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OAK RIDGE National Laboratory

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Experimental Computing Laboratory (ExCL) Update – Nov 2024

PREPARED BY:

Jeffrey Vetter, Aaron Young,
Steve Moulton, Narasinga Rao Miniskar

PRESENTED BY: Mohammad Alaul Haque Monil

Advanced Computing Research Section

U.S. DEPARTMENT OF ENERGY

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FY24 Highlights

Testbed deployments	• AMD MI300A • VCK190, U280 FPGAs • NVIDIA H100, A100s • Siemens EDA tools • Embedded Systems

Users	• 60 active users
	  • Incl non-ORNL
	  • Incl International
	• Multiple papers
	• Many presentations

Operations	• Slurm-based distributed computing upgraded • Documentation and help ticketing system • Monthly user meetings • Migration from Centos7 to Rocky9

ORNL Experimental Computing Laboratory

https://excl.ornl.gov

- Founded in 2004
- Provides low-level access to prototype computer architectures to encourage experimentation and prototyping of new hardware and software solutions.
- Not just testbeds, but experts and software environments to support this mode of operation.

ExCL Common Infrastructure

Project and User management
- Accounts via UCAMS and XCAMS
- Projects and Proposals
- Help via ticketing system

Community
- Workshops
- Online discussions, forums, and issues
- Newsletters and monthly user meetings
- Slack channel

Shared Login and Gateway Nodes
- Gateway and data transfer node
- Consistent and secure access to private network compartments
- Accessible via Open Research network

Authentication and Authorization
- Secure operations
- Partition access to specific compartments
- System and account lifecycles
- Experience with management of export controlled and proprietary systems

Shared Filesystems and Databases
- Secure access to filesystems across pillars
- ZFS based with user-accessible snapshots and replication.
- Shared project storage space.

Monitoring and control systems
- Manage access to shared resources
- Manage privileged access levels
- Lights out operation

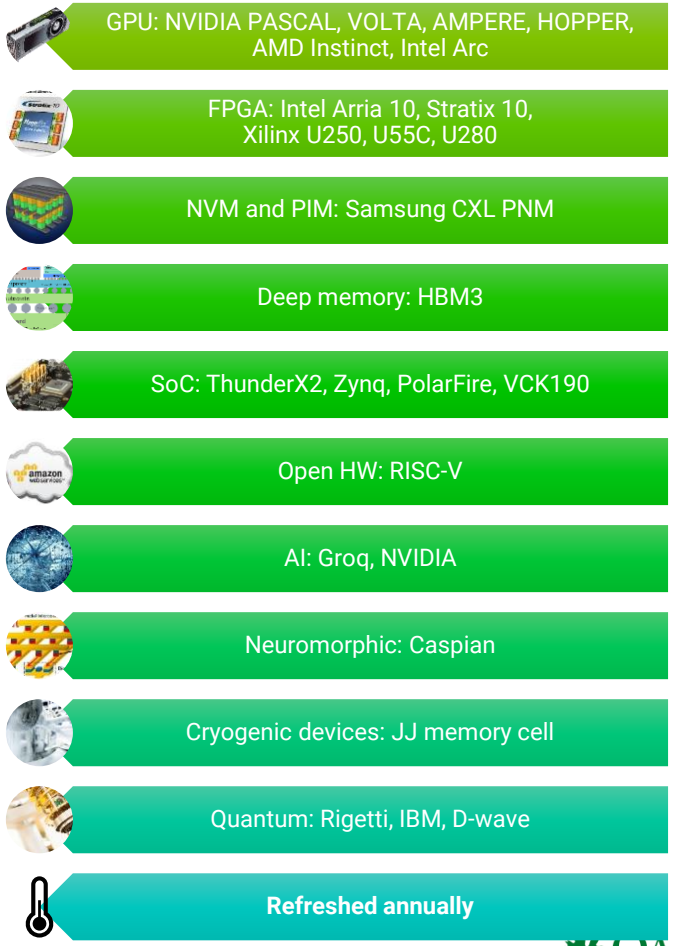
Source Code and Datasets
- Source code repos via external git services.
- Performance databases for applications and architectures

Containers and Virtualization
- Apptainer and Docker
- KVM Virtual Machines.

CI/CD
- Enables automated testing of software on a variety of architectures and accelerators.
- GitLab CI/CD Runners
- GitHub CI/CD Runners

Web
- Educational and reference materials
- Outreach
- Both Open and Controlled access

ExCL Technology Pillars



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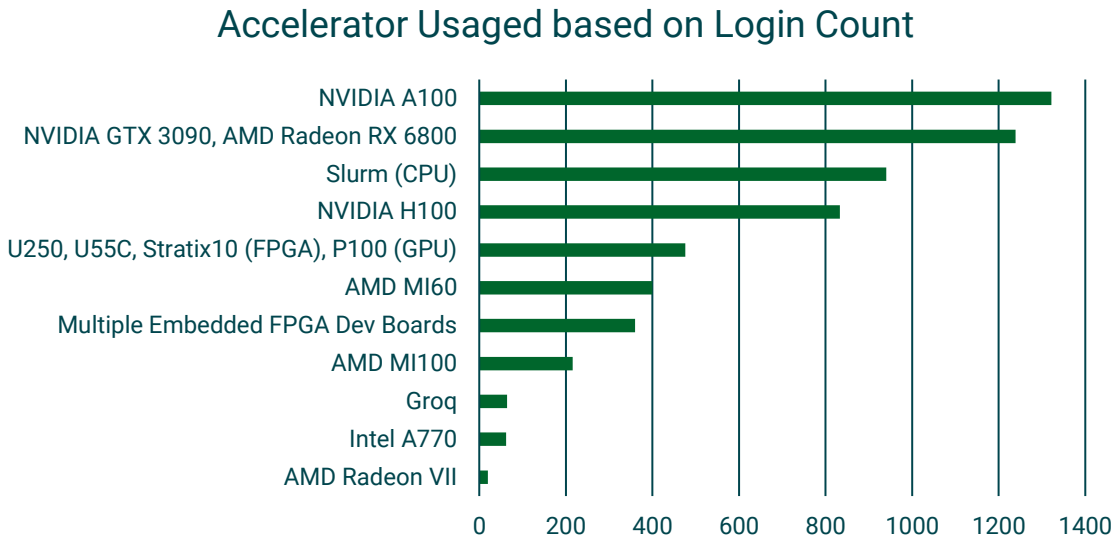
Testbed Highlights

- AMD Epyc servers with 128 cores (256 threads) and 1TB of RAM
- AMD MI100 GPU
- AMD Radeon RX 6800
- Achronix FPGA
- Groq AI Inference Accelerator
- IBM Summit Node with 2 POWER9 CPUs and 6 Volta GPUs
- Intel A770 Accelerator
- Intel ARC GPU
- PolarFire Icicle SoC with RISC-V and FPGA

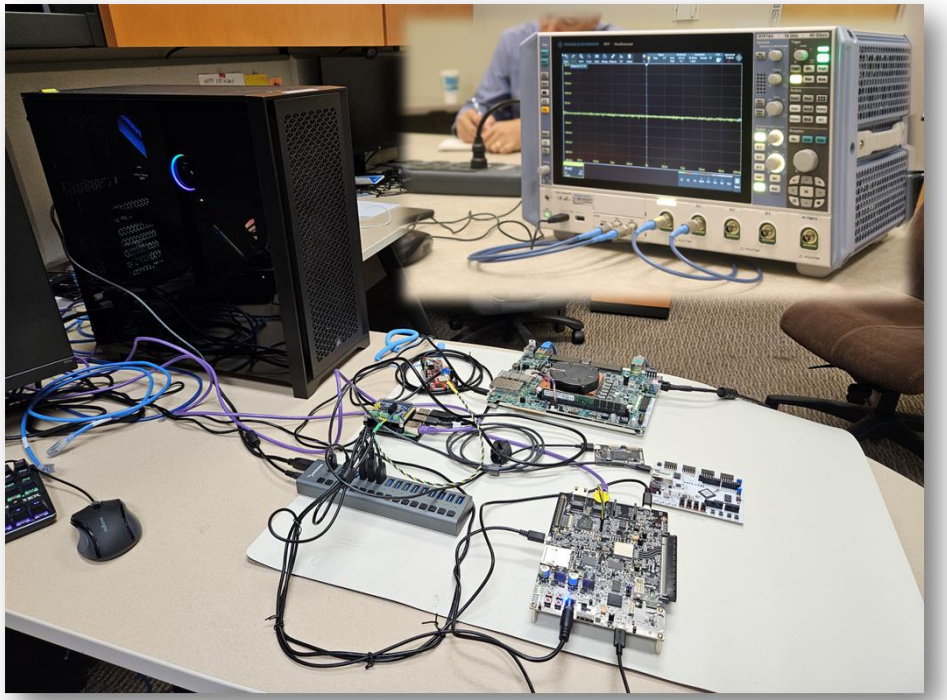
- Sensors
  - iniVation DVXplorer DVS Camera
  - Prophesee GenX320 and HD IMX636 DVS cameras
  - Ettus x410 Zynq US+, RFSoC-based, Software Defined Radios
  - LaBr3 and NaI(Tl) scintillation and SiPM-based detectors integrated with multichannel analyzers for gamma radiation spectroscopy

- NVIDIA A100
- NVIDIA H100
- NVIDIA Bluefield 2 DPUS
- NVIDIA DGX Workstation (V100s)
- NVIDIA Jetson AGX Orin
- Qualcomm Snapdragon 855 SoCs
- RTP164 High-Performance Oscilloscope
- Keysight DC Power Analyzer
- Xilinx U250, U280, and U55C FPGAs
- Xilinx Zynq RFSoC 4x2

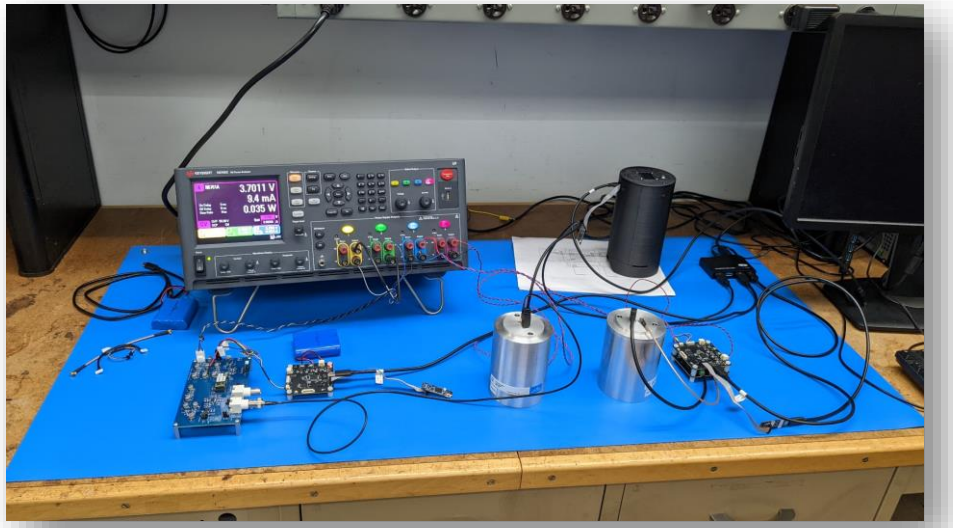


Benchtop Systems

- Custom-built Host PC.
- Embedded FPGA Development Boards
  - Arty-A7 100T
  - Alchitry
  - Polarfire SoC Icicle Kit
  - VCK190
  - Neuromorphic Engine Controller Testbench
- Custom Project-specific PCB Boards
- FTP164 - 16 GHz Oscilloscope
- Keysight DC Power Analyzer
- Ethernet Controlled Power Switch
- Integrated and reservable via Slurm with helper shell functions to reserve boards.



Embedded FPGA testbench with multiple FPGA dev boards



Radiation detection testbench

Recent ExCL Papers and Presentation

- 8 Papers

Title	Conference	Authors	Publish Fiscal Year
IRIS-MEMFLOW: Data Flow Enabled Portable Memory Orchestration in IRIS Runtime for Diverse Heterogeneity	HPEC24: 28th Annual IEEE High Performance Extreme Computing Virtual Conference	M. A. H. Monil, Narasinga Rao Miniskar, Seyong Lee, Beau Johnston, Pedro Valero Lara, Aaron Young, Keita Teranishi, Jeffrey Vetter	
FFTX-IRIS: Towards Performance Portability and Heterogeneity for SPIRAL Generated Code	RSDHA 23: 3rd Workshop on Redefining Scalability for Diversely Heterogeneous Architectures at SC23: The International Conference for High Performance Computing, Networking, Storage, and Analysis	Sanil Rao, M. A. H. Monil, Het Mankad, Jeffrey Vetter, Franz Franchetti	2024
MatRIS: Addressing the Challenges for Portability and Heterogeneity Using Tasking for Matrix Decomposition (Cholesky)	WAMTA 24: Workshop on Asynchronous Many-Task Systems and Applications 2024	M. A. H. Monil, Narasinga Rao Miniskar, Pedro Valero Lara, Keita Teranishi, Jeffrey Vetter	2024
MatRIS: Multi-level Math Library Abstraction for Heterogeneity and Performance Portability using IRIS Runtime	2023 International Workshop on Performance, Portability & Productivity in HPC at SC23:The International Conference for High Performance Computing, Networking, Storage, and Analysis	M. A. H. Monil, Narasinga Rao Miniskar, Keita Teranishi, Jeffrey Vetter, Pedro Valero Lara	2024
IRIS Reimagined: Advancements in Intelligent Runtime System for Task-Based Programming	Workshop on Asynchronous Many-Task Systems and Applications 2024	Narasinga Rao Miniskar, Seyong Lee, Beau Johnston, Aaron Young, M. A. H. Monil, Pedro Valero Lara, Jeffrey Vetter	2024
Neuro-Spark: A Submicrosecond Spiking Neural Networks Architecture for In-Sensor Filtering	International Conference on Neuromorphic Systems (ICONS) 2024	Narasinga Rao Miniskar, Aaron Young, Kazi Asifuzzaman, Shruti Kulkarni, Prasanna Date, Alice Bean, Jeffrey Vetter	
Clacc: OpenACC for C/C++ in Clang		Joel Denny, Seyong Lee, Pedro Valero Lara, Marc Gonzalez Tallada, Keita Teranishi, Jeffrey Vetter	2024
Adrastea: An Efficient FPGA Design Environment for Heterogeneous Scientific Computing and Machine Learning	Smoky Mountains Computational Sciences and Engineering Conference (SMC)	Aaron Young, Narasinga Rao Miniskar, Frank Liu, Willem Blokland, Jeffrey Vetter	2023

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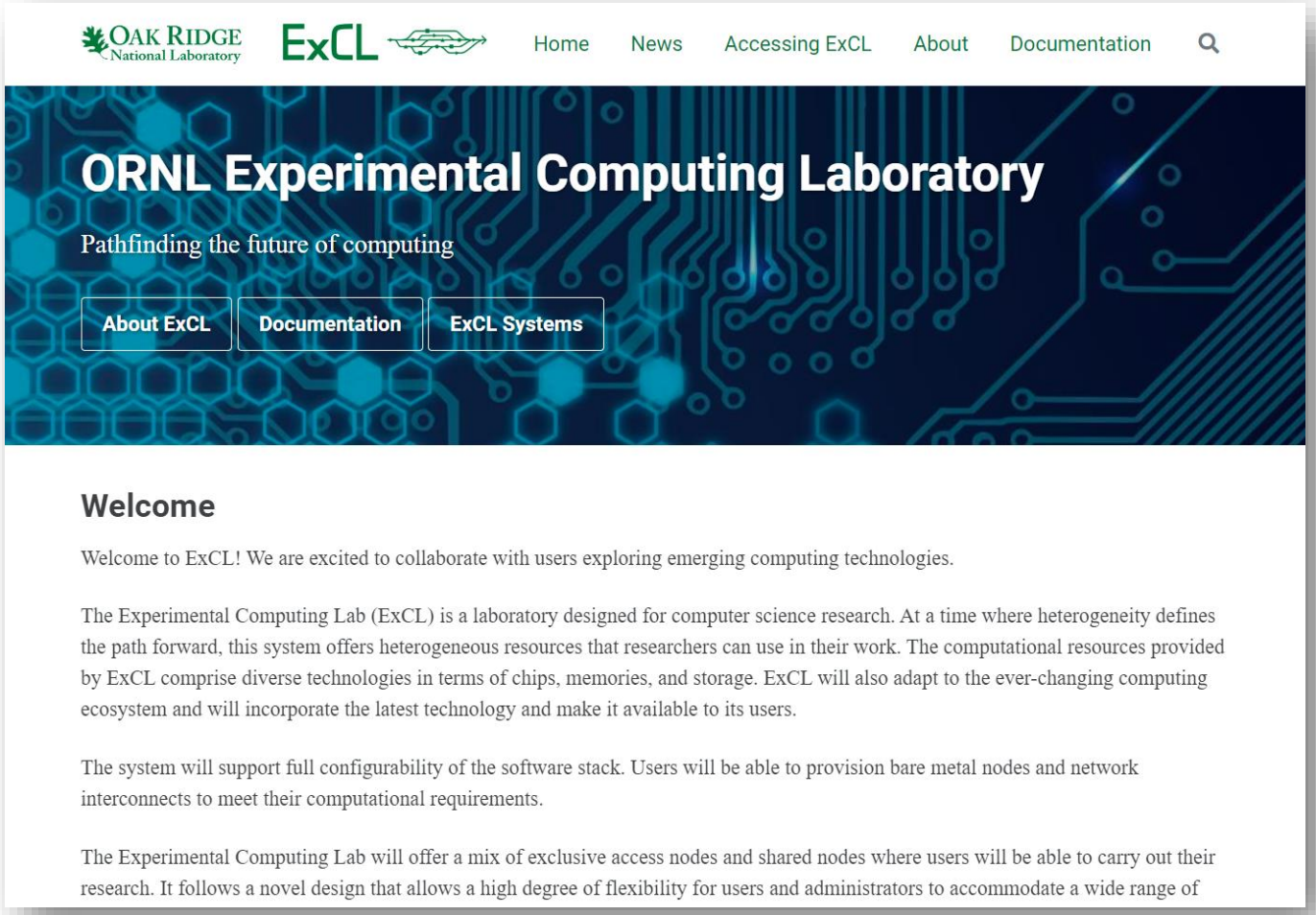

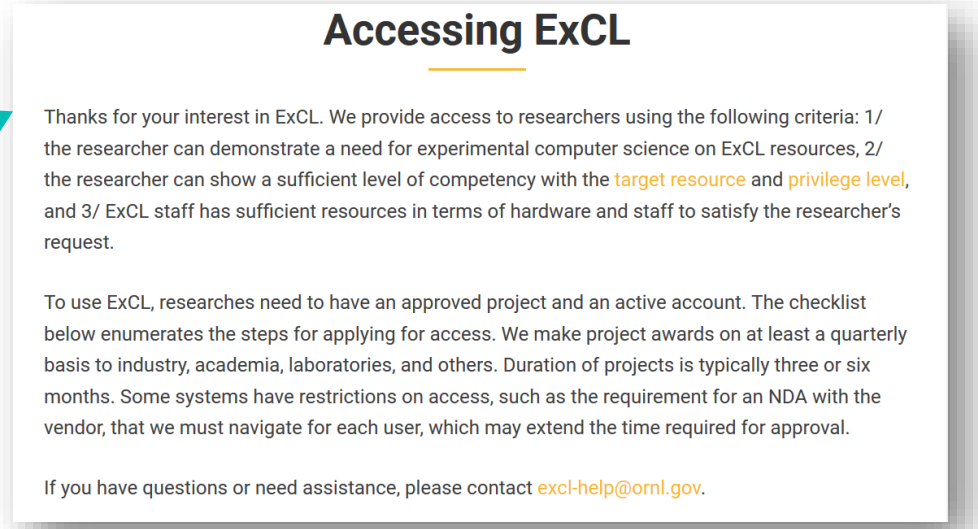

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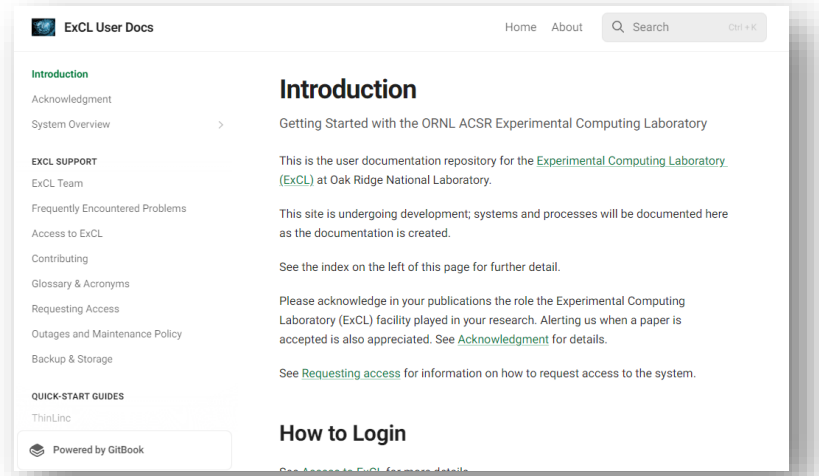

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Project Approval → Apply for ExCL Access → Review

Thanks