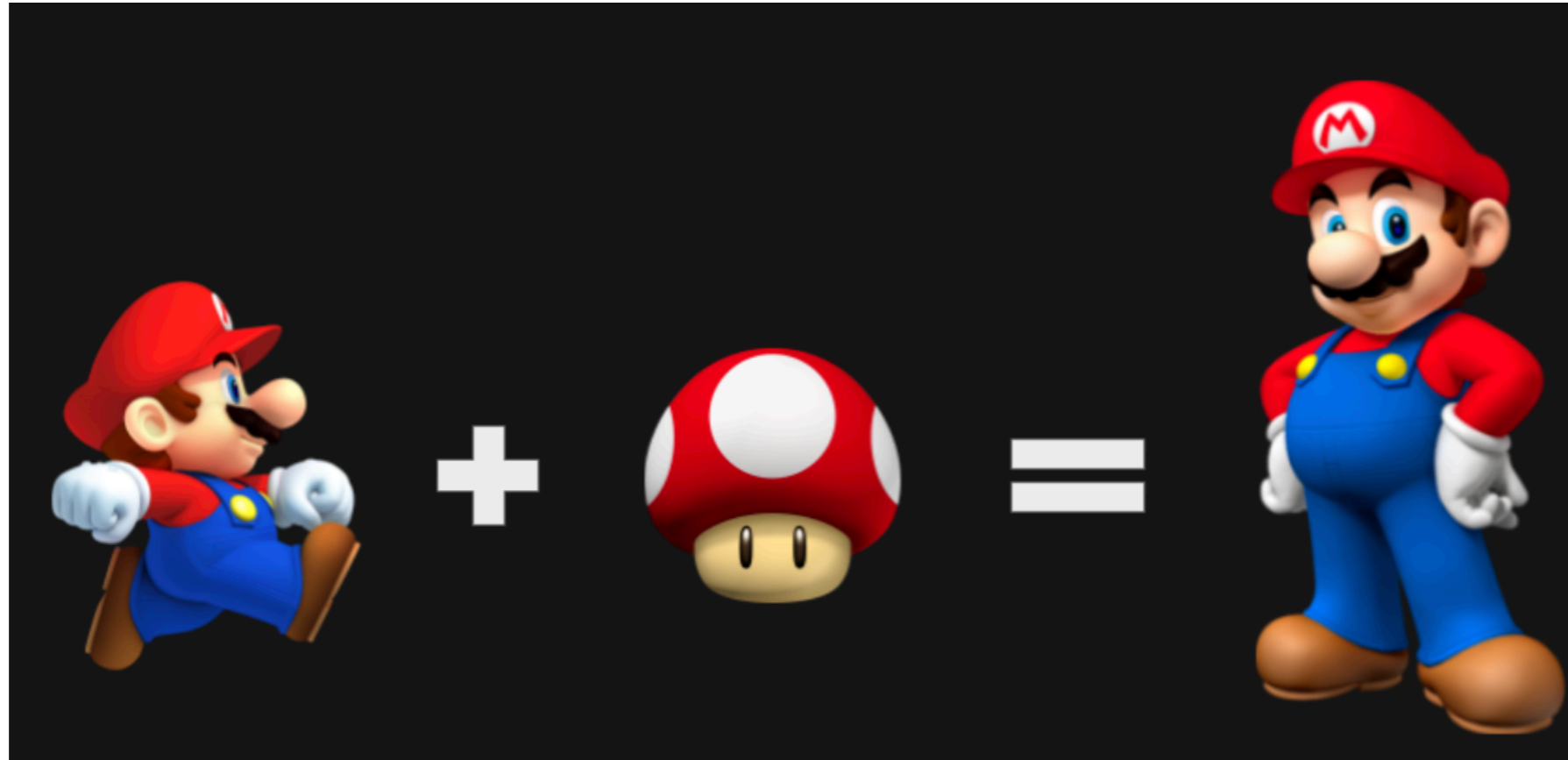


Towards a common software framework



Many people* ... (Harm Schoorlemmer)

* and hopefully more after this meeting

The tools

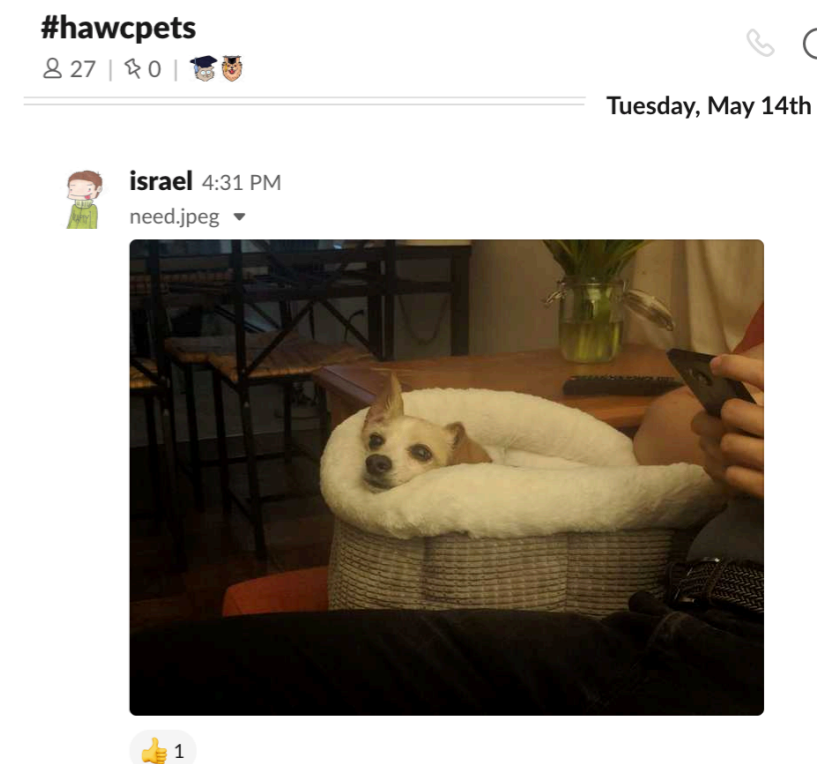


<https://gitlab.com/sgso-alliance>

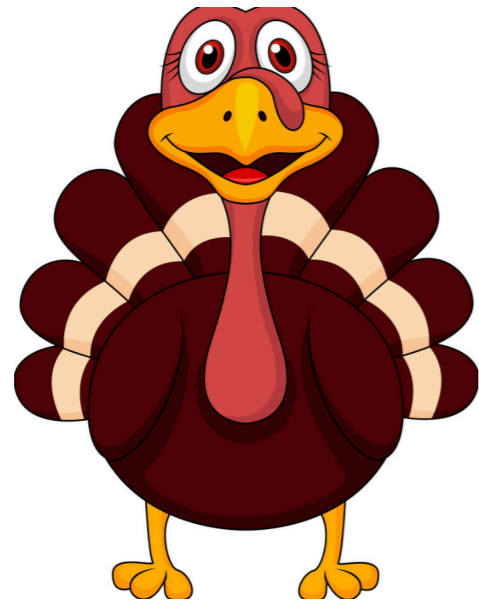
- ▶ Repository (a lot like github)
- ▶ Issue tracking
- ▶ Code review
- ▶ Controlled access (not public yet)



- ▶ Multi-channel chat program
- ▶ Post results / ask questions
- ▶ Discuss



Joining efforts



- ▶ Use HAWC software package as joint starting point
- ▶ Merge independent efforts
- ▶ Develop together and compare different designs



Joint software & simulation development...

- ▶ Meeting in Heidelberg
 - <https://indico.in2p3.fr/event/18564/>
 - Start of joined development based on the HAWC software framework
 - Installation difficult
 - Defined milestones

Milestones

1. put the SW to run in **LIP/MPIK** clusters (currently in progress)
2. Perform a critical review of HAWC SW
 1. To assess if the simulation output structure is adequate
 2. Check the simulation of noise and electronics and trigger
 3. Check interface with G4
3. Adapt HAWCsim
 - Create an abstract layer to select different units (G4 simulations)
 - Implement different units in the SW and develop steering cards for these different units
4. Validate implementation at station level using stand-alone simulations
5. Perform a critical review of HAWCrec
 - Adapt to each unit
 - Build a simple reconstruction chain (including trigger)
 - Adapt/create an event display to check for problems
6. Compute the instrument response functions
7. Create/adapt/use module to compute the sensitivity

Shared (private) repository on gitlab

The screenshot shows the GitLab interface for a group named 'SGSO software'. The browser address bar shows 'gitlab.com/sgso-alliance'. The page title is 'SGSO software - GitLab'. The navigation bar includes 'GitLab Next', 'Projects', 'Groups', 'Activity', 'Milestones', 'Snippets', a search bar, and a 'New project' button. The left sidebar contains navigation links: Overview, Details, Activity, Contribution Analytics, Issues (2), Merge Requests (1), Kubernetes, Members, and Settings. The main content area shows the group name 'SGSO software' with a lock icon and 'Group ID: 4709130 | Leave group'. Below this is the description 'Software for the Southern Gamma-ray Survey Observatory.' and tabs for 'Subgroups and projects', 'Shared projects', and 'Archived projects'. A search bar and a 'Last created' dropdown are present. The list of subgroups and projects includes:

Subgroup/Project Name	Description	Stars	Lock	Created
documentation	A place to put documentation related to software and repository	0	Yes	2 months ago
sandboxes	Sandboxes to play around in...	0	Yes	2 months ago
examples		0	Yes	2 months ago
hawcsim-gui-example	Basic example on how to use the HAWCSim graphical interface	0	Yes	2 months ago
aerie-install	Installing externals and aerie.	0	Yes	2 months ago
aerie	SGSO's Aerie fork.	0	Yes	3 weeks ago
HAWC limited code release		0	Yes	2 months ago
aerie documentation		0	Yes	2 months ago



Shared (private) repository on gitlab



Subgroups and projects



Shared projects



Archived projects

>   **documentation** Owner
A place to put documentation related to software and repository

>   **sandboxes** Owner
Sandboxes to play around in...

  **examples**

  **hawcsim-gui-example**
Basic example on how to use the HAWCSim graphical interface

  **aerie-install**
Installing externals and aerie.

  **aerie**
SGSO's Aerie fork.

  **HAWC limited code release**

  **aerie documentation**

Slack chat: #simulation channel

SouthernGamma ▾

harm

All Threads

Channels

- anr_dpg_proposal
- # dark_matter
- # extragalactic
- # fermi_bubbles_etc
- # galatic_accelerators
- # gemingas
- # general
- # pevatronsection
- # random
- science_case_wg
- # simulations**
- # transients

Direct Messages

- Slackbot
- harm (you)
- Aion Viana
- Aion Viana, harding, Ji...
- fabian.schussler
- fabian.schussler, syben...
- henrikef
- marcos
- ropez
- sybenzvi
- watsonjj

#simulations

☆ | 👤 27 | 📌 0 | ➕ Add a topic

Tuesday, April 16th



harm 9:39 AM

okay it is merged back into the master. You need to compile GEANT4 with the

```
[package geant4]
cmakeOptions = -DGEANT4_USE_OPENGL_X11=ON -DGEANT4_USE_RAYTRACER_X11=ON
```

in the install script (<https://gitlab.com/sgso-alliance/aerie-install/blob/master/install.sh>)
any objections if I make that default?

The modification to CMakeFile.txt. in <https://gitlab.com/sgso-alliance/aerie/blob/master/src/hawcsim/CMakeLists.txt> were a bit sloppy (i.e. I made it work pragmatically.. but there should be a nicer more robust way of doing this) . It would be great if [@lukasnellen](#) and [@sybenzvi](#) could have a look on how to improve...

 GitLab
[Sign in](#)
[GitLab.com](#)



sybenzvi 3:43 PM

[@harm](#), have you tested on OS X and Linux? I'm inclined to say go right ahead in any case, but I'm curious.



harm 3:45 PM

yes. I was able to run both on OS X and Linux. Maybe [@colas](#) can comment on what his findings were..



colas 3:53 PM

I merged the CMakeLists change because it works. But it is a hack, we're reducing the functionalities. CMake was supposed to conditionally build the GUI, and the right targets depending on what is available. Now, we always build the GUI and all the possible targets, regardless of what is available. Sounds bad, but it did work on my mac (compilation + run the GUI) and it kind of worked on the UMD cluster (i.e. compilation was fine, but I had a runtime error while running the GUI, but that's as good as I could get for any other solution anyway). And apparently compilation and GUI work for Harm on the MPIK cluster. It is not good, but it's better than what we had before, so I accepted the MR. But it is not a proper solution. (edited)



lukasnellen 3:54 PM

I'll have a look at the cmake. Could you make it an issue on gitlab and assign to me?

 1 reply 21 days ago



Message #simulations



Recent code development

SGSO software > aerie > Repository

You pushed to **bigger-detector** 7 minutes ago

Create merge request

master

aerie / src / hawcsim / include / hawcsim /

+ v

History

Find file

Web IDE

⌵



small changes to facilitate the merge request
Harm Schoorlemmer authored 1 day ago



fb603f7b



Name	Last commit	Last update
..		

new abstract class

Significantly reduced

-
-
-

Tank.hh	Merge branch 'addDLWCD' into HEAD	1 day ago
TankArray.hh	PMTs can only be declared once (don't exactly und...	2 days ago
TankDLWCD.hh	small changes to facilitate the merge request	1 day ago
TankHAWC300.hh	PMTs can only be declared once (don't exactly und...	2 days ago
TankHAWCOR.hh	PMTs can only be declared once (don't exactly und...	2 days ago

implementation of different designs

Recent code development

SGSO software > aerie > Repository

You pushed to **bigger-detector** 7 minutes ago

Create merge request

master

aerie / src / hawcsim / include / hawcsim / +

History

Find file

Web IDE



smal
Harr

ADD YOUR DESIGN HERE!!!

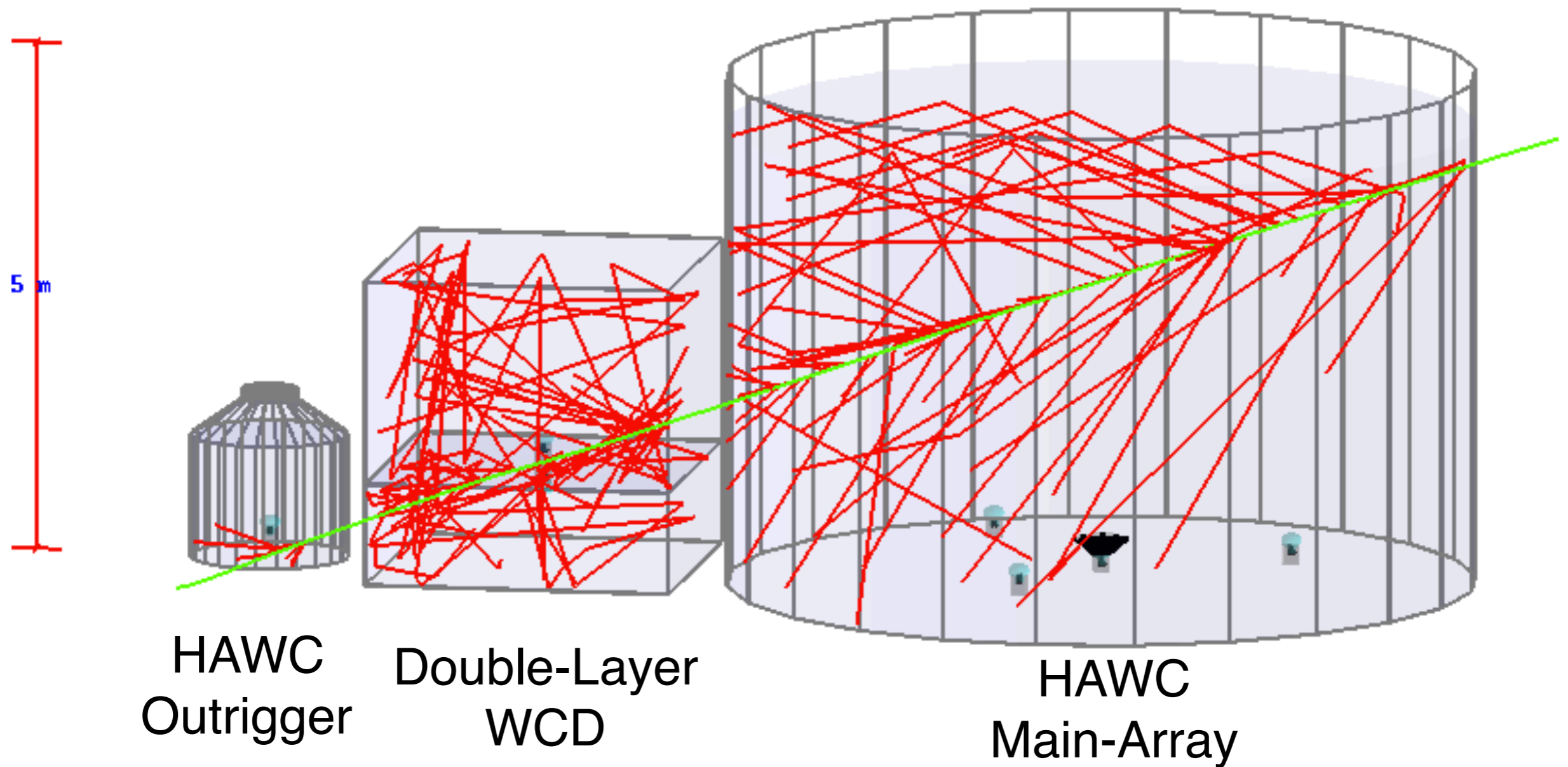
Name	Last commit	Last update
..		
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new abstract class

Significantly reduced

implementation of different designs

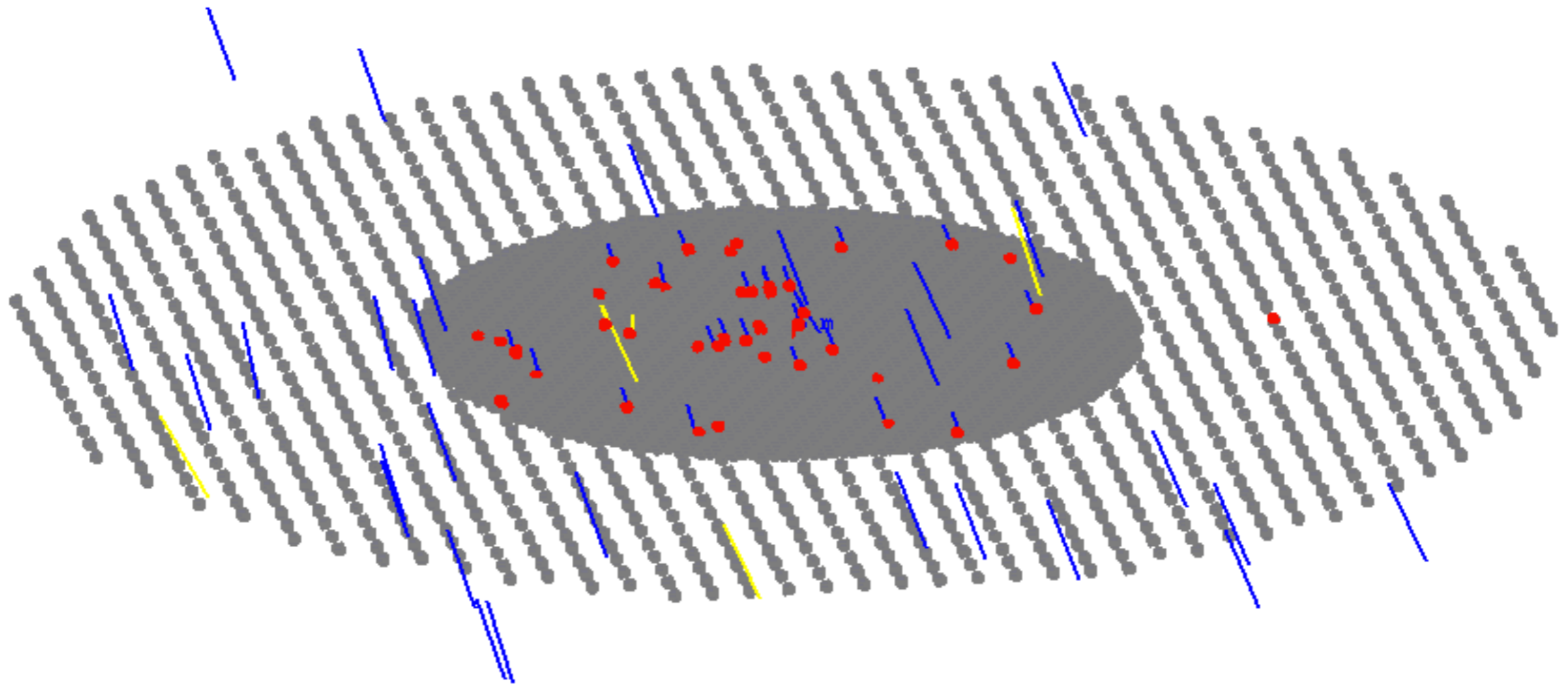
Recent code development: three amigos



<https://gitlab.com/sgso-alliance/hawcsim-gui-example>

Recent code development: Straw man design array

500 GeV gamma rays
Altitude 5 km

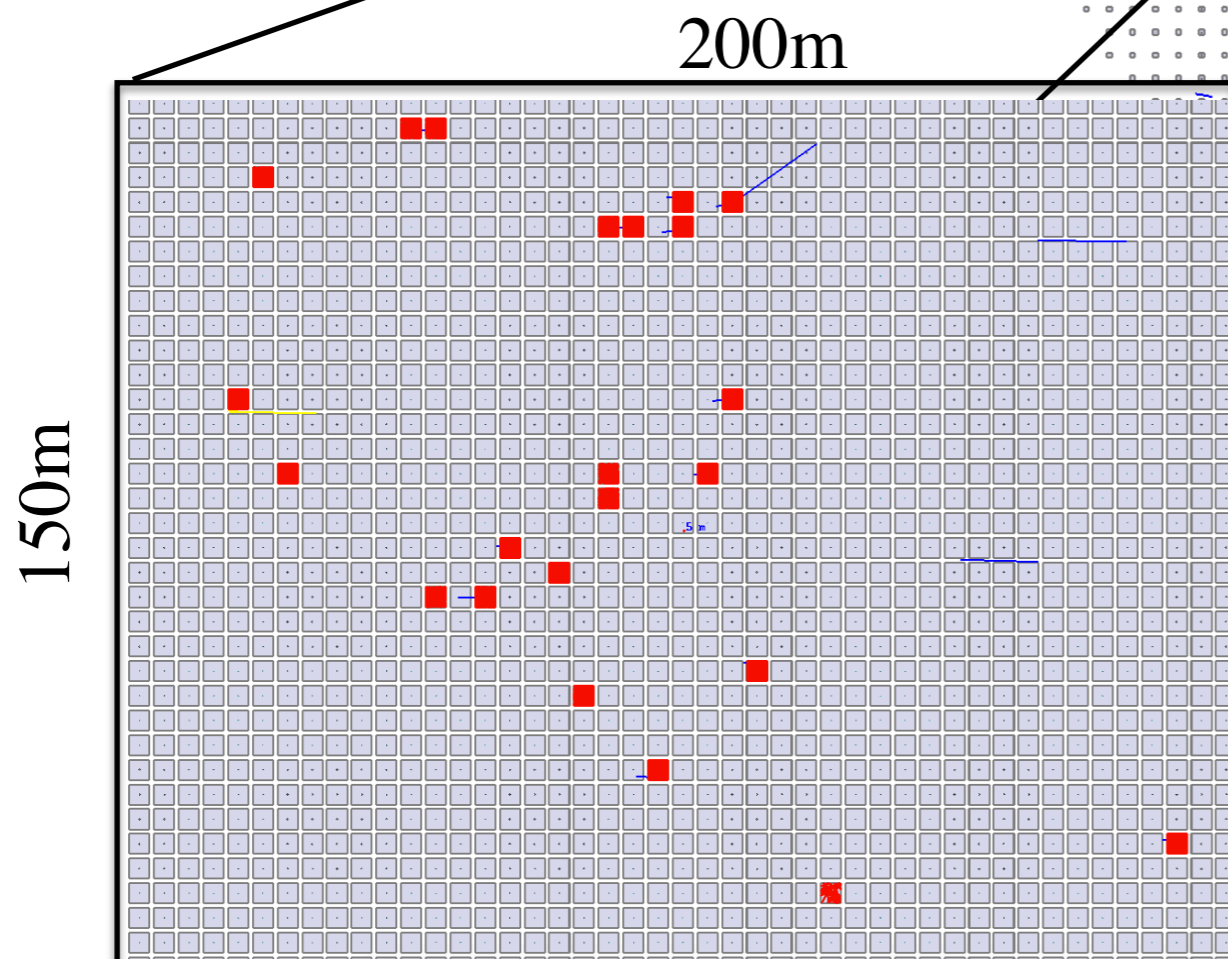


<https://gitlab.com/sgso-alliance/examples>

Recent code development: Straw man design array

500 GeV
showers are
not compact! *

Need for
a big array!



* *Accepted EPCJ*,
HS, J. Hinton, R. López-Coto
<https://arxiv.org/abs/1905.06816>

Where are we at ...

- ▶ Building upon HAWC framework
- ▶ Corsika -> GEANT 4 -> Output
- ▶ Repository / organization
- ▶ Installation procedure

Where do we go next...

- ▶ Add more designs
- ▶ Share CORSIKA production
- ▶ Trigger and noise modeling
- ▶ Reconstruction Chain
- ▶ Sensitivity estimates
- ▶ Make repository public, after HAWC will make theirs public



Michigan
Technological
University



3ML

The Multi-Mission Maximum Likelihood framework

for high-level data analysis

Henrike Fleischhack
May 21st 2019

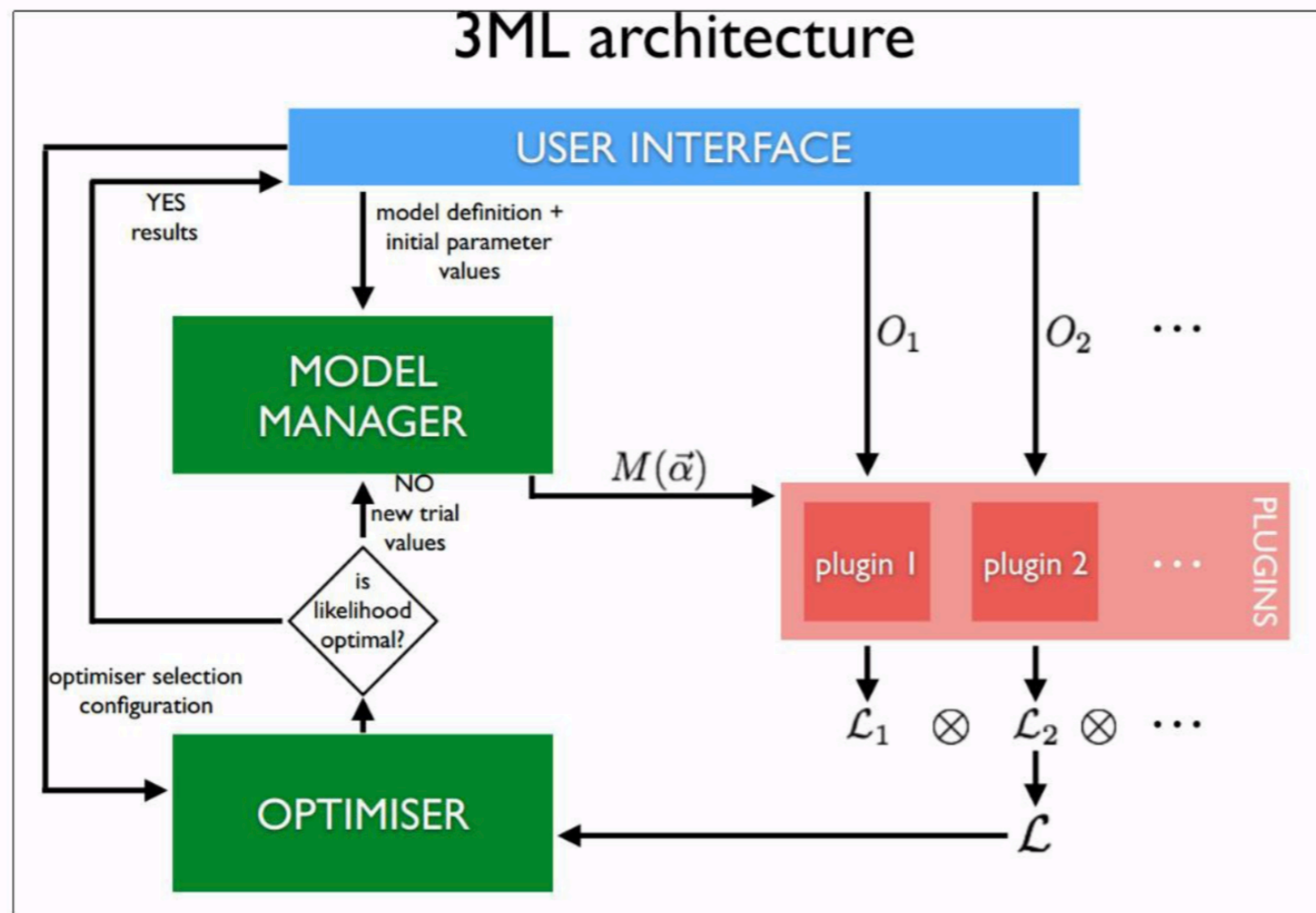


threeML/astromodels

- threeML provides a framework for multi-instrument likelihood analysis.
- Independent of format for data/instrument response files (data access encapsulated in 'plugins').
- Lots of functionality e.g. plotting, source injection, ...
- astromodels enables detailed spectral/spatial modeling of astrophysical sources.
- See <https://github.com/threeML/> and <https://arxiv.org/abs/1507.08343>
- Actively being used/developed for HAWC analyses, X-ray, ...
- Plugins available also for Fermi-LAT, VERITAS, general spectra, ...
- Still growing with new plugins, bayesian samplers etc. being added.

3ML is different

this slide by G. Vianello



- short pieces of software connecting the framework with the instrument-specific software
 - receive in input the model, give in output the likelihood value
- no constraints on:
 - messenger, data formats, response specification, likelihood implementation, background estimation and handling, language (C++, fortran...)
- existing and new solutions (ST, sherpa, xspec, gammapy, isis) can be used as plugins

Existing plugins

this slide by G. Vianello

- HAWC: both point-like sources and extended sources

- Fermi/LAT:

- Fermipy: point-like sources, extended source in the working

- Unbinned analysis: for GRB-type analysis of point sources

- VERITAS: prototype for point sources ready

- Swift, Chandra, XMM, Fermi/GBM, Konus... (all spectra you can read in XSpec): ready (only point sources)

- Optical with ~2000 filters (thanks to the Spanish Virtual Observatory's Filter Profile service)

- SED / "xy" data

- Still need a volunteer for Radio data

NEW

NEW

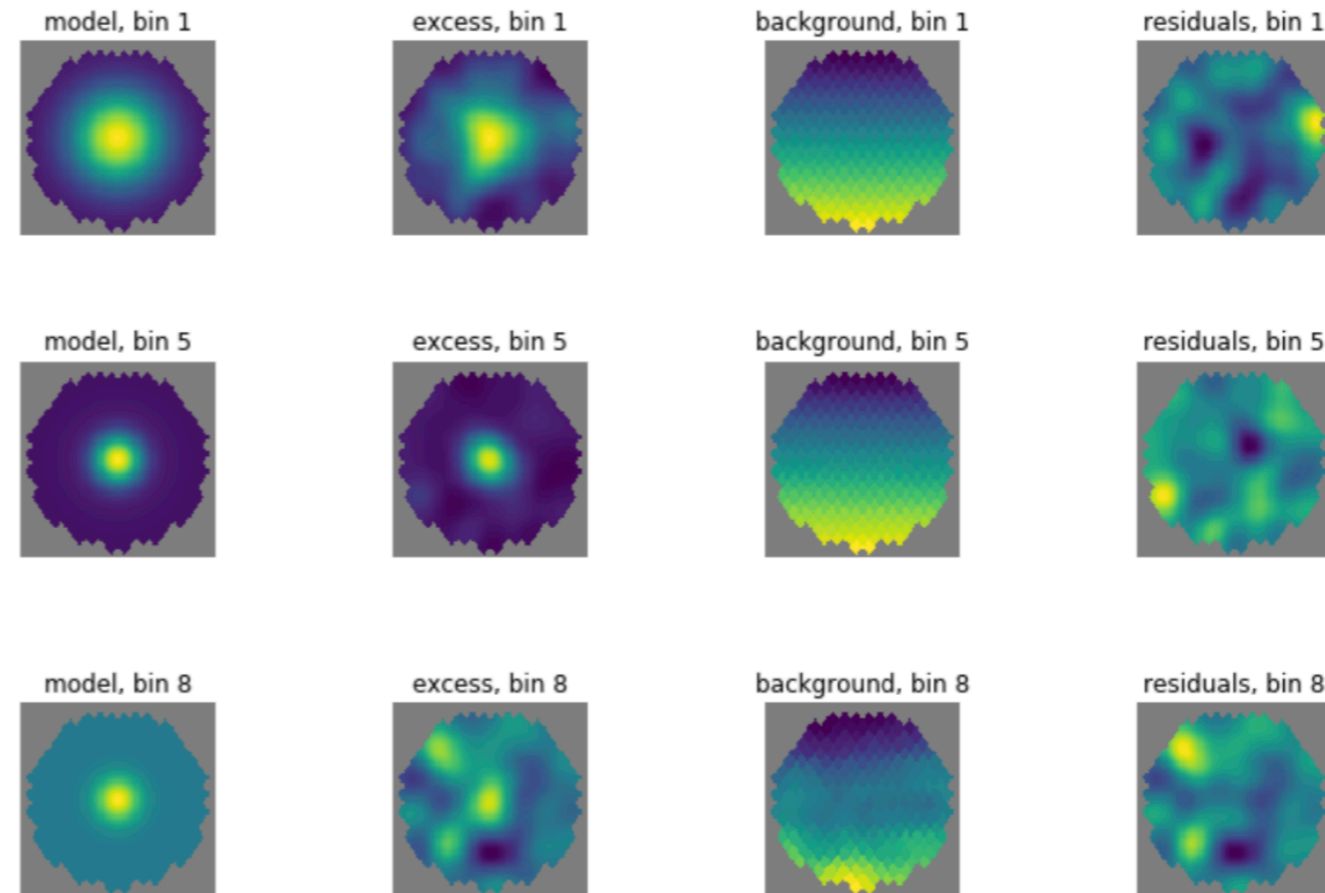
NEW

NEW



HAWC source fitting: forward folding

- We have events and background maps for several analysis bins (nHit or energy).
- We have a detector response which gives the PSF and the expected gamma-ray counts expectation for a point source at a given position and fixed spectrum
- HAL:
 - computes the expectation for a model (set of sources with given morphologies and spectra):
 - re-weights to arbitrary spectra
 - convolves source morphologies with PSF
 - computes the likelihood of the data given the model+background, using Poisson statistics.
- 3ML:
 - provides the model to HAL, runs the likelihood maximization



this slide by C. Riviere



Proposal for SGSO

- Propose to use threeML for high-level analysis (spectra, morphology, sensitivity).
- Can use the HAL (HAWC Accelerated Likelihood) plugin for now (https://github.com/threeML/hawc_hal) and work on a dedicated plugin later.
- Would like to implement some mock instrument response files using our design sensitivity while we wait for a full simulation/analysis chain.
- No sensitivity calculation yet in threeML but can be implemented easily on top of existing infrastructure for source injection etc.

Collaborators welcome! Would like to hear of any other approaches to high-level analysis!

Join us!!!!





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3ML

The Multi-Mission Maximum Likelihood framework

for high-level data analysis

Henrike Fleischhack
May 21st 2019



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3ML

The Multi-Mission Maximum Likelihood framework

for high-level data analysis

Henrike Fleischhack
May 21st 2019

Sensitivity estimates... Higher level public tools

- Would like to make quantitative statements about SGSO's sensitivity to different kinds of sources/physics questions.
- Need to know how detector performance affects sensitivity.
- For that, need high-level analysis tools.
- I propose to use `threeML/astromodels` with the `HAL` plugin.
- Should be developed in parallel to detector design, reconstruction algorithm etc.
- Any other plans for high-level analysis yet?

General remarks

- ▶ Update your code (installation)
- ▶ Use slack-channel to ask for help
- ▶ We need more people to make better use of merge procedure
- ▶ Many things to work on, see milestone list.

Running the gui example

SGSO software > hawcsim-gui-example > Details



hawcsim-gui-example

Project ID: 11144472

Star 0 Fork 0 Clone

Add license 20 Commits 2 Branches 0 Tags 492 KB Files

Basic example on how to use the HAWCSim graphical interface

Forked from [hawc-observatory / sandboxes / israel / myscratch / hawcsim-gui-example](#)



Auto DevOps

It will automatically build, test, and deploy your application based on a predefined CI/CD configuration.

Learn more in the [Auto DevOps documentation](#)

Enable in settings

master hawcsim-gui-example / History Find file Web IDE






Merge branch 'three-amigos' into 'master'
Harm Schoorlemmer authored 14 minutes ago



4c7e5f1b


README Add CHANGELOG Add CONTRIBUTING Add Kubernetes cluster Set up CI/CD

Name	Last commit	Last update
hawcsim_config	Show all three tank types and fire a muon through it.	3 hours ago
README.md	Adapt to new install instructions.	2 months ago
muon.in	Show all three tank types and fire a muon through it.	3 hours ago
run_gui.sh	simple command to run gui	1 day ago




Code development: merging

 **Request to merge** `sgso-alliance/sandboxes/harmscho:three-amigos`  into `master` 






 **Merged by**  **Harm Schoorlemmer** 10 minutes ago Revert Cherry-pick

The changes were merged into `master` with `4c7e5f1b` 

The source branch has been deleted






 0  0 

Discussion 3 Commits 6 Changes 6 Show all activity ▾


 **Harm Schoorlemmer** @harmscho · 3 hours ago Owner    


[@israelmcmc](#) can you try this? I think might need to update to the latest version of sgso-aerie (+install procedure). Do you want to have merge rights for this project?






Let me know if this is too much work,

 **Israel Martinez** @israelmcmc · 1 hour ago Developer    

[@harmscho](#) This looks good to me but I don't have much time until July, sorry (thesis). I think I would indeed need to install the latest external and the sgso-aerie because of the DLWCD addition.

 **Harm Schoorlemmer** @harmscho merged 10 minutes ago

 **Harm Schoorlemmer** @harmscho mentioned in commit `4c7e5f1b` 10 minutes ago

 **Harm Schoorlemmer** @harmscho · 10 minutes ago Owner    

Alright, I tested at Mac and Cluster at MPI-K.. since it will not break anything crucial. I will merge it.

Recent code development

```
class Tank
{
public:
    Tank();

    virtual ~Tank() {};
    //Abstract function that needs to be implemented
    // by derived classes
    virtual G4PVPlacement *AddTankToLogicWorld(G4LogicalVolume* LogicWorld, d

    TankType GetTankType() {
        return type_;
    }
    TankType type_;
};

bool TankArray::LoadTanks(G4LogicalVolume* logicWorld)
{
    DetectorService& detSrvc = GetService<DetectorService>("det");

    DataBase &db (DataBase::GetDB() );

    double sGPSfrac;
    double sGPSdbl = modf(db.GetVal("GPSSeconds"),&sGPSfrac);
    double nsGPSdbl = floor(sGPSfrac*pow(10.,9.));
   TimeStamp ctime( static_cast<int>(sGPSdbl),
                    static_cast<int>(nsGPSdbl) );
    det::Detector det = detSrvc.GetDetector(ctime);

    //all different kind of tanks
    Tank
    *DLWCD = new TankDLWCD(),
    *NormalTank = new TankHAWC300(),
    *Outrigger = new TankHAWCOR(),
    // *DLWCD = new TankDLWCD(),
    *Tank = NULL;

    det::Detector::TankIterator tnkItr = det.TanksBegin();
    Vector arrayCenter = det.GetArrayCenter();

    for (;tnkItr != det.TanksEnd();++tnkItr) {
        //select tank type
        int tankType = tnkItr -> GetTankType();
        if (tankType == DLTank) {
            Tank = DLWCD;
        }
        else if (tankType == OutriggerTank) {
            Tank = Outrigger;
        }
        else {
            Tank = NormalTank;
        }
        //add tank to logical world
        Tank->AddTankToLogicWorld(logicWorld,*tnkItr,arrayCenter,PMTVolumes,logicPMTs);
    }

    return true;
}
```

