AIDA 2020

Advanced European Infrastructures for Detectors at Accelerators

The future version of AIDA-2020 and the roadmap to Horizon Europe

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CSN1
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History

- FP6: EUDET: 2006-2010
  - Detector development for linear collider
- FP7: AIDA: 2011-2014
  - Detector development for LHC upgrades and linear colliders
  - Project-specific work packages
- FP8: AIDA-2020 started in May 2015
  - Common LC and LHC work packages
  - New communities: large cryogenic neutrino experiments, new topics
  - New innovation measures, with industry
- **All projects have a strong leverage on matching funds**

Increasing level of integration

AIDA

AIDA 2020

AIDA 2020

Advanced European infrastructure for Detectors at Accelerators

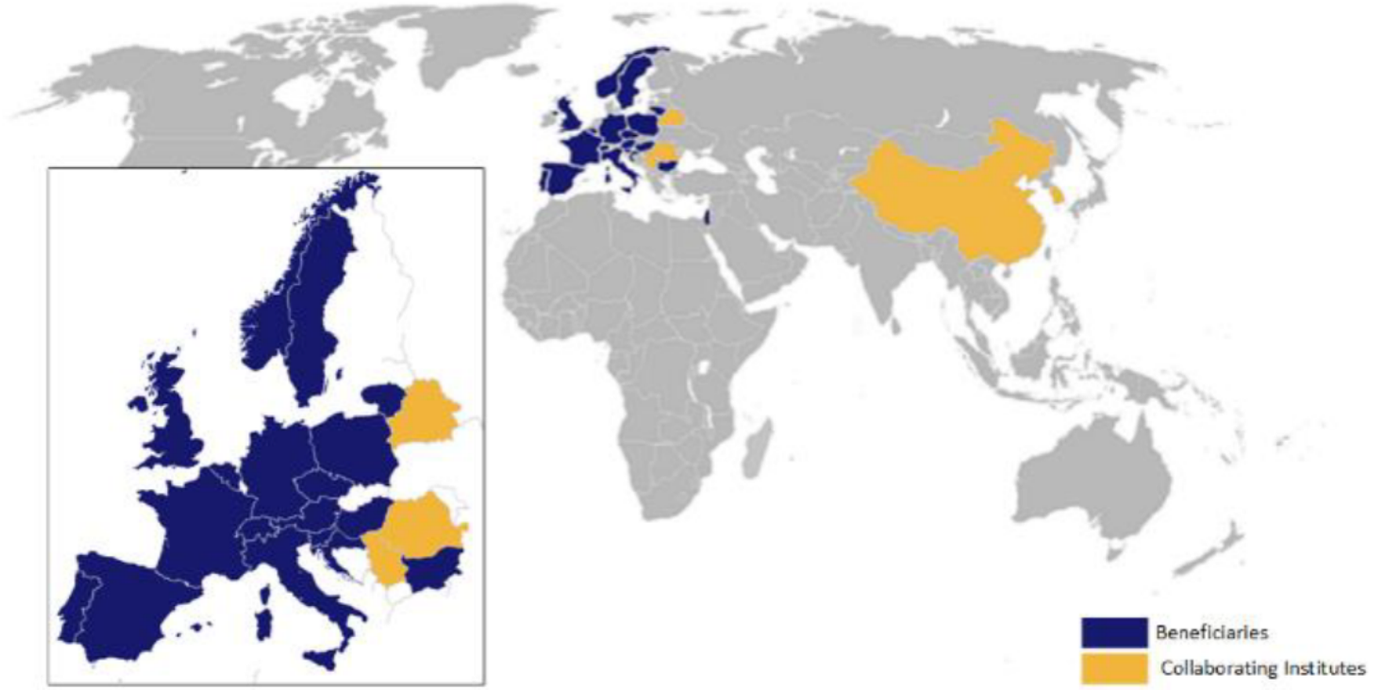
- Collaborative framework
- Infrastructure: common interest

https://aida2020.web.cern.ch

- 19 countries
- 39 beneficiaries
  - + 20 collaborating institutes
- Coordinated by CERN

- Total budget 29.8 M€
- EC contribution 10.0 M€

- Activities:
  - Mainly: Joint Research & Networks (85%)
  - Transnational Access (13%)



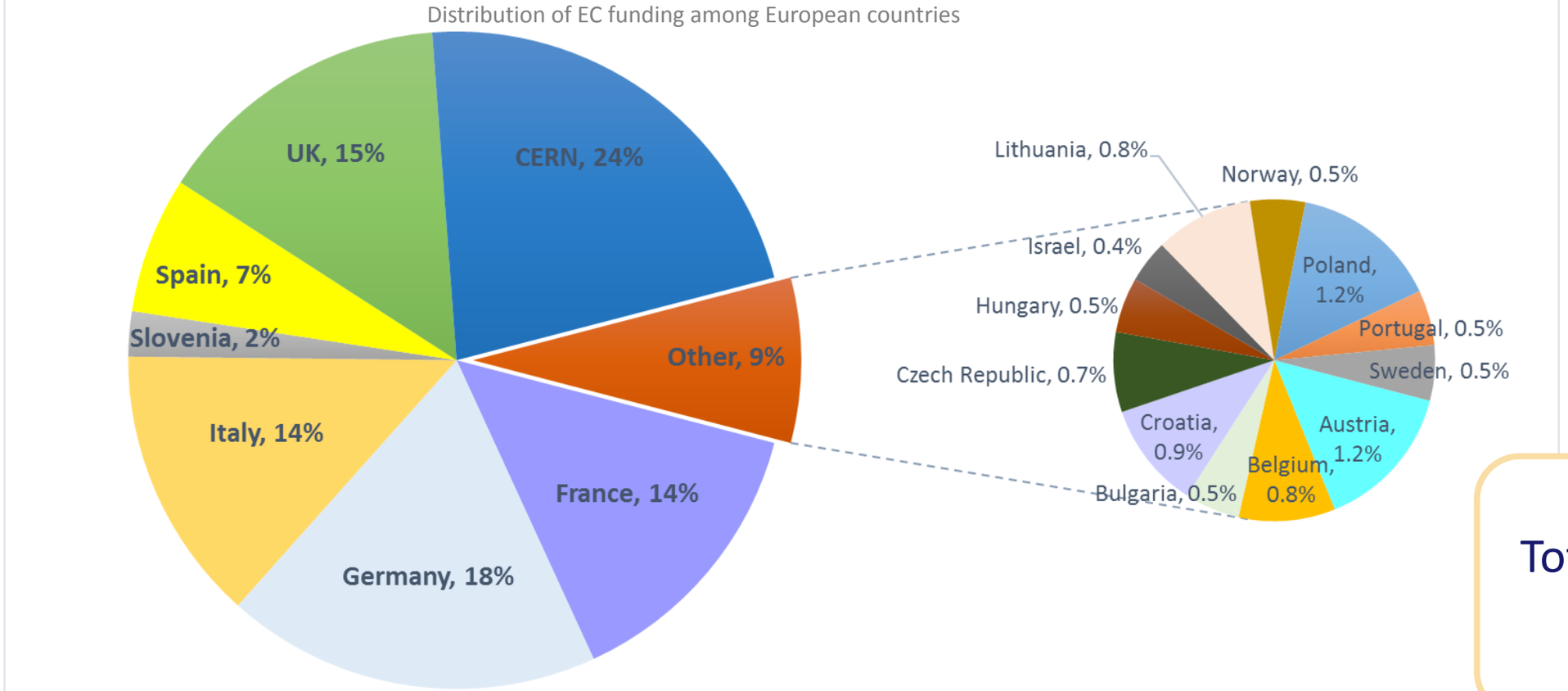
Participants bring in complementary competences and a balanced coverage of projects.

Resources

Full costs budget AIDA-2020 = **~ 29 M€**

EC contribution = **10 M€**

→ all partners contribute with a certain amount of matching funds and the funding rate for the beneficiaries varies between 29% (JRA) and 95% (TA)

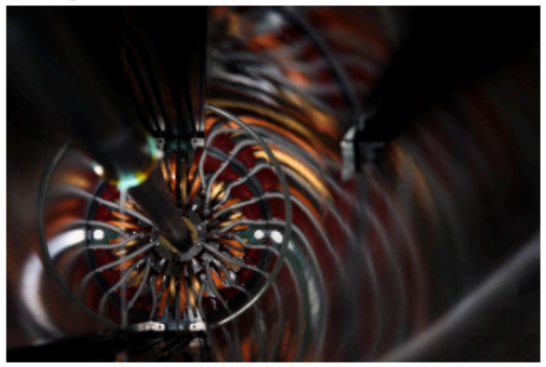


Key for involving small countries

Total Person-Months = **2,525.5 PM**

Activities

AIDA-2020 is divided into 15 Work Packages. A Work Package (WP) is a unit of work within the project. The WPs are theoretically independent but they were defined in order to foster synergies in AIDA-2020.



Management and Coordination

- WP1 (MGT): Project management and coordination

Networking Activities

- WP2 (NA1): Innovation and Outreach
- WP3 (NA2): Advanced Software
- WP4 (NA3): Micro-electronics and interconnections
- WP5 (NA4): Data acquisition system for beam tests
- WP6 (NA5): Novel high voltage and resistive CMOS sensors
- WP7 (NA6): Advanced hybrid pixel detectors
- WP8 (NA7): Large scale cryogenic liquid detectors
- WP9 (NA8): New support structures and micro-channel cooling

Transnational Access

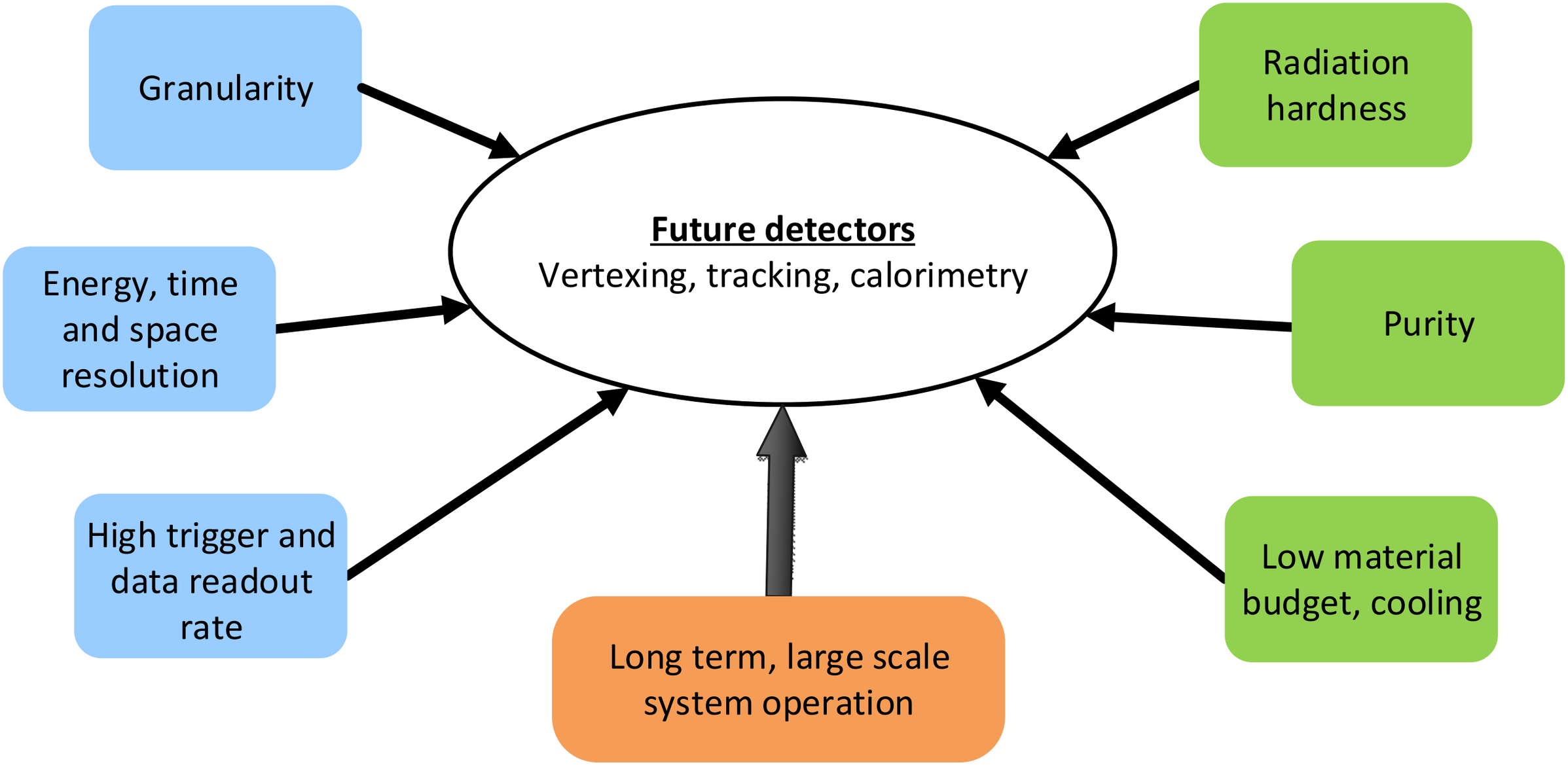
- WP10 (TA1): Beam test facilities
- WP11 (TA2): Irradiation test facilities
- WP12 (TA3): Detector characterisation facilities

Joint Research Activities

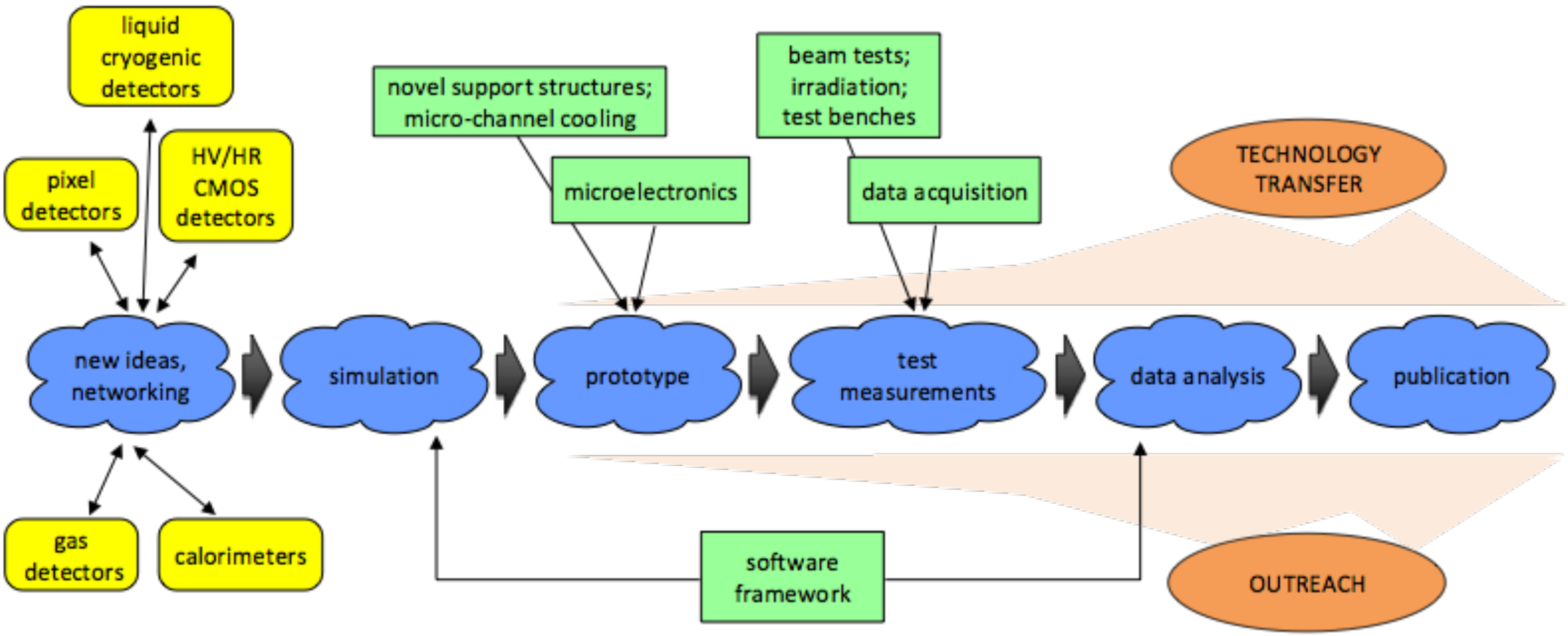
- WP13 (JRA1): Innovative gas detectors
- WP14 (JRA2): Infrastructure for advanced calorimeters
- WP15 (JRA3): Upgrade of beam and irradiation test infrastructure

Technology challenges

Pushing detector technologies beyond state-of-the-art



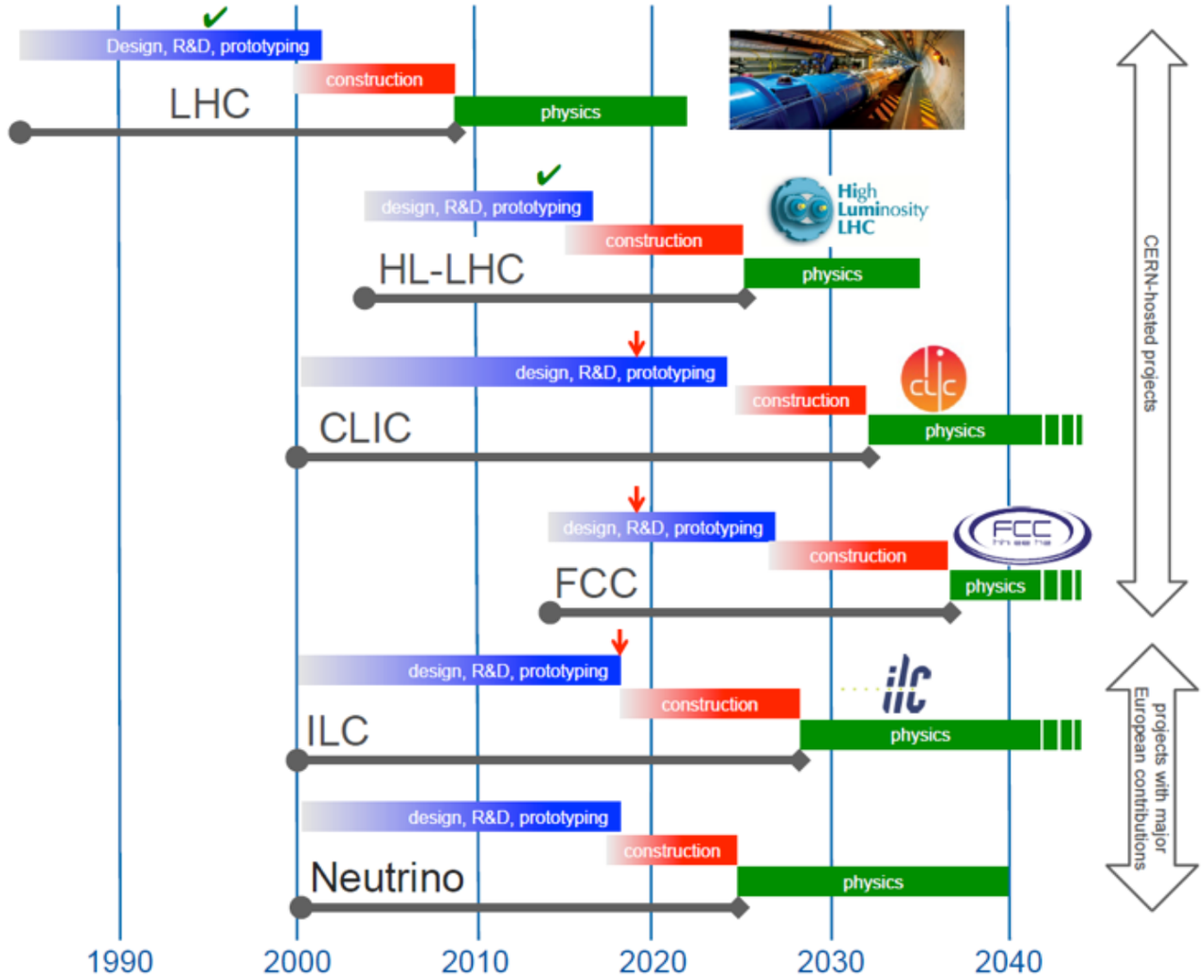
Detector life cycle



Strategy

- European strategy for particle physics
  - Process led by CERN Council
  - Input from global community
- Updates 2012-13, 2019-20

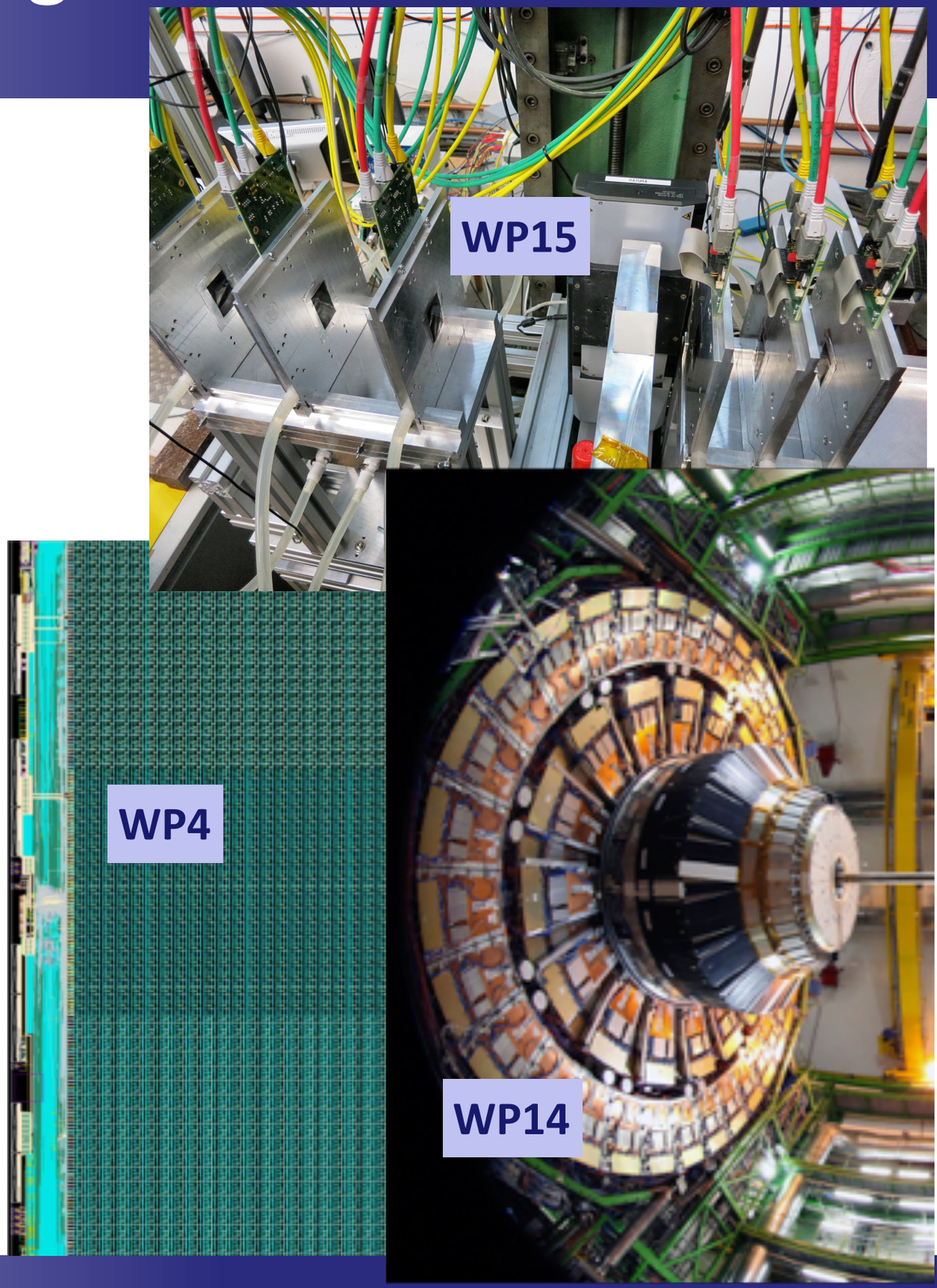
- Future projects have many detector R&D issues in common
- **EC initiatives unique in creating coherence at European level**
  - **Closely follow European Strategy**



AIDA 2020

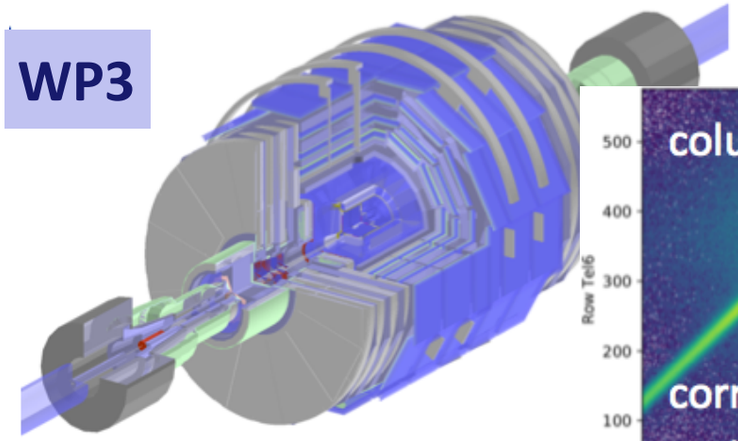
Highlights

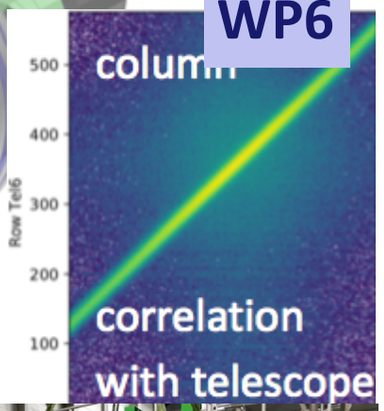
- Common micro-chip development
  - Expensive submissions
- Test beam instrumentation
  - Keep pace with increasing precision
- Common test beam DAQ
  - Easy prototype integration, LC **and** LHC
- Common software frameworks and tools
  - Parallel and vector computing
- Joining forces for novel detectors
  - LHC tracker technology and LC calorimetry -> imaging calorimeter for HL-LHC
- Test infrastructures
  - Mechanics, cooling, optical materials, electro-magnetic, irradiation, data base support….

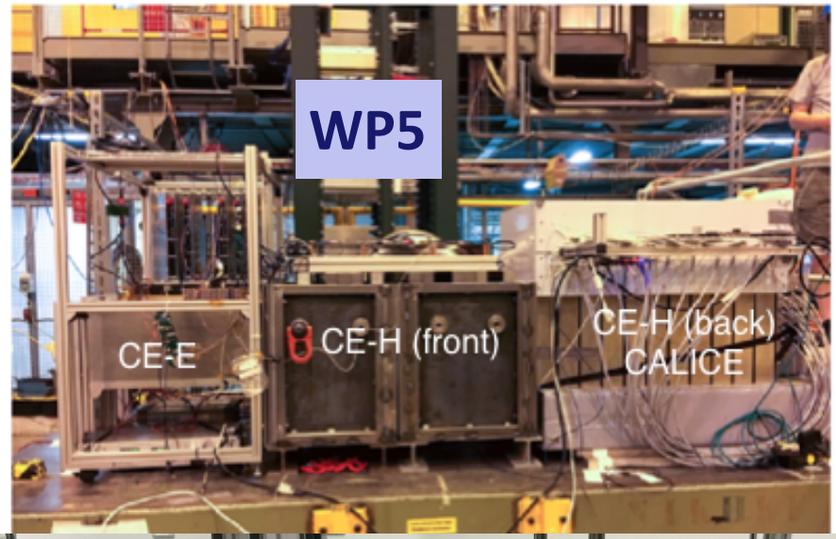


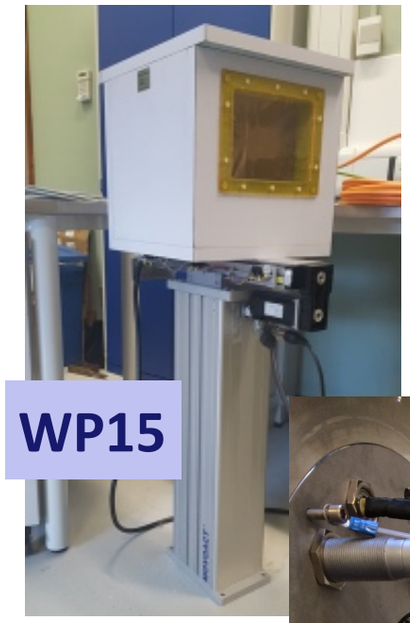
More Highlights

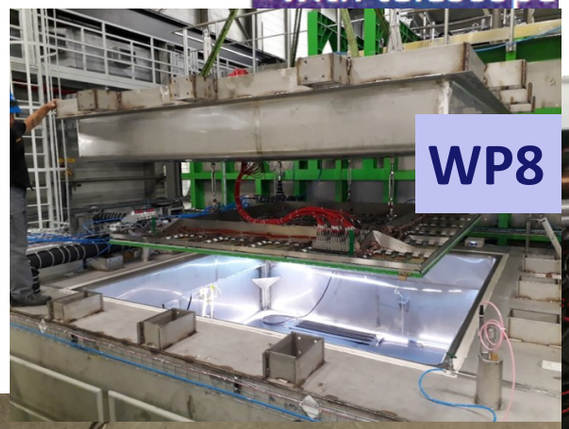
- WP3 VecGeom for CMSSW
- WP5: Common DAQ for LHC & LC beam tests
- WP6: DMAPS beam tests
- WP8: LAr dual phase operation
- WP9: CO_2 facility
- WP13: High-rate μRWELLs
- WP14: Test bench stands
- WP15: Cold irradiations

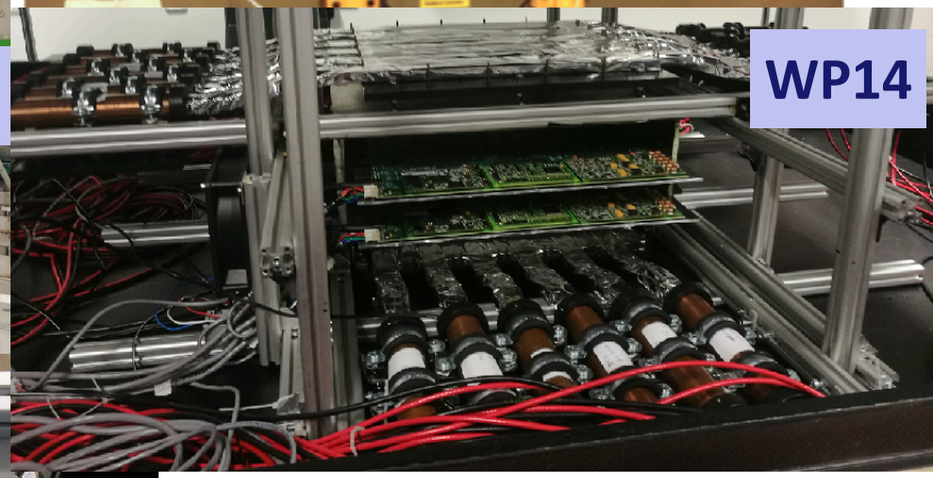


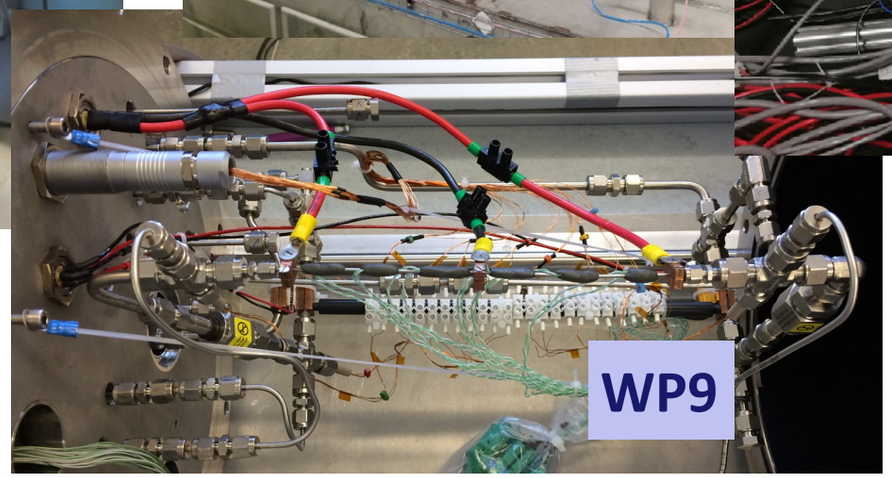


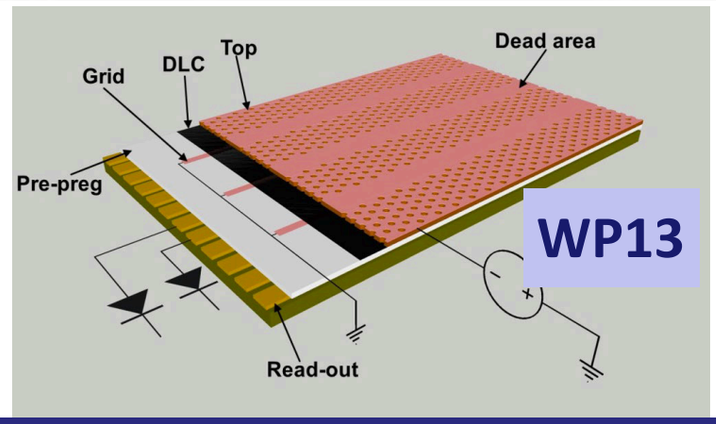












New Call in Horizon 2020

- Informal information from meeting at Brussels on March 5
- FP8 Call 5: Large initiatives and support measures to **foster the innovation potential of research infrastructures:**
  - New directions in EC funding instruments, addressing established communities
  - Following consultations with communities to prepare for FP9
  - To be published in summer

- INFRAINNOV-03-2020 - Co-Innovation platform for research infrastructure technologies (2020 – xx M€)
  - This is where ATTRACT phase 2 will be
- INFRAINNOV-04-2020 - **Innovation pilots** (2020 – yy M€, max zz M€ each)
  - Innovation in light source technologies
  - **Innovation in detector technologies**
  - Innovation in accelerator technologies
- **Deadline March 17, 2020**

New Pilot call INFRAINNOV-04-2020

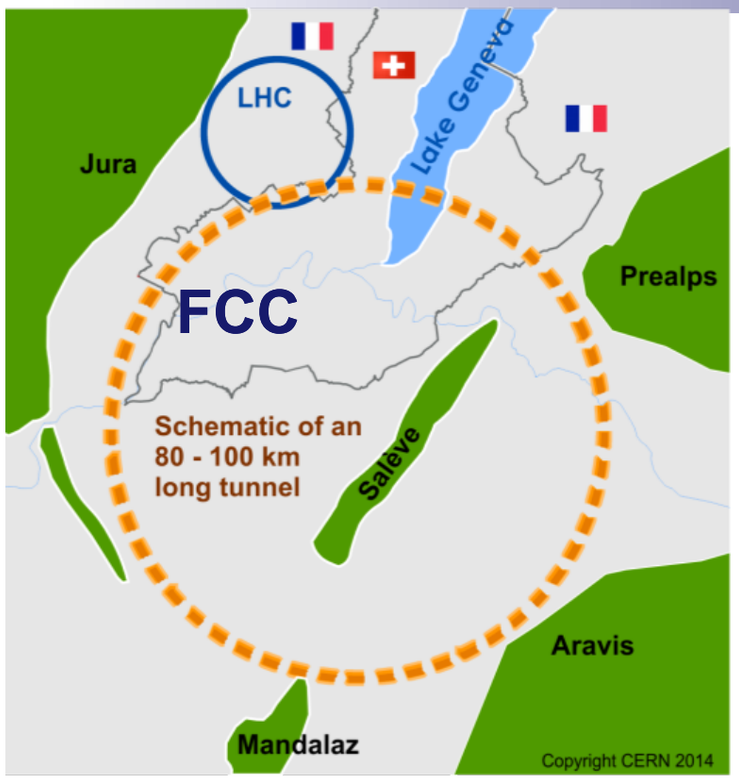
OBJECTIVES

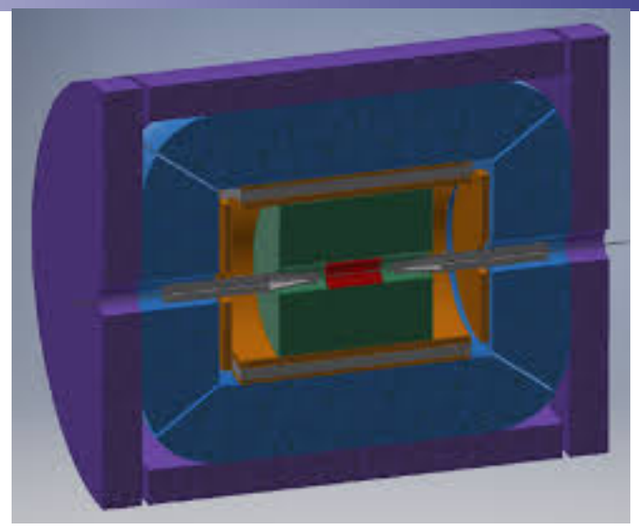
- **Integrate the key players** of the HEP detector community, unite them behind **common goals and interests**, based on the **major challenges** defined with a broad **consensus**.
- **Coordination** of transversal R&D activities **between different technologies**, e.g. between sensors and their read-out electronics and data acquisition, which is essential for the overall progress towards detector **systems**.
- Maintain the **world-class level of the European** detector development and test **infrastructure.**
- **Leverage national funding** through the matching resources of all participants, thus achieving far more ambitious objectives than with the EC funding alone
- A **unique collaborative European platform** for coherent and coordinated efforts for detector R&D programmes towards and across future projects in HEP.
- Strong **impact on innovation** through joint R&D programmes with **knowledge transfer to European industry** to tackle the challenges of series productions for large-scale experiments.

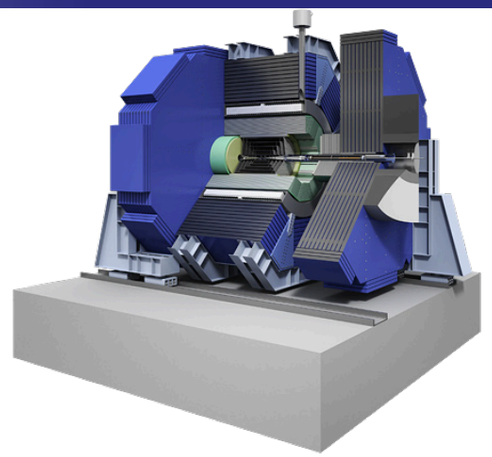
Upcoming Challenges

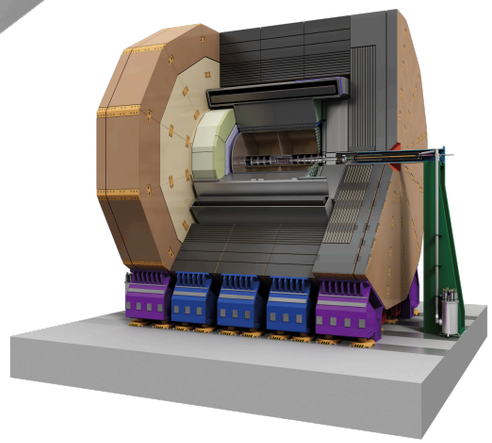
- HL-LHC upgrades now moving to production
  - R&D largely done - will not guide AIDA++
- New in AIDA-2020 – could be expanded
  - Precision mechanics and CO_2 micro-cooling
  - Large cryogenic detectors
- Future lepton colliders
  - Higher precision, less material
  - Requirements for linear and circular machines very similar
    - Except electronics, powering, cooling
    - Circular machines have much higher rates and require continuous powering
    - Need to push limits of particle ID
    - Gaseous tracking
  - Most aggressive requirements may be posed by the Z factory
    - 10000 x LEP statistics
- Future hadron colliders
  - Fast timing for pile-up rejection increasingly important
    - Sensors, electronics and test infrastructures, beam instrumentation
  - Radiation tolerance requirements even more demanding
    - Sensors, electronics and “low-tech”: powering
    - Highly granular LAr calorimeters
    - Irradiation facilities
  - Machine learning for fast track and image reconstruction, trigger
- Non-collider experiments

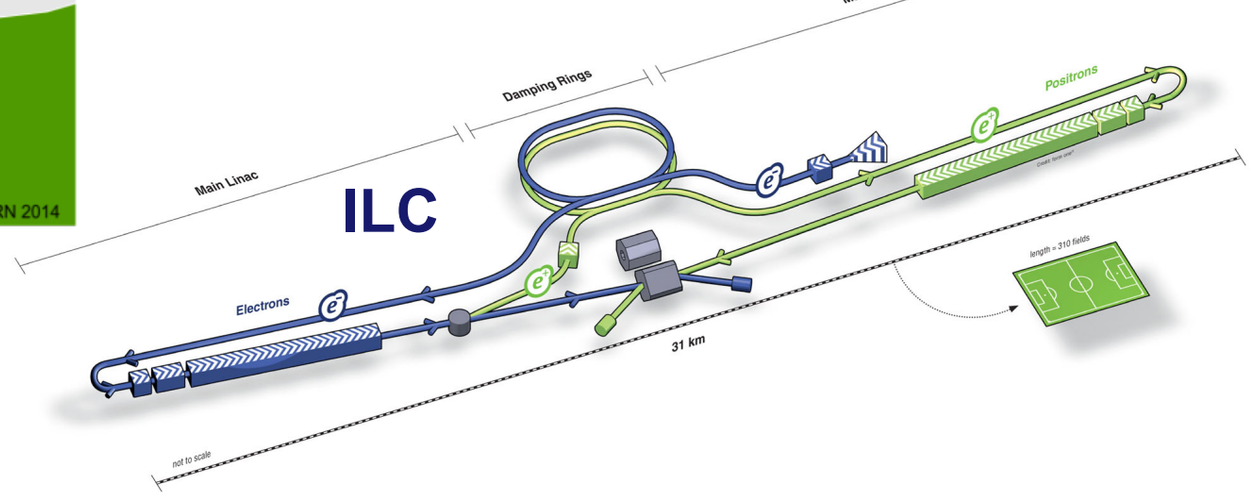
Upcoming Challenges

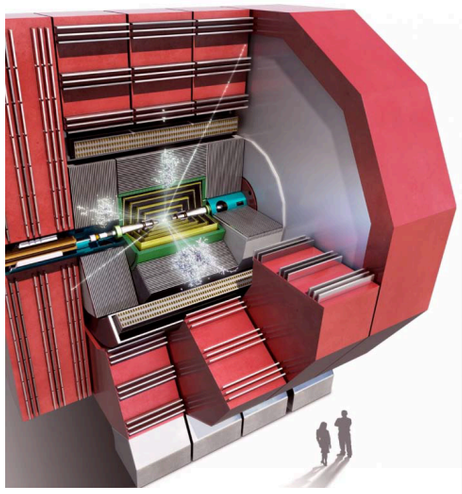


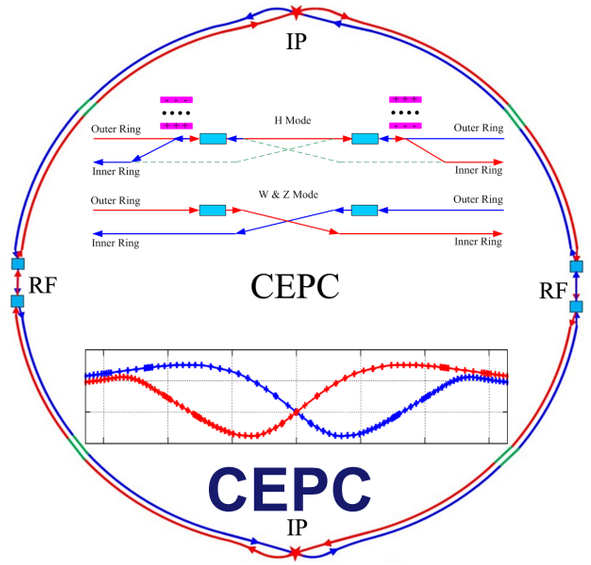












Sketch of AIDA-2020++

Possible topics:

- **Advanced R&D and infrastructure** for detectors at future colliders
  - Leptonic colliders
    - Circular
    - Linear
  - Hadronic colliders
- **Novel detector technologies** for large-scale particle physics experiments
- **Innovative software** solutions (ML, etc.) for future detectors
  - Triggering
  - Tracking
  - Calorimetry
- Extended neutrino WP with also short baseline neutrino detectors
- **Joint R&D** programmes with **industrial beneficiaries**
- Proof of Concept (competitive allocation after start of project) higher risk projects ("blue sky" R&D)

Preparation of AIDA-2020++

Actions:

- **Sent e-mail** requesting for **Expressions of Interest (EoI)**
  - Deadline for EoIs is **July 15th**
- Based on the EoI received start preparing the new structure of AIDA-2020++
- **General meeting** at CERN on **September 4th**
- After the meeting define a **Proposal Committee (order 10 persons)**
  - Define **WPs** and respective **coordinators**
- Prepare the proposal
  - **Deadline** to submit the proposal **17/03/2020**
- If successful, AIDA-2020++ could be funded as early as **October 2020**

Preparation of EoIs

Expression of Interest

- **One-page document**
  - 2-6 participating institutes (**companies** as **beneficiaries** is a **plus**)
  - Contact for each institute
  - Description of the **activity**
    - At the level of a **Task** (not a WP!)
  - List of **Deliverables** (max. 3)
  - **Budget** estimate
    - **Manpower**
    - **Full cost**
      - Including **Personnel** and other **direct costs** (**1/3 EC contribution**, **2/3 matching funds**)
      - Do not include overheads!

Preparation of EoIs

Meeting Italia

- **C. Meroni (and myself)** is organising an Italian meeting to try and coordinate the EoIs to be submitted for AIDA-2020++
- Date is 7/6 at 10:00:
  - Agenda: **https://agenda.infn.it/event/19410/**
  - People interested in submitting EoIs are warmly encouraged to attend

IDEA Collaboration meeting

IDEA

- **New detector concept for an experiment at a Circular e^+e^- Collider**
  - Proposed by several INFN groups
  - Accepted by both **FCC-ee** and **CEPC**
  - Described in both **CDRs**
- **Collaboration meeting** in Bologna
  - **June 13th and 14th: https://agenda.infn.it/event/19360/**
  - **Main items**
    - Review of the **status** of the various **sub detectors** and **software**
    - **Preparation** of **EoIs** for **AIDA-2020++**
      - Collaboration with **foreign institutes** (**China**, **Russia**, **Serbia**, **Switzerland**, **USA**, **UK**)
      - Collaboration with **industries**, **CAEN** will participate (**Eltos** also interested)
- Will be preceded, on **June 12th and 13th**, by a special **Software Workshop**
  - **Aim** is to reach a **common software framework**
  - **Participation** from **CERN, ILC, CLIC, FCC, CEPC and HSF** communities

Summary

- **AIDA-2020** has already a **long history** behind it
  - **EUDET**
  - **AIDA**
- AIDA-2020 (and its predecessors) has proven to be a very successful example of an **EC co-funded scientific project**
- The new pilot call INFRAINNOV-04-2020 gives this community the possibility to:
  - Prepare and respond to **upcoming challenges** represented by **future experiments** with **new accelerator** facilities
  - Further improve Academia-Industry collaboration on **R&D and infrastructures** for **detectors at accelerators**
  - Develop **innovative detectors** and complete systems with all the needed services (HV, LV, electronics, cooling, software, DAQ, etc.)
  - Further **extend the network of collaborating institutes** and researchers
  - Significantly enhance **European's excellence** in this field

Backup

Innovation Pilots

- Objective*:*
- Support RI*networks developing and implementing a **common strategy/roadmap including** technological development required for improving their services through **partnership with industry;**
- Support **incremental innovation** and cooperation with **industry and academia** in areas such as scientific instrumentation
- Target:
- **Advanced Integrated Activities****, which have reached a high level of integration and can **focus on joint** research developments

- * RI – Research Infrastructure
- ** e.g. AIDA-2020

ATTRACT & AIDA-2020++

ATTRACT

- Emerging communities
- Competitive
- Independent projects
- Fully bottom-up approach

- Break-through development
- Co-innovation for non-HEP markets
- Third-party funding
- Diversifying

Applications outside HEP

AIDA-2020++

- Advanced community
- Collaborative, compete globally
- Interdependent work packages
- Aligned with European Strategy and corresponding roadmaps

- Evolutionary development
- Innovation mainly via pre-procurement R&D for HEP
- Leverage on national funding
- Integrating

Applications within HEP

We will establish frameworks for regular information exchange between the two projects

Innovation in AIDA++ and ATTRACT

- **Separation** between call II-03 and II-04, in particular AIDA++ and ATTRACT
- II-03 aims at **innovation for markets outside RI**
- II-04 **innovation for the delivery of services, or new services of RI**

- What is **Innovation**?
- For ATTRACT: launch of a new product to market
- For us: we are invited to interpret the topic for our community
  - Can be incremental
  - Low and high TRLs**

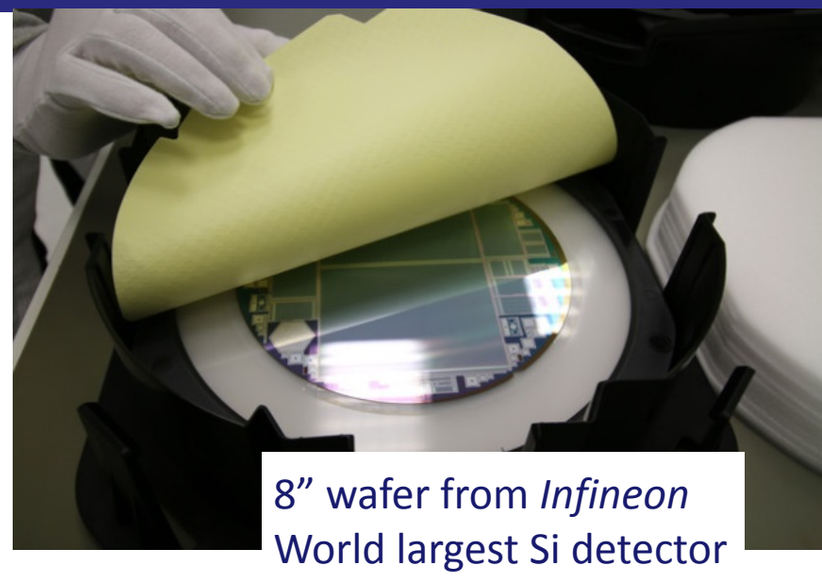
- * **RI** – Research Infrastructure
- ** **TRL -** Technological readiness level

Main Challenges for a New Proposal

- **No Transnational Access:**
- This was one of our biggest successes; need to find new ways of directing EC funds to facilities; WP15-type of upgrade (“innovation”) activities, network
- Involvement of **industrial partners as beneficiaries:**
- Works in parallel Accelerator Initiative ARIES; need to understand how to protect their IP; start with known partners
- Emerging **roadmap** of future collider projects:
- Need to establish our own technological roadmap, in the proposal and during the project, long-term projects require intermediate goals
- **Sustainability** of matching funds:
- Will need to find ways to demonstrate the long-term commitment of partners

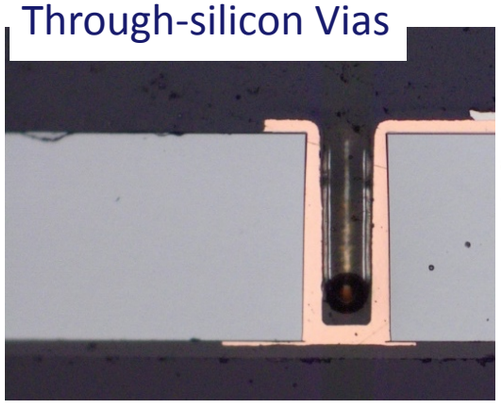
Innovation

- Technology transfer to industry: two pillars:
- 1. Pre-procurement R&D
  - Detector elements needed in large quantities
  - But: not off-the-shelf products
  - After initial R&D: involve industry to adapt design to mass production requirements
  - Then transfer technology and cooperate in qualification of protocols
  - Industrial partners use acquired knowledge in non-HEP markets
- 2. Spin-off to non-HEP applications
  - Typical examples in dosimetry, medical imaging and generic image sensor technologies
  - Starting from higher TRLs
  - Co-innovation effort, often with SME
- Type 1 is more typical for HEP community
- AIDA-2020 supports both



8” wafer from *Infineon*
World largest Si detector

Through-silicon Vias



Radon
Monitoring