

Detector R&D

Make things happen



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Nikhef

Goal of workshop

The workshop "Instrumentation at Nikhef - focus and challenges" is dedicated to instrumentation at Nikhef. With instrumentation we mean everything that is needed to construct a detector part and be able to use it.

We like to discuss the following topics:

- **Upgrades**, maintenance and new experiments: what technologies and competences do we need?
- **Production**: what production capacity will we need?
- **Exploitation**: what support is needed, which facilities are needed at Nikhef?
- **Efficiency**: what project planning do we need and is agile working helping us?

During the morning we invite program leaders and project leaders to give statements on the issues above – during a free session with pitches.

In the afternoon we zoom-in on the MT, CT and ET to see what are the competences we have at Nikhef, and where we want to go. These discussions are introduced by the TGL's. All staff members are invited to participate.

Goal of the workshop meeting is to have a clear picture on:

- What **competences** in MA, CT and ET do we need at Nikhef – in which priorities?
- What is the impact on the instrumentation activities at Nikhef?

DR&D program

- **Instrumentation R&D**
 - **Explore new technologies**
 - **Knowledge transfer**
- with (future) Nikhef experimental programs
 - in synergy with Nikhef engineering departments
 - with high-tech institutes, Dutch top-sector & industry

Detector R&D strategy 2017-2022:

- Smart and fast pixel detectors
- Gravitational wave detector instrumentation
- Collaborate with high-tech industry

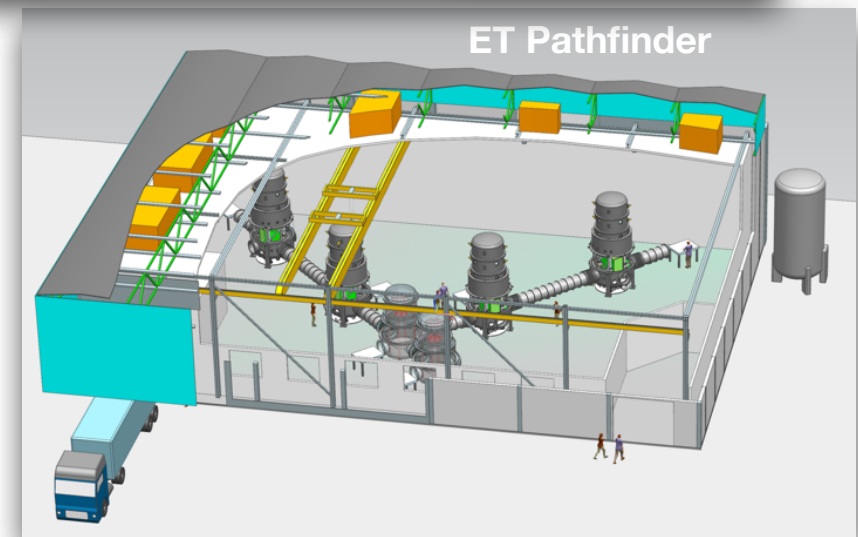


DR&D strategy

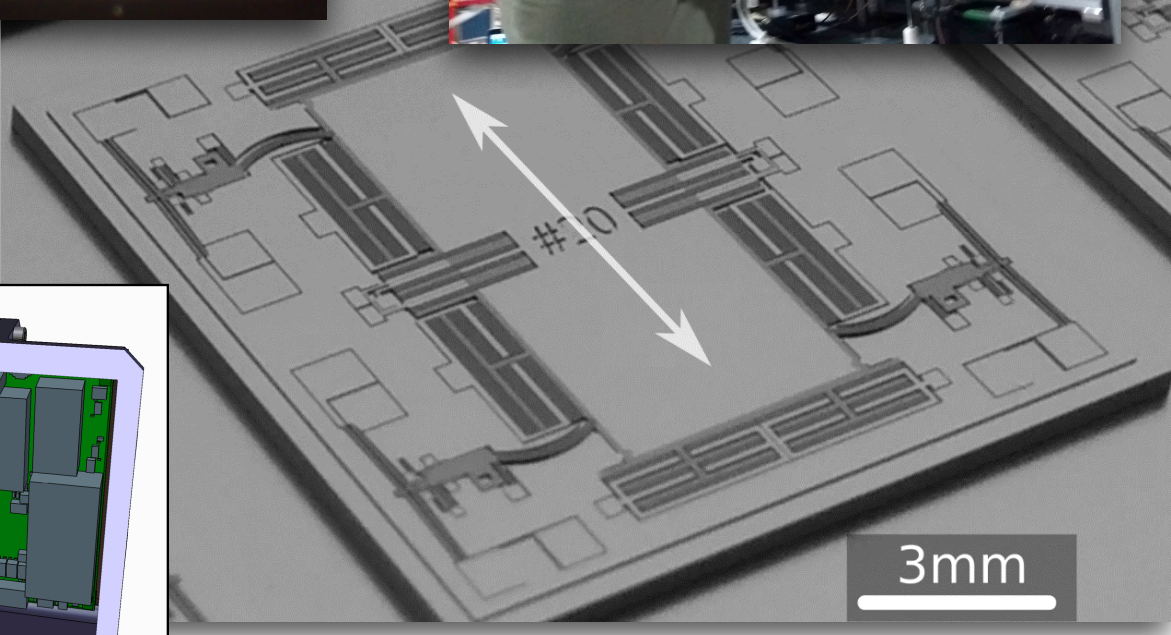
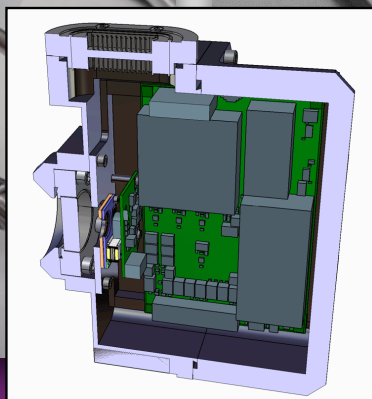
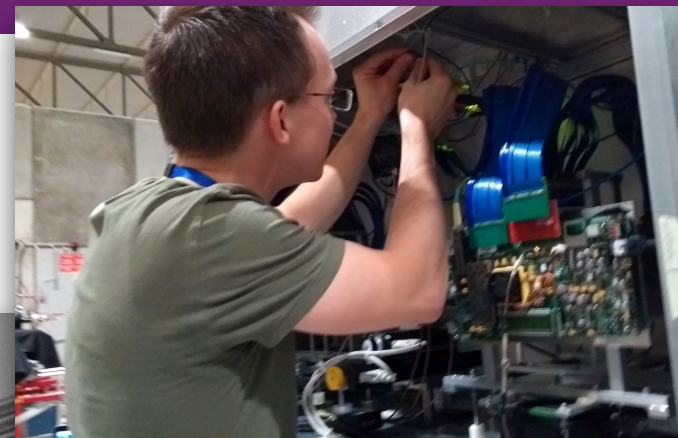
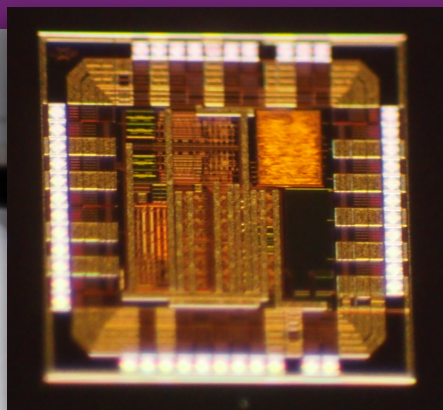
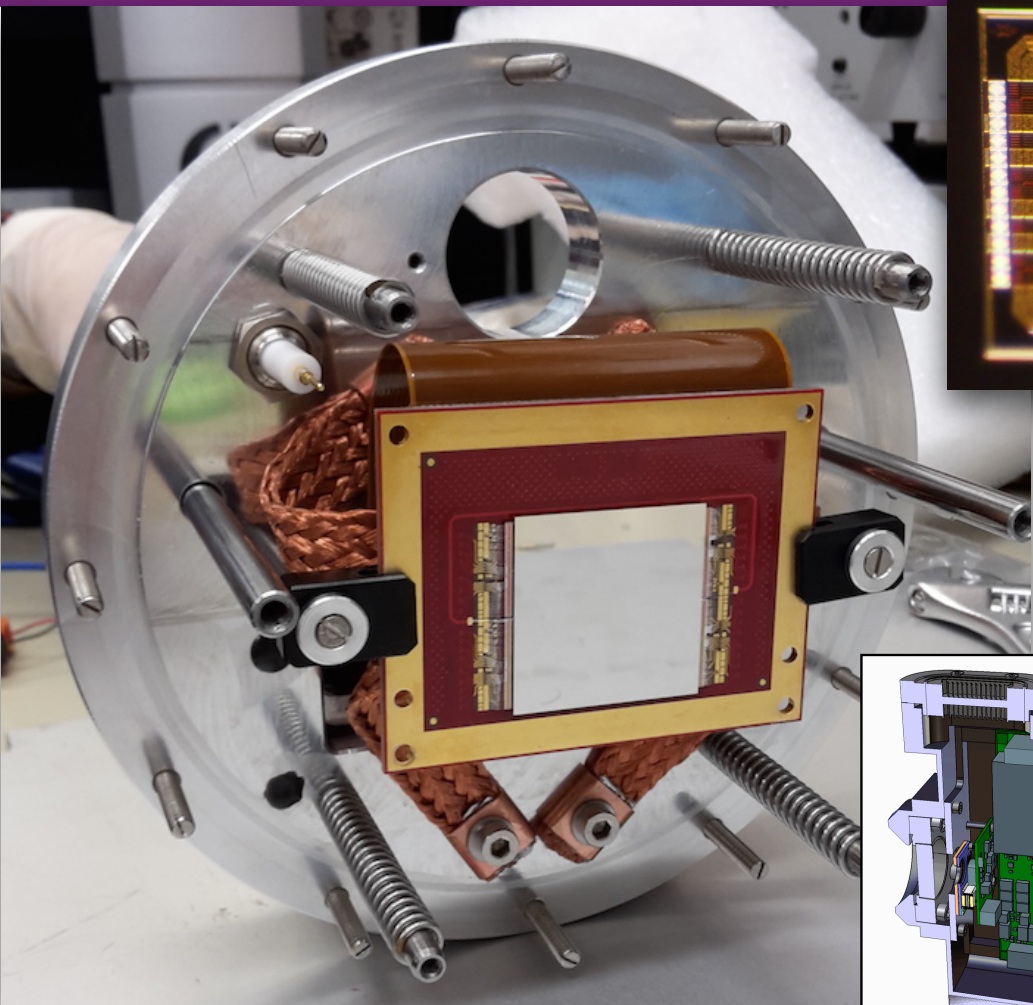
ECFA Detector Panel Report 2018

Most promising future R&Ds	# answers (380 total)
Precision timing	210
Precise position resolution	63
Precise energy measurements	25
Radiation Hardness	29
CMOS HV-MAPS monolithic	24
High granularity imaging calorimetry	21
Artificial intelligence / Machine Learning	16
Fast (tracker) triggers (online)	16
High rate capability	14
Low power consumption in detector systems/electronics,	14
4D tracking	14

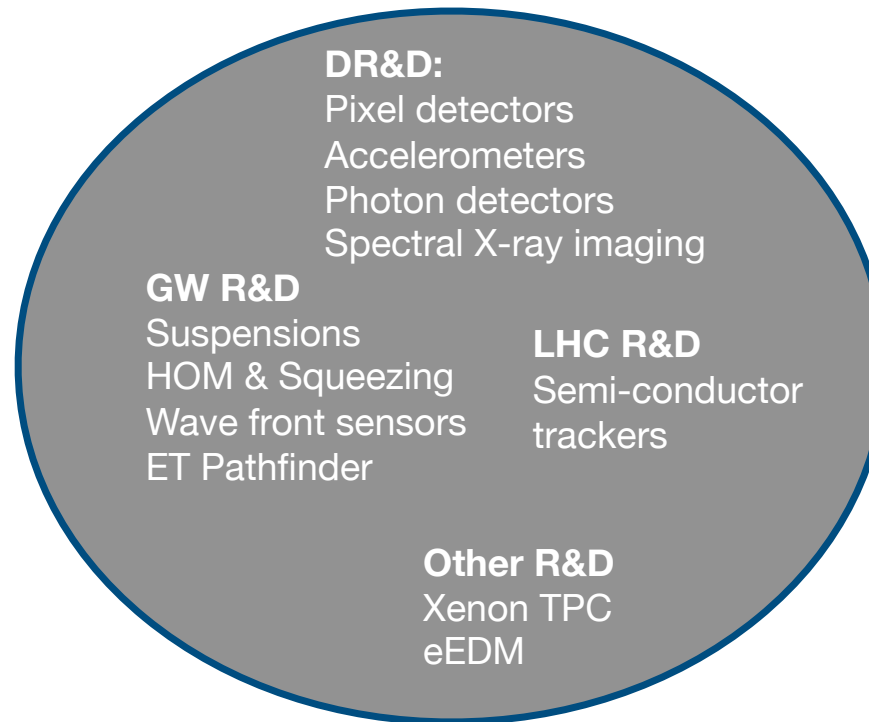
Table 11: Perceived most promising future R&D topics (top-11).



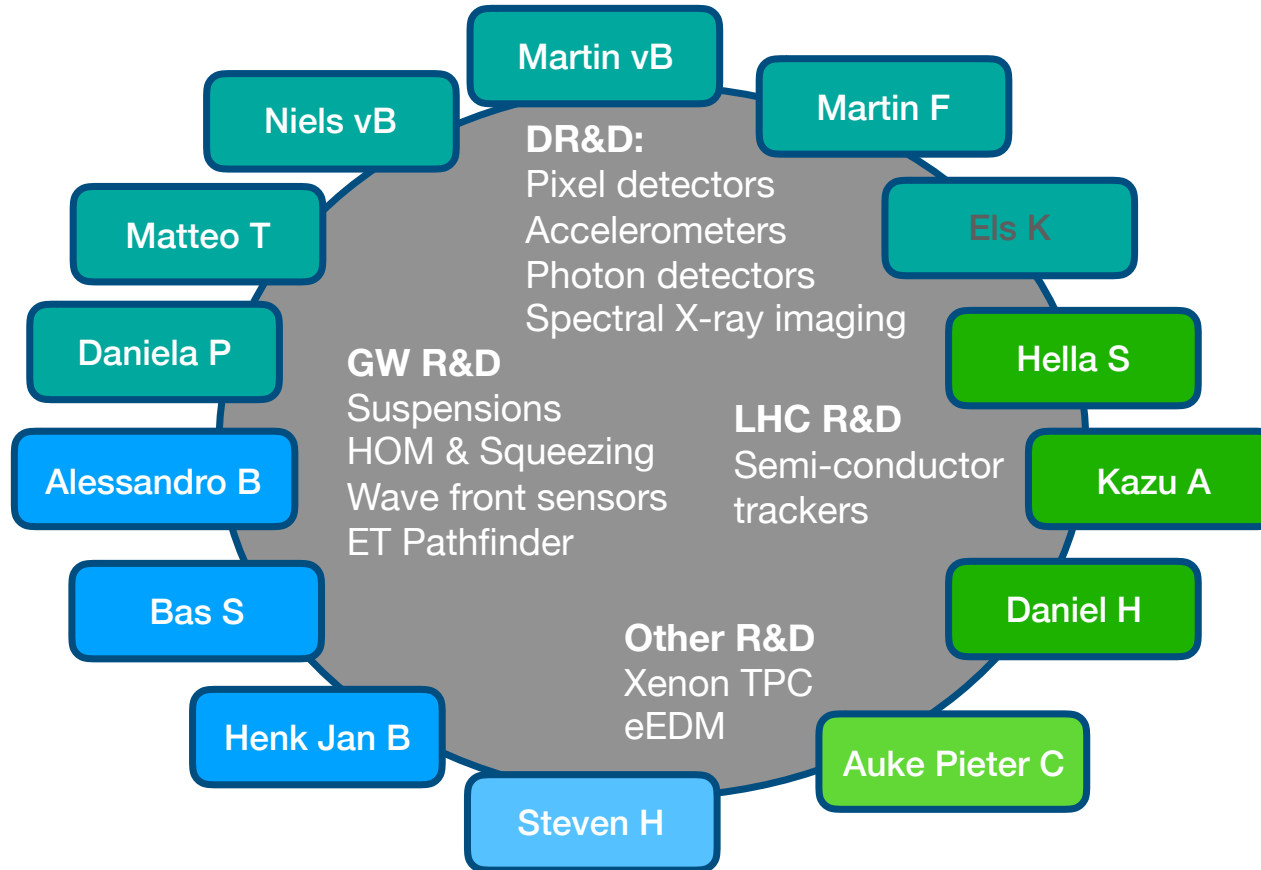
Proto 2018 - Thanks, ET, MT & CT!



DR&D



DR&D - Physicists



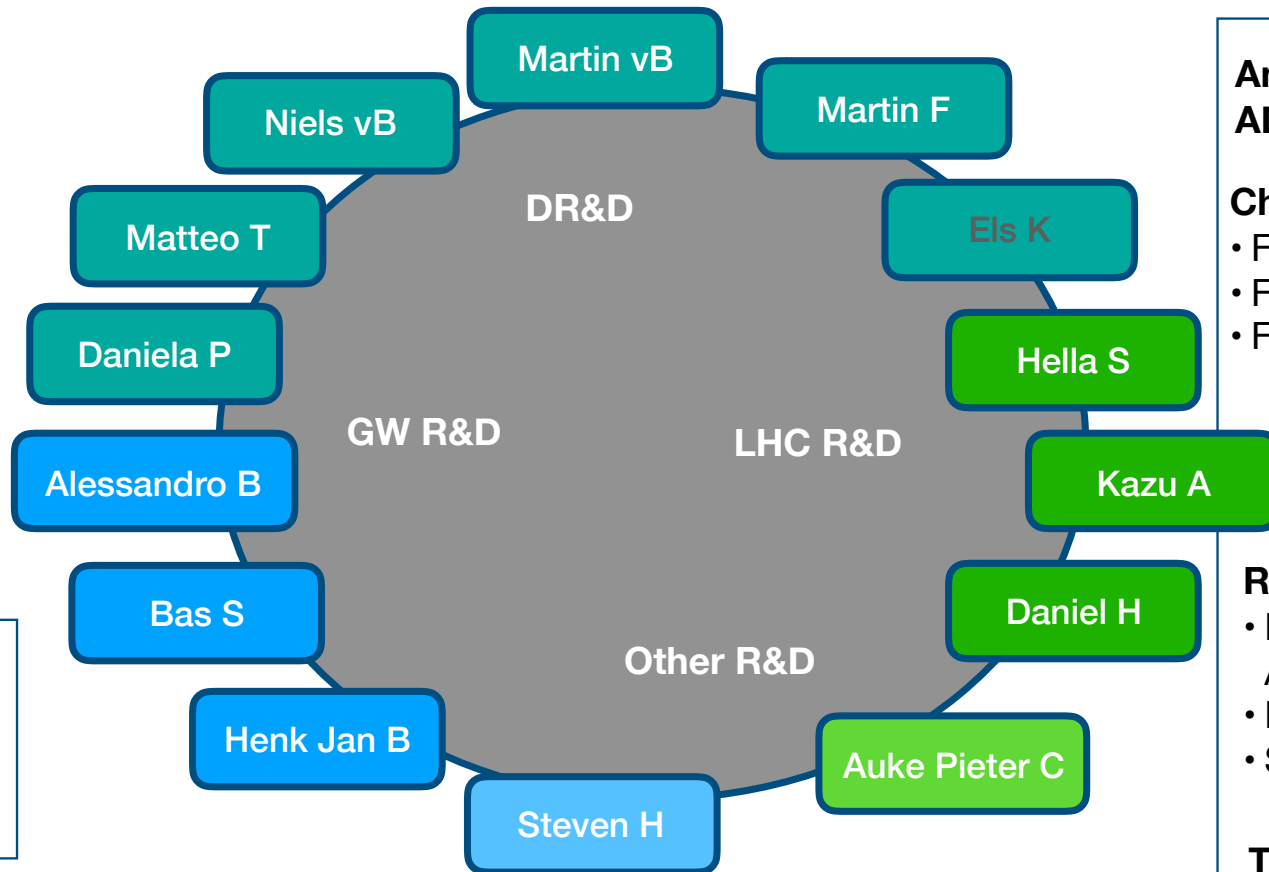
DR&D - Physicists - Technology

Mechanical Technology

- Precision machining & Detector assembly
- Mathematical and computer modeling (FEM)
- Cryogenics & vacuum
- Materials

Computer Technology

- Software for readout
- Slow controls
- Computing infrastructure (e.g. Stoomboot)



Analog (RF) frontends and ADCs for photo-diodes

Chip design

- Fast rad-hard serializers
- Fast Time Of Arrival per pixel
- Frontend chip for MEMS

Readout systems

- High rate readout for pixel ASICs
- Phase cameras
- Signal processing

Timing and calibration methods (White Rabbit)

DR&D - Physicists - Technology - ?

MEMS:

- Mass-spring systems
- Membranes
- Wafer post-processing

Mechanical Technology

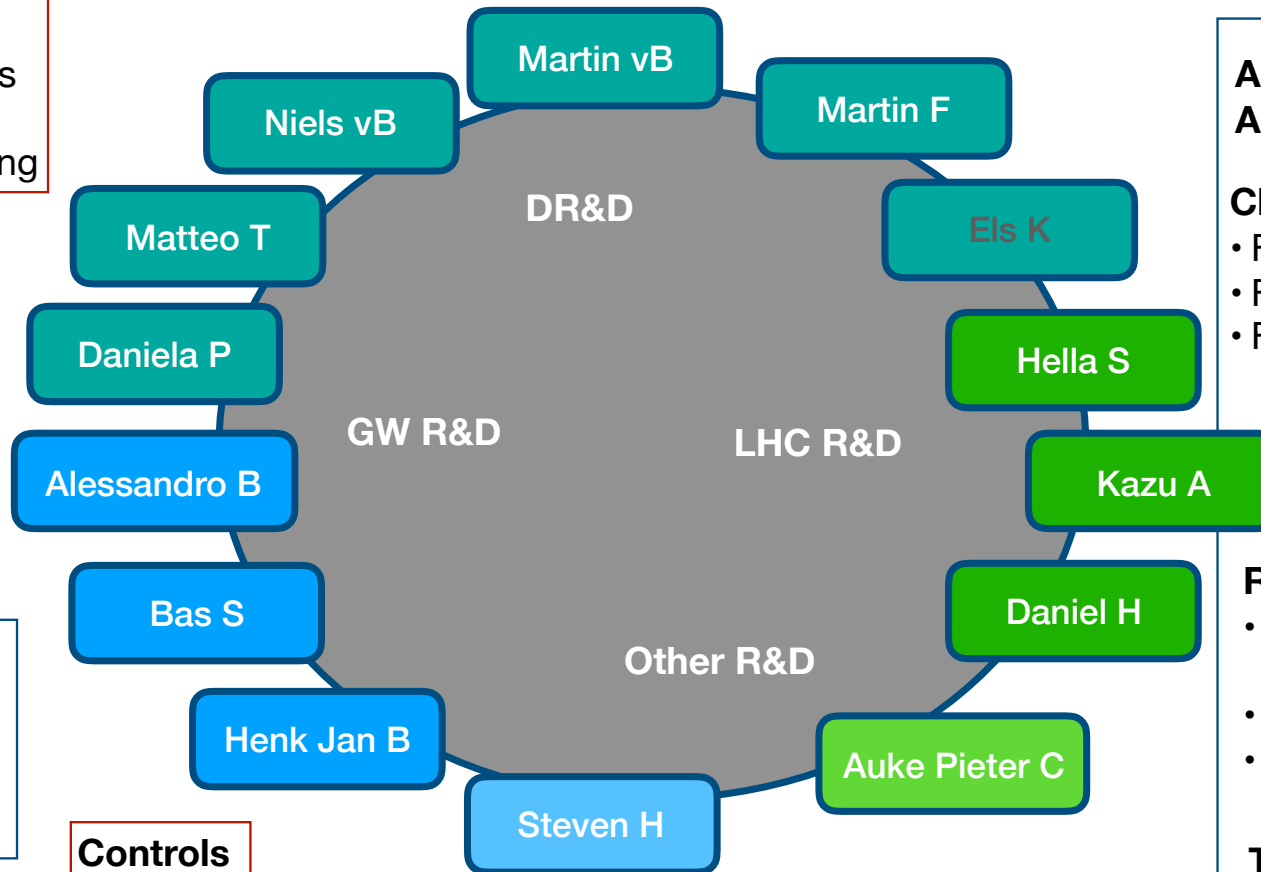
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Controls
Optics
Lasers

Machine learning



Analog (RF) frontends and ADCs for photo-diodes

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Photonics

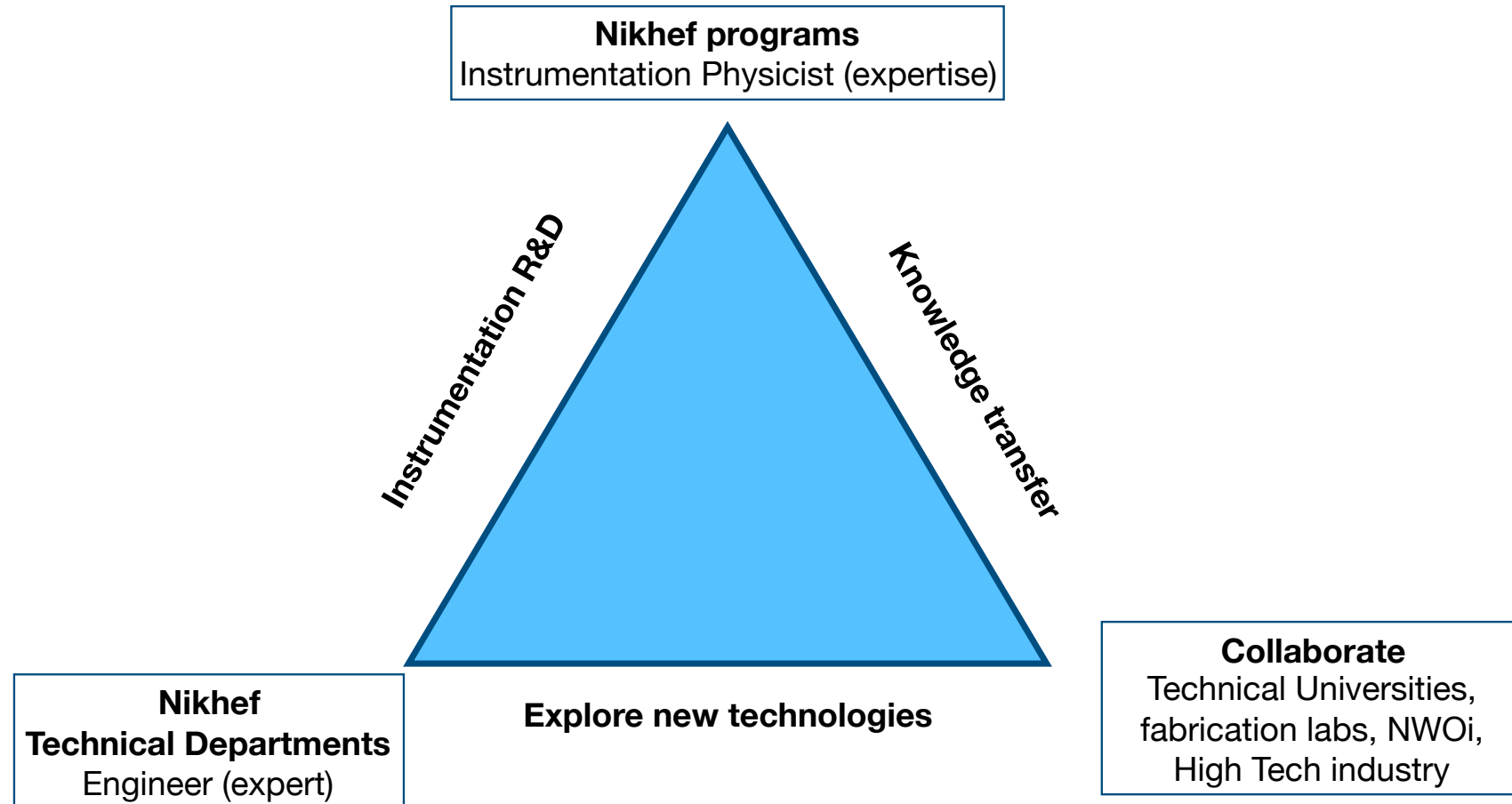
- Photonic ICs
- InGaAs, InP

Readout systems

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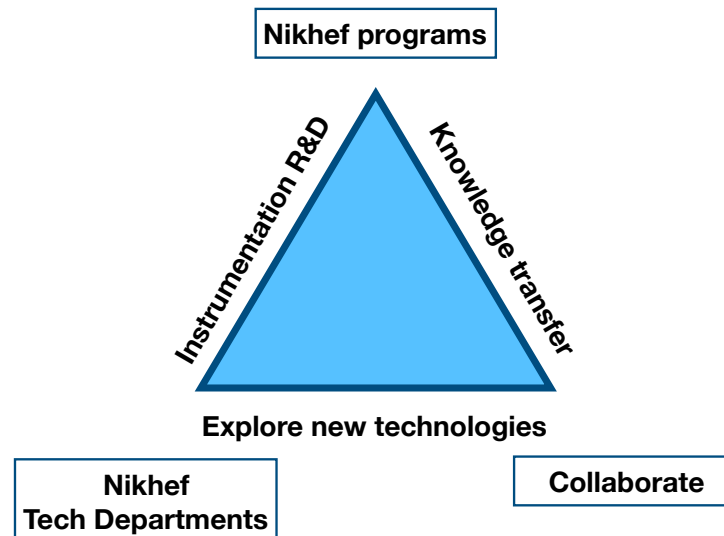
Timing and calibration methods (White Rabbit)

Nikhef R&D model



Discussion

- **New TD competences**
 - Controls - ET or MT
 - Machine learning (for controls)
 - Digital signal processing
 - Photonics
- ➔ Need critical mass, like in ASIC design
- **Worries MT**
 - Outgoing top-notch mechanical designers
 - Cryogenic and vacuum
- **Support for infrastructure**
 - Si-alley
 - Optical lab
 - DR&D labs
 - Beam telescopes



- **Complex new technologies**
 - Need TU students - requires High Tech atmosphere at Nikhef
 - Require access to sophisticated fabrication labs
 - Physicists and/or engineer liaisons on key technologies (e.g. MEMS, photonics)
- **Project management:**
 - Good that we started Agile
 - Awareness ⇔ Happy