DRD-on-Calorimetry
Overview on further Testbeam Facilities

Roman Pöschl

DRD Calo Collaboration Meeting – April 2024

Testbeam facilities – Prologue

- Let us first thank the beam test and radiation facilities operators and the lab and institute managements for the availability of the facilities

- The following is a mix of information extracted from the input proposals and my own experience and observations

- A lot of input for this talk came also from the ongoing 11th BTTB Workshop at DESY
  - https://indico.cern.ch/event/1232761/
  - Sorry I didn't find time to update, might be of for today
  - Check also 12th BTTB next week

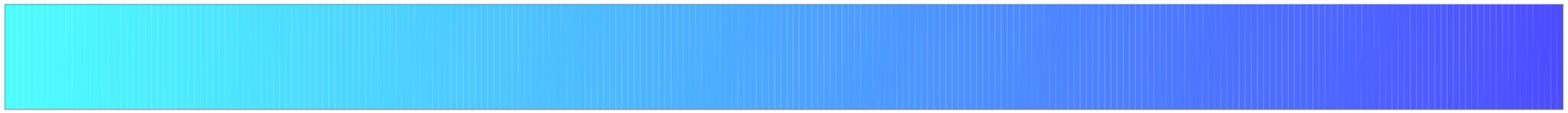
Beam tests – Funding opportunities

EURO-LABS
EUROPEAN LABORATORIES FOR ACCELERATOR BASED SCIENCES

Access to Research Infrastructures for
Nuclear Physics - Accelerator R&D – Particle Physics

- 4 year project started September 2022
- Transnational Access to a range of facilities – emphasis on students and post-docs
  - Access to e.g. DESY and CERN
  - Full list of facilities in backup

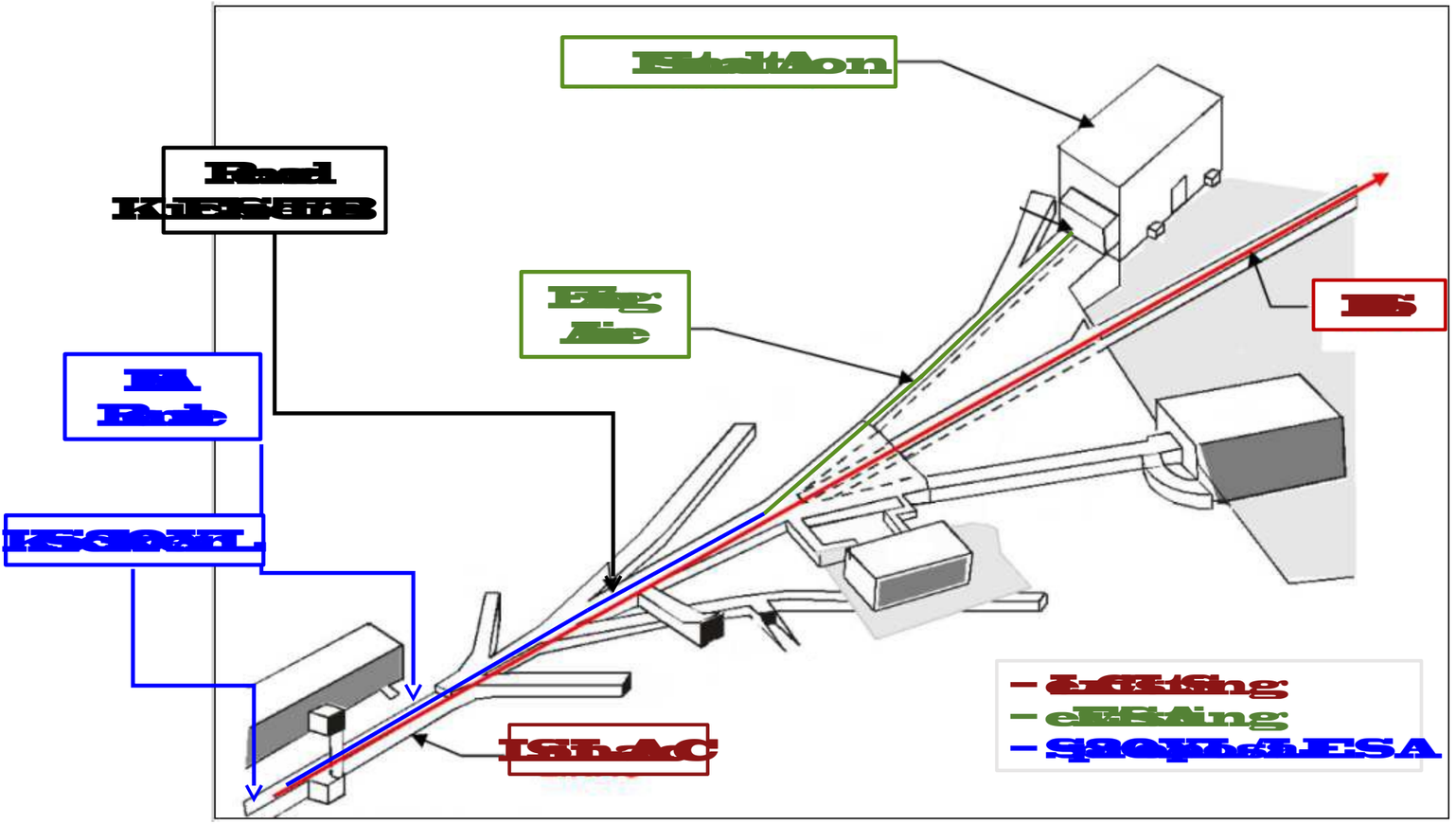
Input proposals - “Testbeam schedule”



- Input-proposals reveal (relatively) little need at the beginning
  - Start with prototypes that are either existing or currently under construction
  - Benefitting from AIDAinnova and EUROLABS funding
- Relatively high density of beam tests with new (large scale) prototypes after 2025
- The large scale beam tests will be preceded by smaller scale beam tests
  - Individual layers smaller systems before “mass production”

Testbeam facilities – SLAC

Linac to End Station A (LESA)



- Beam Energy
  - Pegged to LCLS-II
  - 4 GeV and then 8 GeV with LCLS-II-HE
  - Can tune energy lower in A-Line (when making secondaries: a few to << 1 e– per pulse)
- Variable Current
  - Up to 25 nA (3000 e–/bunch) with 50% duty cycle (useful for irradiation tests, testing integrating detectors)
  - Down to Poisson average < 1 e– per pulse
- Repetition rate 46MHz@50% duty cycle
- Now beam in S30XL
- Availability > 2026
- If available ~250 user days

Citation Carsten:

I Hope We Can Continue Electron Test Beams at SLAC's ESA Soon

Details see Carsten Hast at BTTB 11

Testbeam facilities – KEK

I. Nakamura, 11th BTTB Meeting

PF-AR

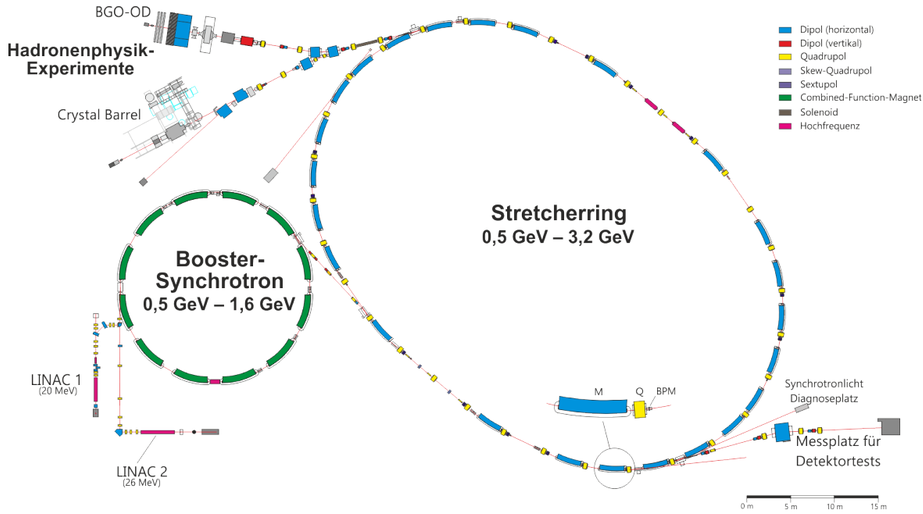
- PF-AR (Photon Factory Advanced Ring)
  - Photon Source Facility (High Energy X-ray)
  - former booster (8 GeV) of TRISTAN e^+e^- collider
- Maximum 6.5 GeV, 60 mA, Single Bunch (Run at 6.5 or 5 GeV, 50 mA, Top-up)
- 377m Circumference (1.26 μs or 795 kHz)
- Four Expermental Halls North/East/West/South

Smaller facilities (Incomplete list)

JGU Mainz

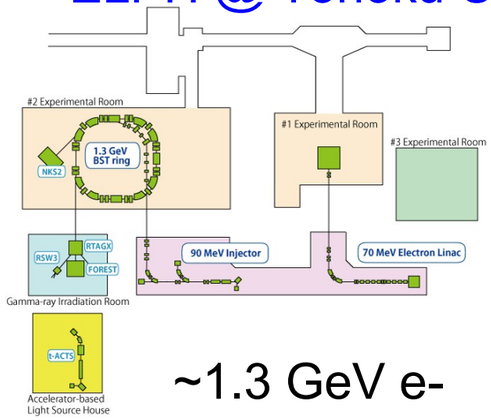
~1 GeV e-

ELSA @ Uni Bonn



~3 GeV e-

ELPH @ Tohoku U

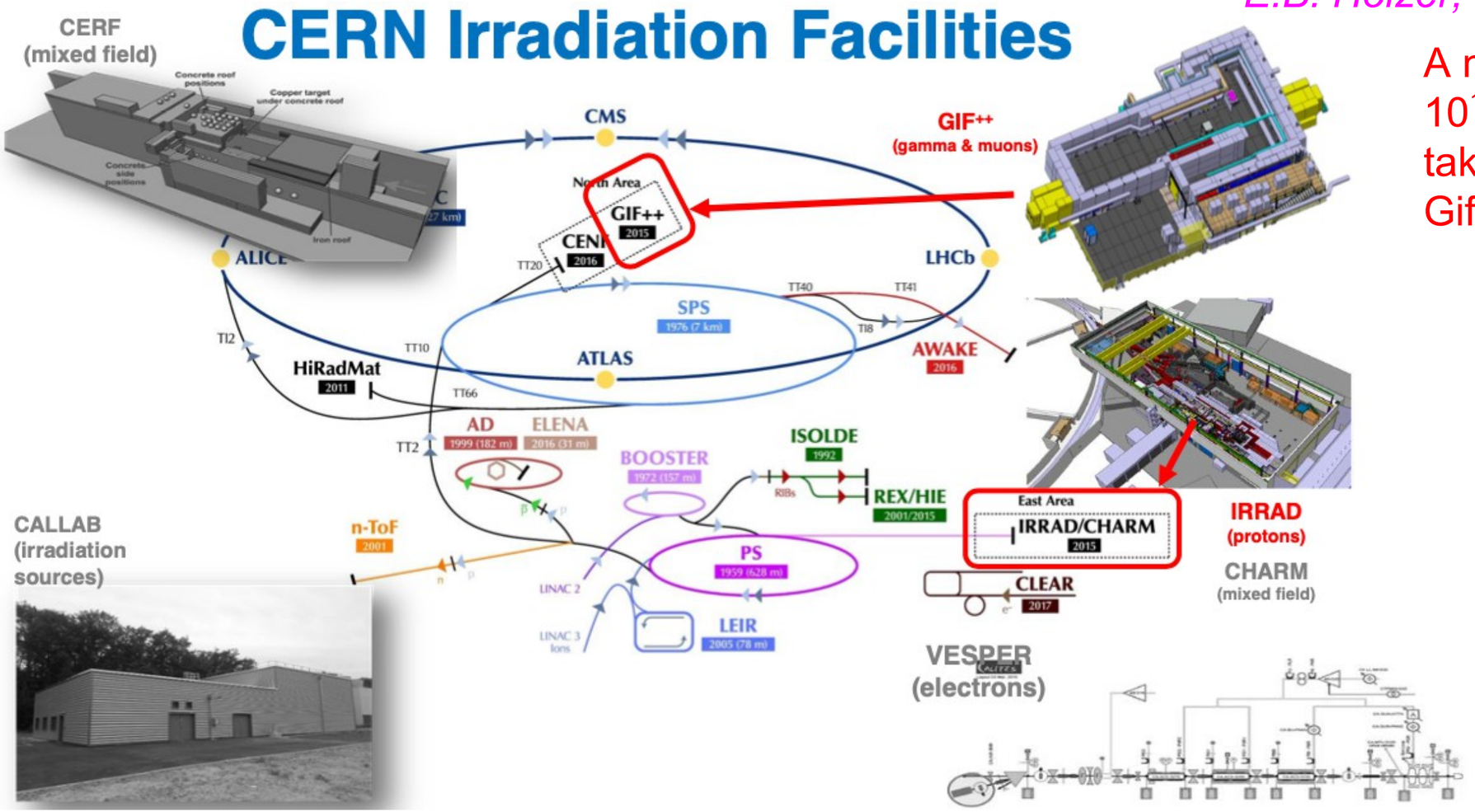


~1.3 GeV e-

- Apologises to those that are not listed
- Please help us to complete this list

Irradiation facilities – Example CERN

E.B. Holzer, 11th BTTB Workshop



A number:
10^{17} p/cm^2
take one year at Gif++

I don't forget: JSI Triga, U.o.B Cyclotron, Louvain, ITAINNOVA, Groningen and there are others

Match Irradiation/Beamtest Facilities Detector Needs

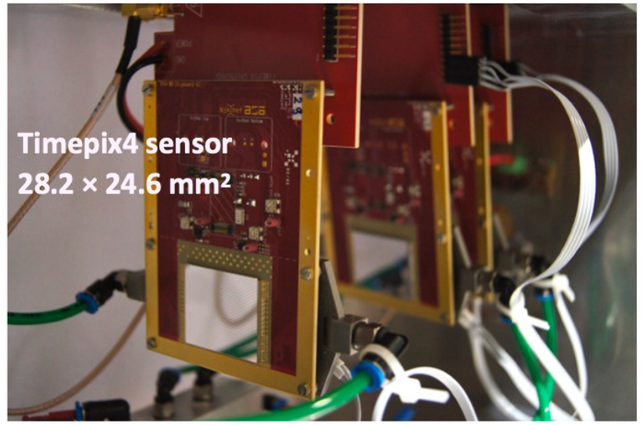
	Energy	Irradiation
Higgs Factory CMS energy 90-1 TeV Radiation <= 10^{14} $n_{eq/}cm^2$	✓	✓
HL-LHC CMS energy 14 TeV (shared by partons) Radiation ~10^{16} n_{eq}/cm^2	(✓)	✓
Muon Collider CMS energy 3-10 TeV Radiation ~HL-LHC	x	✓
Future Hadron Collider CMS energy 100 TeV (shared by partons) Radiation up to ~10^{18} n_{eq}/cm^2	x	x

Testbeam facilities – (Needed) infrastructure

Telescopes:

Cerenkov Counters:

Telescopes with time reference:



Expect: ~50ps with LGADs (enough?)

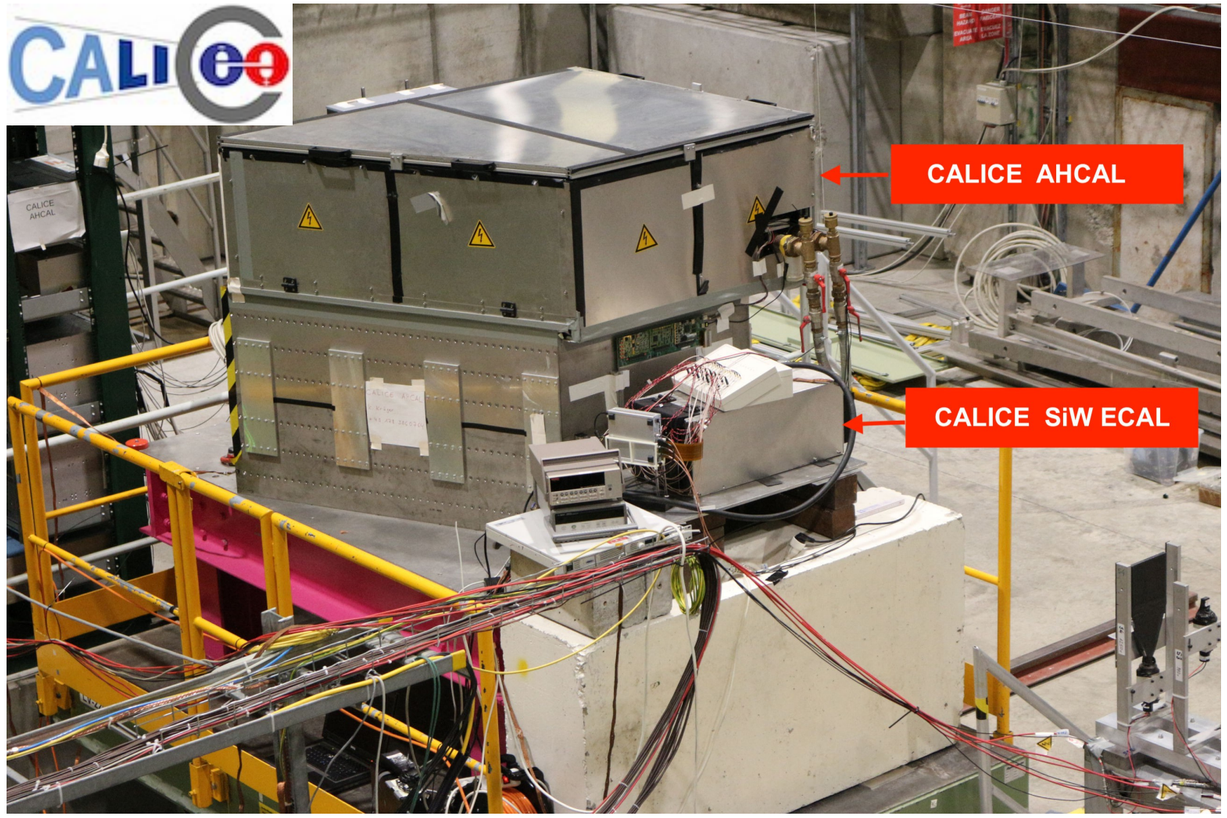
Magnets:

Interaction between DRD and facilities

- Facilities have to provide the beams, the beamline devices and the user support
  - Facilities have to be enabled to provide this support

- User support is not customer service
  - DRD has/have to provide contacts and to cooperate with facilities

Dedicated Calorimeter Area?



Common setup at CERN June 2022

- Calorimeters are typically large objects
  - A beam test is similar to a small experiment
- Difficult for facility managers to schedule calorimeter beam tests
  - No concurring running with other devices possible
- Takes lots of expertise to carry out a successful beam test campaign
  - Implies use of infrastructure
- A dedicated beam line maybe with dedicated slots during a year may help curing these issues
  - Would need sustained expertise on the beamline

Points for Discussion 1

Disclaimer: This slide and the following are issue of a short e-mail exchange between Gabri and R.P. Their purpose is to animate the discussion. Your input is welcome and needed.

1) How should we plan beam tests in DRD Calo?

- Individual or central request?
  - We know that there are pros and cons but a common beam test area may imply a common planning
  - Should we plan from the beginning to regular reports on requests to e.g. CERN SPS-C (and corresponding panels at other beam test sites) or should be wait to “get invited”
- Can we expect mutual help during preparation and during the actual data taking from other projects in DRD Calo?
  - Help with shifts, setting up of beams and beam lines devices and further infrastructure
  - Will be different depending on the beam line and the beam test scope but we may want to define “points of orientation”
  - Depends also on our understanding of a “Common beam test area”
- Role of Technical Board and interplay with WG on Testbeams

Points for Discussion 2

2) A common beam test area, what does it mean?

- Which common equipment and how to organise potential investments?
  - Equipment
    - Tracker (Telescope), Cherenkov detectors for PID, Muon tagger, Laser system, XY table (plus rotation rotating platform (e.g. H8 line in P168)
    - EUDAQ system in which we could plug our detectors
    - Computing equipment (local storage, data links)
  - Investments
    - Mix of facility investments and investment proper to DRD Calo?
    - If proper to DRD Calo: Common fund or individual investments put at disposal of DRD Calo?
- Responsibilities for the equipment and communication with facility managers and operators?
  - A dedicated pool of people who come from different institutes and projects who regardless of their "origin"?
  - A simple transfer of knowledge from Team A to Team B
- Suppose we get a common area at Facility A (say CERN), what can be transferred to Facility B
- Role of Technical Board and Testbeam WG?
  - It may be one of the tasks of the Chair of the Technical Board to set up the WG and adjust its role to the “real conditions”

Backup

Testbeam facilities – General remarks

- Let us first thank the beam test and radiation facilities operators and the lab and institute managements for the availability of the facilities

- The importance of beam tests during detector development cannot be overrated
  - Recent refurbishment of various beam test sites witness that this is recognised by the lab managements

- Maybe more than other detectors calorimeters need a large variety of particle momenta, particle types and beam rates

- The portfolio of the EPPSU comprises projects supposed to run between now and 2080-2090
  - During all these decades we need versatile beam test and radiation facilities to accompany the R&D program
  - ... including competent staff to run these facilities (-> investment in accelerator and instrumentation experts)
  - Maybe some steps can be executed with powerful computing, AI or whatever the future brings
  - However, it can never be desirable that the first beam a detector sees is the beam in the final experiment
    - Despite the fact that the return vessel of Apollo 11 has also never been tested before ;-)

- A future hadron collider would require to make a test beam facility part of the LHC programme

EUROLABS Participating Institutes

Participants

- 34 participating Laboratories
- Access to 43 Research Infrastructures (RIs)
- Spread in 12 countries across Europe

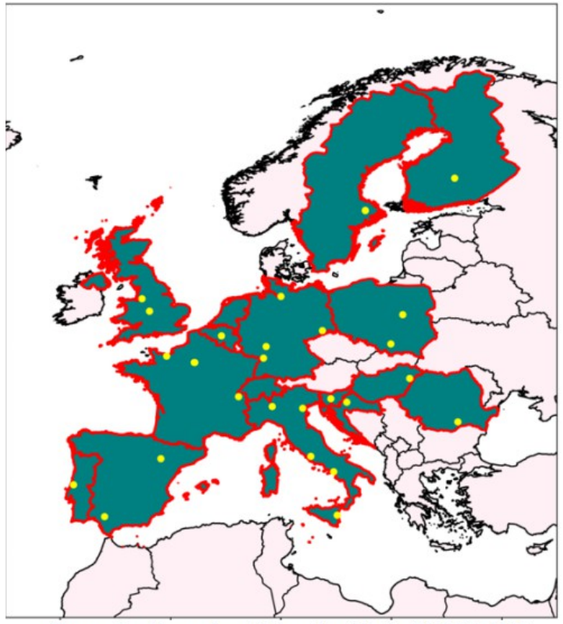


Figure 1 - Map of participating RIs in EURO-LABS

Participant short name	Participant name	Country	Country Code	Role	WP
INFN	**National Institute for Nuclear Physics**	**Italy**	**IT**	**Coordinator**	WP1, WP2, WP3, WP5
GANIL	GRAND ACCELERATEUR NATIONAL D'IONS LOURDS	France	FR	Partner	WP2, WP5
CERN	European Organization for Nuclear Research	Switzerland	CH	Partner	WP1, WP2, WP3, WP4
JSI	INSTITUT JOZEF STEFAN	Slovenia	SI	Partner	WP4
IFJ-PAN	THE HENRYK NIEWODNICZANSKI INSTITUTE OF NUCLEAR PHYSICS, P	Poland	PL	Partner	WP2, WP4
DESY	STIFTUNG DEUTSCHES ELEKTRONEN-SYNCHROTRON DESY	Germany	DE	Partner	WP4
UCLouvain	UNIVERSITE CATHOLIQUE DE LOUVAIN	Belgium	BE	Partner	WP4
RBI	RUDER BOSKOVIC INSTITUTE	Croatia	HR	Partner	WP4
CNRS	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS	France	FR	Partner	WP2, WP3, WP5
FBK	FONDAZIONE BRUNO KESSLER	Italy	IT	Partner	WP2
ITAINNOVA	INSTITUTO TECNOLOGICO DE ARAGON	Spain	ES	Partner	WP4
UoB	THE UNIVERSITY OF BIRMINGHAM	UK	UK	Partner	WP4
UNIWARSAW	UNIWERSYTET WARSZAWSKI	Poland	PL	Partner	WP2
GSI	GSI HELMHOLTZZENTRUM FUR SCHWERIONENFORSCHUNG GMBH	Germany	DE	Partner	WP2, WP5
IFIN	INSTITUTUL NATIONAL DE CERCETARE-DEZVOLTARE PENTRU FIZICA	Romania	RO	Partner	WP2, WP5
USE	UNIVERSIDAD DE SEVILLA	Spain	ES	Partner	WP2
IST	INSTITUTO SUPERIOR TECNICO	Portugal	PT	Partner	WP2
ATOMKI	ATOMMAGKUTATO INTEZET	Hungary	HU	Partner	WP2
JYU	JYVASKYLAN YLIOPISTO	Finland	FI	Partner	WP2
UU	UPPSALA UNIVERSITET	Sweden	SE	Partner	WP3
CEA	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERN	France	FR	Partner	WP2, WP3, WP5
KIT	KARLSRUHER INSTITUT FUER TECHNOLOGIE	Germany	DE	Partner	WP3
UKRI	UNITED KINGDOM RESEARCH AND INNOVATION	UK	UK	Partner	WP3
UMCG	ACADEMISCH ZIEKENHUIS GRONINGEN	Netherlands	NL	Partner	WP2
FEP	Fraunhofer Institute for Organic Electronics, Electron Beam and Plasm	Germany	DE	Partner	
INCT	INSTYTUT CHEMII I TECHNIKI JADROWEJ	Poland	PL	Partner	WP3
CSIC	AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENT	Spain	ES	Partner	WP5
PSI	*PAUL SCHERRER INSTITUT*	*Switzerland*	*CH*	*Associated*	WP4
JINR	*JOINT INSTITUTE FOR NUCLEAR RESEARCH*	*Russian Federation*	*RU*	*Associated*	
RIKEN	*RIKEN THE INSTITUTE OF PHYSICAL ANDCHEMICAL RESEARCH*	*Japan*	*JP*	*Associated*	
MSU	*MICHIGAN STATE UNIVERSITY*	*USA*	*US*	*Associated*	
TUD	*TECHNISCHE UNIVERSITAET DRESDEN*	*Germany*	*DE*	*Associated*	
UMIL	UNIVERSITA DEGLI STUDI DI MILANO	Italy	IT	Partner	WP2
LIP	*LABORATORIO DE INSTRUMENTACAO E FISICA EXPERIMENTAL DE F*	*Portugal*	*PT*	*Associated*	