Report on the DUNE ND Workshop at DESY.

DUNE Monthly CM Call

Eldwan Brianne
DESY, 8th November 2019

DEEP UNDERGROUND NEUTRINO EXPERIMENT

HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Max-Planck-Institut für Physik (Werner-Heisenberg-Institut)

The DUNE Near detector Workshop.

~2 weeks ago

- Open workshop concentrated on the DUNE ND sub-detectors, particularly MPD, Magnet.
- Various topics covered
  - Physics
  - HPgTPC
  - The MPD magnet system
  - MPD ECal
  - Integration in the ND Hall
  - Software

The DUNE Near detector Workshop.

Specifics

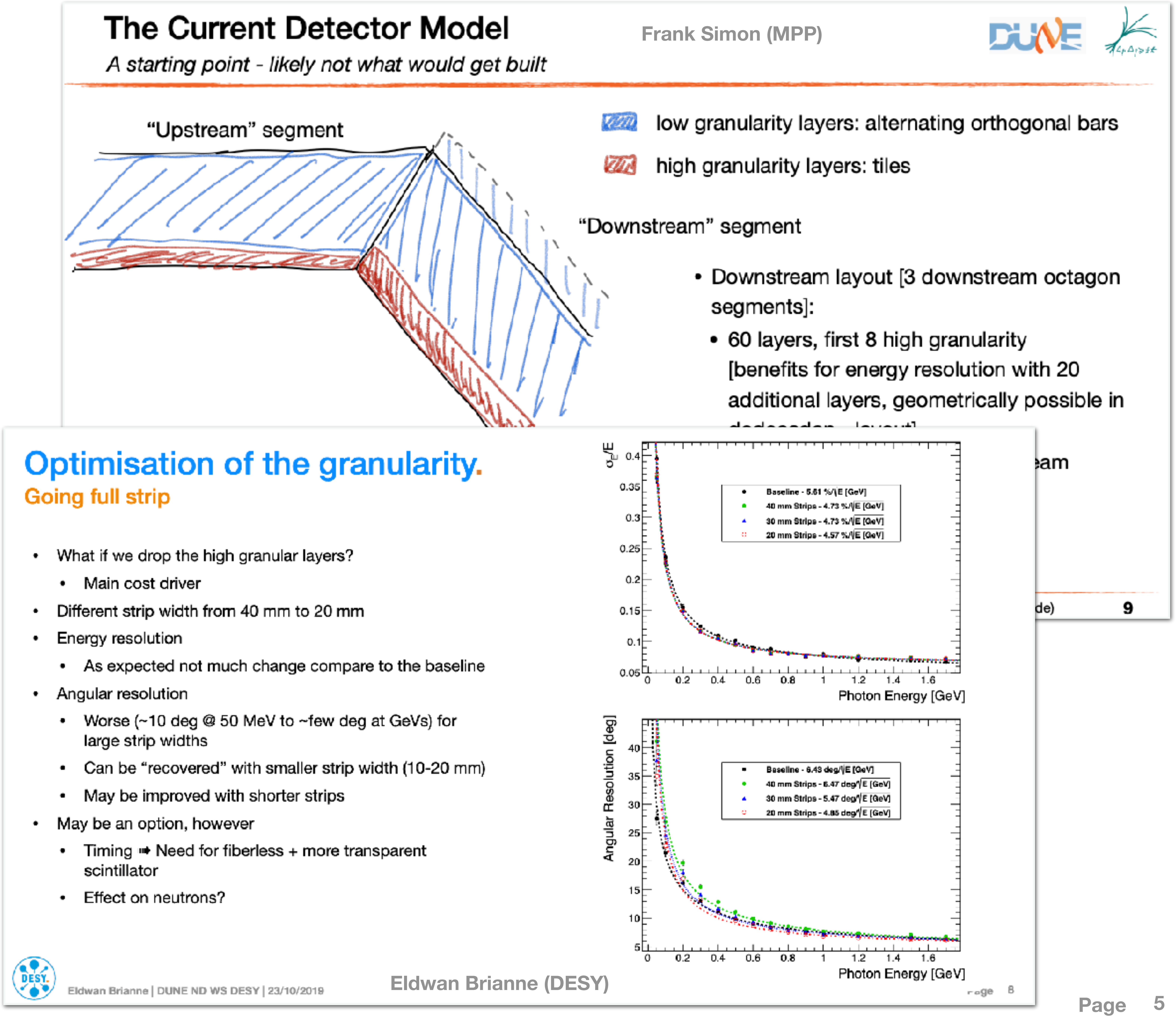
- Was held for the first time in Germany at DESY
- ~3.5 days of meetings (quite full agenda - 41 talks)
  - Pre-meeting on Sunday and Monday morning
  - Overview of the ND sub-detectors
  - ECAL/HPgTPC
  - Software/Muon system
  - Magnet/Integration
- Participation ~60 people
  - Much more than what was expected!
- Large participation from
  - US, UK, Italy, Germany, France and Switzerland
- Great opportunity for discussions on the potential German contribution to the DUNE ND
- Agenda: https://indico.fnal.gov/event/21340/other-view?view=standard

Some highlights.

ECAL Highlights.

Concept and simulation

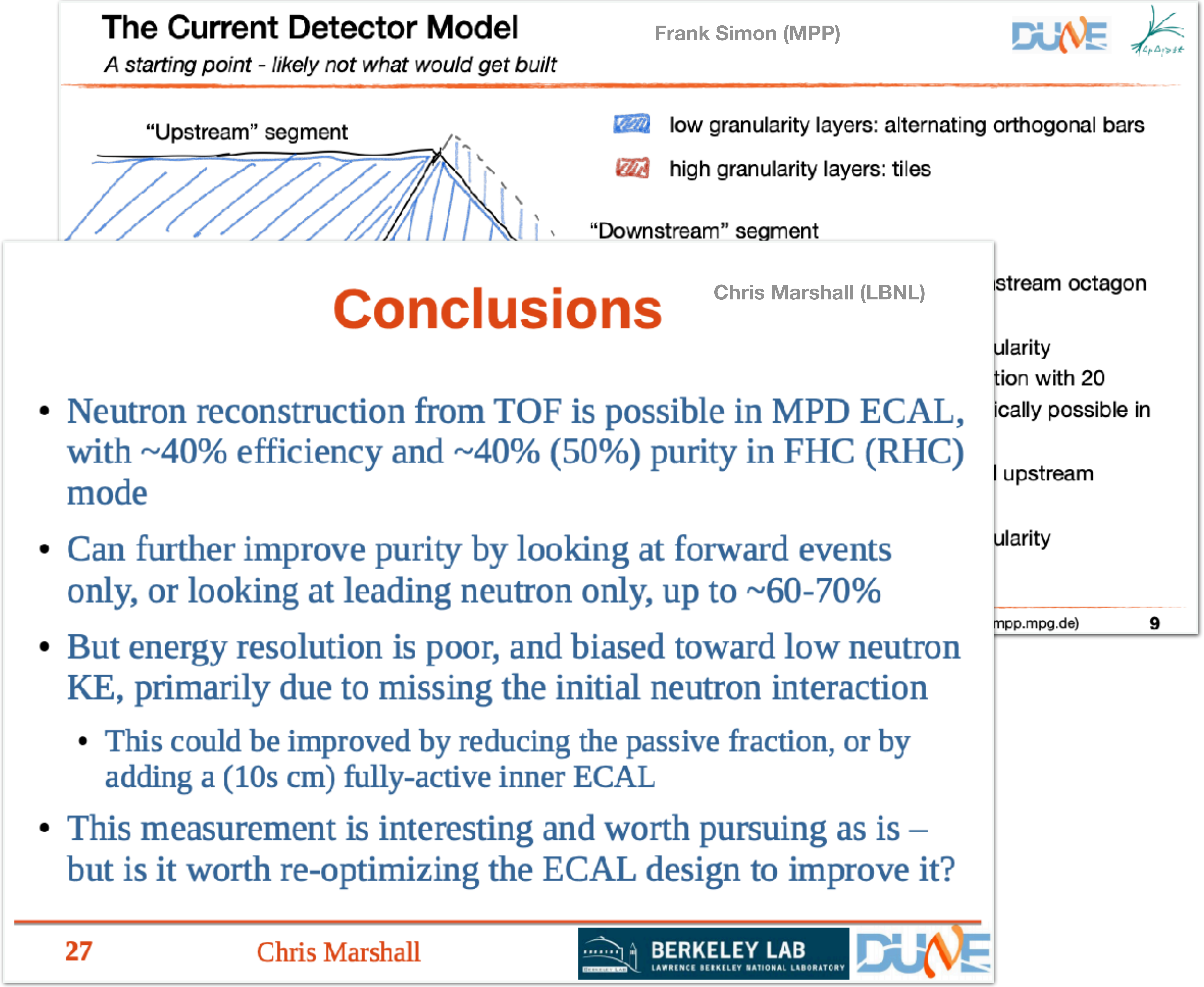
- The DUNE ND ECAL Concept is evolving fast to the needs of the ND
    - Simulation are ongoing to optimise the detector performance and cost



ECAL Highlights.

Neutrons!

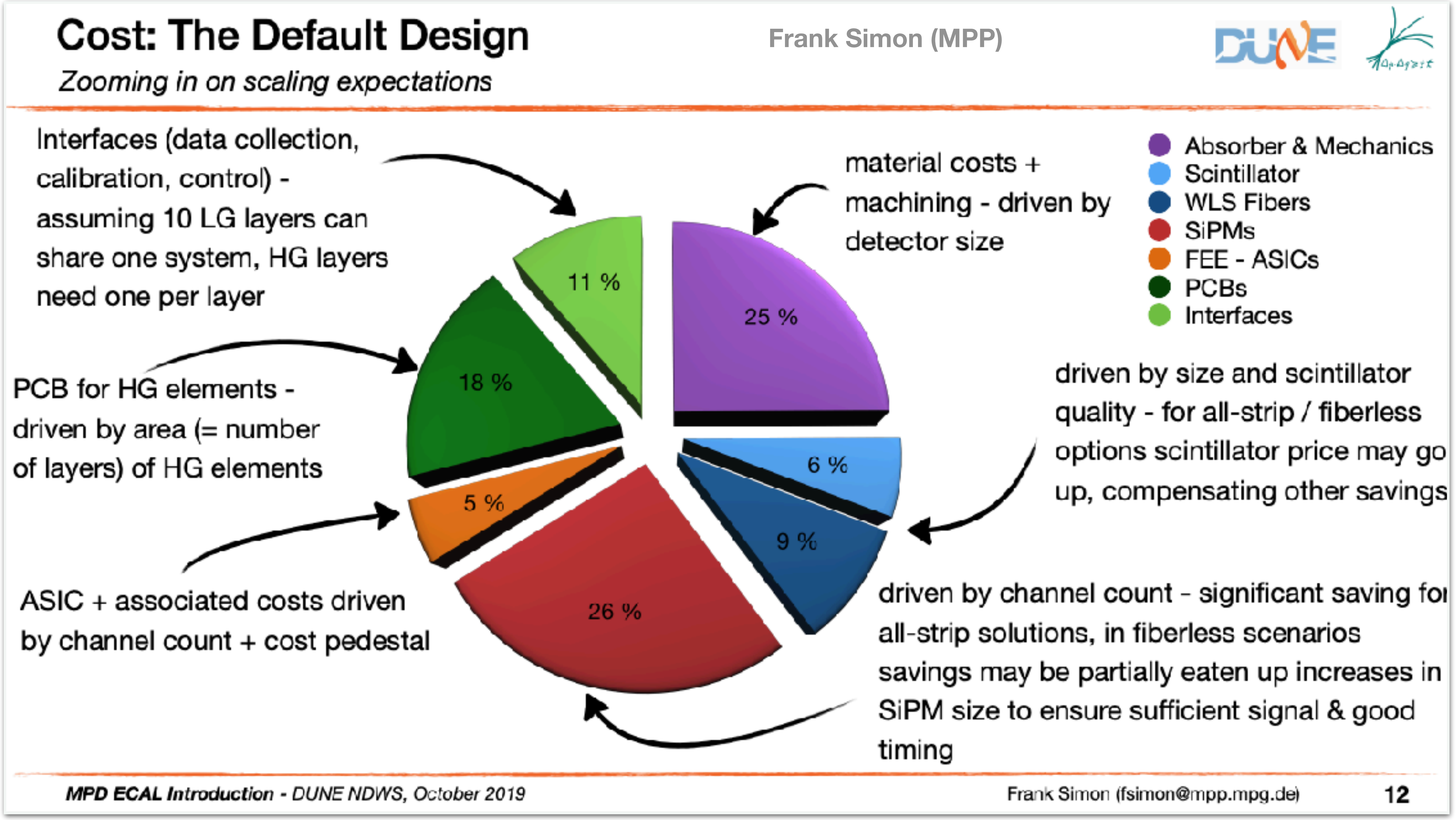
- The DUNE ND ECAL Concept is evolving fast to the needs of the ND
  - Simulation are ongoing to optimise the detector performance and cost
- With the current concept, the ECAL does well at neutron detection and energy reconstruction (optimisation should take it into account)



ECAL Highlights.

Cost modelling

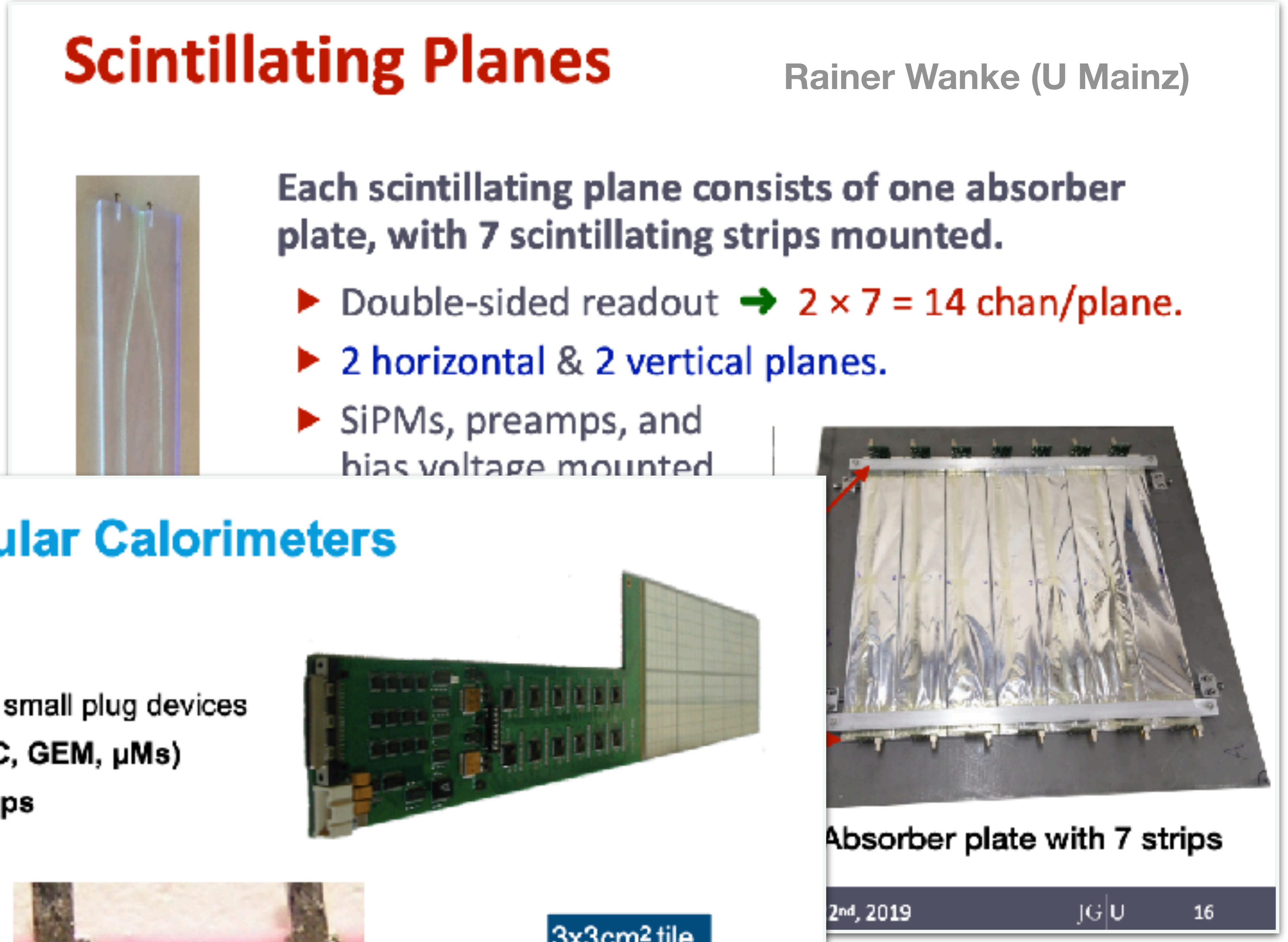
- The DUNE ND ECAL Concept is evolving fast to the needs of the ND
    - Simulation are ongoing to optimise the detector performance and cost
- With the current concept, the ECAL does well at neutron detection and energy reconstruction (optimisation should take it into account)
- A cost model is well established and understood where the main cost drivers are

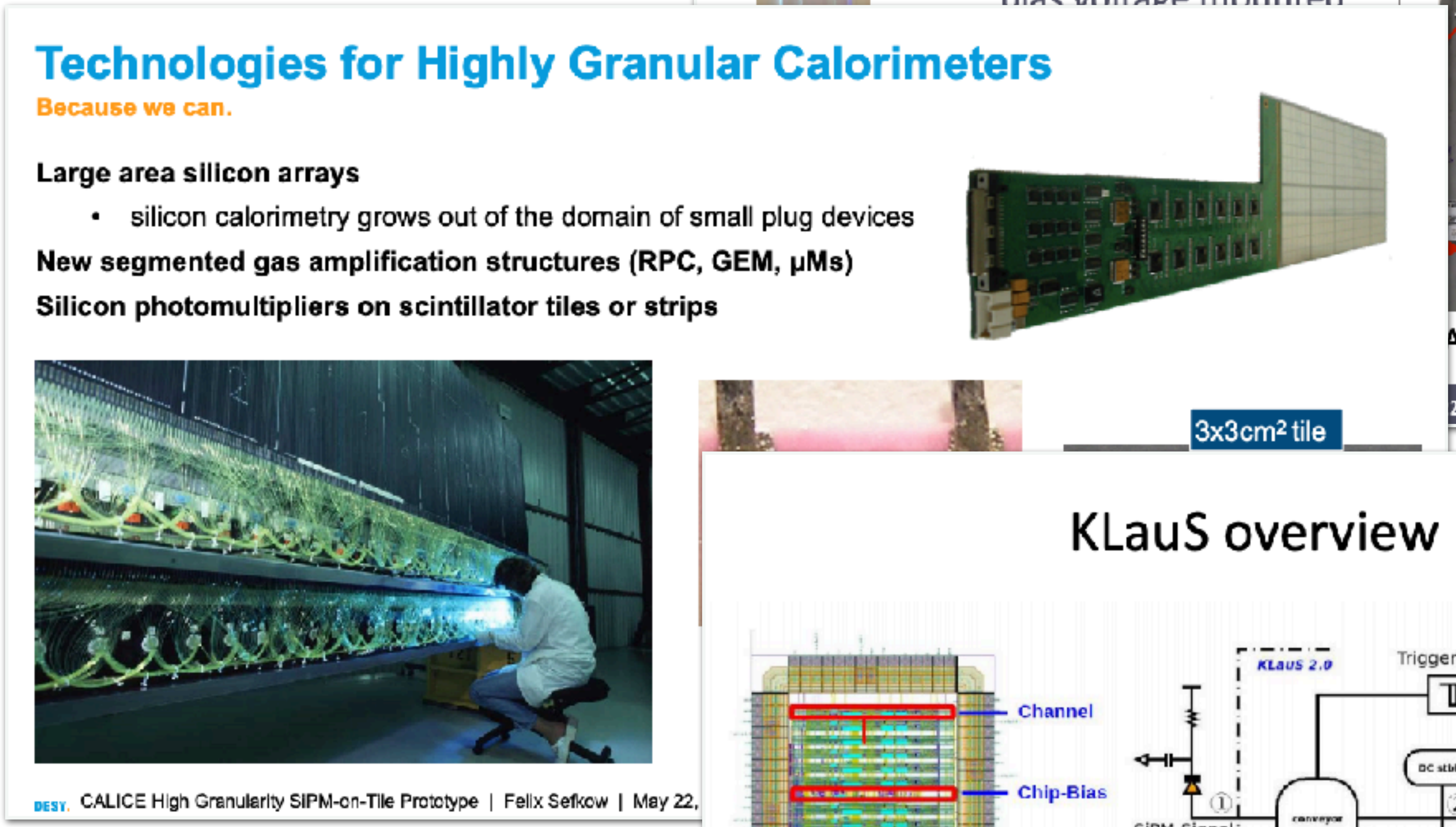


ECAL Highlights.

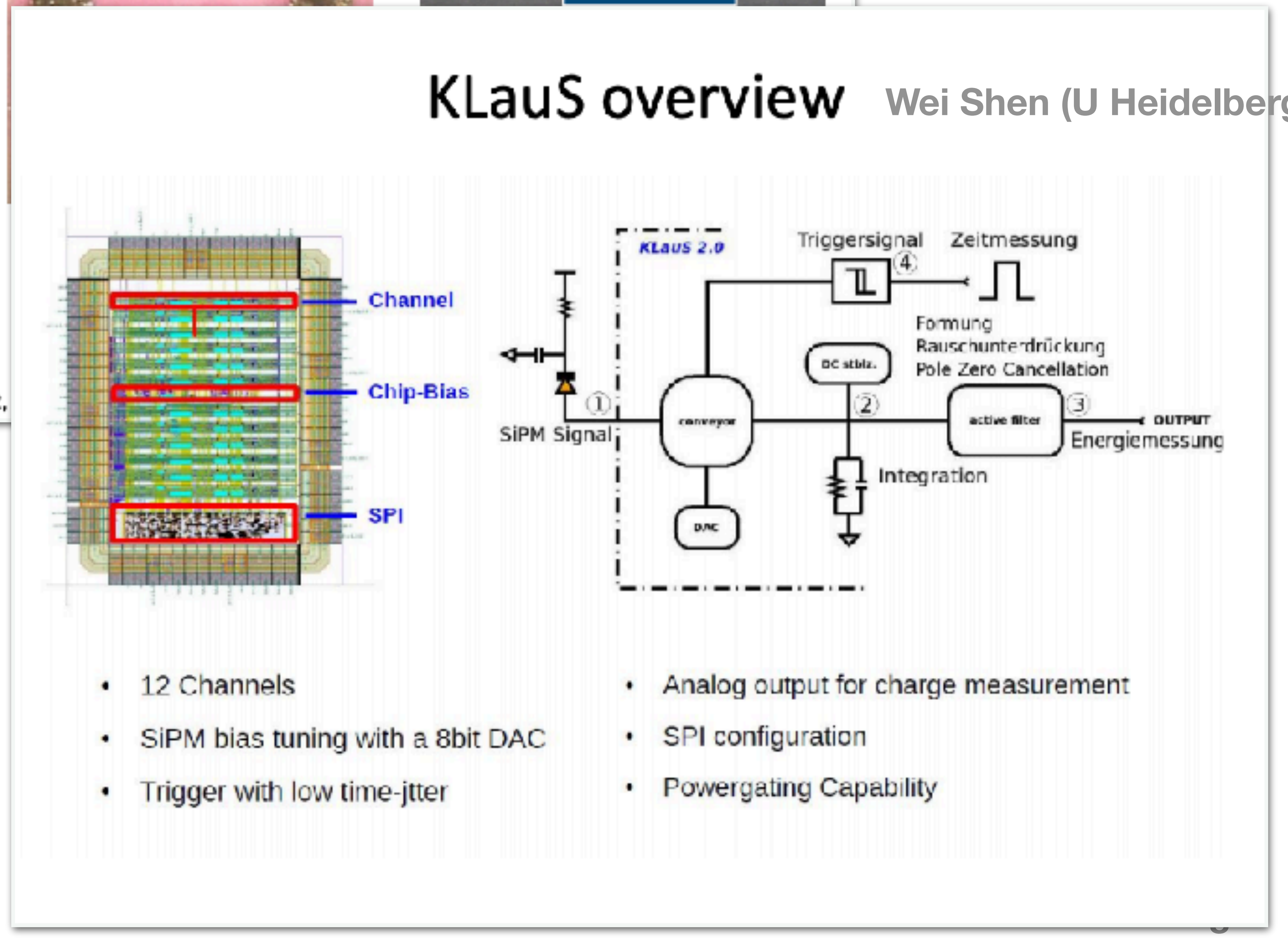
Expertise from Germany

- The DUNE ND ECAL Concept is evolving fast to the needs of the ND
  - Simulation are ongoing to optimise the detector performance and cost
- With the current concept, the ECAL does well at neutron detection and energy reconstruction (optimisation should take it into account)
- A cost model is well established and understood where the main cost drivers are
- Can benefit from the expertise of several German groups
  - DESY (AHCAL/CMS), Mainz (Ship), ASIC design (Heidelberg)



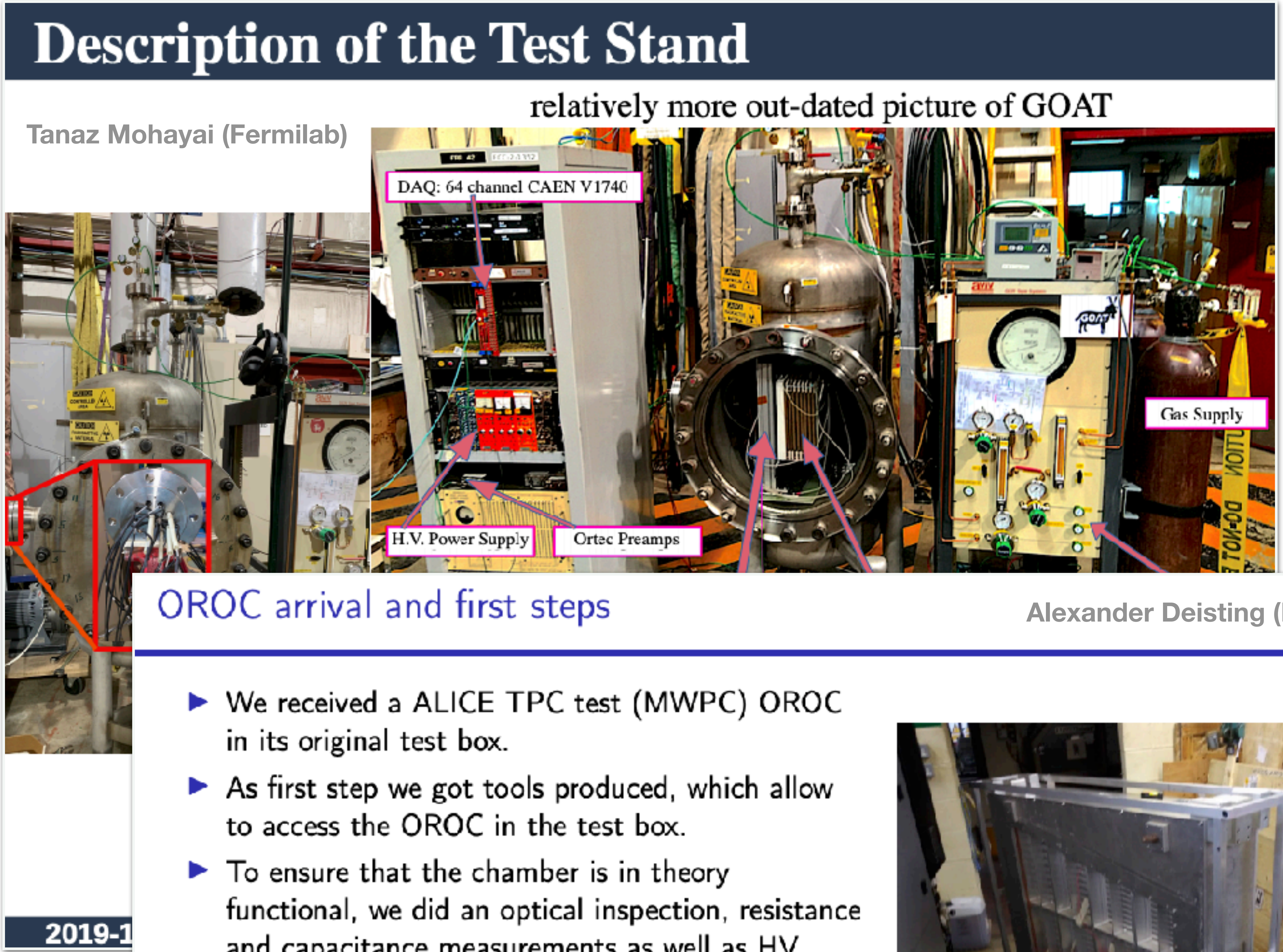


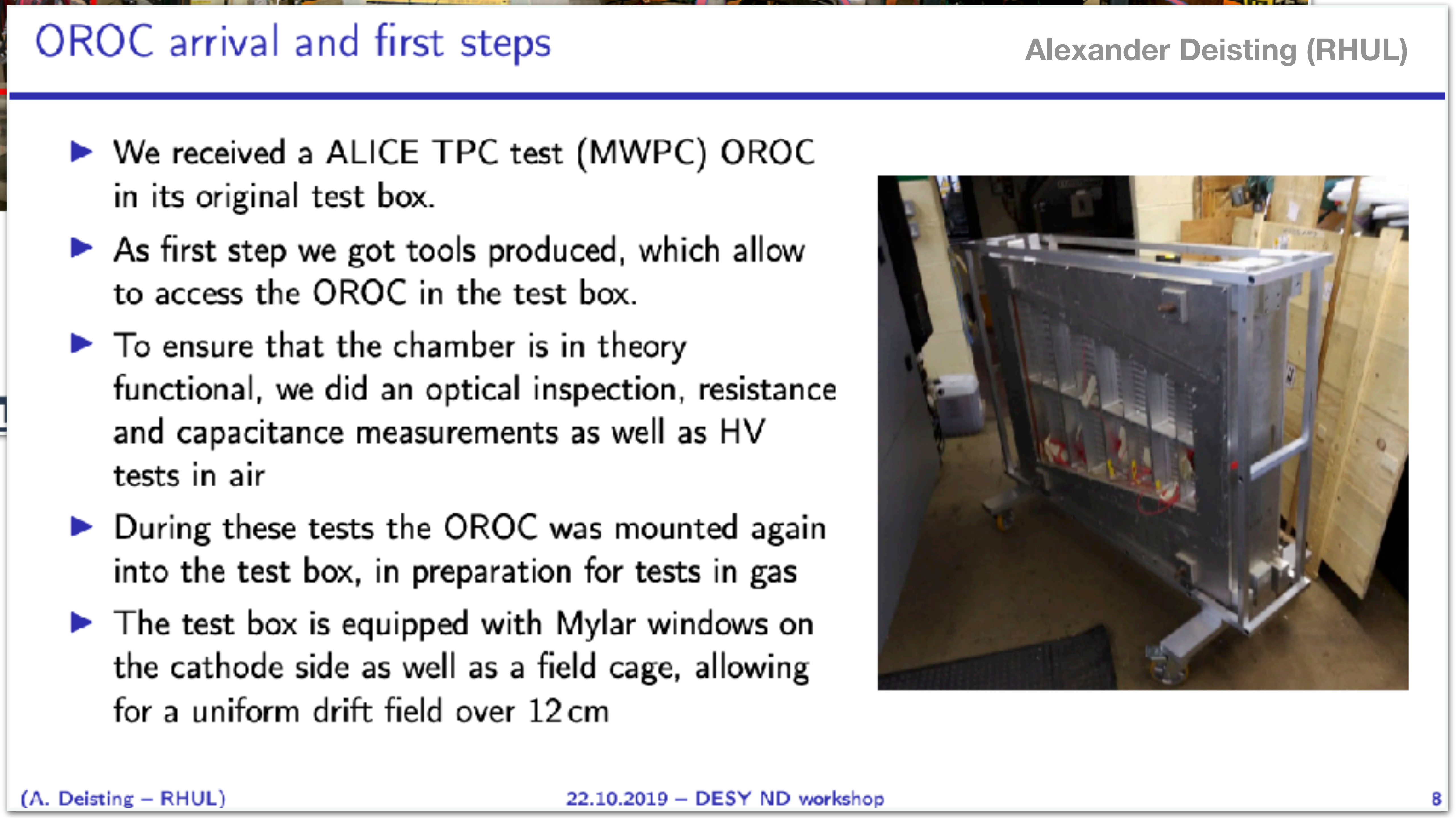
Felix Sefkow (DESY)



TPC Highlights.
Test stands

- The design of the TPC is going forward
- Testing of ALICE chambers is ongoing at different voltages and pressures at Fermilab and RHUL/ICL
- Great ideas are coming for T0 fluorescence tagging

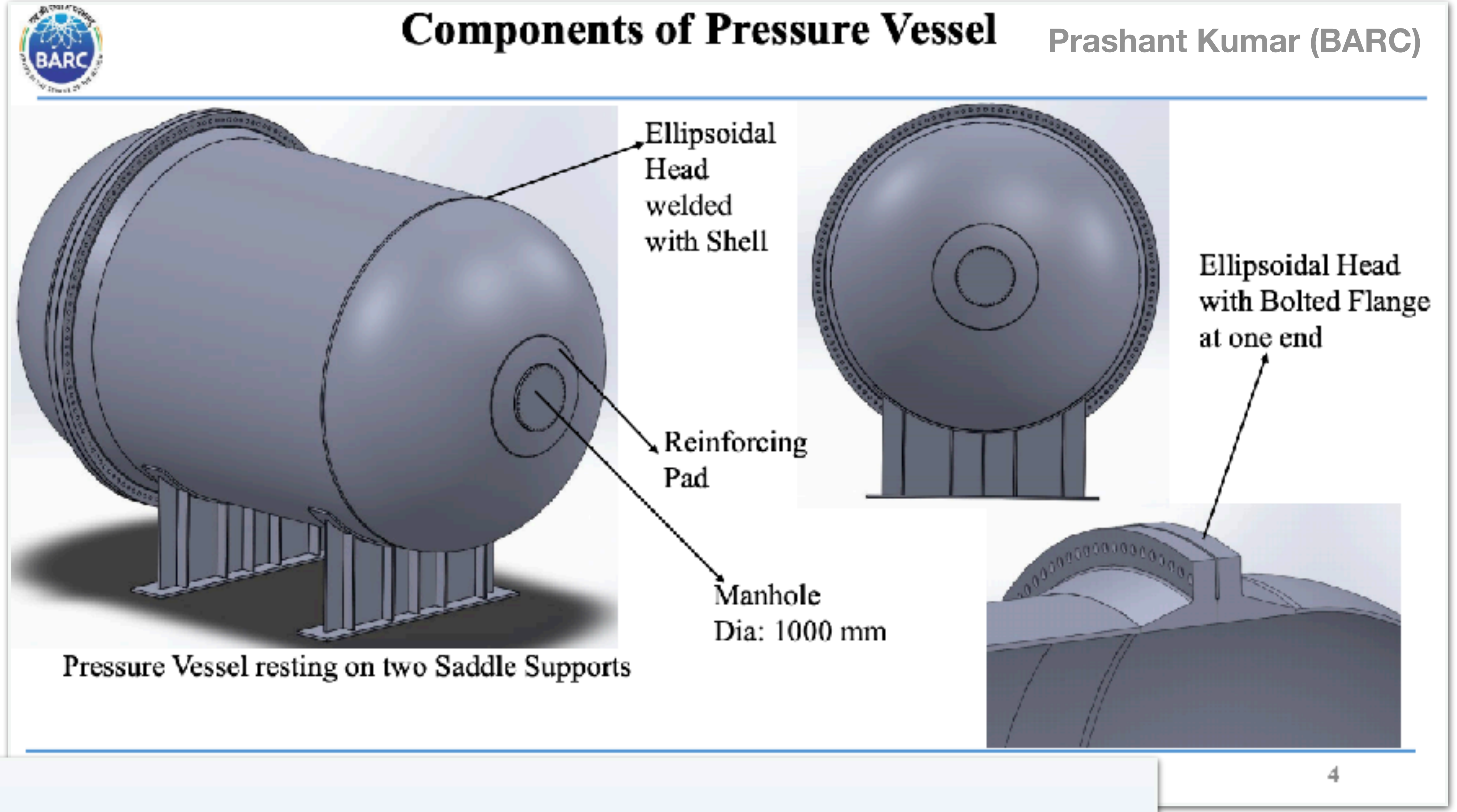


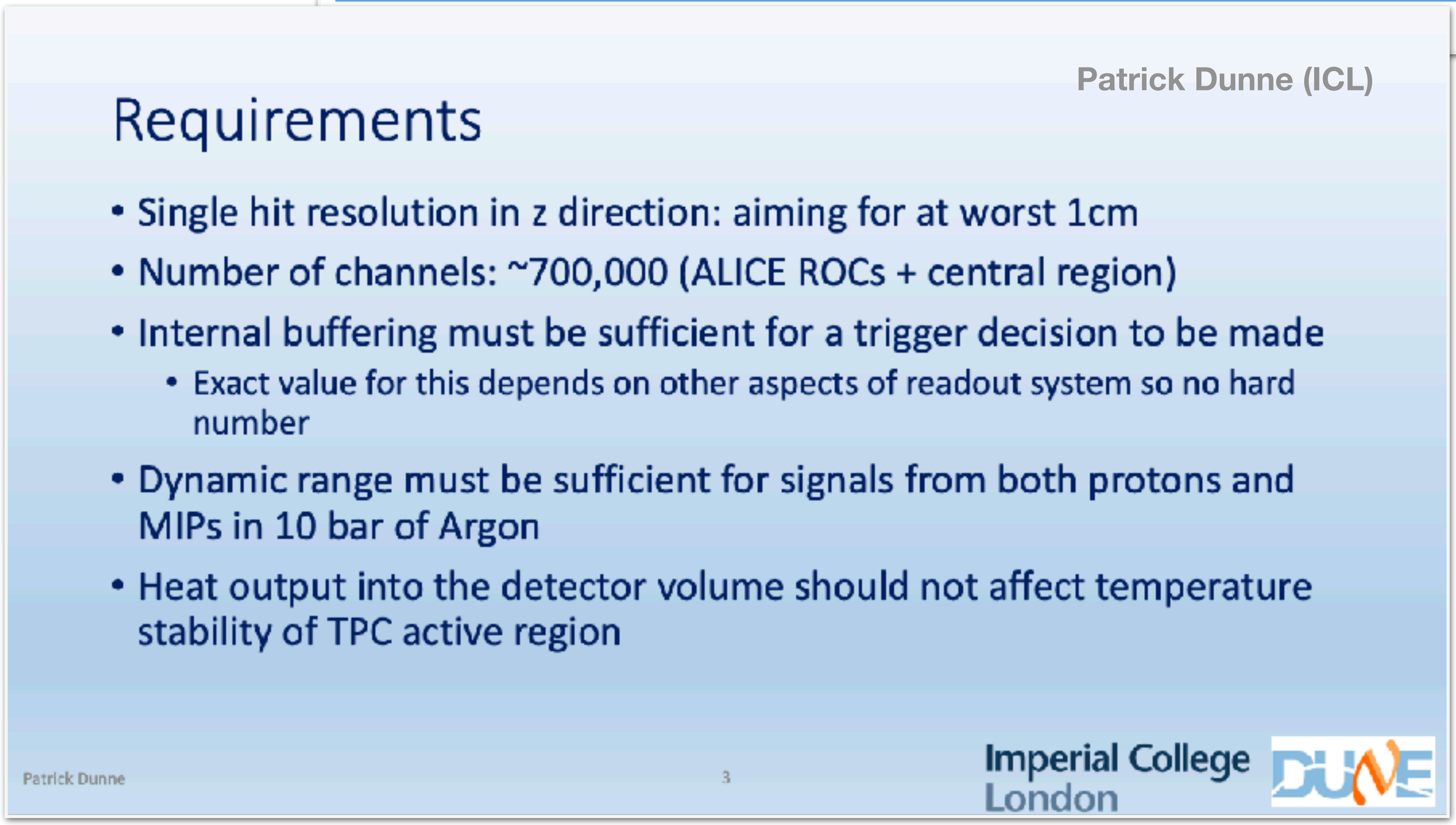


TPC Highlights.

PV and Readout

- The design of the TPC is going forward
- Testing of ALICE chambers is ongoing at different voltages and pressures at Fermilab and RHUL/ICL
- Great ideas are coming for T0 fluorescence tagging
- The design of the pressure vessel is well advanced! Minimum material between TPC and ECAL + would be able to support 300t mass ECAL
- The central region has few preliminary designs ➠ more work is needed in this area
- A conceptual design for the TPC readout is ongoing ➠ occupancy will drive the system requirements

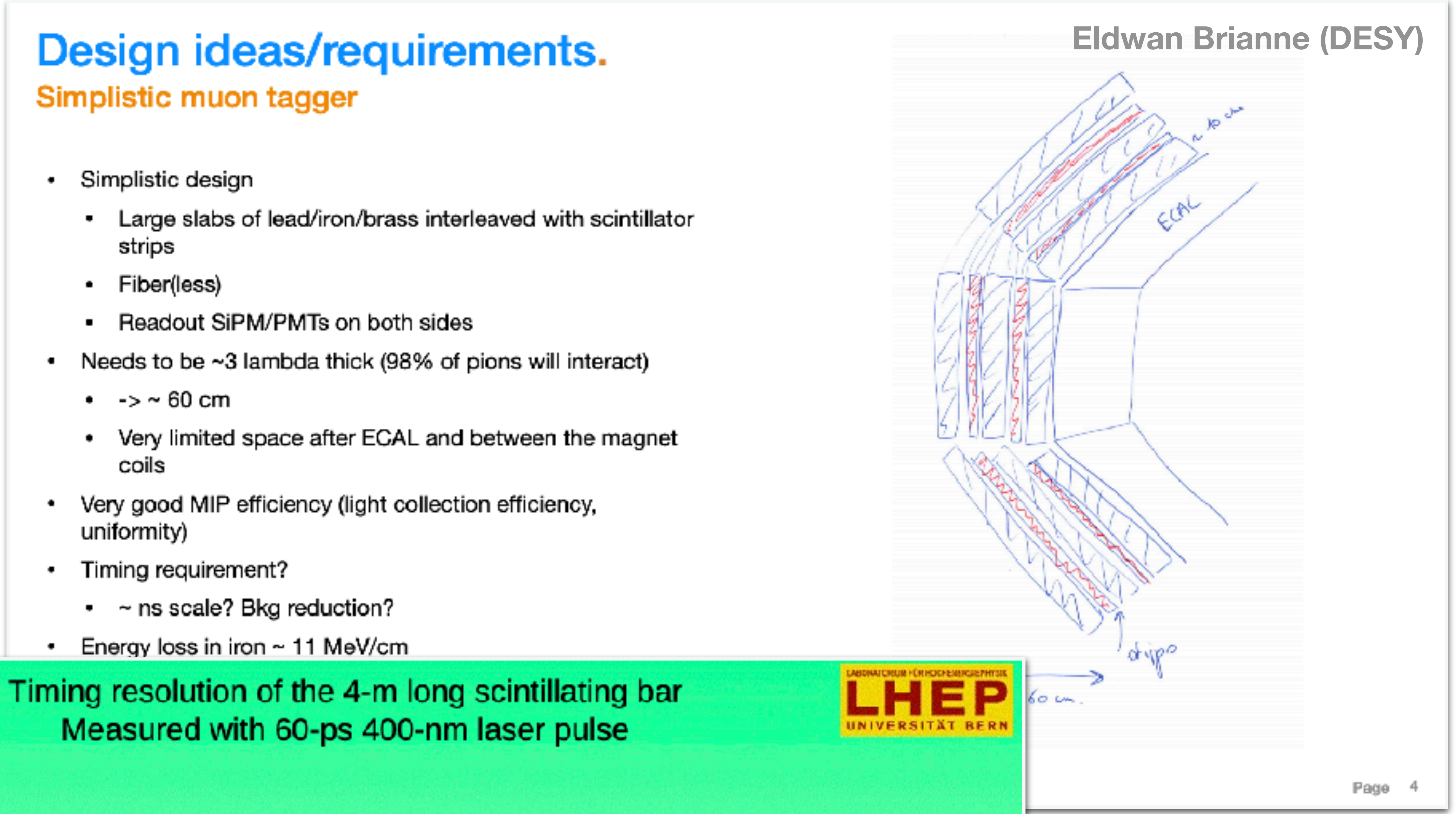


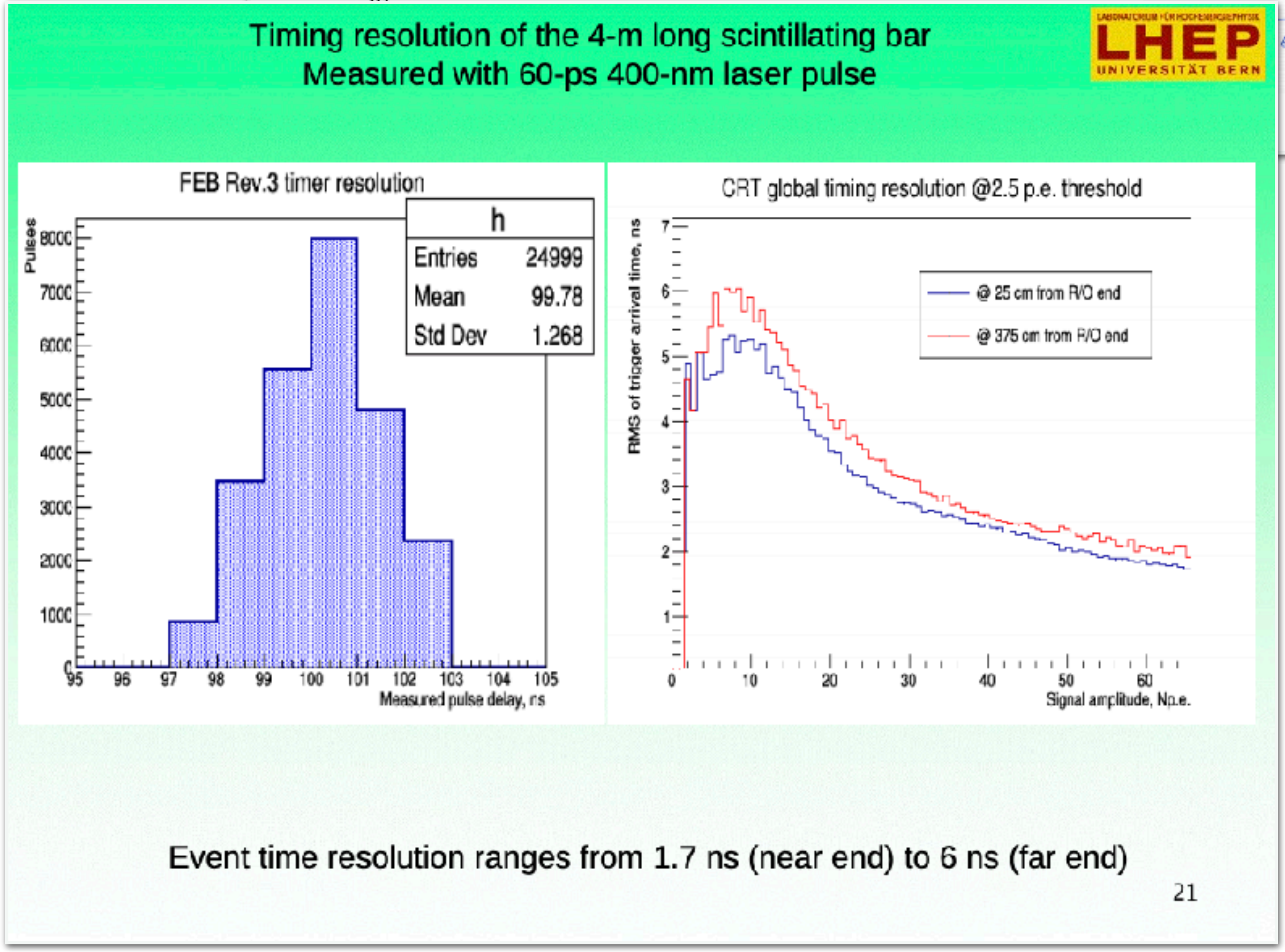


Muon System Highlights.

Conceptual design/ideas

- A muon system is critically needed for the MPD
  - Needs to separate pions/muons (no need to measure the momentum)
- Few thoughts are being put into it
  - Integration after the ECAL between the MPD coils
  - Relatively similar to ECAL design with thick absorbers and strips, could use other technologies
- Design correlated to the magnet design
  - Could be integrated in a Yoke (see later slides)
- Need for simulation studies
  - Acceptance
  - Integration





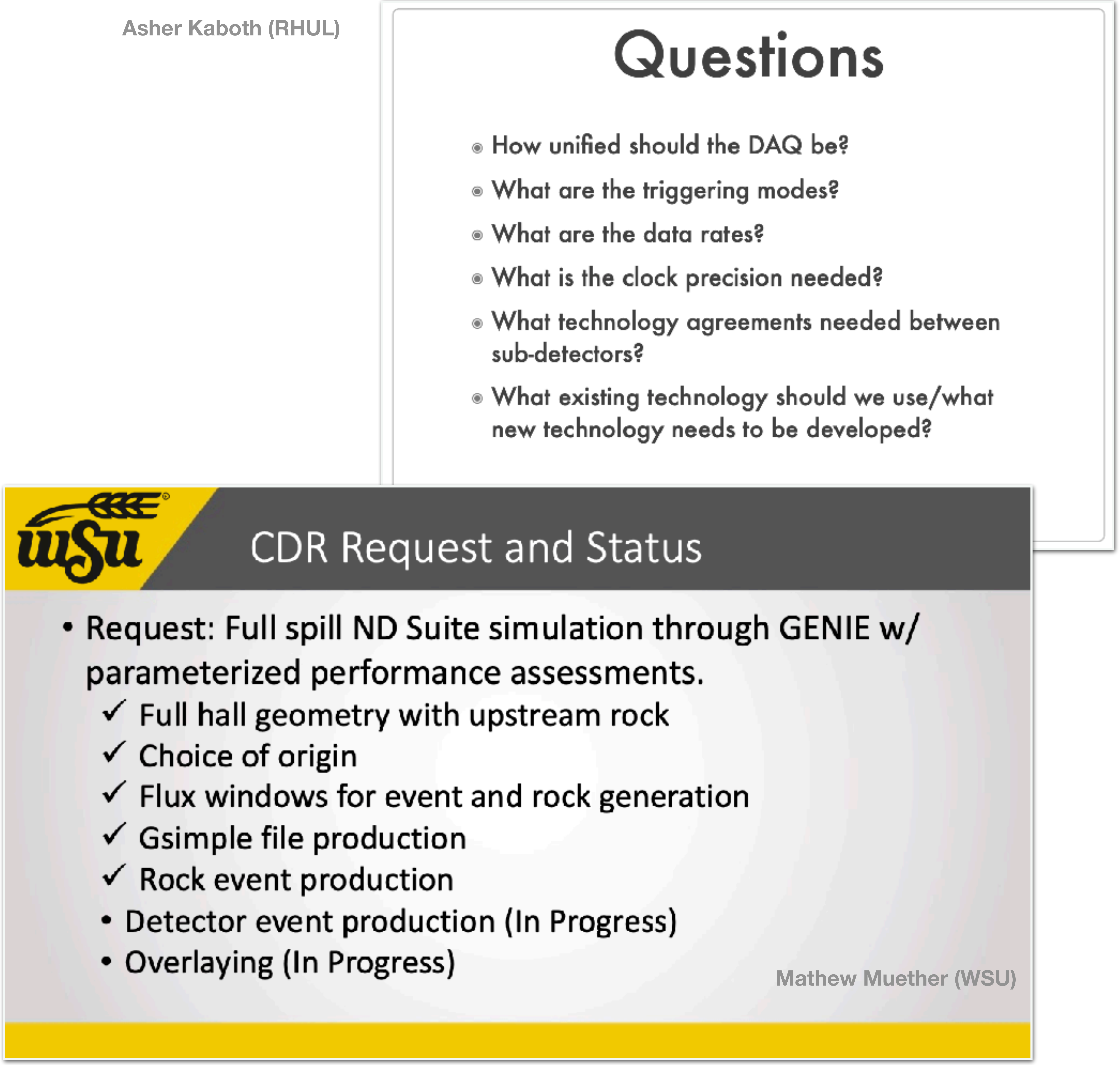
Igor Kreslo (LHEP)

Software Highlights.

DAQ/Delivery for the CDR

- First discussions on what the ND DAQ should look like
    - Trigger modes, rate, clock precision…
    - Working group is being put in place to provide an initial plan by the January CM
- Software integration group has been working hard to bring the sub-detectors together
    - Full ND suite almost there
- Rock samples have been produced
- Per-detector samples have been produced
- Overlaying in progress
    - ➠ to be used for low-level analysis for the CDR / TDR
- Looking forward
    - Use of different generators, reconstruction framework

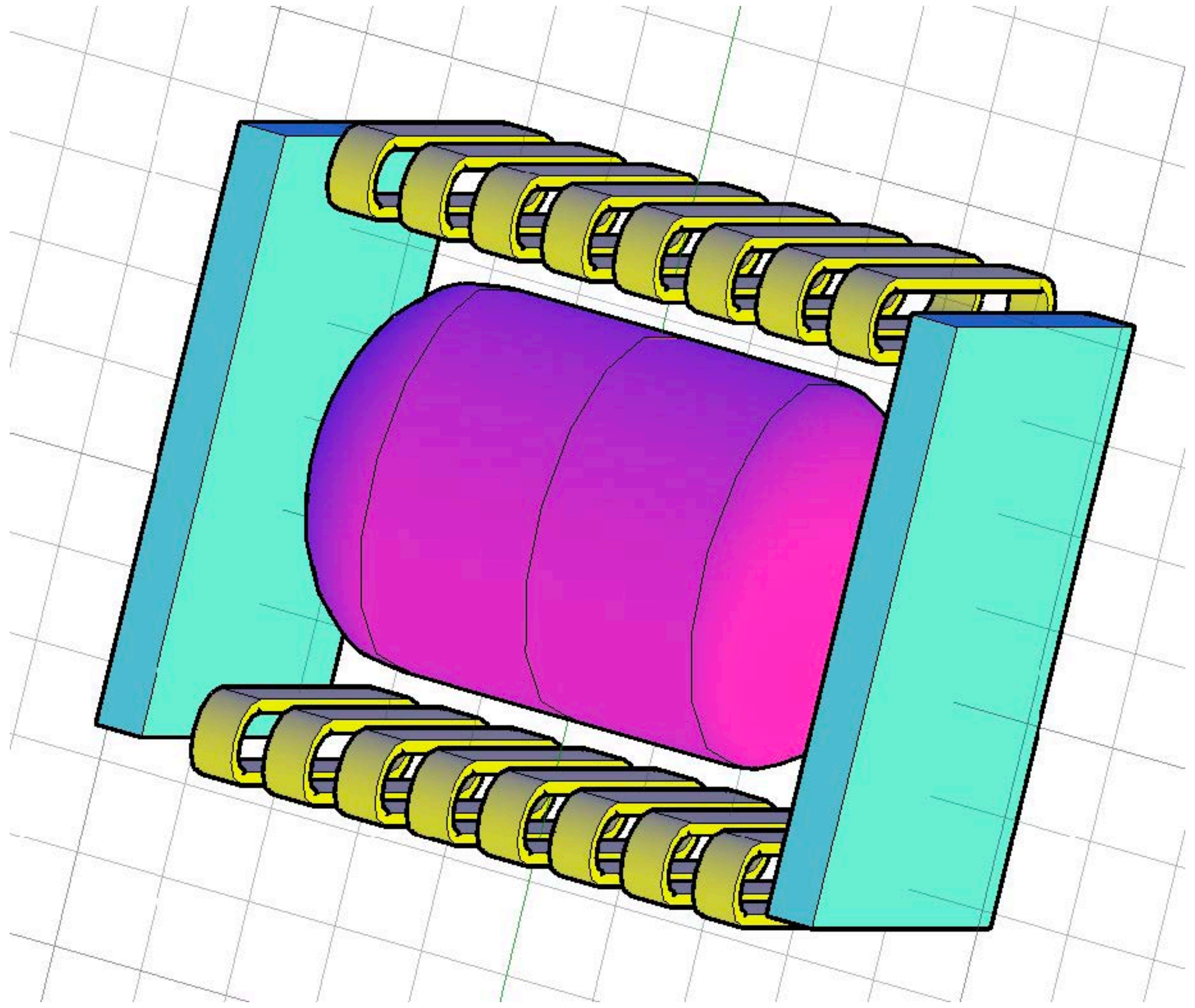
Asher Kaboth (RHUL)



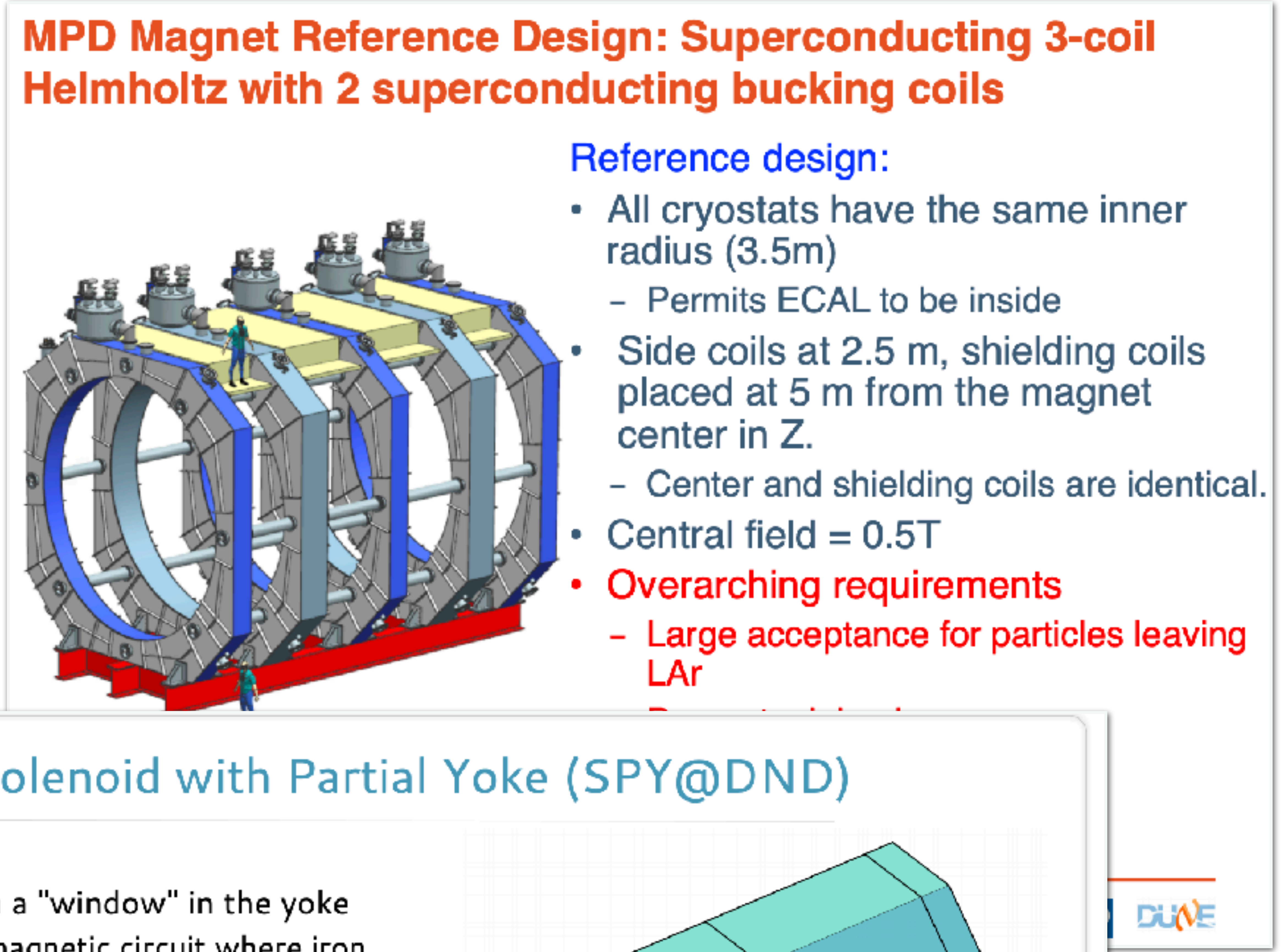
Magnet Highlights.

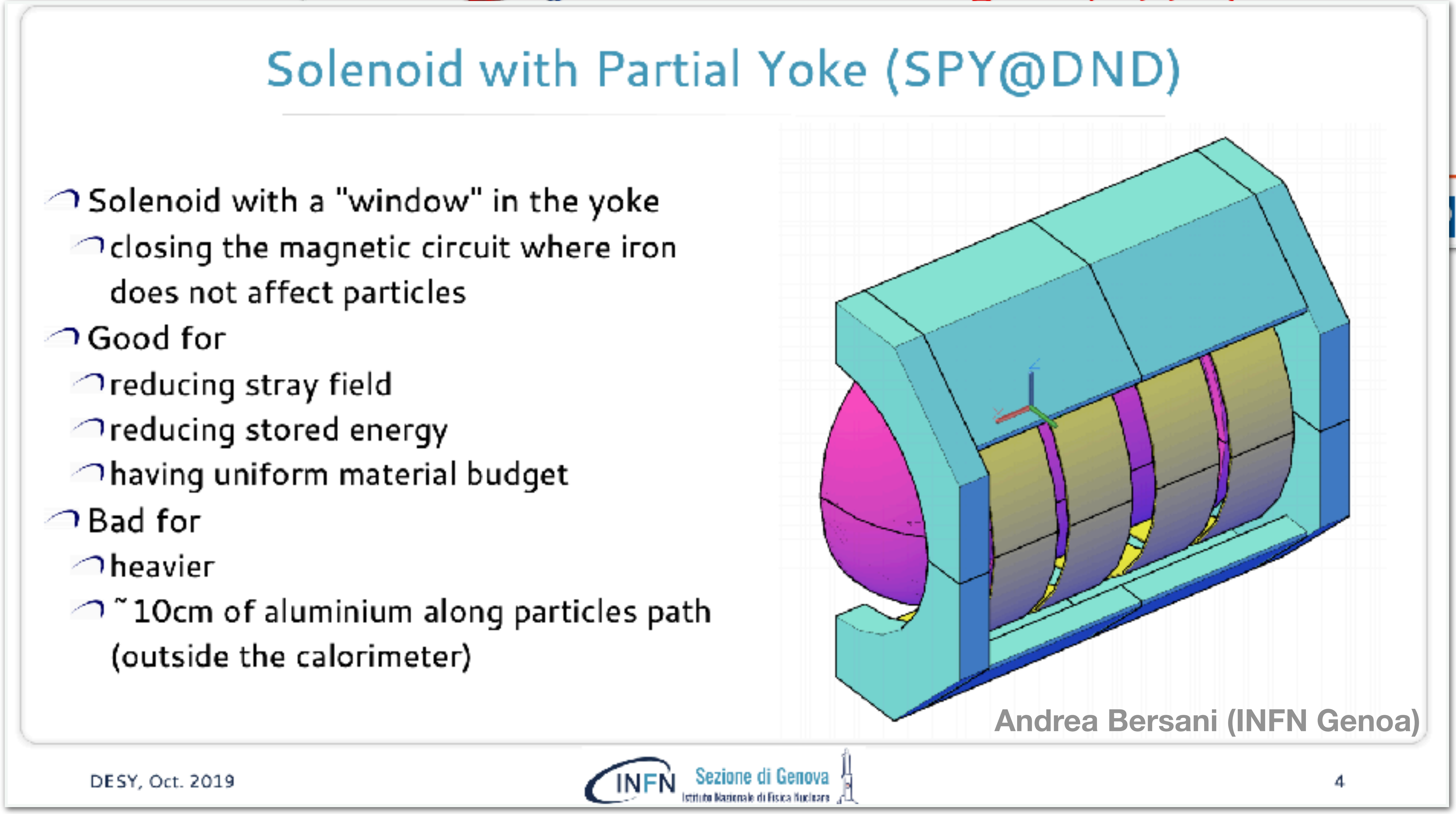
Getting very mature

- A reference design for the MPD magnet is well defined (5 Helmholtz coils)
  - Alternatively, 3 or 2 with PRY coils design are being discussed
- An alternative design appears promising
  - Solenoid with partial return yoke studied in Genoa
- Double dipole concept (with racetrack coils) is dropped



Alan Bross (Fermilab)





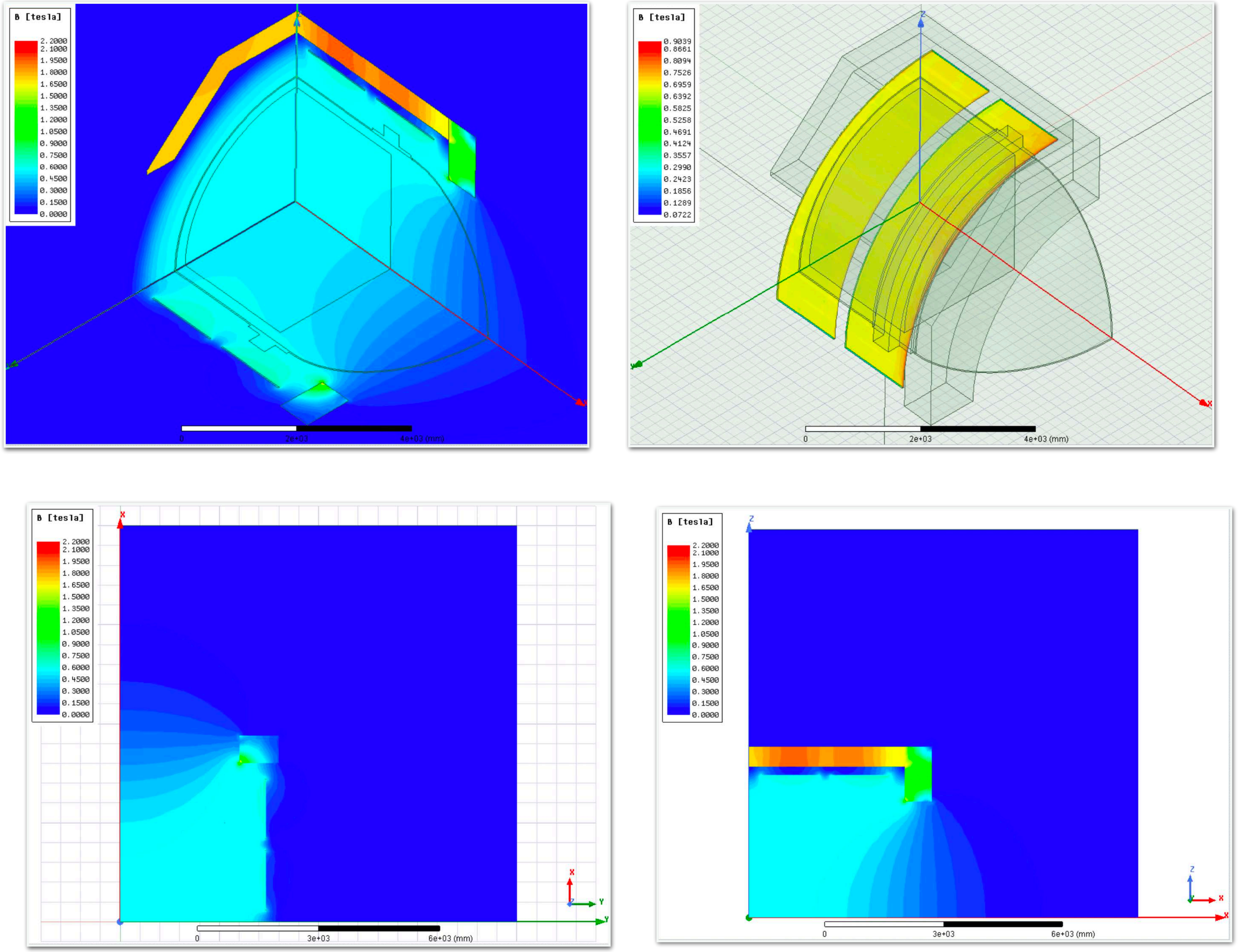
Andrea Bersani (INFN Genoa)

Magnet Highlights.

Getting very mature

- Need to define clear criterium to judge the designs against
  - Impact of field non-uniformity
  - Material distribution/mass
  - Stored energy/stray field
  - cost
- Moving forward
  - Need detailed PRY design
    - Support structure
    - Moving platform
    - Services
  - Try to also utilise the same PRY design for the SPY and 2 coils option

SPY design: preliminary studies (yoke field, coil field, stray field…)

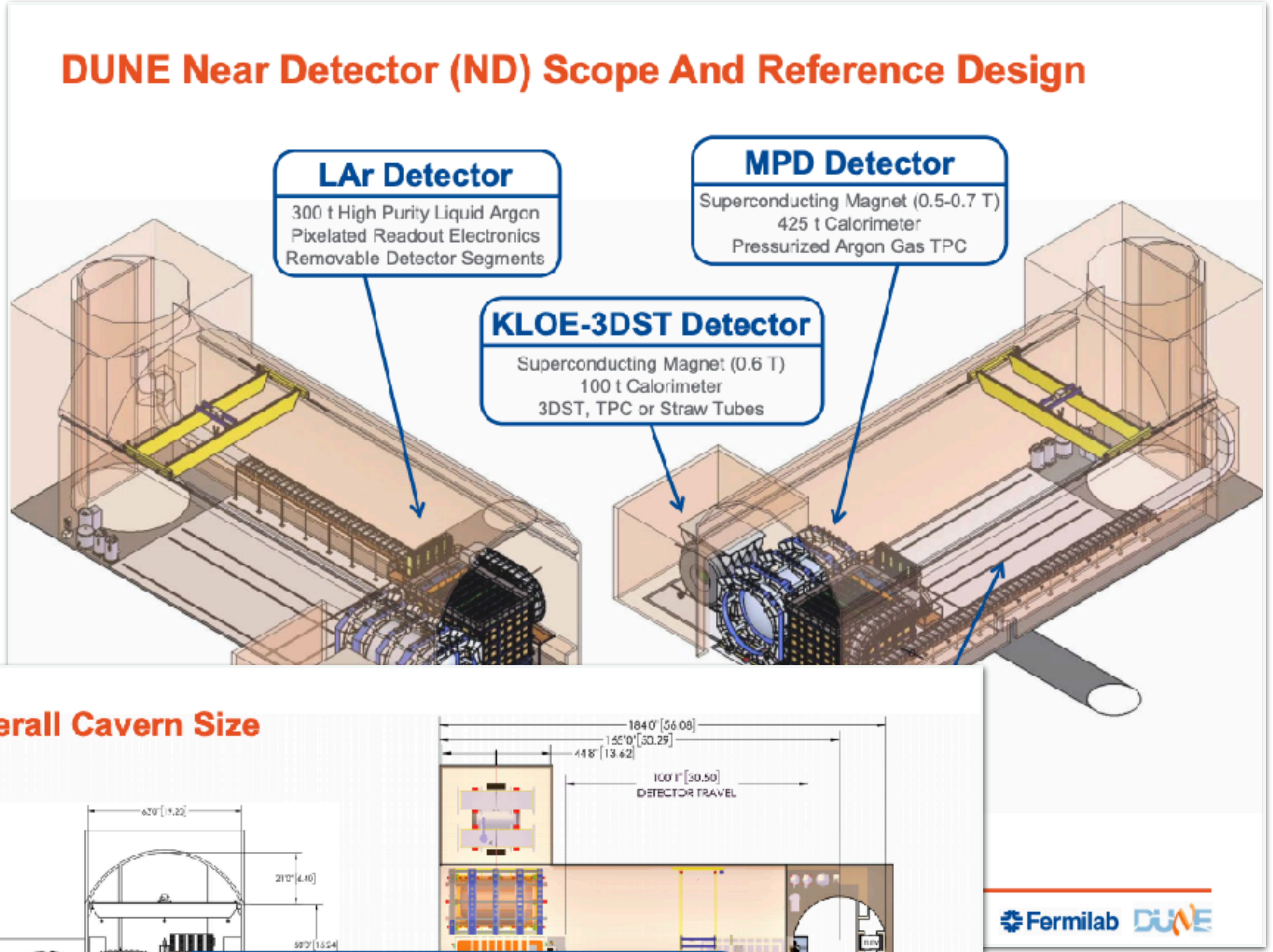


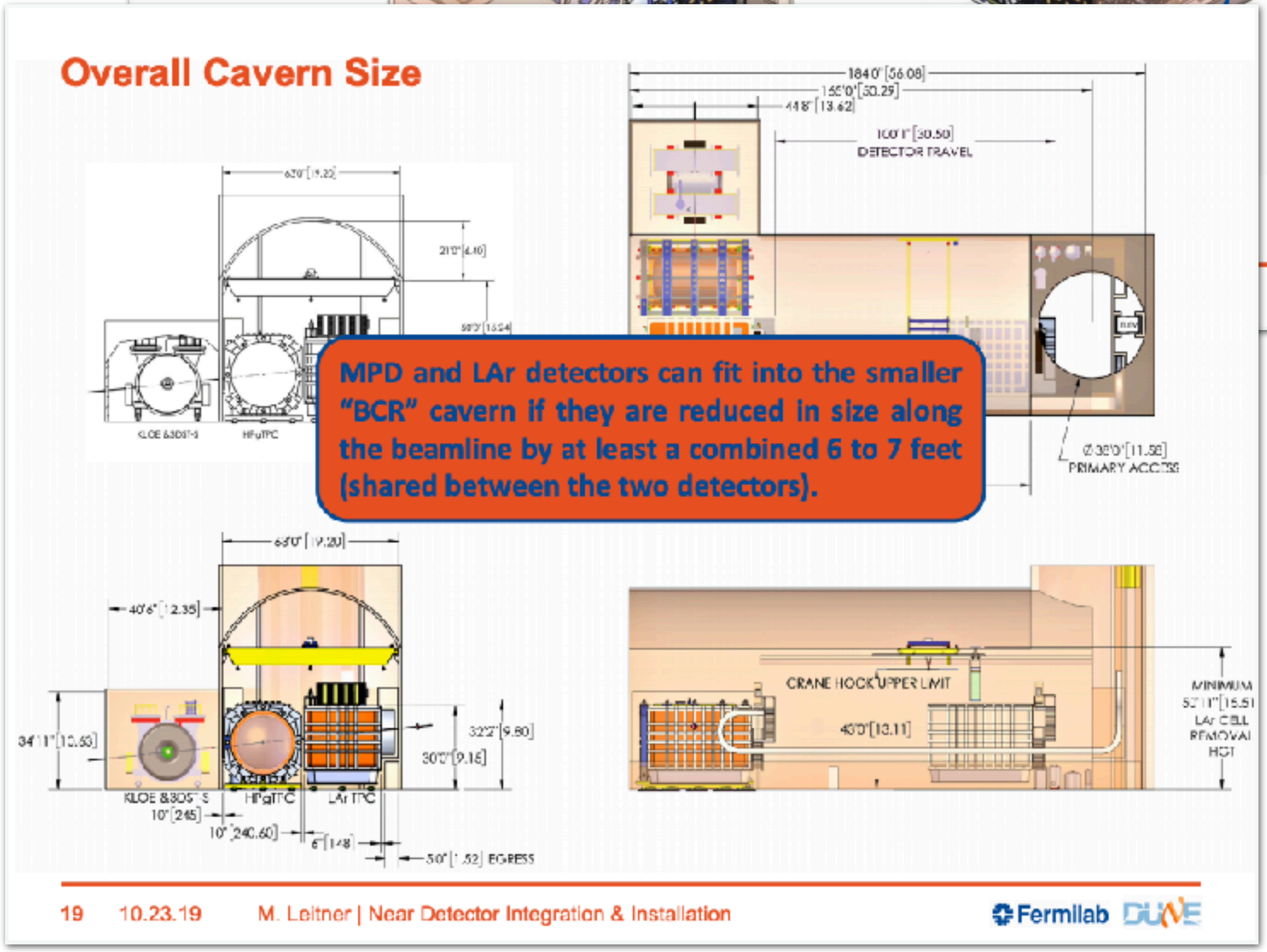
ND Complex Highlights.

Hall size and integration

Matthaeus Leitner
(LBNL)

- The size of the detector hall drives the size of the ND sub-detectors
- Fully integrated design of all ND sub-detectors into the hall
- Load requirements
  - Defined by the heaviest piece: ~50t (KLOE Magnet)
- Overall cavern size
  - 63’ in width, 50’ in height and 184’ in length
- Rock quality not optimal at the site… impact on the structural design of the cavern
  - need effort to reduce cavern height/width
  - MPD + LAr ideally should be reduced in size along the beam by around 6/7’ (shared between)
    - Need to evaluate the impact on the physics, MPD design, LAr design, cost… within months





Conclusions.

A wonderful workshop

- The DUNE ND concept has significantly matured in all areas in the last few months
- A lot of interesting talks and following discussions!
- We need to keep the steam going for the following months (CDR) / year (TDR)
- Overall, very successful workshop!

Backup Slides.