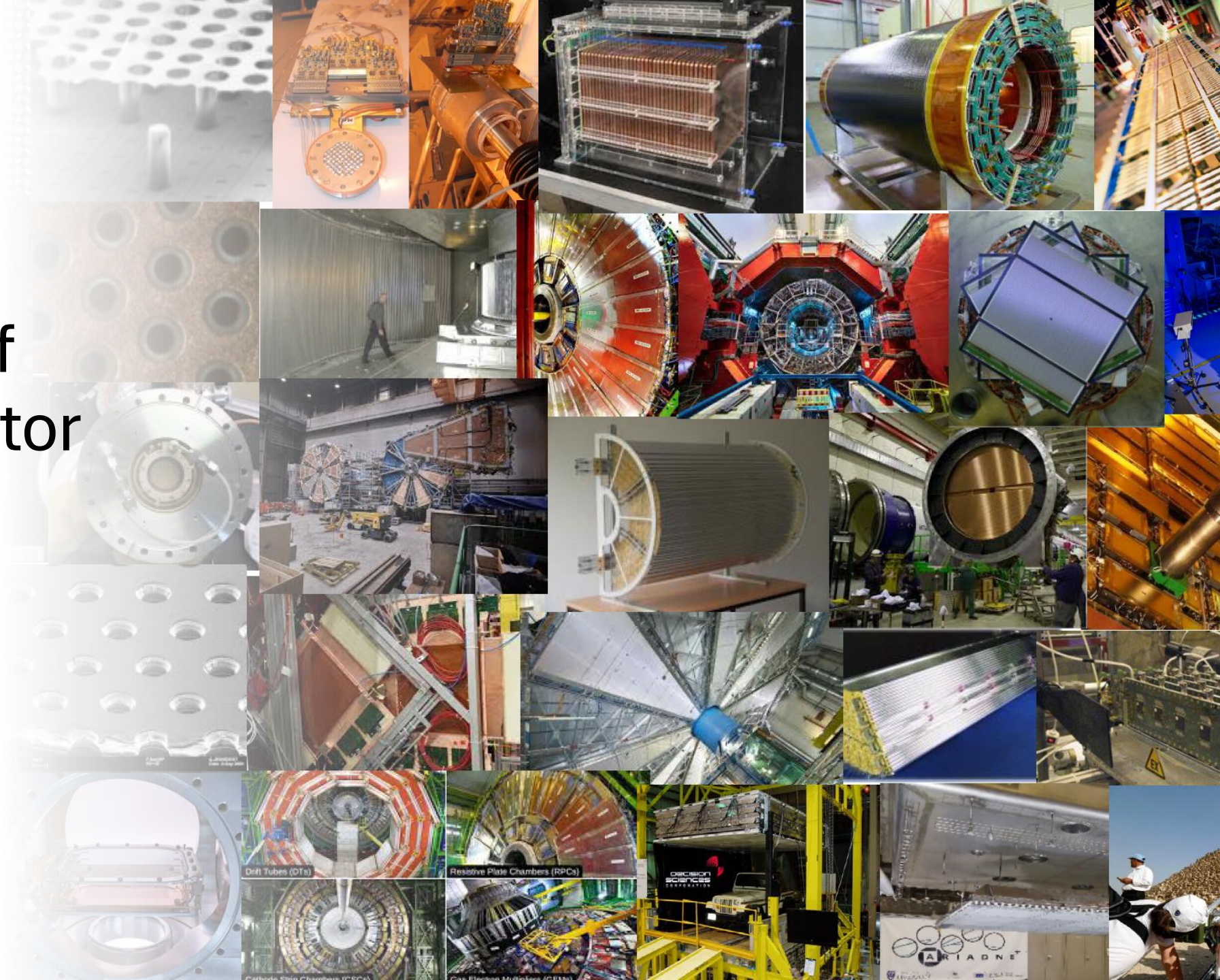


# DRD1

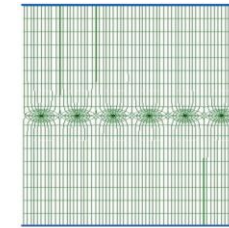
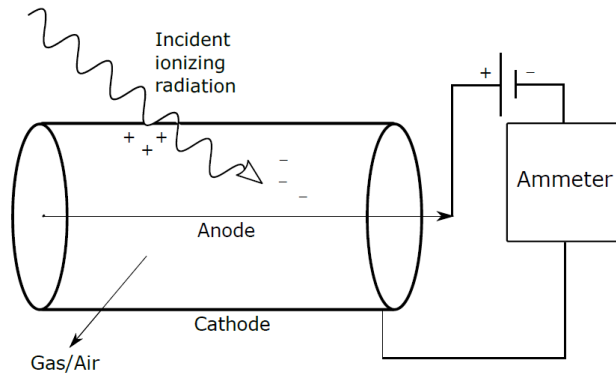
## Development of Gaseous Detector Technologies



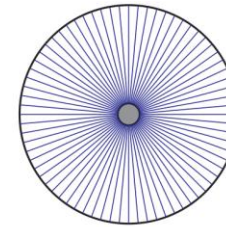
Kirill Salamatin

# What are Gaseous Detectors?

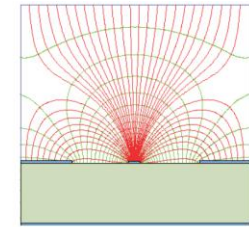
- Particle detection via ionisation in gas
- Large-area, flexible detector technology
- Used for tracking, timing, calorimetry, PID



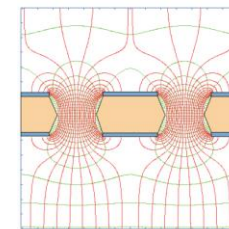
multiwire



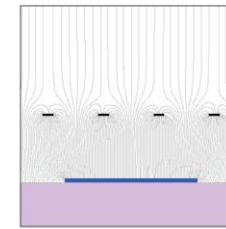
single wire



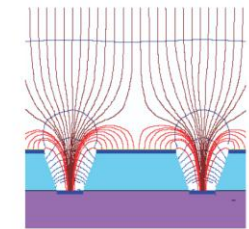
strips



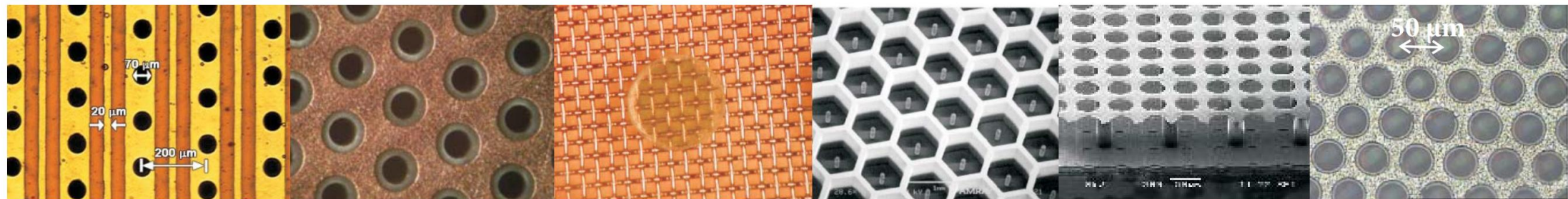
holes



parallel plate



grooves



microhole & strip plate

thickGEM

bulk Micromegas

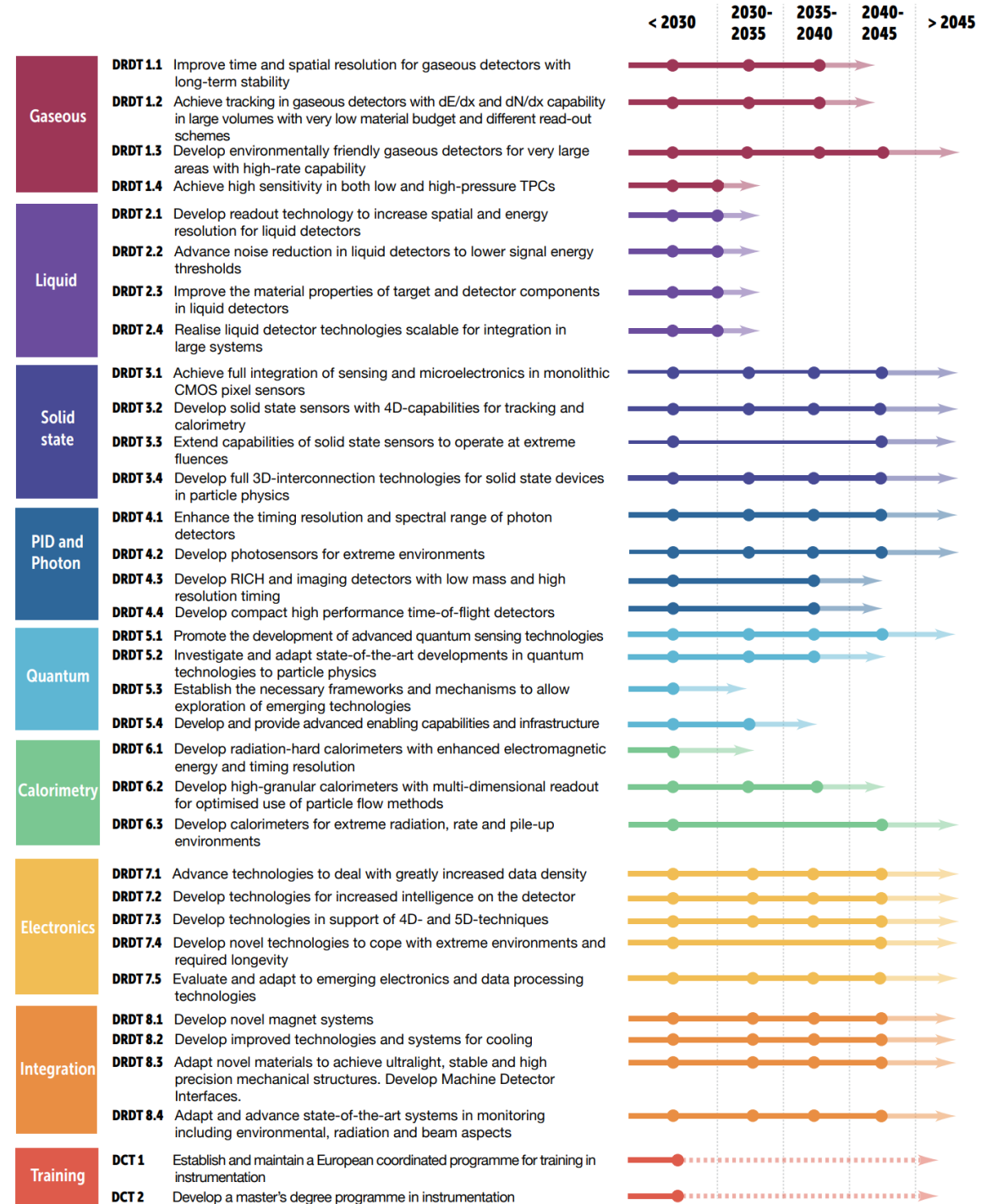
micropin array

InGrid on pixel chip

fine-pitch GEM

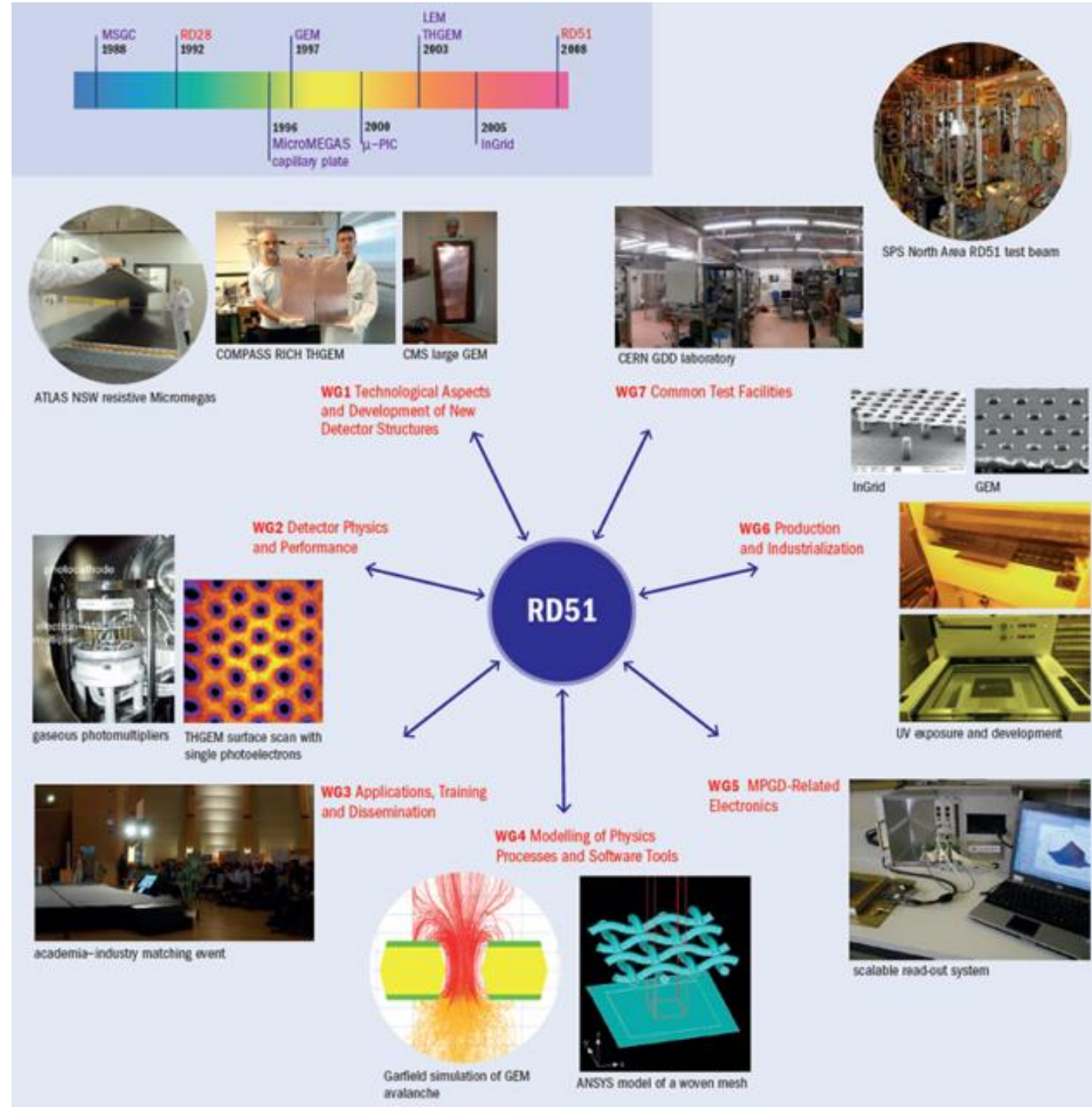
# Why DRD Collaborations?

- Detector R&D is increasingly complex and costly
- Long timescales for future experiments
- Need for coordination and shared infrastructure
- Driven by the ECFA Detector R&D Roadmap



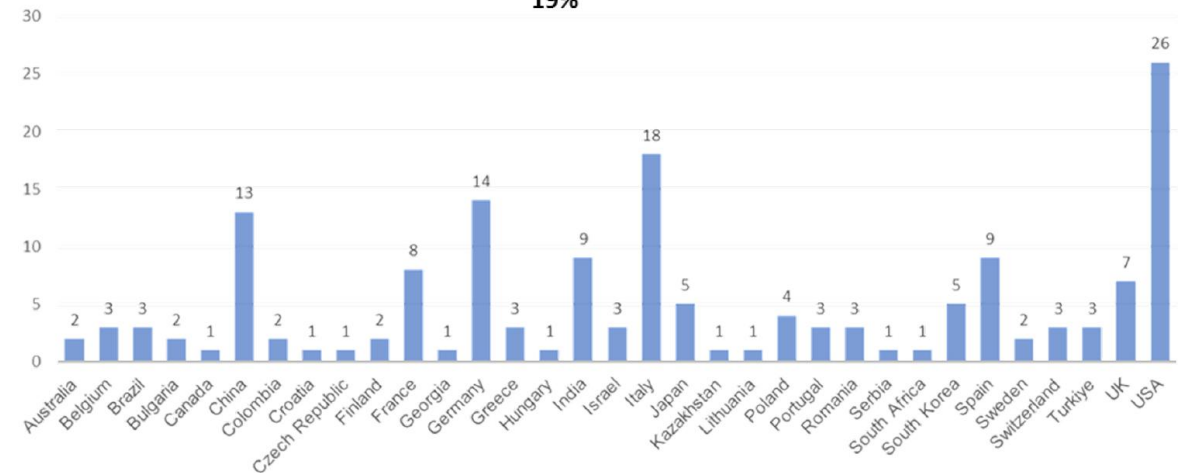
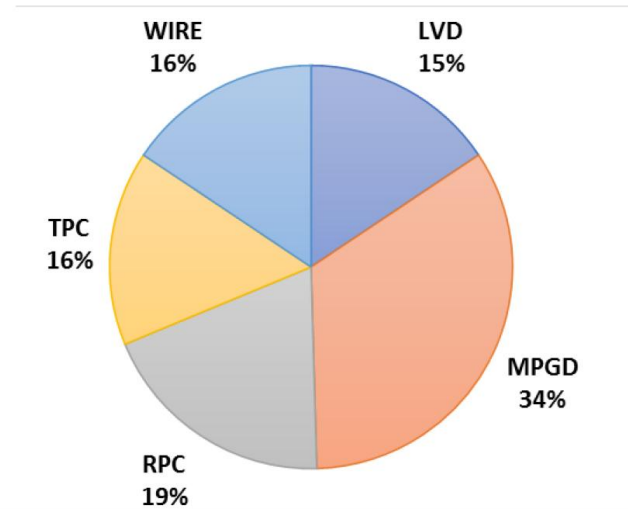
# From RD51 to DRD1

- Founded at CERN in 2008 to coordinate gaseous detector R&D
- Focused on Micro-Pattern Gaseous Detectors (MPGDs)
- International community of ~70+ institutes and 25+ countries
- Shared infrastructure: tools, test beams, simulation & workshops
- Paved the way for DRD1 evolution



# DRD1 Community

- **161 Institutes**
- **5 Industrial, Semi-Industrial and Research Foundations**
- **33 Countries**
- **More than 700 members**



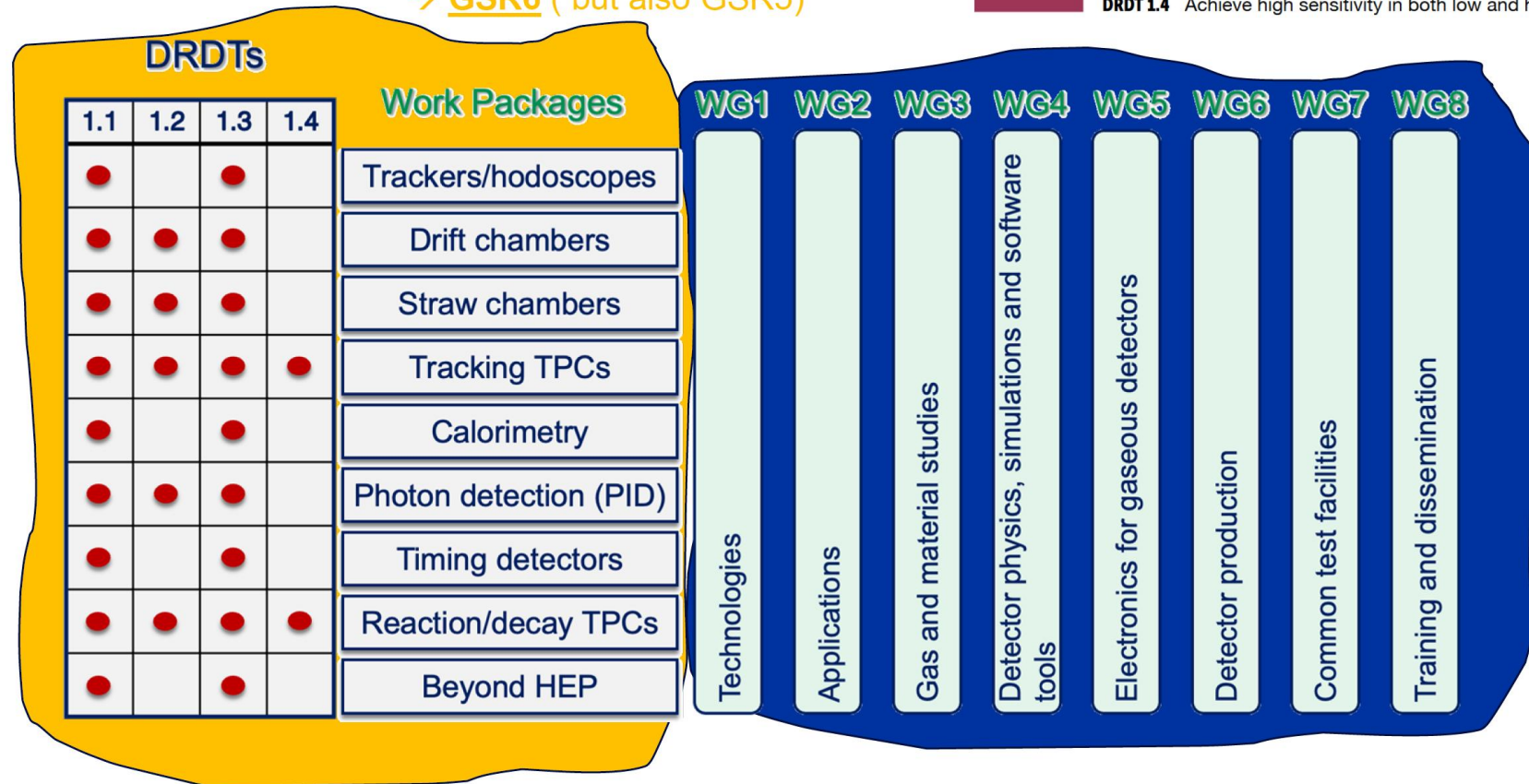
Countries of DRD1 Institutes (today)

# How DRD1 is Organized

Strategic R&D and Long-Term Funding based on Work Packages  
 → GSR6 ( but also GSR5)

Gaseous

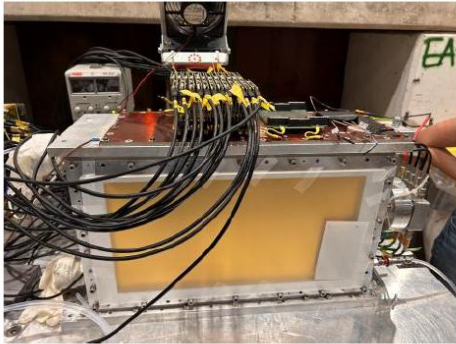
- DRDT 1.1** Improve time and spatial resolution for gaseous detectors with long-term stability
- DRDT 1.2** Achieve tracking in gaseous detectors with  $dE/dx$  and  $dN/dx$  capability in large volumes with very low material budget and different read-out schemes
- DRDT 1.3** Develop environmentally friendly gaseous detectors for very large areas with high-rate capability
- DRDT 1.4** Achieve high sensitivity in both low and high-pressure TPCs



R&D Framework based on Working Groups  
 → GSR5 (but also GSR6)

# Scientific Scope of DRD1

## High-Rate Tracking (HYDRA)

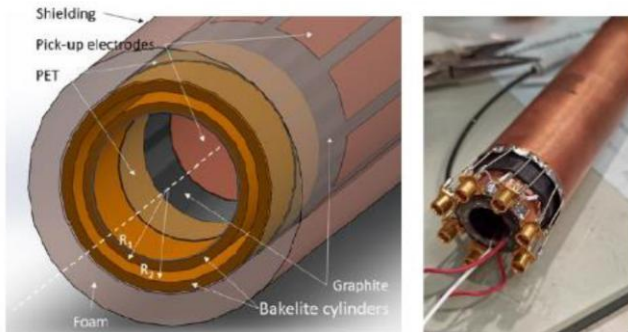


HYDRA pion tracker, GEM+MM TPC with VMM3a readout



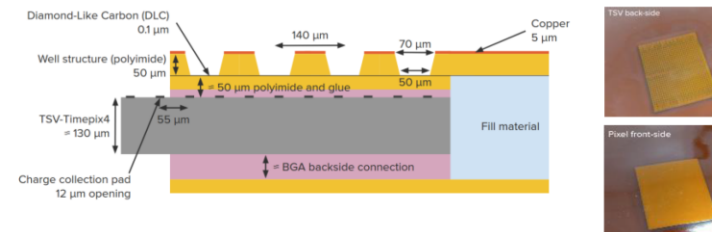
Self-supporting Straw module (PANDA-STT)

## New Detector Structures

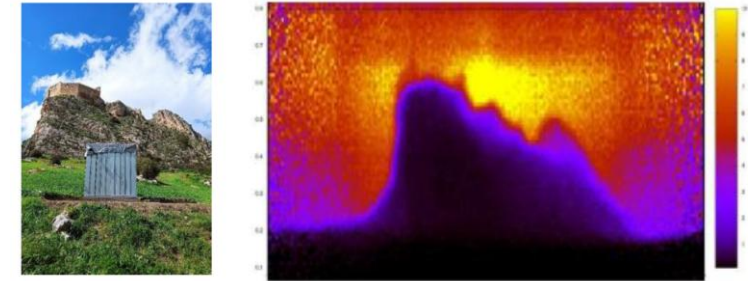


Resistive Cylindrical Chamber: RCC  
<https://doi.org/10.1016/j.nima.2023.168822>

## Timepix4 Embedding in uRWELL/MM



## Muon imaging and extreme environment conditions



Sealed mode operation demonstrated for over 6 months for RPCs and MWPCs.

## Ultrasonic Welding Technique



USW procedure for double side alu-metalized films

# Examples of DRD1 Activities

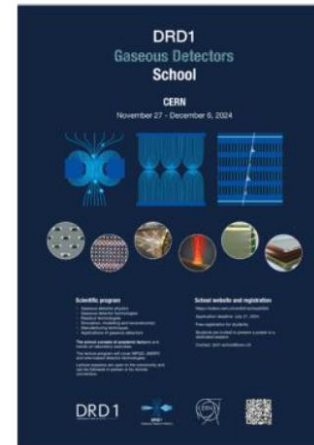
- New detector concepts
- Eco-friendly gas mixtures
- Advanced electronics and DAQ
- Test beams and irradiation
- Detector schools

## Lab exercises

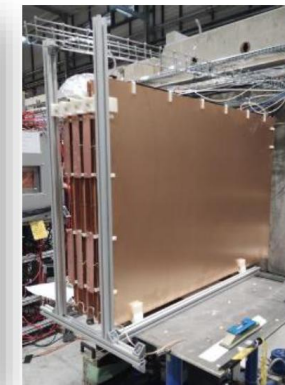
FTD at Bonn University hosting the school was a unique opportunity to include lab exercises on the **manufacturing and assembly** of GEMs in the in-house cleanroom facilities as well as the readout of a small TPC with **GridPix** detectors.



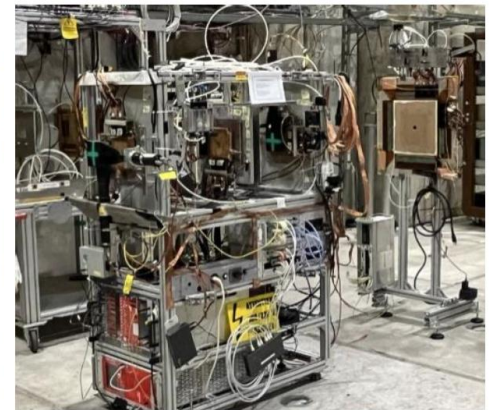
## DRD1 Gaseous Detector Schools



## FE & DAQ for Test Beam



## DRD1 Beam telescopes



# Training & Opportunities for Students

- DRD1 detector schools
- Hands-on lab and test-beam work
- MSc & PhD thesis projects
- International networking



**DRD1**  
Gaseous Detector School

Facility for Rare Isotope Beams (FRIB)  
Michigan State University (MSU), USA  
8-17 July 2026

**Scientific program**

- Gaseous detector advances
- Gaseous detector development
- Simulation, modelling and optimization
- Manufacturing techniques
- Applications in particle physics

The current contents of scientific lectures and hands-on laboratory exercises.

The lecture program will cover DRD1, BEPCII and new gaseous detector technologies.

Lectures presented are open to the community and can be followed in person or by remote connection.

**School website and registration**

Website: [www.cern.ch/drdsims2026](http://www.cern.ch/drdsims2026)  
Registration deadline: 31 April 2026  
Final acceptance for students: 15 May 2026

**Organizers**

Dr. Marco Goffin, FRIB  
Dr. Giancarlo Cerretti, FRIB  
Julia Maria Martin, FRIB  
Santosh Singh, FRIB  
Konrad Grawert, FRIB

**Contact**

[drdsims2026@cern.ch](mailto:drdsims2026@cern.ch)

**GD SIMS 2026**

**DRD1 GASEOUS DETECTORS  
SIMULATION SCHOOL 2026**

*A School for the Next generation Detector Scientists*

**BARI, MAY 18-22, 2026**

**SCHOOL WEBSITE AND  
REGISTRATION**

[INDICO.CERN.CH/E/DRD1-GDSIMS2026](http://INDICO.CERN.CH/E/DRD1-GDSIMS2026)  
APPLICATION DEADLINE: JANUARY 31, 2026

**LOCAL ORGANIZING COMMITTEE**

MARCELLO ABBRESCIA  
NICOLA DE FILIPPIS  
RAFFAELLA RADOGNA  
FEDERICA MARIA SIMONE  
PIET VERWILLIGEN

**CONTACT**

[DRD1-GDSIMS2026@CERN.CH](mailto:DRD1-GDSIMS2026@CERN.CH)

**SCIENTIFIC PROGRAM**

- ✓ ADVANCED INTERACTION OF RADIATION WITH MATTER
- ✓ MONTE CARLO TECHNIQUES
- ✓ FINITE ELEMENTS TECHNIQUES
- ✓ SIGNAL INDUCTION

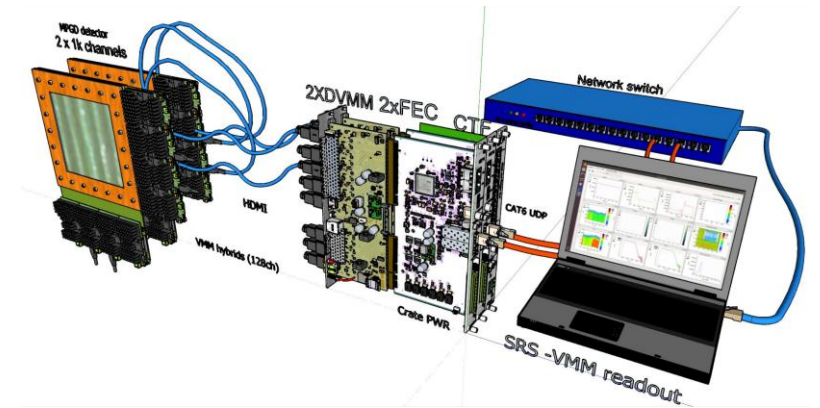
# DRD1 Interests @ IFIC

Related to the **NA64** project:

- Integration of readout pipeline and FE into NA64 DAQ
- Joint testbeam campaigns for detectors, electronics and gas studies

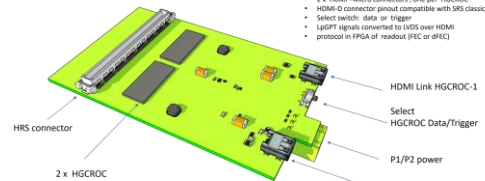
Related to the **NEXT** project:

- Electroluminescent Xe TPCs for  $0\nu\beta\beta$
- Low-diffusion gases for high-pressure Xe TPCs
- Dense SiPM tracking for topology & energy reconstruction



Possible new SRS Frontends (tbd)

example study case: 128 ch HGCR0C



- 2x HGCR0C per hybrid with 128 ch HRS connector
- 2 x HDMI-Micro connectors, one per HGCR0C
- HDMI-D connector pinout compatible with SRS classic
- Select switch: data or trigger
- LpGBT signals converted to LVDS over HDMI
- protocol in FPGA of readout (PEC or dFEC)

