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

Paolo Giacomelli
INFN Bologna

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This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 654168.
• 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
Advanced European infrastructure for Detectors at Accelerators

- Collaborative framework
- Infrastructure: common interest

- 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.

https://aida2020.web.cern.ch
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

Distribution of EC funding among European 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
Pushing detector technologies beyond state-of-the-art

Future detectors
Vertexing, tracking, calorimetry

- Granularity
- Radiation hardness
- Purity
- Energy, time and space resolution
- High trigger and data readout rate
- Low material budget, cooling
- Long term, large scale system operation
Detector life cycle
• 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
• 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, electromagnetic, irradiation, data base support….
• WP3 VecGeom for CMSSW
• WP5: Common DAQ for LHC & LC beam tests
• WP6: DMAPS beam tests
• WP8: LAr dual phase operation
• WP9: C0₂ facility
• WP13: High-rate µWELLs
• WP14: Test bench stands
• WP15: Cold irradiations
• 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
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 CO₂ 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
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**
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!
**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/](https://agenda.infn.it/event/19410/)
  - People interested in submitting EoIs are warmly encouraged to attend
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
• **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
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
ATTRACTION & AIDA-2020++

**ATTRACTION**

- 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.
• **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
• 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