

Docker containers and CLAS12 distribution

Docker: clas12 simulations and reconstruction:

- ✓ distribute software
- ✓ running generator, simulation and reconstruction

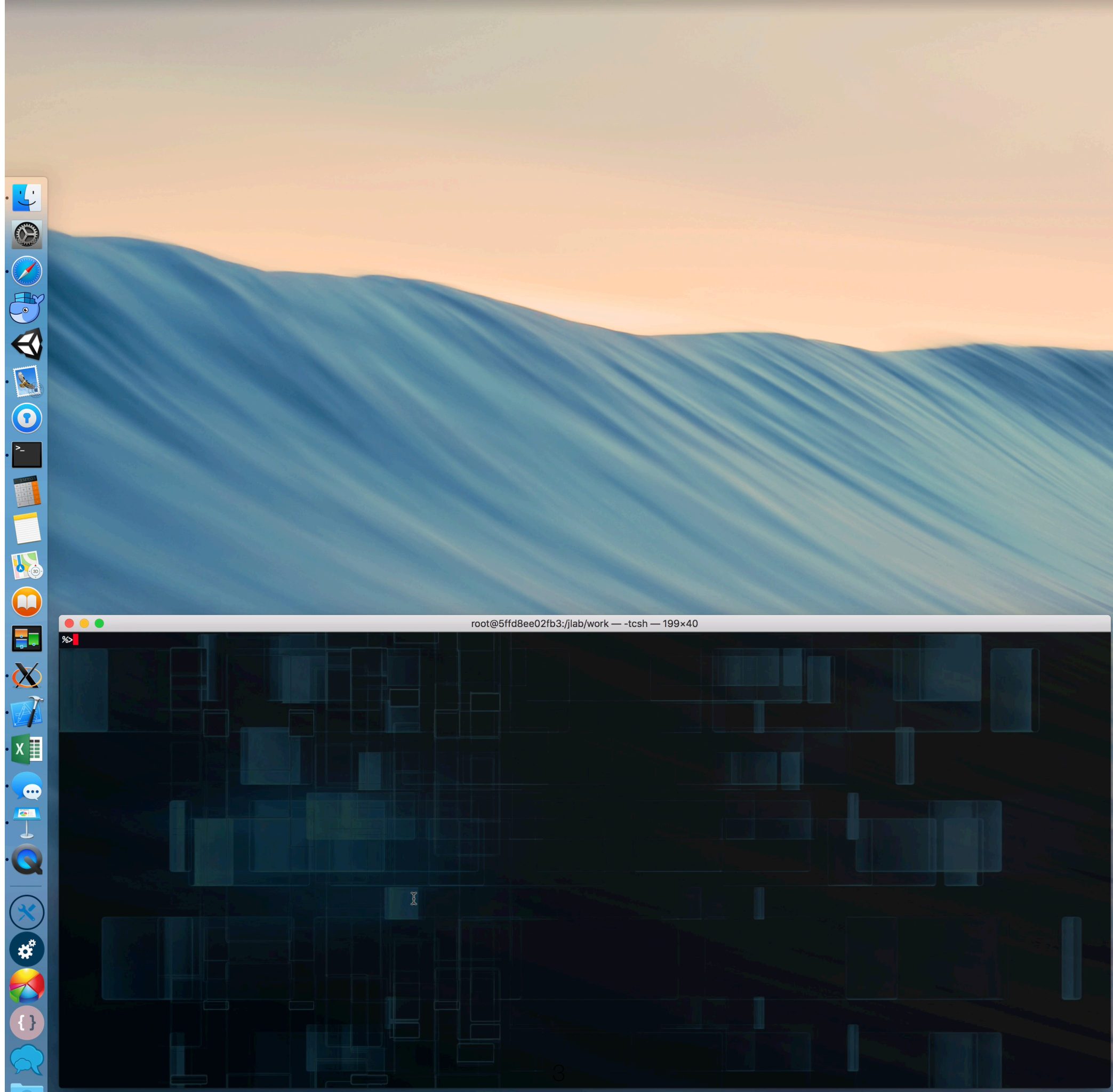
Batch Farm: OSG

- ✓ docker image used in OSG
- ✓ submitting jobs on the Open Science Grid

Friday Demo

Run simulation and reconstruction
Submit Jobs to OSG

Why Docker?



GEMC "native" installation (still valid)

Software installation instructions (JLAB_VERSION 2.2)

These instructions are verified on:

Linux:

- CentOS 7

Mac:

- Sierra
- High Sierra

These are instructions to install JLAB_VERSION 2.2. You can find supported JLAB_VERSION releases instructions below:

- [Development Version](#)
- [Version 2.2](#)
- [Version 2.1](#)
- [Version 2.0](#)

General Requirements:

- csh shell
- cmake >= 3.3 (for geant4, check with *cmake --version*)
- network connection to download the various packages during installation
- wget
- scons version 2 to 2.5.1
- mysql
- git
- recommended: qt

⌘ MAC OS specific requirements

Make sure you have the latest xcode tools with:

```
xcode-select --install
```

You can install the dependencies with [homebrew](#):

[List of packages](#)

🐧 Ubuntu (Debian-line) specific requirements

You can install the dependencies with apt-get:

[List of packages](#)

🐧 Fedora (red-hat line) specific requirements

You can install the dependencies with dnf (or yum):

[List of packages](#)

Compilation of gemc from scratch remains **grueling on the users and on system admins for offsite farms.**

Installation procedure also needs frequent adapting to OSes and Software libraries changes.

Installation:

- Choose a place (JLAB_ROOT) to install the software

A good choice for **JLAB_ROOT** is **/opt/jlab_software**:

```
set JLAB_ROOT=/opt/jlab_software
```

Create the working directory:

```
mkdir -p $JLAB_ROOT/2.2
```

- Get the installation scripts:

```
cd $JLAB_ROOT
wget http://www.jlab.org/12gev_phys/packages/sources/ceInstall/ceInstall_2.2.tar.gz
tar -zxpf ceInstall_2.2.tar.gz --strip-components 1 -C 2.2
```

- Set the environment variables. You should put these lines in your login script:

```
setenv JLAB_ROOT /opt/jlab_software
source $JLAB_ROOT/2.2/ce/jlab.csh
```

- Start a new shell. Now you should see a log similar to this

```
> Common Environment Version: <2.2> (Wed March 18 2018)
> Running as mauri on 1.800.gemc.cool.org
> OS Release: Darwin_macosx10.13-x86_64-clang9.0.0
> JLAB_ROOT set to: /opt/jlab_software
> '/opt/jlab_software/2.2/Darwin_macosx10.13-x86_64-clang9.0.0' is not a directory. Creating it.

!! Attention: BANKS installation check /opt/jlab_software/2.2/Darwin_macosx10.13-x86_64-clang9.0.0/banks/1.4/bin not found
!! Attention: CCDB installation check /opt/jlab_software/2.2/Darwin_macosx10.13-x86_64-clang9.0.0/ccdb/ccdb-1.06.02/lib not found
!! Attention: CLHEP installation check /opt/jlab_software/2.2/Darwin_macosx10.13-x86_64-clang9.0.0/clhep/2.3.4.5/lib not found
!! Attention: EVIO installation check /opt/jlab_software/2.2/Darwin_macosx10.13-x86_64-clang9.0.0/evio/5.1/bin not found
!! Attention: GEANT4 installation check /opt/jlab_software/2.2/Darwin_macosx10.13-x86_64-clang9.0.0/geant4/4.10.03.p02/bin not found
!! Attention: GEMC installation check /opt/jlab_software/2.2/Darwin_macosx10.13-x86_64-clang9.0.0/gemc/2.7/gemc not found
!! Attention: JANA installation check /opt/jlab_software/2.2/Darwin_macosx10.13-x86_64-clang9.0.0/jana/0.7.7pl1/bin/jana not found
!! Attention: MLIBRARY installation check /opt/jlab_software/2.2/Darwin_macosx10.13-x86_64-clang9.0.0/mlibrary/1.2/lib not found
!! Attention: MYSQL installation check /opt/jlab_software/2.2/Darwin_macosx10.13-x86_64-clang9.0.0/mysql/lib not found
!! Attention: QT installation check /opt/jlab_software/2.2/Darwin_macosx10.13-x86_64-clang9.0.0/qt/5.9.1/5.9.1/clang_64/lib not found
!! Attention: ROOT installation check /opt/jlab_software/2.2/Darwin_macosx10.13-x86_64-clang9.0.0/root/6.12.06/bin/root-config not found
!! Attention: SCONS installation check /opt/jlab_software/2.2/scons_bm/1.6/site_tools not found
!! Attention: XERCECSC installation check /opt/jlab_software/2.2/Darwin_macosx10.13-x86_64-clang9.0.0/xercesc/3.2.0/lib not found
```

If you do, great! The enviroment seems correct and you're ready to run the installation scripts. Every script that you run below will replace the warning log with a successful one. Notice: if you already have some existing environment variables that you want to keep, use the option "keepmine":

```
source $JLAB_ROOT/2.2/ce/jlab.csh keepmine
```

- Choose the packages you wish to install by executing the corresponding script:

```
cd $JLAB_ROOT/2.2/install
```

```
./go_clhep
./go_xercesc
```

If you have a system installation of qt (see instructions on requirements on how to install it):

```
./go_qt system
```

Otherwise the following command will downlowad the qt installer for you. Follow instructions for the installation:

```
./go_qt
```

Continue with the rest of the package installation:

```
./go_geant4
./go_sconsscript
./go_evio
./go_mysql
./go_ccdb
./go_mlibrary
./go_gemc
./go_fields
./go_root
./go_banks
./go_jana
```


Docker One-Liner

```
docker run -it --rm maureeungaro/clas12simulations:iprod bash
```

Docker One-Liner

```
docker run -it --rm maureeungaro/clas12simulations:iproduct bash
```

This opens a shell with available:

- clasdis, clasdvcs generators
- gemc
- ced
- decoder
- clara, coatjava
- monitoring utilities
- Will work exactly the same regardless of your OS
- No worries about software tags

clas12simulations:iproduct

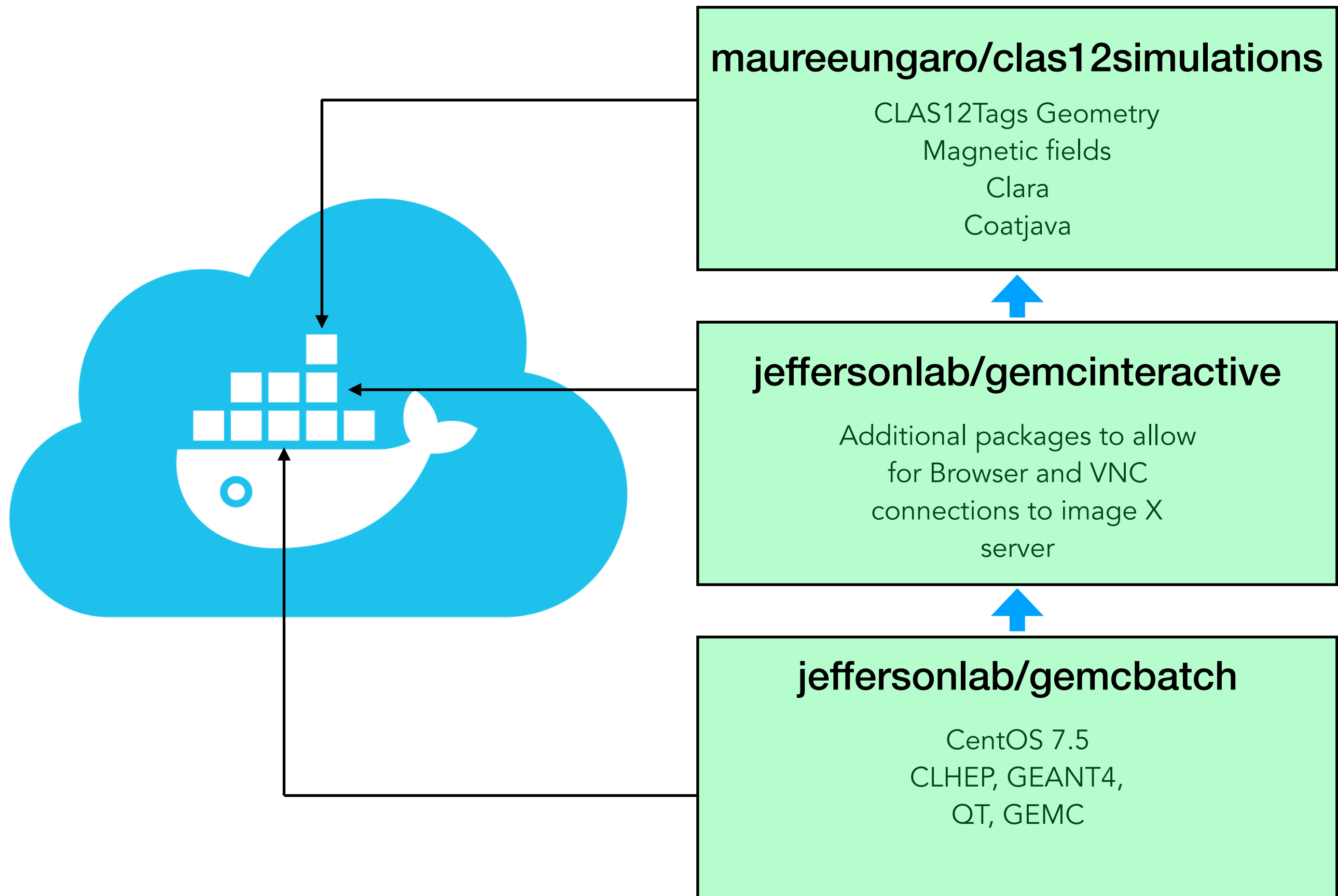
```
docker run -it --rm maureeungaro/clas12simulations:iproduct bash
```

cloud docker
repository
(will move to
Jeffersonlab)

image name

image tag

clas12simulations:iproduct image



clas12simulations:iproduct image

Software libraries tags are matched to work together

geant4 10.4

gemc: 4a.2.5

4a.2.5 geometry and gcard

clara: 4.3.3

coatjava: 5b.7.1

The image itself is tagged. We can use image tags to run old simulation/reconstruction software for comparisons.

Running clas12simulations in batch mode

```
docker run -it --rm maureeungaro/clas12simulations:iproduct bash
```

```
%>
%>docker run -it --rm clas12simulations:iproduct bash

> Common Environment Version: <2.3> (Wed October 3 2018)
> Running as root on 92daa13a0bb7
> OS Release: Linux_CentOS7.5.1804-x86_64-gcc4.8.5
> JLAB_ROOT set to: /jlab
> JLAB_SOFTWARE set to: /jlab/2.3/Linux_CentOS7.5.1804-x86_64-gcc4.8.5

> CCDB          version: 1.06.02
> CLHEP          version: 2.4.0.4
> GEANT4         version: 4.10.04.p02
> QT             using system installation
> XERCES          version: 3.2.2
> GEMC           custom location: /jlab/clas12Tags/4a.2.5/source
> EVIO           version: 5.1
> MLIBRARY        version: 1.3
> SCONS           version: 1.7

[root@92daa13a0bb7 work]# gemc -help
Entering initializeCNDConstants
Entering initializeCTOF
> Data loaded in translation table dcTT

Help Options:

> -help-all: all available options.

> -help-          options.
> -help-control  control options.
> -help-general  general options.
> -help-generator generator options.
> -help-luminosity luminosity options.
> -help-mysql    mysql options.
> -help-output   output options.
> -help-physics  physics options.
> -help-verbosity verbosity options.

[root@92daa13a0bb7 work]# clara-shell

  CLARA  4.3

Run 'help' to show available commands.

clara>
```

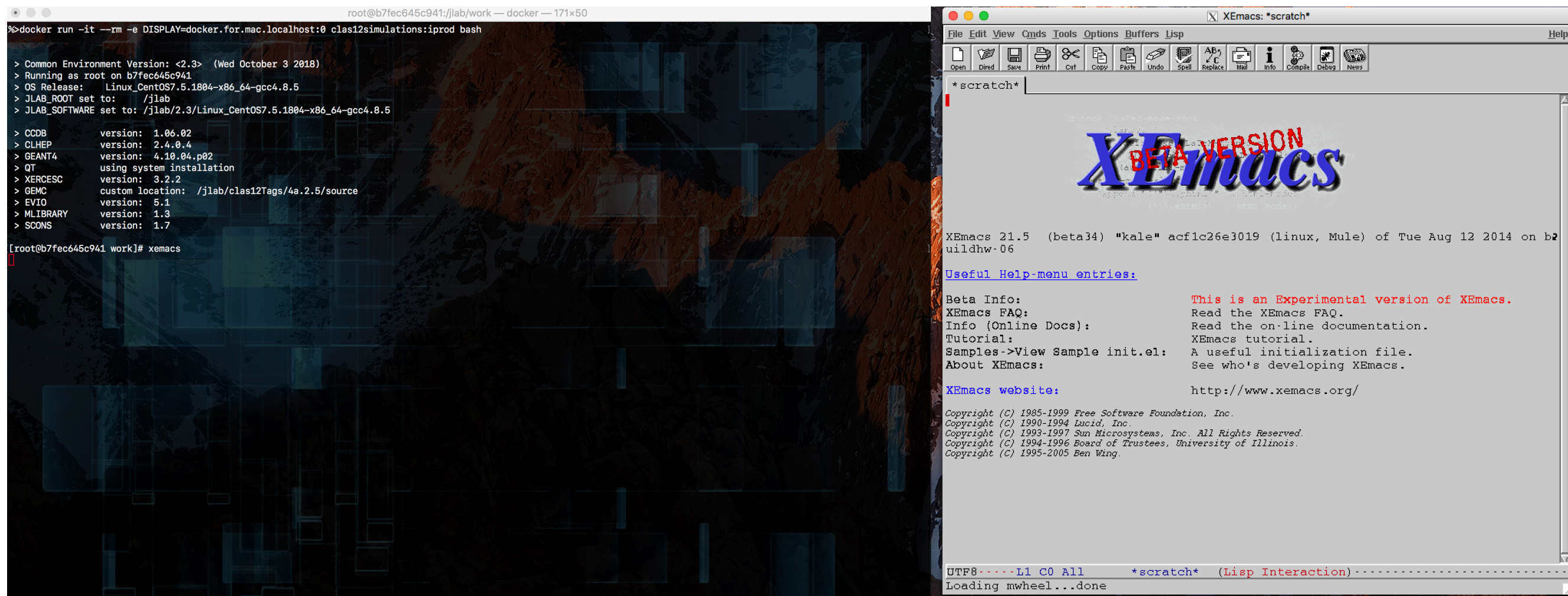

Running clas12simulations in interactive mode

can run xemacs, java GUIs, anything in a normal X server...

...except opengl (so no gemc interactive)

requires "xhost +"

```
docker run -it --rm -e DISPLAY=docker.for.mac.localhost:0 clas12simulations:iproduct bash
```



```
root@b7fec645c941:/jlab/work — docker — 171x50
% docker run -it --rm -e DISPLAY=docker.for.mac.localhost:0 clas12simulations:iproduct bash

> Common Environment Version: <2.3> (Wed October 3 2018)
> Running as root on b7fec645c941
> OS Release: Linux_CentOS7.5.1804-x86_64-gcc4.8.5
> JLAB_ROOT set to: /jlab
> JLAB_SOFTWARE set to: /jlab/2.3/Linux_CentOS7.5.1804-x86_64-gcc4.8.5

> CCDB version: 1.06.02
> CLHEP version: 2.4.0.4
> GEANT4 version: 4.10.04.p02
> QT using system installation
> XERCESC version: 3.2.2
> GEMC custom location: /jlab/clas12Tags/4a.2.5/source
> EVIO version: 5.1
> MLIBRARY version: 1.3
> SCONS version: 1.7

[root@b7fec645c941 work]# xemacs

XEmacs 21.5 (beta34) "kale" acf1c26e3019 (linux, Mule) of Tue Aug 12 2014 on b2
uildhw-06

Useful Help-menu entries:

Beta Info: This is an Experimental version of XEmacs.
XEmacs FAQ: Read the XEmacs FAQ.
Info (Online Docs): Read the on-line documentation.
Tutorial: XEmacs tutorial.
Samples->View Sample init.el: A useful initialization file.
About XEmacs: See who's developing XEmacs.

XEmacs website: http://www.xemacs.org/

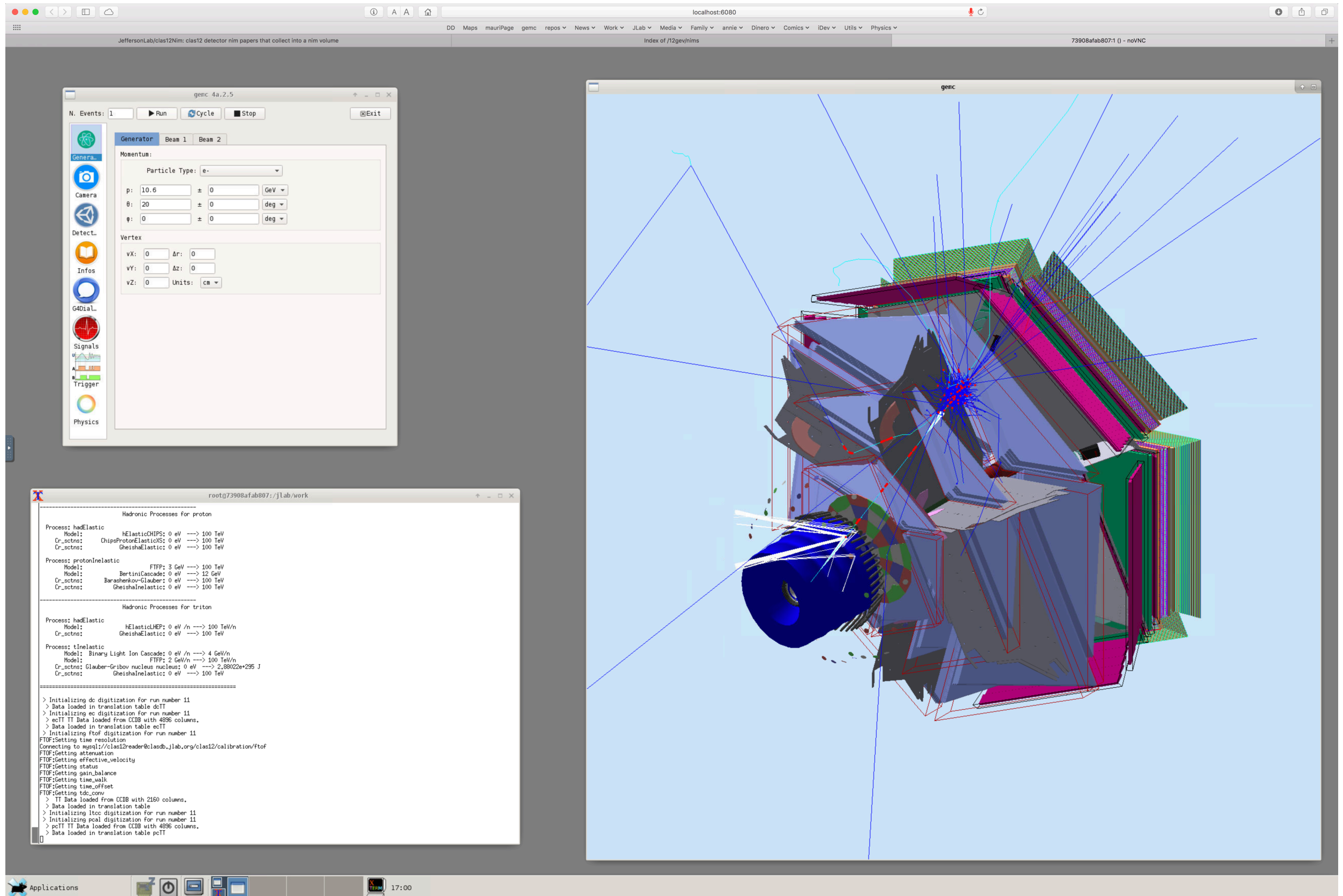
Copyright (C) 1985-1999 Free Software Foundation, Inc.
Copyright (C) 1990-1994 Lucid, Inc.
Copyright (C) 1993-1997 Sun Microsystems, Inc. All Rights Reserved.
Copyright (C) 1994-1996 Board of Trustees, University of Illinois.
Copyright (C) 1995-2005 Ben Wing.

UTF8-----L1 C0 All *scratch* (Lisp Interaction)-----
Loading mwheel...done
```

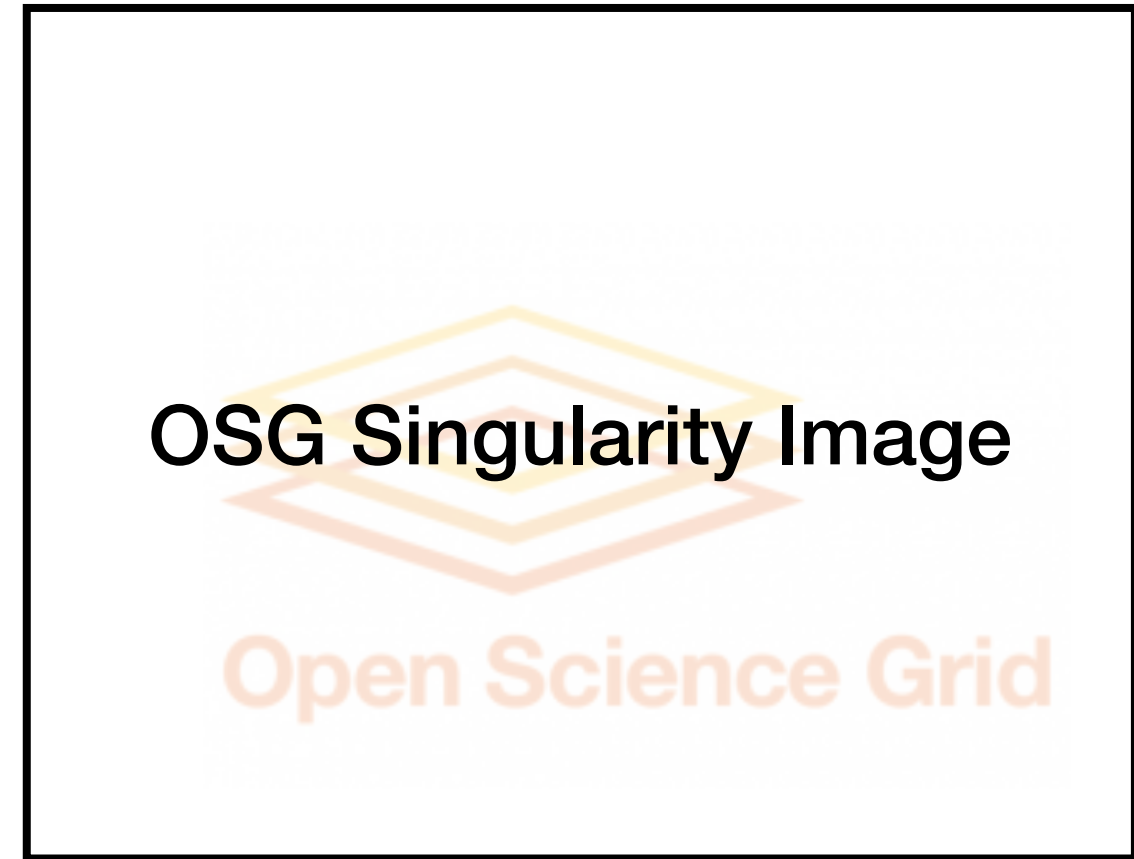
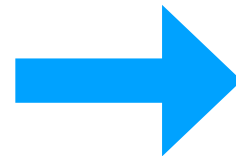
Running clas12simulations in interactive mode

includes opengl

`docker run -it --rm -p 6080:6080 clas12simulations:iprod`



CLAS12 Docker container and Open Science Grid



**clas12simulations
docker image**

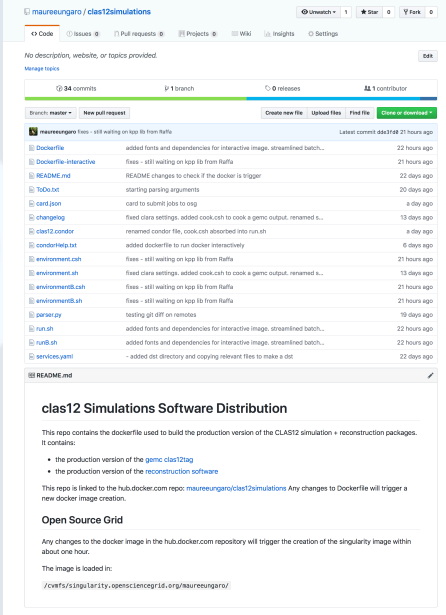
**clas12simulations
singularity image
on OSG Nodes**

CLAS12 Docker container and Open Science Grid

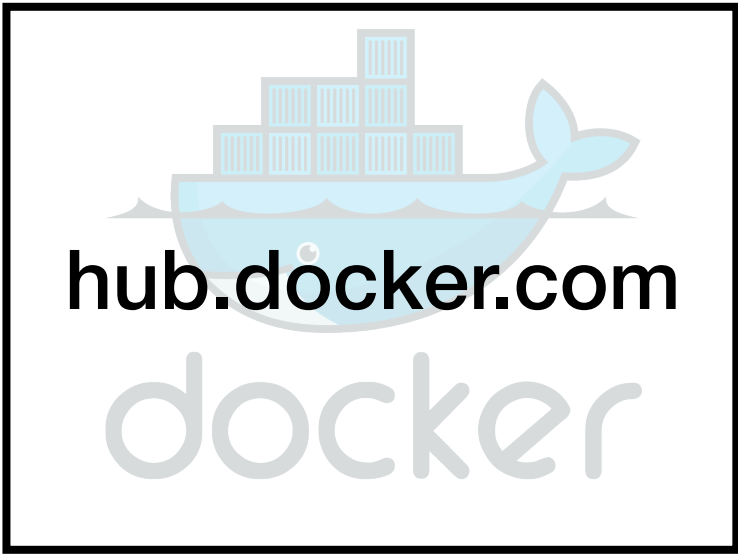
- ✓ OSG project: **osg.clas12MC**
- ✓ automatic docker image creation chain at hub.docker.com:
automatic github to docker cloud
- ✓ docker tags linked to github tags/branches
- ✓ automatic OSG singularity image creation from docker cloud
- ✓ OSG singularity tags linked to docker tags
- ✓ Jefferson Lab OSG node can be used to submit jobs to OSG
(we'll demo that on Friday)

CLAS12 Docker container and Open Science Grid

Gitub Repo:



Automatic, ~30 minutes



PUBLIC | AUTOMATED BUILD

maureeungaro/clas12simulations ★

Last pushed: 21 hours ago

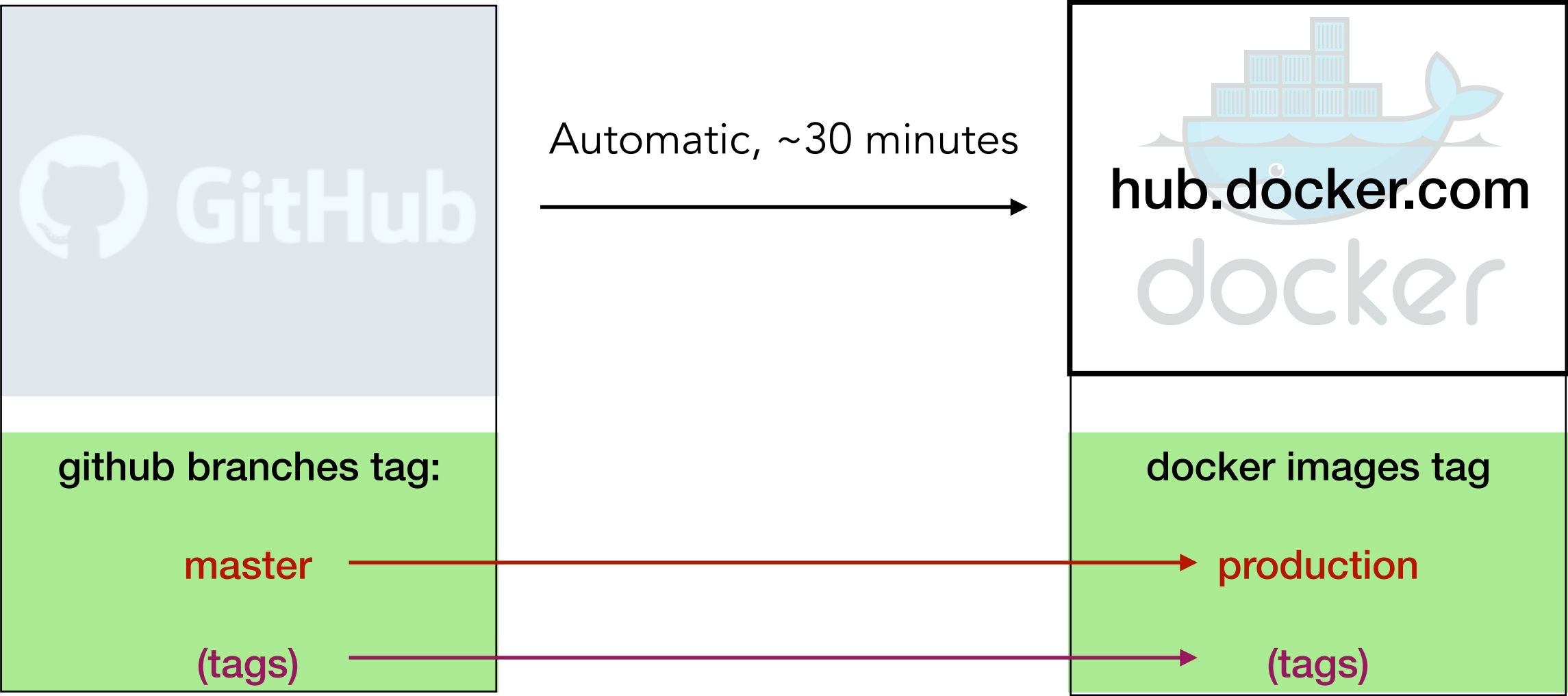
Essential software to run
simulation and
reconstruction on OSG
nodes

geant4 10.4
gemc: 4a.2.5
clara: 4.3.3
coatjava: 5b.7.1

Repo Info Tags Dockerfile Build Details Build Settings Collaborators Webhooks Settings

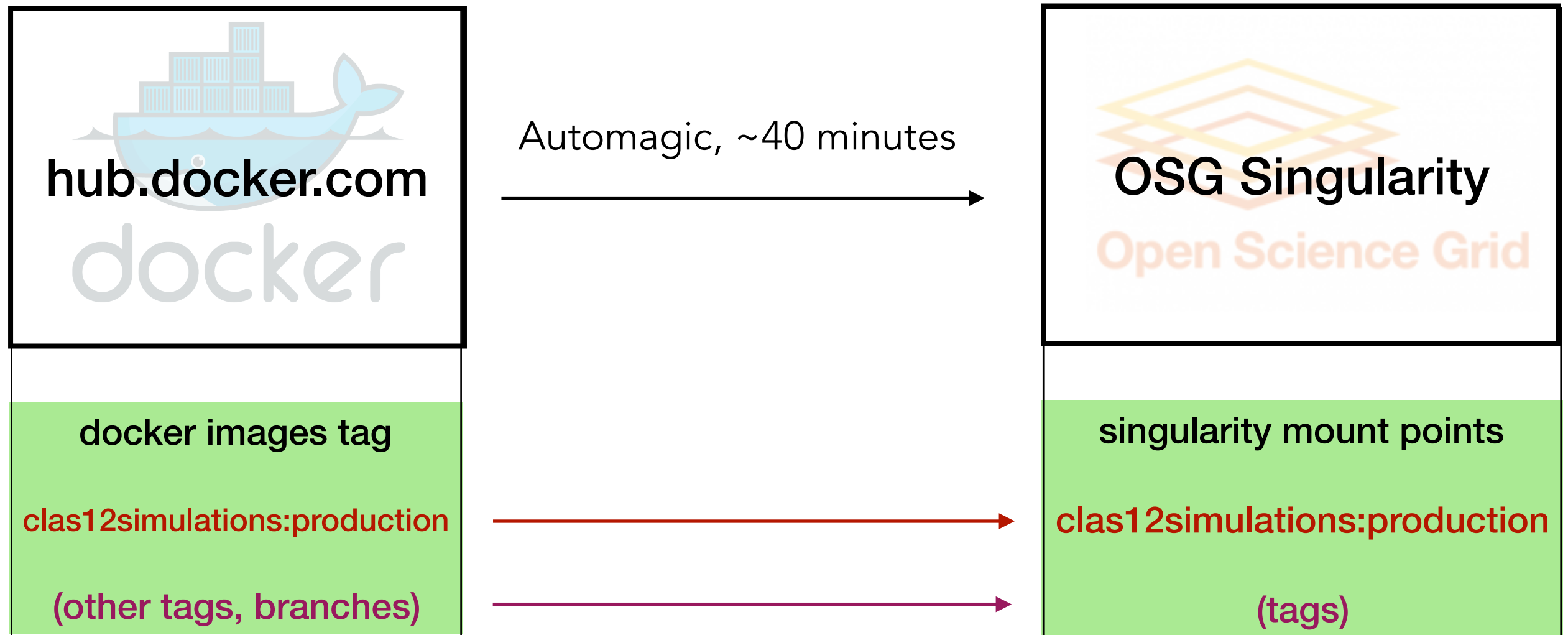
Status	Actions	Tag	Created	Last Updated
⛔ Canceled		production	21 hours ago	21 hours ago
✔ Success		production	a day ago	21 hours ago
✔ Success		production	a day ago	a day ago
✔ Success		production	a day ago	a day ago
⛔ Canceled		production	6 days ago	6 days ago
✔ Success		production	13 days ago	13 days ago
⛔ Canceled		production	13 days ago	13 days ago
⛔ Canceled		production	13 days ago	13 days ago
✔ Success		production	13 days ago	13 days ago

CLAS12 Docker container and Open Science Grid



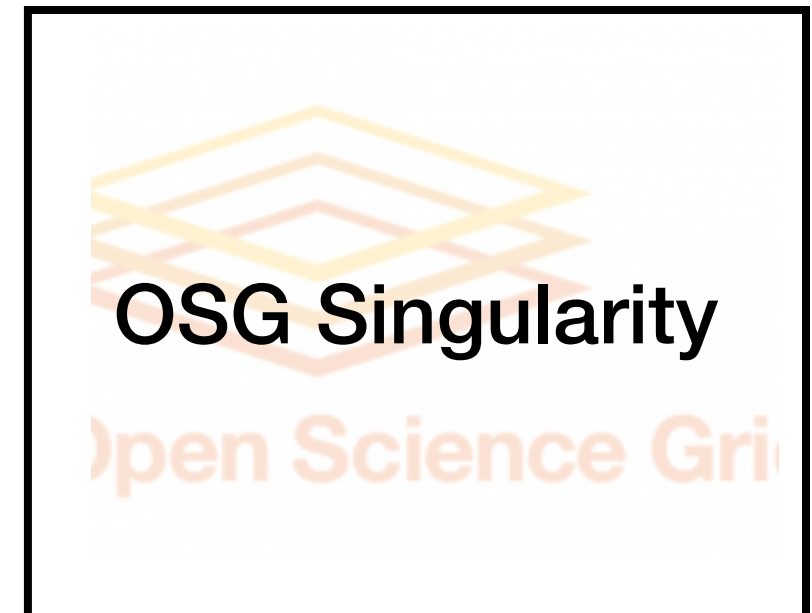
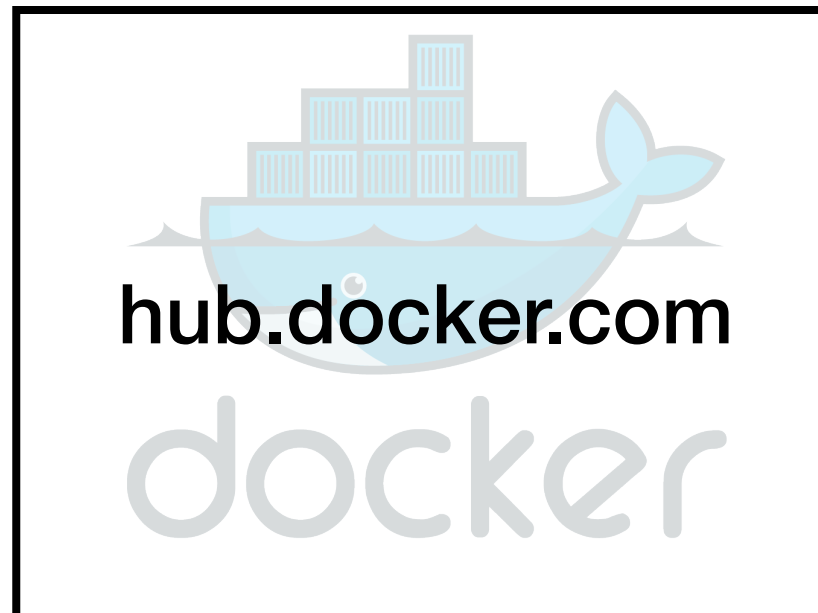
Type	Name	Dockerfile Location	Docker Tag Name		
Branch ▾	master	/	production	+	Trigger
Branch ▾	All branches except master	/	Same as branch	-	

CLAS12 Docker container and Open Science Grid



CLAS12 Singularity image automatically distributed to ALL OSG nodes.

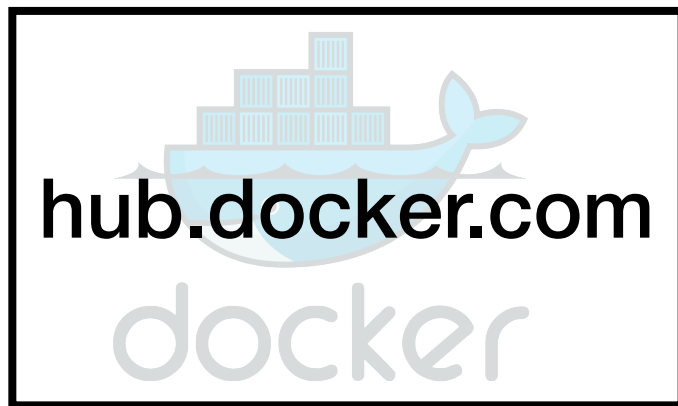
CLAS12 Docker container and Open Science Grid



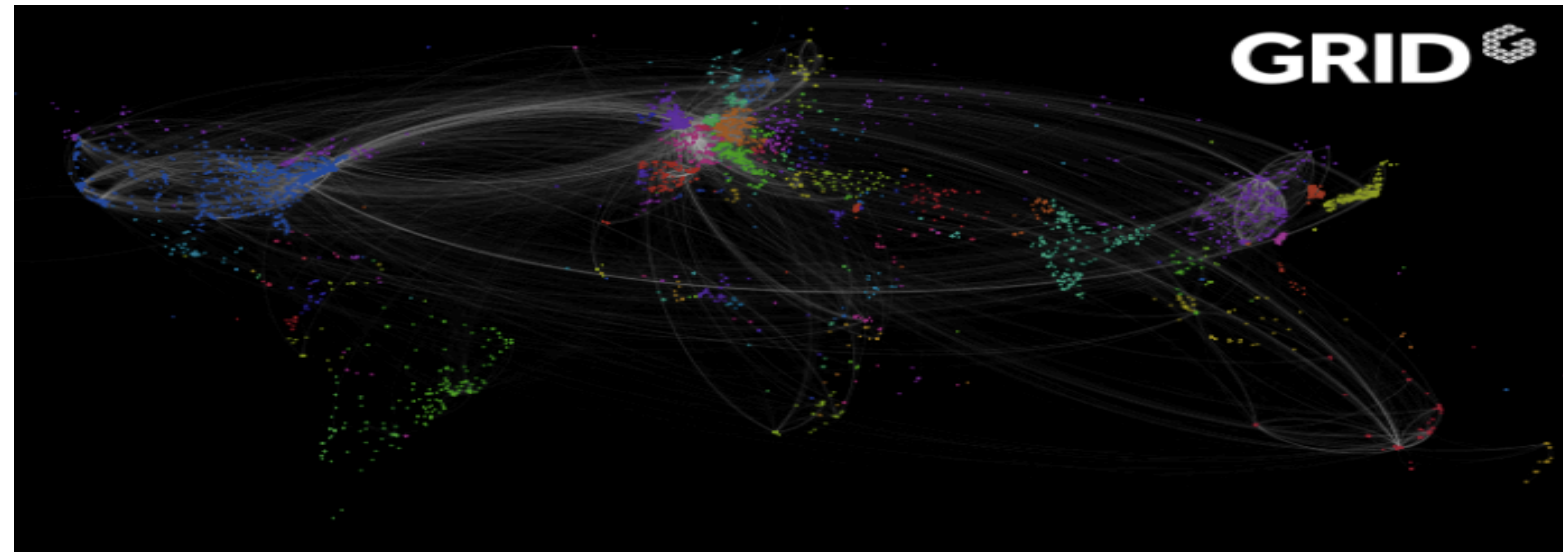
GITHUB > DOCKER > OSG Connection is completed and operational

CLAS12 Docker container and Open Science Grid

Summary

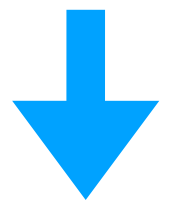


User can run interactively
generator
gemc simulation
clara reconstruction
ced
save data to be analyze



- submit jobs
- provide generator files
- or use generator in the image

**JLab OSG
Node**



Output File

Currently: 10 GB / s
connection.
FY2020: should be 100
GB connection.

Friday Demo

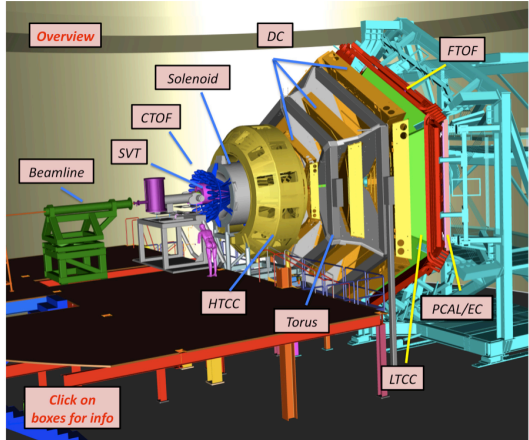
Experimental Hall B

[Hall B Main](#) [CLAS](#) [CLAS12](#) [Other Expts](#) [Run Info](#) [Publications](#) [Public Interest](#)

[print version](#)

CLAS12

CLAS12 Subsystems



Baseline Equipment

- DC: Drift Chambers ([specs](#))
- CTOF: Central Time-of-Flight ([specs](#), [web page](#))
- HTCC: High Threshold Cherenkov Counter ([specs](#), [web page](#))
- Solenoid: ([specs](#))
- SVT: Silicon Vertex Tracker ([specs](#), [web page](#))
- Beamline: ([specs](#))
- FTOF: Forward Time-of-Flight ([specs](#), [web page](#))
- Torus: ([specs](#))
- LTCC: Low Threshold Cherenkov Counter ([specs](#))
- PCAL/EC: Electromagnetic Calorimeters ([specs](#))
- Other Infrastructure:
 - DAQ: Data Acquisition/Trigger Electronics ([specs](#))
 - Hall B Infrastructure: ([specs](#))
 - Offline Software: ([specs](#))

Non-baseline Equipment

- RICH: Ring-Imaging Cherenkov Detector ([specs](#), [wiki page](#))
- MM: Micromegas Tracker ([specs](#), [wiki page](#))
- CND: Central Neutron Detector ([specs](#), [wiki page](#))
- FT: Forward Tagger ([specs](#), [web page](#), [wiki page](#), [TDR](#))
- Polarized Targets:
 - Longitudinally Polarized Target ([specs](#))
 - Transversely Polarized Target (HD-Ice) ([specs](#))

CLAS12 Physics Program

- Experimental Program:
 - [Approved Experiments](#)
 - CLAS12 Run Groups: [Listings](#), [Details](#)
- Conditionally Approved and non-CLAS12 Experiments
 - [Summary Table](#)
 - [Heavy Photon Search \(HPS\)](#)
 - [Proton Charge Radius](#)

CLAS12 Databases

- [Calibration Constant Database - CCDB](#)
- [Run Control Database - RCDB](#)
- [CLAS Equipment Inventory Database](#)

CLAS12 Reviews

- [Torus Cooldown Review](#) (Apr. 13 and Jun. 27, 2016)
- [Ancillary Equipment Review](#) (Jun. 13-14, 2016)
- [Torus Power-up Review](#) (Jul. 18, 2016)
- [CLAS12 Equipment Review](#) (Dec. 6-7, 2016)
- [Solenoid Cool-down and Power-up Review](#) (Jul. 6-7, 2017)
- [Ready for Science Review](#) (Sep. 25-26, 2017)

CLAS12 Documentation

- [CLAS12 Wiki](#)
- [CLAS12 Operations Documentation](#)
- [First Experiment Document Database](#)
- Commissioning Plans:
 - [CLAS12 KPP Commissioning Document](#) (Dec. 13, 2016)
 - [KPP Demonstration Slides](#)
 - [CLAS12 Engineering Run Commissioning Document](#) (Jan. 2018)
- [JLab Data Management Plan](#)
- [Hall B Data Management Plan](#)

CLAS12 Software

- [Offline Github Repository](#)
- [CLARA Documentation](#)
- [GEMC: GEANT4 Monte Carlo Simulation](#)
- [COATJAVA Documentation](#)
- [Data Format \(HIPO\) and Analysis Train Documentation](#)
- [DST Documentation](#)
- [CLAS12 Software Distribution](#)
- [CLAS12 Forum](#)

CLAS12 Upgrades

- [Luminosity Increase](#)
- [Drift Chamber Readout Boards \(DCRB\)](#)

Please have docker installed.
Please have docker image downloaded.
I'm available to help.

Installing Docker

- Mac users can download it [here](#). Once installed, run the docker app.
- Linux users can install it using yum. Detailed instructions for Ubuntu can be found [at this page](#).

Download the image

Use the following command to download the clas12 software image for the first time:

```
docker run -it --rm maureeungaro/clas12simulations:iprod bash
```

Click CLAS12
Software
Distribution

Friday Demo

You will run Docker to:

- generate events using clasdis/clasdvcs
- using gemc to simulate those events
- using clara to run reconstruction multi-threaded
- check results

You will submit jobs to OSG and get results:

- clasdis/clasdvcs generator
- run gemc
- run reconstruction
- get filtered output file