

# ifarm and GlueX Environment

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# Outline

- Terminology
- Shells
- Environment set up scenarios:
  - Beginner: run software already built without modification
  - Intermediate: perform custom data analysis tasks
  - Advanced: create new features or debug old problems in existing software
- Data and Computing Resources
- How to Get Help

# Terminology

- Reconstruction
  - Take raw data, transform into particle or particle-like entities
- Simulation (or Monte Carlo)
  - Creation of make-believe events
  - Generation: create particles at reaction point
  - Detector simulation: track particles, create detector hits
  - Smearing: add detector resolution to created hits
- Analysis
  - Take particles, transform into physics-relevant quantities
  - Particle sources:
    - REST Files
    - ROOT Trees

# Shells

- Supported shells:
  - `tcsh`
  - `bash`
- Common convention (examples only):
  - `script.sh` is for `bash`
  - `script.csh` is for `tcsh`
- This talk will use `bash` for all examples.

# Beginner Scenario

Run software already built without modification.

Put the following line your `.profile` file

```
source /group/halld/Software/build_scripts/gluex_env_boot_jlab.sh
```

This defines the command `gxenv`:

```
> gxenv
```

for default versions of the software.

To specify another other version set, e. g., version set 4.4.0

```
> gxenv $DIST/version_4.4.0.xml
```

# Version Set Files

`$DIST/version_4.4.0.xml` is:

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl"
href="https://halldweb.jlab.org/dist/version4.xsl"?>
<gversions file="version_4.4.0.xml" date="2019-04-16">
<description>Update releases.</description>
<package name="jana" version="0.7.9p1" dirtag="ccdb166"/>
<package name="halld_recon" version="4.3.0"/>
<package name="halld_sim" version="4.3.0"/>
<package name="hdds" version="4.2.0"/>
<package name="lapack" version="3.6.0"/>
<package name="cernlib" version="2005" word_length="64-bit"/>
<package name="xerces-c" version="3.1.4"/>
<package name="root" version="6.08.06"/>
<package name="ccdb" version="1.06.06"/>
...
```

## Version Set Files (continued)

```
...  
<package name="evio" version="4.4.6"/>  
<package name="rcdb" version="0.03.01"/>  
<package name="geant4" version="10.02.p02"/>  
<package name="hdgeant4" version="2.2.0"/>  
<package name="hd_utilities" version="1.17"/>  
<package name="gluex_MCwrapper" version="v2.1.0"/>  
<package name="gluex_root_analysis" version="1.1.0" dirtag="hdr430"/>  
<package name="amptools" version="0.9.4"/>  
<package name="sqlitecpp" version="2.2.0" dirtag="bs130"/>  
<package name="sqlite" version="3.13.0" year="2016" dirtag="bs130"/>  
</gversions>
```

# List of Environment Variables Defined by `gxenv`

```
AMPLOTTER=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/amptools/AmpTools-0.9.4/AmpPlotter
AMPTOOLS=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/amptools/AmpTools-0.9.4/AmpTools
AMPTOOLS_HOME=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/amptools/AmpTools-0.9.4
AMPTOOLS_VERSION=0.9.4
BMS_OSNAME=Linux_RHEL7-x86_64-gcc4.8.5
BUILD_SCRIPTS=/group/halld/Software/build_scripts
BUILD_SCRIPTS=/group/halld/Software/build_scripts
CCDB_CONNECTION=mysql://ccdb_user@halldb.jlab.org/ccdb
CCDB_HOME=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/ccdb/ccdb_1.06.06
CCDB_USER=marki
CCDB_VERSION=1.06.06
CERN=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/cernlib
CERN_LEVEL=2005
CERNLIB_VERSION=2005
CERNLIB_WORD_LENGTH=64-bit
CERN_ROOT=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/cernlib/2005
EVIO_ROOT=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/evio/evio-4.4.6/Linux-x86_64
EVIO_VERSION=4.4.6
G4ABLA_DATA=/u/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/geant4/geant4.10.02.p02/share/Geant4-10.2.2/data/G4ABLA3.0
G4ENSDFASTATEDATA=/u/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/geant4/geant4.10.02.p02/share/Geant4-10.2.2/data/G4ENSDFASTATEDATA1.2.3
G4INCLUDE=/u/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/geant4/geant4.10.02.p02/include/Geant4
G4INSTALL=/u/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/geant4/geant4.10.02.p02/share/Geant4-10.2.2/geant4make
G4LEDATA=/u/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/geant4/geant4.10.02.p02/share/Geant4-10.2.2/data/G4EMLOW6.48
G4LEVELGAMMADATA=/u/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/geant4/geant4.10.02.p02/share/Geant4-10.2.2/data/PhotonEvaporation3.2
G4LIB_BUILD_SHARED=1
```



# List of Environment Variables Defined by `gxenv` (continued)

```
G4LIB=/u/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/geant4/geant4.10.02.p02/lib64/Geant4-10.2.2
G4LIB_USE_GDML=1
G4LIB_USE_ZLIB=1
G4MULTITHREADED=1
G4NEUTRONHPDATA=/u/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/geant4/geant4.10.02.p02/share/Geant4-10.2.2/data/G4NDL4.5
G4NEUTRONXSDATA=/u/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/geant4/geant4.10.02.p02/share/Geant4-10.2.2/data/G4NEUTRO
NXS1.4
G4PIIDATA=/u/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/geant4/geant4.10.02.p02/share/Geant4-10.2.2/data/G4PII1.3
G4RADIOACTIVEDATA=/u/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/geant4/geant4.10.02.p02/share/Geant4-10.2.2/data/Radioa
ctiveDecay4.3.2
G4REALSURFACEDATA=/u/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/geant4/geant4.10.02.p02/share/Geant4-10.2.2/data/RealSu
rface1.0
G4ROOT=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/geant4/geant4.10.02.p02
G4SAIDXSDATA=/u/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/geant4/geant4.10.02.p02/share/Geant4-10.2.2/data/G4SAIDDATA1
.1
G4SYSTEM=Linux-g++
G4UI_USE_QT=1
G4UI_USE_TCSH=1
G4UI_USE_XM=1
G4VIS_USE_DAWN=1
G4VIS_USE_OPENGLQT=1
G4VIS_USE_OPENGLX=1
G4VIS_USE_OPENGLXM=1
G4VIS_USE_RAYTRACERX=1
G4WORKDIR=/home/marki/geant4_workdir
GEANT4_VERSION=10.02.p02
GLUEX_MCWRAPPER_VERSION=v2.1.0
```

# List of Environment Variables Defined by `gxenv` (continued)

```
GLUEX_ROOT_ANALYSIS_DIRTAG=hdr430
GLUEX_ROOT_ANALYSIS_VERSION=1.1.0
GLUEX_TOP=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5
HALLD_MY=/home/marki/halld_my
HALLD_RECON_DEBUG_LEVEL=1
HALLD_RECON_HOME=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/halld_recon/halld_recon-4.3.0
HALLD_RECON_VERSION=4.3.0
HALLD_SIM_DEBUG_LEVEL=1
HALLD_SIM_HOME=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/halld_sim/halld_sim-4.3.0
HALLD_SIM_VERSION=4.3.0
HDDS_HOME=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/hdds/hdds-4.2.0
HDDS_VERSION=4.2.0
HDGEANT4_HOME=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/hdgeant4/hdgeant4-2.2.0
HDGEANT4_VERSION=2.2.0
HD_UTILITIES_HOME=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/hd_utilities/hd_utilities-1.17
HD_UTILITIES_VERSION=1.17
JANA_CALIB_URL=mysql://ccdb_user@hallddb.jlab.org/ccdb
JANA_DIRTAG=ccdb166
JANA_GEOMETRY_URL=ccdb:///GEOMETRY/main_HDDS.xml
JANA_HOME=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/jana/jana_0.7.9p1^ccdb166/Linux_RHEL7-x86_64-gcc4.8.5
JANA_PLUGIN_PATH=/home/marki/halld_my/Linux_RHEL7-x86_64-gcc4.8.5/plugins:/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/halld_recon/halld_recon-4.3.0/Linux_RHEL7-x86_64-gcc4.8.5/plugins:/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/halld_recon/halld_recon-4.3.0/Linux_RHEL7-x86_64-gcc4.8.5/plugins:/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/jana/jana_0.7.9p1^ccdb166/Linux_RHEL7-x86_64-gcc4.8.5/plugins:/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/jana/jana_0.7.9p1^ccdb166/Linux_RHEL7-x86_64-gcc4.8.5/lib
JANA_RESOURCE_DIR=/group/halld/www/halldweb/html/resources
JANA_VERSION=0.7.9p1
```

# List of Environment Variables Defined by gxenv (continued)

```
LAPACK_HOME=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/lapack/lapack-3.6.0
LAPACK_VERSION=3.6.0
LD_LIBRARY_PATH=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/gluex_root_analysis/gluex_root_analysis-1.1.0^hdr430/Linux_RHEL7-x86_64-gcc4.8.5/lib/:/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/evio/evio-4.4.6/Linux-x86_64/lib:/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/rcdb/rcdb_0.03.01/cpp/lib:/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/ccdb/ccdb_1.06.06/lib:/u/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/geant4/geant4.10.02.p02/lib64:/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/root/root-6.08.06/lib:/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/xerces-c/xerces-c-3.1.4/lib:
MCWRAPPER_CENTRAL=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/gluex_MCwrapper/gluex_MCwrapper-v2.1.0
PATH=/apps/cmake/cmake-3.5.1/bin:/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/gluex_root_analysis/gluex_root_analysis-1.1.0^hdr430/Linux_RHEL7-x86_64-gcc4.8.5/bin:/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/gluex_MCwrapper/gluex_MCwrapper-v2.1.0:/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/hdgeant4/hdgeant4-2.2.0/bin/Linux-g++:/home/marki/halld_my/Linux_RHEL7-x86_64-gcc4.8.5/bin:/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/halld_sim/halld_sim-4.3.0/Linux_RHEL7-x86_64-gcc4.8.5/bin:/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/halld_recon/halld_recon-4.3.0/Linux_RHEL7-x86_64-gcc4.8.5/bin:/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/jana/jana_0.7.9p1^ccdb166/Linux_RHEL7-x86_64-gcc4.8.5/bin:/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/rcdb/rcdb_0.03.01:/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/rcdb/rcdb_0.03.01/bin:/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/rcdb/rcdb_0.03.01/cpp/bin:/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/ccdb/ccdb_1.06.06/bin:/home/marki/geant4_workdir/bin/Linux-g++:/u/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/geant4/geant4.10.02.p02/bin:/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/cernlib/2005/bin:/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/root/root-6.08.06/bin:/apps/perl/bin:/apps/bin:/group/halld/Software/build_scripts:/site/bin:./home/marki/bin:/usr/lib64/qt-3.3/bin:/home/marki/perl5/bin:/usr/local/bin:/usr/local/sbin:/usr/bin:/usr/sbin:/bin:/sbin:/opt/puppetlabs/bin:/opt/puppetlabs/bin
PYTHONPATH=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/halld_recon/halld_recon-4.3.0/Linux_RHEL7-x86_64-gcc4.8.5/python2:/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/rcdb/rcdb_0.03.01/python:/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/ccdb/ccdb_1.06.06/python:/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/ccdb/ccdb_1.06.06/python/ccdb/ccdb_pyllapi:/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/root/root-6.08.06/lib:
QTHOME=/usr/lib64/qt4
QTLIBPATH=/usr/lib64
```

# List of Environment Variables Defined by `gxenv` (continued)

```
RCDB_CONNECTION=mysql://rcdb@halldb.jlab.org/rcdb
RCDB_HOME=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/rcdb/rcdb_0.03.01
RCDB_VERSION=0.03.01
ROOT_ANALYSIS_HOME=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/gluex_root_analysis/gluex_root_analysis-1.1.0^hdr430
ROOTSYS=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/root/root-6.08.06
ROOT_VERSION=6.08.06
SQLITECPP_DIRTAG=bs130
SQLITECPP_HOME=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/sqlitecpp/SQLiteCpp-2.2.0^bs130
SQLITECPP_VERSION=2.2.0
SQLITE_DIRTAG=bs130
SQLITE_HOME=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/sqlite/sqlite-3.13.0^bs130
SQLITE_VERSION=3.13.0
SQLITE_YEAR=2016
XERCESCROOT=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/xerces-c/xerces-c-3.1.4
XERCES_C_VERSION=3.1.4
XERCES_INCLUDE=/group/halld/Software/builds/Linux_RHEL7-x86_64-gcc4.8.5/xerces-c/xerces-c-3.1.4/include
```

# Run the Software

```
> hd_root
```

```
Usage:
```

```
    hd_root [options] source1 source2 ...
```

Process events from a Hall-D data source (e.g. a file)

This will create a ROOT file that plugins or debug histos can write into.

Options:

```
--janaversion          Print JANA version information
--nthreads=X           Launch X processing threads
--plugin=plugin_name   Attach the plug-in named "plugin_name"
```

```
...
```

## Summary for `gluex_env_boot_jlab.sh`

- Defines the `gxenv` command
  - Sets up environment variables according to version set file (`version.xml`)
- Defines the `gxclean` command
  - Removes environment changes made by `gxenv`
- Defines `BUILD_SCRIPTS` environment variable
- Puts `BUILD_SCRIPTS` into your path (`$PATH`)
- Does not set-up the environment

# Intermediate Scenario

Perform custom data analysis tasks, customization of type anticipated by the software system.

See the other talks in the tutorial...

# Advanced Scenario

- Develop new features or debug old problems in existing software.
- Create custom version of reconstruction and simulation.

```
cd /scratch/marki
mkdir custom
cd custom
gxclean
$BUILD_SCRIPTS/my_halld_build_jlab
```

- Starts with current default version set.
- Defines local, custom versions of hdds, halld\_recon, halld\_sim, hdgeant4, gluex\_root\_analysis.
- Builds them.
- Creates set-up scripts to use the build after everything done. In the example above, in the directory /scratch/marki/custom the files setup\_gluex.csh and setup\_gluex.sh will be created.



## Example Run of my\_halld\_build\_jlab

```
ifarm1401:marki:custom> my_halld_build_jlab -n 6  
For usage message, type "my_halld_build_jlab -h"
```

```
Info: contents of version.xml:
```

```
-----  
<gversion version="1.0"  
><package name="jana" version="0.7.9p1" dirtag="ccdb166"  
 /><package name="halld_recon" home="/u/scratch/marki/custom/halld_recon"  
 /><package name="halld_sim" home="/u/scratch/marki/custom/halld_sim"  
 /><package name="hdds" home="/u/scratch/marki/custom/hdds"  
 /><package name="lapack" version="3.6.0"  
 /><package name="cernlib" version="2005"  
 /><package name="xerces-c" version="3.1.4"  
 /><package name="root" version="6.08.06"  
 /><package name="ccdb" version="1.06.06"  
 ...
```

## Example Run of my\_halld\_build\_jlab (continued)

...

```
><package name="sqlite" version="3.13.0" dirtag="bs130"  
  /></gversion
```

>

-----

Will build the following packages in the local directory:

```
hdds halld_recon halld_sim hdgeant4 gluex_root_analysis
```

Is this OK? y

```
git clone -b master https://github.com/jeffersonlab/hdds hdds  
Cloning into 'hdds'...
```

...

```
git clone -b master https://github.com/jeffersonlab/halld_recon halld_recon  
Cloning into 'halld_recon'...
```

...

## Example Run of my\_halld\_build\_jlab (continued)

```
git clone -b master https://github.com/jeffersonlab/halld_sim halld_sim
Cloning into 'halld_sim'...
...
git clone -b master https://github.com/jeffersonlab/hdgeant4 hdgeant4
Cloning into 'hdgeant4'...
...
git clone -b master https://github.com/jeffersonlab/gluex_root_analysis
gluex_root_analysis
Cloning into 'gluex_root_analysis'...
...
ifarm1401:marki:custom> ls
gluex_root_analysis  halld_sim  hdgeant4          setup_gluex.sh
halld_recon          hdds       setup_gluex.csh  version.xml
```

# Data and Computing Resources

See [talk at GlueX Physics Workshop, 2016](#) for info on CPU, disk, tape resources at JLab.

But two items from that talk...

# Disk: SciComp (farm/ifarm only)

- /work
  - Large files, personal builds
  - /work/halld, 173 TB, traditional RAID
- /mss
  - Front-end representation of tape library
- /cache, Hall D: 220 TB of pinned files
  - Actual file realization of /mss
  - Use jcache command
- /volatile, Hall D: 30 TB
  - Temporary storage, old files deleted to make space for new



# How to Get Help

- Offline Software Wiki Page
  - [https://halldweb.jlab.org/wiki/index.php/GlueX\\_Offline\\_Software](https://halldweb.jlab.org/wiki/index.php/GlueX_Offline_Software)
  - Main source of documentation
- JLab Scientific Computing Documentation
  - <https://scicomp.jlab.org/docs/>
  - Information on systems maintained by SciComp
- Email Lists
  - [halld-offline@jlab.org](mailto:halld-offline@jlab.org), <https://mailman.jlab.org/mailman/listinfo/halld-offline>
    - Announcements, news, information, discussion
  - [gluex-software@googlegroups.com](mailto:gluex-software@googlegroups.com), <https://groups.google.com/forum/#!forum/gluex-software>
    - “I’m having the following problem....” “Can someone explain to me why...”
- Slack (<https://slack.com>)
  - Chat rooms, direct messages
  - Use JLab email address to sign in
  - Workspace: Jefferson Lab (jlab12gev.slack.com)
  - Channel: #halld