



EuCAIF



EuCAIF

EuCAIF, who ordered this???

European Coalition for AI in Fundamental Physics

 **Upcoming**

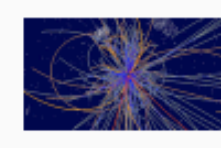
EuCAIFCon 2025
June 16 - 20, Sardinia

EuCAIF is an European initiative for advancing the use of
Artificial Intelligence (AI) in Fundamental Physics.



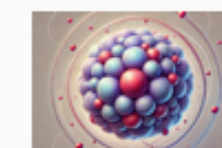
Theoretical physics

Crafting mathematical frameworks to predict and explain the fundamental laws of nature.



Particle physics

Unlocking the secrets of the tiniest building blocks of the universe.



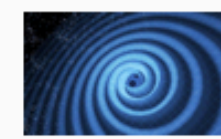
Nuclear physics

Studying atomic nuclei to understand the forces that power stars and shape the elements around us.



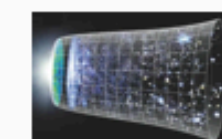
Astroparticle physics

Exploring cosmic rays, neutrinos, and dark matter to reveal the universe's mysteries.



Gravitational waves

Listening to the ripples in spacetime to witness the most violent cosmic events.



Cosmology

Investigating the origins, evolution, and ultimate fate of the universe on the grandest scales.




Accelerator physics

Pushing the frontiers of technology to accelerate particles and probe the structure of matter.

**Draft website
of EuCAIF**

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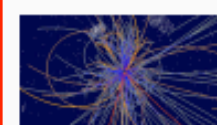
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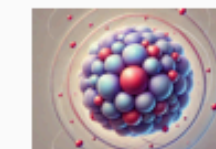
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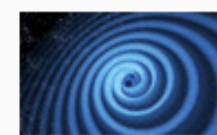
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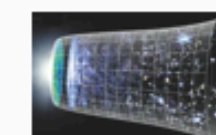
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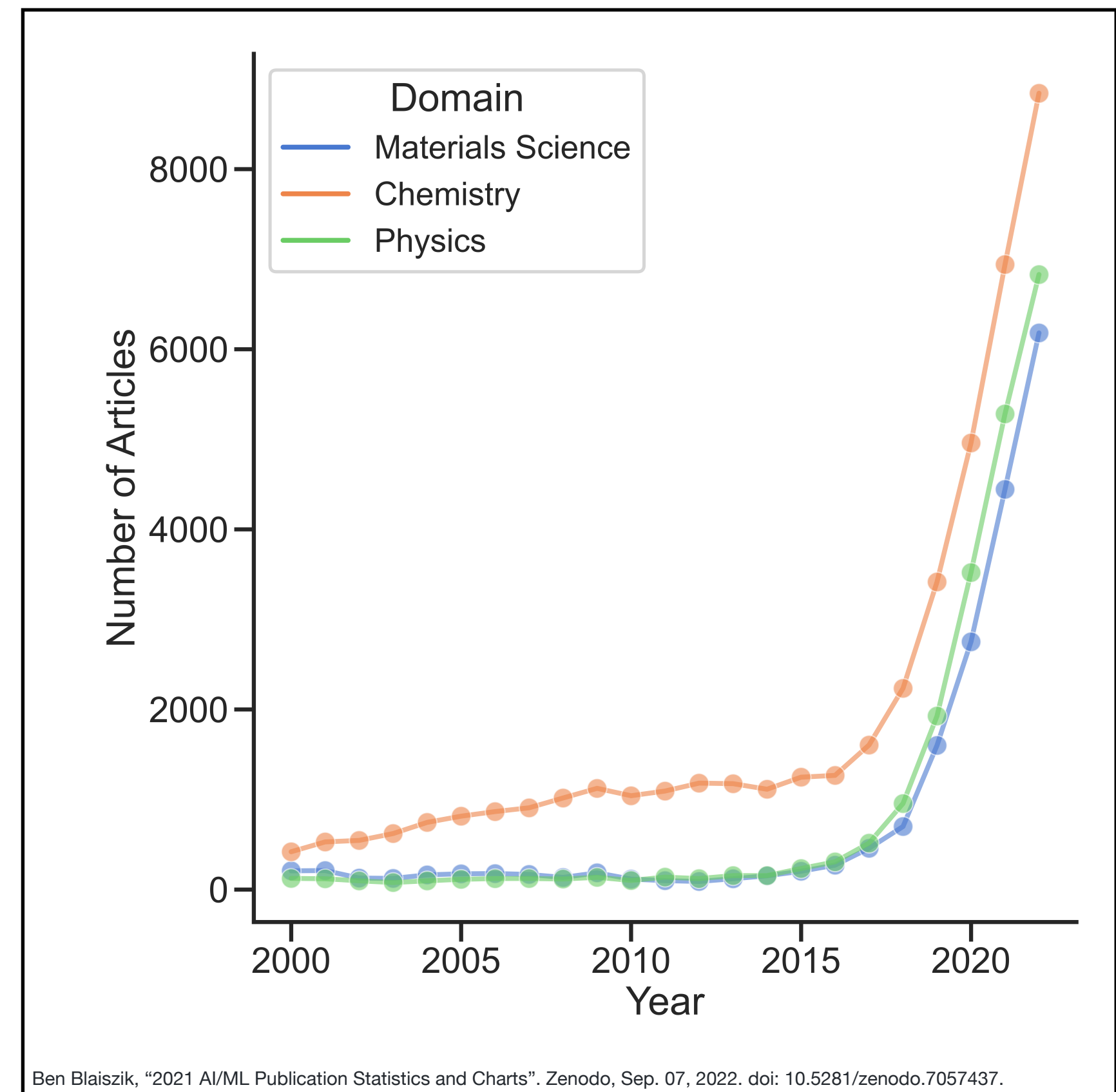
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Overall mission statement (draft)

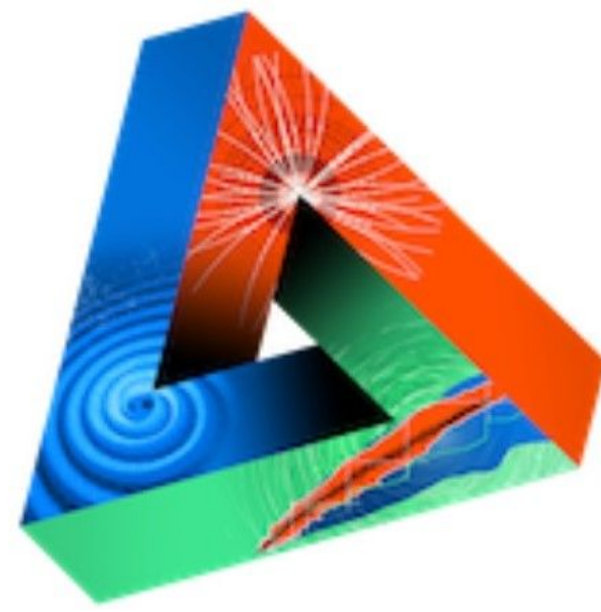
AI and modern machine learning are not only revolutionizing our every-day lives, they are also **transforming the way we do fundamental physics research** in particle physics, astroparticle physics, nuclear physics, gravitational wave physics, cosmology, and theoretical physics. Common defining aspects are large datasets, first-principle simulations, and a wide range of numerical methods. They indicate a transformative potential of AI-applications, provided that we develop science-specific AI-methods. Requirements on these AI-methods include control, robustness, uncertainty estimation, and explainability in scientific terms, with the ultimate goal to broaden the impact of science in fundamental physics research. **We view ourselves as developers of such science-specific AI-methods, which should enable scientific discoveries and benefit the broader AI-community through research and training.**

EuCAIF is creating a **network of researchers at European institutions to build bridges between fundamental physics and AI-research and to connect high-caliber scientists** (i) visibly advancing both fields, (ii) leading the community in Europe, and (iii) training the young generation realizing this transformation.



FAIR and EuCAIF...

FAIR and EuCAIF...



JENAA

Joint ECFA-NuPECC-APPEC Activities

ECFA

European Committee for Future Accelerators

European Committee for
Future Accelerators

NuPECC

Nuclear Physics European
Collaboration Committee

APPEC

Astroparticle Physics
European Consortium

About us

This JENAA site was established after the Joint ECFA-NuPECC-APPEC Seminar ([JENAS](#)) at Orsay, that allowed **astroparticle, nuclear and particle physics researchers to peek into each other's activities**. The identified overlapping challenges might **transform via joint programs into stronger opportunities** to further our understanding of both the smallest and the largest structures in nature.

Being informed by the presentations and discussions and with a view to further explore topical synergies between our disciplines, we **issue a call for novel Expressions-of-Interest (EoI)**. We seek bottom-up and community thoughts expressed in a non-binding EoI for further discussion within the APPEC, ECFA and NuPECC committees or consortia. These thoughts can revolve around potential synergies in technology, physics, organization and/or applications.

EoIs in the form of a brief letter are to be submitted to the chairs of the committees/consortia. In the letter you can elaborate on the synergy topic, the objectives, the initial thoughts and the potential communities involved. This letter is not the end of the process, but potentially the start of further communications on the expressed interest.

Within our committees/consortia and taking into account their respective roles in our communities, we will discuss and propose actions to further your thoughts.

Andreas Haungs, APPEC Chair, andreas.haungs@kit.edu

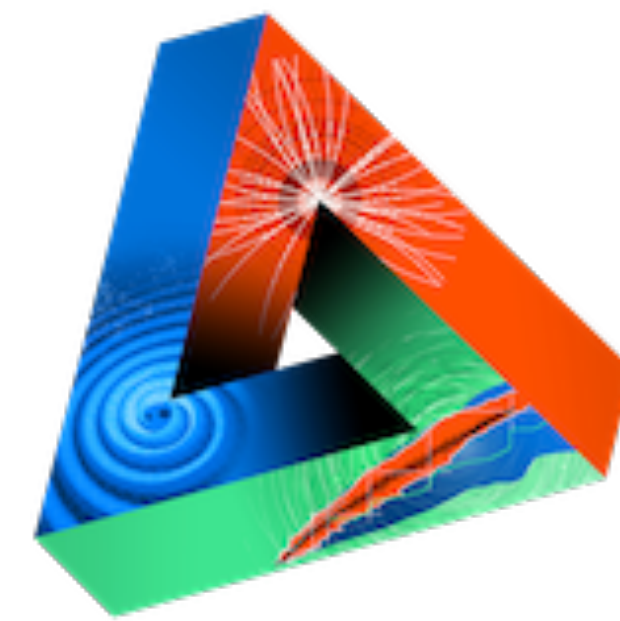
Paraskevas Sphicas, ECFA Chair, Paraskevas.Sphicas@cern.ch

Marek Lewitowicz, NuPECC Chair, Marek.Lewitowicz@ganil.fr

JENA Expressions of Interest

List of submitted Eol:

1. Dark Matter - iDMEu (<https://indico.cern.ch/event/869195/overview>)
2. Gravitational Waves for fundamental physics (<https://agenda.infn.it/event/22947/overview>)
3. Machine-Learning Optimized Design of Experiments - MODE (<https://mode-collaboration.github.io/#home>)
4. Nuclear Physics at the LHC (<https://indico.ph.tum.de/event/4492/>)
5. Storage Rings for the Search of Charged-Particle Electric Dipole Moments (EDM) (<https://indico.ph.tum.de/event/4482/overview>)
6. Synergies between the Electron-Ion Collider and the Large Hadron Collider experiments (<https://indico.ph.tum.de/event/7004/>)
7. **European Coalition for Artificial Intelligence (AI) in Fundamental Physics.** (<https://www.eucaif.org/>)



JENAA

Joint ECFA-NuPECC-APPEC Activities

Expression of Interest

July, 2023

for a synergic research plan of potential interest of the
JENA group

Project title:

**European Coalition for AI in Fundamental physics
(EuCAIF)**

Keywords: European Initiative, Machine Learning (ML), Artificial Intelligence (AI), Fundamental Physics, Particle Physics, Astroparticle Physics, Nuclear Physics, Gravitational Wave Physics, Theoretical Physics, Simulation, Computational Infrastructure

Individuals signing Eol:

Elena Cuoco (European Gravitational Observatory and Scuola Normale Superiore, Italy)
Sascha Caron (Radboud University, Nijmegen and Nikhef, Amsterdam) PI
Tilman Plehn (Heidelberg University)
Pietro Vischia (Universidad de Oviedo and ICTEA)
Roberto Trotta (SISSA and Imperial College London)
Tommaso Dorigo (INFN Padova and University of Padova)
Julian Garcia Pardinias (CERN)
Ik Siong Heng (University of Glasgow)
Stefano Forte (Milan University)
Anastasios Belias (GSI/FAIR)
Johan Messchendorp (GSI/FAIR)
Helena Albers (GSI/FAIR)
Adrian Oeftiger (GSI/FAIR)
Roberto Ruiz de Austri (IFIC/CSIC and University of Valencia)
Stefano Carrazza (Milan University & INFN)
Christoph Weniger (GRAPPA, University of Amsterdam)
Daniel Nieto (IPARCOS, Universidad Complutense de Madrid)
Lorenzo Moneta (CERN)
Lucio Anderlini (INFN Firenze)
David Rousseau (IJCLab, CNRS/IN2P3, U Paris-Saclay)
Steven Schramm (University of Geneva)
Steffen Schumann (University of Göttingen)
Martin Erdmann (RWTH Aachen University)
Gabrijela Zaharijas (Center for Astrophysics and Cosmology (CAC), University of Nova Gorica)
Caterina Doglioni (University of Manchester, endorser)
Verena Kain (CERN)
Veronica Sanz (Sussex&Valencia)
Andreas Ipp (TU Wien)
Stephen Green (University of Nottingham)
Tobias Golling (University of Geneva)
Maurizio Pierini (CERN)
Thomas Eberl (ECAP / FAU Erlangen-Nürnberg)
Gregor Kasieczka (University of Hamburg)
Annalisa Pillepich (MPI, Heidelberg)
Nicola Serra (University of Zürich)
Sofia Vallecorsa (CERN)
Hiranya Peiris (University of Cambridge)
Will Handley (University of Cambridge)

EuCAIF - Organisation

Management board

(5 persons)

Rotating from steering group, in office till June 2025:

- Sascha Caron (Radboud University and Nikhef, Netherlands)
- Elena Cuoco (European Gravitational Observatory and Scuola Normale Superiore, Italy)
- Johan Messchendorp (GSI/FAIR, Germany)
- Tilman Plehn (Heidelberg University, Germany)
- Christoph Weniger (University of Amsterdam, Netherlands)

+ International
Advisory Board

Steering group

(Today 41 persons)

The steering group is responsible for overseeing the implementation of the EuCAIF initiative, to provide guidance and make strategic decisions, through regular meetings, and to elect the members of the management board. **Permanently employed scientists with strong track records and high visibility in the field of AI** can apply on our website to become members of the EuCAIF steering group for five years. More specifically, the requirements are (i) international high-impact publications in their research domain; (ii) international high-impact publications in AI-applications to their domain; (iii) training young scientists driving the AI-revolution of fundamental physics; (iv) active and leading contributions to the EuCAIF activities. Each application for the steering group will be evaluated by three independent referees, one from the candidate's research field, one from a loosely related field, and one member from the EuCAIF management board. The decision will then be made by the management board.

Members

(....)

We invite **everyone involved in AI-applications to fundamental physics research**, particularly young researchers, to become EuCAIF members and to take part in our activities and working groups. Diversity, including geography and research fields, is a key value behind the EuCAIF mission. EuCAIF membership requires endorsement by two members of the steering group.

!! Governance rules still in draft !!

EuCAIFCon 2024 in Amsterdam



30 April 2024 to 3 May 2024
Amsterdam, Hotel CASA

EuCAIFCon 2024 in Amsterdam



EuCAIFCon2025: June 16-20, 2025, Sardinia, Italy

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EuCAIFCon 2024

30 April 2024 to 3 May 2024
Amsterdam, Hotel CASA
Europe/Amsterdam timezone

Enter your search term

Overview

Timetable

Searchable timetable

Mobile phone app

Contribution List

Insert cards

EuCAIF workgroups

Zoom broadcast of
plenary program

Scientific advisory board

Plenary speakers

Venue & Fee

Code of conduct

Wednesday evening
event

Parallel sessions
instructions

Contact

▼ c.weniger@uva.nl

▼ scaron@nikhef.nl

Plenary speakers

Confirmed plenary speakers for talks & panel discussions

- [Thea Klaeboe Aarrestad](#) (ETH Zurich)
- [Amber Boehnlein](#) (Jefferson Lab)
- [Daniele Bonacorsi](#) (University of Bologna)
- [Kyle Cranmer](#) (University of Wisconsin-Madison)
- [Miles Cranmer](#) (University of Cambridge)
- [Elena Cuoco](#) (European Gravitational Observatory)
- [Verena Kain](#) (CERN)
- [Gregor Kasieczka](#) (University Hamburg)
- [Siddharth Mishra-Sharma](#) (IAIFI/Harvard/MIT)
- [Anna Scaife](#) (University of Manchester)
- [Matthew D. Schwartz](#) (Harvard University)
- [Sofia Vallecorsa](#) (CERN)

Confirmed speakers for the public evening event

- [Caterina Doglioni](#) (Manchester University)
- [Michela Paganini](#) (DeepMind)
- [Max Welling](#) (University of Amsterdam)
- Moderator: [Martijn van Calmthout](#) (Nikhef)

~250 participants

11 plenary talks

4 panel discussion

>160 parallel talks+posters

5 working group meetings



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EuCAIF workgroups

1 Foundation models & discovery

[Sign up here to WG1](#)

Tentative mission/goals: The current pinnacle of AI are so-called foundation models (FMs) as pioneered in LLMs like ChatGPT or image generators like DALLÉ. Multimodal FMs centralize information from various data modalities and domains and encode them in a common meaningful latent representation. They offer an opportunity to go from narrow task-centric applications to general-purpose tasks. This session will serve as a platform to discuss the potential transformative impact of FMs for fundamental science and discovery in particular, and how we can as a community foster progress.

2 AI-assisted co-design of future ground- and space-based detectors

[Sign up here to WG2](#)

Tentative mission/goals:

- 1) "Identify existing design paradigms for particle and astroparticle physics instruments which have become obsolete in the AI era, and assemble software strategies and research paths to overtake them"
- 2) "Support the development of simulation tools that constitute enablers of co-design approaches to holistic optimization for detector use cases in HEP, astro-HEP, nuclear and neutrino physics."
- 3) "Understand physical limits of information generated by particle interactions in granular calorimeters and conditions for its lossless extraction, as a preliminary step toward the AI-assisted hybridization of calorimeters and tracking detectors into optimized variable-density systems"

5 Building bridges: Community, connections and funding

[Sign up here to WG5](#)

Mission/goals: ML in particle physics is a very small field, and the way we usually operate is that we identify field-specific opportunities and challenges and then develop new solutions together with ML-experts from other fields (or based on their work). The obvious questions are (i) how can we make this communication more efficient? And, (ii) how can we organize a proper feedback loop, so our solutions are used by the ML community?

3 FAIR-ness & Sustainability

[Sign up here to WG3](#)

Tentative mission/goals:

- 1) review existing activities exist in fundamental physics that strive to make ML algorithms Findable, Available, Interoperable and Reproducible (may include ML datasets)
- 2) understand what the barriers to making ML FAIR are - this includes availability of standardised tools and computing facilities for retraining or using someone else's model
- 3) discuss steps to facilitate and promote FAIR ML in fundamental science
- 4) start efforts to review and frame the environmental sustainability of ML algorithms (potential discussion of \trade-off with performance)

4 JENA WP4: Machine Learning and Artificial Intelligence Infrastructure

[Sign up here to WG4](#)

Tentative mission/goals:

The mission of the Joint ECFA-NuPECC-APPEC (JENA) Computing Initiative's Machine Learning (ML) and Artificial Intelligence (AI) Working Group is to strategize and implement European federated computing solutions for future large-scale research facilities. Through a comprehensive survey, we aim to assess and quantify the resource needs of physicists to run ML workloads effectively.

Open for other workgroups

EuCAIF - take aways

- **It is a brand-new initiative...**
 - ...still in its “baby shoes”
 - ...room to steer its direction
- **Supported by Joint ECFA NuPECC APPEC**
 - ...as requested from funding agencies
 - ...in the context of “federated” computing infrastructures
 - ...”European” equivalent to DIG-UM (sort of)
- **Role of GSI/FAIR**
 - ...leading the “nuclear physics” (NuPECC) domain in EuCAIF
 - ...stronger involvement in working groups?!?
 - ...organise EuCAIFCon 2026?



If you like to follow the activities of EuCAIF please join the following e-group: eucaif-info@cern.ch
—> get membership of CERN e-group, checkout <http://cern.ch/egroups>

2022

FAIR and EuCAIF...

Joint ECFA-NuPECC-APPEC (JENA) Seminar in May 2022 in Madrid

<https://indico.cern.ch/event/1040535/>

- Identification of joint computing requirements for the next decade.
- Discussions with funding agency representatives on the strategy and implementation of **European federated computing** at future large-scale research facilities.



Joint ECFA-NuPECC-APPEC Computing Initiative workshop June 2023 in Bologna

2023

<https://agenda.infn.it/event/34738/>

- **Creation of five working groups** to coordinate a white paper:
 1. HTC, WLCG and HPC (HPC)
 2. Software and Heterogeneous Architectures (Software)
 3. Federate Data Management, Virtual Research Environments and FAIR/Open Data (Data)
 4. **Machine Learning (ML) and Artificial Intelligence (AI)**
 5. Training, Dissemination, Education (TDE)



Objectives & Activities of EuCAIF

Objectives and Key Focus Areas

- Promote Cross-disciplinary Collaboration
- Promote the integration of AI/ML into Data & Computing Infrastructure for Current and Upcoming Experiments
- Promote the development of Novel Algorithms for Physics
- Promote and validate Benchmarks, Open Data and (upcoming) scientific AI systems like question answering machines
- Training and Education and Outreach
- Infrastructure and Resources

Concrete Activities

- Workshops and Conferences
- Initiate new Research Projects
- Data Challenges and Benchmarks
- Training Programs and Outreach activities
- Networking and Exchange
- Webpage and Online Presence

