AIDA-2020
WP2: Innovation & Outreach

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Objectives

- Scientific Coordination
- Communication, dissemination and outreach
- Industrial relations and technology transfer
- Management of the Proof-of-Concept (PoC) fund
- Pre-industrialisation of large area silicon detectors

Task 2.3 Industrial relations and technology transfer

- Academia meets Industry Symposium
- Why on Non-Destructive Testing?

- Market study:
  - 2016: 15 billions $
  - GR: 8-10 %

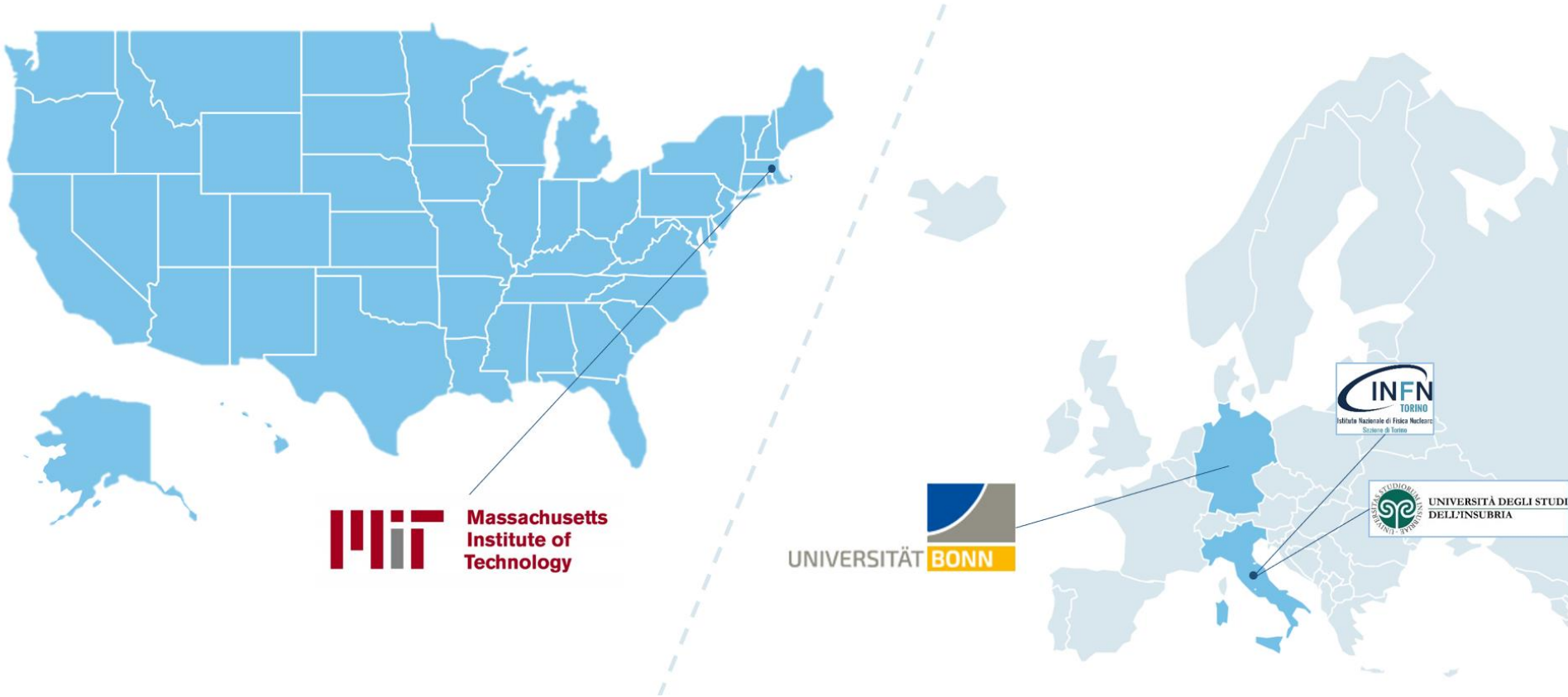
- Technologies used in NDT:
  - X-ray technologies (closed to HEP)

Task 2.3 Industrial relations and technology transfer

- Key elements
- 12 companies with a booth (+140%)
- 18 speakers:
  - 4 from academia (-60%)
  - 14 from industry (+100%)

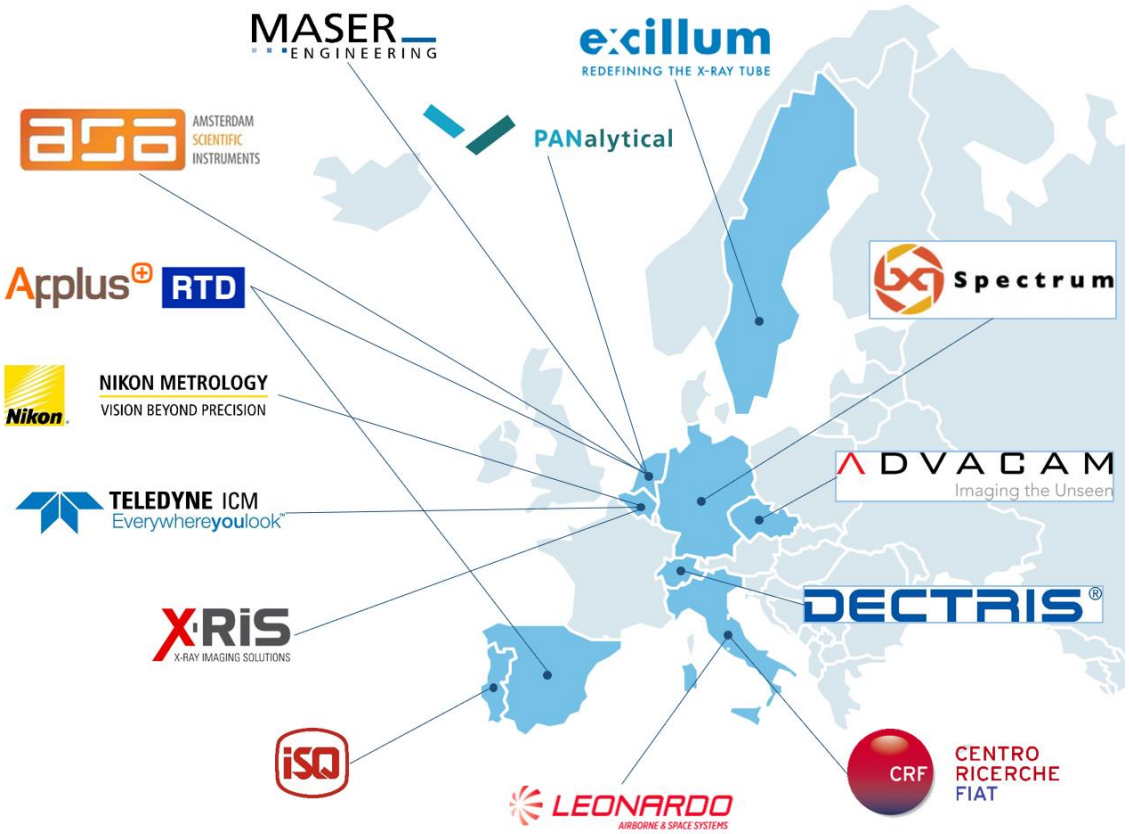
Task 2.3 Industrial relations and technology transfer

- From academia:



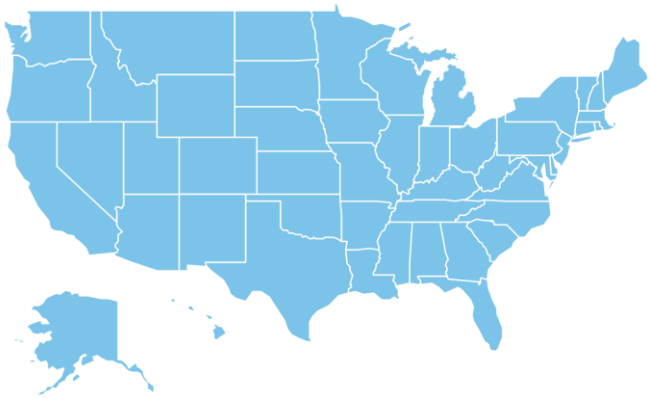
Task 2.3 Industrial relations and technology transfer

- From industry:



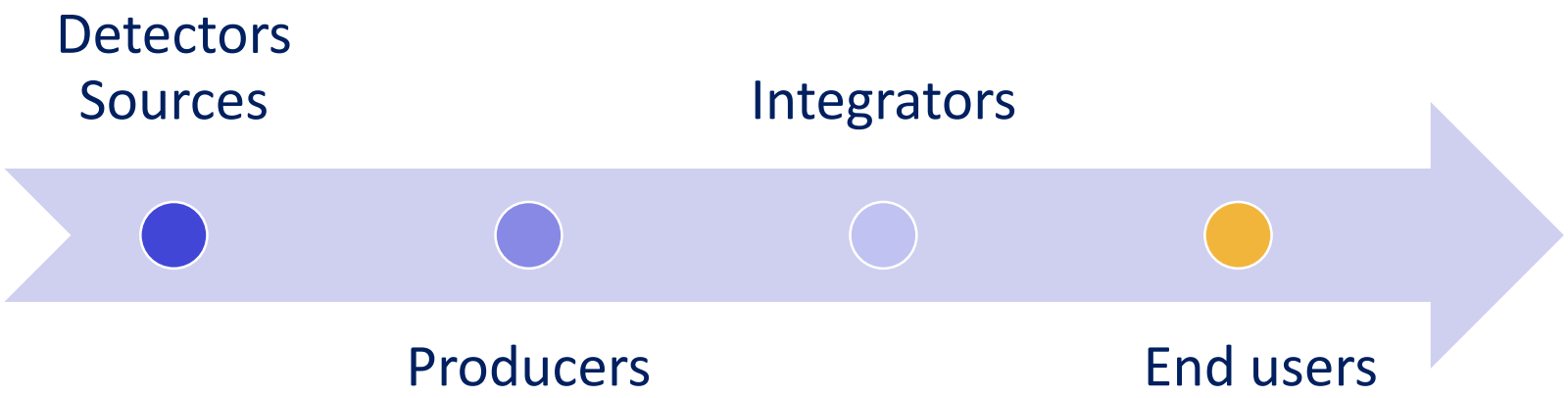
Task 2.3 Industrial relations and technology transfer

- 87 participants (+45%) from 18 countries
  - 31 from industry
  - 56 from academia



Task 2.3 Industrial relations and technology transfer

- Academia meets Industry Symposium:



Task 2.3 Industrial relations and technology transfer

- Academia meets Industry Symposium

- B2B meetings:
  - 11 meetings organized industry-industry
  - 7 meetings organized industry-academic
  - 1 meeting organized Academia-Academia

  - + All the discussions during coffee breaks and networking event

Task 2.3 Industrial relations and technology transfer

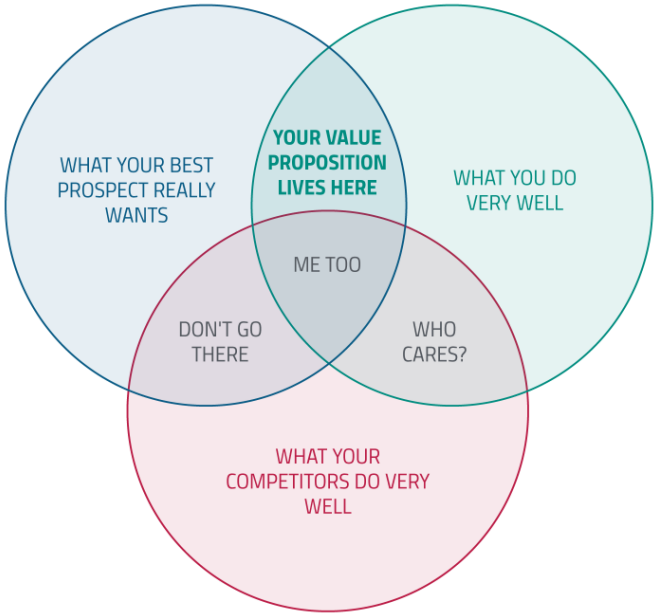
- How to measure the impact of an Academia meets Industry?

- Feedback:

  - Online survey available
  - Interview will be schedule with the industrial speakers in September as a follow-up.
  - Numbers of contract in discussion and /or signed thanks to the event

Task 2.3 Industrial relations and technology transfer

- How to improve the KT/TT from AIDA2020 to Industry?
  - Prepare a value proposition of what is unique in each WP:
    - 1slide to explain what is done or what is the specific know-how developpedin AIDA2020, what is in it for Industry and the type of industry that might be interested



Task 2.3 Industrial relations and technology transfer

- Why should we start this activity?
  - To show EC that we understand the requirements to work closer to industries
  - Having a set of slides to be presented to industry to partner for the next project
  - Having a set of slides to be presented to industry during the next BSBF

Task 2.4 Management of the Proof-of-Concept (PoC) fund

- Objectives of PoC:
  - General field of detector development
  - Collaborative project industry oriented
  - Bringing technologies closer to the market

    → **Impact beyond high energy physics**

Task 2.4 Management of the Proof-of-Concept (PoC) fund

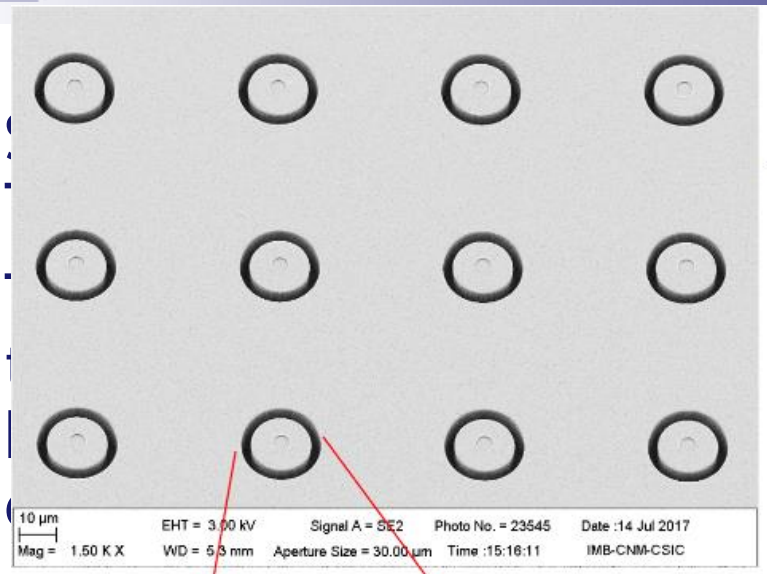
- 3 projects funded:

Budget €	Title	Lead Institute	Partners
45,600 €	Silicon-based Microdosimetry System for Advanced Radiation Therapies	Instituto de Microelectronica de Barcelona	
74,825 €	Advanced Through Silicon Vias for Pixel Detectors	University of Bonn	Fraunhofer IZM
66,641 €	RaDoM	CERN	Politecnico di Milano, Mi.am

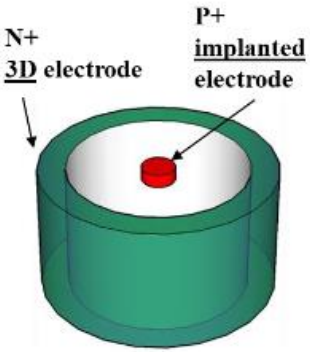
Task 2.4 Management of the Proof-of-Concept (PoC) fund

- Silicon-based Microdosimetry System for Advanced Radiation Therapies
- Motivations:
  - 1 out of 2 persons born today will be diagnosed with cancer in their lifetime (SEER Cancer Statistics Review 1975-2013)
  - More than 50% of all cancer patiens will receive radiotherapy for curative or palliative aims
  - Hadrontherapy is a fast-growing modality of radiation therapy
- Objectives:
- Realization of a new microdosimetry tool optimized for clinical application for verification of hadron treatment plans.

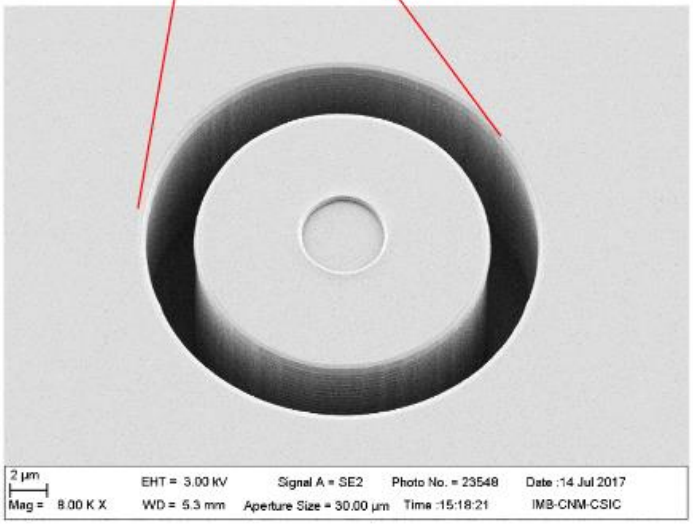
Task 2.4 Management of the Proof-of-Concept (PoC) fund

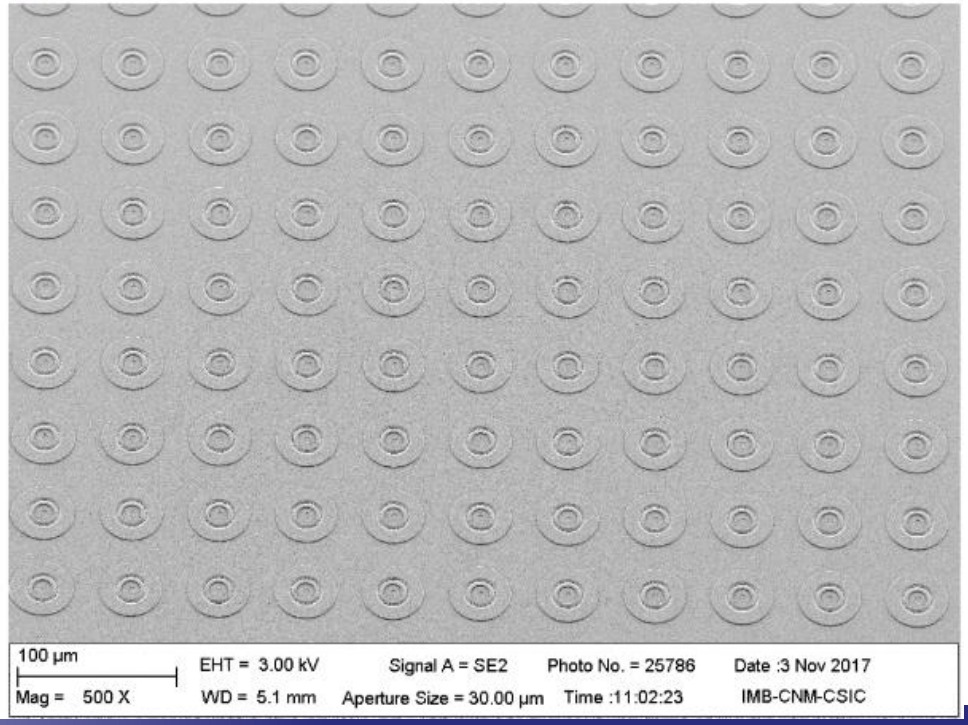


SEM image of wafer in production with microsensor unit cells defined, central contact visible



Finished unit cells: trenches filled with doped polysilicon to form the external electrode

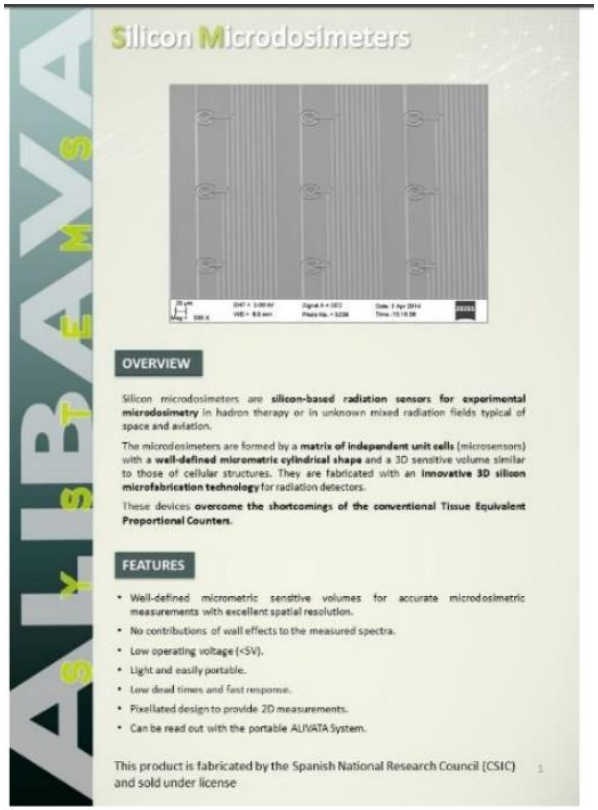




Task 2.4 Management of the Proof-of-Concept (PoC) fund

- Silicon-based Microdosimetry System for Advanced Radiation Therapies

- Partner with Alibava system
- Looking for other fields of application



ALIBAVA SYSTEMS

Silicon Microdosimeters

OVERVIEW

Silicon microdosimeters are **silicon-based radiation sensors for experimental microdosimetry** in hadron therapy or in unknown mixed radiation fields typical of space and aviation.

The microdosimeters are formed by a **matrix of independent unit cells** (microsensors) with a **well-defined micrometric cylindrical shape** and a 3D sensitive volume similar to those of cellular structures. They are fabricated with an **innovative 3D silicon microfabrication technology** for radiation detectors.

These devices **overcome the shortcomings of the conventional Tissue Equivalent Proportional Counters.**

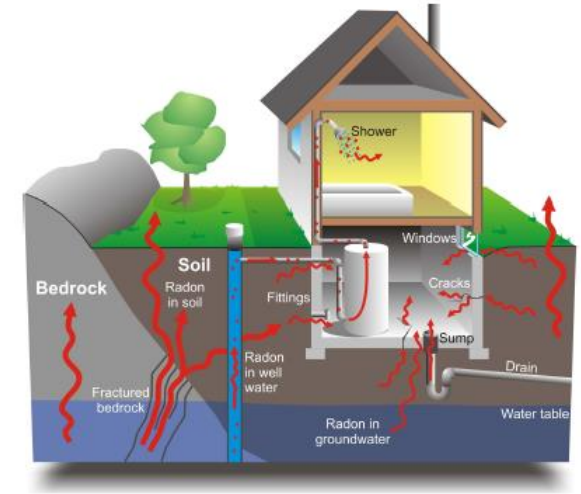
FEATURES

- Well-defined micrometric sensitive volumes for accurate microdosimetric measurements with excellent spatial resolution.
- No contributions of wall effects to the measured spectra.
- Low operating voltage (<5V).
- Light and easily portable.
- Low dead times and fast response.
- Pixellated design to provide 2D measurements.
- Can be read out with the portable ALIVATA System.

This product is fabricated by the Spanish National Research Council (CSIC) and sold under license

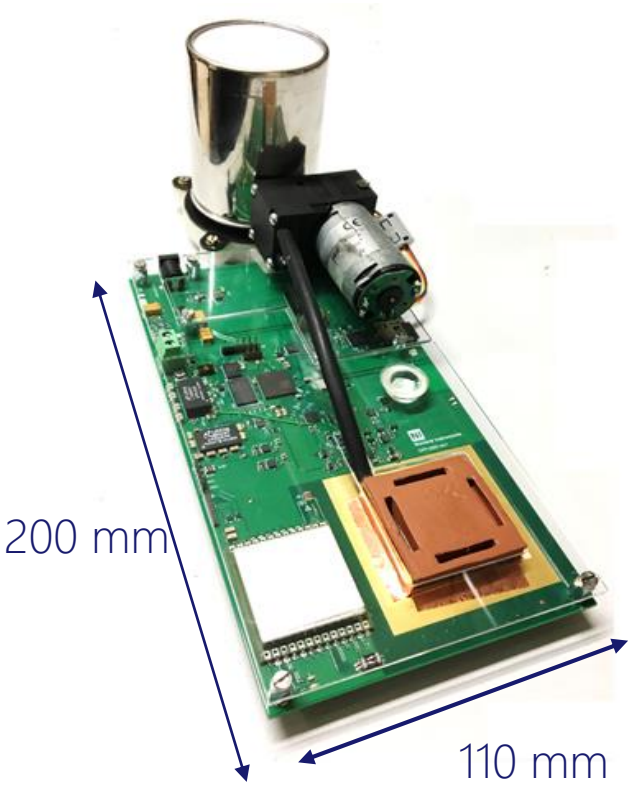
Task 2.4 Management of the Proof-of-Concept (PoC) fund

- RaDoM
- Radon gas is the most important source of ionizing radiation among those of natural origin.
- Currently the dose is estimated by measuring radon and/or radon progeny concentrations.
- In the dose estimation, lots of parameters are taken as default, such as the **aerosol size**, the **equilibrium factor**, **particle density** and shape, etc, leading to <u>significant uncertainties</u>.
- Matching fund from CERN-MAPF



Task 2.4 Management of the Proof-of-Concept (PoC) fund

- RaDoM: current status



- **High resolution alpha particle spectrometer**:
  - radon, thoron and actinium daughters
- **External plug-in radon concentration probe**
- 15-minute time resolution
- Embedded shock, temperature and humidity sensors
- Optional environmental sensors, e.g. CO_2
- Powered by Linux
- LoRa, WiFi, Bluetooth, LTE connectivity
- Cloud platform
- iOS and android apps

Task 2.4 Management of the Proof-of-Concept (PoC) fund

- RaDoM: starting the spin-off journey

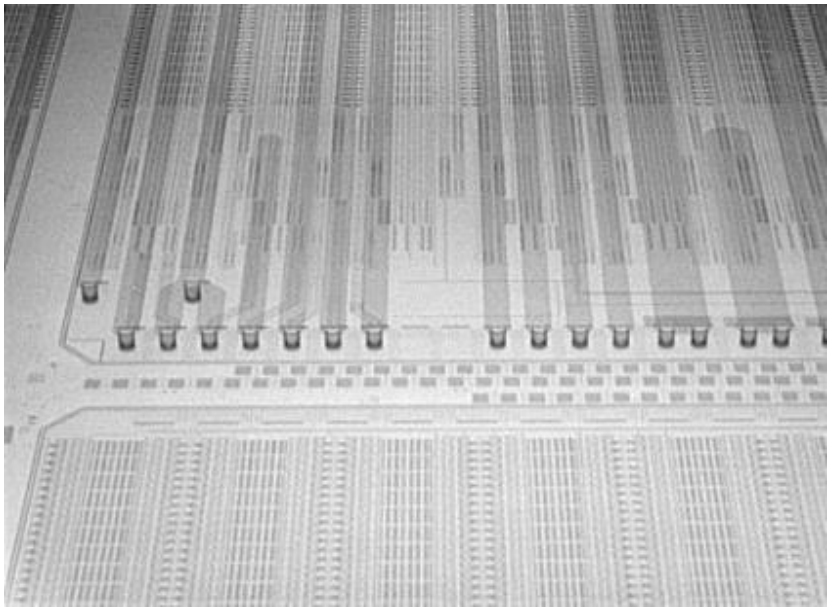
- RaDoM project was selected from 450 applicants as one of the 75 finalists for the MassChallenge2017 Accelerator Programme in Switzerland and passed the VentureKick Phase 1 selection for funding
- 3 Pilot projects are running
- 30pages business plan ready for investors

Task 2.4 Management of the Proof-of-Concept (PoC) fund

- Advanced Through Silicon Vias for Pixel Detectors
- **Goal:** establish high yield TSV + RDL process for pixel modules
  - straight vias through ultra thinned FE-I4 wafers and chips: note 2x2 cm2 chip size
  - 80 – 100 µm thickness (to be optimized),
  - aspect ratio = 2 : 1 (via diameter 60 µm)
  - thin wafer backside process using carrier wafer
  - complete development including flip-chipping process for the final pixel module
- **Challenges of the project:**
  - reliable TSV fabrication ... yield hoped/expected to be much better than for project 2
  - thin (100 µm) wafers are needed for the goal of "large yield" challenge is the handling of large and very thin wafers/chips
  - surprises during flip-chipping can also be an issue

Task 2.4 Management of the Proof-of-Concept (PoC) fund

- Advanced Through Silicon Vias for Pixel Detectors



- Detectable breakdown voltage starting at 40V, max. 100V
- Process optimization possible → benchmark of 80V breakdown achievable but not required here

Task 2.4 Management of the Proof-of-Concept (PoC) fund

- Advanced Through Silicon Vias for Pixel Detectors

- Several Industrial projects started based on this development

Dual Source Strategy

- To have (at least) a second option which can immediately take over in case of problems is in principle not a bad idea
  - Imagine: quality issues, bankruptcy, earthquakes,…

Task 2.5 Pre-industrialisation of large area silicon detectors

- Market survey: Common MS CMS/ATLAS
  - Identify an EU company able to produce sensors on a large scale

- **Step 1:** Companies need to return the *"Technical Questionnaire"* document where the responses need to fulfil the requirements set in the *"Qualification Criteria"* document → **ADIA-2020 Milestone MS30 (2016)**

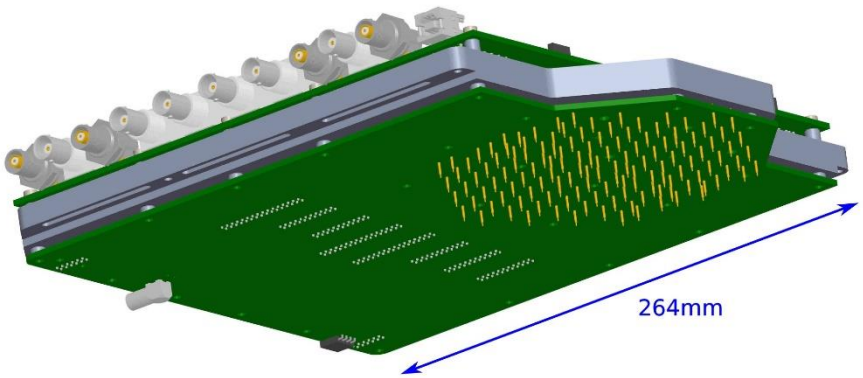
- **Step 2:** Companies need to provide samples free of charge of functional devices of e.g. previous project → **2nd annual meeting (2017)**
  - **ATLAS and CMS qualified samples developed by HEPHY-ÖAW as 8" proof-of-principle**

- **Step 3**: CMS/ATLAS orders (and remunerates) a batch of prototype sensors according to CMS layout and specs → **ongoing 2018**
  - **ATLAS and CMS ordered close-to-final prototypes as described in the TDRs**

Task 2.5 Pre-industrialisation of large area silicon detectors

- HGCAl sensors:
  - Infineon: production of Si pad sensors for HGCal
- Quality constantly improving
  - One remaining problem: premature IV breakdowns, scaling with sensor size
  - Addressed now by thicker backside implantation

- Full probe card development



Milestones and Deliverables

- Milestones since last annual meeting:
  - MS45: 1st AIDA-2020 “Academia meets Industry” event (M24)
  - MS71: Progress review of the selected projects(s) for the PoC Fund (M34)
  - MS79:2nd AIDA-2020 “Academia meets Industry” event (M36)- in progress

Coming year

- Follow-up PoC projects
- Prepare value proposition with WP leaders and TTO