

Frequently Asked Questions (FAQs) for the **ARTIFICIAL INTELLIGENCE RESEARCH FOR HIGH ENERGY PHYSICS** Funding Opportunity Announcement (DE-FOA-0002705)

How does the Office of High Energy Physics currently support AI/ML research?

AI/ML research is currently supported by the Office of High Energy Physics (OHEP) through three programs. The largest fraction of research support is from the university and lab comparative review program. This program supports **Programmatic AI/ML** research to further an HEP Frontier's mission. This work is primarily applications of ML to frontier specific problems.

In addition, through FOA based awards OHEP has supported **Core AI/ML** research into more ambitious topics. This work has been supported through FOAs such as the Early Career Researcher program, the DOE Office of Science (SC) FOA to support Data, Artificial Intelligence, and Machine Learning at Scientific User Facilities.

How does this new solicitation fit in to the overall HEP AI/ML Research program?

This FOA seeks to support research that pushes beyond what is currently possible in HEP, by advancing new AI applications that enable new lines of investigation into the P5 Science Drivers or significantly enhance sensitivity or interpretation of HEP results. This program additionally seeks to consolidate diffuse efforts that cross institutions into projects with committed leadership to deliver high impact AI applications. This program seeks to seed high-risk high-reward blue-sky research with the potential to grow into future high impact applications.

Of equal importance is to provide an opportunity for new researchers to participate in AI and HEP research to foster a robust HEP-AI research community. Applications to develop tools necessary to facilitate broad future participation in HEP and AI research, including and especially from historically underserved communities is sought.

What work is considered currently supported?

Currently supported research is referring to support by a funding source external to a PIs affiliated institution. For this FOA the target result/application and not the technical approach will be used to determine potential overlap in scope. Grant or Field Work Proposal funding received from federal funding agencies such as DOE, NSF, NASA, etc. or a private funding institution either directly or indirectly as a subaward or work for others contract is considered currently supported. Work supported by funding originating internal to an institution is not considered currently supported. Research supported by University overhead return, Lab LDRD programs, or any similar program is not considered currently supported.

How are AI and ML defined for this FOA?

Artificial Intelligence refers to computational systems that respond to data and take action, without human intervention, to achieve a goal and the development of those systems. It includes validation and interpretation work beyond dataset cultivation, training, and algorithm optimization to allow trustworthy autonomous action by the computational system. AI is the field of endeavor.

Machine Learning refers to computational algorithms that are not rigidly programmed but have parameters learned from data. This includes cultivation of datasets and selecting, tuning, and training models to achieve optimal performance. ML is a tool often used in AI research.

How is innovative defined for this FOA?

Research that tries to address an existing gap or unresolved question in the AI or HEP literature is deemed innovative.

What are you looking for in the *AI for HEP* track?

The **AI for HEP** track seeks ambitious research projects that deliver high impact results either through ambitious new projects or consolidation of existing research efforts. Applications are sought that are well aligned with the HEP program priorities. AI research that advances the P5 science drivers, or development of new AI-based technologies that expand paths of investigation for HEP beyond what was considered in the P5 report are encouraged. Ambitious applications of AI benefitting multiple HEP programs or experiments coherently and which are of broad interest are especially sought, as are innovative applications that can deliver significant advances to HEP experimental reach or theoretical understanding.

What are you looking for in the *HEP for AI* track?

The **HEP for AI** track seeks projects that utilize unique aspects of HEP to improve the understanding of the theoretical capabilities and limitations of fundamental AI. Research into robust scientific ML, data intensive ML, ML-enhanced Modeling and Simulation, Uncertainty Quantification, and Physics Informed ML that exploits HEP theoretical understanding, experimental data, or simulations to provide insight into general AI/ML methods are encouraged. An example of a possible research topic in this area would be evaluation of various Physics Informed ML techniques compared to training/inferring with more traditional networks.

What are you looking for in the *HEP AI Ecosystem* track?

The **HEP AI Ecosystem** track seeks to support work toward production of open datasets, collaboration with industrial or national laboratory partners, as well as development of “ecosystem” software allowing for straightforward training and deployment of models. Applications that address democratic access among all-sized institutions to computing resources and continued development and retention of the workforce for the products being

developed are especially welcome. Examples of possible topics in this area would be curating HEP datasets for public access, or integration of ML software into standard HEP tools.

Who can apply?

DOE National Labs -- Office of Science or NNSA labs -- may apply as the lead of a multi-institution team. Multi-institution teams may propose subawards to other DOE National Labs or FFRDCs, universities or colleges, or other eligible public or private institutions as identified in the FOA. There is no restriction or requirement on the institute teaming arrangement for multi-institution applications. A single application is submitted representing the team, with one lead-PI from the lead-lab identified.

Other eligible institutions such as Universities and Colleges may apply for single-institution "seed" awards. Multiple PIs from the same institution may apply on a single seed application.

What restrictions are there on applications?

Each institution may submit up to four (4) applications to their allowed path.

The lead institution of multi-institution teams must have a lead-PI who is expected to charge at least 25% of their time to the award. This lead-PI may only participate in the application they lead and may not participate in any other applications.

Who can participate in a multi-institution team?

Multi-institution teams may propose subawards to other DOE National Labs or FFRDCs, universities or colleges, or other eligible public or private institutions as identified in the FOA. There is no restriction or requirement on the institute teaming arrangement for multi-institution applications. A DOE National Lab may partner with as many or as few institutions as necessary and appropriate to carry out the research being proposed.

What are you looking for in a multi-institution team?

Multi-institution teams should have the appropriate technical skill and level of effort to address all aspects of the multi-faceted research being proposed. Clear explanation of what each institution contributes and why it is necessary for the success of the project should be clear from the FOA. Description of the management and coordination of multi-institution teams should be included to demonstrate that the team has thought through the communication needed for successful development, but also the risk mitigation necessary to respond to issues that may arise over the course of a multi-year research project and ensure the proposed research is carried out successfully. Explanations of these breakdowns are expected to be more thorough for the larger lab-led proposals.

What are the award sizes?

There are different award sizes in the multi-institution and seed award paths.

Multi-institution team awards have a floor of \$350,000 and a ceiling of \$3,000,000 per year. The expected range of awards is between \$350,000 and \$1,500,000 per year with the median award size expected to be between \$500,000 and \$750,000 per year.

Single-institution seed awards have a floor of \$50,000 and a ceiling of \$150,000 per year. The expected range of awards is between \$50,000 and \$100,000 per year with the median award size expected to be between \$50,000 and \$75,000 per year.

What should the budget narrative include?

For all applications the budget narrative should go beyond stating the costs of the proposal, and should provide an explanation and justification for the funding requests from **all participants**, including subawards to the non-lead institution, if relevant. This should include high level descriptions of the work being carried out and the level of effort needed to accomplish it at each institution in each year. Direct and indirect charges may be separated out for easier explanation. It should be clear to reviewers why in each fiscal year the work being done requires the budget being requested.

What are Letters of Collaboration and why might I need one?

Letters of Collaboration are statements that, should a project be supported, the letter writer and the collaboration they represent agrees, in principle, to support the resulting product through routine maintenance and upkeep using funding external to this FOA.

Applications targeting large collaborations, may choose to include such letters to provide reviewers with a level of assurance that the proposed impact of the research will be realized. An example of when this might be appropriate could be development of a detector independent charged particle tracking algorithm based on a neural net with proposed applications to ATLAS, CMS, DUNE, and LHCb. Letters of Collaboration from appropriate ATLAS, CMS, DUNE, and LHCb Managers stating an intention to take on the routine support and maintenance of this new algorithm in their software environment would assure reviewers that the proposed multi-experiment impact would be realized if successful.

What level of hardware support is acceptable?

This FOA seeks to support research activities. Purchases of hardware necessary to carry out research activities is allowed but expected to be at a modest level. As guidance, laptops for newly hired postdocs or grad students is viewed as modest, while an institution or research group specific GPU cluster is not. More substantial hardware investment in the **HEP AI Ecosystem** path may be appropriate, but support external to this FOA for costs associated with long term facility maintenance and support should be explicitly identified and supported by a Letter of Collaboration.

Is travel allowed?

Travel will be supported at a lower priority level, but modest requests are permissible to facilitate collaboration and disseminate scientific results.

My institution is allowed to submit four applications, should we?

The limit of four applications was set to allow larger institutions the opportunity to submit strong proposals across multiple HEP program and AI research areas. Judging between diverse proposal topics can be difficult for a single institution to determine what will review best. It is expected that it will be rare that this high upper limit should be approached.

The review process is expected to be extremely competitive, and institutions should prioritize submitting high quality proposals.

There seems to be conflicting information between the FOA and other sources, which is right?

If conflicting information is circulating, the FOA is correct. Please alert [Jeremy Love](#) to address the issue.