

# Data & Analysis Preservation in PHENIX: status of the website and future plans

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***PHENIX EC Meeting***

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# This presentation

- An introduction to the original version of the PHENIX redesigned website was presented to the EC in March 2020:
  - [https://docs.google.com/presentation/d/1Vnq0wl9PyZKYmfRw\\_k9ZOHko6lwZDDQymUixDA-Srvq/edit?usp=sharing](https://docs.google.com/presentation/d/1Vnq0wl9PyZKYmfRw_k9ZOHko6lwZDDQymUixDA-Srvq/edit?usp=sharing)
  - Please see the link above for a more generic discussion of motivations, technology choices etc
- Today we shall review the current status of the website and how it leverages the available cloud resources
- ...and discuss ways to ensure usefulness of the website as a component of Analysis Preservation and its potential to advance more immediate goals of PHENIX
- Some auxiliary info can be found in the “backup slides”

# Some background

- The legacy PHENIX website had been showing its age for a while
  - Some useful information was spread over multiple web servers
  - Used as a document repository with limited functionality and lack of external visibility
  - Certain software modules in its framework were potentially vulnerable security-wise
- Technical problems encountered in 2020 illustrate operational risks due to difficulty of upgrades e.g. maintaining the legacy software stack in the evolving OS environment while staying abreast of security requirements
- Less DB support available as time goes on (actually none at this point)

# Strategy 2020

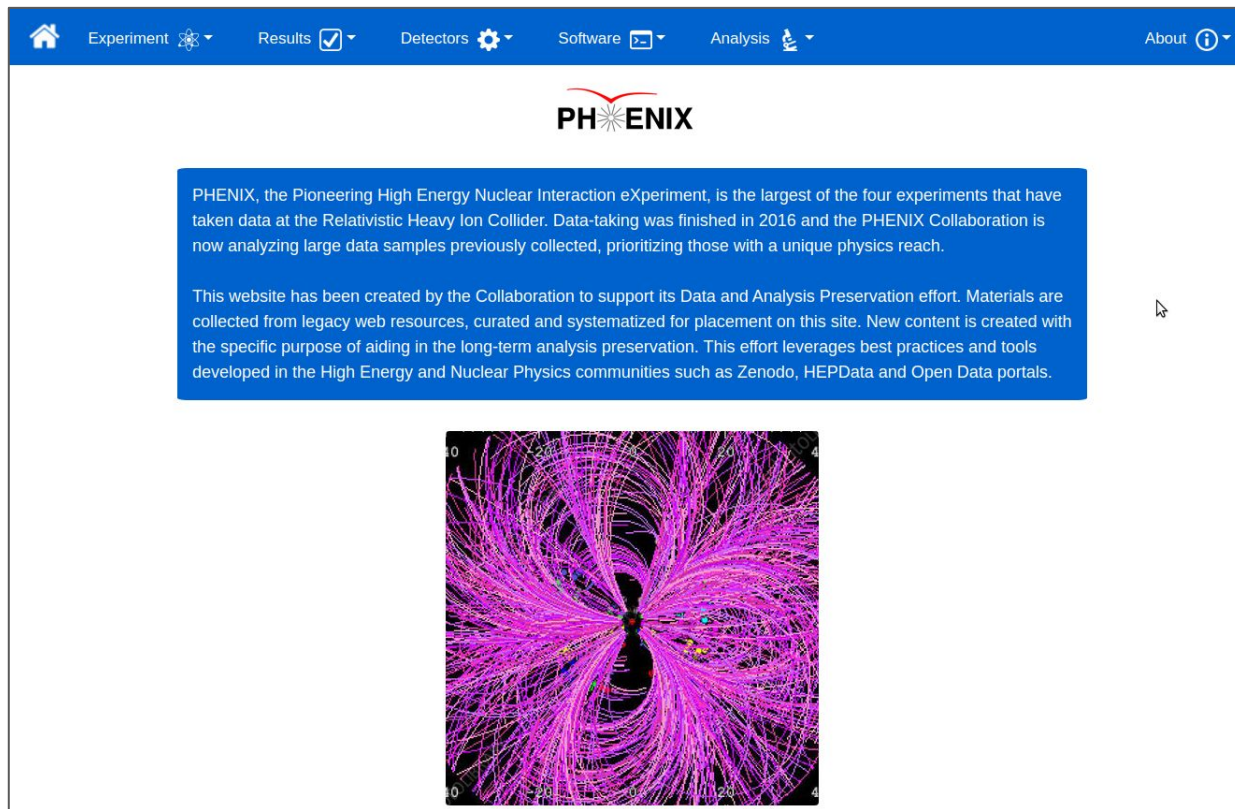
- DAP = Data and Analysis Preservation
- Design a new website aligned with the goals of DAP, with emphasis on ease of maintenance and long-term durability
- Collect and curate materials from available resources, create new ones where possible and necessary
- Factor out the repository and other similar functionality by leveraging modern solutions developed and employed in the NP and HEP communities
  - The website effectively becomes a portal to cloud resources, with a modest amount of material still hosted locally

# The website technology

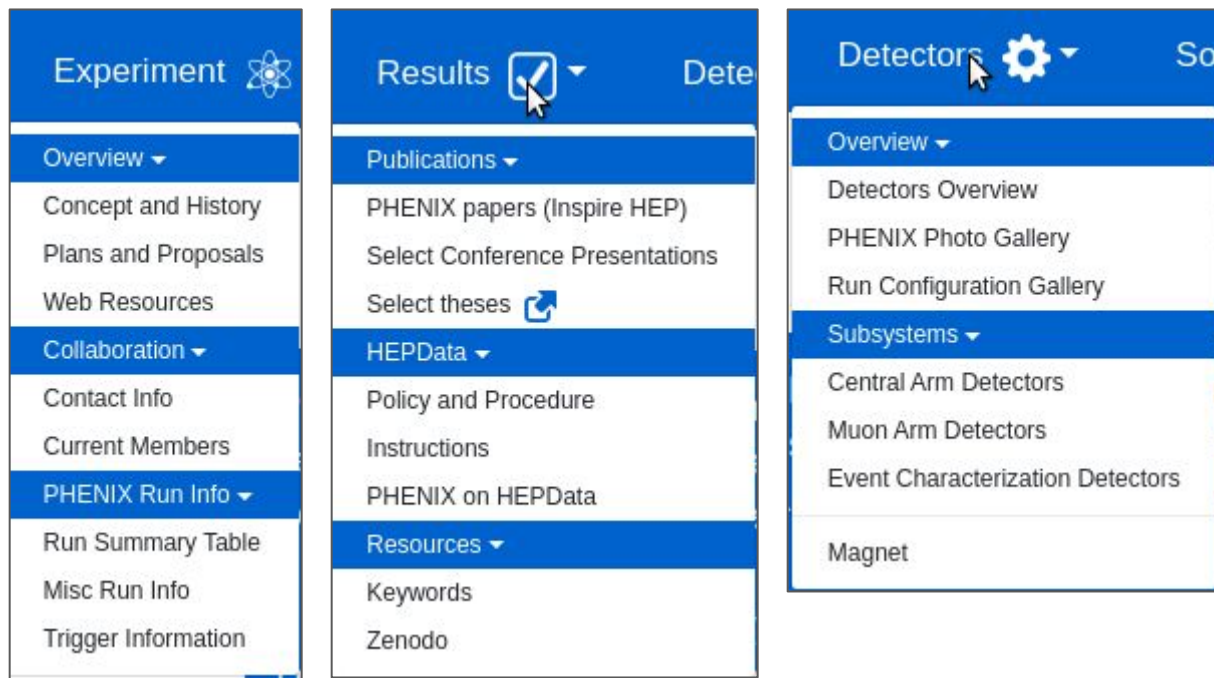
- Use a static website generator for speed and security
- Content and layout are separate; easy to use markup (not HTML)
- Data kept in specially formatted files (YAML) to provide DB-like functionality without having an actual database, also flexibility and consistency across multiple pages - define data once, use in many places
- Free hosting of the development version on GitHub pages
- As of Fall 2020 the production version is officially hosted at BNL at the canonical URL: <https://www.phenix.bnl.gov/>
- In the following few slides we will review the site

# Website: the landing page

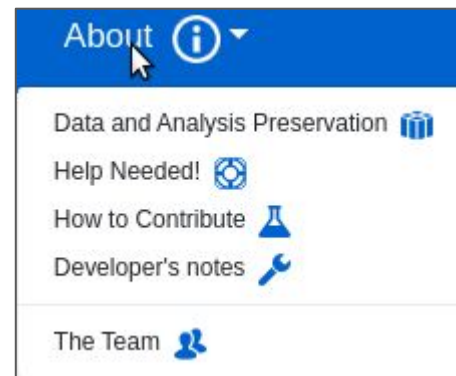
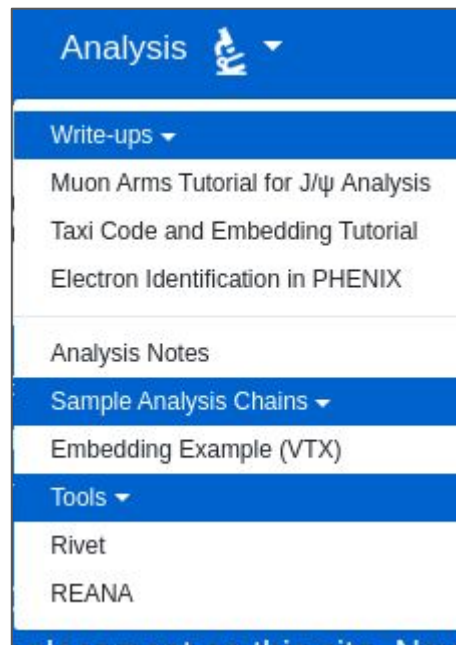
Menus



# Website: dropdown menus (1)



# Website: dropdown menus (2)

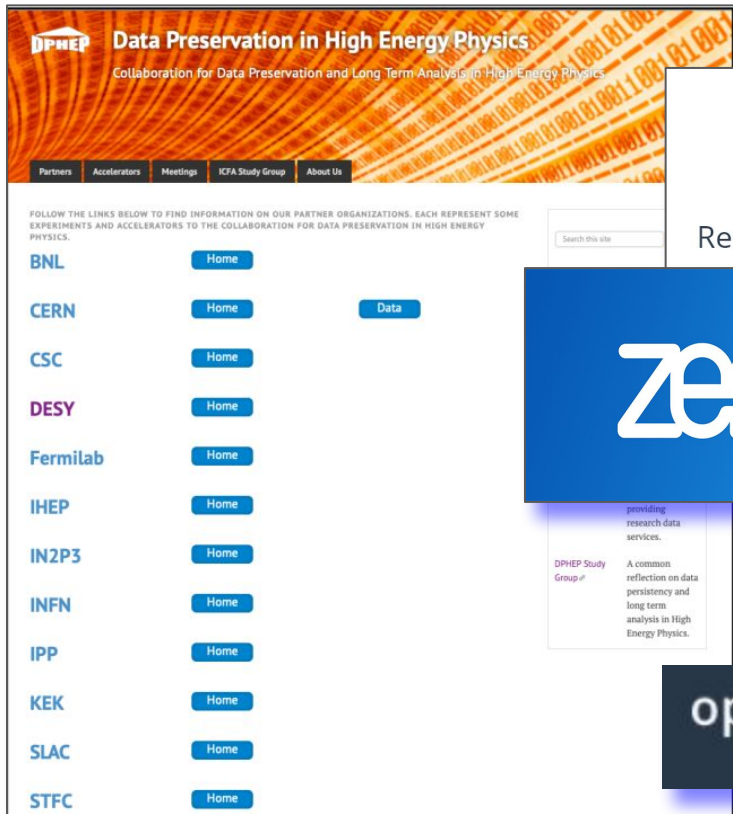




# Leveraging the community cloud resources

- Use well established solutions widely adopted in the community
  - NB. solid back-end and support
  - Look at best practices at CERN and other labs
  - Reduces cost and increases long-term viability of the PHENIX Web infrastructure
- Resources already adopted by PHENIX
  - Zenodo (a digital repository)
  - HEPData - a repository for numerical data used in publications
  - InspireHEP - a searchable publication catalog
- i.e. this type of functionality effectively migrated to the cloud from the legacy site
- Heavy investment in Zenodo and HEPData
- Upcoming: OpenData and REANA

# CERN and community tools for DAP



reana

Reproducible research data analysis platform



HEPData

zenodo

iNSPIRE<sup>HEP</sup>

opendata  
CERN

# Zenodo

- Zenodo - close to 200 PHENIX items made available on the portal
- Let me point out once again that DOIs are an important feature for long-term preservation
- Uploaded/tagged  $\frac{2}{3}$  of PHENIX theses (currently at 124), work in progress with completion date in 2021 - thanks to Stacyann Nelson
- Steady upload of conference/workshop and other presentation, with a dedicated page on the new site
- Keywords - essential for discoverability and integrity of references
  - A list is carefully curated and used with all uploads

# Zenodo keywords page

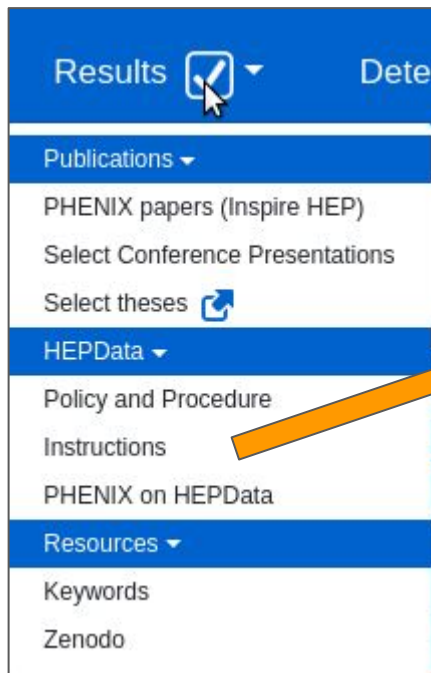
Working query links

Experiment		Results	Detectors	Software	Analysis
General (8 items)					
Keyword	Description				
<a href="#">alice</a>	ALICE - an experiment at CERN				
<a href="#">bup</a>	Beam Use Proposal				
<a href="#">decadal plan</a>	Two long-term proposals for the PHENIX research program				
<a href="#">phenix</a>	Pioneering High Energy Nuclear Interaction Experiment (PHENIX)				
<a href="#">phobos</a>	PHOBOS - an experiment at RHIC				
<a href="#">rhic</a>	Relativistic Heavy Ion Collider (RHIC)				
<a href="#">star</a>	STAR - an experiment at RHIC				
<a href="#">wa98</a>	WA98 - an experiment at CERN				
Conferences (13 items)					
Keyword	Description				
<a href="#">aum19</a>	2019 RHIC & AGS Annual Users Meeting				
<a href="#">dnp19</a>	DNP (2019)				
<a href="#">dnp20</a>	DNP (2020)				
<a href="#">hp18</a>	Hard Probes 2018				
<a href="#">hp20</a>	Hard Probes 2020				
<a href="#">ismd19</a>	International Symposium on Multiparticle Dynamics (2019)				
<a href="#">lahos2020</a>	17th International Workshop on Hadron Structure and Spectroscopy				
<a href="#">qm2019</a>	Quark Matter (2019)				
<a href="#">sjfm20</a>	Santa Fe Jets and Heavy Flavor Workshop (2020)				
<a href="#">wpct2018</a>	XIII Workshop on Particle Correlations and Femtoscopy				
<a href="#">wvmd2020</a>	The 36th Winter Workshop on Nuclear Dynamics (2020)				
<a href="#">zs19</a>	Zimanyi School (2019)				
<a href="#">zs20</a>	Zimanyi School (2020)				
Physics (88 items)					
Keyword	Description				
<a href="#">3he+au</a>	Helium3-on-gold collisions				
<a href="#">anisotropy</a>	Anisotropy				
<a href="#">asymmetry</a>	Asymmetry				
<a href="#">au+au</a>	Gold-on-gold collisions				
<a href="#">azimuthal</a>	Azimuthal				
<a href="#">b-meson</a>	B meson				
<a href="#">backward-rapidity</a>	The backward kinematic region				
<a href="#">binary scaling</a>	Binary scaling				
<a href="#">bose-einstein</a>	Bose-Einstein statistics				
<a href="#">bottom</a>	Particles containing the b-quark				
<a href="#">centrality</a>	Centrality characteristic of the collision				
<a href="#">cgc</a>	Color Glass Condensate (type of matter)				
<a href="#">charm</a>	Particles containing the c-quark				
<a href="#">charmonium</a>	Meson containing a c-quark and its antiparticle				
<a href="#">cnn effects</a>	Cold Nuclear Matter effects				
<a href="#">correlations</a>	Various types of correlations				
<a href="#">crown effect</a>	Crown effect				
<a href="#">cross section</a>	Cross section (as it applies to scattering)				
<a href="#">cu+au</a>	Copper-on-gold collisions				
<a href="#">d+au</a>	deuteron-on-gold collisions				
<a href="#">d-meson</a>	D meson				
<a href="#">dca</a>	Distance of Closest Approach				

# HEPData

- 46 items uploaded i.e. data from 46 published papers (such as used in plots) is now available for reliable download in a standard format, and is indexed and discoverable.
- We are still catching up with other major experiments who started investing in this earlier.
- Once again, DOIs.
- The official publication policy in PHENIX mandates the HEPData process for each potential publication. Steady state work now.
- HEPData/Rivet workshops in Fall 2020 (thanks to Christine for organizing this).
- Documentation: based on our experience the policies and procedures have been discussed and updated.
- Extensive re-write of the corresponding documentation on the website (next page)

# HEPData Instructions and Policies



**Instructions**

**Summary**

An outline of the HEPData publishing process can be found on the ["Policy and Procedure"](#) page. It involves uploading a tar or gzip archive of data files in the HEPData-compliant format (YAML) and having the uploaded material checked by a designated IRC member directly on the HEPData site. Communication between the uploader and the reviewer is arranged by the HEPData coordinator. Once the uploaded material is reviewed and certified by the IRC it will be made public ("finalized") by the HEPData coordinator.

**The Format**

The data package prepared for submission to HEPData must conform to the specific format required by the HEPData portal - please see the [HEPData documentation](#) for details of the requirements. There is a useful [collection of tips](#) on the HEPData site, please peruse it. In addition, the DAP team created a few [simple examples](#) kept in the PHENIX repository on GitHub to illustrate basic features and options of the HEPData format. Beginners are encouraged to experiment with these examples by using the "sandbox" feature of the HEPData Portal (see [Appendix B](#) below).

The basic structure of a submission package is as follows. Data contents of each item included in the package (e.g. a plot) are described in a corresponding item file formatted as YAML. For example, if there are 5 plots in the paper you are expected to provide 5 YAML data files. In addition, a special YAML file `submission.yml` describes the submission package as a whole e.g. provides the names of the data and optional image files, **list of keywords** etc. It also contains an abstract (typically imported as LaTeX from the publication material); unfortunately, not every LaTeX feature will work correctly on HEPData and the output will need to be checked (see the "sandbox" reference below). The text of the abstract is contained in an attribute of the YAML structure which is named "comment" (which may be confusing).

Since YAML allows comments - lines starting with a "#" sign - it is very easy to add any sort of extra information to `submission.yml` that may be helpful for communication with members of the Collaboration, reviewers and for the workflow of the submission process in general. For example, it is necessary to provide the **Inspire ID** of the paper for the HEPData submission. It should be placed in a comment line. Also, including the PHENIX-internal **PPG identifier** is highly recommended as it reduces the chances of human error and facilitates communication. Both Inspire ID and the PPG identifier can be easily incorporated in the comment lines of the `submission.yml` file mentioned above (i.e. in lines of text starting with "#"). There can be any number of comment lines. Including information about the designated reviewer (member of the IRC for the paper) as an additional comment line is encouraged but not mandatory. Consider the following mock-up comment lines (which would be found on the top of the submission yml):

```
# PPD000
# InspireHEP: 99999
# Reviewing IRC member: M.Phenix.sphenix@bnl.gov
```

This is not to be confused with the `comment` attribute of the YAML file which almost always contains the abstract of the published paper, typically typeset in LaTeX:

```
comment: The PHENIX Collaboration at the Relativistic Heavy Ion Collider has measured
open heavy-flavor production in minimum bias Au+Au collisions at  $\sqrt{s_{NN}}=2008$  GeV
```

It is probably the easiest to use existing examples of the submission yml files for guidance. They can be found in the [official PHENIX repository](#). If there are existing data files in an ad-hoc format (text etc) these can be converted to the HEPData format with some effort. The DAP team is looking at technical solutions to facilitate this process. For example, if plots are generated using ROOT macros the code can be instrumented to output same data in a format compatible with HEPData. There is a helpful write-up about preparing data for upload:

- [DOI: 10.5281/zenodo.3974601](#) How to make HEPData input (C. Natrass)

**Keywords:** [an Overview](#)

Like with many other data repositories, consistent use of keywords is essential for data discoverability. HEPData makes it possible to attach a set of keywords and keyphrases to the submission package, by adding a properly formatted section to the `submission.yml` file as illustrated below:

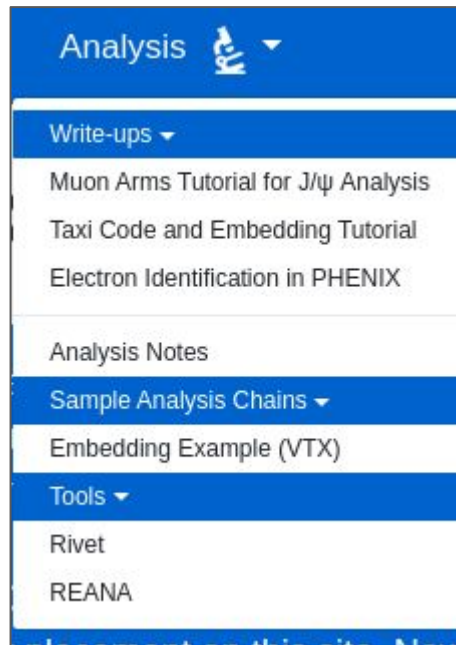
```
keywords: # used for searching, possibly multiple values for each keyword
- (name: reactions, values: [P P -> Z0 Z0 X])
- (name: observables, values: [SIG])
- (name: cenergies, values: [7000, 8])
- (name: phrases, values: [Inclusive, Integrated Cross Section, Cross Section, Proton-Proton Scattering, Z Production, Z pair Production])
```

The [HEPData keywords page](#) contains useful details. The [examples](#) created by the PHENIX team as tutorials illustrate how the keywords are placed in the `submission.yml` file. The examples use a slightly different YAML notation which is equally valid:

```
keywords:
- name: observables
  values: [MAGS]
- name: cenergies
  values: [2000, 8]
- name: reactions
  values: [p-p, 7000, 8, 2000, 8, 2000, 8]
```

# Analysis resources on the site

- Progress has been made with creating updated tutorials for specific work areas (see on the site)
- Currently implemented as write-ups published on Zenodo and linked on the site
- Caveat: these materials need another round of updates to account for mode code access (i.e. update or eliminate references to the code browser only available internally, review placement of code on AFS and whether it's suitable for publication etc)



# Example of a tutorial uploaded to Zenodo

The screenshot shows a Zenodo record for a working paper titled "Electron Identification in PHENIX" by Esha, Roli. The paper is dated September 15, 2020, and is available under a Creative Commons Attribution 4.0 International license. The record includes a preview of the PDF, which shows the title, author, and the beginning of the text. The text describes the procedure for identifying electrons within the PHENIX framework and includes a section titled "3 Building the analysis module". The preview also shows a list of files: autogen.sh, configure.in, Makefile.am, and Analysis files in class structure (\*.C and \*.h and \*.LinkDef.h). The record has 26 views and 18 downloads. It is indexed in OpenAIRE and has a DOI of 10.5281/zenodo.4029678. The record is part of the PHENIX Collaboration community.

zenodo Search Upload Communities phenix-dap-l@lists.bnl.gov

September 15, 2020 Working paper Open Access Edit

## Electron Identification in PHENIX

Esha, Roli

This document outlines the procedure for identifying electrons within the PHENIX framework.

Preview

Page 4 of 7 Automatic Zoom

$EMCdz < 20 \text{ cm}; EMCd\phi < 0.05$  or  $|EMCdz| < 5; |EMC\phi| < 5$

- DC side – RICH side – PC1 side to avoid side crossing tracks.

Other cuts can be introduced depending on the analysis and the desired purity of the electron candidates.

### 3 Building the analysis module

The analysis module is a folder containing all the files used to run the code on taxi. The main ingredients are the following:

- autogen.sh
- configure.in
- Makefile.am
- Analysis files in class structure (\*.C and \*.h and \*.LinkDef.h)

A ready-to-run explicit example can be found at  
offline/AnalysisTrain/ExampleElectronAnalysis

Files (268.5 kB)

Name	Size	Preview	Download
electron_identification_phenix.pdf	268.5 kB		

md5:d71fab7564c5aa78120e3ef197bb1e9e

Citations 0

Show only: ☐ Literature (0) ☐ Dataset (0) ☐ Software (0) ☐ Unknown (0) ☐ Citations to this version

No citations.

26 views 18 downloads See more details...

Indexed in OpenAIRE

Publication date: September 15, 2020  
DOI: 10.5281/zenodo.4029678  
Keyword(s): phenix, particle identification, electron  
Communities: PHENIX Collaboration  
License (for files): Creative Commons Attribution 4.0 International

Versions  
Version 1 10.5281/zenodo.4029678 Sep 15, 2020



# Analysis Content on the site

- Having well documented use cases (tutorials and/or complete preserved analyses) is obviously conducive to both efficiencies in medium term and longer term DAP
- Better engagement by the PHENIX community still remains on the critical path
  - Reverse engineering of prior analyses turns out to be close to impossible
  - Analyzers active in a given area are the best resource we have to create materials to meet education and analysis preservation goals
- We have good technology when it comes to DAP implementation (Zenodo, REANA etc) but the actual materials still need to be produced

# PHENIX School in 2021

- The website can be leveraged as the portal to the necessary writeups and materials
- How much material can be made reusable?
- Timing/schedule?

# REANA

- A framework already used by LHC experiments
- Captures
  - Details of the analysis workflow by utilizing a structured description (graph)
  - Software and environment by means of [containerization](#)
- A test instance recently became available at BNL thanks to SDCC, initial testing for PHENIX in progress
- At a minimum, requires Docker expertise
- Still need to evaluate cost/benefit
- Looks promising

# OpenData

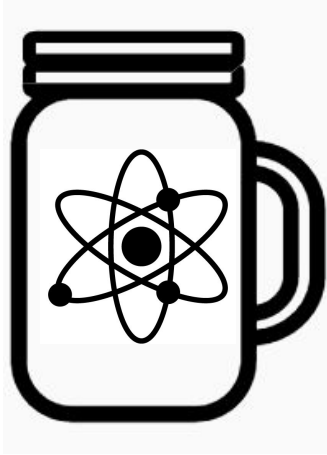
- A CERN portal for capture and publishing of data samples, software and documentation
- Initially reserved for LHC experiments
- PHENIX was given an approval and access in Fall 2020
- Storage allocated
- Currently no cost to PHENIX
- The first package/analysis is currently in the works (thanks Gabor)

# Status and Plans

- The new durable DAP website has been commissioned
- Content is being developed and added
- Ongoing creation and uploads of curated and tagged materials to Zenodo
- Systematized submissions to HEPData
- Planned adoption of OpenData and REANA technologies
- Main concern is lack of documented analysis use cases and vetted tutorials
- Preparation for the PHENIX School and DAP are closely related tasks
- Can the EC appoint/name people who would contribute to this effort?

# Backup slides

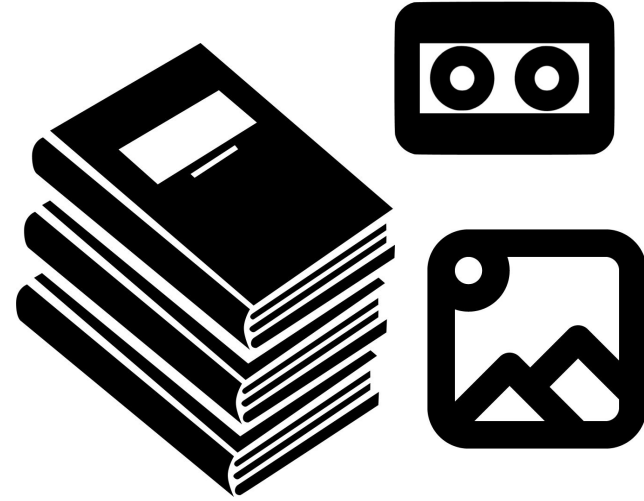
# A practical approach to the components of the Knowledge Management in PHENIX



Analysis capture



Web-based documentation



A highly-functional repository for research materials

# The website technology

- Inspired by the websites of the HEP Software Foundation and NPPS
  - <https://hepsoftwarefoundation.org/>
  - <https://npps.bnl.gov/>
- The website is static (no DB) - using the Jekyll static website generator
  - HTML is generated, not written by hand
  - Easy to contribute (Markdown, YAML) and easy to maintain
  - Data content kept separately from the layout
  - Manipulation of structured data in Jekyll makes for a compact and efficient design of pages, and automated content generation - DB-like functionality at compile time
  - GitHub Pages for management and development + version control + Jekyll builds
  - Portability (easy to export/migrate the complete site as HTML)
  - Performance
  - Security
- The “Bootstrap” toolkit for the layouts/navigation (no custom JS/CSS needed)



# Structured data used to generate the site

```
##### RUN 12
- run: run12
  title: Run 12
  period: 2011-2012
  coordinator: Xiaochun He, GSU.
  rhic:
    - {
      species: 'polarized p+p',
      energy: 100.2,
      lumi: '- /10 <i>pb</i><sup>-1</sup>',
      Nevents:
    }
    - {
      species: 'polarized p+p',
      energy: 254.9,
      lumi: '32/- <i>pb</i><sup>-1</sup>',
      Nevents:
    }
    - {
      species: '<sup>238</sup>U<sup>92</sup>+<sup>238</sup>U<sup>92</sup>',
      energy: 96.4,
      lumi: '0.2<i>nb</i><sup>-1</sup>',
      Nevents: 1.28/0.88
    }
    - {
      species: '<sup>63</sup>Cu<sup>29</sup>+<sup>197</sup>Au<sup>79</sup>',
      energy: 99.9+100.0,
      lumi: '5<i>nb</i><sup>-1</sup>',
      Nevents: 0.88/8.18
    }
    - {
      species: '<sup>197</sup>Au<sup>79</sup>+<sup>197</sup>Au<sup>79</sup>',
      energy: 2.5,
      lumi: '-',
      Nevents: Very short
    }
  ert_comment: Summary of thresholds (DAC values). Values in parentheses are for the PbG1.
  ert_thresholds:
    - '02/09/12, 358208, 30(29), 31(30), 29(29), 29(25), 920, Run12pp200 - Pedestal tuned - EMCal dynamic range ~25GeV'
    - '03/20/12, 364957, 30(29), 31(30), 29(29), 29(25), 920, Run12pp510 - EMCal dynamic range ~50GeV'
    - '04/23/12, 369200, 30(29), 31(30), 29(29), 29(25), 920, Run12UU193 - EMCal dynamic range ~25GeV'
    - '05/16/12, 372155, 31(30), 32(31), 30(29), 49(45), 920, Run12CuAu200 - EMCal dynamic range ~25GeV'
```

# Leveraging CERN-based tools

- Using **InspireHEP** to keep the publication list and cross-reference HEPData
- **Zenodo**
  - Based on the Invenio framework created at CERN
  - Active migration of relevant documents from legacy services to Zenodo is under way
  - Using a curated list of keywords for - easy to find physics topics, detector elements, conference materials etc
  - Easy to cite using the DOIs (persistent identifiers)
  - BNL is a collaborator in the InvenioRDM project - the next generation repository
- **HEPData**
  - Based on the Invenio framework
  - Recently renewed effort to create submission packages and commit new data to the service
  - **As of this week, new policy by PHENIX IB in place: HEPData package as a prerequisite for publication**
- The CERN Open Data Portal - material in the works, testing under way
- REANA - initial testing

# Zenodo@CERN - the PHENIX community

- Branded
- Curated
- Discoverable
- Indexed (keywords)
- Elastic search capability

The screenshot shows the Zenodo interface for the PHENIX Collaboration community. The header includes the Zenodo logo, a search bar, and navigation links for 'Upload' and 'Communities'. The user profile 'phenix-dap-l@lists.bnl.gov' is visible in the top right. The main content area is titled 'PHENIX Collaboration' and features a 'Recent uploads' section. This section lists three publications with their dates, authors, titles, and brief descriptions. Each entry includes a 'View' button. On the right side, there is a 'New upload' button and a community profile section for 'PHENIX Collaboration'. This section includes the community's logo, a description of its purpose, and details about its curation and creation. At the bottom right, there is a prompt to 'Want your upload to appear in this community?' with a link to click the button above to upload a record.

zenodo Search Upload Communities phenix-dap-l@lists.bnl.gov

## PHENIX Collaboration

### Recent uploads

Search PHENIX Collaboration

**September 21, 2020 (v1)** Thesis Open Access View

**$\pi^0$ -hadron correlations in 200GeV Au+Au collisions**  
Wong, Cheuk-Ping;  
The study of jet modifications helps to understand the properties of the QGP. In this research, jets are studied using  $\pi^0$ -hadron azimuth correlations which use high momentum neutral pions as triggers to indicate the presence of a jet.  
Uploaded on September 21, 2020

**September 20, 2020 (v1)** Presentation Open Access View

**PHENIX measurement of system size dependence of low momentum photon production**  
Esha, Roli;  
Direct photons provide information about the space-time evolution of matter produced in relativistic heavy-ion collisions. PHENIX results are presented.  
Uploaded on September 20, 2020

**September 20, 2020 (v1)** Presentation Open Access View

**Study of jet modifications at PHENIX using two-particle azimuthal correlations and high- $p_T$  hadrons**  
Wong, Cheuk-Ping;  
Summary of observables in heavy-ion collisions and the nuclear modification factors.  
Uploaded on September 20, 2020

**September 17, 2020 (v1)** Presentation Open Access View

**Signature of collective flow and beam-like and beam-anti-like small-scale charge**

**New upload**

Community

**PHENIX**

**PHENIX Collaboration**  
The purpose of this community is to promote the long-term Data and Analysis Preservation goals and mandate of the PHENIX Collaboration (RHIC).

**Curated by:**  
PhenixCollaboration

**Curation policy:**  
Not specified

**Created:**  
May 18, 2020

**Harvesting API:**  
[OAI-PMH interface](#)

Want your upload to appear in this community?  
• Click the button above to upload a record

# An example of a PHENIX item on Zenodo

December 1, 2013

Thesis Open Access

Low Momentum Direct Photons as a Probe of Heavy Ion Collisions

Petti, Richard

Thesis supervisor(s)

Drees, Axel

Essential to the study of heavy ion collisions are probes that are produced in the collision itself. Photons are a very useful probe of the collisions, since they escape the fireball virtually unmodified and carry with them information about the environment in which it was produced. Recent interest in low momentum direct photons has increased, due to the onset of the "thermal photon puzzle" and the apparent inability for typical models to explain both a large direct photon yield excess and large azimuthal production asymmetry ( $v_2$ ) at low momentum measured by PHENIX.

Preview

Page: 39 of 192

Automatic Zoom:

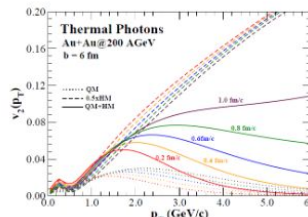


Figure 1.20: A calculation of the thermal photon  $v_2$  from [23]. The dotted curves represent the  $v_2$  of thermal photons emitted from the QGP, dashed curves represent the  $v_2$  of thermal photons emitted from the hadron gas, and solid curves represent the time averaged thermal photon  $v_2$  integrated over the entire evolution of the system. The various colors represent the calculation

Files (10.8 MB)

Edit

New version

Communities

PHENIX Collaboration

Remove

8 views

5 downloads

See more details...

Indexed in

OpenAIRE

Publication date:

December 1, 2013

DOI:

DOI 10.5281/zenodo.3887326

Keyword(s):

RHIC direct photon PID emcal PHENIX

hbd zdc run07 heavy ion

Awarding University:

SUNY

Communities:

PHENIX Collaboration

Keywords

# HEPData: an example of a PHENIX entry

[Browse all](#)
[Adare, A. et al.](#)

[About](#)
[Submission Help](#)
[Sign in](#)

Last updated on 2014-08-11 17:26
[Accessed 799 times](#)
[Cite](#)
[JSON](#)

[Hide Publication Information](#)

Inclusive double-helicity asymmetries in neutral-pion and eta-meson production in  $\vec{p} + \vec{p}$  collisions at  $\sqrt{s} = 200$  GeV

The PHENIX collaboration

Adare, A., Aidala, C., Ajitanand, N.N., Akiba, Y., Akimoto, R., Al-Ta'ani, H., Alexander, J., Andrews, K.R., Angerami, A., Aoki, K.

Phys.Rev. D90 (2014) 012007, 2014.

<https://doi.org/10.17182/hepdata.64716>

[Journal](#)
[INSPIRE](#)
[HepData](#)
[Resources](#)

**Abstract (download)**

BNL-RHIC. Results are presented from data recorded in 2009 by the PHENIX experiment at the Relativistic Heavy Ion Collider for the double-longitudinal spin asymmetry,  $A_{LL}$ , for  $\pi^0$  and  $\eta$  production in  $\sqrt{s} = 200$  GeV polarized  $p$ - $p$  collisions. Comparison of the  $\pi^0$  results with different theory expectations based on fits of other polarized data showed a preference for small positive values of gluon polarization,  $\Delta G$ , in the proton in the probed Bjorken  $x$ ,  $x_B$ , range. The effect of adding the new 2009  $\pi^0$  data to a recent global analysis of polarized scattering data is given.

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Filter 9 data tables

**Table 1**

Data from Table 4

10.17182/hepdata.64716.v1/t1

$\pi^0$  ASYM(LL) measurements from 2005.

**Table 2**

Data from Table 4

10.17182/hepdata.64716.v1/t2

$\pi^0$  ASYM(LL) measurements from 2006.

**Table 3**

Data from Table 4

10.17182/hepdata.64716.v1/t3

$\pi^0$  ASYM(LL) measurements from 2005.

**Table 4**

Data from Table 5

10.17182/hepdata.64716.v1/t4

$\eta$  ASYM(LL) measurements from 2005.

**Table 5**

Data from Table 5

10.17182/hepdata.64716.v1/t5

$\eta$  ASYM(LL) measurements from 2006.

**Table 2** [10.17182/hepdata.64716.v1/t2](#)

Data from Table 4

$\pi^0$  ASYM(LL) measurements from 2006.

**cmenergies**

200.0

**observables**

ASYM

**phrases**

Inclusive

Asymmetry Measurement

Proton-Proton Scattering

**reactions**


P P  $\rightarrow$   $\pi^0$  X

RE	P P $\rightarrow$ $\pi^0$ < GAMMA GAMMA > X
SQRT(S)	200.0 GeV
PT( $\pi^0$ ) [GeV]	ASYM(LL)
1.3 (bin: 1.0 - 1.5)	0.0012 $\pm 0.0013$ stat $\pm 0.00075$ sys,rel,lumi. $\pm 8.3\%$ sys.pol.
1.5 - 2.0	0.00146 $\pm 0.00082$ stat $\pm 0.00075$ sys,rel,lumi. $\pm 8.3\%$ sys.pol.
2.23 (bin: 2.0 - 2.5)	0.0007 $\pm 0.00084$ stat $\pm 0.00075$ sys,rel,lumi. $\pm 8.3\%$ sys.pol.
2.72 (bin: 2.5 - 3.0)	0.0 $\pm 0.0011$ stat $\pm 0.00075$ sys,rel,lumi. $\pm 8.3\%$ sys.pol.
3.22 (bin: 3.0 - 3.5)	-0.0006 $\pm 0.0016$ stat $\pm 0.00075$ sys,rel,lumi. $\pm 8.3\%$ sys.pol.
3.72 (bin: 3.5 - 4.0)	-0.0013 $\pm 0.0023$ stat $\pm 0.00075$ sys,rel,lumi. $\pm 8.3\%$ sys.pol.

Visualize

# Open Data Definitions

- “Canonical” data levels

- Level 1 data provides more information on published results
-  Level 2 data includes simplified data formats for outreach and analysis training
- Level 3 data comprises reconstructed collision data and simulated data together with analysis-level experiment-specific software
- Level 4 data covers basic raw data

- Where does PHENIX stand?

- Level 1 is covered by the current HEPData activity and auxiliary info committed to Zenodo
- Level 2: work underway to create Ntuples illustrating analysis techniques (*next slide*)
- Level 2: the Open Data Portal (*under discussion*)
- Levels 3 and 4 are not practical for public access for much of the same reasons as exist in other experiments (e.g. access to calibrations and access to sites)

# The Open Data effort: annotated Ntuples (G. David)

system ( $x > 0$  is the west arm, negative  $z$  is South).

The *MBntup.root* file is produced from minimum bias data (no lower limit on single cluster  $p_T$  in *gnt* or pair  $p_T$  in *ggntuple*), whereas in *ERTntup.root* the threshold for single cluster  $p_T$  in *gnt* is 5 GeV, and the threshold for pair  $p_T$  in *ggntuple* is also 5 GeV. Note that here we restrict only the pair  $p_T$ , the energy of the individual clusters can be (and often is) significantly lower.

Variable name	Description
cent	Event centrality
vtxZ	$z$ -vertex of the event
pt	Transverse momentum of the cluster
costheta	Polar angle of the cluster ( $\theta$ )
phi	Azimuthal angle of the cluster ( $\phi$ )
sec	EMCal sector of the cluster ( $\gamma$ -candidate)
ecore	"Core" energy of the cluster ( $\gamma$ -candidate)
ecent	Energy in the central tower of the cluster ( $\gamma$ -candidate)
tof	Time-of-flight in the central tower of the cluster ( $\gamma$ -candidate)
prob	Probability that the cluster is a photon (based on $\chi^2$ )
disp	Dispersion of the cluster ( $\gamma$ -candidate)
chisq	$\chi^2$ from expected photon shape of the cluster ( $\gamma$ -candidate)
twrhit	Number of towers in the cluster ( $\gamma$ -candidate)
stoch	Combined variable to describe "photonness" of the cluster ( $\gamma$ -candidate)
x	$x$ -position of impact point on the EMCal surface
y	$y$ -position of impact point on the EMCal surface
z	$z$ -position of impact point on the EMCal surface

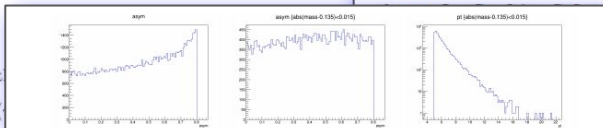


FIG. 2. ERT data, plots from the pair ntuple. Left: energy asymmetry distribution for all pairs.

```
ggntuple->Draw("mass", "mass<1.0");
ggntuple->Draw("mass", "mass<0.4&&pt>8.0");
ggntuple->Draw("mass">>htemp1, "mass<0.4");
ggntuple->Draw("mass">>htemp2, "mass<0.4&&chisq1<2.0&&chisq2<2.0");
htemp1->SetLineColor(1);
htemp2->SetLineColor(2);
```

see Fig. 1.

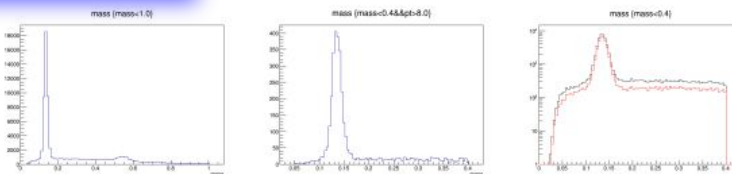


FIG. 1. ERT data, plots from the pair ntuple. Left: Invariant mass in the 0-1 GeV region. You can see a strong  $\pi^0$  and a well-recognizable  $\eta$  peak. Middle:  $\pi^0$  peak for pairs with  $p_T$  greater than 8 GeV/c. You can clearly see the combinatorial background outside the peak, which should

Ntuples: O(100MB) each  
Hosting options: Zenodo, Open Data