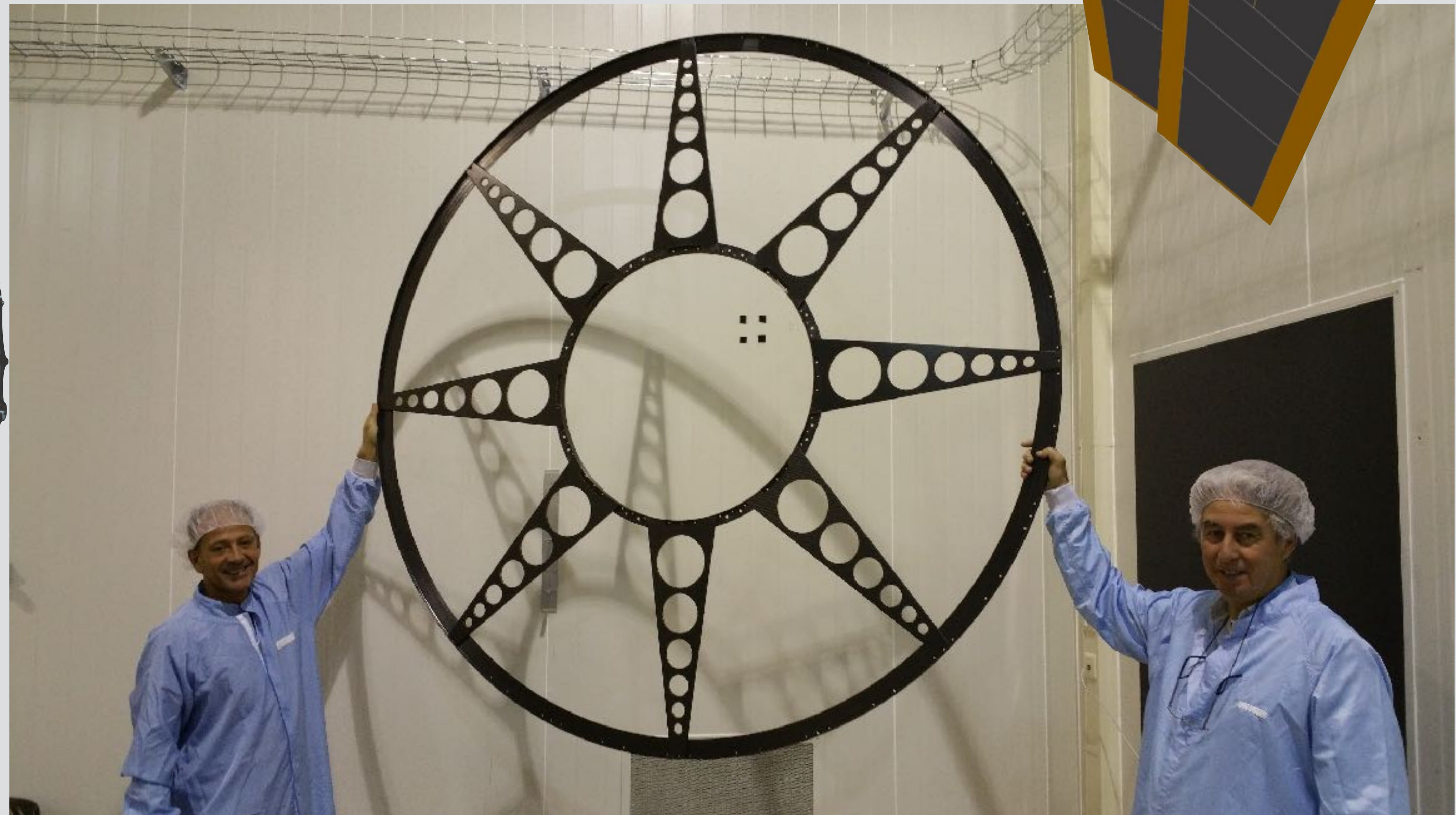
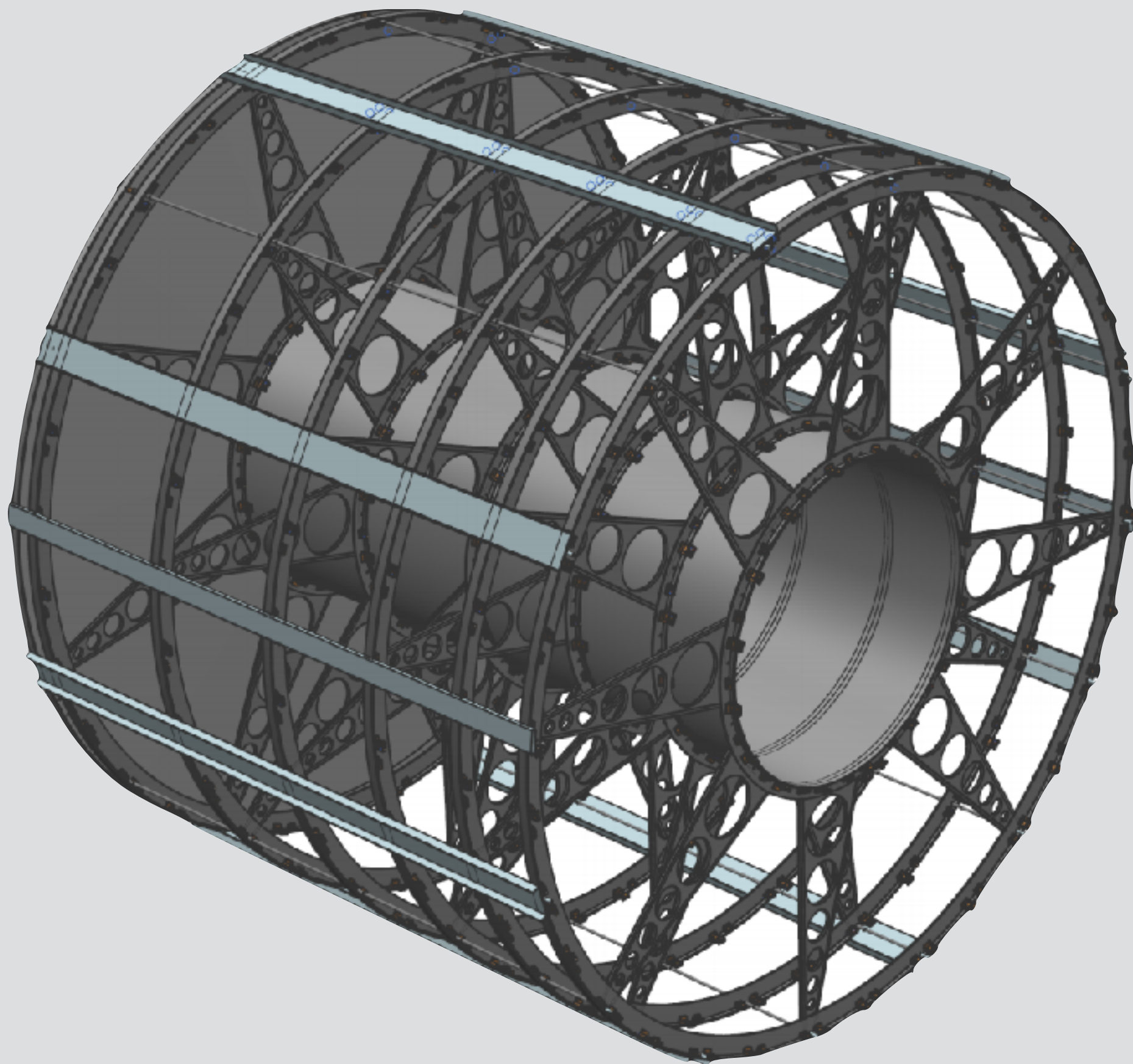
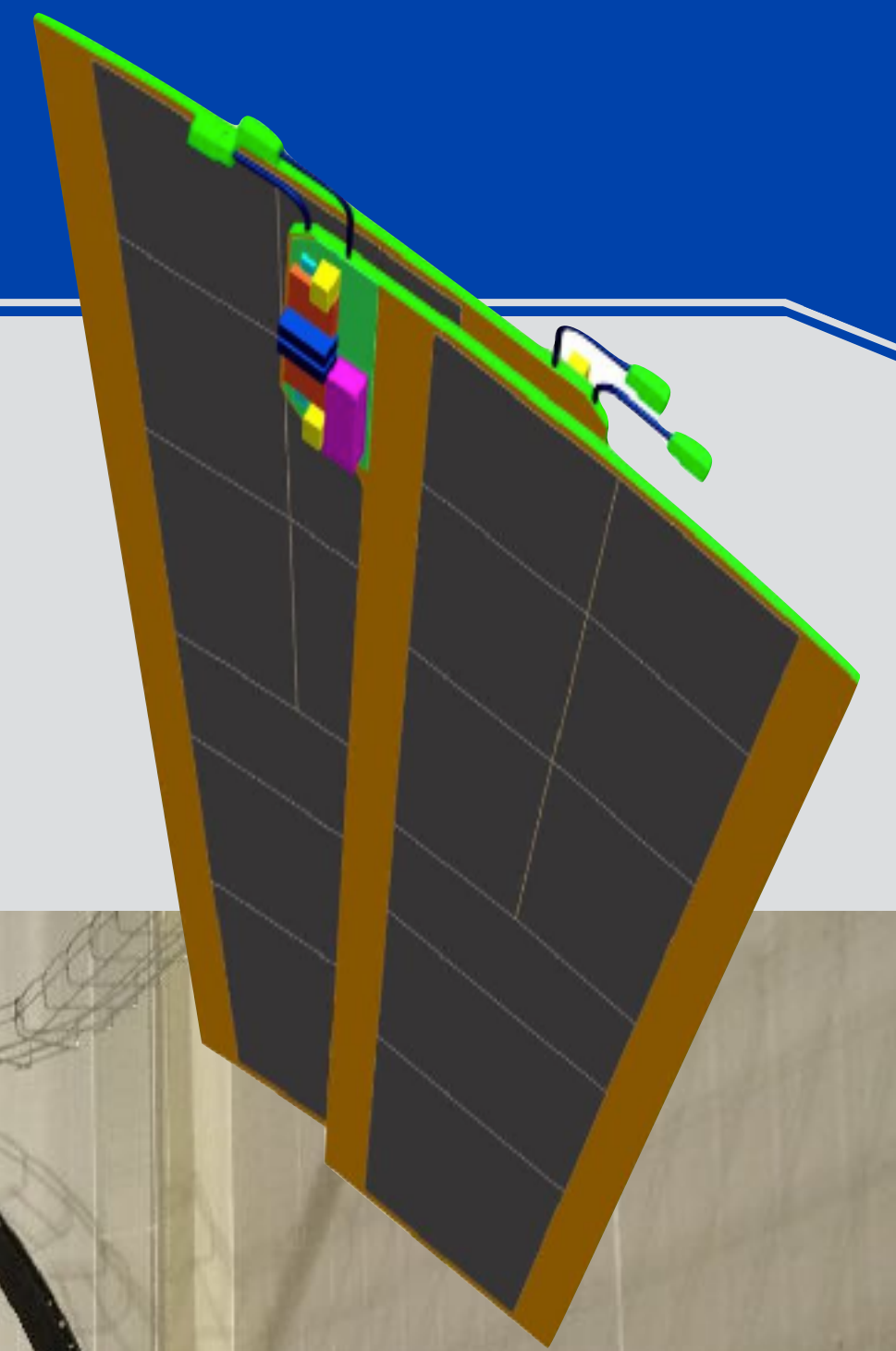
Endcap
Toroid

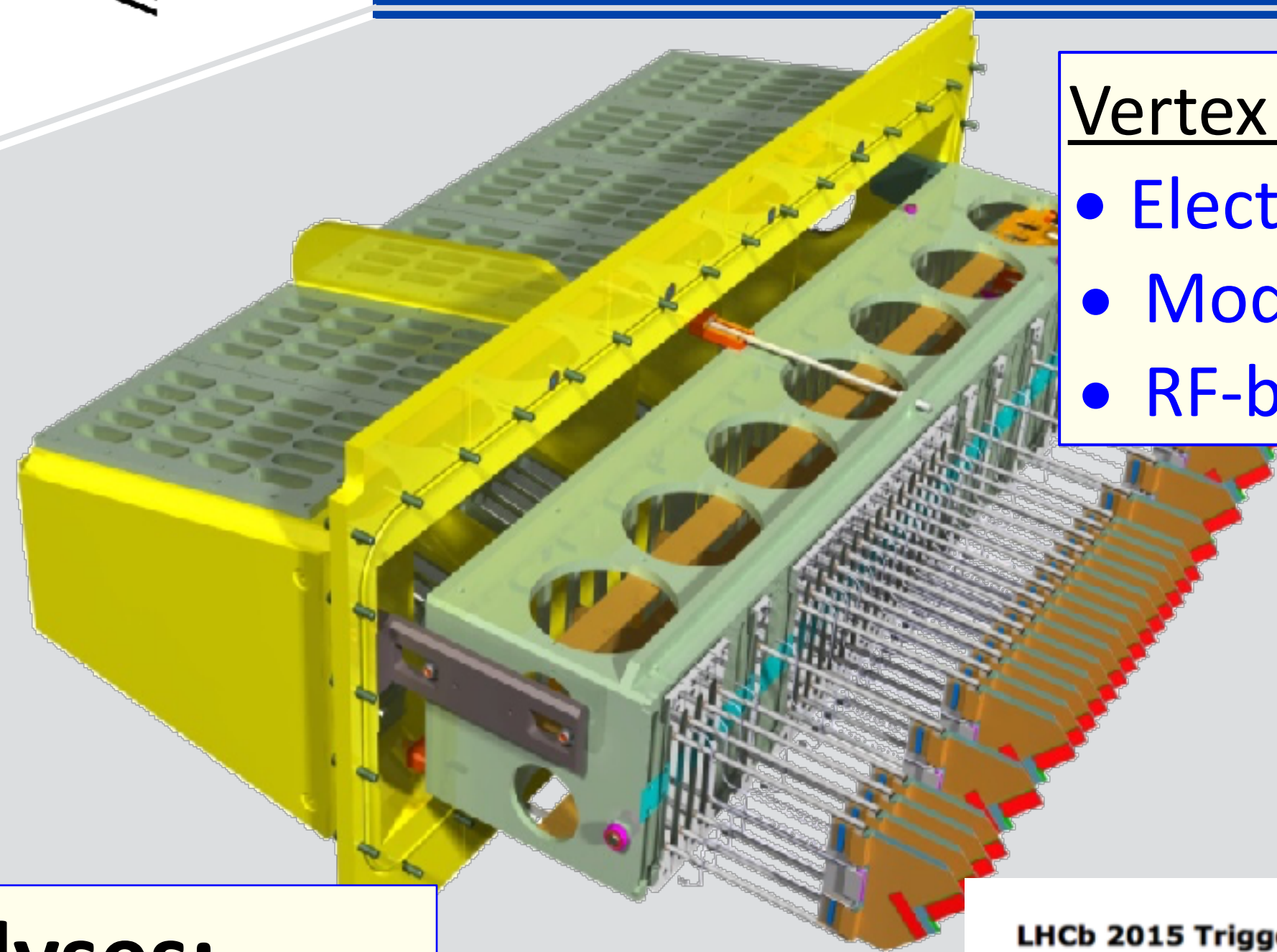
Physics:
Higgs

Upgrade

Physics: Susy
and exotica

- ITk prototyping - phase2 upgrade
 - Collaboration DESY, Valencia





Vertex Locator:

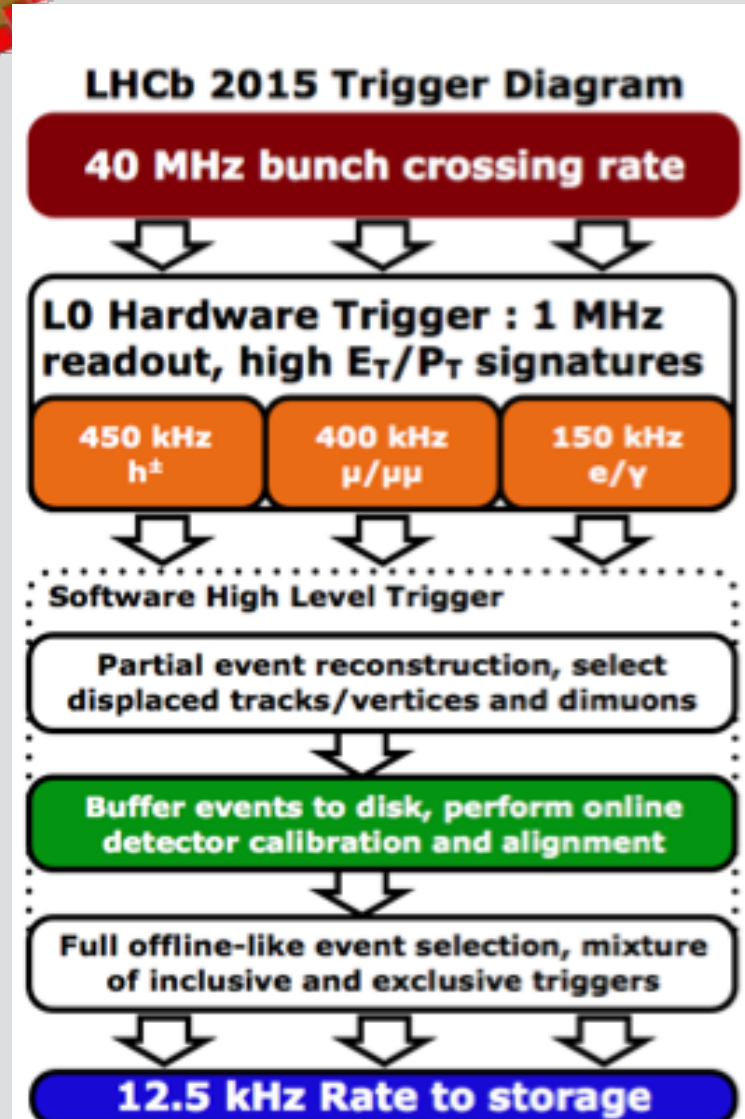
- Electronics
- Module design
- RF-box

Analyses:

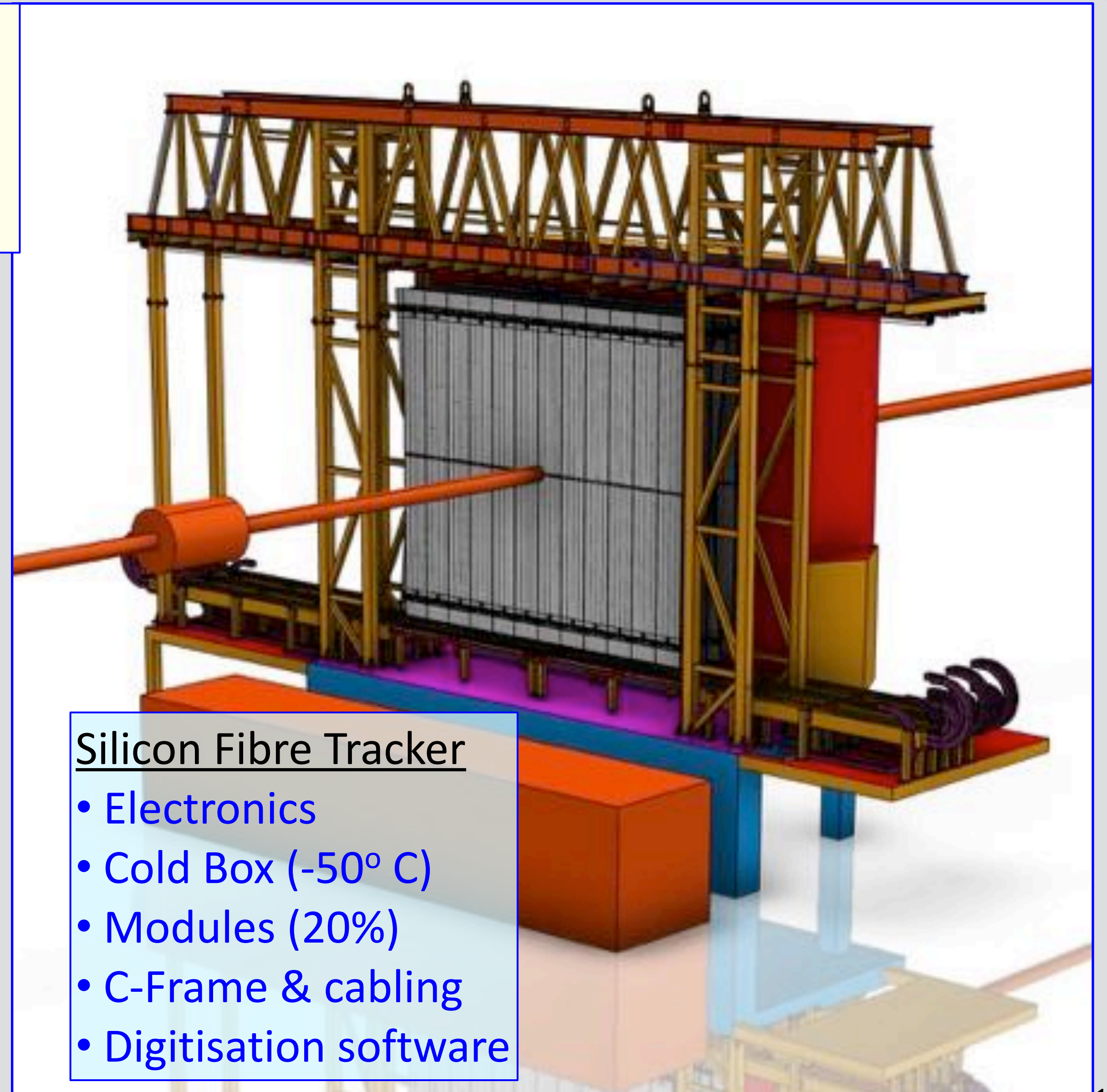
- Tracking
- CP violation
- Rare Decays

Detectors:

- Velo, OT, HLT



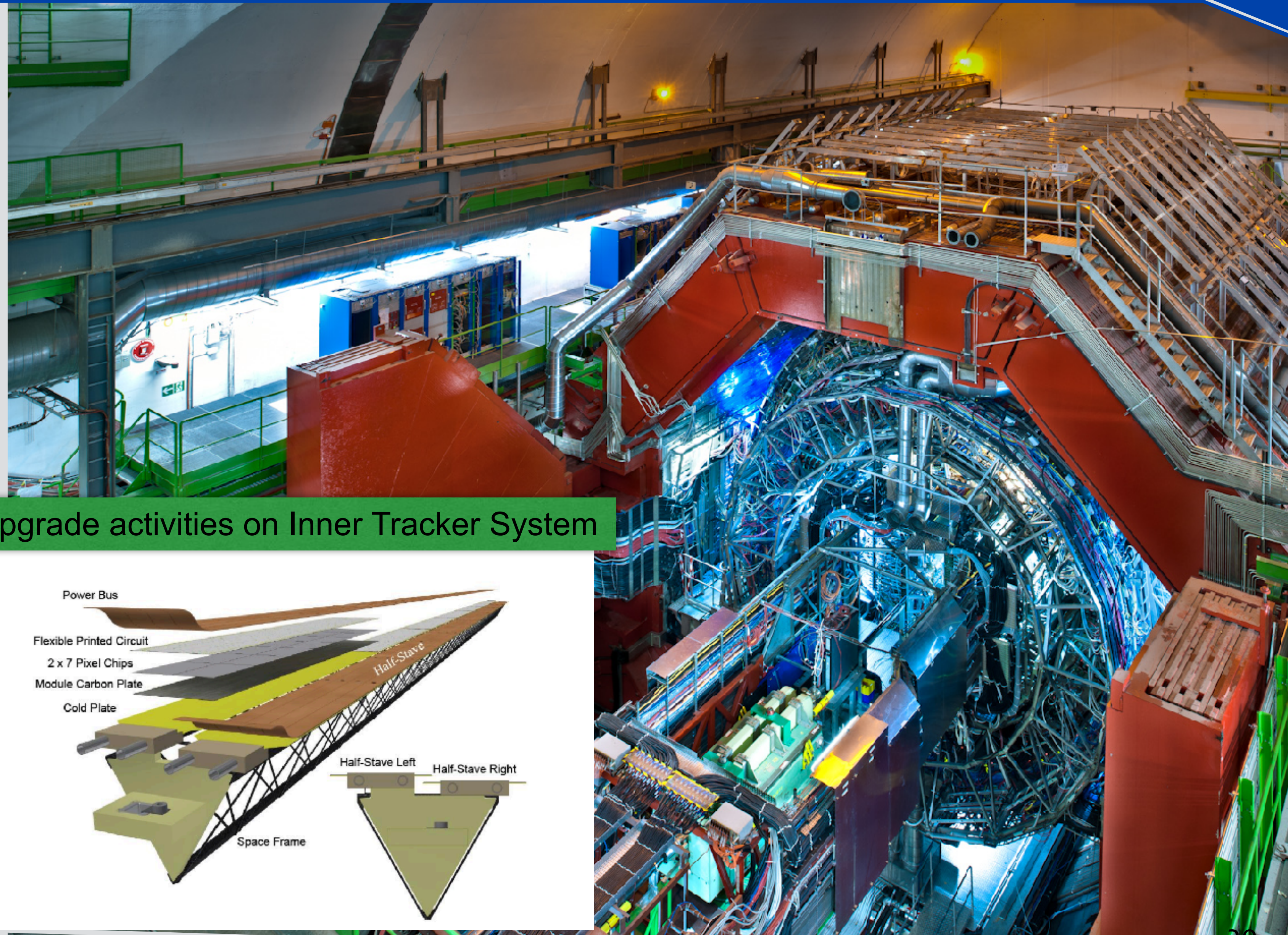
High Level trigger in S/W



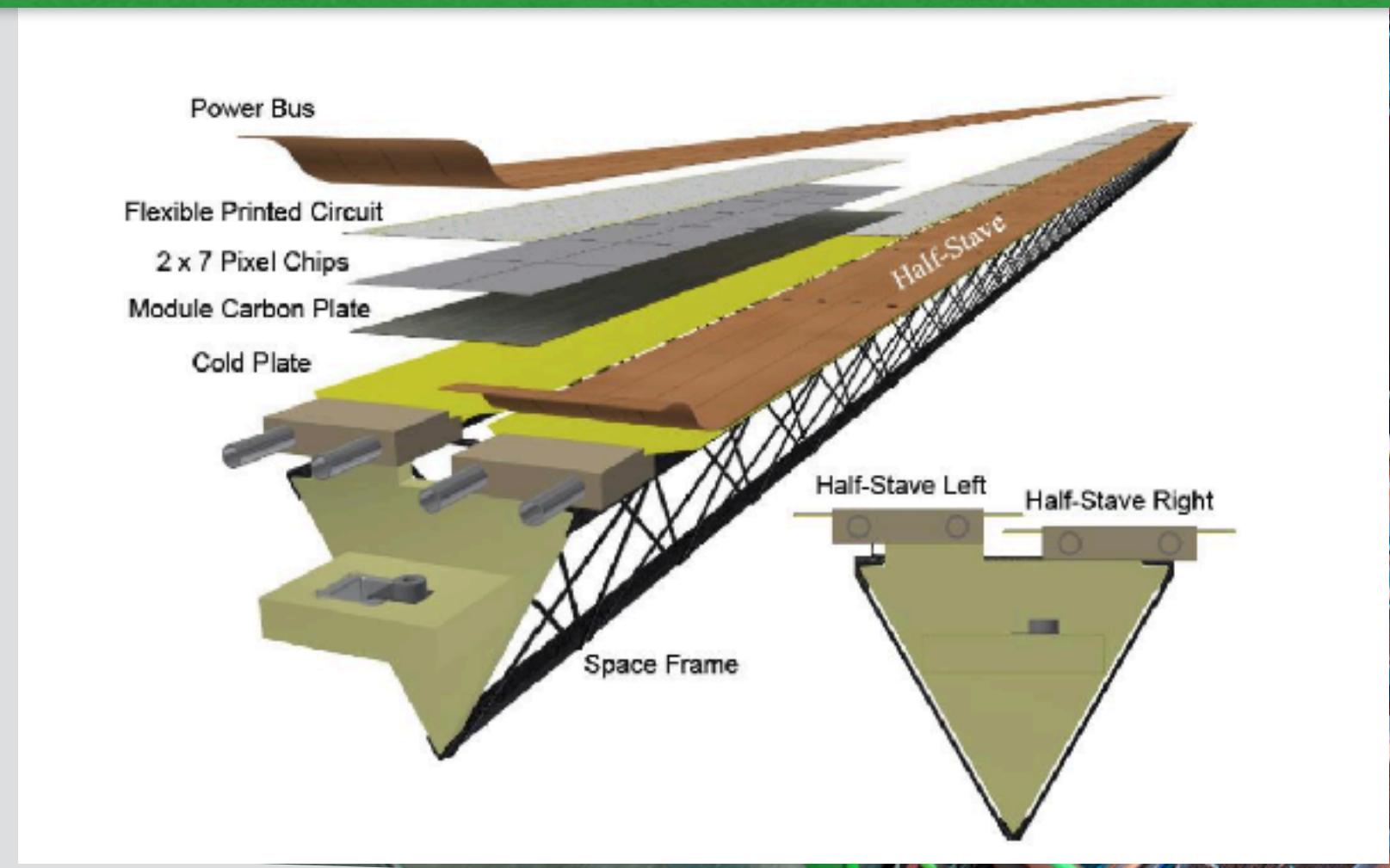
Silicon Fibre Tracker

- Electronics
- Cold Box (-50° C)
- Modules (20%)
- C-Frame & cabling
- Digitisation software

- Physics activities
 - bulk observables (correlations e.g. collective flow)
 - heavy-quarks and jets
 - electromagnetic probes
- Nikhef quite visible



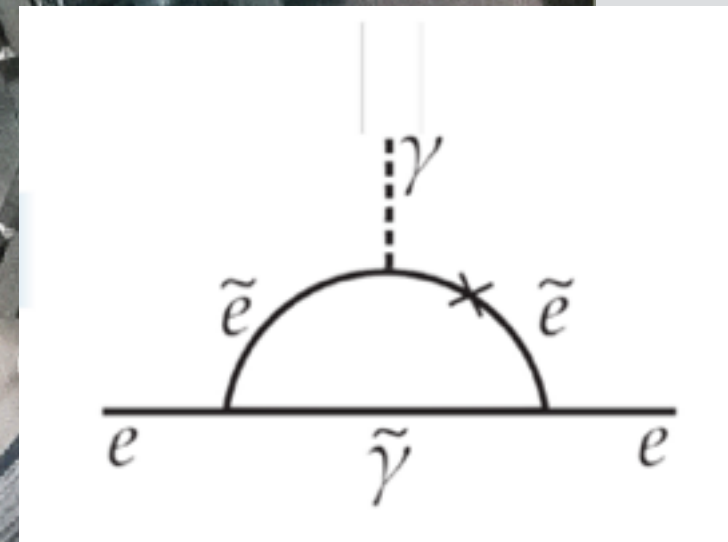
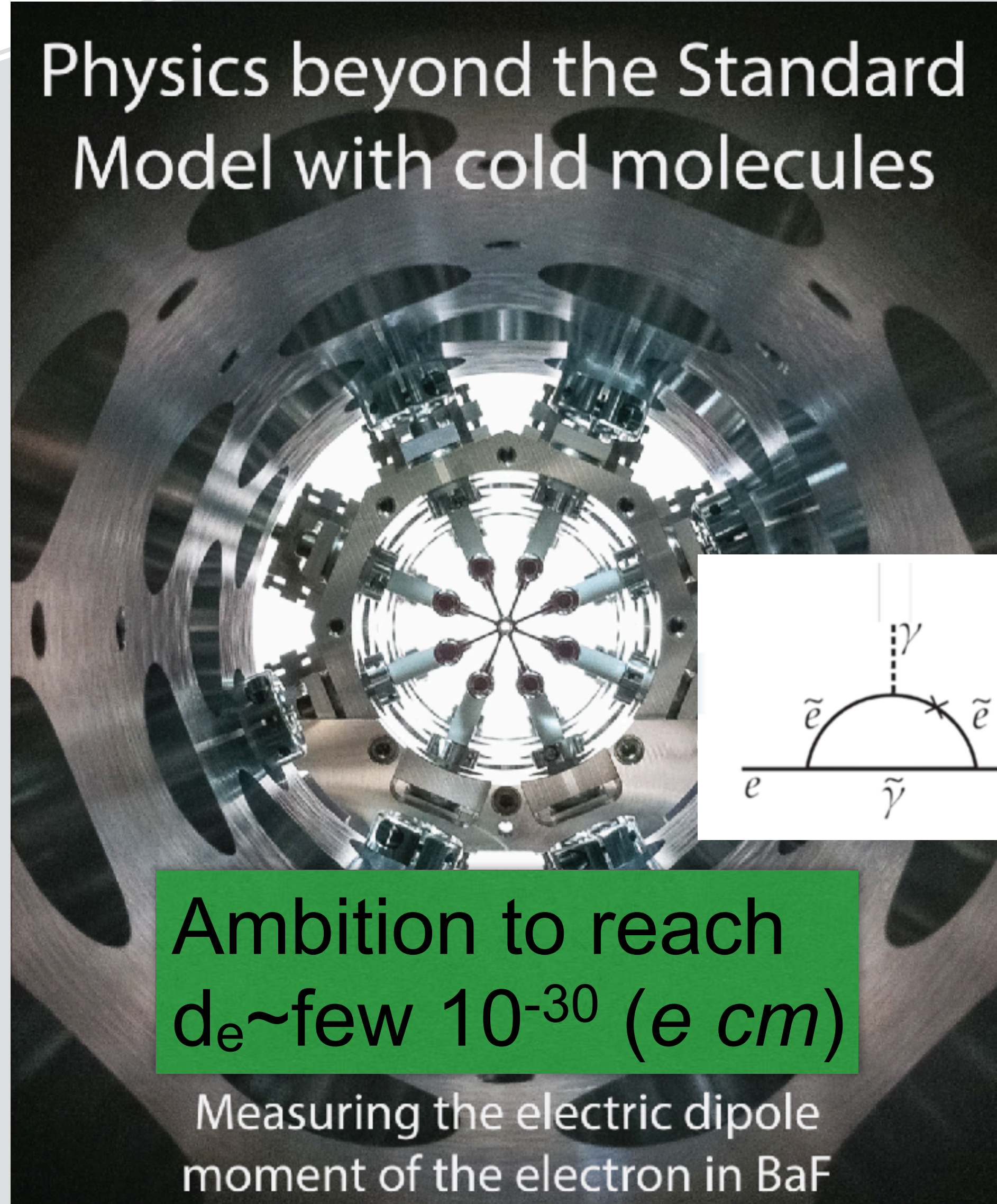
Upgrade activities on Inner Tracker System



Physics beyond the Standard Model with cold molecules

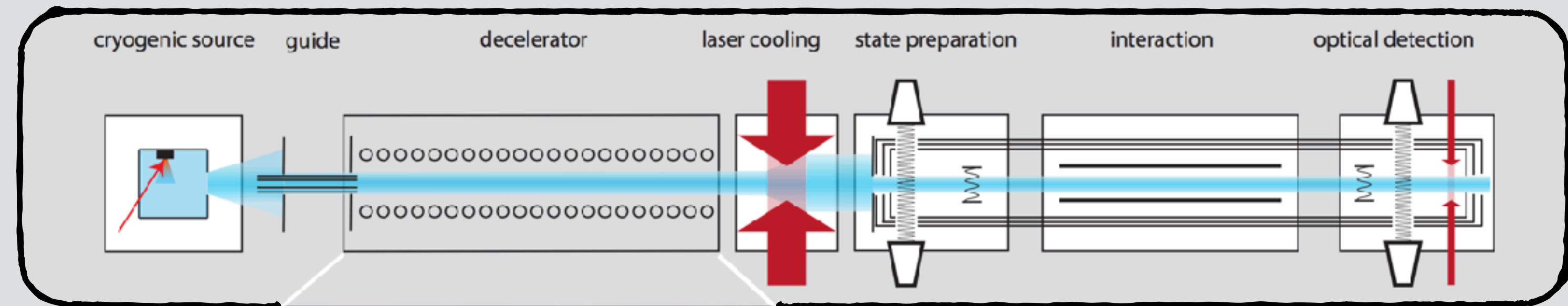
Start-up program:

- Strong E-field in BaF molecule
 - Cold molecule: long coherent measurement time



Ambition to reach $d_e \sim \text{few } 10^{-30} \text{ (e cm)}$

Measuring the electric dipole moment of the electron in BaF



The choice of these experiments, which can be seen as the elite of particle- and astroparticle physics experiments, is excellent.

European Strategy for Astroparticle Physics

APPEC—Astroparticle Physics European Consortium



Pierre Auger - cosmic rays



Xenon1T - Dark Matter



KM3NeT - neutrino detection



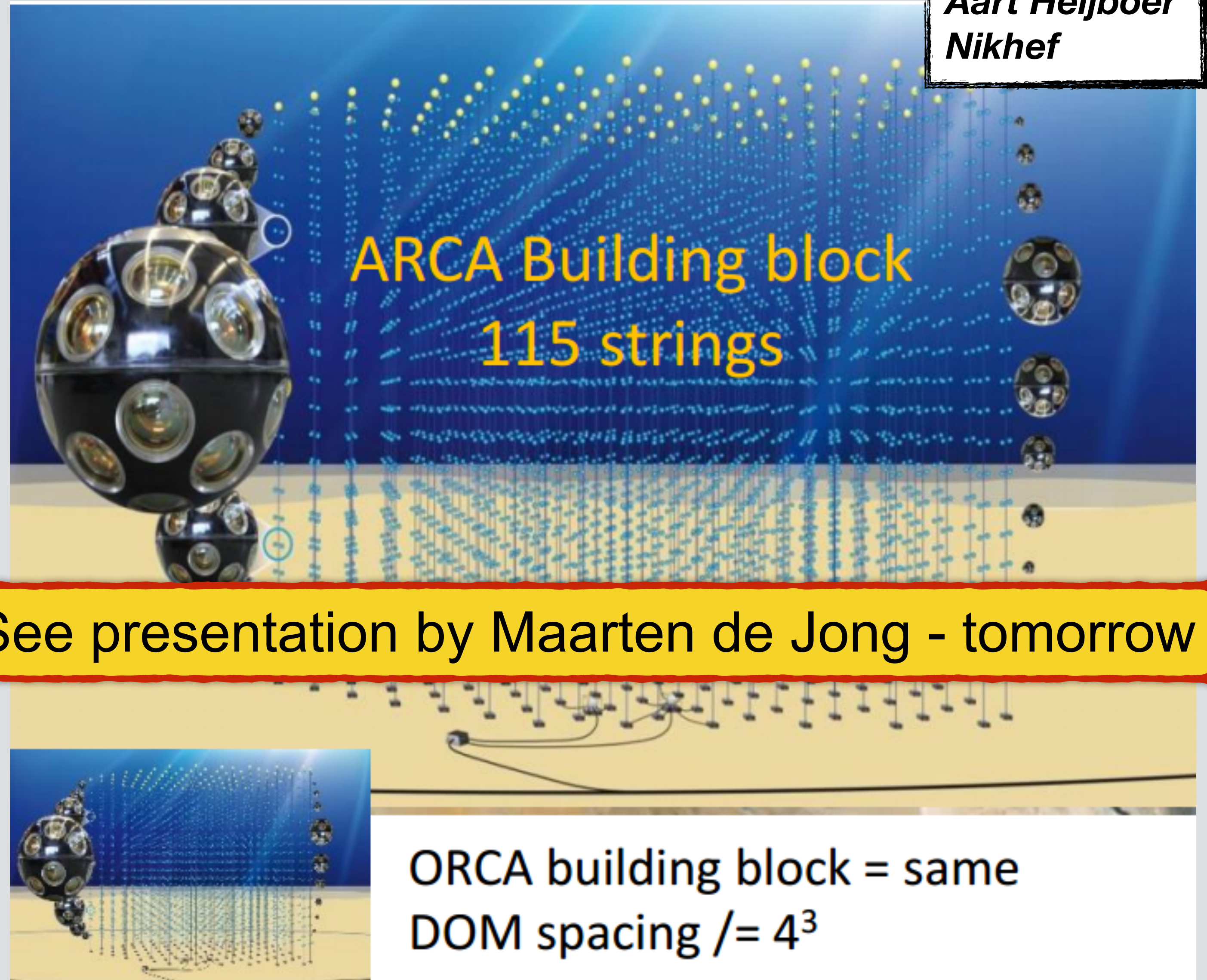
Adv VIRGO - Gravitational Waves

- Priorities in recommendations roadmap APPEC

Aart Heijboer
Nikhef

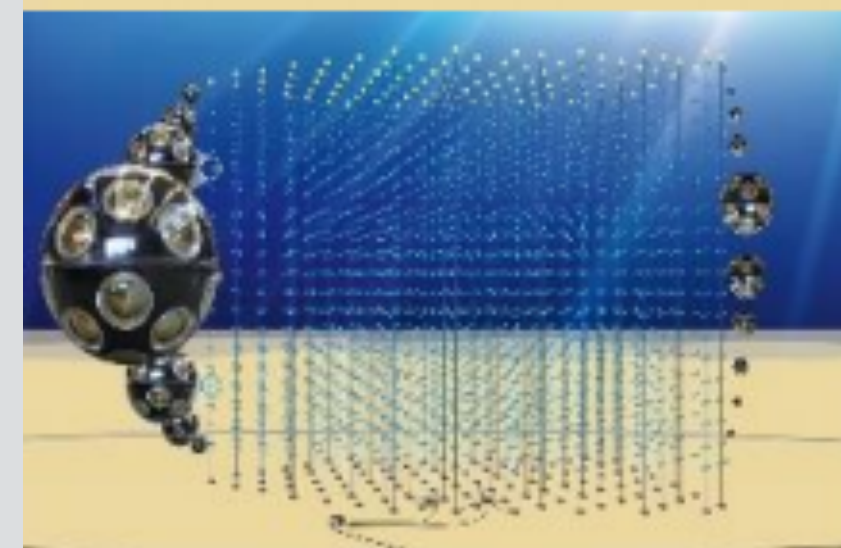
- KM3NeT 2.0 on ESFRI
 - Support at ministerial level from France, Italy, Greece and the Netherlands
- ARCA: Astrophysical Research with Cosmic in the Abyss
 - 2 building blocks
- ORCA: Oscillations Research with Cosmics in the Abyss
 - 1 building block

Largest activity of Nikhef workshops



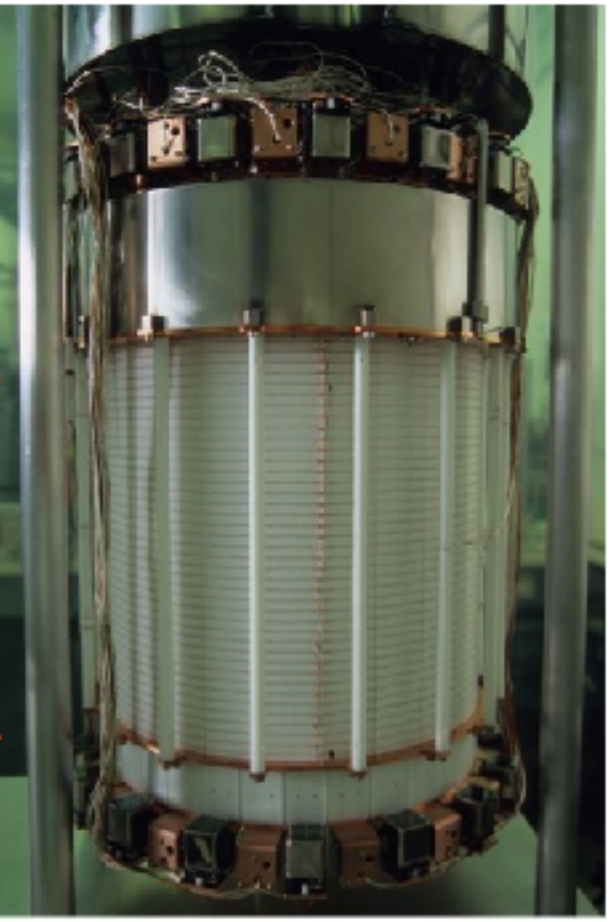
ARCA Building block
115 strings

See presentation by Maarten de Jong - tomorrow




ORCA building block = same
DOM spacing $\neq 4^3$

P. Decowski
University of Amsterdam



30cm

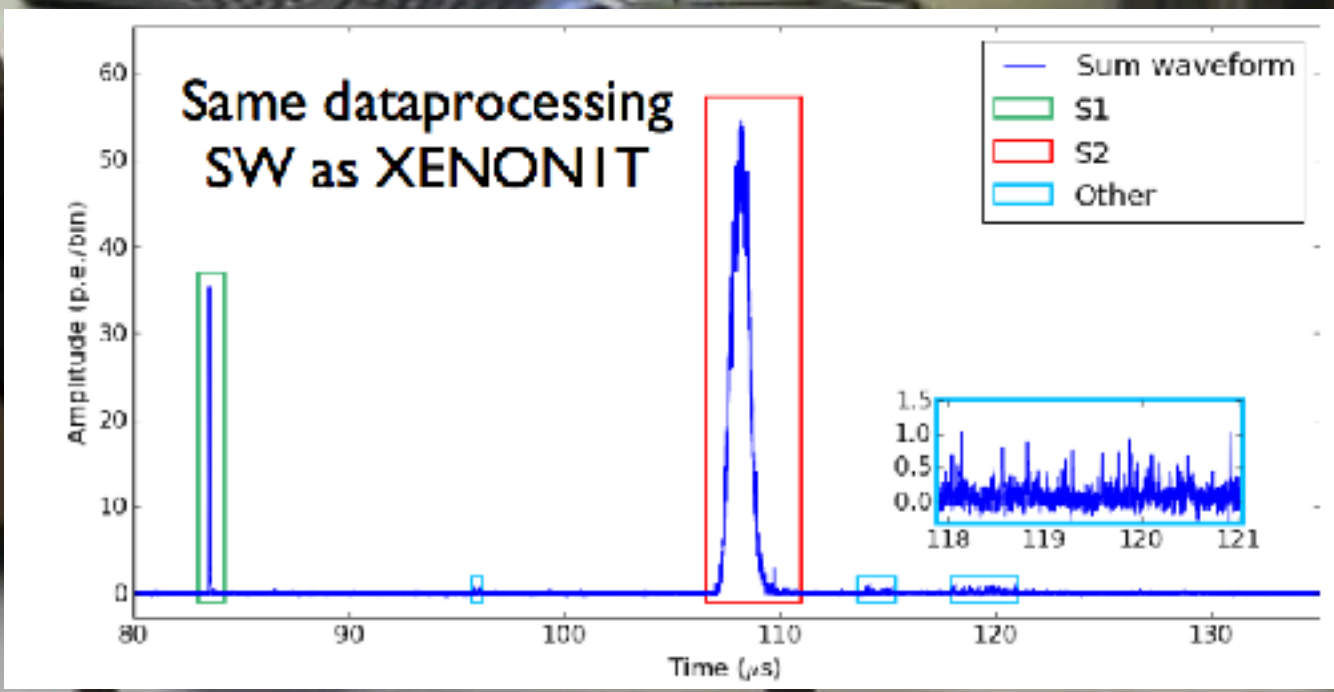
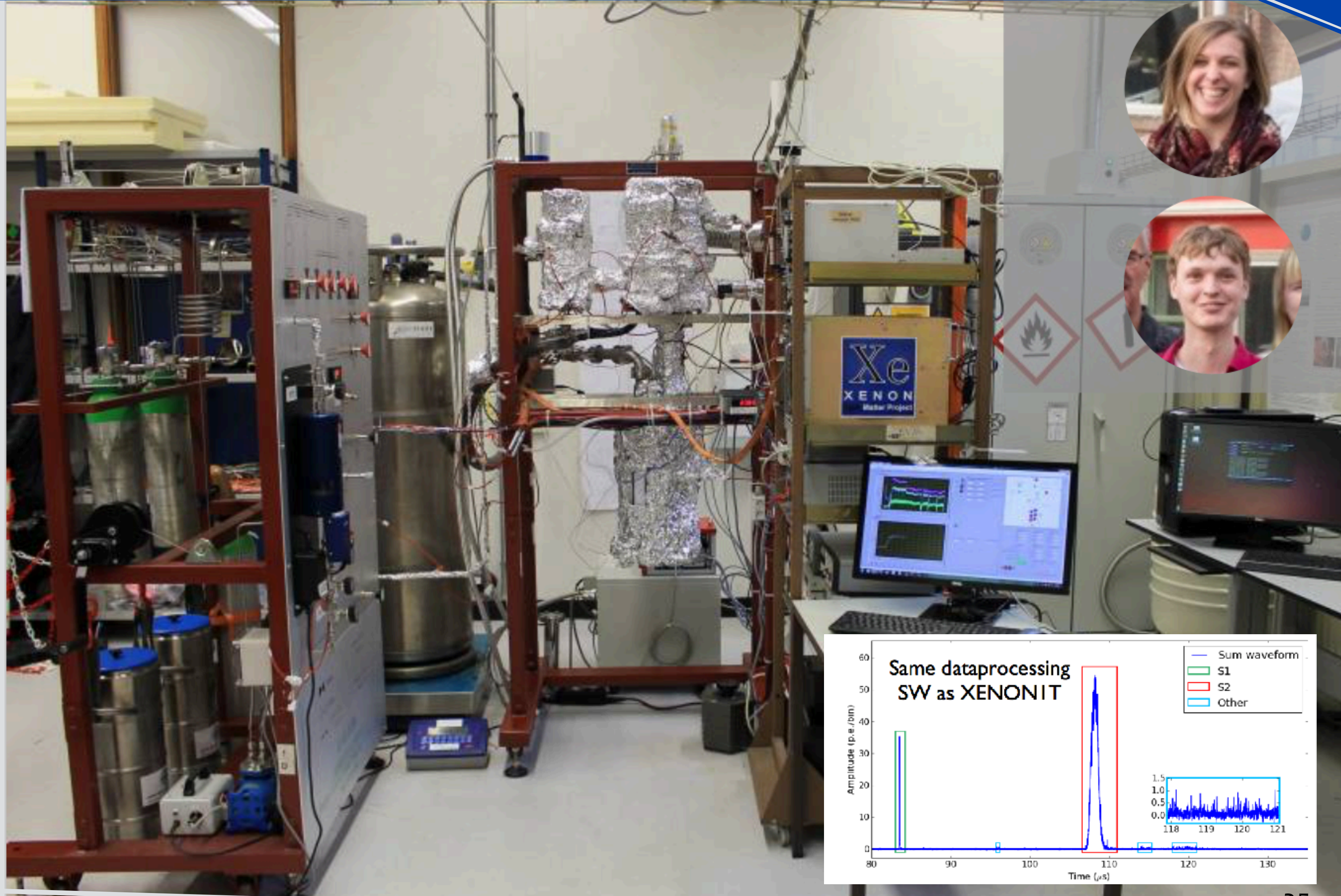
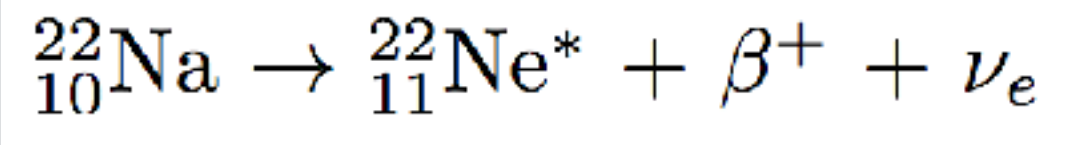
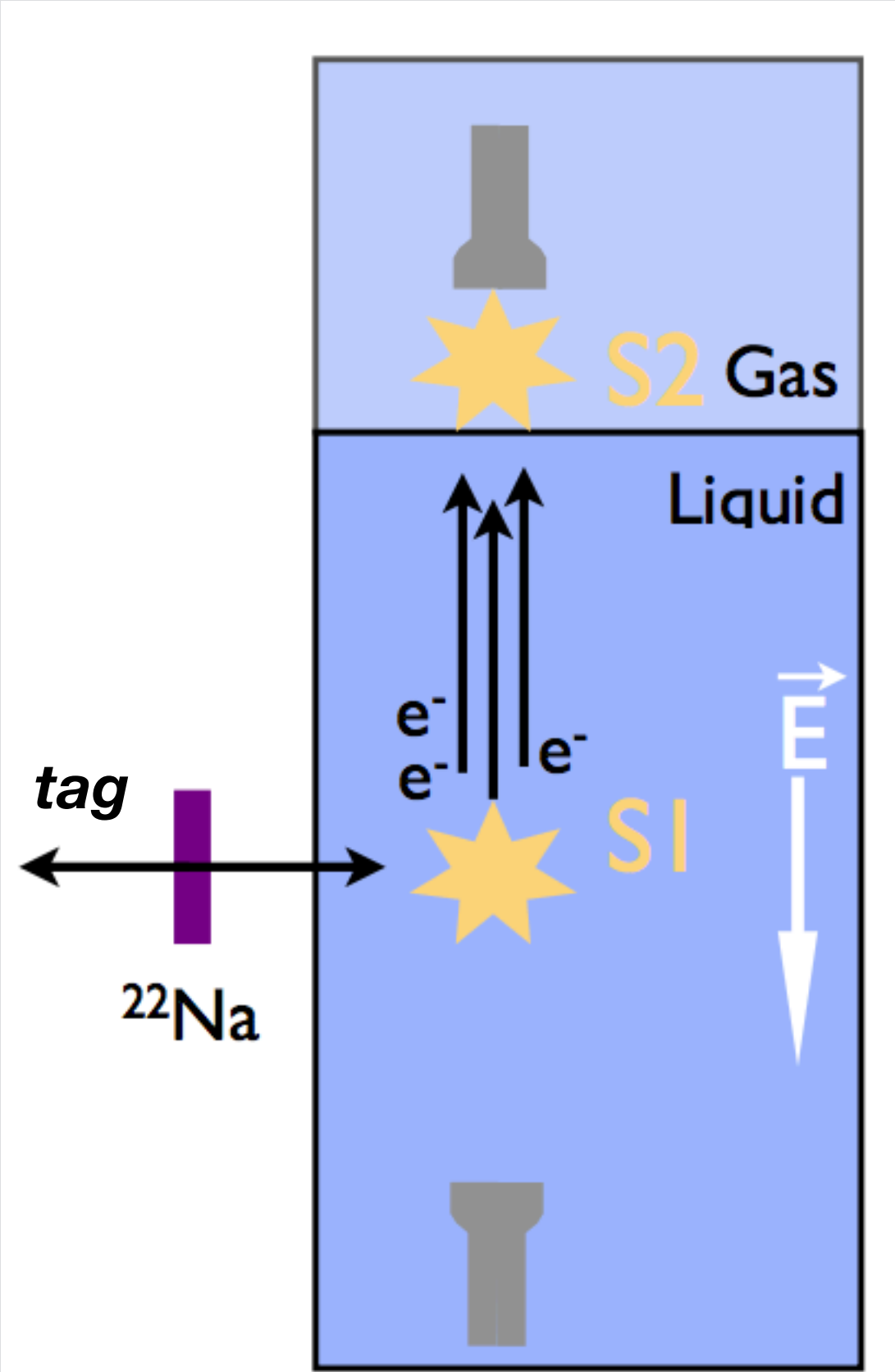
XENON100
(160kg Xe):
Analysis



100cm

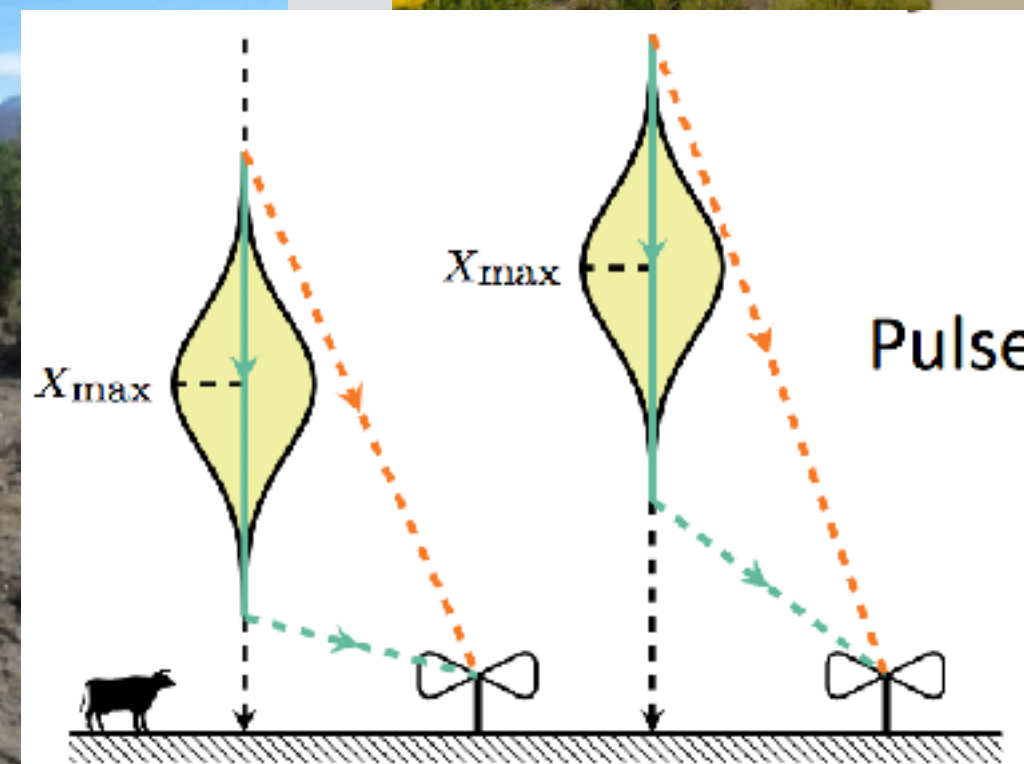
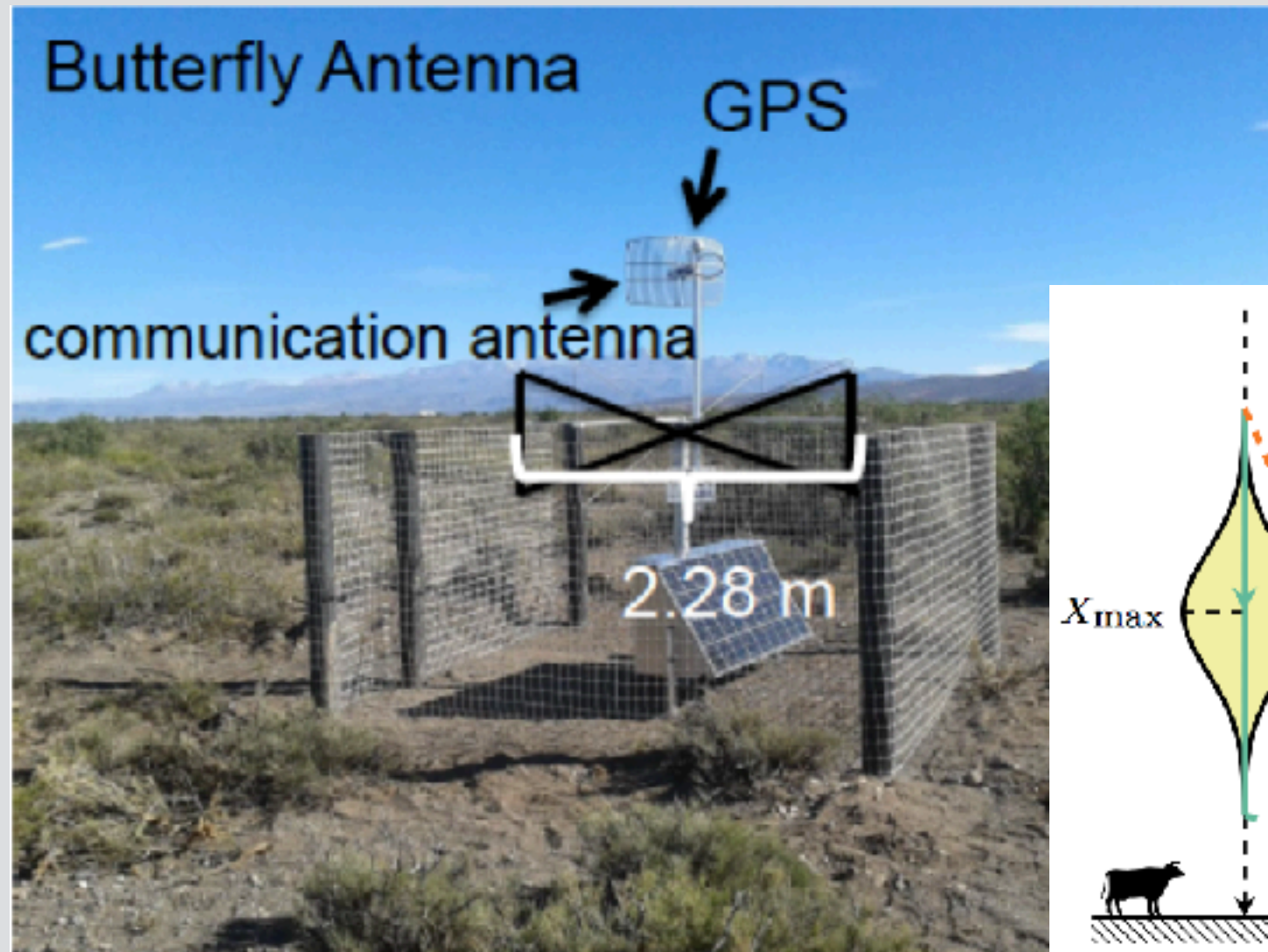
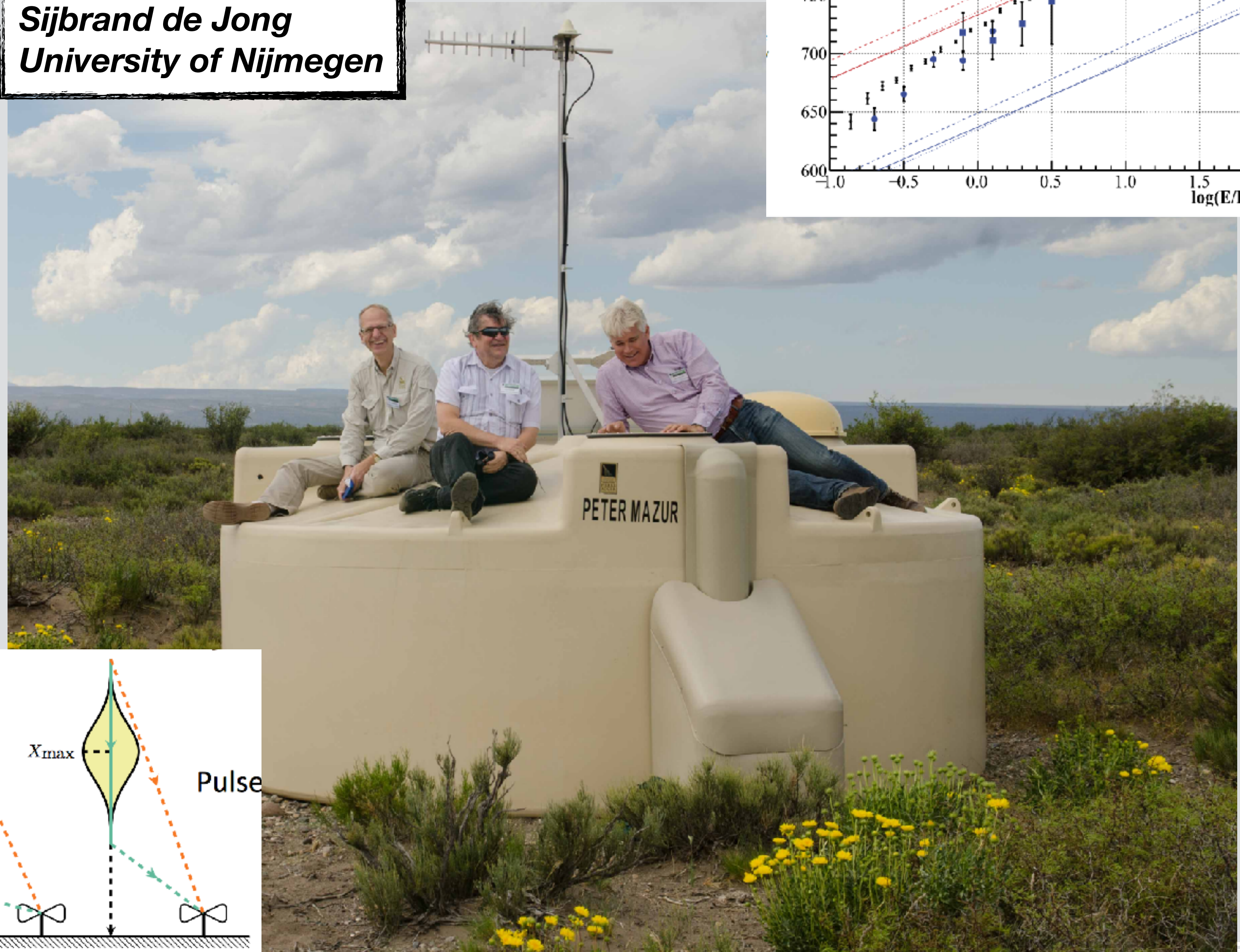
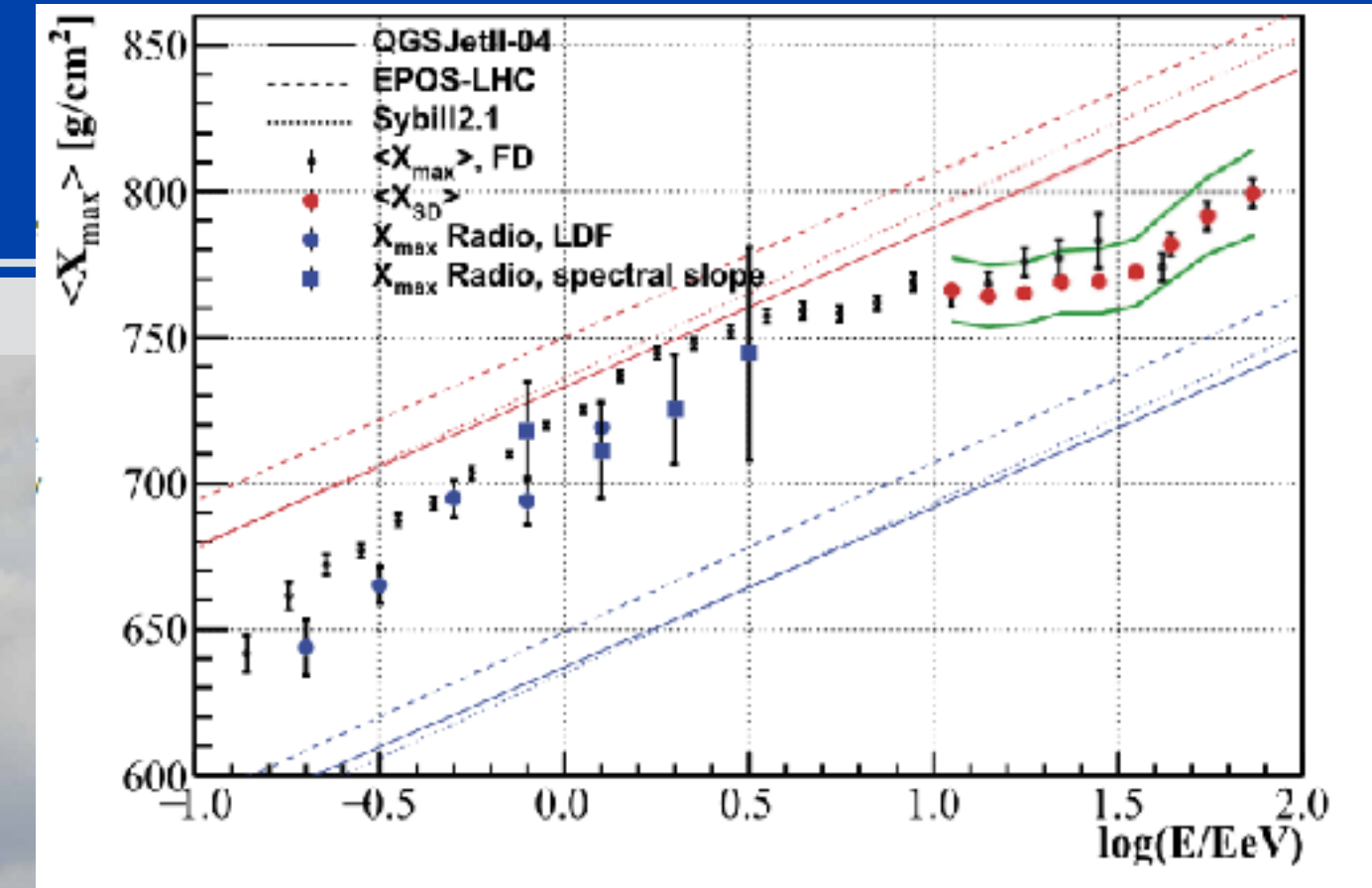
XENONIT
(3500kg Xe),
XENONnT
(7500kg Xe)
Cryostat & Support
DAQ / Trigger
Dataprocessor





Sijbrand de Jong
University of Nijmegen

- Mass composition
 - Detection CR with radio (AERA)
 - Surface Detection of cosmic rays

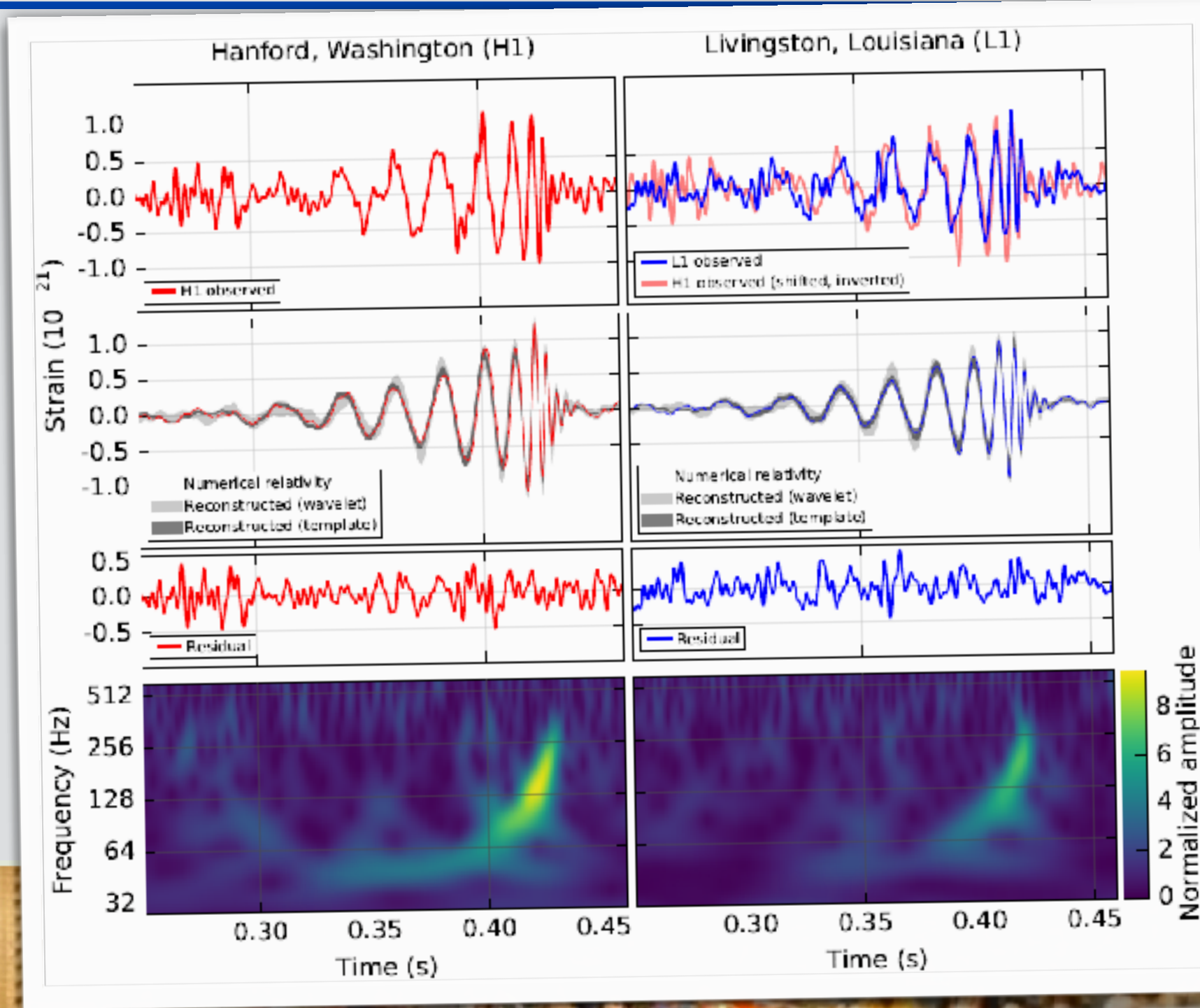
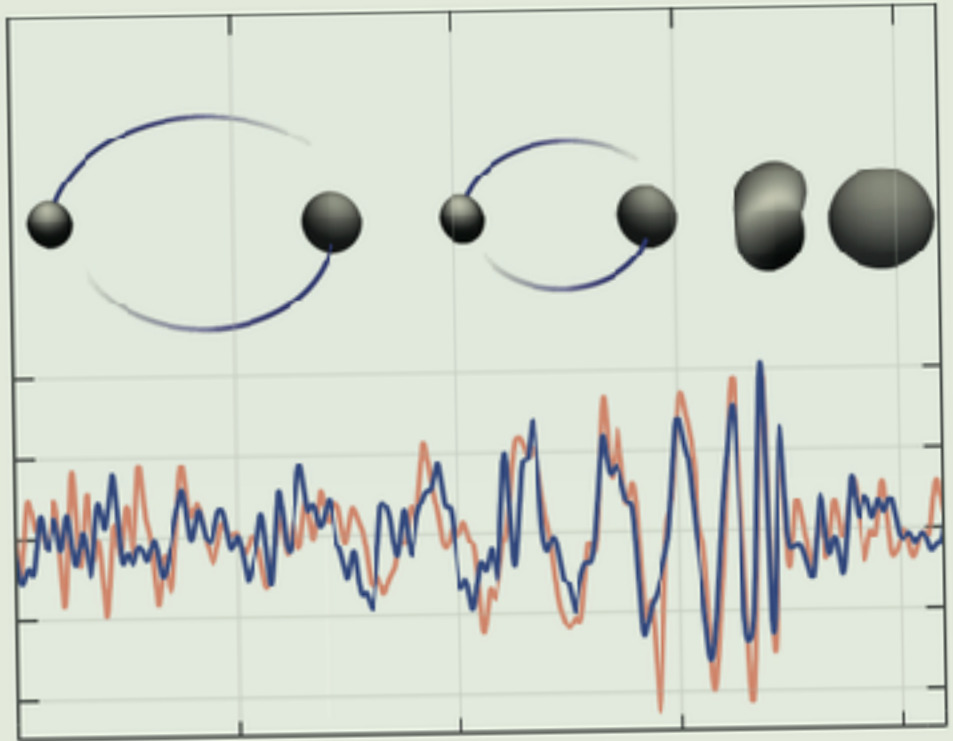


LIGO/aVirgo collaboration

PHYSICAL
REVIEW
LETTERS™

Member Subscription Copy
Library or Other Institutional Use Prohibited Until 2017

Articles published week ending 12 FEBRUARY 2016

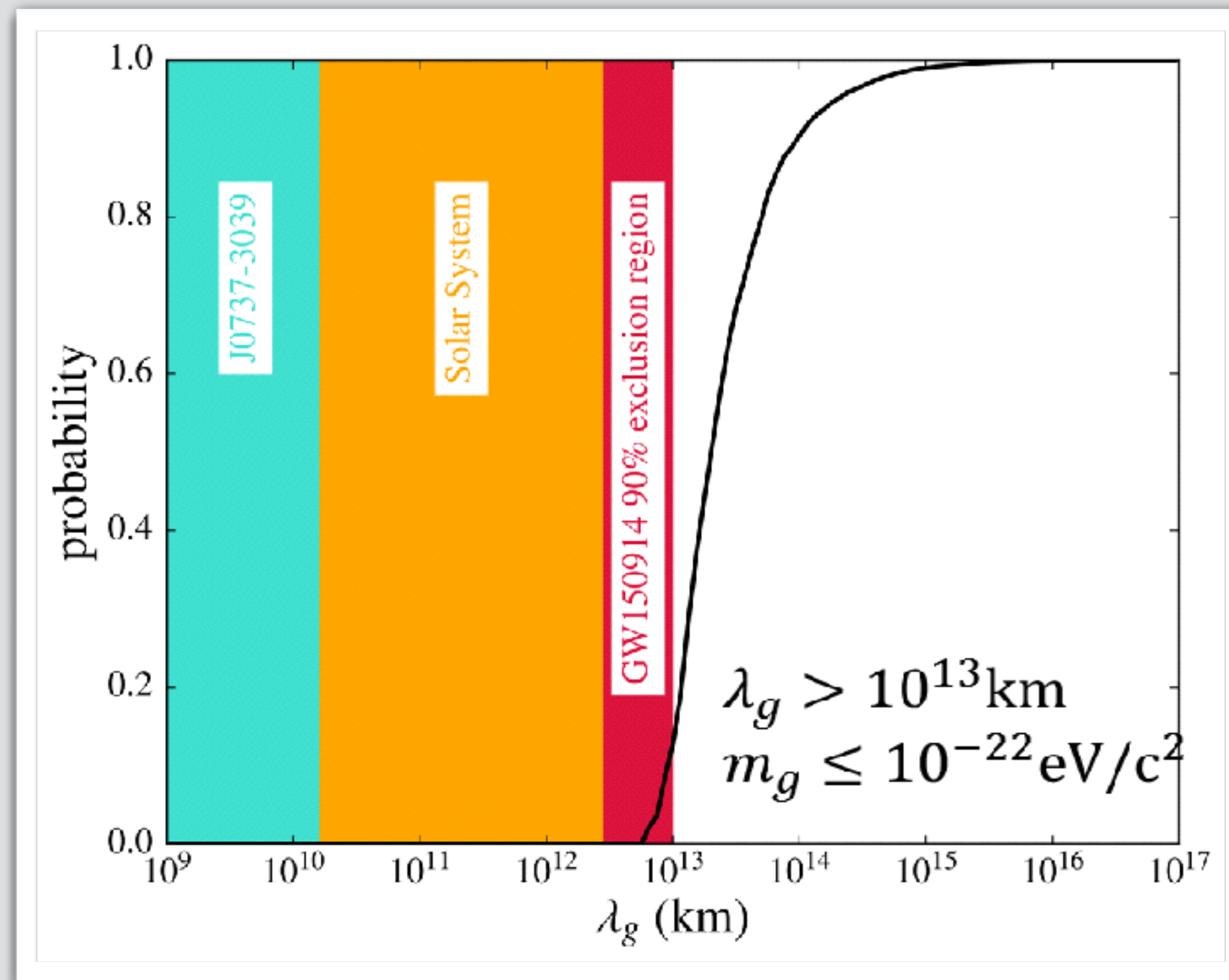


Jo van den Brand
Free University Amsterdam



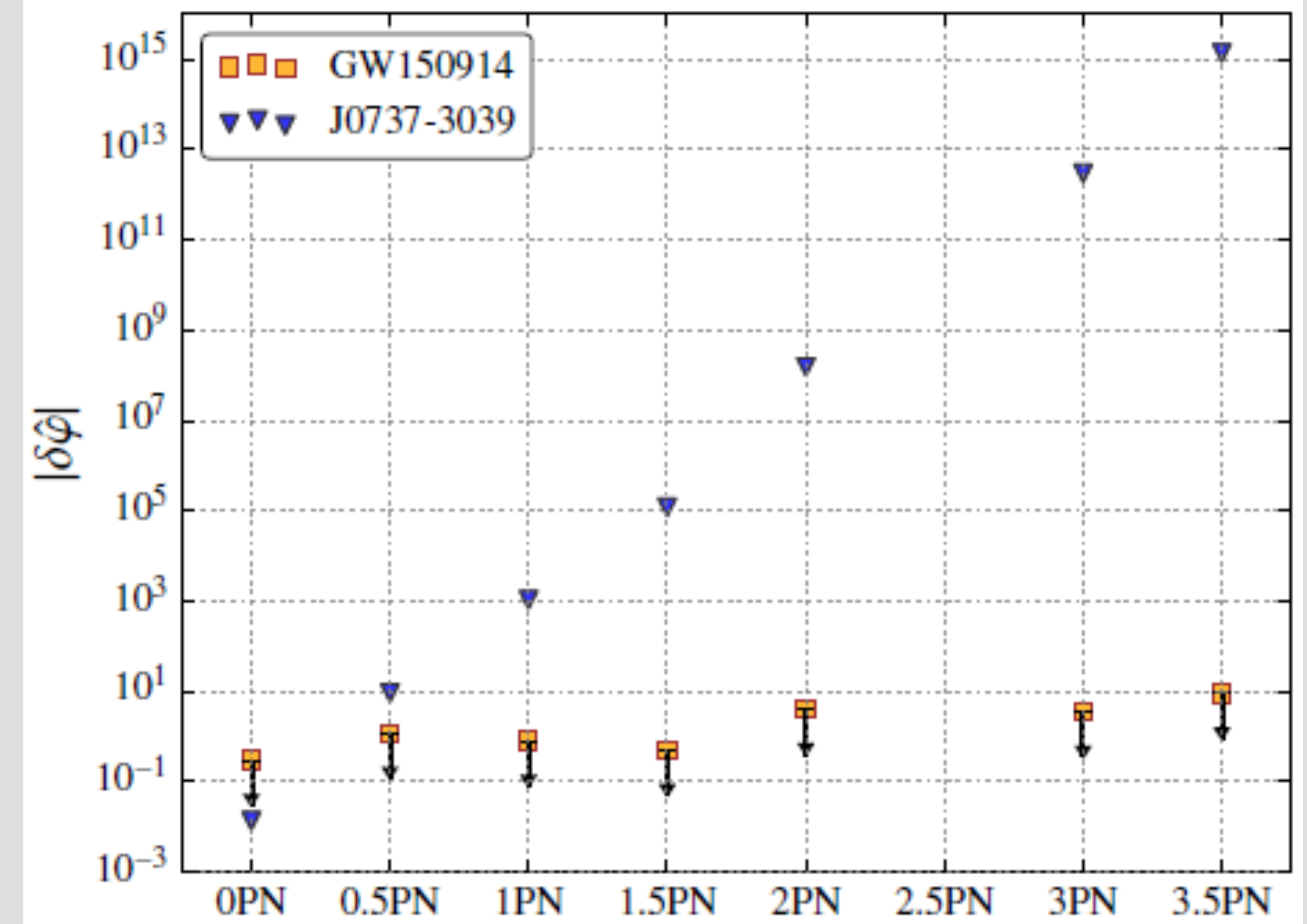
Nikhef, February 11, 2016

- First GW detection activities
 - Precision tests General Relativity
 - Limits on mass gravitino
 - Consistency BH-BH coalescence



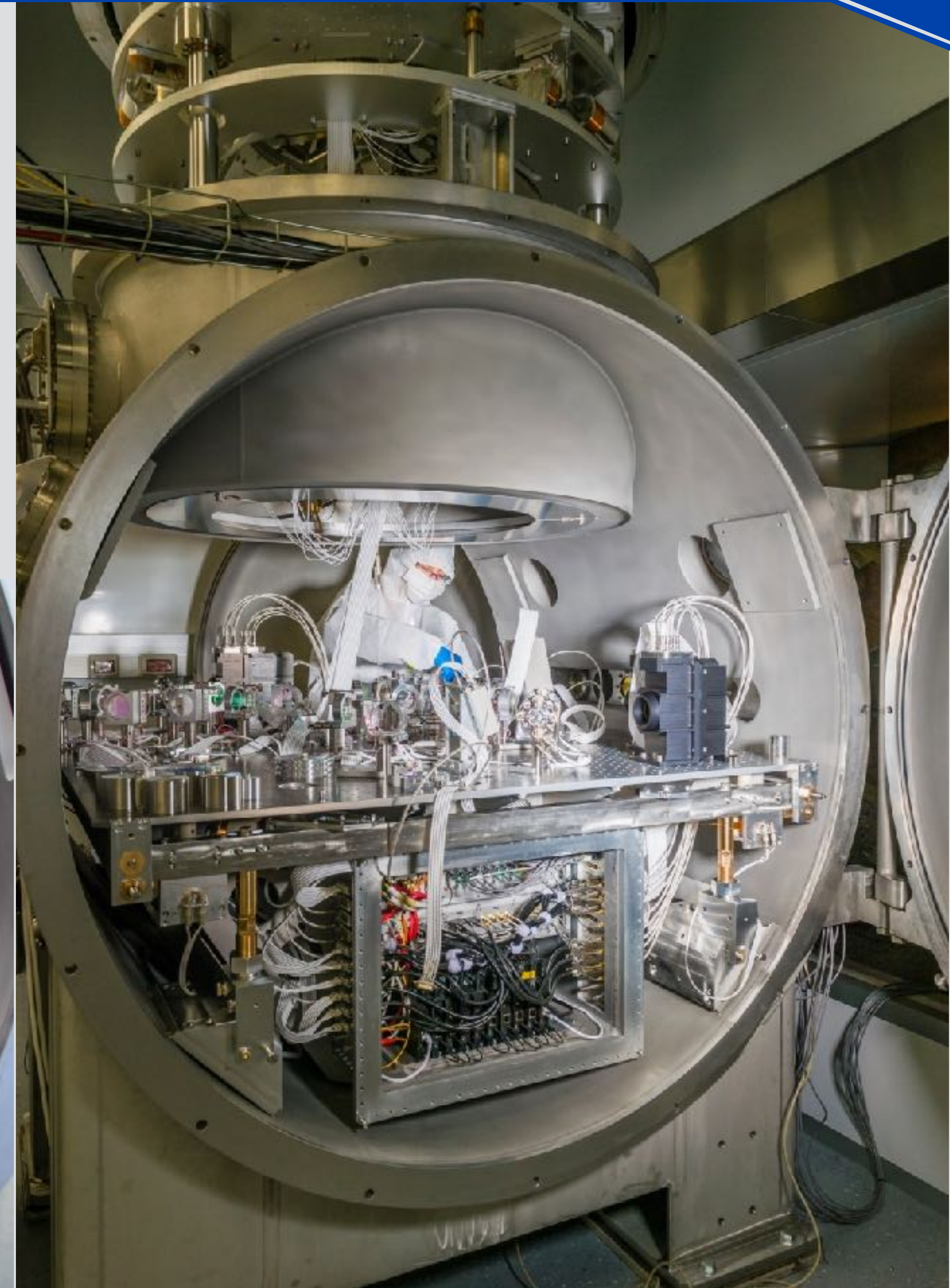
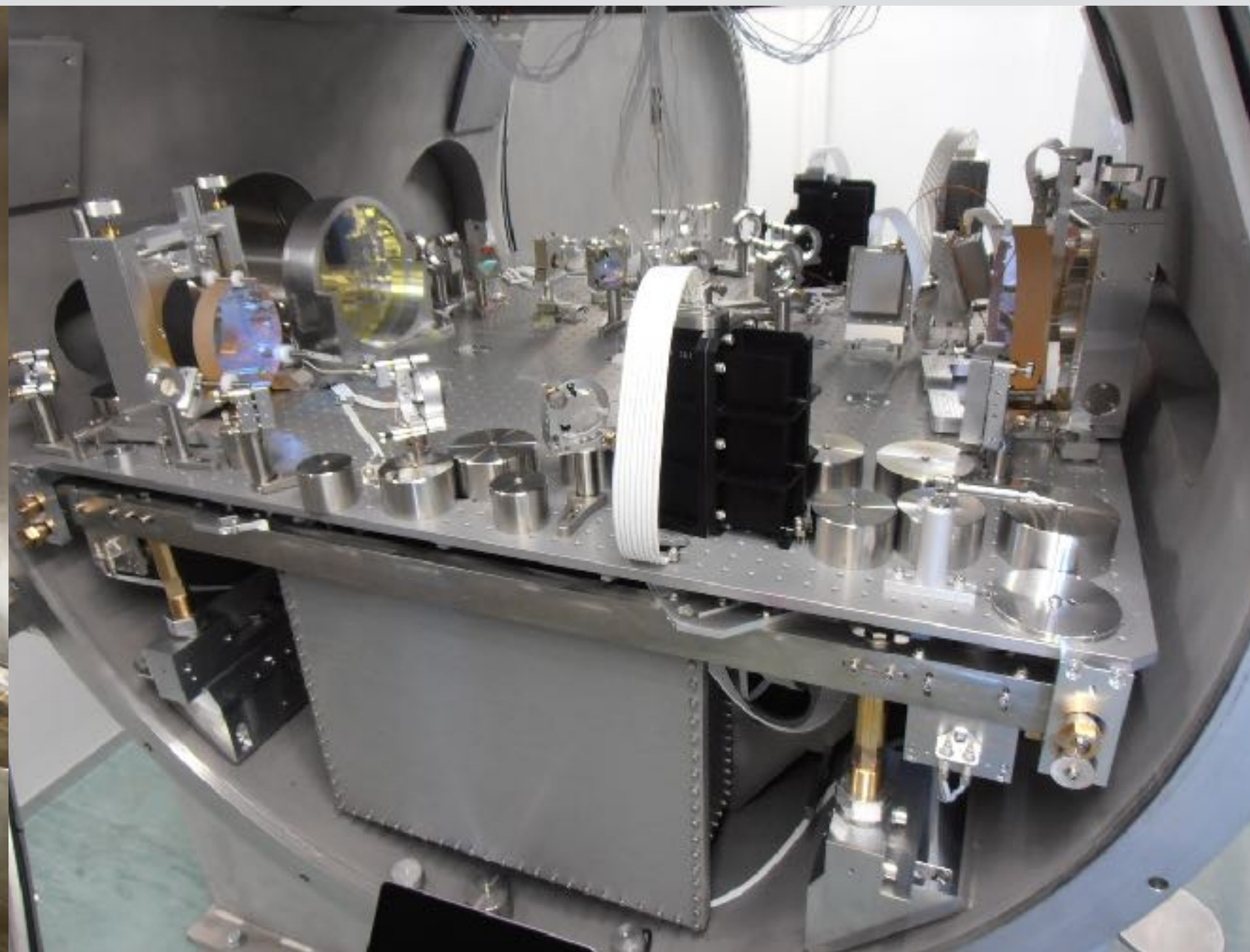
Orbital phase (post Newtonian expansion)

$$\Phi(v) = \left(\frac{v}{c}\right)^{-5} \sum_{n=0}^{\infty} \left[\varphi_n + \varphi_n^{(l)} \ln\left(\frac{v}{c}\right) \right] \left(\frac{v}{c}\right)^n$$



First serious tests of strong field physics in General Relativity

- Hardware responsibilities
 - MultiSAS, cryolinks, linear alignment, phase camera.
 - Commissioning work ...

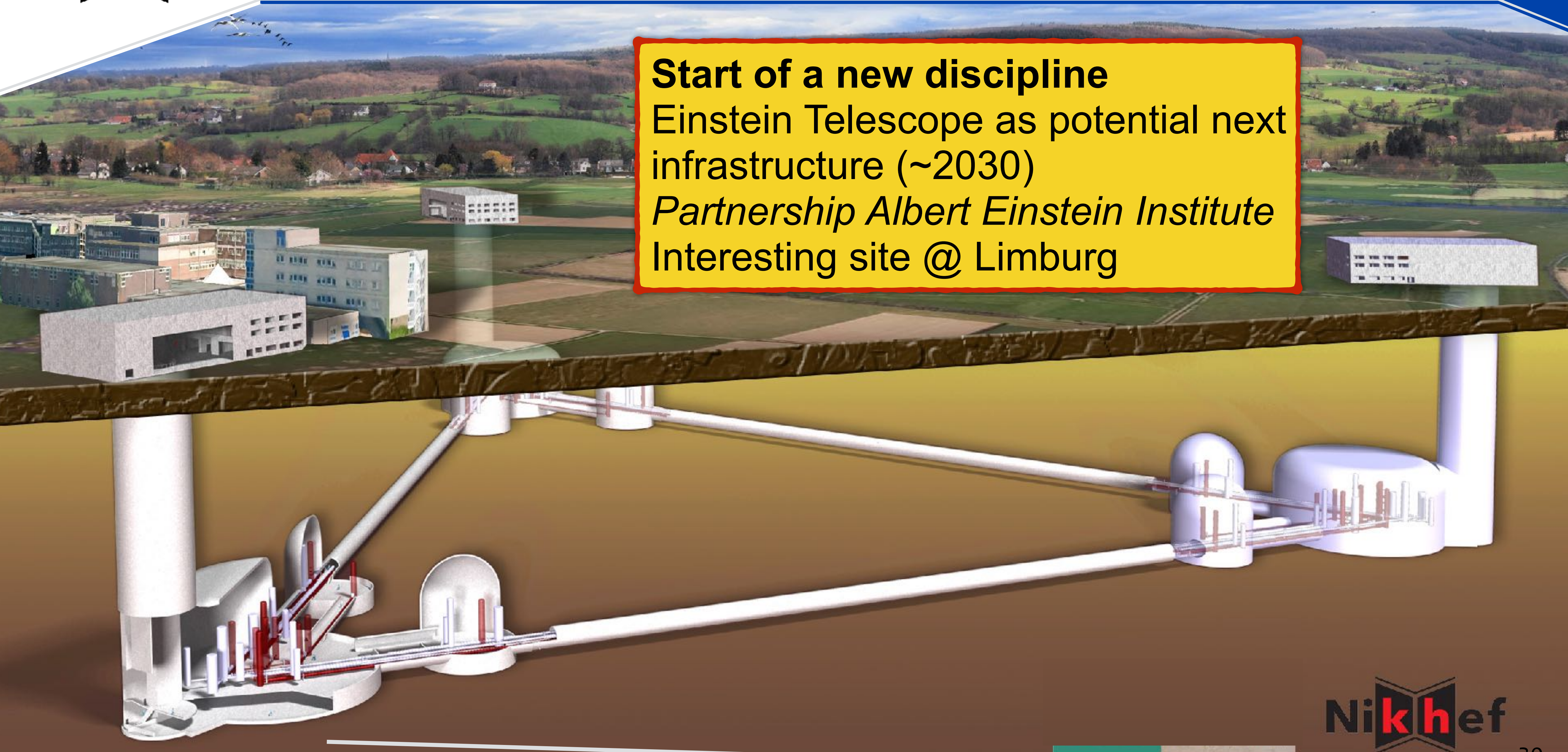


Start of a new discipline

Einstein Telescope as potential next infrastructure (~2030)

Partnership Albert Einstein Institute

Interesting site @ Limburg



*Strategy discussion **Vista25** (January - May 2017)*

- **Purpose**

- Optimization Nikhef activities -
- Input Institute evaluation 2017
- European Strategy Particle Physics update (2018-2020)

- **Goals**

- LHC: balance experiments ATLAS, LHCb, ALICE @HL-LHC
- Make KM3NeT2.0 a success
- Scenario's eg Einstein Telescope @Netherlands
- Prepare new programs: DUNE, e+e- physics, FCC
- Utilize thematic connections: Dark Matter, Neutrino, ...