Strategic R&D Programme on Technologies for future Experiments

WELCOME

https://ep-rnd.web.cern.ch/

EP R&D in 2 minutes

- Initiative by CERN EP Department to perform R&D on key technologies for future experiments.
- ‘future’ = beyond approved LHC upgrades, e.g. FCC-ee/hh
- Following tradition of DRDC (LHC phase 0), White Paper R&D (LHC phase 1)
- Detectors, electronics, software, mechanics++, magnets
- Technology oriented rather than experiment specific
- Initial period of approval 2020 – 2024
- 11 work packages
- Total budget 28.7 MCHF (material, fellows, students)
- Supervision by fractions of staff (~20 FTE accumulated)
- Steering Committee (11 persons) + project coordinator
- Open to cooperation on all levels ➔ EIC satellite event tomorrow 12 Nov, 14:00
- Strong links/overlap with RD50, RD51, RD18 and AIDAinnova

WP1: Silicon Sensors

Module development

Novel hybrid pixel detectors

Ultimate time/space accuracy and rad hardness

Monolithic pixel detectors

Cost effective depleted CMOS for ee and hh

Simulation and characterization

WP2: Gas Detectors

Solutions for large area gas based detector systems

GEMs, μ–megas or μRWELL

Industrialisation & performance scaling

Tools

- Gas studies,
- Simulation and modelling,
- Electronics and instrumentation

Novel technologies

- Very fast gas detectors
- Additive production techniques

WP3: Calorimetry + Light based

LAr

Electrodes, σ_t, high ionisation rates, feedthroughs

In/organic scint.

Tile-cal, hi segm. fibre cal., rad hard

Hi granularity Si

CMS HGCAL

CLIC, FCC-ee/hh

RICH

- Light weight mirrors
- Low temp photosensor housing

SciFi

- Fibre light yield
- Fibre production techniques

Advanced scint. (Crystal Clear)

WP4: Mechanics++

Low mass structures

- Vertex detectors
- Cryostats for calorimetry + magnets

Cooling techno-logies

- Methods (gas/liquid)
- Coolants (GWP)
- Piping and instrumentation

Interfaces and service architectures for automated installation and maintenance, in future high radiation environments

AIDA Jointly with AIDA

On Hold

WP5: IC Technologies

CMOS

28 nm planar
16 nm FinFET

- Process selection
- Qualification
- Enablers

Design & micro Blocks

- Volt. ref.
- LN amp.
- ADC, DAC
- PLL,DLL, TDC
- …

Assembly Techno

- TSV
- 28 nm on 12''

Power distribution

- On-chip power management

WP6: High Speed Links

ASICs

- Aggregator /transmitter
- Optoelectronics drivers
- Low-mass elec-trical cable transmission

Opto-electronics

- Si Phot. system & chip design
- Si Phot. rad hardness
- Next-gen VCSEL-based optical link
- Si Phot. packaging

FPGA

FPGA-based system for testing and emulation

WP7: Software

Multi-Experiment Data Management

Turnkey Software Stack for Detector R&D

Reconstruction at high pile-up

Faster Simulation

Efficient Analysis Facility

Frameworks for Heterogeneous Computing

WP8: Exp. Magnets

Reinforced Super Conductors and Cold Masses

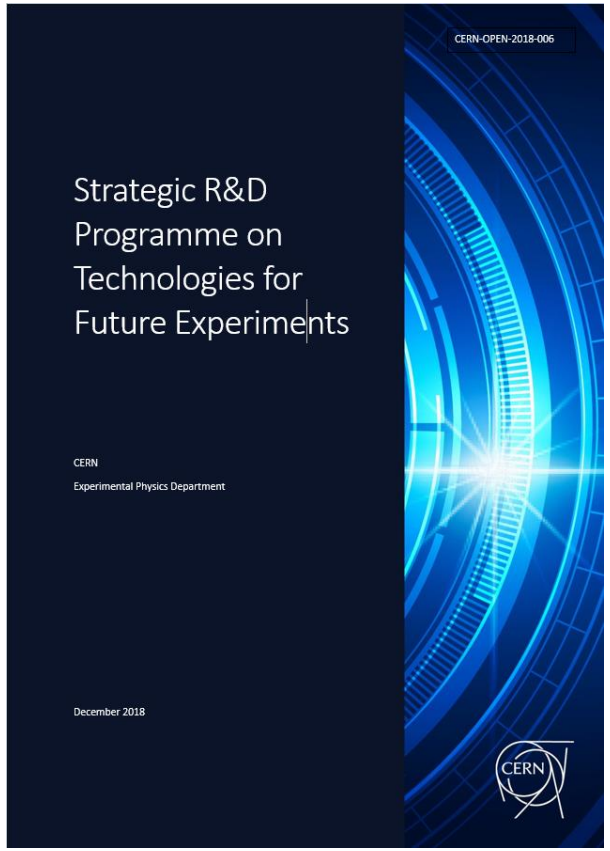
Ultra-Light Cryostat Studies (with WP4)

Advanced Magnet Powering

Magnet Controls, Safety & Instrumentation

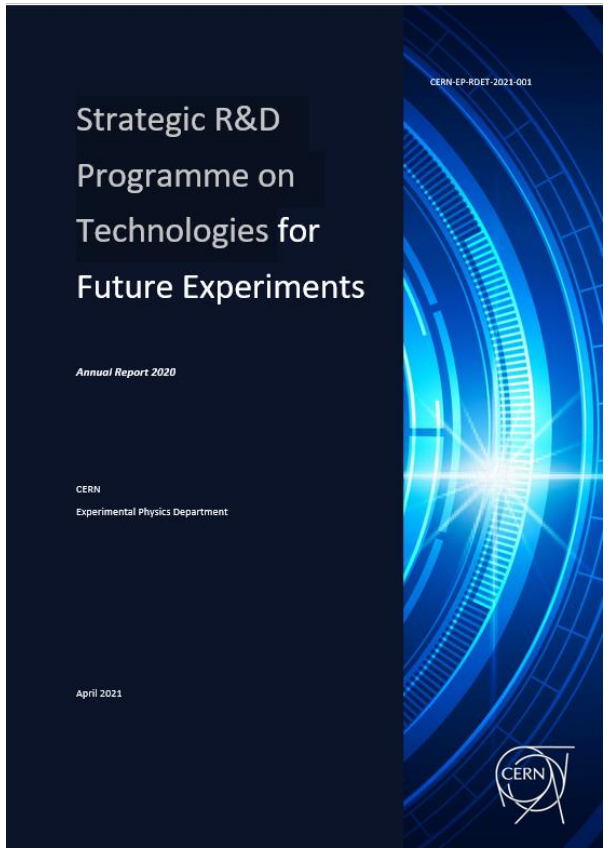
Design of a 4 T General Purpose Magnet Facility for Detector Testing

Documentation

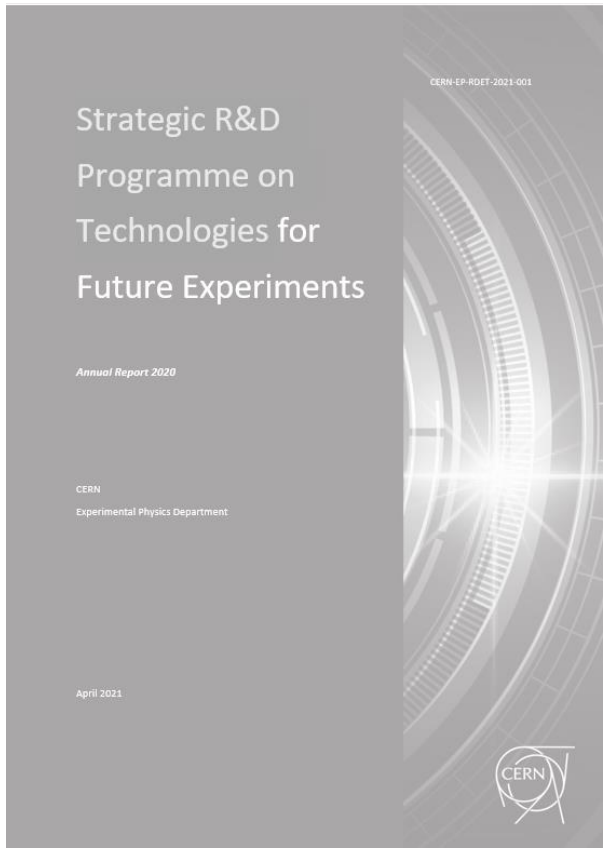


R&D report, CERN-OPEN-2018-006, ~100 pages

https://cds.cern.ch/record/2649646



Annual report 2020, CERN-OPEN-2021-001, ~66 pages



Annual report 2021, to come…

Some news

- “AIDAInnova” (Advancement and Innovation for Detectors at Accelerators) project has taken off (April 2021). Several EP R&D WPs have joint/overlapping activities and profit from some (modest) extra funds.
- Several EP R&D researchers have written proposals for AIDAInnova WP13: Prospective and Technology-driven ("Blue Sky") R&D. 0.55 MEUR (+overheads) to fund ≥3 projects.
- Many of you have contributed in one way or another in the ECFA roadmap study. Discussions about possible adaptations of the EP R&D programme will only start after the publication of the roadmap (December Council).
- CERN Quantum Technology Initiative has launched activities on Quantum Sensing, Metrology and Materials. These aren’t part of EP R&D but we are very interested to follow them. M. Doser will give an overview of status and prospects.

Program of today

Review progress, problems and plans of the 11 EP R&D work packages

3 Sessions, chaired by

WP1.1 - WP1.4 (9:00 – 10:30) Lucie
WP2 - WP4 (10:45 – 12:15) Pere / Werner
WP5 - WP8 (14:00 – 16:00) Dave

Thanks to all speakers for respecting their time slot. 5 minutes discussion per WP are included.

Program of tomorrow

(chaired by Manfred Krammer)

Discuss technological needs and possible opportunities for cooperation with groups involved in detector R&D for the future Electron Ion Collider (Brookhaven, US).

Announcement of this event has triggered some questions ➔ Some clarifications…

- EP R&D is a technology driven program with an approved work plan and budget.
- We are very open to share the work and results with other groups. This happens already in several WPs.
- We aren't developing experiment-specific detectors.

This is a first meeting to understand needs and potentials. Most likely not the last !