Software Update

Online HPS Collaboration Meeting.

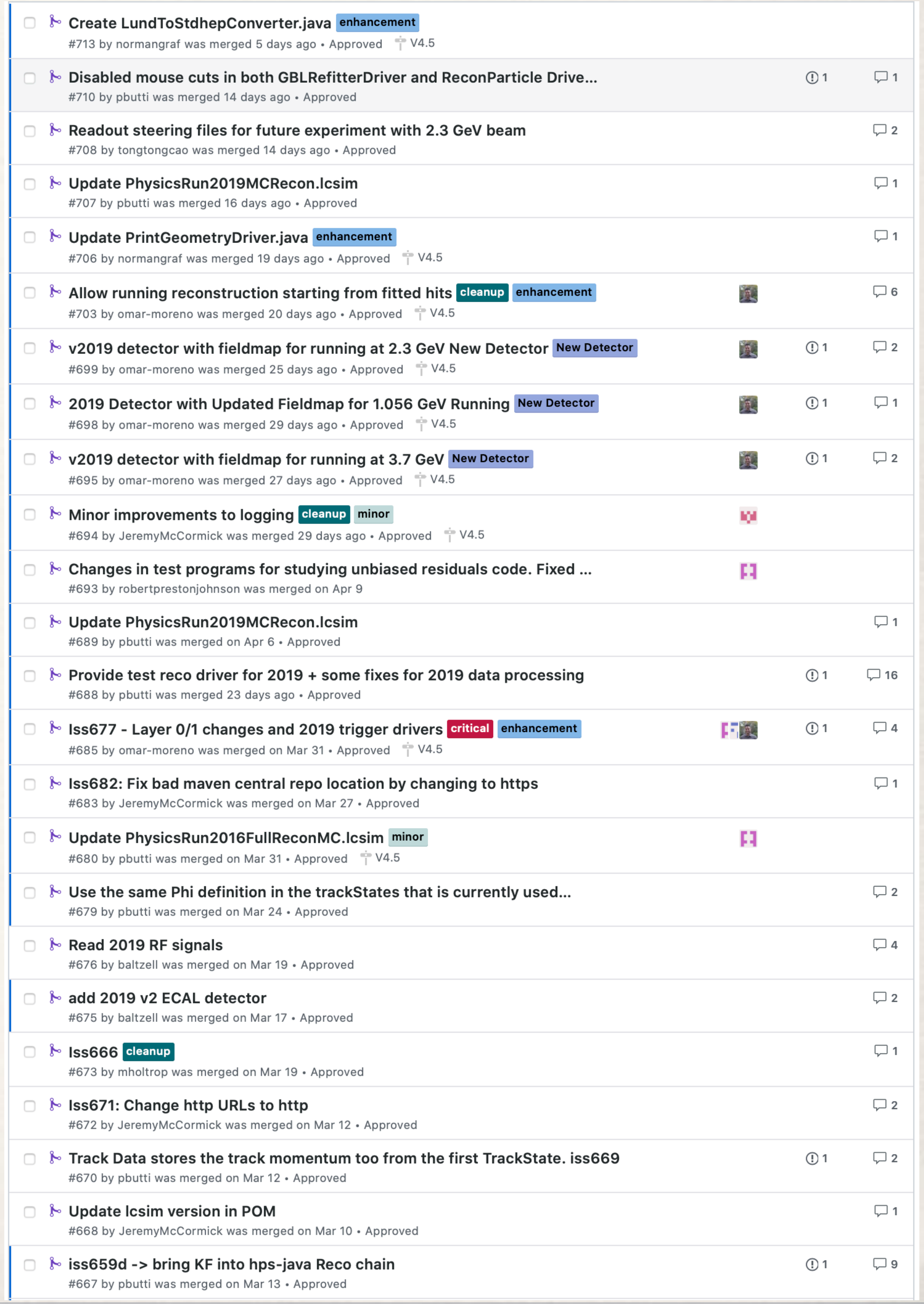
May 14, 2020

Outline

- Current status.
- Priorities
- Recent decision that impact software use.
- Lowering barriers: Docker

Status of the software

- The entire software chain works well for 2015 & 2016 analysis.
  - Yes, there are always more improvements possible/desirable…
- Development cycle has been fairly smooth.
  - Most “pull requests” are merged fairly quickly.
    - reviewers have generally given good feedback.
  - Many current issues are actively resolved.
    - but there is a big old list of old ones we should address.
- Recent updates
  - Some larger changes.
  - Many small changes.
  - Probably time for a release soon.



□ Create LundToStdhepConverter.java enhancement
#713 by normangraf was merged 5 days ago • Approved V4.5

□ Disabled mouse cuts in both GBLRefitterDriver and ReconParticle Drive… (!) 1 💬 1
#710 by pbutti was merged 14 days ago • Approved

□ Readout steering files for future experiment with 2.3 GeV beam 💬 2
#708 by tongtongcao was merged 14 days ago • Approved

□ Update PhysicsRun2019MCRecon.lcsim 💬 1
#707 by pbutti was merged 16 days ago • Approved

□ Update PrintGeometryDriver.java enhancement 💬 1
#706 by normangraf was merged 19 days ago • Approved V4.5

□ Allow running reconstruction starting from fitted hits cleanup enhancement 💬 6
#703 by omar-moreno was merged 20 days ago • Approved V4.5

□ v2019 detector with fieldmap for running at 2.3 GeV New Detector New Detector (!) 1 💬 2
#699 by omar-moreno was merged 25 days ago • Approved V4.5

□ 2019 Detector with Updated Fieldmap for 1.056 GeV Running New Detector (!) 1 💬 1
#698 by omar-moreno was merged 29 days ago • Approved V4.5

□ v2019 detector with fieldmap for running at 3.7 GeV New Detector (!) 1 💬 2
#695 by omar-moreno was merged 27 days ago • Approved V4.5

□ Minor improvements to logging cleanup minor
#694 by JeremyMcCormick was merged 29 days ago • Approved V4.5

□ Changes in test programs for studying unbiased residuals code. Fixed …
#693 by robertprestonjohnson was merged on Apr 9

□ Update PhysicsRun2019MCRecon.lcsim 💬 1
#689 by pbutti was merged on Apr 6 • Approved

□ Provide test reco driver for 2019 + some fixes for 2019 data processing (!) 1 💬 16
#688 by pbutti was merged 23 days ago • Approved

□ Iss677 - Layer 0/1 changes and 2019 trigger drivers critical enhancement (!) 1 💬 4
#685 by omar-moreno was merged on Mar 31 • Approved V4.5

□ Iss682: Fix bad maven central repo location by changing to https 💬 1
#683 by JeremyMcCormick was merged on Mar 27 • Approved

□ Update PhysicsRun2016FullReconMC.lcsim minor
#680 by pbutti was merged on Mar 31 • Approved V4.5

□ Use the same Phi definition in the trackStates that is currently used… 💬 2
#679 by pbutti was merged on Mar 24 • Approved

□ Read 2019 RF signals 💬 4
#676 by baltzell was merged on Mar 19 • Approved

□ add 2019 v2 ECAL detector 💬 2
#675 by baltzell was merged on Mar 17 • Approved

□ Iss666 cleanup 💬 1
#673 by mholtrop was merged on Mar 19 • Approved

□ Iss671: Change http URLs to http 💬 2
#672 by JeremyMcCormick was merged on Mar 12 • Approved

□ Track Data stores the track momentum too from the first TrackState. iss669 (!) 1 💬 2
#670 by pbutti was merged on Mar 12 • Approved

□ Update lcsim version in POM 💬 1
#668 by JeremyMcCormick was merged on Mar 10 • Approved

□ iss659d -> bring KF into hps-java Reco chain (!) 1 💬 9
#667 by pbutti was merged on Mar 13 • Approved

Status of the software

- For 2019 data, some critical updates were needed.
  - Implement code for MC readout of L0 & L1 SVT layers.✓ (Omar)
  - Create 2019 versions of detector. ✓
  - Evio readers for Hodoscope and RF ✓
  - Trigger simulation & analysis - ★ Not finished. (Tongtong)
  - + all the things that were done before the run ✓✓✓!
- Lots of bugs fixed in this process.
- Big leaps forward:
  - Kalman Filter + seed finder (Robert + PF)
    - Still needs finishing touches and further testing but looks very promising.
  - Improvement in analysis tools, "hpstr" (Cameron + PF)
    - This will be ongoing, see presentation 2nd after this one.

Priorities

- **Top Priorities:**
  - Finish 2019 calibrations.
    - Code changes, bug fixes, needed for 2019 calibration, alignment, production reconstruction.
    - Eg - immediately fix the (-x,-y) missing ECal hits.
  - Get started on 2019 MC production. Next presentation. (Tongtong)
    - Code changes, bug fixes, needed for 2019 MC production.
    - Convert MC production chain into clear recipes.
  - Trigger simulation & analysis code. (Tongtong)
  - Beam background merging. (Cameron? + Kyle?)
  - WAB biassing in MC (Omar)
  - Finish Kalman Filter + seed finder (Robert + PF)
    - Plus all the tracking studies associated with this: tracking efficiency, etc.

Priorities

- **Other Priorities:**
  - Improve MC - Data agreement accuracy.
  - Optimizations for code speedup:
    - Early cutting of bad events.
    - Pulse fitting improvements.
    - Other code optimization.
  - Run MC chain on OSG.
  - Documentation:
    - We need to keep improving the docs!

C++17 and ldmx-sw

- Move MC detector simulation to ldmx-sw
  - To accommodate Omar implementing the WAB biassing code, a decision was made to go from SLIC to ldmx-sw (instead of hps-sim).
  - Many of the other required changes to ldmx-sw to become HPS compatible were already implanted (Cameron and Omar).
  - This will require some validation (but no more than for hps-sim).
- The “hpstr” development moves to C++17 level compilers.
  - Ubuntu 18.04 (gcc 7) and 20.04 (gcc 9), Centos 8 (gcc 8 or 9) and MacOS (clang) are already c++17 compatible.
  - ldmx-sw also requires C++17, so we need it there anyhow.
  - For Centos 7 (gcc 4.8): We will need to make use of a newer compiler, compile root, lcio, hpstr with it.
    - We may need/want to update the LCIO headers.

Docker

- What is Docker?
  - Not quite a Virtual Machine, not quite an application: Containerization.
  - Containerization: Wrap your application with a very much reduced operating system into a single purpose image that can now run anywhere.
  - Benefits: Easy to ship!
- Using a Docker images makes it very easy to run HPS software on your local machine (laptop, desktop, server).
  - Everything you need comes in a single downloaded container.
  - All your computer resources (cpu’s, memory, disk) are accessible to the container.
  - The image is much smaller than a virtual machine “disk”.
  - When running, the image does not load your computer as much as a virtual machine.
  - Images can easily be deployed on “the cloud” (Azure, AWS, OSG, …)

Docker and hpstr

Simplistic example of using docker locally.

Start a docker container (run)
Translate port 22 (ssh) to 2222

Bind my home directory to that of the “hps” user: the home directory on my system is now mounted at /home/hps in Docker.

Get the image: maurik/ubuntu_hps_hpstr
If it is not already on my system, it will download.
Run it in the background (-d instead of -i)
Cleanup when I am done (--rm)

```
> docker run -p 2222:22 -v /Users/maurik:/home/hps --rm -d maurik/ubuntu_hps_hpstr
```

```
> ssh -Y hps@localhost -p 2222
password: hps
```

Connect to docker with ssh -Y, so X11 is forwarded, to port 2222 as user “hps” (password is also “hps”)

```
hps@09d9b0108889 ~$ pwd
/home/hps
hps@09d9b0108889 ~$ root
   ------------------------------------------------------------------
  | Welcome to ROOT 6.20/05                        https://root.cern |
  | (c) 1995-2020, The ROOT Team; conception: R. Brun, F. Rademakers |
  | Built for linuxx8664gcc on May 09 2020, 10:59:00                 |
  | From heads/v6-20-00-patches@v6-20-04-49-gc916bee956              |
  | Try '.help', '.demo', '.license', '.credits', '.quit'/'.q'       |
   ------------------------------------------------------------------
root [0] R__LOAD_LIBRARY(libevent)
root [1] auto *evt = new EventHeader()
(EventHeader *) 0x558a82e89290
root [2]
```

My home directory is now at “/home/hps”.
File permissions are translated automatically.

gcc/g++, ROOT, LCIO and hpstr are pre-installed
(but nothing else!)

From here you can do analysis as if you were running an app on your machine.
(Entire home directory tree visible to app)

No changes to the operating system are persisted!

Docker

- Current available container: maurik/ubuntu_hps_hpstr
    - Based on Ubuntu 20.04, with gcc 9
    - All development library for building root, lcio and hpstr.
    - root v6.20, lcio and hpstr (current master) pre-installed in /usr/local
- Work in progress.
    - I need testers!
    - Because the container cannot be modified, it cannot be corrupted.
    - BUT, if you want to add/subtract something, you make a new image.
        - You would want to try to keep the image a small as reasonable, rather than add everything you might possibly need.
- Next:
    - Adapt the MC chain to Docker containers for off site running (OSG).
    - Put recipes up on GitHub and write documentation.
        - Include documentation on how you can customize your containers.

Conclusions

- A lot got done
  - A lot of critical tasks have been completed.
- A lot more needs doing
  - Some larger tasks have been talked about for long time.
  - Many smaller tasks, ongoing.