

# LDG-ECFA DETECTOR R&D INFRASTRUCTURE

## Panel for the LDG and ECFA infrastructure

### Co-chairs

- Marko Mikuz (ECFA, Slovenia)
- Stan Bentvelsen (LDG, ECFA, the Netherlands)

### LDG Members:

- J. Mnich (CERN)
- One other representative

### ECFA members:

- Rep. from BMBF/Universities Germany
- Rep. from IN2P3/Universities France
- Rep. from Italy INFN
- Rep. from UK universities
- Rep. from smaller countries

### Ex officio

- Dave Newbold, LDG
- Karl Jakobs, ECFA
- Phil Allport, Detector roadmap

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Carlos Lacasta	Spain
Nadia Pastrone	Italy
Laurent Serin	France
Iacopo Vivarelli	UK
Jiri Kroll	Czech Republic
Rosemarie Aben	Nikhef

# DETECTOR RESEARCH AND DEVELOPMENT THEMES

## Detector R&D themes (DRDT)

< 2030    2030-2035    2035-2040    2040-2045    > 2045

- 1. Gaseous
- 2. Liquid
- 3. Solid state
- 4. PID and photon
- 5. Quantum
- 6. Calorimetry
- 7. Electronics
- 8. Integration

- Each DRDT has a target date assigned for completion of the R&D.
- This date is set as required by the latest known future facility/experiment for which an R&D programme would still be needed in that area.
- This includes anticipation for experiment-specific prototyping, procurement, construction, installation and commissioning.
- Earlier milestones represent the time-frame of intermediate “stepping stone” projects where dates for the corresponding facilities/experiments are known.

Plus two training DCT's

- DCT1: Establish and maintain a European coordinated programme for training in instrumentation
- DCT2: Develop a master's degree programme in instrumentation

The DRDs are taking shape  
See the presentation of Phil

# LDG-ECFA DETECTOR R&D INFRASTRUCTURE

Set-up further European cooperation between CERN and the Large National Labs, with universities and smaller labs, to list and coordinate facilities and expertise that DR&D activities need

- R&D infrastructure that are needed by the DRD themes
- Involvement of the Large National Labs as indicated by (some of the) GSRs

In our view this “nexus process” requires several stages

1. Create an inventory of available resources & expertises at labs
2. Monitor requests of DRD themes, match-making with labs
3. Develop (federated) organisation between labs (incl. CERN) with the aim to optimise R&D resources needs

# PRELIMINARY RESULTS SURVEY

Survey to the coordinators of the DRD themes have been send-out

- Responses received so far

- DRD1 - Gaseous
- DRD3 - Solid State
- DRD4 - PID and photon
- DRD5 - Quantum
- DRD7 - Electronics

Yorgos Tsipolitis
Michael Moll
Christian Joram
Michael Doser
Francois VASEY

- Still missing DRD2 (Liquid), DRD6 (Calorimetry) and DRD8 (Integration)

Survey to the (national) labs is pending

- Survey is ready to send around
- Need proper introduction to the labs - we need more commitment from CERN
  - Propose to take care after summer

# SOME RESULTS OF THE SURVEY

## Which testbeams do you plan to use?

		Other...
DRD1	SPS, PS, DESY,PSI	DESY II, GSI, Fermilab, Frascati, Bonn... Critical period is expected during CERN LS3, DESY (2026-27), Fermilab (2026-28) shutdown.
DRD3	SPS, PS, DESY,PSI	Further facilities mentioned in the DRD3 meeting, but do not represent a complete list. MAMI (Mainz), ELSA (Bonn) ,Frascati, COSY, CYRCE (IPHC), Micro
DRD4	SPS, PS, DESY,PSI	BTF, DAFNE
DRD5	SPS, PS	Infrastructures of most of the participating countries (Europe, US, India, Japan, ...) will most likely be used for at least one WP.
DRD7	None	No

# INFRASTRUCTURE

## What of the following infrastructure is needed ?

	<i>Trigger system</i>	<i>Tracking telescope</i>	<i>Calorimeter</i>	<i>Fast timing reference detector</i>	<i>Reconstruction software</i>	<i>Particle ID</i>
DRD1	Yes	Yes	No	Yes	Yes	Yes
DRD3	Yes	Yes	No	Yes	Yes	Yes
DRD4	Yes	Yes	No	Yes	No	Yes
DRD5	Yes	Yes	No	Yes	No	No
DRD7	No	No	No	No	No	No

### *Is any other infrastructure needed?*

Support for test beams and infrastructure plays a crucial role in the success of DRD1. Currently, within RD51, support and shared infrastructures have been established and maintained by the collaboration, albeit with limited resources. If, in the context of the ECFA Detector Roadmap implementation, these resources can be integrated with external resources or initiatives, it would have a significant impact on the strategic research activities of the DRD1 groups.

(Large) remotely controlled position stages allowing for precise positioning and rotation an xyz movements Patch panels between beam zone and control rooms (BNC, SHV, RJ45, optical fiber); low jitter clock distribution systems.

not foreseeable

many different types of novel materials to be tested: impossible to provide a list now

I entered "no" test beam infrastructure need, since I expect this need to be specified by the detector-related DRDs, not by the more generic DRD7 group.

# IRRADIATION FACILITIES

## Which irradiation facilities are you needing?

	<i>CERN IRRAD</i>	<i>CERN GIF++</i>	<i>JSI TRIGA Reactor</i>	<i>IFJ PAN AIC-144</i>	<i>UV Louvain CRC</i>	<i>UoB MC40 Cyclotron</i>
DRD1	Yes	Yes	Yes	Yes	Yes	Yes
DRD3	Yes	Yes	Yes	Yes	Yes	Yes
DRD4	Yes	No	Yes	No	No	No
DRD5	Yes	Yes	No	No	No	No
DRD7	Yes	Yes	Yes	No	Yes	Yes

### *Other...*

CERN CHARM, SFTC/RAL ISIS/NILE, ERIC, Demokritos, LNL ... Different requirements from many users for long irradiation to a few users for limited time

Radiation testing for the complex radiation fields in high energy physics experiments requires a wide range of facilities to test for individual parts

No

as for test beam, worldwide infrastructure might be useful, although most likely, CERN-only + neutron irradiation could suffice

PSI, CERN-CC60

### *What else is missing or would be nice to have ?*

Access to detector laboratories, clean rooms, and mechanical workshops nearby the test facilities when possible (this applies to test beams as well).

A variety of heavy ions with different LET for SEE testing; storage in a cold refrigerator and material shipping service; stages allowing to perform uniform irradiation (with small beam) or allowing to move equipment out of the beam for testing; Irradiation facilities have to be operated, maintained by an expert team with expertise in dosimetry

standardised readout system

presumably, some active detectors will be involved in the characterization of devices (producing light, electronic signals). Some of these will require a cryogenic environment, room for mu-metal shielding, device-specific electronics.

Co60 irradiation facilities with large dose-rate to reach GRads in reasonable time.

# CENTRALISED INFRASTRUCTURES

*Is there any need for centrally accessible infrastructures such as Detector Characterisation Laboratory?*

- DRD1 DRD1 is organizing a detector laboratories network (see Draft Extended DRD1 Proposal <https://cernbox.cern.ch/s/BKQsu6oiuhPWDaa> sec. 4.7.1). Resources, in addition to the limited ones of the collaboration, would allow increasing the impact in the community of such a network. The collaboration will moreover investigate the possibility of recovering infrastructures released by closed projects. Support from LDG-ECFA in this could have a positive impact.
- DRD3 Some centralized community laboratories, best in connection with test beam and/or irradiation facilities are needed, this holds especially for CERN. In these facilities at minimum cold IV/CV bench test should be available. It might be interesting to have a centrally accessible TPA laser and a TDR (Time Domain Reflectometer), but also EMC testing and TID lab testing facilities. Material characterization facilities are also of high demand (SIMS, FIB,...) and would be very useful to have accessible w
- DRD4 no, infrastructure available in DRD4
- DRD5 would be helpful for comparative studies of new materials, but those will probably require too device-specific infrastructure for a generic lab to be able to cover all needs
- DRD7 High end facilities for testing state of the art electronics are available in a few labs today. However, as technology will become more sophisticated, it is likely that future test equipment will only be affordable if the entire community sets up a shared central laboratory. The equipment concerned is high end probe stations for 30cm wafers, sub-um precision die placement tools, high speed scopes for 25GHz bandwidths and above, high precision timing instrumentation with ps resolution etc.



# CENTRALISED FACILITIES

## *Manufacturing and Production Workshop?*

DRD1 is organizing common production facilities for the various covered technologies (see Draft Extended DRD1 Proposal <https://cernbox.cern.ch/s/BKQsu6oiuhPWDaa> sec. 4.6.1) following the experience in RD51 with the CERN EP-DT Micro Pattern Technology (MPT) Workshop. Centralised resources in addition to the limited one of the collaboration, would allow to secure their support to strategic R&D activities.

not really clear what is meant by this ; common mechanics should be provided at institute level; access to mechanics facilities at test beam/irradiation facilities for repair/ modification is needed.

infrastructure available in DRD4

possibly, although probably not

## *Assembly facilities?*

DRD1 is organizing assembly facilities for the various covered technologies. Resources in addition to the limited one of the collaboration, would allow increasing the impact in the community.

access to wirebonding/interconnect facilities at test beam facilities for repair/modification ; access to wire bonding facilities with expert wire bonders is generally of interest; common in-house interconnect techniques; bump-bonding, gluing...; visual inspection infrastructure; These facilities should be establish within the collaborative network of institutes

infrastructure available in DRD4

no

## *Clean Rooms: Which clean room classes ?*

ISO 6 is the preferred solution in most of cases and in particular for MPGD, ISO 7 is acceptable in some cases.

most probably no centralized clean room needed; the collaboration will have several institutes with clean rooms and could internally try to organize access, if needed.

infrastructure available in DRD4

if a central electronics characterization laboratory is built, a clean room should host the wafer probing and die attach stations

# WORKSHOPS

	<i>Mechanical workshops beyond normal standards?</i>	<i>Electronics Workshop beyond normal standards?</i>	<i>Analysis Laboratory?</i>	<i>Metrology Laboratory?</i>
DRD1	Very important and essential, in particular for what concerns precision mechanics (um) on large areas (m2).	Very important and essential, in particular for PCB design, assembly and fast prototype production (covering high performances FE, protection circuits, HV powering and high-resolution monitoring units - see Draft Extended DRD1 Proposal <a href="https://cernbox.cern.ch/s/BKQsu6oiuhPWDaa">https://cernbox.cern.ch/s/BKQsu6oiuhPWDaa</a> sec. 4.5 ).	Despite being covered by the DRD1 proposal (see Draft Extended DRD1 Proposal <a href="https://cernbox.cern.ch/s/BKQsu6oiuhPWDaa">https://cernbox.cern.ch/s/BKQsu6oiuhPWDaa</a> sec. 4.3.3 and 4.3 more generally), a common and centralized strategy to support access to a diversified set of Analysis laboratories will be very beneficial for DRD1, in particular for ageing studies and detector long-term operation.	It will benefit if a general and central strategy will be set up to support these laboratories at a European level. As RD51, important support from CERN EN Mechanical and Materials Engineering (MME) Group.
DRD3	Some vibration testing might be needed for more complex objects (within collaboration)	No	No, but see comments above for material characterization	No
DRD4	infrastructure available in DRD4 (incl. CERN)	infrastructure available in DRD4, count on support by DRD7	equipment and expertise available in DRD4 and at CERN is normally sufficient	equipment and expertise available in DRD4 and at CERN is normally sufficient
DRD5		cryogenic electronics are expected to be one area of study (at 4K)		
DRD7				

# SOFTWARE

## 40 Is your DRD community needing any specific software/licences/license sharing to support the work?

Matrix of multiple choices , answers 5x, unanswered 0x

Answer	<input type="radio"/> yes	<input type="radio"/> no	<input type="radio"/> do not know	<input type="radio"/> probably
Maintained software:	4 (80.0%)	0	0	1 (20.0%)
New software packages:	3 (60.0%)	0	1 (20.0%)	1 (20.0%)

## 41 Simulation software & support? (Monte Carlo)

Matrix of multiple choices , answers 5x, unanswered 0x

Answer	<input type="radio"/> yes	<input type="radio"/> no	<input type="radio"/> do not know	<input type="radio"/> probably
Maintained software:	3 (60.0%)	0	1 (20.0%)	1 (20.0%)
New software packages:	2 (40.0%)	0	2 (40.0%)	1 (20.0%)

# REMARKS

Responses of DRD's clearly show the need for facilities and infrastructures

- Not only at CERN - but in many places
- Coordination seems very much appreciated

We plan to complete and analyse the surveys

- Involve all DRDs
- Submit the survey to the labs

This provides valuable input for the DRD collaborations & committee

- Essential part of the roadmap -

