



HPSF

HIGH PERFORMANCE
SOFTWARE FOUNDATION

Building the Future of HPC Software, Together!

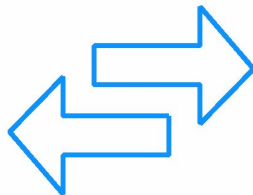
Julien Bigot, Xavier Delaruelle & Axel Huebl

HPC Best Practices webinar 2026-10-28

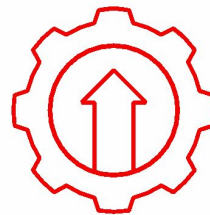
The High Performance Software Foundation?



Performance



Portability



Productivity

A **neutral** hub for **open source**, **high performance** software

In 2023, ECP was ending,
efforts like NumPEx, or Fugaku-next were starting
... How to sustain the software stack, together?



launched at ISC 2024

#Neutral

#Open-source

#High-performance

#Sustainable

Neutrality as a way to sustainability

Solving the “chicken & egg” problem of **sustainability**

Sustainability in OSS is ensured by large & diverse contributor base

1. **Contributors** emerge from the **community** and require **trust**
 - No one organization can **control** the direction of the project
 - Projects are **open** to new contributors and new ideas
2. **Communities** emerge around **good products** and **trust**
 - Projects are and will remain **usable by anyone**
3. **Good products** require enough **contributors** to build them

Neutral, open governance ensures that we can
build the **broadest** possible **communities**

Trust in a sustained open-source strategy

- Projects write an **open-source project charter**: clarify governance model
 - Who leads the project? What are the process to select new leaders?
 - The project is and will remain committed to open-source
- **Transfer the name** and associated rights to LF
 - Brand, trademark, website, domain name, github / public forge co-ownership, ...
- **Code ownership remains with its authors**
 - Under an OSI-compliant open-source licence
- **LF gives back the usage right** on everything transferred
 - Acts as a trusted third party
 - Ensures the charter is and will remain followed, that the project is committed to open-source
 - Enforces that no `{myproject}`-enterprise tries to leach on the project popularity
 - Offers last resort ownership to ensure transition if all project owners evaporate

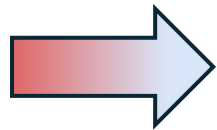
HPSF project lifecycle as a path to sustainability



Emerging

- Libre, open source, vendor-neutral HPC project
- Committed to open governance
- Working towards best practices

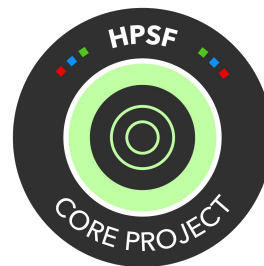
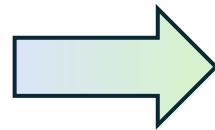
Open-source & committed to move forward



Established

- Wide usage by at least 3 organizations
- Steady development
- Robust development practices & processes, open to new developers

Robust for production use & committed to move forward



Core

- Steady development from multiple organizations
- No single organization has a majority in governance
- Sustainable cycle of development and maintenance

No single institution is the bottleneck



HPSF
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SOFTWARE FOUNDATION

Fund & vote

Members



Microsoft



Sandia
National
Laboratories



Governing Board

Participate & vote



WGs & committees

Outreach

Events

CBench

CI/CD

Binaries

Workforce

...

...

Technical Advisory Council

Join & vote

Projects



RAMBLE

Premier
\$175k/y



General
\$5k-50k/y



**Associate
for Academia**



Who are we?

Julien Bigot:

- Representative of CEA (France Atomic Energy Commission)
- Elected at the governing board by general members



Xavier Delaruelle

- TAC representative for Environment Modules project



Axel Huebl

- TAC representative for WarpX project
- Elected at the governing board by the TAC



Membership

Americas

Europe

Asia

Premier



General



Associate



What's in it for members?



HPC Providers (HW/SW/Services)



- **Leverage HPSF projects** to enhance your services and products
- **Ensure your products are well supported** by HPSF software
- **Secure mindshare** and collaborate with some of the leading software teams in the HPC space



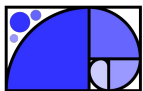
HPC Users (Scientists, Analysts)

- **Leverage HPSF projects** to develop, build, deploy and profile your projects
- **Connect with a community** that can help you use the latest high performance computing software and hardware
 - CPUs, GPUs, AI/ML architectures
- **Voice concerns and requirements** to the HPSF community
- **De-risk software decisions** knowing there's a community to rely on

Projects



ClusterShell



AMReX



Spack



wi4mpi



RAMBLE



APTAINER

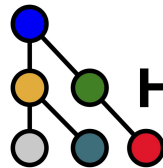
Open



HAMI



Charliecloud



HPCToolkit



ENVIRONMENT
MODULES

E4S



kokkos



TRILINOS

HPX



VISKORES

WARPX

flux



CHAPEL



HPSF

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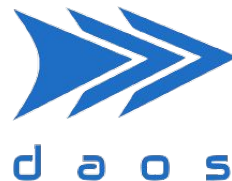
What's in it for projects?

- **Build a community**
 - grounded in **neutral open source governance**
- **Share knowledge** and **find synergies** with others
 - Improve your governance model and learn from the most advanced projects
 - CI, software engineering best practices, community upkeep
 - Participate in working groups that aim to bring HPC open source software to the wider computing world
- **Get support** for all the “boring” aspects
 - Marketing, legal, collaborative tools, logos & website design, meetings organization, event promotion, etc.



The LF is a broad scope foundation

Being part of this ecosystem make collaboration beyond HPSF easier



Expanding the HPC Workforce: HPSF & Sustainable Research Pathways

- **Strategic Partnership:** Leveraging Sustainable Horizons Institute (SHI) to bridge the gap between students and HPSF open-source projects.
- **Mentorship Focus:** Connecting scientists, mathematicians, and engineers with expert HPSF contributors.
- **Proven Pipeline:** Successful matching completed in December 2025; inaugural cohort begins **Summer 2026**.



in collaboration with:



HPSF Conference Last year in Chicago

HPSFcon plenary

- Building & Sustaining Communities
- Emerging Technologies & the Future of HPC
- Productivity, Performance, & the HPC Pipeline
- Project & Ecosystem Growth
- Trust, Security, & Open Collaboration
- User Experiences

Project Working Sessions

- **Programming systems:** HPX, Kokkos
- **Deployment:** Apptainer, Charliecloud, Spack, Environment Modules
- **Libraries:** AMReX, Trilinos
- **System management:** OpenChami, Flux Framework

Join us this year in
Montreal!
April 12 - 16



HPSF Community Summit in Europe



- **Last year:** February 25 - 27, 2026
- **Location:** TU Braunschweig, Germany

A platform in Europe for users, developers and members of HPSF projects to:

- **learn** about recent developments,
- **report** on their use cases and experiences,
- **interact** with core developers and the community,
- form a network of HPSF project users and developers in Europe.

Expect a new announcement for fall 2027

Committees & Working Groups: Driving the Ecosystem

CI/CD

Providing access to GPUs and next-gen architectures

Leads/Contact:
Alec Scott & Zack Galbreath



Benchmarking

Developing reproducible performance benchmarks for diverse software stacks

Leads/Contact:
Olga Pearce & Jayesh Badwaik



Binaries

Reducing sysadmin burden via ABI compatibility and secure binary signing

Leads/Contact:
Ryan Krattiger



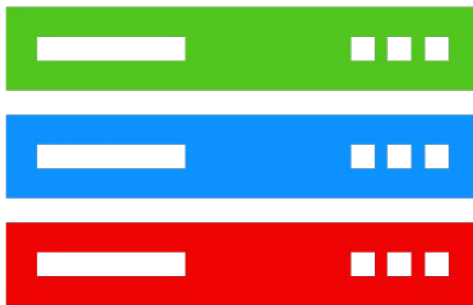
Outreach Committee

Drive community outreach to boost HPSF & Project visibility.



Conclusion

- HPSF is a **gathering of projects**
- Supported by **member** institutions
- HPSF helps get some **trust** on the long term **viability** of these projects
- It also offers them **support** to develop and grow
- But the real value is in collaboration
 - **Let's hear from actual project representatives**



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ENVIRONMENT
MODULES

Environment Modules: from a 1991 tool to an HPSF project

Xavier Delaruelle, CEA

HPC Best Practices webinar, October 28, 2026

Change the shell environment on the fly



Load, unload, switch

A modulefile describes environment changes. module load applies them, module unload reverts them, in one atomic step.



One command for every shell

Same interface in bash, zsh, ksh, csh, tcsh, fish, cmd and PowerShell, and from Python, Perl, Ruby, R, CMake and Tcl scripts.



A script that prints shell code

modulecmd.tcl evaluates the modulefile and emits the matching shell commands, which the module function evals in the session.

```
$ cat /path/to/modulefiles/foo
#%Module
prepend-path PATH /path/to/apps/foo/bin

$ which foo
foo not found

$ module load foo
$ which foo
/path/to/apps/foo/bin/foo

$ module unload foo
$ which foo
foo not found
```

The front door to HPC software catalogs



Many applications, many versions

module avail lists the catalog, module load picks a version. Several versions of a tool coexist with no conflict.



One interface for every installer

Spack, EasyBuild and other installers all emit modulefiles. Users get the same command whatever produced the software stack.



Dependencies resolved automatically

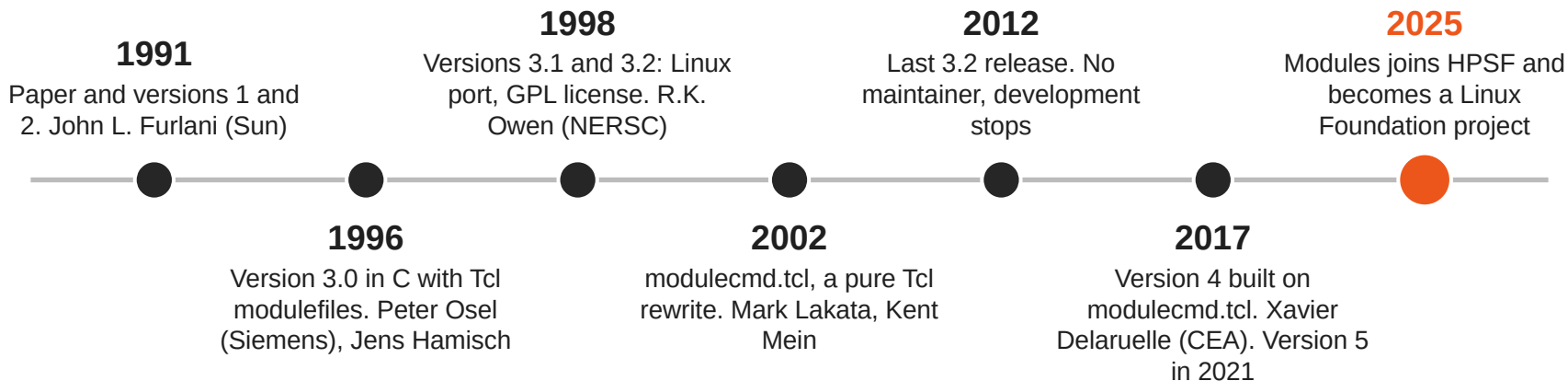
Requirements get loaded, conflicts unloaded, dependents reloaded. Module hierarchies and variants use the same mechanism.



More than software access

MPI profiles, data endpoints, development setups, collections: environment variables, but also aliases, shell functions and completion.

35 years old, revived by CEA in 2017



2 feature releases a year

~50 user-visible changes per release

24k+ non-regression tests, 99.5% coverage

v5.7.0 released September 2026

Prominent features added since 2017

For users

Collections

[v4.0](#) module save and restore a whole environment

Automated dependency handling

[v4.2](#) requirements, conflicts, dependent reload

Advanced version specifiers

[v4.4](#) module load foo@3.2:3.5

Module variants

[v4.8](#) module load foo@2 +mpi
toolchain=foss24a

Environment control

Initial environment and stash

[v5.2](#) module reset, stash and stashpop

Extra specifiers

[v5.3](#) module avail envvar:PATH require:foo

Module hierarchy

[v5.6](#) spider and requiring via a module

Windows and PowerShell

[v4.5](#) cmd support, PowerShell since v5.5

For sysadmins

Hide, forbid and tag modules

[v4.6](#) control what users see and may load

source-sh

[v4.6](#) turn a vendor shell script into a modulefile

Module cache

[v5.3](#) and 63% faster loads in v5.7

Linting, logging and hook API

[v5.2 to 5.7](#) quality checks, audit trail, site hooks

Why HPSF: one lab and one person is fragile

The situation in 2024

- CEA alone has carried the project since 2017, with a single maintainer.
- Name, logo and domain belonged to one organization: any hand-over would have been painful.
- A wide user base, but about two external contributors per release.

What a neutral foundation changes

- Linux Foundation Europe owns the project assets. No single employer controls the direction.
- Open governance written down: charter, roles, decisions taken in public.
- Visibility and new contributors through HPSF outreach, HPSFcon and sister projects such as Spack and Kokkos.

How it went

Dec 2024

Repository moved to the neutral envmodules GitHub organization; governance written

Jan 2025

Project proposal presented to the HPSF Technical Advisory Council

Sep 2025

Charter adopted; contributor agreement moves the assets to LF Europe

Nov 2025

HPSF announces Modules as an Established project

Feb 2026

First open TSC meeting; first project meeting at HPSFcon in March

Under HPSF: charter, TSC and open meetings



Linux Foundation Europe

Legal home of the project. Holds its name, logo and domain. Every contribution carries a DCO sign-off.



High Performance Software Foundation

Directed fund of the Linux Foundation. Governing Board, Technical Advisory Council where Modules holds a seat, working groups, outreach team. Modules is at the Established stage.



Modules project

Technical Charter, adopted Sep 4, 2025

Mission, scope, roles and decision process. Maintainers, Collaborators and Former members listed in the GOVERNANCE file.

Technical Steering Committee

The TSC is made of the project maintainers. A majority vote adds or removes a maintainer. The TSC chair is the liaison with HPSF.

Decisions in the open

Quarterly TSC meetings on LFX Zoom, open to anyone, with agenda and notes on the GitHub wiki. The content of each release is agreed there.

One year in: more hands, more visibility



Governance that outlives its founder

Writing the charter made the project define roles and processes it had never written down.



A second maintainer

Adrien Cotte (AS+) joined the TSC in 2026. We look for new contributors who could become maintainers.



More contributions

A neutral home draws more interest: contributions have increased since the project joined.



A session at the HPSF annual conference

HPSFcon 2026 put us in touch with our user community. Their feedback now guides the roadmap.



Visibility and services

HPSF outreach: announcement, social media. LFX services: domain, mailing list, Zoom.

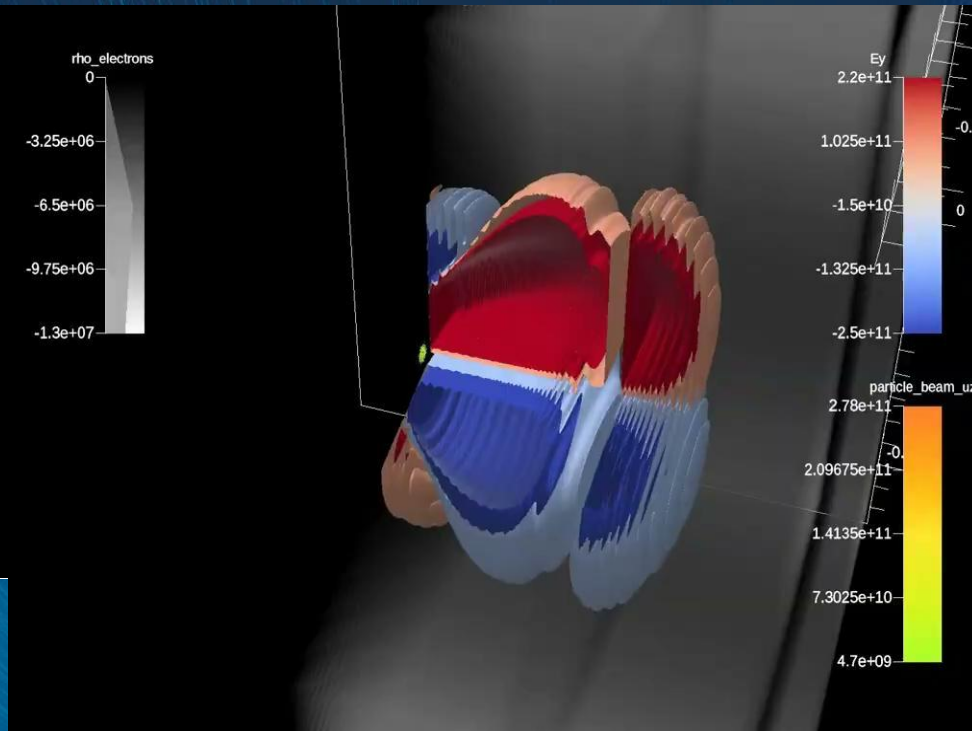


Get involved

github.com/envmodules/modules
envmodules.io, docs at modules.readthedocs.io
lists.hpsf.io/g/modules-interest, [#modules:matrix.org](https://matrix.org)
Quarterly TSC meetings open to all (project wiki)

The HPSF: Building the Future of High-Performance Software, Together – WarpX Project

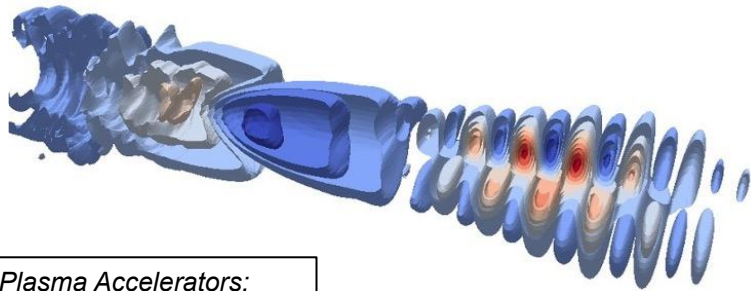
Axel Huebl for the BLAST WarpX team and collaborators at
LBNL, LLNL, CEA-LIDYL, SLAC, DESY, CERN, Helion Energy, Avalanche, TAE, Realta Fusion



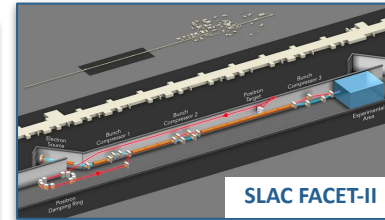
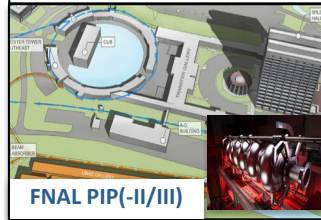
multi-stage LPA simulation in a
boosted frame with WarpX
transversely focusing fields & beam



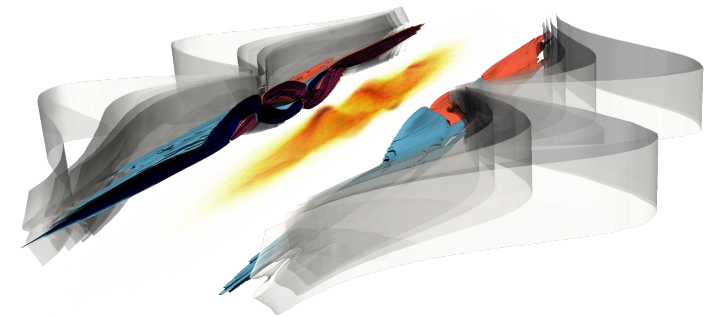
Visualization of Selected Applications



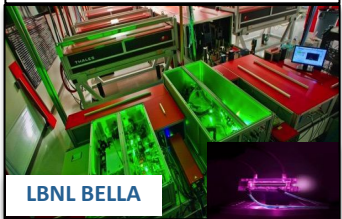
Radio-Frequency Accelerators



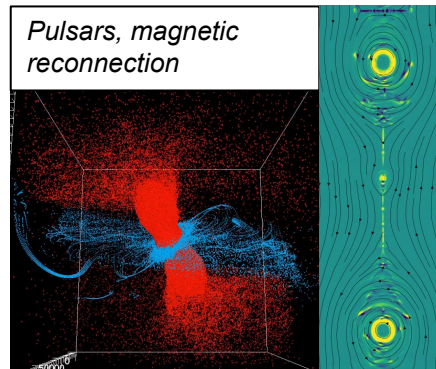
High-Energy Physics: Interaction Point (Beam-Beam)



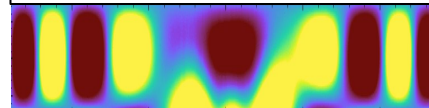
Plasma Accelerators:
Laser- or Beam-Driven



Pulsars, magnetic reconnection

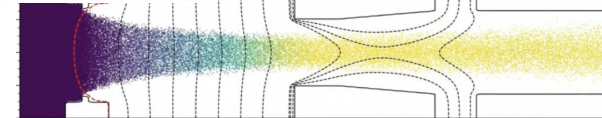


Microelectronics

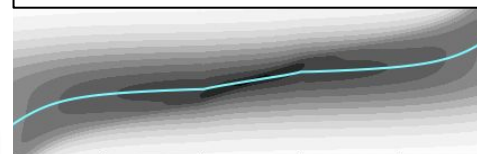


Alternative/Commercial/Startup Fusion Schemes

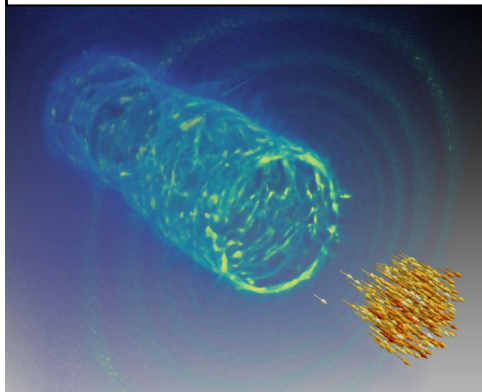
REALITY FUSION



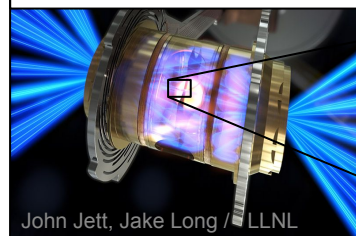
Magnetic Fusion Sheets



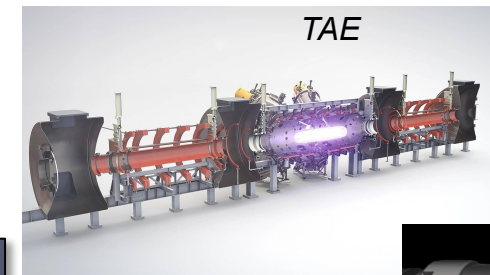
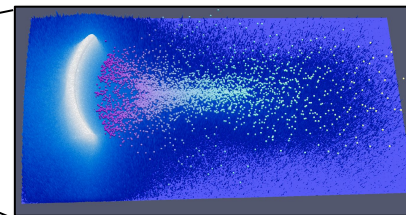
Laser-Plasma Interaction, Laser-Ion acceleration, High-Energy Density Physics



Kinetic effects in Inertial Confinement Fusion



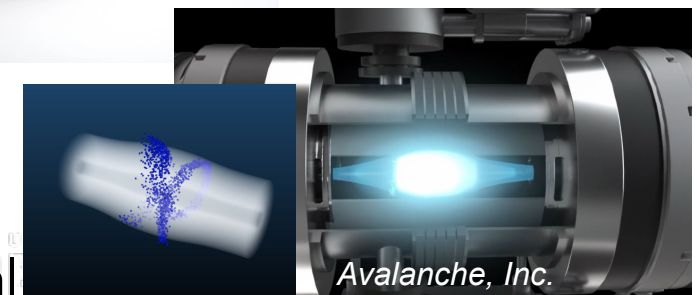
John Jett, Jake Long / LLNL



TAE



Zap Energy

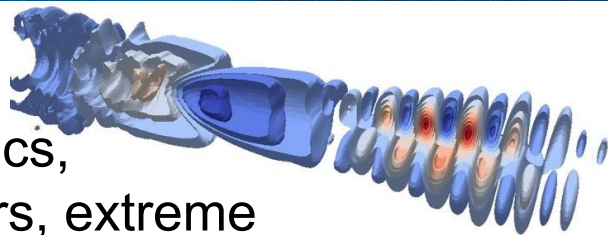


Avalanche, Inc.

<https://warpX.readthedocs.io/en/latest/highlights.html>

Applications

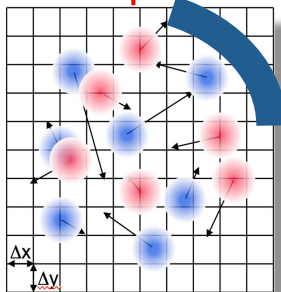
laser-plasma physics,
particle accelerators, extreme
light sources, fusion devices & plasmas, ...



Particle-in-Cell

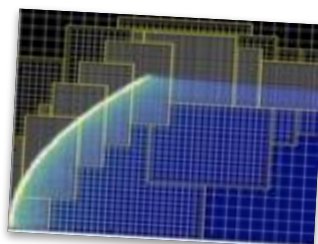
- electromagnetic or electro/magnetostatic
- 1-3D, RZ+, spherical
- time integration: explicit, implicit

Macroparticles



Surfaces

adaptive mesh-
refinement
(AMR)

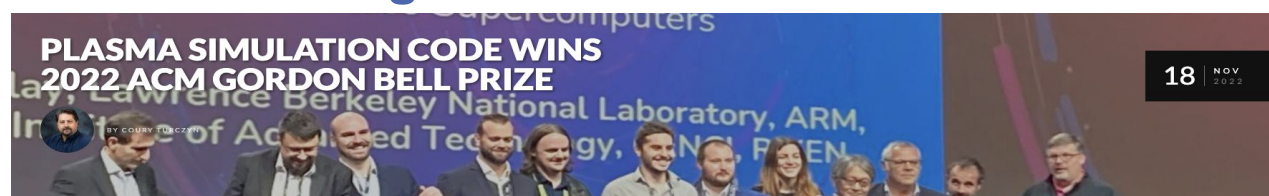


electromagnetic
(EM) fields on a grid

International Contributors incl. private sector



Award-Winning Code & Science



Detailed Physical Models

- Full documentation, benchmarks, examples
- Easy-to-use boosted frame
- collisional, quantum & fusion processes
- PIC-fluid hybrid, *and much more*



Portable, Multi-Level Parallelization

- GPUs & CPUs
- Desktop to supercomputer



Scalable & Standardized

- Python APIs, schemas
- In situ processing
- Open community ecosystem



Developed by an international, multidisciplinary team



Jean-Luc Vay



Ji Qiang



Arianna Formentii



Axel Huebl



Rémi Lehe



Chad Mitchell



Olga Shapoval



Edoardo Zoni



David Grote



Justin Angus



Ann Almgren



Kevin Gott



Junmin Gu



Revathi Jambunathan



Andrew Myers



Wei-quan Zhang



Kale Weichmann



Roelof Groenewald



Eric Clark



Prabhat Kumar



Germany
Maxence Thévenet



Alexander Sinn



Ángel Ferran Pousa*



Rob Shalloo



France



Igor Andriyash



Switzerland



Lorenzo Giacomel*



Severin Diederichs



Lixin Ge



France

Henri Vincenti



Luca Fedeli



Thomas Clark



Pierre Bartoli*



Franz Poeschel



Ryan Sandberg



Marco Garten



over 120 contributors, incl. from the private sector

*former members

Reuse: In Applications like WarpX, *"Everything"* Comes Together

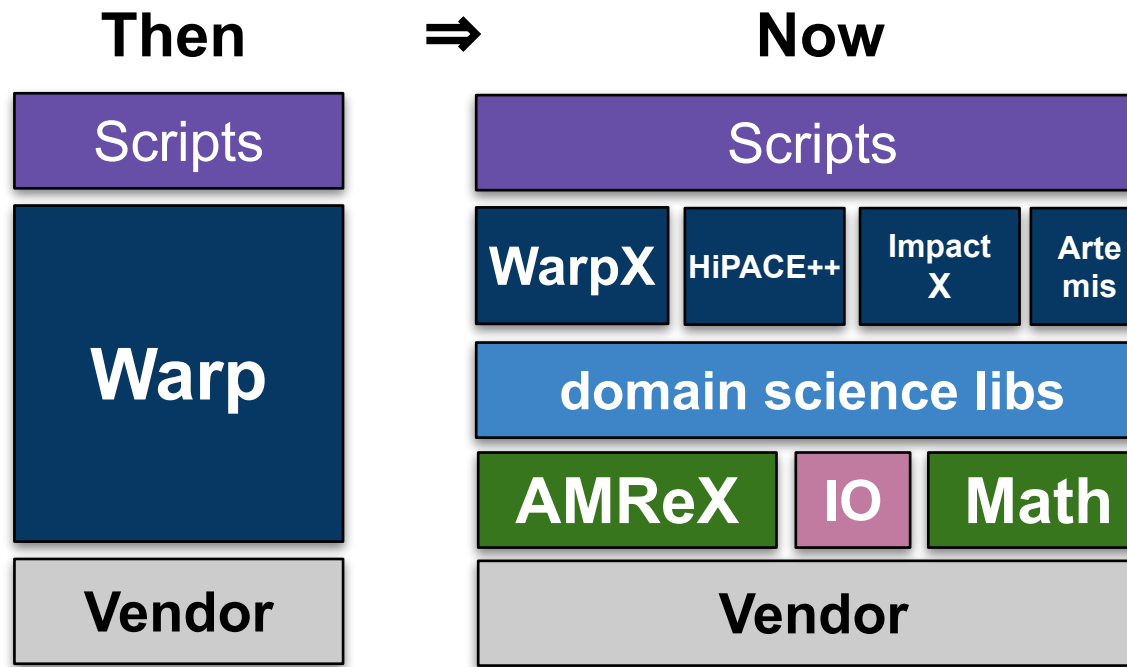


Desktop
to
HPC

We "graduated" from the "DIY" world

Deep, long-term collaborations:

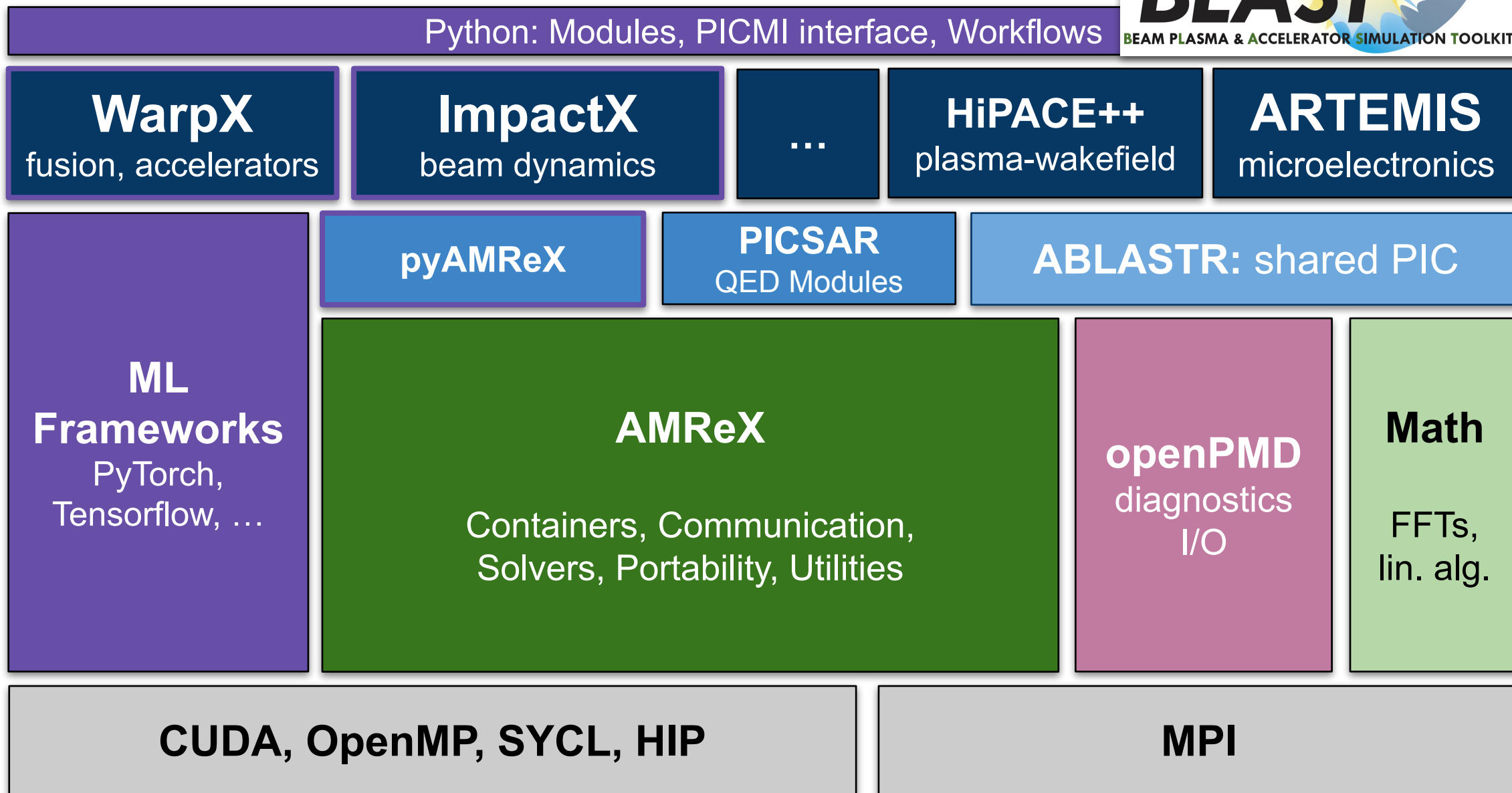
- vendors, DOE ASCR, HPC centers, ...
- own sub-libraries/modules, contributions
- machines & deployed environments



Modular Software Architecture



Desktop
to
HPC



WarpX: Open, international, neutral governance

Steering Committee (SC)

- admins (of last resort)

Technical Committee (TC)

- core governance body, where decisions are made
- maintainers, merge permissions

Contributors

- known contributors w/ triage & elevated testing privileges

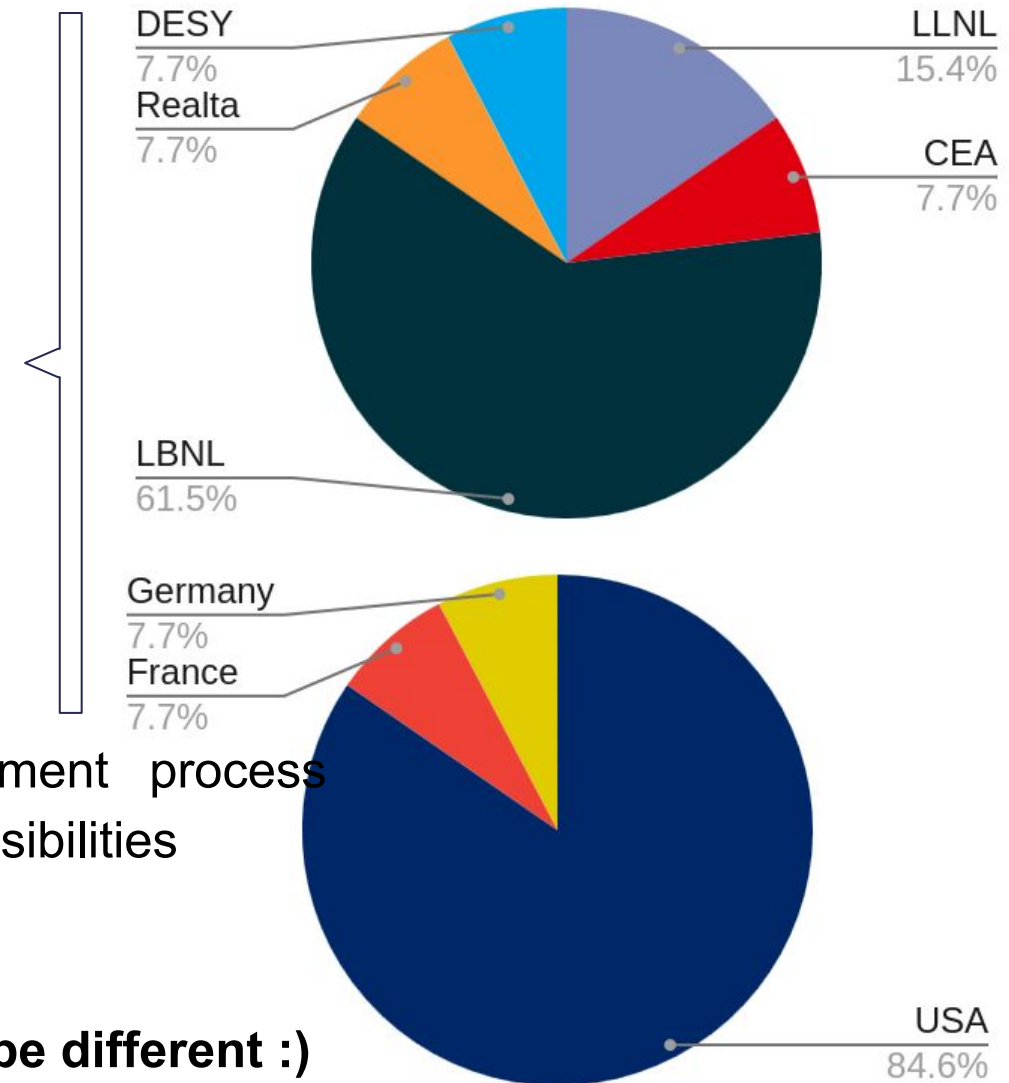
Each role: current roster, role, decision process, appointment process

→ weekly developer meetings, expectations, privileges + responsibilities

Goal: sustainable, representative of work on the ground

This is documenting *our* governance structure – yours can be different :)

<https://warpx.readthedocs.io/en/latest/governance.html>



Participation in the HPSF Annual Developer Conference

Since 2025 an annual conference, dedicated to advancing community-driven solutions for performance, portability, and productivity in a rapidly evolving High Performance Computing (HPC) landscape.

HPSF project AMReX hosted a **Project Meeting** day, which HPSF project WarpX joined.

- connected across WarpX developer & AMReX project scopes
- discussed emerging technologies and needs



Additionally, contributed to **plenary talks** and **conference discussions**, e.g.,

- exchanged on HPC programming languages
 - C++: Kokkos, HPX, ISO C++, etc.
 - Python, standardization, workflows
- packaging & deployment
- project growth strategies
- project technical & community management
- hands-on hacked GPU CI with two distributed partners

In essence: Sharing, discovering, forming new collaborations.



HPSF TAC: A Wealth of Opportunity to Engage



Interaction w/ TAC projects

- **AMReX** – central partner for WarpX
 - upstream & downstream contribs
 - cross-project needs with other AMReX science applications
 - shared Python and AI/ML strategy
- **Spack** – central for packaging
 - WarpX ships Spack & Conda/Pixi
 - Spack is best-in-class for performance, GPU and HPC deployments, incl. **E4S**
 - Containers – growing adoption and **Apptainer** a very likely supported solution for us
- C++ Projects – harmonize & standardize
 - ISO C++, **Kokkos** & **HPX**
- In situ visualization – **Viskores** formerly VTK-m

WG services: GPU CI

- we collab'ed with U Oregon + Kitware
- our need: secure, GitHub-integrated, per-PR CI on real GPU hardware
- solution: maintainer-authorized (label/comment), GitLab mirrored, GH-status-indicated runners on recent Nvidia, AMD and Intel datacenter GPUs

Non-profit benefits

- The Linux Foundation is a non-profit
- Collective negotiations, e.g., for **Slack** licenses
- Shared resources & analysis, e.g., **project logo, health and planning** (LFX), outreach & **tutorials**
- Interaction w/ vendors (feedback, tests, bugs)