



RD50 online Workshop – 21-24.06.2022



Welcome to the 40th RD50 Workshop

**Radiation hard semiconductor devices
for very high luminosity colliders**

CERN (in-person/online) 21-24.06.2021

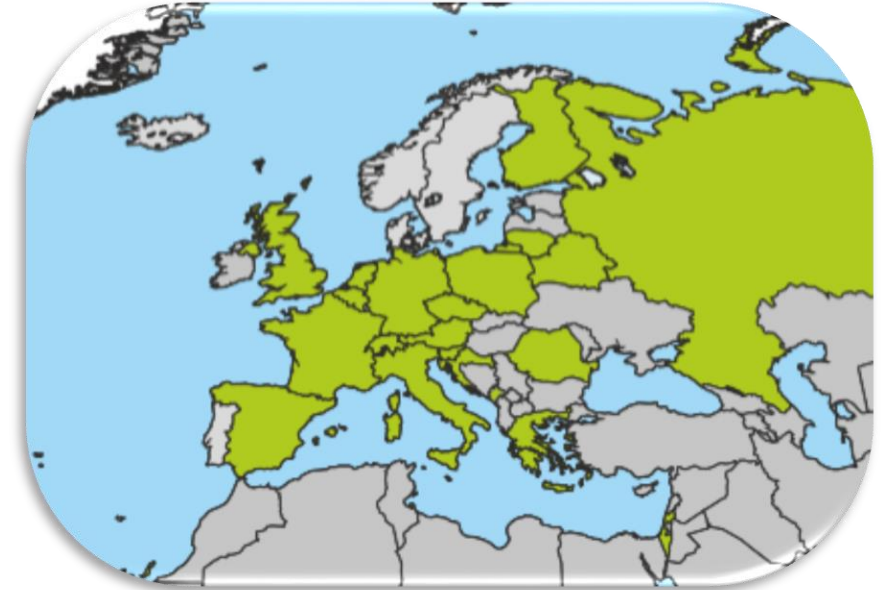
The RD50 Collaboration



- RD50: 66 institutes and 430 members

51 European institutes

Austria (HEPHY), **Belarus** (Minsk), **Czech Republic** (Prague (3x)), **Finland** (Helsinki, Lappeenranta), **France** (Marseille, Paris, Orsay), **Germany** (Bonn, Dortmund, Freiburg, Göttingen, Hamburg (Uni & DESY), Karlsruhe, Munich (MPI & MPG HLL)), **Greece** (Demokritos), **Italy** (Bari, Perugia, Pisa, Trento, Torino), **Croatia** (Zagreb), **Lithuania** (Vilnius), **Montenegro** (Montenegro), **Netherlands** (NIKHEF), **Poland** (Krakow), **Romania** (Bucharest), **Russia** (Moscow, St.Petersburg), **Slovenia** (Ljubljana), **Spain** (Barcelona(3x), Santander, Sevilla (2x), Valencia), **Switzerland** (CERN, PSI, Zurich), **United Kingdom** (Birmingham, Glasgow, Lancaster, Liverpool, Oxford, Manchester, RAL)

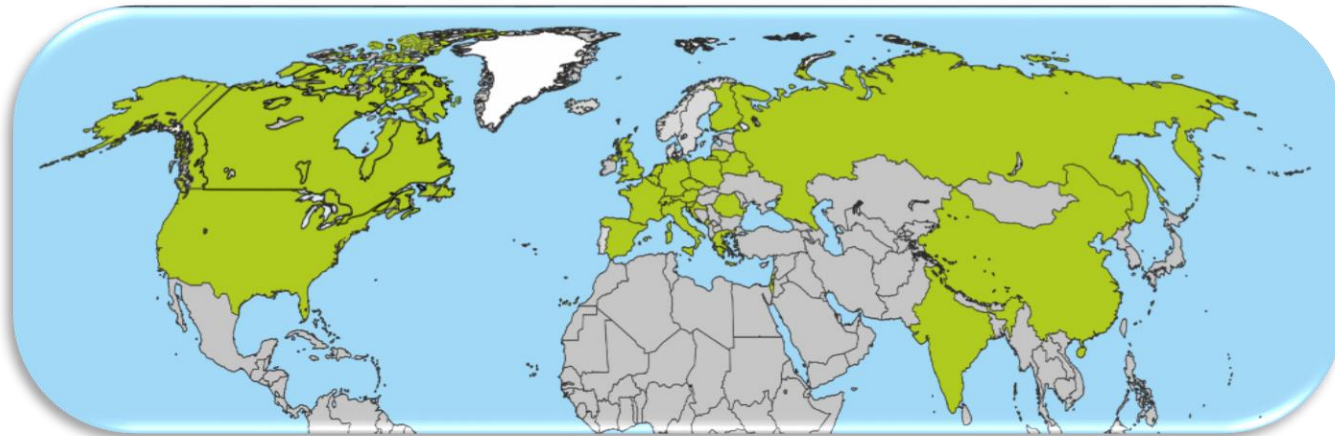


8 North-American institutes

Canada (Ottawa), **USA** (BNL, Brown Uni, Fermilab, LBNL, New Mexico, Santa Cruz, Syracuse)

7 Asian institutes

China (Beijing-IHEP, Dalian, Hefei, Jilin, Shanghai),
India (Delhi), **Israel** (Tel Aviv)



Full member list: www.cern.ch/rd50

Organizational Structure / Work Program



Covering all fields of semiconductor detectors exposed to radiation

Co-Spokespersons
Gianluigi Casse and *Michael Moll*
 (Liverpool University, UK & FBK-CMM, Trento, Italy) (CERN EP-DT)

Targeting new solid-state detector technologies including high precision 4D detectors

Spokespersons and management team were re-elected for two years in June 2021

CB chair was re-elected for 2 yrs. in December 2020

Defect / Material Characterization
Ioana Pintilie
 (NIMP Bucharest)

- Characterization of microscopic properties of standard-, defect engineered and new materials; pre- and post- irradiation
- DLTS, TSC,
- SIMS, SR, ...
- NIEL (calculations)
- Cluster and point defects
- Boron related defects
- SiC/GaN based detectors

Detector Characterization
Eckhart Fretwurst
 (Hamburg University)

- Characterization of test structures (IV, CV, CCE, TCT,..)
- Development and testing of defect engineered devices
- EPI, MCZ and other materials
- NIEL (experimental)
- Device modeling
- Operational conditions
- Common irradiations
- Very high radiation fluences
- Wafer procurement (M.Moll)
- Acceptor removal (Kramberger)
- TCAD modeling (J.Schwandt)

New Structures
Giulio Pellegrini
 (CNM Barcelona)

- 3D detectors
- Thin detectors
- Cost effective solutions
- Other new structures
- Detectors with internal gain
- LGAD:Low Gain Avalanche Det.
- Deep Depleted Avalanche Det.
- Slim Edges
- HVCMOS
- LGAD (S.Hidalgo)
- HVCMOS (E. Vilella)

Full Detector Systems
Gregor Kramberger
 (Ljubljana University)

- LHC-like tests
- Links to HEP (LHC P2, FCC)
- Links electronics R&D
- Low rho strips
- Sensor readout (Caribou,Alibava)
- Comparison:
 - pad-mini-full detectors
 - different producers
- Radiation Damage in HEP detectors
- Timing detectors
- Test beams (M.Bomben & G.Casse)

RD50 work program and key achievements documented in a 5yrs work plan 2018-23 (70 milestones)

Collaboration Board Chair & Deputy: G.Kramberger (Ljubljana) & Daniel Münstermann (Lancaster), Conference committee: U.Parzefall (Freiburg)
 CERN contact: M.Moll (EP-DT), Secretary: V.Wedlake (EP-DT), Budget holder: M.Moll & M.Glaser (EP-DT) , EXSO: R.Costanzi (EP-DT)

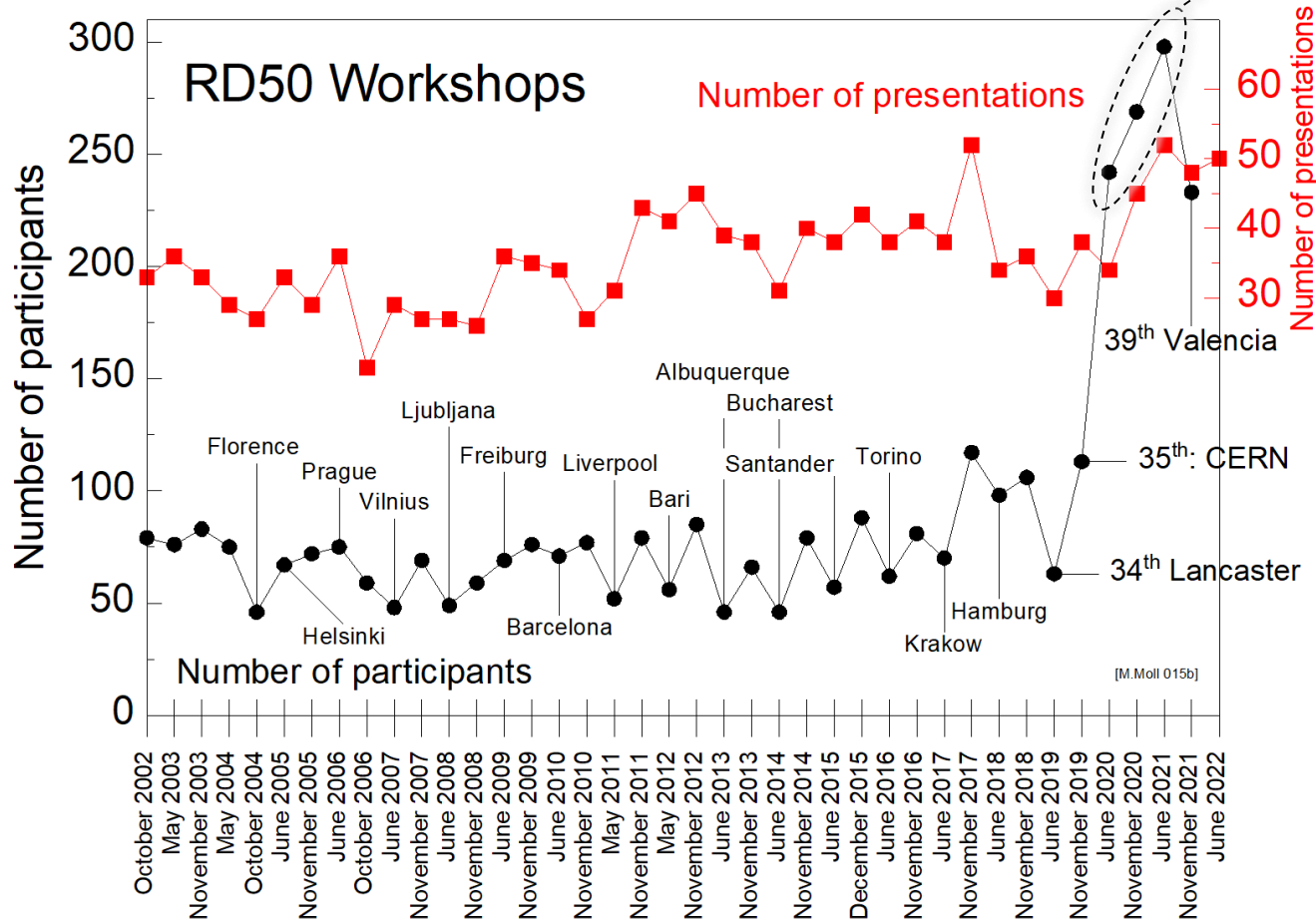
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RD50 Workshop statistics



Online workshops

- RD50 holds every year two RD50 workshops
- Average numbers for RD50 Workshops: <36 talks> <98 participants>



- November 2021 : Valencia, Spain
 - First in-person workshops since November 2019
 - 233 registered participants (>50% of collaboration)
 - 48 talks and 5 discussion sessions in 3 days
- June 2022 : CERN, Geneva, CH
 - 40th RD50 Workshop
 - Hybrid Workshop (in-person/online)
 - 1st 4-day Workshop (Tuesday – Friday)
 - 157 registered participants (Sunday before workshop)
 - 72 in-person participants (Sunday before workshop)
 - 50 talks – 7 discussion sessions
 - Long CB meeting (ECFA Roadmap Implementation)
- November 2022 : Seville, Spain
 - 41st RD50 Workshop
- Summer 23 not fixed

Program: 40th Workshop [4 days!]



- **DAY1** - Tuesday 21.06.2022

- 9:00-13:00: **Defect, Material and Sensor Characterization - Silicon** (7 talks + discussion)
- *Lunch*
- 14:00: **Irradiation facilities** (2 talks + discussion on facilities in Wednesday afternoon discussion)
- 14:20: “Open Collaboration Board”: **Discussion on ECFA Detector Roadmap** (2 talks + discussion)

- 16:15: **Collaboration Board** (closed session – RD50 institute representatives)
 - Main topic: Detector Roadmap Implementation & Next RD50 Workplan

50 talks
&
7 discussion
sessions

- **DAY2** - Wednesday 22.06.2021

- 9:00-13:00: **Wide Bandgap Semiconductors – SiC and GaN** (8 talks + discussion)
- *Lunch*
- 14:00: **LHC experiment sensors & fundamentals of radiation damage** (6 talks + discussion)

Program: 40th Workshop [4 days!]



- **DAY3** - Thursday 23.06.2022

- 9:00-17:00: **LGAD – Low Gain Avalanche Detectors** (15 talks + discussion)
- *Lunch*
- 17:00-18:20: **3D and New structures** (3 talks + discussion)
- *Evening: Workshop Dinner*

- **DAY4** - Friday 24.06.2021

- 9:00-13:00: **MAPS and CMOS** (7 talks + discussion)
- *End of Workshop*

50 talks
&
7 discussion
sessions

Dinner on Thursday evening



- More details on Thursday
 - Bus will leave CERN at 19:30



For those that are “old enough”:

... remember,

.... we went there already ...

... for the 1st RD50 Workshop dinner in October 2002



June 2022



RD50 Workshop

Thanks to Session and Discussion Chairs



• Tuesday

- 9:00 – 10:30 Defects & Materials: Michael Moll
- 11:00- 12:40 Defects & Materials: Ioana Pintilie
- **Discussion: Defects & Materials Ioana / Michael**

- 14:00-14:40 Facilities: Daniel Muenstermann

- Collaboration Board: Gregor Kramberger

• Wednesday

- 09:00-10:20 Wide Band Gap - Thomas Koffas
- 10:50-12:40 Wide Band Gap - Giulio Pellegrini
- **Discussion: Wide Band Gap Sensors: Giulio Pellegrini**

- 14:10-15:30 Sensors: LHC experiments & radiation damage
Thomas Bergauer
- 16:00-17:00 radiation damage silicon :: Marko Mikuz
- **Discussion: Sensor Damage/Ultrahigh fluences
Marko Mikuz**

• Thursday

- 09:00-10:30 LGAD I – Valentina Sola
- 11:00-12:10 LGAD II – Marcos Fernandez Garcia
- 13:40-15:20 LGAD III – Ivan Vila
- 15:50-16:30 LGAD IV – Nicolo Cartiglia
- **Discussion: LGAD --- Nicolo/Gregor**
- 17:00-18:20: New Structures: Maurizio Boscardin
- **Discussion: New Structures (3D + other) Gregor**

• Friday

- 09:00-10:30 CMOS I – Eva
- 10:50-12:20 CMOS II – Tilman Rohe
- **Discussion: CMOS sensors - Eva**

Many thanks to ...

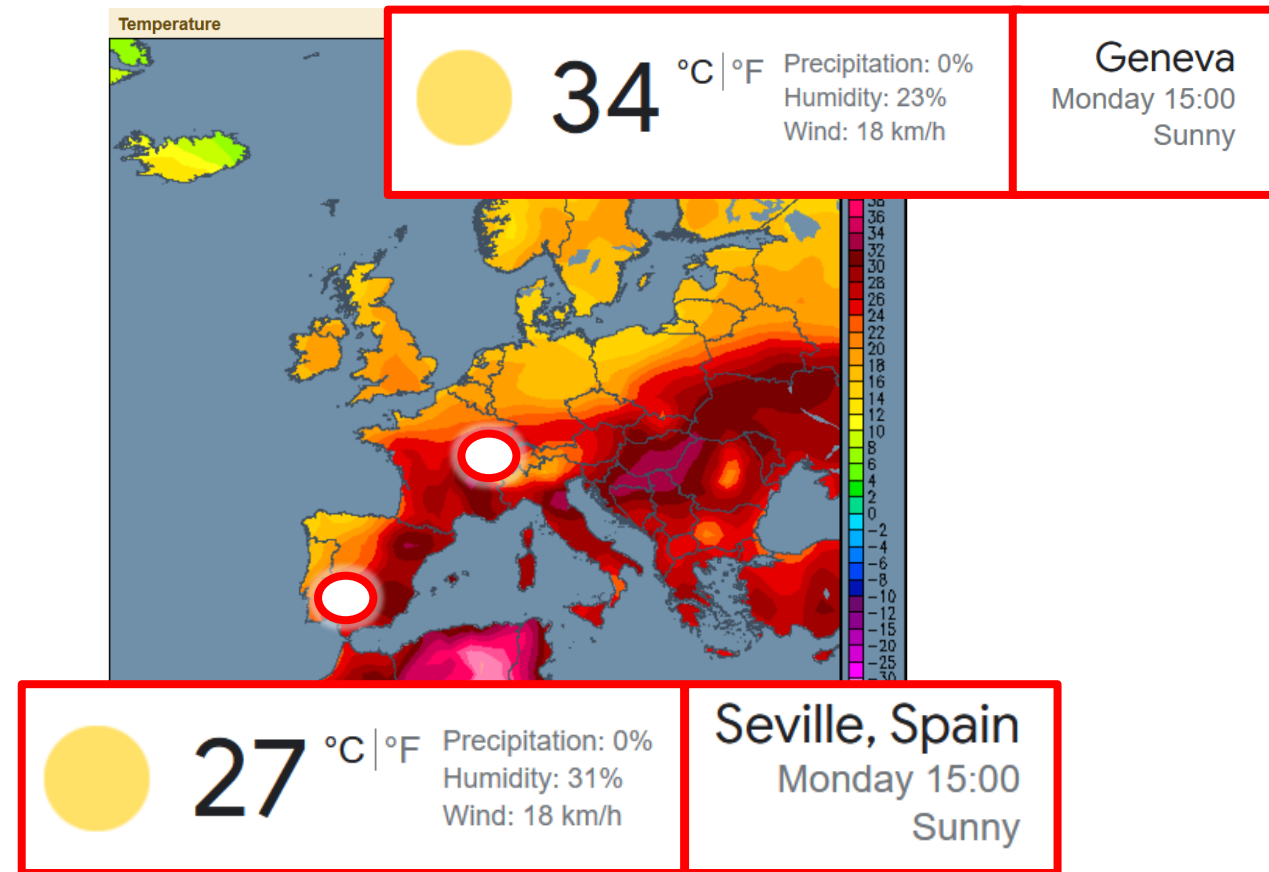
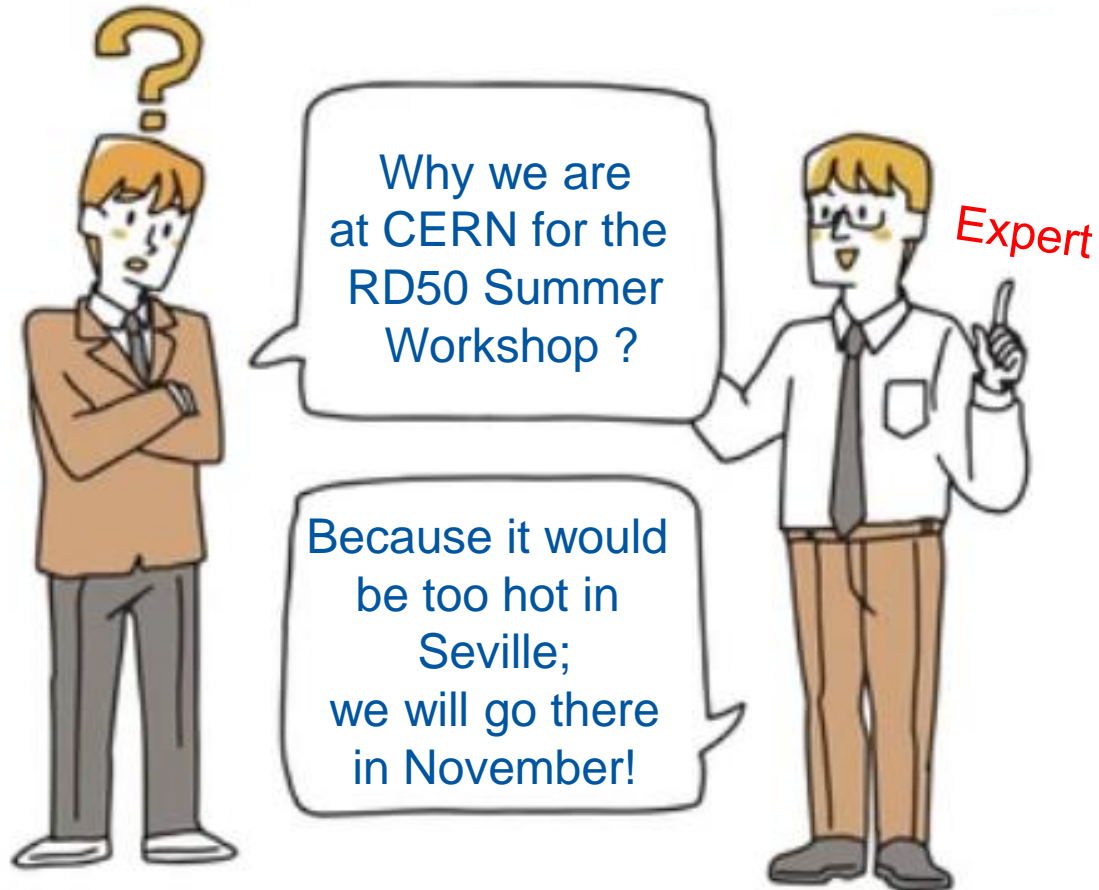


- ... all speakers
- the local organization team
 - ... Veronique, Esteban, Ruddy, Yana, Anja, Sebastian, Vendula,
- ... and on behalf of all RD50
 - .. to **Veronique Wedlake** for doing such a great job as RD50 secretary!
 - .. to **Maurice Glaser** for helping to handle the RD50 finances while enjoying his retirement in Brazil!
- *An excuse to Gianluigi:*
 - *Workshop date is conflicting with another obligation Gian has and he therefore cannot participate. We knew this when finally fixing the date, but could not avoid scheduling the workshop to the present date due to availability of rooms and other conflicts.*

Enjoy the Workshop



- Lesson of the day: Not all predictions turn out to be true.



....next RD50 Workshop: 29 November to 2 December in Seville, Spain