# LDG/ECFA Detector R&D Infrastructure Panel DRD Requirements & Lab Resources Survey Reports

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# LDG/ECFA Detector R&D Infrastructure Panel

- To assist the DRD's with infrastructure resources needed for detector R&D that are not available within the DRD's themselves
- Availability either in big National Laboratories (LDG) or Institutes/Universities throughout Europe (ECFA)
- Panel composed of
- First step: two surveys
  - Identify the *needs* of the DRD communities
  - Map out the *availability* of relevant resources in Europe
- Two sub-committees formed to execute these surveys
- First report on the DRD Survey
- Second report on the Labs Survey

| | |
|---|---|
| Stan Bentvelsen (Co-chair) | Nikhef |
| Marko Mikuž (Co-chair) | Ljubljana |
| Karl Jakobs | Ex-officio - ECFA |
| Dave Newbold | Ex-officio - LDG |
| Phil Allport | Ex-officio - EDP |
| Joachim Mnich | LDG - CERN |
| Achille Stocchi | LDG - IJCLab |
| Ingrid Gregor | Germany |
| Mogens Dam | Denmark |
| Carlos Lacasta | Spain |
| Nadia Pastrone | Italy |
| Laurent Serin | France |
| Chris Parkes | UK |
| Jiri Kroll | Czech Republic |
| Rosemarie Aben | Nikhef |

# DRD Survey

- Survey hosted by NIKHEF in Survio
  - https://www.survio.com/survey/d/M1T1S4B8X9D5W5L1G
  - Survey finalized after a couple of sub-committee meetings
    - Consulted within RECFA and shown at an LDG meeting
  - Distributed to DRD's round June 15th, often after a chat with the key proponents (each member approached 2-3 DRD's)
    - Most of the considerations were that the survey comes in too early in the game
    - Still the need for such endavour thankfully recognized
    - Would like the replies considered preliminary
  - Deadline set to July 1st...

# Survey Return

✓After some struggle, replies received from all DRDs:

- **DRD1 Gaseous Detectors**
- **DRD2 Liquid Detectors**
- **DRD3 Solid State Detectors**
- **DRD4 Particle ID and Photon Detectors**
- **DRD5 Quantum and Emerging Technologies**
- **DRD6 Calorimetry**
- **DRD7 Electronics**

- Results available on PECFA Indico
  - “digested” version of the survey appended to agenda
- 43 questions answered
  - Time invested in filling out the survey typically more than 1 hour


Thanks to all DRD’s for participating and providing valuable input!

# Detector R&D Infrastructure – EURO-LABS

- Currently, Detector R&D is sponsored by two Horizon Europe projects
  - AIDAinnova – Joint Research & Networking Activities (HEP Detectors exclusive)
  - EURO-LABS - Transnational Access (TA) to Research Infrastructures (47 RIs – joint venture with Nuclear Physics and HEP Accelerators)
- EURO-LABS WP4 (Access to RI for Detectors) comprises 11 RIs: 3 Test Beams, 2 Detector Characterization and 6 Irradiations
  - Running for 4 years 2022-26 (good overlap with AIDAinnova 2021-25)
  - Budget ~4 MEUR
- Ideally suited for the transition phase from RDxx to DRDx
  - Access to RIs free of charge for the detector R&D teams
- Even with the DRDs in place vital to keep such TA scheme alive
  - Facilitate especially prospective (blue-sky) and guided R&D where funding is scarce
- All 11 RIs explicitly offered as an infrastructure resource in the survey

EUROPEAN LABORATORIES FOR ACCELERATOR BASED SCIENCES

https://web.infn.it/EURO-LABS/

# Results – Test Beams

- No surprise - all but DRD7 require test beams
- CERN, DESY and PSI (all in EURO-LABS) cover most of the needs
- Other: BTF, DAFNE, MAMI, ELSA, Frascati, COSY, CYRCE, Micro, GSI, FNAL ($p$,$\nu$), Oak Ridge NSS, KEK
- Remark: Critical period is expected during CERN LS3, DESY (2026-27), Fermilab (2026-28) shutdown!
- Add-ons:
  - Magnet, trigger, telescope, timing (~all)
  - PID, Cryo, reco software (some)
- Usage: (couple of weeks – more than a year)/year

| Answer Choices | Responses | Comment |
|---|---|---|
| None | 1 | DRD7 |
| CERN SPS | **6** | EURO-LABS |
| CERN PS | 5 | EURO-LABS |
| DESY | 4 | EURO-LABS |
| PSI | 3 | EURO-LABS |
| Other... | **6** | |

# Results – Irradiations

- No surprise - all but DRD2 need irradiations
- EURO-LABS sites cover most of the needs
- Other: PSI, CERN-Co60, CERN CHARM, SFTC/RAL ISIS/NILE, ERIC, Demokritos, LNL, not assessed yet!
- Fluence range: $10^{11}$ – $10^{17+}/cm^2$
- Remark:
  - Radiation testing for the complex radiation fields in high energy physics experiments requires a wide range of facilities to test for individual particles
- In addition: flux, particle type, infrastructure…
- Usage: (a couple - >100 irradiations)/year

| Answer Choices | Responses | Comment |
|---|---|---|
| None | 1 | DRD2 |
| CERN IRRAD | **6** | EURO-LABS |
| CERN GIF++ | 5 | EURO-LABS |
| JSI TRIGA Reactor | 5 | EURO-LABS |
| IFJ PAN AIC-144 | 3 | EURO-LABS |
| UV Louvain CRC | 4 | EURO-LABS |
| UoB MC40 Cyclotron | 4 | EURO-LABS |
| Other… | **5** | |

# Results – Software

- Remarks – no DRD claims it does not need software support…
  - GEANT4 support is of vital interest.
  - Further development of Geant4 towards ultralow energy deposits; COMSOL; agent-based software (for multi-particle interactions).
  - Keeping alive the EUROPRACTICE like access to software tools with reasonable license fees is very important (concerning Cadence design suite, Synopsis TCAD, …) The cost outside Europractice is 2-3 order of magnitude higher. Central access to high performance computing for simulation would be helpful (as compatible with the licensing). Support for Corryvreckan for test beam analysis. (request to LDG).
  - Ref. (https://cernbox.cern.ch/s/BKQsu6oiuhPWDaa sec. 4.4). Support for software like Garfield++, MAGBOLTZ, HEED... is important in view of design optimization of new detector concepts. Although initially developed for gaseous detectors, they showed their validity for other technologies (e.g. solid- state devices).Geant4, FLUKA (and their interface to previously mentioned tools) is important. Access to licensed software will be of high importance FEA, CAD,PCB Design/Analysis SW, LabVIEW, WinCC OA.
  - To work in a collaborative mode, design files will need to be exchanged across partners. A legal framework may have to be setup to allow seamless sharing of files produced by licensed software. This is typically possible for global multinational companies with multiple labs, but collaborations of independent institutes are not always allowed to share files (see for instance EDA software for ASIC design).

Specific software/licences/license sharing

| | yes | no | do not know | probably |
|---|---|---|---|---|
| **Maintained software:** | 4 | **0** | 1 | 2 |
| **New software packages:** | 3 | **0** | 2 | 2 |

Simulation software & support

| | yes | no | do not know | probably |
|---|---|---|---|---|
| **Maintained software:** | 5 | **0** | 1 | 1 |
| **New software packages:** | 4 | **0** | 2 | 1 |

# DRD Survey Wrap-Up

- There is much more info in the survey - 43 questions were answered.
- There is a clear request to the LDG (and beyond) to provide infrastructure not present within institutes participating in DRD's.
- EURO-LABS facilities provide a good starting point although do not exhaust the DRD wish list.

# Involvement of the Laboratories

- Involvement of (national & regional) labs in the General Strategic Recommendations of the Detector R&D Roadmap
  - **GSR 1 - Supporting R&D facilities**
  - **GSR 2 - Engineering support for detector R&D**
  - **GSR 3 - Specific software for instrumentation**
  - **GSR 5 - Distributed R&D activities with centralised facilities**
- We setup a survey to create an inventory of the resources that reside in these labs. With this overview, in a next step we like to take the 'nexus role' and try to connect these resources with the requests of the DRDs.

# Lab Survey

- The survey aims to gather information and seek a match with DRD needs
  - With this effort we plan to optimize the Detector R&D efforts and potentially provide new opportunities to the (national) labs to acquire funding for these activities.
- Survey structure
  - Test-beam and Irradiation facilities
    - Existing facilities
    - Plans and ambitions
  - Characterization and test-bench measurement facilities
  - Local expertise, status and ambitions/plans
    - Electronics expertise
    - Mechanical expertise
    - Software support
- Survey is still ‘open’ for further submissions at

https://www.survio.com/survey/d/S6X/ECFA-LDG-infra-LabsSurvey

# Responses Collected

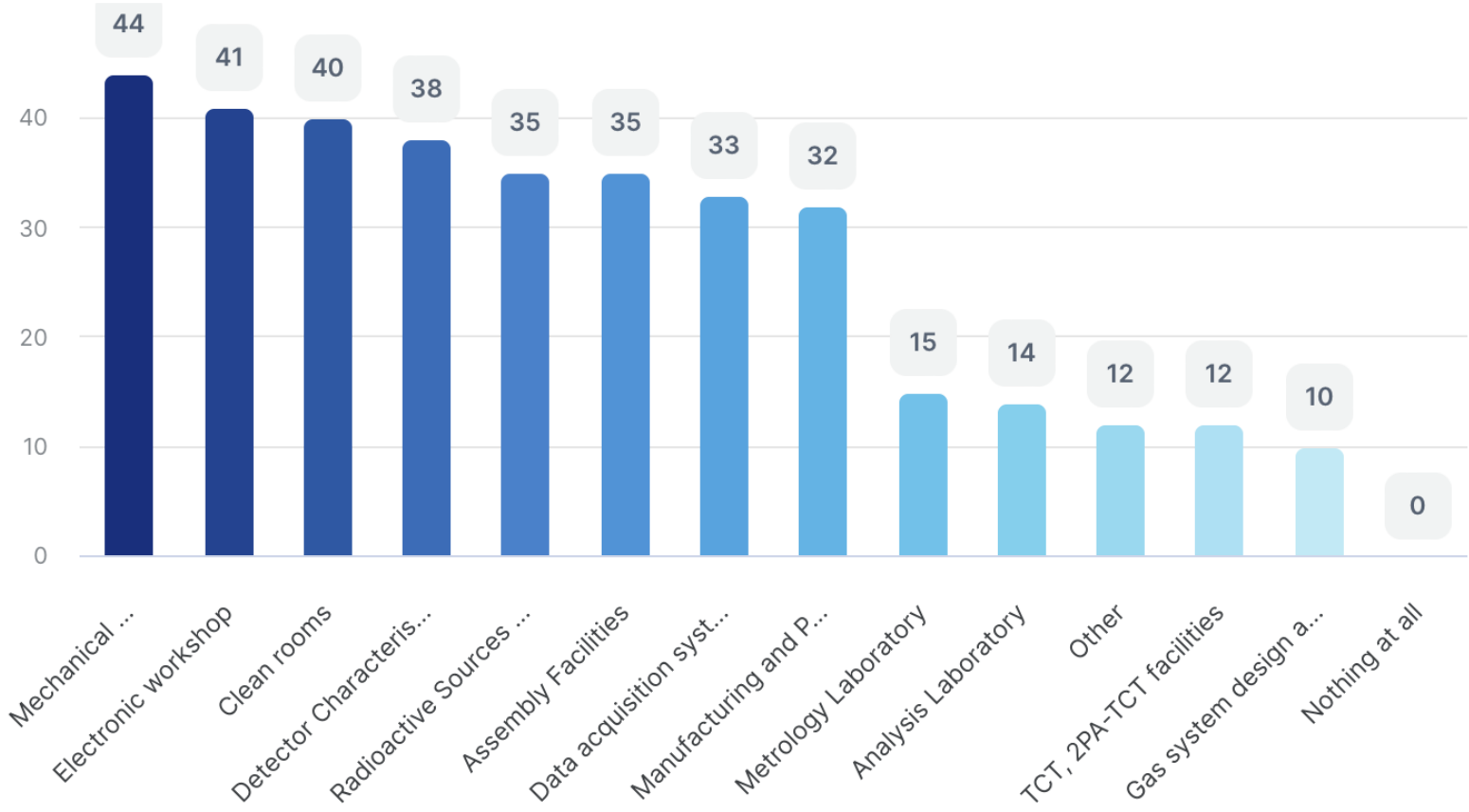
- Responses collected until November 13th
  - Replies from 47 labs in 12 countries
    - In some countries coverage is excellent
  - We still have large gaps in pan-European coverage
    - ECFA covers 28 countries!
- We plan to complete this survey in coming weeks!

| | |
|---|---|
| **BE** | 1 |
| **CH** | 1 |
| **CZ** | 6 |
| **DE** | 1 |
| **DK** | 1 |
| **FI** | 1 |
| **FR** | 2 |
| **IT** | **21** |
| **NL** | 1 |
| **NO** | 1 |
| **SE** | 2 |
| **UK** | 9 |

| Country | Abbrev | Identify your lab or institute |
|---|---|---|
| BE | Louvain | UCLouvain - CP3 |
| CH | CERN | CERN, Geneva |
| CZ | CTU Prague, FNSPE | Faculty of Nuclear Science and Physical Engineering |
| CZ | Academy IoP | "Laboratory for testing of semiconductor particle detectors, Institute of Physics of the Czech Academy of Sciences" |
| CZ | Academy-Nuclear | Nuclear Physics Institute of the Czech Academy of Sciences |
| CZ | Charles | Charles University, Prague, Czech Republic |
| CZ | Olomouc | Joint Laboratory of Optics, Palacky University Olomouc |
| CZ | CTU Prague | "Institute of Experimental and Applied Physics, Czech Technical University in Prague Husova 240/5, 110 00 Praha 1, Czech Republic" |
| DE | DESY | "Deutsches Elektronen-Synchrotron DESY Notkestr. 85 22607 Hamburg Germany" |
| DK | Copenhagen | Niels Bohr Institute, Copenhagen University, Denmark |
| FI | Helsinki | "Detector Laboratory Helsinki Institute of Physics P.O.Box 64 (Gustaf Hallstromin katu 2) 00014 University of Helsinki FINLAND" |
| FR | CEA | "CEA-IRFU . CE SACLAY 91191 Gif sur Yvette Cedex " |
| FR | CEA-dis | CEA Paris-Saclay/Irfu/DIS |
| IT | Bari | "INFN - Bari Unit via E. Orabona, 4 - 70126 - Bari - Italy" |
| IT | Bologna | INFN-BOLOGNA |
| IT | Cagliari | "INFN Sezione di Cagliari Physics Dept. Cittadella Universitaria 09042 Monserrato (Cagliari) Italy" |
| IT | Catania | NFN Laboratori Nazionali del Sud , via S.Sofia 62, 95123 Catania, ITALY |
| IT | Ferrara | INFN , Division of Ferrara |
| IT | Firenze | "INFN - Sezione di Firenze via Sansone 1, 50019 Sesto Fiorentino (Firenze) ITALY" |
| IT | Frascati | "Laboratori Nazionali di Frascati INFN via E. Fermi 54 00044 Frascati (Italy)" |
| IT | Gran Sasso | INFN - Gran Sasso National Laboratory |
| IT | Lagnaro | Laboratori Nazionali di Legnaro |
| IT | Milano | INFN, Sezione di Milano Bicocca, Piazza della Scienza 3, 20126 Milano (Italy) |
| IT | Milano | INFN -Sezione di Milano |
| IT | Napoli | INFN Sezione di Napoli |
| IT | Padova | INFN Sezione di Padova - via Marzolo 8 - 35131 Padova - Italy |
| IT | Padova | "INFN Sezione di Padova via Marzolo 8 - 35131 Padova - Italy" |
| IT | Pavia | INFN - Pavia Unit |
| IT | Perugia | Sezione INFN di Perugia, Via A. Pascoli, 06123 Perugia |
| IT | Roma Sapienza | "INFN division of Rome "Sapienza" P.le A. Moro 2 - Roma 00185 Italy" |
| IT | Roma Tre | INFN Sezione di Roma Tre, via della Vasca Navale 84, 00146 Roma |
| IT | Rome Vergata | INFN structure of Rome Tor Vergata |
| IT | Torino | "INFN - Sezione di Torino Via Pietro Giuria 1 - 10125 - Torino - ITALY" |
| IT | Trieste | Istituto Nazionale di Fisica Nucleare, INFN Section of Trieste |
| NL | Nikhef | Nikhef, Science Parc 105, 1098 XG, Amsterdam |
| NO | NTNU | Power Electronics lab at the Department of Electric Energy, Norwegian University of Science and Technology (NTNU) |
| SE | Uppsala | Uppsala university, Dept. Physics and Astonomy, Rgementsvagen 1, Uppsala, Sweden |
| SE | Uppsala-FREIA | FREIA laboratory of Uppsala University |
| UK | Birmingham | School of Physics and Astronomy, University of Birmingham, Edgbaston, B15 2TT, Birmingham, UK |
| UK | Daresbury | Daresbury Laboratory |
| UK | Daresbury-tech | Technology at Daresbury (Part of STFC Daresbury Laboratory) |
| UK | Glasgow | PPE - Glasgow Univiersity |
| UK | Imperial | "High Energy Physics Group Imperial College London South Kensington SW72AZ" |
| UK | Manchester | University of Manchester |
| UK | Oxford | "University of Oxford Sub department of Particle Physics Denys Wilkinson Building Keble Road Oxford, OX1 3RH" |
| UK | RAL-PP | Particle Physics Department, Rutherford Appleton Laboratory, Harwell Campus, Didcot, Oxon, OX11 )QX, UK |
| UK | RAL-technology | Technology Department. Rutherford Appleton Laboratory, Chilton, Didcot, Oxon, OX11 0QX UK |

# Example

## 6. Does your lab contain test set-up for characterisation and test-bench measurements?



# What now?

- We will match the DRD requirements to the available resources
  - It will require substantial work to interpret the survey data
  - Many labs are actually already connected to the DRD activities
    - We aim to conclude the survey early December

- Identify where the institutes can/should step in
  - Once we identify the ‘missing facilities’ we can approach funding agencies
  - Add more transparency of the institutes’ roles in the DRD activities
    - The LDG will have to play the essential nexus role

- *Final aim:*

*Provide the Infrastructures to make the Detector R&D Roadmap a success*