

# E4S



Trilinos Users Group Meeting 2022, Wednesday, Oct. 26, 2022, 10:30am MDT/9:30am PDT

[https://trilinos.github.io/trilinos\\_user-developer\\_group\\_meeting\\_2022.html](https://trilinos.github.io/trilinos_user-developer_group_meeting_2022.html)

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[https://e4s.io/talks/E4S\\_TUG22.pdf](https://e4s.io/talks/E4S_TUG22.pdf)



UNIVERSITY  
OF OREGON



U.S. DEPARTMENT OF  
**ENERGY**

Office of  
Science

# E4S: Extreme-scale Scientific Software Stack

- E4S is a community effort to provide open-source software packages for developing, deploying and running scientific applications on HPC platforms.
- E4S has built a comprehensive, coherent software stack that enables application developers to productively develop highly parallel applications that effectively target diverse exascale architectures.
- E4S provides a curated, Spack based software distribution of 100+ HPC and AI/ML packages (e.g., TensorFlow, PyTorch).
- With E4S Spack binary build caches, E4S supports both bare-metal and containerized deployment for GPU based platforms.
  - X86\_64, ppc64le (IBM Power 9), aarch64 (ARM64) with support for GPUs from NVIDIA, AMD, and Intel
  - HPC and AI/ML packages are optimized for GPUs and CPUs.
- Container images on DockerHub and E4S website of pre-built binaries of ECP ST products.
- Base images and full featured containers (with GPU support).
- Commercial support for E4S through ParaTools, Inc. for installation, maintaining an issue tracker, and ECP AD engagement.
  - <https://dashboard.e4s.io> [https://e4s.io/talks/E4S\\_Support\\_Sep22.pdf](https://e4s.io/talks/E4S_Support_Sep22.pdf)
- E4S for commercial cloud platforms: AWS image supports multiple MPI implementations and containers with remote desktop (DCV).
  - Intel MPI, NVHPC, MVAPICH2, MPICH, OpenMPI
- e4s-cl container launch tool allows binary distribution of applications by substituting MPI in the containerized app with the system MPI.
- Quarterly releases: E4S 22.08 released on August 31, 2022: [https://e4s.io/E4S\\_22.08.pdf](https://e4s.io/E4S_22.08.pdf)

# E4S: Extreme-scale Scientific Software Stack

- Curated, Spack based software distribution
- Spack binary build caches for bare-metal installs with 90,000+ binaries
- Container images on DockerHub and E4S website of pre-built binaries of ECP ST products
- Base images and full featured containers (with GPU support)
- GitHub recipes for creating custom images from base images
- GitLab integration for building E4S images
- E4S validation test suite on GitHub
- e4s-cl container launcher tool for MPI substitution in applications
- E4S VirtualBox image with support for container runtimes
  - Docker
  - Singularity
  - Shifter
  - Charliecloud
- AWS and GCP images to deploy E4S

# Extreme-scale Scientific Software Stack (E4S)

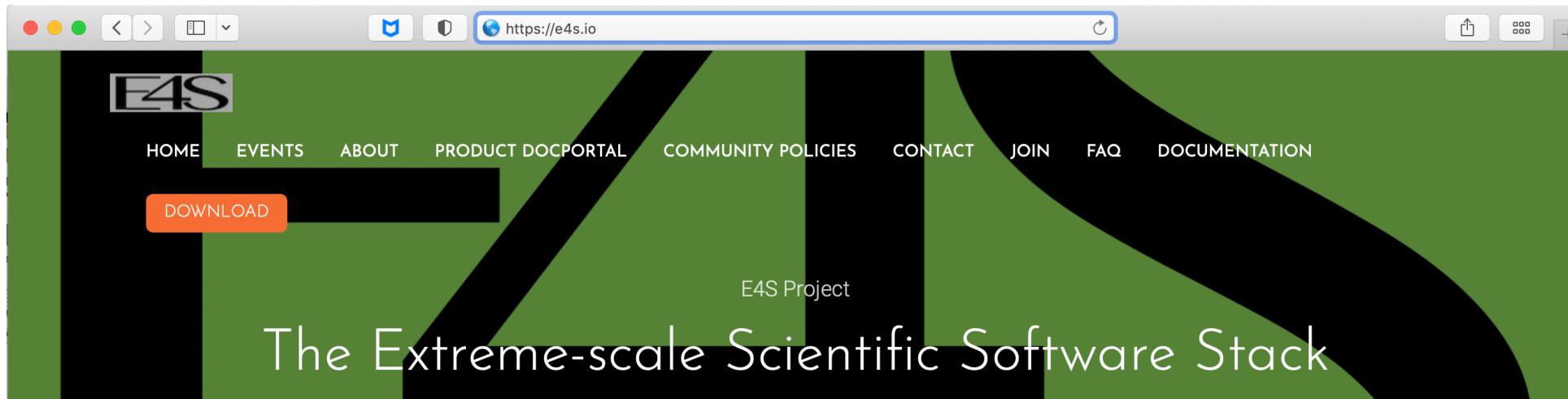
- E4S: HPC Software Ecosystem – a curated software portfolio
- A **Spack-based** distribution of software tested for interoperability and portability to multiple architectures with support for GPUs from NVIDIA, AMD, and Intel in a single distribution
- Available from **source, containers, cloud, binary caches**
- Leverages and enhances SDK interoperability thrust
- Not a commercial product – an open resource for all
- Oct 2018: E4S 0.1 - 24 full, 24 partial release products
- Jan 2019: E4S 0.2 - 37 full, 10 partial release products
- Nov 2019: E4S 1.0 - 50 full, 5 partial release products
- Feb 2020: E4S 1.1 - 61 full release products
- Nov 2020: E4S 1.2 (aka, 20.10) - 67 full release products
- Feb 2021: E4S 21.02 - 67 full release, 4 partial release
- May 2021: E4S 21.05 - 76 full release products
- Aug 2021: E4S 21.08 - 88 full release products
- Nov 2021: E4S 21.11 - 91 full release products
- Feb 2022: E4S 22.02 – 100 full release products
- May 2022: E4S 22.05 – 101 full release products
- August 2022: E4S 22.08 – 102 full release products



<https://e4s.io>

Also include other products .e.g.,  
AI: PyTorch, TensorFlow (CUDA, ROCm)  
Co-Design: AMReX, Cabana, MFEM

# E4S Download from <https://e4s.io>



## What is E4S?

The Extreme-scale Scientific Software Stack (E4S) is a community effort to provide open source software packages for developing, deploying and running scientific applications on high-performance computing (HPC) platforms. E4S provides from-source builds and containers of a [broad collection of HPC software packages](#).

# Download E4S 22.08 GPU Container Images: NVIDIA, AMD, Intel



## Acquiring E4S Containers

The current E4S container offerings include Docker images based on Red Hat Enterprise Linux 7, Red Hat Enterprise Linux 8, Ubuntu 18.04 (Bionic), and Ubuntu 20.04 (Focal Fossa) for Continuous Integration. Our images can run on X86\_64, PPC64LE, and AARCH64 depending on the particular image. Our full E4S Release images (not for Continuous Integration) are based on Ubuntu 18.04 (ppc64le) and Ubuntu 20.04 (x86\_64). In addition to offering a full E4S image containing a comprehensive selection of E4S software released on a quarterly cycle, we also offer a set of minimal base images suitable for use in Continuous Integration (CI) pipelines where Spack is used to build packages.

Docker images are available on the [E4S Docker Hub](#).



### Container Releases

- [④ Docker Downloads - CUDA](#)
- [④ Docker Downloads - ROCm](#)
- [④ Docker Downloads - OneAPI](#)
- [④ Singularity x86\\_64 Download - CUDA](#)
- [④ Singularity ppc64le Download - CUDA](#)
- [④ Singularity aarch64 Download - CUDA](#)
- [④ Singularity x86\\_64 Download - ROCm](#)
- [④ Singularity x86\\_64 Download - OneAPI](#)
- [④ OVA Download](#)



### From source with Spack

[Visit the Spack Project](#)

Spack contains packages for all of the products listed in the E4S 22.08 Full Release category (see above Release Notes). General instructions for building software with Spack can be found at the Spack website. Questions concerning building those packages are deferred to the associated package development team.

- Separate full featured Singularity images for 3 GPU architectures
- GPU full featured images for
  - x86\_64 (Intel, AMD, NVIDIA)
  - ppc64le (NVIDIA)
  - aarch64 (NVIDIA) NEW!
- Full featured images available on Dockerhub
- 100+ products on 3 architectures

# Download E4S 22.05 GPU Container Images: NVIDIA, AMD, Intel

## Note on Container Images

Container images contain binary versions of the Full Release packages listed above. Full-featured GPU-enabled container images are available from Dockerhub:

```
# docker pull ecpe4s/e4s-cuda:22.08  
  
# docker pull ecpe4s/e4s-rocm:22.08  
  
# docker pull ecpe4s/e4s-oneapi:22.08
```

## E4S Full GPU Images

These images contain a full Spack-based deployment of E4S, including GPU-enabled packages for NVIDIA, AMD, or Intel GPUs.

These images also contain TensorFlow, PyTorch, and TAU.

### AMD ROCm (x86\_64)

ecpe4s/e4s-rocm:22.08    
e4s-rocm-22.08.sif 

### NVIDIA CUDA (x86\_64, ppc64le, aarch64)

ecpe4s/e4s-cuda:22.08    
e4s-cuda-x86\_64-22.08.sif   
e4s-cuda-ppc64le-22.08.sif   
e4s-cuda-aarch64-22.08.sif 

### Intel OneAPI (x86\_64)

ecpe4s/e4s-oneapi:22.08    
e4s-oneapi-22.08.sif 

# E4S 22.08 Full Featured and Base Images

## E4S Full GPU Images

These images contain a full Spack-based deployment of E4S, including GPU-enabled packages for NVIDIA, AMD, or Intel GPUs.

These images also contain TensorFlow, PyTorch, and TAU.

### AMD ROCm (x86\_64)

ecpe4s/e4s-rocm:22.08 

e4s-rocm-22.08.sif  mirror 1

### NVIDIA CUDA (x86\_64, ppc64le, aarch64)

ecpe4s/e4s-cuda:22.08 

e4s-cuda-x86\_64-22.08.sif  mirror 1

e4s-cuda-ppc64le-22.08.sif  mirror 1

e4s-cuda-aarch64-22.08.sif  mirror 1

### Intel OneAPI (x86\_64)

ecpe4s/e4s-oneapi:22.08 

e4s-oneapi-22.08.sif  mirror 1

## GPU Base Images

These images come with MPICH, CMake, and the relevant GPU SDK – either AMD ROCm, NVIDIA CUDA Toolkit and NVHPC, or Intel OneAPI.

### NVIDIA Multi-Arch (X86\_64, PPC64LE, AARCH64)

ecpe4s/e4s-base-cuda:22.08 

e4s-base-cuda-x86\_64-22.08.sif  mirror 1

e4s-base-cuda-aarch64-22.08.sif  mirror 1

e4s-base-cuda-ppc64le-22.08.sif  mirror 1

### ROCM X86\_64

ecpe4s/e4s-base-rocm:22.08 

e4s-base-rocm-22.08.sif  mirror 1

### Intel OneAPI X86\_64

ecpe4s/e4s-base-oneapi:22.08 

e4s-base-oneapi-22.08.sif  mirror 1

# 22.08 Release: 102 Official Products + dependencies (gcc, cuda, x86\_64)

```
1: adios2
2: alquimia
3: aml
4: amrex
5: arborx
6: archer
7: argobots
8: ascent
9: axom
10: bolt
11: bricks
12: butterflypack
13: cabana
14: caliper
15: chai
16: conduit
17: darshan-runtime
18: datatransferkit
19: dyninst
20: faodel
21: flecsi
22: flit
23: flux-sched
24: fortrilinos
25: gasnet
26: geomp
27: ginkgo
28: globalarrays
29: gotcha
30: gptune
31: h5bench
32: hdf5
33: hdf5-vol-async
34: heffte
35: hpctoolkit
36: hpx
37: hypre
38: kokkos
39: kokkos-kernels
40: lammps
41: legion
42: libnrm
43: libquo
44: loki
45: magma
46: mercury
47: metall
48: mfem
49: mpark-variant
50: mpich
51: mpifileutils
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/adios2-2.8.3-ifkuulgk4fcrgcizlflfquna2x5ofay
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/alquimia-1.0.9-2lrac704ffv4rqt42vgzjud3tkjwkrd
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/aml-0.2.0-pwiapiue4qrmlv64dvz6ztnlryomtxov
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/amrex-22.08-2k6mn7x6c6bn37e4qhqccjjpopf5l663ec
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/arborx-1.2-hpqevuvvjodfpqgt3334czut4secym7u
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/archer-2.0.0-ubhbdononoquovu6i6yh6byf5vkjqdstds
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/argobots-main-62s4jy7ijfzur2pw2rzadwo5ixgnizjl
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/ascent-0.8.0-k6pkjgeaxjb7jnqv4galvfi76a3tecyn
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/axom-0.6.1-adc6pqaa3eh47lt62cd7gx6qv3qebj
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/bolt-2.0-t3nxv37r4r4b4v604tmjp1lxosamm65
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/bricks-r0.1-75cmpltkjkrkwjk1lkzks5khajjf72lco
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/butterflypack-2.1.1-q5eimvsxo5jzoxylaq7mrkoe715o3y2n
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/cabana-0.5.0-uzm7gvptohxz3fpvxbob2sq4a5bbli
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/caliper-2.8.0-v4tnqpfcc5dcnxslg4ltuqkhxcr6aydfa
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/chai-2022.03.0-v4q3jdzv5zvmq4x2gswjxscqonewm43j
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/conduit-0.8.3-zphidjhxjhkiukwbg4sdftgsrjbfov5y3
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/darshan-runtime-3.4.0-caydqukivwqaecivrajoj5nusrqzgl7t
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/datatransferkit-3.1-rc3-blednv72j7co7xf7j3wspaswy6jtxbxw
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/dyninst-12.2.0-3dwen3nn22mkqjsisivkkdd43rr14vehvz
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/faodel-1.2108.1-kqkwty5hn4cvjrgbvutzgk3p45tb5sdc
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/flecsi-2.1.0-jdt5s7vquugxnqcco3hiqyqdtc6p3jlp3
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/flit-2.1.0-hh43s4mmqrw3p7zj2h1kyl1klgr3tgff5
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/flux-sched-0.23.0-qod4dtvrvmat3npnpwysrpebxjexsxhr
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/fortrilinos-2.0.0-6lceq2wyliv7xakif2es47bpgm3ztvxj
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/gasnet-2022.3.0-mjam365qep6iiqr36s454x4psmgrkwp6
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/geomp-1.1.0-vzi6bqaktmcahuu66oozto2wtoe271a
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/ginkgo-1.4.0-7iqzf3oxkmk2iv3i74eu4d44otnqh37
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/globalarrays-5.8-2qdkpnndvvqylybsfxps2px3ansltxn
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/gotcha-1.0.3-a2gy4enms44svpeak5vzlvnalx3pr6ia
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/gptune-3.0.0-db3njgcxugdun5d452wiw7goxw4hyhky
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/h5bench-1.2-hul73s3xt12srumekg7cuo2bb533fmot
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/hdf5-1.13.2-doki3exhf60fx2gum2nv6fdjs3lab4s
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/hdf5-vol-async-1.2-34dt32vinsj52cwxykv6jzcpbnejdptf
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/heffte-2.2.0-gouvp4n2hgxdtezc3g6r7isf4h5jvsm3
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/hpctoolkit-2022.05.15-xjug5hvocxzdrbooncuk3te6t3rw7wa
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/hpx-1.8.1-lrb5wsjktqgsswclupnaaby2ohq3ptkw
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/hypre-2.25.0-4nmvphj2dtfh7uisr44f7oftptmen131
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/kokkos-3.6.01-7vuflt6v5ahimf6e3noa6067kx5ut3ns
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/kokkos-kernels-3.6.00-uihsqkd6swloqua3hdke6kr5oaolxxz
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/lammps-20220623-5cqu3suoycin5fgoz4cv3qzq7elqqif
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/legion-21.03.0-y36c4daichtlrjq32larfdcenlndktb
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/libnrm-0.1.0-tj463dbbvyerlzhescpp525byjmug5n
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/libquo-1.3.1-zihxwoeobknja3bmaybfaoqn3jwfvs0
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/loki-0.1.7-rge16sujgugxzqvtddd2jibhuw7dmhai
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/magma-2.6.2-zw7i6ultwjuxsyztuyijx72fle7yt1l
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/mercury-2.1.0-ubccpuuys2e6mbwe26kg5rerwuzfrqno
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/metall-0.21-vi6z32g7zotumjtcgonykfhje35z4lmr
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/mfem-4.4.0-bcbkjggyj26nvx7ojhxyats3mbm57ycl
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/mpark-variant-1.4.0-fokhy4zs3yd7uh75qo43ifjnzchsbr3g
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/mpich-4.0.2-yurg3uwktdw4kw76r5djfsnjdzdmp6cm
      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/mpifileutils-0.11.1-6dj2vqlpw5qydyq7v52uba55op3ajpq7
```

- NVHPC 22.7 with CUDA 11.7
- Support for A100 and V100 GPUs
- TensorFlow v2.9.1 and
- PyTorch v1.12.1 optimized for GPUs

# 22.08 Release: 102 Official Products + dependencies (gcc, cuda, x86\_64) (contd.)

```
52: netlib-scalapack          /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/netlib-scalapack-2.2.0-25vd6rfq4ufuesofo57jysj5x53nxu74
53: nccmp                      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/nccmp-1.9.0.1-ftszrnqzc2cygoqrtrioee6h3fjx6w6yv
54: nco                         /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/nco-5.0.1-rlffrqp2xzxm4uvdwqqodtn3exrr2dlnd
55: nrm                         /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/nrm-0.1-uwg666h4ka32lj2bxmc4nj36liyil3zq
56: omega-h                     /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/omega-h-9.34.1-27heb5almci24q7zg7mfn2mdqq6562va
57: openmpi                      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/openmpi-4.1.4-7co3hc3hfgfszjffum3fu7c3q23ozqy4
58: openpmd-api                  /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/openpmd-api-0.14.5-pj2hi5r2m5wubpacflddd3tivqjwunbi
59: papi                         /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/papi-6.0.0.1-yjnhz45s2nzeeb553px5ximn73jdgz
60: papyrus                     /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/papyrus-1.0.2-aetpqcjst2utsbtgq6x3q4e5tqzpgocb
61: parallel-netcdf              /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/parallel-netcdf-1.12.2-v7h7r3hjqw6vakzqj6uarb465ss4oj6v
62: paraview                     /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/paraview-5.10.1-lf7udp3dnwkptjh5mxr4xotc4wuf2jfm
63: parsec                       /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/parsec-3.0.2012-7hbcudupjm1fcgihtfp7pe2moszdvc1
64: pdt                          /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/pdt-3.25.1-22x4lgxduh2ejs477htndgxuiha5uo2s
65: petsc                        /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/petsc-3.17.4-ywonj5xmzv4nsjahsg5ow6f246t7r62
66: phist                        /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/phist-1.9.5-ey2e2xjqrkogucncqlcaiy5pi5yqnpo
67: plasma                        /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/plasma-21.8.29-q4m6euppnulfmx15aufityd3kgdhvtts
68: plumed                        /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/plumed-2.8.0-z265gszbvzb43xn421ajf6d3fa6k6jn2
69: precice                       /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/precice-2.5.0-mojal5qfqzzeifja5xdulyeukdzjm1
70: pruners-ninja                /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/pruners-ninja-1.0.1-0kgynfnztj2rfcyltth4n4oeexghk445hr
71: pumi                          /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/pumi-2.2.7-whec6o6kj7qpo53s2yyqch5xda5akdgp
72: py-cinemasci                 /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/py-cinemasci-1.7.0-n3pshnjlwj5mddpp4m3w5xc42h3cufci3
73: py-jupyterhub                 /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/py-jupyterhub-1.4.1-odbpt2k2xolyk4qnfteti6pyjlrxm7n2a
74: py-libensemble                 /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/py-libensemble-0.9.2-2zeffvm7ymmap5i66nie5ocfq7a7ewz7v
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76: py-radical-saga               /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/py-radical-saga-1.16.0-qkvgejg5dw7x2245wgah6h7yobzvto
77: qthreads                      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/qthreads-1.16-ujujtsewvsa2drshokdnv14l6cp6d
78: raja                          /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/raja-2022.03.0-shzxmdu6mmyuw1xfwsa6k54njfu34r23
79: rempi                        /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/rempi-1.1.0-3fg5re7uwjzb33j7dq2mathmosmmisq
80: scr                           /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/scr-3.0-7wiky6bzgdc3tjt5ifb2mjqpohp2yfs7
81: slate                        /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/slate-2022.06.00-7cfcrzgha7ds1zh7b5zut5al5msxt3gr
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86: superlu-dist                  /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/superlu-dist-7.2.0-wcbmvrhgeedp7yboeyfjyq2g6isxtd3
87: swig                          /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/swig-4.0.2-fortran-2lwjtiomnbzbgiiewcmal7au5dcf4vcu
88: sz                            /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/sz-2.1.12.2-akue3hil6zq2zzennpezzg45bbqt3i5yn
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90: tau                           /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/tau-2.31.1-eaz3114c7te7unzirnnprsa0aweoogjc
91: trilinos                     /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/trilinos-13.4.0-lxifibtz722twlogwq7am3513wqvlggx
92: turbine                      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/turbine-1.3.0-1jsro3a0dyokmmijj1lttzzzlmorqzzkp
93: umap                          /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/umap-2.1.0-4pteduzi242xrweax7fx3mpgcrd42bl
94: umpire                       /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/umpire-2022.03.1-jd62ya4tnh57jsg6mnyaa646hxcscfhadm
95: unifyfs                      /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/unifyfs-0.9.2-pacjxtgk7jmvfkolj4iy077n2xxxgh6
96: upcxx                        /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/upcxx-2022.3.0-rafoonfubm2nlnwdfwtq4zmr2vcbg36
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102: zfp                           /spack/opt/spack/linux-ubuntu20.04-x86_64/gcc-9.4.0/zfp-0.5.5-15glkgnjhnf7voxbu4xzvsh4yu53d2
```

- Trilinos v13.4.0
- NVHPC 22.7 with CUDA 11.7
- Support for A100 and V100 GPUs
- TensorFlow v2.9.1 and
- PyTorch v1.12.1 optimized for GPUs
- Also, support for ROCm 5.2.0 optimized for MI250X and MI100
- Intel oneAPI 2022.1.0

# 22.08 Release: 102 Official Products + dependencies (gcc, cuda, ppc64le)

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3: aml             /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/aml-0.2.0-s5it2fyntsesiracr6txvi5knccwvttla
4: amrex           /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/amrex-22.08-34qawx6htuds6wgagr5ru3eo7z4np5
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7: argobots        /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/argobots-main-ilx5nitwe7gaacifewubp2dvcx2uskuq
8: ascent           /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/ascent-0.8.0-totua2ppnfyfhdysz5saikevjlala5qj
9: axom            /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/axom-0.6.1-dej5vhwggy2vnydantd3haclvhny55m
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13: caliper         /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/caliper-2.8.0-k5ufu72t43udvlbz513hf6gysorcihys
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16: darshan-runtime  /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/darshan-runtime-3.4.0-cgw2cs256bs2aessqxjhzwzwrqwxwei
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22: flit             /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/flit-2.1.0-2kawcymwozn66hkq4np4jcogbt34zbxn
23: flux-sched       /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/flux-sched-0.23.0-4odnpsy56mqdxlgrzufzdtroq43qxq6
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26: ginkgo           /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/ginkgo-1.4.0-3ra2f2ndjvda45kaoa6ob5oev3xwzthm
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28: gotcha          /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/gotcha-1.0.3-hue5wt5nlveea5vze6anftnfdb2pdadb
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35: hpx              /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/hpx-1.7.1-j5q4id6ky7pgifga4j32kay2ma0lb4hb
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39: lammps           /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/lammps-20220623-id74dp3jg7thpobmyrtxfu6zhbt0fh7
40: legion           /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/legion-21.03.0-kwymsynejvpyh6stctqgy64zfnqsjbm
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51: netlib-scalapack /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/netlib-scalapack-2.2.0-lj7jrdvxmoabn6odyu7wswftmobiub7o
```

- NVHPC 22.7 with CUDA 11.7
- Support for NVIDIA GPUs
- TensorFlow v2.5.1 and
- PyTorch v1.9.0a0

# 22.08 Release: 102 Official Products + dependencies (gcc, cuda, ppc64le) (contd.)

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64: petsc          /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/petsc-3.17.4-drtsee2jxausu3yt4rxnnxutp4r3syyk
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66: plumed         /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/plumed-2.8.0-2pj7ienqinrmh2t5pgsfuk1wg7jjnta
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71: py-jupyterhub   /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/py-jupyterhub-1.4.1-tqkcrgnrqesdl7uryr7aokofl7ms5tal
72: py-libensemble  /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/py-libensemble-0.9.2-zeug2attuhymijafg5ihemah1rhhwzjn
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74: py-parsl        /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/py-parsl-1.1.0-pyryfx5atbfm6funwxbkksa56zvvpzk
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84: strumpack       /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/strumpack-6.3.1-miudgjbb046plywx524uehbzbwqiqn46
85: sundials         /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/sundials-6.2.0-cfsjagqxuefeuvq3frd34jcl4rswash
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87: swig             /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/swig-4.0.2-fortran-gjatmtgc7n6gqbmvmdu77oyynjh6iflz
88: sz               /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/sz-2.1.12.2-v7tu5keyes62dnabc47a77gz3h14e12a
89: tasmanian       /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/tasmanian-7.7-77vj27ggcesbfxgwfdivjgvtr3dm7izb
90: tau              /snack/ont/snack/linux-ubuntu18.04-nnc64le/ncc-7.5.0/tau-2.31.1-ho4i5lhtnu7lwmiux6vnkanm4m37s3wn
91: trilinos        /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/trilinos-13.4.0-gukyoepnsoxg5pdnnnowjzyrxggtejkjb
92: turbine         /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/turbine-1.3.0-5vvkb76rob34yz7td22f13yzwj1vm7
93: umap             /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/umap-2.1.0-gfccivqkrovuknxzahlinua6b2lps2r
94: umpire          /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/umpire-2022.03.1-6uumqt5rw72uqr5llybqtbgezhjzz6a
95: unifyfs         /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/unifyfs-0.9.2-q717n6bdohgq3fhplaae52fav6webk14
96: upcxx            /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/upcxx-2022.3.0-xp vexkttg576asxt2genlwaczxryy2
97: veloc            /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/veloc-1.5-cnqwbrks1gu51frdon73qqde2znaep7n
98: vtk-m            /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/vtk-m-1.8.0-msm4mqdhfqgywx45juamwyi6j5nybqxh
99: wannier90        /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/wannier90-3.1.0-3wohurtflidtoz2yy4uepvrivr6iiy2k
100: warpx           /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/warpx-22.08-asny47ruhqvuyjfemc276zo36n31bhu
101: yaksa           /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/yaksa-0.2-6rybbzhpvm4clemvrcncycqjndnhwf436
102: zfp              /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.5.0/zfp-0.5.5-mk5enpg1kfouqzvc6vh74fnooyzv5yi
```

- Trilinos v13.4.0 for ppc64le
- NVHPC 22.7 with CUDA 11.7
- Support for NVIDIA GPUs
- TensorFlow v2.5.1 and
- PyTorch v1.9.0a0

# 22.08 Release: 101 Official Products + dependencies (gcc, cuda, aarch64) NEW!

```
1: adios2
2: alquimia
3: aml
4: amrex
5: arborx
6: archer
7: argobots
8: ascent
9: axom
10: bolt
11: butterflypack
12: cabana
13: caliper
14: chai
15: conduit
16: darshan-runtime
17: datatransferkit
18: dyninst
19: exaworks
20: faodel
21: flecsi
22: flit
23: flux-sched
24: fortrilinos
25: gasnet
26: ginkgo
27: globalarrays
28: gotcha
29: gptune
30: h5bench
31: hdf5
32: hdf5-vol-async
33: heffte
34: hpctoolkit
35: hypre
36: kokkos
37: kokkos-kernels
38: lammps
39: legion
40: libnrm
41: libquo
42: loki
43: magma
44: mercury
45: metall
46: mfem
47: mpark-variant
48: mpich
49: mpifileutils
50: netlib-scalapack
51: nccmp
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      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/alquimia-1.0.9-teodompfaqz7via2ctczfjipeeoqtwv
      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/aml-0.2.0-tim3isvremvkujg7y6ckvtuwuhxhmao
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      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/archer-2.0.0-4scivwwlzlrl7nu63lpln443twh746xmig
      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/argobots-main-bmuh5lksxsx7l6xu7bsm5ayofvw6ml04k
      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/ascent-0.8.0-fcvvqoqxw7ri4fvblgyuiaqsiamf7g
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      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/bolt-2.0-pgzaq5au1lxnnjchzyums74qyut37jtk
      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/butterflypack-2.1.1-rejgtjhcc1bov7brawhxe7cilibtv
      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/cabana-0.5.0-edh3x7tosealn3sady14gr6piouv4t2r
      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/caliper-2.8.0-g07uhpm6qqy5i2brnbty3qgbeaqd2njf
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      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/darshan-runtime-3.4.0-rklgx5hbnq3vgylaw6s34fpwyq4iqrlc
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      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/fortrilinos-2.0.0-ti6atcwidvwx7am1345tad1jktq52vg
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      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/ginkgo-1.4.0-2045765ui46inv3i46io7lwohdqy2rj
      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/globalarrays-5.8-vmsjflq4ebhorerizfakwwqmwqvb4cm
      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/gotcha-1.0.3-jqzmqv4n5mt7pmugchp7s35dpnzbyrd4
      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/gptune-3.0.0-hhmgrhop7dlqrkt4m5yj2ceq7fyaa6dj
      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/h5bench-1.2-xqv6sfmaa4ad5sirfymaxx2t62dgypdd5
      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/hdf5-1.13.2-ewffjmwgvsll6naya3k36yoyt3777qk
      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/hdf5-vol-async-1.2-zzbuohnrofagelyvk4t7xytufpqh4b4h
      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/heffte-2.2.0-wmrpm672x3e6v5acq7hetopxsmez26g
      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/hpctoolkit-2022.05.15-rzz2ekngpsvpnhlp3ize2xh7zz22dnuz
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      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/kokkos-3.6.01-cvv2233fqh7pnzt3xd3gxrg6enihak6g
      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/kokkos-kernels-3.6.00-znn2n5ppc7bo7xsnfnaz3eq56tp74nu
      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/lammps-20220623-r7quv3v5tusjyaoprhw4cklsuv5hfw
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      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/libquo-1.3.1-xm3d4gimqssduwhdecszuhtzsfxgymo
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      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/mercury-2.1.0-fv5bxqdvqb3l1v57s77xw3pmmj1k45gcq
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      /spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/netlib-scalapack-2.2.0-ogqhecw42emxrccrn57teamqxhlwiv22
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```

- NVHPC 22.7 with CUDA 11.7
- Support for NVIDIA GPUs
- PyTorch v1.12.1

# 22.08 Release: 101 Official Products + dependencies (gcc, cuda, aarch64) NEW!

```
52: nco
53: nrm
54: omega-h
55: openmpi
56: openpmd-api
57: papi
58: papyrus
59: parallel-netcdf
60: paraview
61: parsec
62: pdt
63: petsc
64: plasma
65: plumed
66: precice
67: pruners-ninja
68: pumi
69: py-cinemasci
70: py-jupyterhub
71: py-libensemble
72: py-opentuner
73: py-parsl
74: py-radical-pilot
75: py-radical-saga
76: qthreads
77: raja
78: rempi
79: scr
80: slate
81: slepc
82: stc
83: strumpack
84: sundials
85: superlu-dist
86: swig
87: sz
88: tasmanian
89: tau
90: trilinos
91: turbine
92: umap
93: umpire
94: unifyfs
95: upcxx
96: veloc
97: vtk-m
98: wannier90
99: warpX
100: yaksa
101: zfp
```

---

```
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/spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/papi-6.0.0.1-srlrzt2prj2k47kzlgtg7555nelbxi7n
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/spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/paraview-5.10.1-w2l134wojcu5urjayyxwkpymflogth
/spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/parsec-3.0.2012-ebkp56dh3hqm13fqtfltdtzd5e32op2e
/spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/pdt-3.25.1-abjcjdc5w2hdvhb27b3xguyfzeo3hhh
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/spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/py-radical-pilot-1.16.0-5l3efsvga3ot2bmdm26katk7z274tmxk
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/spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/tasmanian-7.7-jodfk74drvk6kunjwz5jzw7ifj6odnzg
/spack/opt/snack/linux-ubuntu20.04-aarch64/gcc-9.4.0/tau-2.31.1-vdhuxahnarhidmlxnij7e2enuztdwwik2
/spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/trilinos-13.4.0-eqvhpdo6elszekkzyovcobzw6hv6jzw
/spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/turbine-1.3.0-3vou37d6rrodyhmwivlu7gb33fywipbs
/spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/umap-2.1.0-ikhuysi655ghcdyrtx4a65rtmcibntjz
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/spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/veloc-1.5-vunhtbm5se6sc4e4mr6x6n6d456f2cr
/spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/vtk-m-1.8.0-yrweg65332slls50nxv7jr4oppqagh3
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/spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/yaksa-0.2-ouc72jlhx5sgfrgmtvvvd2llimnfhir
/spack/opt/spack/linux-ubuntu20.04-aarch64/gcc-9.4.0/zfp-0.5.5-ztprlcezlhtvnntsksotecuze3hkqkax6
```

- Trilinos v13.4.0 for aarch64
- NVHPC 22.7 with CUDA 11.7
- Support for NVIDIA GPUs
- PyTorch v1.12.1

# E4S 22.08: Trilinos Spack configuration +cuda cuda\_arch=80

```
Singularity> spack find trilinos +cuda cuda_arch=80
]==> 1 installed package
-- linux-ubuntu20.04-x86_64 / gcc@9.4.0 -----
trilinos@13.4.0
Singularity> spack find -dl -v trilinos +cuda cuda_arch=80
]==> 1 installed package
-- linux-ubuntu20.04-x86_64 / gcc@9.4.0 -----
lxifibt trilinos@13.4.0~adelus~adios2+amesos+amesos2+anasazi+aztec~basker+belos+boost~chaco~complex+cuda~cuda_rdc~debug~dtk+epetra+epetraext~epetraextbt~epetraextexperimental~epetraextgraphreorderings~exodus+explicit_template_instantiation~float+fortran~gtest~hdf5~hypre+ifpack+ifpack2+intrepid+intrepid2~ip0+isorropia+kokkos~mesquite+minitensor+ml+mpi+muelu~mumps+nox~openmp~panzer+phalanx+piro~python~rocm~rocm_rdc+rol+rythmos+sacado~scorec+shards+shared+shylib+stk+stokhos+stratimikos~strumpack~suite~sparse~superlu+superlu-dist+teko+tempus+thyra+tpetra+trilinoscouplings~uvm+wrapper~x11+zoltan+zoltan2 build_type=RelWithDebInfo cuda_arch=80 cxxstd=14 gotype=long_long
57jswcn boost@1.79.0~atomic~chrono~clanglibcpp~container~context~contract~coroutine~date_time~debug+exception~fiber~filesystem+graph~graph_parallel~icu~iostreams~json~locale~log+math+mpi+multithreaded~nowide~numpy~pic~program_options~python~random~regex~serialization+shared~signals~singlethreaded+stacktrace~system~taggedlayout~test~thread~timer~type_erasure~versionedlayout~wave cxxstd=98 patches=a440f96,b8569d7 visibility=hidden
yurg3uw mpich@4.0.2~argobots+cuda+fortran+hwloc+hydra+libxml2+pci~rocm+romio~slurm~two_level_namespace~vci~verbs~wrapperrpath datatype=engine=auto device=ch4 netmod=ofi patches=d4c0e99 pmi=pmi
2meaymk findutils@4.9.0 patches=440b954
poo3xn4 hwloc@2.8.0~cairo+cuda~g1~libudev+libxml2~netloc~nvml~oneapi-level-zero~opencl+pci~rocm+shared
slt5lpw cuda@11.4.4~allow-unsupported-compilers~dev
q4psrtu libpciaccess@0.16
4o7qnnns libtool@2.4.7
qr7lniy m4@1.4.19+sigsegv patches=9dc5fdbd,bfdffa7
n2fjcg5 diffutils@3.8
c75f7vl libiconv@1.16 libs=shared,static
xu34agk libsigsegv@2.13
jodzku6 pkgconf@1.8.0
kgquruf util-macros@1.19.3
wmzytwr libxml2@2.9.13~python
odpuh4q xz@5.2.5+pic libs=shared,static
2jmcbiq zlib@1.2.12+optimize+pic+shared patches=0d38234
sf14ust ncurses@6.3~symlinks+termlib abi=none
cfy25dm libfabric@1.14.1~debug~kdreg fabrics=rxm,sockets,tcp,udp
3cws7on yaksa@0.2~cuda~rocm
bqg7jkg autoconf@2.69 patches=35c4492,7793209,a49dd5b
nkpm5ba perl@5.34.1+cpanm+shared+threads
5ddr2oz berkeley-db@18.1.40+cxx~docs+stl patches=b231fcc
sy4wi34 bzip2@1.0.8~debug~pic+shared
uv6hph5 gdbm@1.19
xv7r2sl readline@8.1.2
clt6yw4 automake@1.16.5
hhokobj python@3.8.13+bz2+ctypes+dbm~debug+libxml2+lzma~nis~optimizations+pic+pyexpat+pythoncmd+readline+shared+sqlite3+ssl~tix~tkinter~ucs4+uuid+zlib patches=0d98e93,4c24573,f2fd060
```

- Trilinos 13.4.0
- CUDA 11.4.4
- cuda\_arch=80  
(for A100)

# E4S 22.08 Release: NVIDIA GPU, x86\_64, ppc64le, and aarch64

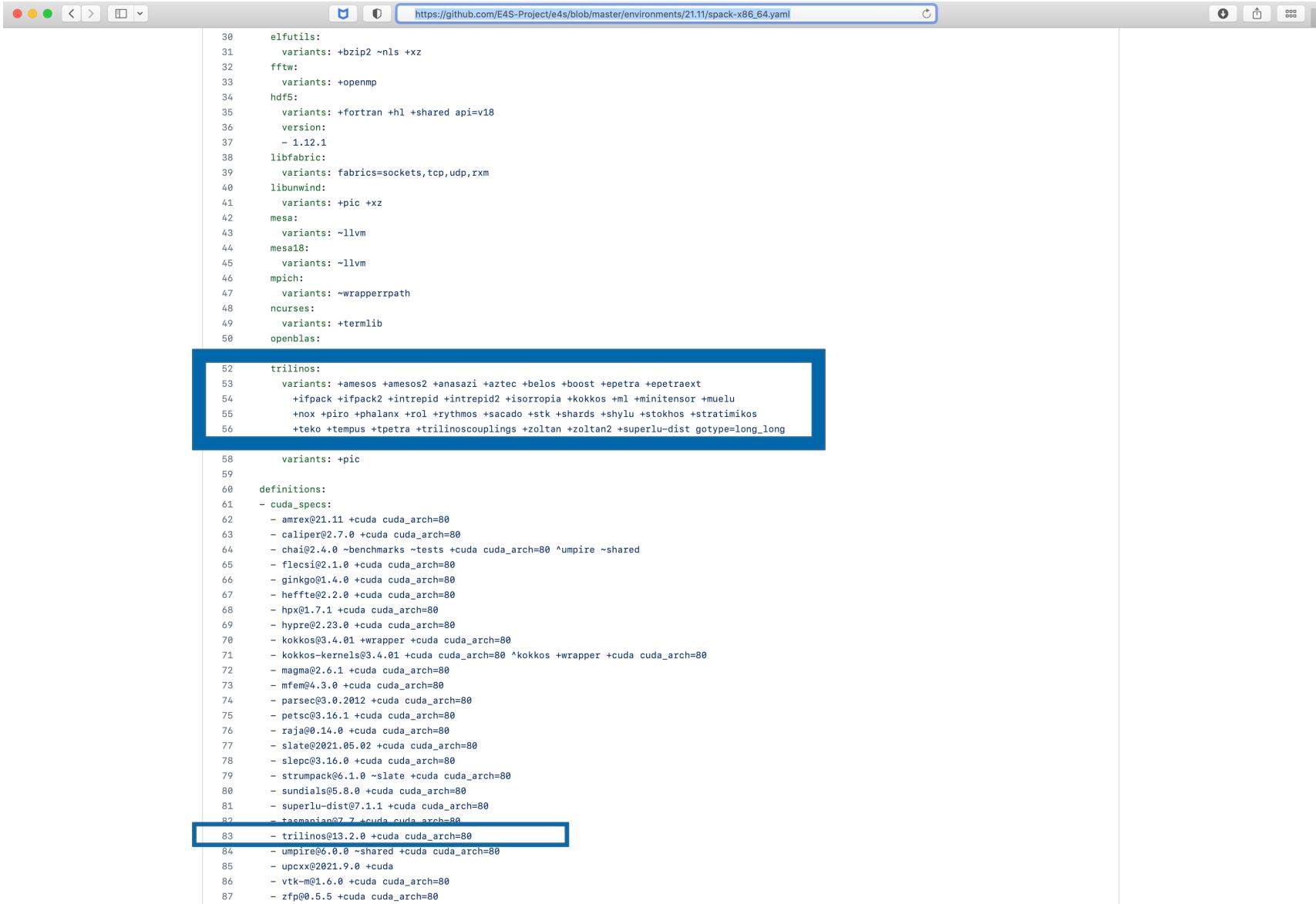
The screenshot shows the Dockerhub interface for the repository `ecpe4s/e4s-cuda`. The repository was created by `ecpe4s` and updated 2 months ago. It has 58 pulls. The `Tags` tab is selected, showing the `22.08` tag which was last pushed 2 months ago by `esw123`. The repository supports multiple architectures: `linux/amd64`, `linux/arm64/v8`, and `linux/ppc64le`. The compressed size for each architecture is listed as 44.78 GB, 27.58 GB, and 30.58 GB respectively. A button labeled `docker pull ecpe4s/e4s-cuda:...` with a copy icon is visible.

DIGEST	OS/ARCH	LAST PULL	COMPRESSED SIZE
<a href="#">d184e1dd27db</a>	linux/amd64	a month ago	44.78 GB
<a href="#">1dc06a4b53e5</a>	linux/arm64/v8	---	27.58 GB
<a href="#">10dc074ca355</a>	linux/ppc64le	---	30.58 GB

- 100+ E4S Products
- Dockerhub
- Support for NVIDIA
  - ppc64le, x86\_64, and aarch64 in a single image

% docker pull ecpe4s/e4s-cuda

# E4S bare-metal installation spack.yaml recipe



```
30   elfutils:
31     variants: +bzip2 ~nls +xz
32   fftw:
33     variants: +openmp
34   hdf5:
35     variants: +fortran +hl +shared api=v18
36   version:
37   = 1.12.1
38   libfabric:
39     variants: fabrics=sockets,tcp,udp,rxm
40   libunwind:
41     variants: +pic +xz
42   mesa:
43     variants: ~llvm
44   mesa18:
45     variants: ~llvm
46   mpich:
47     variants: ~wrapperrpath
48   ncurses:
49     variants: +termlib
50   openblas:
51
52   trilinos:
53     variants: +amesos +amesos2 +anasazi +aztec +belos +boost +epetra +epetraext
54     +ifpack +ifpack2 +intrepid +intrepid2 +isorropia +kokkos +ml +minitensor +muelu
55     +nox +piro +phalanx +rol +rythmos +sacado +stk +shards +shyLU +stokhos +stratimikos
56     +teko +tempus +tpetra +trilinoscouplings +zoltan +zoltan2 +superlu-dist gotype=long_long
57
58     variants: +pic
59
60   definitions:
61   - cuda_specs:
62     - amrex@21.11 +cuda cuda_arch=80
63     - caliper@2.7.0 +cuda cuda_arch=80
64     - chai@2.4.0 ~benchmarks ~tests +cuda cuda_arch=80 ^umpire ~shared
65     - flecsi@2.1.0 +cuda cuda_arch=80
66     - ginkgo@1.4.0 +cuda cuda_arch=80
67     - heffte@2.2.0 +cuda cuda_arch=80
68     - hpx@1.7.1 +cuda cuda_arch=80
69     - hypre@2.23.0 +cuda cuda_arch=80
70     - kokkos@3.4.01 +wrapper +cuda cuda_arch=80
71     - kokkos-kernels@3.4.01 +cuda cuda_arch=80 ^kokkos +wrapper +cuda cuda_arch=80
72     - magma@2.6.1 +cuda cuda_arch=80
73     - mfem@4.3.0 +cuda cuda_arch=80
74     - parsec@3.0.2012 +cuda cuda_arch=80
75     - petsc@3.16.1 +cuda cuda_arch=80
76     - raja@0.14.0 +cuda cuda_arch=80
77     - slate@2021.05.02 +cuda cuda_arch=80
78     - slepc@3.16.0 +cuda cuda_arch=80
79     - strumpack@6.1.0 ~slate +cuda cuda_arch=80
80     - sundials@5.8.0 +cuda cuda_arch=80
81     - superlu-dist@7.1.1 +cuda cuda_arch=80
82     - tasmani@0.7.7 +cuda cuda_arch=80
83     - trilinos@13.2.0 +cuda cuda_arch=80
84     - umpire@6.0.0 ~shared +cuda cuda_arch=80
85     - upcxx@2021.9.0 +cuda
86     - vtk-m@1.6.0 +cuda cuda_arch=80
87     - zfp@0.5.5 +cuda cuda_arch=80
```

- Trilinos variants
- Built with CUDA

# E4S: Spack Build Cache at U. Oregon to speed up installation

To add this mirror to your Spack:

```
$> spack mirror add E4S https://cache.e4s.io
$> spack buildcache keys -it
```

92,085 total packages

Last updated 2022-09-27 19:20 PDT

All Arch    PPC64LE    X86\_64  
 All OS    Centos 7    Centos 8    RHEL 7    RHEL 8    Ubuntu 18.04    Ubuntu 20.04

Search

[adiak@0.1.1](#) [adiak@0.2.1](#) [adios2@2.5.0](#) [adios2@2.6.0](#) [adios2@2.7.0](#) [adios2@2.7.1](#) [adios2@2.8.0](#) [adios@1.13.1](#) [adlbx@0.9.2](#) [adlbx@1.0.0](#) [adol-c@2.7.2](#)  
[alquimia@1.0.9](#) [alsa-lib@1.2.3.2](#) [amg@1.2](#) [aml@0.1.0](#) [amr-wind@ascent](#) [amr-wind@main](#) [amrex@20.07](#) [amrex@20.09](#) [amrex@20.10](#) [amrex@20.11](#) [amrex@20.12](#)  
[amrex@21.01](#) [amrex@21.02](#) [amrex@21.03](#) [amrex@21.04](#) [amrex@21.05](#) [amrex@21.06](#) [amrex@21.07](#) [amrex@21.08](#) [amrex@21.09](#) [amrex@21.10](#) [amrex@21.11](#)  
[amrex@21.12](#) [amrex@22.01](#) [amrex@22.02](#) [amrex@22.03](#) [amrex@22.04](#) [amrex@22.05](#) [ant@1.10.0](#) [ant@1.10.7](#) [antlr@2.7.7](#) [arborx@0.9-beta](#) [arborx@1.0](#)  
[arborx@1.1](#) [arborx@1.2](#) [archer@2.0.0](#) [argobots@1.0](#) [argobots@1.0rc1](#) [argobots@1.0rc2](#) [argobots@1.1](#) [arpack-ng@3.7.0](#) [arpack-ng@3.8.0](#) [ascent@0.6.0](#)  
[ascent@0.7.0](#) [ascent@0.7.1](#) [ascent@0.8.0](#) [ascent@develop](#) [ascent@pantheon\\_ver](#) [asio@1.16.1](#) [asio@1.18.2](#) [asio@1.20.0](#) [asio@1.21.0](#) [assimp@4.0.1](#) [assimp@5.0.1](#)

- 92,000+ binaries
- S3 mirror
- No need to build from source code!

- <https://oaciss.uoregon.edu/e4s/inventory.html>

# E4S Frank build statistics, monitoring failure of jobs

Three browser windows showing E4S statistics on Frank and AWS:

- Job Times, Detailed** (Left Window):
 

name	total_runtime	avg_runtime	n	pct_uo	pct_aws
rebuild	16605:48:23.241	00:06:16.086963	158955	60%	40%
e4s-pr-generate	1203:50:57.253	00:22:00.090543	3283	66%	34%
radius-pr-generate	370:30:59.29	00:06:57.483346	3195	65%	35%
e4s-develop-generate	201:14:29.111	00:22:44.348608	531	85%	15%
rebuild-index	188:27:27.859	00:02:44.871898	4115	86%	14%
data-vis-sdk-pr-generate	144:55:12.951	00:02:41.022516	3240	64%	36%
build_systems-pr-generate	134:54:25.661	00:02:26.284838	3320	66%	34%
e4s-on-power-pr-generate	111:39:57.649	00:26:41.584259	251	95%	0%
cleanup	59:17:42.459	00:00:51.83644	4118	84%	16%
no-specs-to-rebuild	57:28:52.156	00:00:21.946352	9429	77%	23%
radius-pr-develop-generate	55:23:44.022	00:06:25.733118	517	82%	18%
tutorial-pr-generate	48:41:52.415	00:03:45.627304	777	52%	48%
data-vis-sdk-develop-generate	20:32:30.767	00:02:23.038234	517	80%	20%
build_systems-develop-generate	19:14:09.214	00:02:13.171565	520	83%	17%
tutorial-develop-generate	05:35:00.044	00:02:48.907933	119	58%	42%
e4s-on-power-develop-generate	03:49:57.882	00:32:51.126	7	71%	0%
other	00:49:16.909	00:00:24.640908	120	98%	2%
- Runner System Failures, by Runner** (Middle Window):
 

runner	n_jobs	n_system_failures	pct_system_failures	facility
large-x86-pub-gitlab-runner-64fcfb66b-w2gnl	41727	50	0.12%	AWS
large-x86-pub-gitlab-runner-64fcfb66b-28pd5	16326	277	1.70%	AWS
medium-x86-pub-gitlab-runner-5b4ddff9758-bxjvf	4002	110	2.75%	AWS
xlarge-x86-pub-gitlab-runner-7c58cc9d47-k87vf	3870	120	3.10%	AWS
medium-x86-pub-gitlab-runner-5b4ddff9758-n62pg	3272	4	0.12%	AWS
xlarge-x86-pub-gitlab-runner-7c58cc9d47-6rh2n	1802	106	5.88%	AWS
medium-x86-pub-gitlab-runner-5b4ddff9758-9qjtp	1400	114	8.14%	AWS
huge-x86-pub-gitlab-runner-658c9ff576-h7czw	174	1	0.57%	AWS
uo-jupiter	26154	0	0.00%	UO
uo-instinct	21024	0	0.00%	UO
uo-illyad	17826	0	0.00%	UO
uo-godzilla	13993	43	0.31%	UO
uo-gilgamesh	12620	0	0.00%	UO
uo-delphi	12444	5	0.04%	UO
uo-saturn	5887	4	0.07%	UO
uo-eagle	3369	1	0.03%	UO
uo-vina	3207	0	0.00%	UO
uo-minotaur	1815	12	0.66%	UO
uo-centaur	1671	29	1.74%	UO
uo-typhon	13	0	0.00%	UO
uo-medusa	9	0	0.00%	UO
- Runner System Failures, by Type, Last 4 Hours** (Right Window):
 

failure_type	n	n_aws	n_uo	percent
empty				

# E4S Base Container Images for x86\_64, ppc64le, and aarch64

Search for great content (e.g., mysql)

Explore Repositories Organizations Help ▾ Upgrade exascaleproject

ecpe4s

Search by repository name

Create Repository

Organizations Create

ecpcontainers Exascale Computing Project Super-container

ecpe4s

ecpsdk

View all...

ecpe4s / ubuntu20.04-gpu-x86\_64 Updated 3 hours ago Not Scanned ⚡ 0 ⌂ 66 Public

ecpe4s / ubuntu18.04-gpu-ppc64le Updated 4 hours ago Not Scanned ⚡ 0 ⌂ 36 Public

ecpe4s / e4s-gpu Updated a day ago Not Scanned ⚡ 0 ⌂ 21 Public

ecpe4s / e4s-base-rocm Updated 6 days ago Not Scanned ⚡ 0 ⌂ 5 Public

ecpe4s / e4s-base-cuda Updated 6 days ago Not Scanned ⚡ 0 ⌂ 13 Public

ecpe4s / e4s-base-oneapi Updated 6 days ago Not Scanned ⚡ 0 ⌂ 5 Public

ecpe4s / ubuntu20.04-cuda-aarch64 Updated 6 days ago Not Scanned ⚡ 0 ⌂ 22 Public

ecpe4s / ubuntu18.04-cuda-ppc64le Updated 6 days ago Not Scanned ⚡ 0 ⌂ 20 Public

ecpe4s / ubuntu20.04-cuda-x86\_64 Updated 6 days ago Not Scanned ⚡ 0 ⌂ 48 Public

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- Hub.docker.com
- ecpe4s
- Platforms:
  - x86\_64
  - Ppc64le
  - aarch64
- GPU runtimes:
  - CUDA
  - ROCm
  - oneAPI

# E4S Base Container Images for x86\_64 with Spack (no GPU)

The screenshot shows the Docker Hub interface for the repository `ecpe4s/ubuntu18.04-spack`. The page includes the repository icon, name, owner, last updated time, description, and download statistics. It also features sections for Overview, Tags, a detailed description, and a Docker Pull Command.

**ecpe4s/ubuntu18.04-spack** ☆

By [ecpe4s](#) • Updated 5 months ago

Extreme-scale Scientific Software Stack (E4S) [https://e4s.io] base Ubuntu image with Spack.

**Overview** Tags

Base image from the Extreme-scale Scientific Software Stack (E4S) [https://e4s.io] project with Ubuntu 18.04 and the Spack package manager [https://spack.io].

**Docker Pull Command**

```
docker pull ecpe4s/ubuntu...
```

- Popular Ubuntu18.04
- 1M+ downloads!

# E4S 22.08 Cloud, CI, and Custom images

The screenshot shows a web browser window with the URL <https://e4s-project.github.io/download.html>. The page title is "Continuous Integration Images". Below the title, there is a section titled "X86\_64" containing links to Docker images for various distributions and versions. There are also sections for "PPC64LE" and "AARCH64" with similar lists of images. The "Custom Images" section contains links to specific images like "exawind-snapshot", "ubuntu1804\_aarch64\_waggle", and "superlu\_sc". The "E4S Facility Deployment" section at the bottom lists "NERSC" and "OLCF".

## Continuous Integration Images

These are barebones operating system images which contain only essential build tools and python packages needed by Spack.

These images are intended to be used in continuous integration workflows where Spack is first cloned and then used to build and test software.

### X86\_64

- [ecpe4s/ubuntu22.04-runner-x86\\_64](#)
- [ecpe4s/ubuntu20.04-runner-x86\\_64](#)
- [ecpe4s/ubuntu18.04-runner-x86\\_64](#)
- [ecpe4s/rhel8-runner-x86\\_64](#)
- [ecpe4s/rhel7-runner-x86\\_64](#)

### PPC64LE

- [ecpe4s/ubuntu22.04-runner-ppc64le](#)
- [ecpe4s/ubuntu20.04-runner-ppc64le](#)
- [ecpe4s/ubuntu18.04-runner-ppc64le](#)
- [ecpe4s/rhel8-runner-ppc64le](#)
- [ecpe4s/rhel7-runner-ppc64le](#)

### AARCH64

- [ecpe4s/ubuntu22.04-runner-aarch64](#)
- [ecpe4s/ubuntu20.04-runner-aarch64](#)
- [ecpe4s/rhel8-runner-aarch64](#)

## Custom Images

- [ecpe4s/exawind-snapshot](#)
- [ecpe4s/ubuntu1804\\_aarch64\\_waggle](#)
- [ecpe4s/superlu\\_sc](#)

## E4S Facility Deployment

NERSC  
OLCF

# E4S GitLab Nightly Testing of Trilinos at U. Oregon on Frank\*

The screenshot shows the GitLab Pipelines interface for the 'uo-public/trilinos' project. The top navigation bar includes the GitLab logo, a search bar, and a 'Sign in' button. The left sidebar has icons for issues, merge requests, and pipelines, with 'Pipelines' selected. The main area displays a table of recent pipeline runs:

Status	Pipeline	Triggerer	Stages
<span>passed</span>	source spack setup-env.sh before using spack... #6742 ➔ master -o b4a13669	Scheduled	<span>passed</span>
<span>passed</span>	source spack setup-env.sh before using spack... #6736 ➔ master -o b4a13669	Scheduled	<span>passed</span>
<span>passed</span>	source spack setup-env.sh before using spack... #6730 ➔ master -o b4a13669	Scheduled	<span>passed</span>
<span>passed</span>	source spack setup-env.sh before using spack... #6708 ➔ master -o b4a13669	Scheduled	<span>passed</span>

Each row in the table provides details about the pipeline run, including the status, pipeline ID, triggerer, and stage status. The stages are represented by colored circles: pink for pending or running, green for passed, and red for failed.

\* <https://oaciss.uoregon.edu/frank>

# E4S GitLab Testing of Trilinos@develop on A100 (CUDA)

The screenshot shows a GitLab pipeline page for a project named "uo-public/trilinos". The pipeline ID is #6742, which was triggered 23 hours ago by an Administrator. The pipeline status is "passed". The main command run is "source spack setup-env.sh before using spack [ci skip]".

Details of the job:

- 1 job for **master** in 76 minutes and 9 seconds (queued for 3 seconds)
- latest branch
- Commit: [b4a13669](#)
- No related merge requests found.

Pipeline summary:

- Pipeline** (selected)
- Needs
- Jobs 1
- Tests 0

Build-and-Test section:

- Tpetra-Saturn-A100 (status: passed)

# E4S GitLab Building Trilinos@develop using CUDA

The screenshot shows a GitLab job log for the Trilinos project. The job is titled "Tpetra-Saturn-A100". The log output is as follows:

```
113 $ time spack -e . install -j32
114 ==> Concretized trilinos@develop+amesos+amesos2+anasazi+aztec+belos+boost+cuda+epetra+epetraext+ifpack+ifpack2+intrepid+intrepid2+isorropia+kokkos+minitensor+ml+muelu+nox+phalanx+piro+rol+rythmos+sacado+shards+shyLU+stk+stokhos+stratimikos+superlu-dist+teko+tempus+tpetra+trilinoscouplings+zoltan+zoltan2 cuda_arch=80 dev_path=/home/gitlab-runner/builds/pdsmuPWL/0/uo-public/trilinos/trilinos gotype=long_long ^superlu-dist@develop
115 - ykk3fcr trilinos@develop%gcc@11.2.0~adelus~adios2+amesos+amesos2+anasazi+aztec~bas
ker+belos+boost~chaco~complex+cuda~cuda_rdc~debug~dtk+epetra+epetraext~epetraextbt~epetraextexperimental~epetraextgraphreorderings~exodus+explicit_template_instantiation~float+f
ortran~gtest~hdf5~hypre+ifpack+ifpack2+intrepid+intrepid2~ipo+isorropia+kokkos~mesquite+m
initensor+ml+mpi+muelu~mumps+nox~openmp~panzer+phalanx+piro~python~rocm~rocm_rdc+rol+rythmos+sacado~scorec+shards+shared+shyLU+stk+stokhos+stratimikos~strumpack~suite-sparse~superlu+superlu-dist+teko+tempus+thyra+tpetra+trilinoscouplings~uvml+wrapper~x11+zoltan+zoltan2 build_type=RelWithDebInfo cuda_arch=80 cxxstd=14 dev_path=/home/gitlab-runner/builds/pdsmuPWL/0/uo-public/trilinos/trilinos gotype=long_long arch=linux-ubuntu20.04-x86_64
116 [^] fnnecho      ^boost@1.79.0%gcc@11.2.0~atomic~chrono~clanglibcpp~container~context~contract~coroutine~date_time~debug~exception~fiber~filesystem~graph~graph_parallel~icu~ios
streams~json~locale~log~math~mpi~multithreaded~nowide~numpy~pic~program_options~python~random~regex~serialization~shared~signals~singlethreaded~stacktrace~system~taggedlayout~test~thread~timer~type_erasure~versionedlayout~wave cxxstd=98 patches=a440f96 visibility=hiden arch=linux-ubuntu20.04-x86_64
117 [^] ey23wrr      ^cmake@3.23.2%gcc@11.2.0~doc+ncurses+ownlibs~qt build_type=Release arch=linux-ubuntu20.04-x86_64
118 [^] jmaohzq      ^ncurses@6.2%gcc@11.2.0~symlinks+termlib abi=none arch=linux-ubuntu20.04-x86_64
```

The job log includes a search bar and various navigation icons. To the right of the log, there is a summary of the job details:

**Tpetra-Saturn-A100**

- Duration:** 76 minutes 9 seconds
- Finished:** 21 hours ago
- Queued:** 3 seconds
- Timeout:** 4h (from project)
- Runner:** #60 (pdsmuPWL) saturn-shell
- Tags:** saturn, shell

---

**Job artifacts**  
These artifacts are the latest. They will not be deleted (even if expired) until newer artifacts are available.

[Download](#) [Browse](#)

---

**Commit** [b4a13669](#)   
source spack setup-env.sh before using spack [ci skip]

---

**Pipeline** #6742 for master

# E4S GitLab: Running Trilinos Tpetra Testcase on A100

The screenshot shows a GitLab job log for a Trilinos Tpetra testcase on an A100 GPU. The log output is as follows:

```
352 $ ./run.sh
353 trilinos+cuda cuda_arch=80 : ykk3fcr
354 + cd ./build
355 + export CUDA_MANAGED_FORCE_DEVICE_ALLOC=1
356 + CUDA_MANAGED_FORCE_DEVICE_ALLOC=1
357 + export CUDA_LAUNCH_BLOCKING=1
358 + CUDA_LAUNCH_BLOCKING=1
359 + export OMP_NUM_THREADS=4
360 + OMP_NUM_THREADS=4
361 + mpirun -np 8 ./iallreduce
362 Teuchos::GlobalMPISession::GlobalMPISession(): started processor with name saturn and rank 2!
363 Teuchos::GlobalMPISession::GlobalMPISession(): started processor with name saturn and rank 3!
364 Teuchos::GlobalMPISession::GlobalMPISession(): started processor with name saturn and rank 5!
365 Teuchos::GlobalMPISession::GlobalMPISession(): started processor with name saturn and rank 6!
366 Teuchos::GlobalMPISession::GlobalMPISession(): started processor with name saturn and rank 7!
367 Teuchos::GlobalMPISession::GlobalMPISession(): started processor with name saturn and rank 0!
368 Teuchos::GlobalMPISession::GlobalMPISession(): started processor with name saturn and rank 1!
```

**Tpetra-Saturn-A100**

Duration: 76 minutes 9 seconds  
Finished: 21 hours ago  
Queued: 3 seconds  
Timeout: 4h (from project)  
Runner: #60 (pdsmuPWL) saturn-shell  
Tags: saturn shell

**Job artifacts**  
These artifacts are the latest. They will not be deleted (even if expired) until newer artifacts are available.

[Download](#) [Browse](#)

**Commit b4a13669**  
source spack setup-env.sh before using spack [ci skip]

**Pipeline #6742 for master**

Build-and-Test

# E4S GitLab: Running Trilinos Tpetra Testcase on A100

The screenshot shows a web browser window with the URL `gitlab.e4s.io`. The main content is a terminal-style log output for a job named **Tpetra-Saturn-A100**.

**Job Log Output:**

```
rank 7!
367 Teuchos::GlobalMPISession::GlobalMPISession(): started processor with name saturn and rank 0!
368 Teuchos::GlobalMPISession::GlobalMPISession(): started processor with name saturn and rank 1!
369 Teuchos::GlobalMPISession::GlobalMPISession(): started processor with name saturn and rank 4!
370 ***
371 *** Unit test suite ...
372 ***
373 Sorting tests by group name then by the order they were added ... (time = 3.48e-06)
374 Running unit tests ...
375 0. iallreduce_basic_UnitTest ... [Passed] (2.36 sec)
376 1. iallreduce_single_int_UnitTest ... [Passed] (5.74e-05 sec)
377 Total Time: 2.36 sec
378 Summary: total = 2, run = 2, passed = 2, failed = 0
379 End Result: TEST PASSED
381 Uploading artifacts for successful job
382 Uploading artifacts...
383 Runtime platform
            arch=amd64 os=linux pid=1136758 revision=bd40e3da version=14.9.1
384 artifacts: found 3 matching files and directories
385 Uploading artifacts as "archive" to coordinator... 201 Created id=213337 responseStatus=201 Created token=gFwJa2GE
387 Cleaning up project directory and file based variables
389 Job succeeded
```

**Job Information:**

- Duration:** 76 minutes 9 seconds
- Finished:** 21 hours ago
- Queued:** 3 seconds
- Timeout:** 4h (from project)
- Runner:** #60 (pdsmuPWL) saturn-shell
- Tags:** saturn shell

**Job Artifacts:** These artifacts are the latest. They will not be deleted (even if expired) until newer artifacts are available.

[Download](#) [Browse](#)

**Commit** [b4a13669](#)

source spack setup-env.sh before using spack [ci skip]

**Pipeline** #6742 for master

Build-and-Test

→ [Tpetra-Saturn-A100](#)

Notifies developers on failure

# E4S Validation Test Suite: Trilinos

- Provides automated build and run tests
- Validate container environments and products

The screenshot shows a GitHub repository page for [https://github.com/E4S-Project/testsuite/tree/master/validation\\_tests/trilinos](https://github.com/E4S-Project/testsuite/tree/master/validation_tests/trilinos). The repository is public and has 11 stars and 19 forks. The commit history shows a recent update by Wyatt Spear changing the app name to Zoltan and using a base cxx compiler provided by CMake. The README.md file contains instructions for building against an installed Trilinos with CMake, including a warning about manual testing.

Wyatt Spear Changed app name to Zoltan. Use base cxx compiler provided by CMake. 360af53 1 hour ago History

CMakeLists.txt, README.md, app.cpp, clean.sh, compile.sh, run.sh, setup.sh

Simple example of building against an install Trilinos with CMake

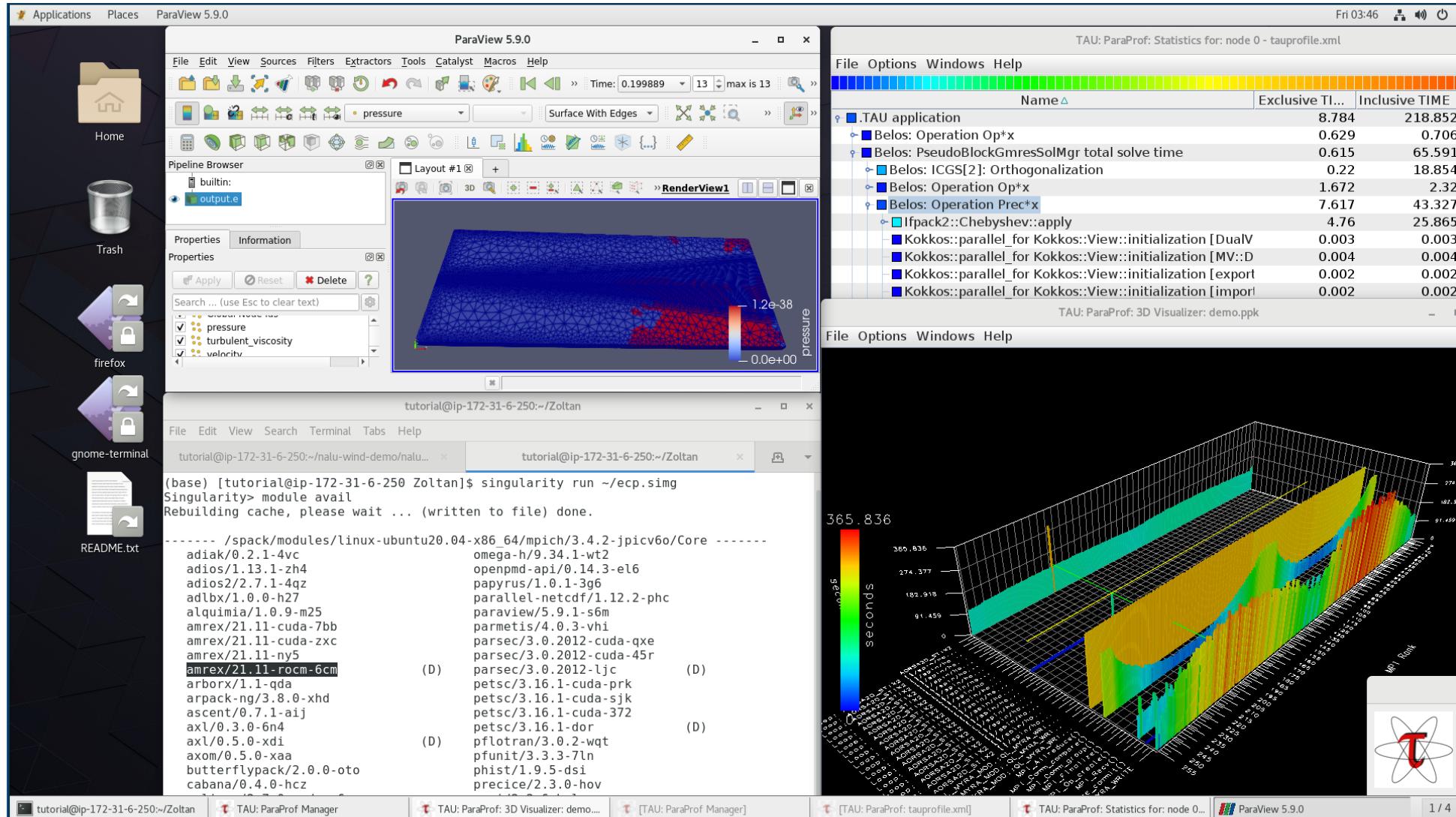
```
*****
*** WARNING: THIS CODE IS NOT AUTOMATICALLY TESTED IN TRILINOS ***
*** BECAUSE IT REQUIRES AN INSTALLED TRILINOS ***
*****
```

This is a small demonstration of how to build an application code using CMake against an installation of Trilinos. This example also demonstrates how to use CTest.

To run this example, do the following steps.

1. Configure Trilinos to be installed:

# E4S 22.08 AWS image: US-West2 (OR) ami-0d7295416d1c63e3a



- E4S 22.08 AWS
- Intel oneAPI
  - CUDA
  - NVHPC
  - ROCm
  - AWS DCV
  - Spack Build Cache
  - ECP: Nalu-Wind
  - Trilinos 13.4.0
  - OpenFOAM
  - ParaView
  - TAU
  - Docker
  - Shifter
  - Charliecloud
  - E4S Singularity...

# e4s-cl: A tool to simplify the launch of MPI jobs in E4S containers

- E4S containers support replacement of MPI libraries using MPICH ABI compatibility layer and Wi4MPI [CEA] for OpenMPI replacement.
- Applications binaries built using E4S can be launched with Singularity using MPI library substitution for efficient inter-node communications.
- e4s-cl is a new tool that simplifies the launch and MPI replacement.
  - `e4s-cl init --backend [singularity|shifter|docker] --image <file> --source <startup_cmds.sh>`
  - `e4s-cl mpirun -np <N> <command>`
- Usage:

```
. /opt/intel/oneapi/setvars.sh
e4s-cl init --backend singularity --image ~/images/e4s-gpu-x86.sif --source ~/source.sh
cat ~/source.sh
  . /spack/share/spack/setup-env.sh
  spack load trilinos+cuda cuda_arch=80
e4s-cl mpirun -np 4 ./a.out
```

<https://github.com/E4S-Project/e4s-cl>

# E4S Summary

## What E4S is not

A closed system taking contributions only from DOE software development teams.

A monolithic, take-it-or-leave-it software behemoth.

A commercial product.

A simple packaging of existing software.

## • What E4S is

Extensible, open architecture software ecosystem accepting contributions from US and international teams.  
Framework for collaborative open-source product integration.

A full collection of compatible software capabilities **and**  
A manifest of a la carte selectable software capabilities.

Vehicle for delivering high-quality reusable software products in collaboration with others.

The conduit for future leading edge HPC software targeting scalable next-generation computing platforms.  
A hierarchical software framework to enhance (via SDKs) software interoperability and quality expectations.

# Vision for E4S Now and in the Future

- E4S has emerged as a new top-level component in the DOE HPC community, enabling fundamentally new relationships
- E4S has similar potential for new interactions with other US agencies, US industry and international collaborators. NSF and UK are examples
- The E4S portfolio can expand to include new domains (ML/AI), lower—level components (OS), and more.
- E4S can provide better (increased quality), faster (timely delivery of leading-edge capabilities) and cheaper (assisting product teams)

# Performance Research Laboratory, University of Oregon, Eugene



# Thank you

<https://www.exascaleproject.org>

*This research was supported by the Exascale Computing Project (17-SC-20-SC), a joint project of the U.S. Department of Energy's Office of Science and National Nuclear Security Administration, responsible for delivering a capable exascale ecosystem, including software, applications, and hardware technology, to support the nation's exascale computing imperative.*



**Thank you** to all collaborators in the ECP and broader computational science communities. The work discussed in this presentation represents creative contributions of many people who are passionately working toward next-generation computational science.