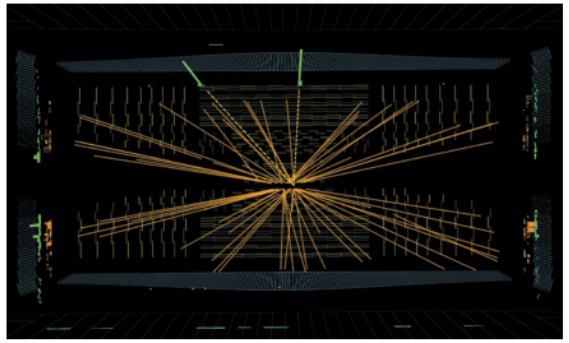
دسترسی به داده‌های آزاد سی.ام.اس

علی فهیـــــم

دانشکده علوم مهندسی – دانشگاه تهران

Gibney, E. LHC plans for open data future. Nature 503, 447 (2013). https://doi.org/10.1038/503447a



THOMAS MCAULEY/LUCAS TAYLOR/CMS COLLECTION/CERN

Data from the Large Hadron Collider, such as this decay of a Higgs boson, could be made publicly available.

PHYSICS

LHC plans for open data future

Researchers share results to keep them accessible.

BY ELIZABETH GIBNEY

When the Large Hadron Collider (LHC) is humming along, the data come in a deluge. The four experimental detectors at the facility, based at CERN, Europe's particle-physics laboratory near Geneva, Switzerland, collect some 25 petabytes of information each year.

Storing the data is not a problem: hard drives are cheap and getting cheaper. The challenge is preserving knowledge that is less commonly stored — the software, algorithms and reference plots specific to each experiment. These often degrade or disappear with time, says Cristinel Diaconu of the Marseilles Centre for Particle Physics in France, who is chair of the international Data Preservation in Long Term Analysis in High Energy Physics (DPHEP) study group. He worries that if the data continue to be stored in their current state, physicists trying to decipher them in 10 years' time will be unable to reconstruct the discovery of the Higgs boson. "When the LHC programme comes to an end, it will probably be the last data at this frontier for many years," he says. "We can't afford to lose it."

The DPHEP is therefore trying to push data-preservation efforts from mere storage to a system of open sharing. The thinking goes that data and the knowledge needed to interpret them are more likely to survive in the long term if many people outside an experiment are constantly trying to make sense of them.

Kati Lassila-Perini, a physicist at the Compact Muon Solenoid (CMS), one of the four experiments at the LHC, has a radical idea for this sort of sharing: giving data away to school pupils. Next year, a pilot scheme she leads will release 2010 CMS data, which the IT Center for Science in Espoo, Finland, will reformat and store. The centre will then share the data with pupils, who will recreate plots of particle decays using analysis tools adapted for the public. The CMS plans to make more data publicly available a few years after collection, and Lassila-Perini hopes that other data centres will adopt such schemes. "We are guaranteeing that the data we are not looking at any more remain accessible," she says.

The intent is not just to keep data for posterity. Old data can be mined to test new theories and provide crucial references for new experiments, says Diaconu. Before the Higgs boson was discovered in 2012, for example, the Large Electron–Positron collider — the LHC's predecessor at CERN — came back into the spotlight as physicists scoured its 1990s-era data, looking for an exotic type of Higgs that had not been theorized at the time the data had been gathered. In this way, the goals of keeping data alive and open are "enlightened self-interest", says Michael Hildreth, a physicist at the University of Notre Dame in Indiana and leader of the US-funded Data and Software Preservation for Open Science (DASPOS) effort, which has similar goals to the DPHEP.

DASPOS is building a template for preserving data — a checklist of items that should be stored, and how to do it. Next year, in a 'curation challenge', DASPOS will task physicists with recreating results from other experiments using only the information collected with this template. One test will almost certainly use LHC data — challenging, for example, CMS physicists to recreate results from the rival ATLAS experiment. Another test could come from a different field, such as astrophysics. If successful, the model could form a generic and simplified architecture for preserving data, says Hildreth.

Part of the challenge is coping with ever-changing algorithms, operating systems and data-analysis hardware. At the German Electron Synchrotron (DESY) in Hamburg, computing coordinator David South is leading a project that is already attempting to protect data in this way. His team has devised a system that will automatically comb through data and software from experiments on DESY's Hadron–Electron Ring Accelerator and test them for compatibility when hardware or operating systems change.

This plan to migrate data repeatedly onto new platforms stands in contrast to an approach at the BaBar experiment at the SLAC National Accelerator Laboratory in Menlo Park, California. There, versions of data and the operating systems needed to analyse them have been frozen in storage centres, where they are supposed to be accessible until at least 2018. South says that DESY's approach is more reliable. Although DESY's system needs monitoring — any incompatibilities must be fixed through human intervention — the goal is to deal with problems as they arise, rather than tackle them years later, when they may have compounded.

"When the LHC programme comes to an end, it will probably be the last data at this frontier for many years. We can't afford to lose it."

DESY scientists would know about that. In the 1990s, physicists wanted to take another look at data from a DESY collider that ran from 1979 to 1986, to further investigate the strong interaction that binds quarks together. They managed to measure it with increased precision, but Diaconu says that it took two years to reconstruct the data, which had not been maintained.

The data preservationists are quick to point out the expense associated with reconstruction efforts. Of course, preservation also costs money, but it is well worth it, says DPHEP project manager Jamie Shiers. He puts the bill for implementing good data-preservation at the LHC at around 1% of operating costs — just a few million dollars per year. "I think it's justified," he says. ■

چشم انداز

- حفظ داده ها و دانش (فراداده)
- اشتراک گذاری آزاد. داده ها و دانش به احتمال زیاد زنده می‌مانند.
- داده ها را در اختیار دانشجویان و محققان قرار دهید و به آنها اجازه دهید به عنوان مثال برای بازسازی کشف هیگز، به فیزیکدانان CMS اجازه دهید نتایج ATLAS را بازسازی کنند و بالعکس.
- استخراج داده‌ها برای آزمایش نظریه‌های جدید و ارائه منابع مهم
- هزینه تقریبا یک درصد از هزینه‌های عملیاتی است پس ارزش تلاش را دارد.

محتوای سامانه‌ی داده‌های آزاد سرن

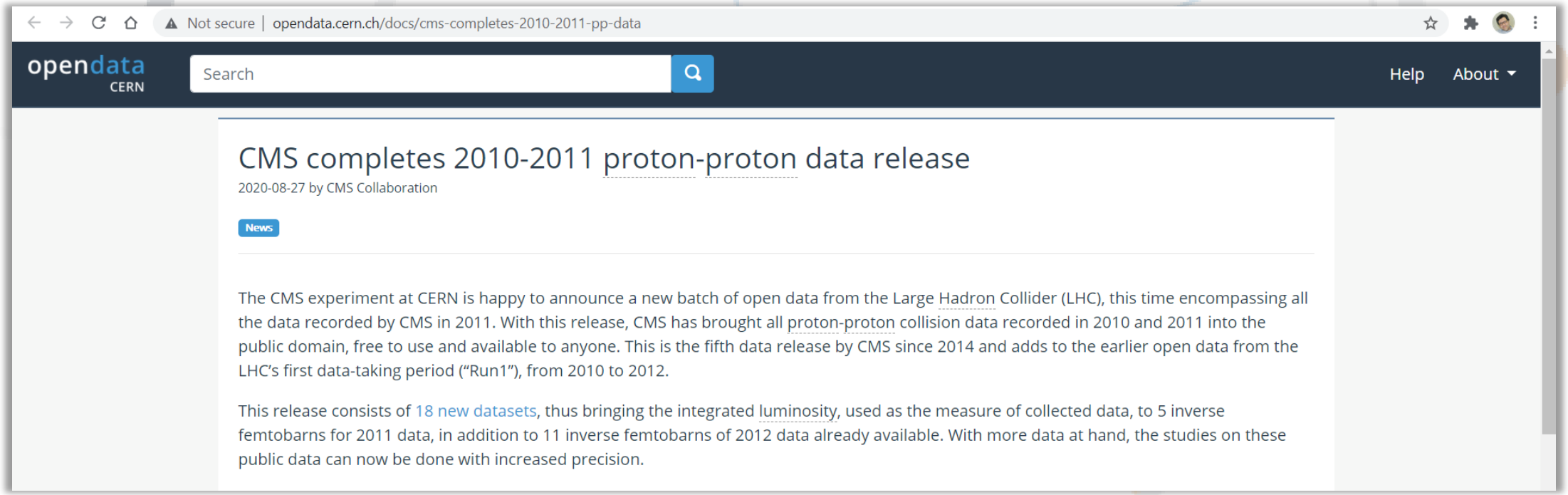
در نوامبر 2014 راه اندازی شد.

محتوای بسیار غنی شامل:

- مجموعه داده های برخوردهای واقعی و شبیه‌سازی شده قابل استفاده برای پژوهش
- مجموعه داده‌های آماده شده برای آموزش دانشجویان
- فایلهای پیکربندی (Configuration files) و مستندات
- ماشین‌های مجازی و تصاویر محتوا (Container images)
- ابزارهای نرم افزاری و نمونه های تجزیه و تحلیل

بیش از 2 پتابایت
توسعه یافته توسط CERN-IT و همکاری آزمایشگاه‌های:

محتوای سامانه‌ی داده‌های آزاد سرن



بستر داده‌های باز

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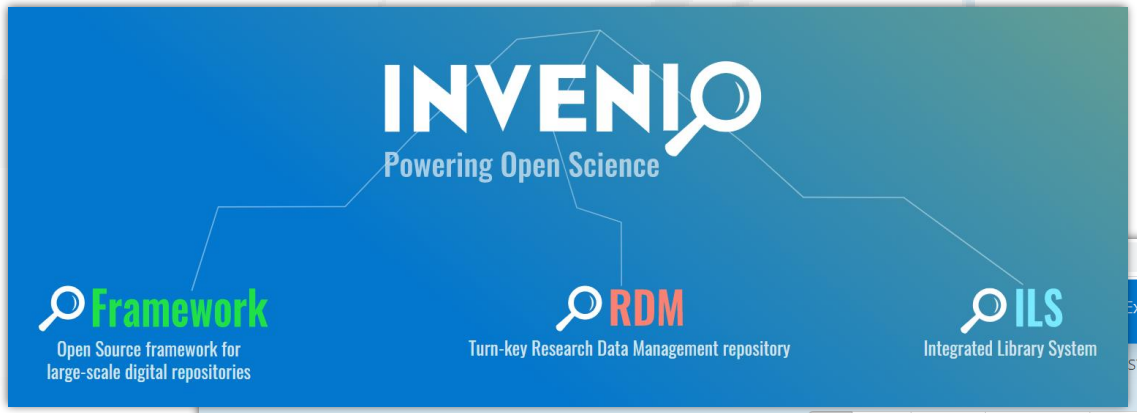

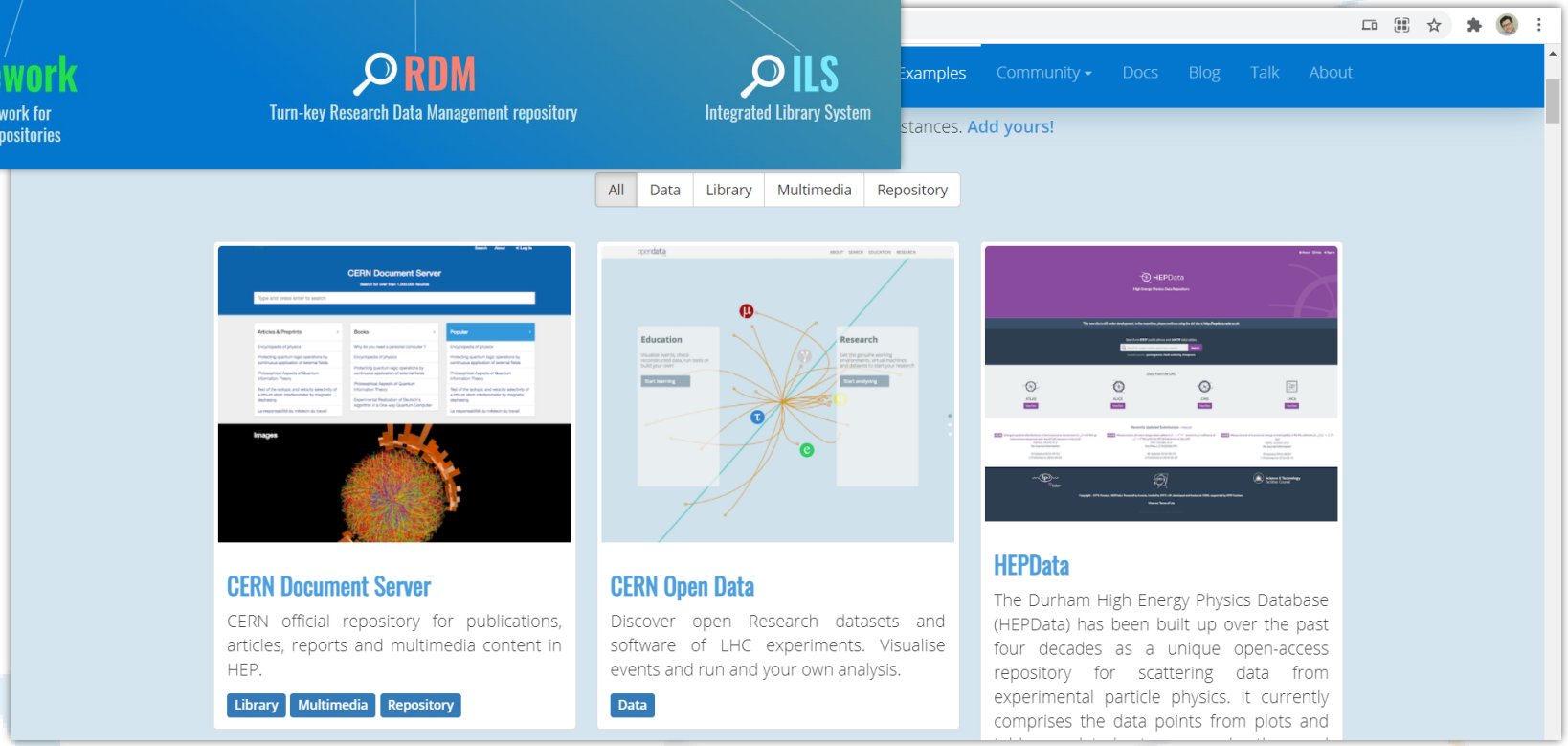

پُرتال داده‌های آزاد سرن

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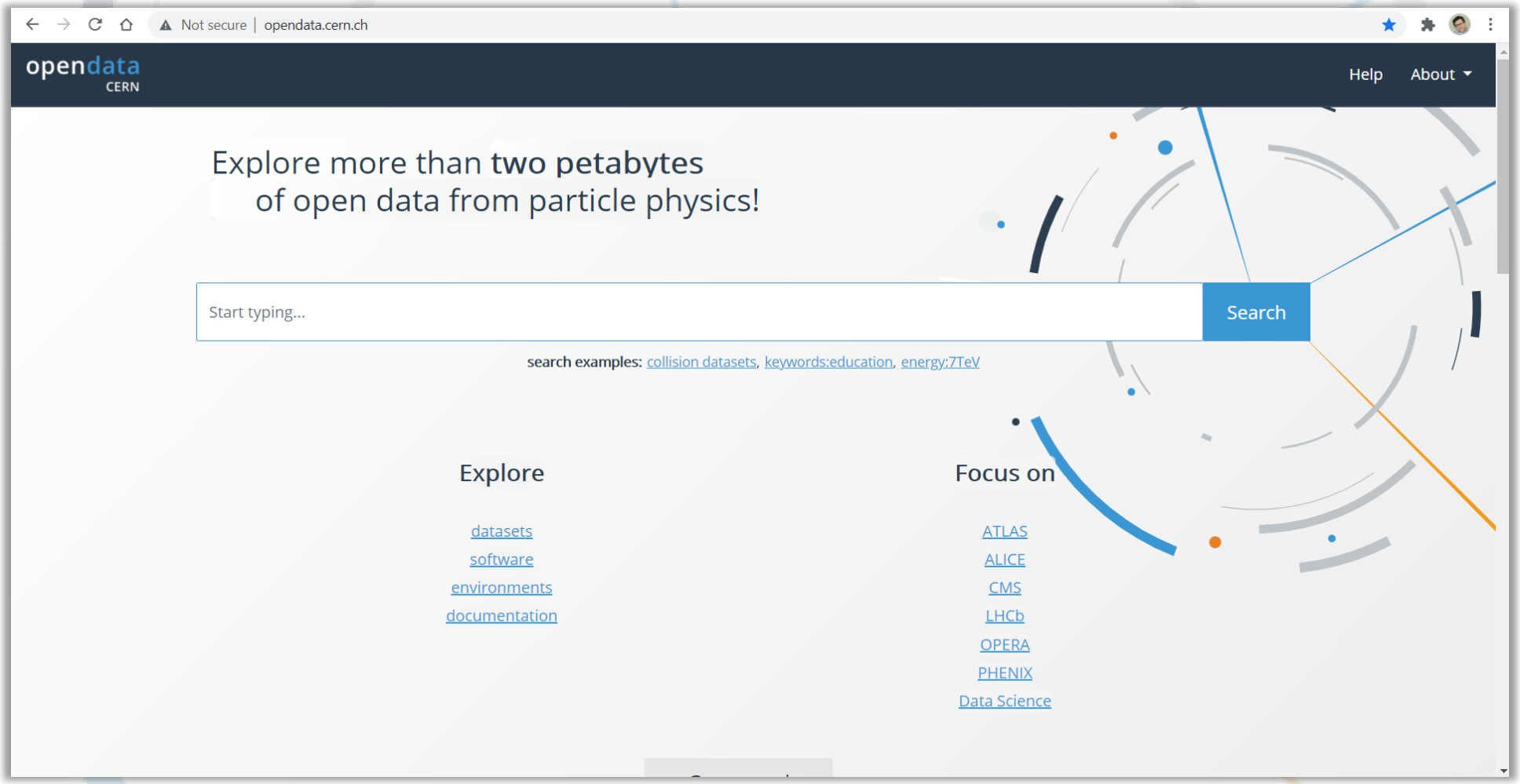
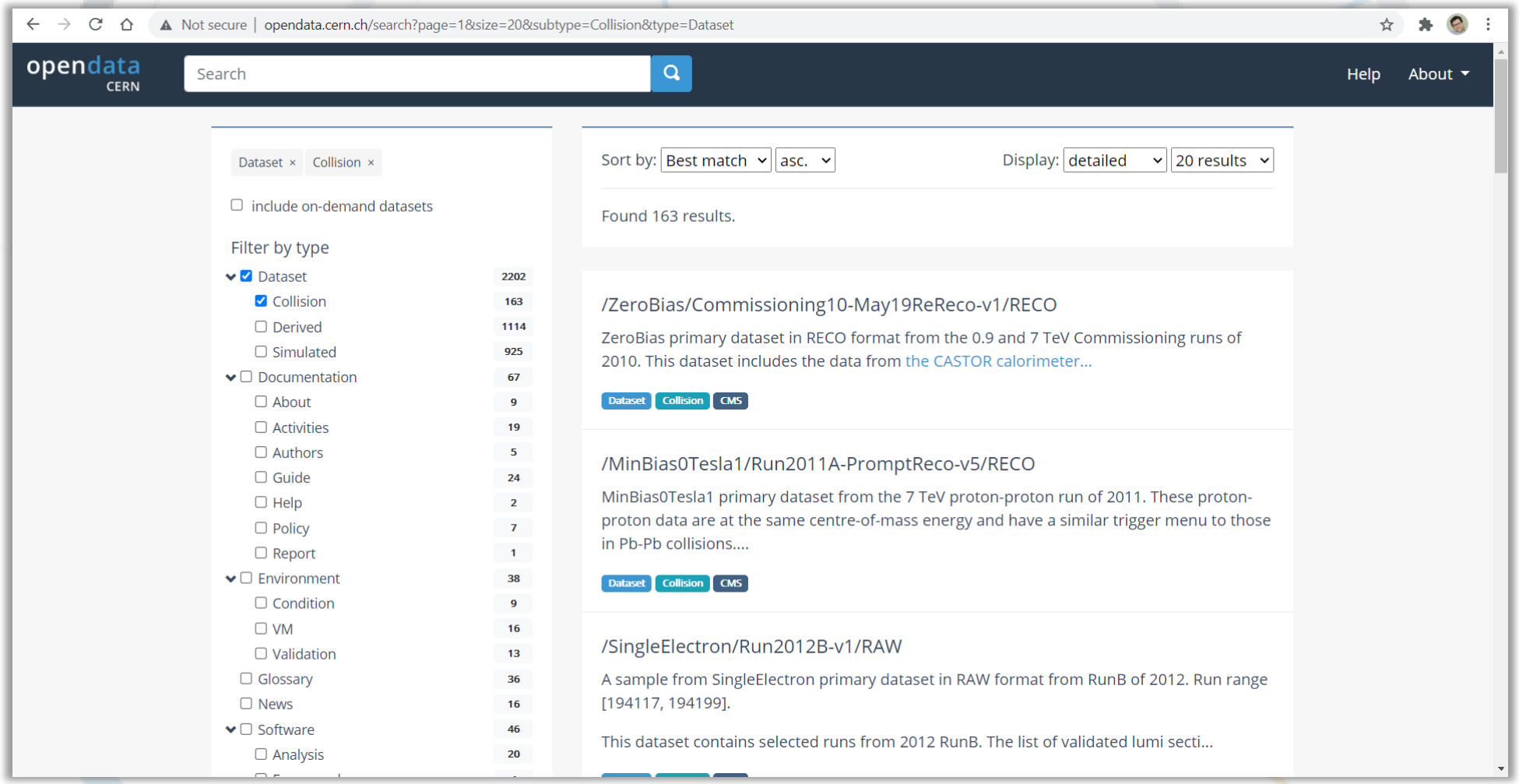


پُرتال داده‌های آزاد سرن

search examples: collision datasets



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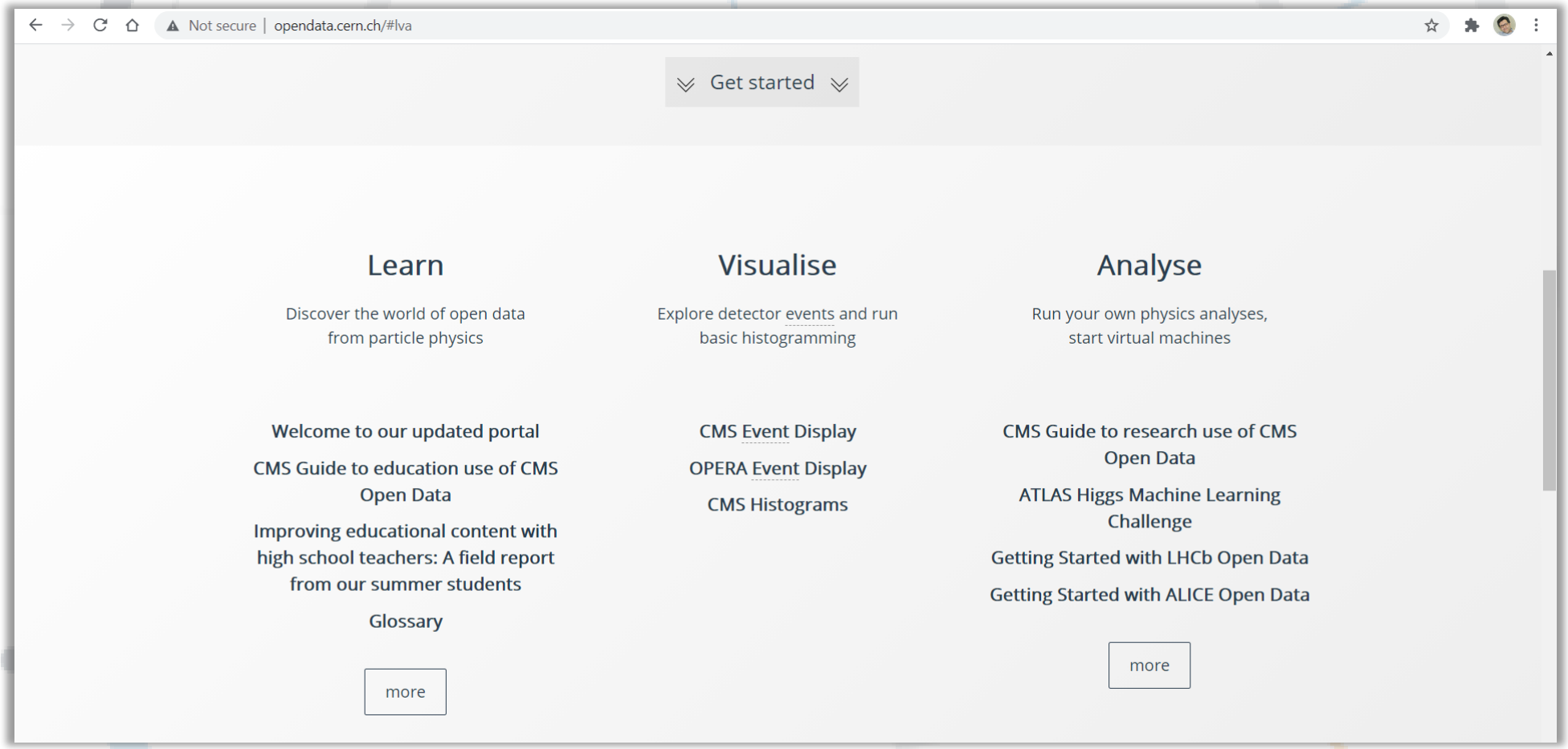


Education

The CMS (Compact Muon Solenoid) experiment is one of two large general-purpose detectors built on the Large Hadron Collider (LHC). Its goal is to investigate a wide range of physics such as the characteristics of the Higgs boson, extra dimensions or dark matter.

Explore CMS >

ALICE (A Large Ion Collider Experiment) is a heavy-ion detector designed to study the physics of strongly interacting matter at extreme energy densities, where a phase of matter called quark-gluon plasma forms. More than 1000 scientists are part of the collaboration.

Explore ALICE >

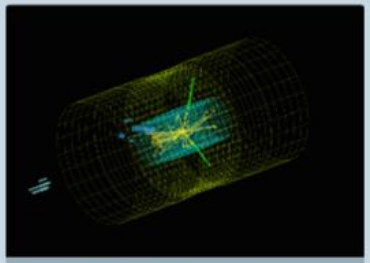
The ATLAS (A Toroidal LHC ApparatuS) experiment is a general purpose detector exploring topics like the properties of the Higgs-like particle, extra dimensions of space, unification of fundamental forces, and evidence for dark matter candidates in the Universe.

Explore ATLAS >

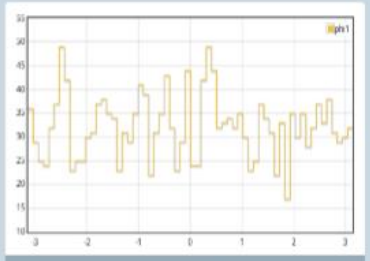
The LHCb (Large Hadron Collider beauty) experiment aims to record the decay of particles containing b and anti-b quarks, known as B mesons. The detector is designed to gather information about the identity, trajectory, momentum and energy of each particle.

Explore LHCb >

For education purposes, the complex primary data need to be processed into a format (examples below) that is good for simple applications. Get in touch if you wish to build your own applications similar to those shown here



Visualise events >



Visualise histograms >

Learning Resources >

انتشار مقالات

PHYSICAL REVIEW D
covering particles, fields, gravitation, and cosmology

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Editors' Suggestion

Jet substructure studies with CMS open data

Aashish Tripathee, Wei Xue, Andrew Larkoski, Simone Marzani, and Jesse Thaler
Phys. Rev. D **96**, 074003 – Published 3 October 2017

14

More

Article References Citing Articles (22) PDF HTML Export Citation

ABSTRACT

We use public data from the CMS experiment to study the two-prong substructure of jets. The CMS open data are based on $31.8\ \mathrm{pb}^{-1}$ of 7 TeV proton-proton collisions recorded at the Large Hadron Collider in 2010, yielding a sample of 768,687 events containing a high-quality central jet with transverse momentum larger than 85 GeV. Using CMS's particle flow reconstruction algorithm to obtain jet constituents, we extract the two-prong substructure of the leading jet using soft-drop declustering. We find good agreement between results obtained from the CMS open data and those obtained from parton shower generators, and we also compare to analytic jet substructure calculations performed to modified leading-logarithmic accuracy. Although the 2010 CMS open data do not include simulated data to help estimate systematic uncertainties, we use track-only observables to validate these substructure studies.

Issue
Vol. 96, Iss. 7 — 1 October 2017

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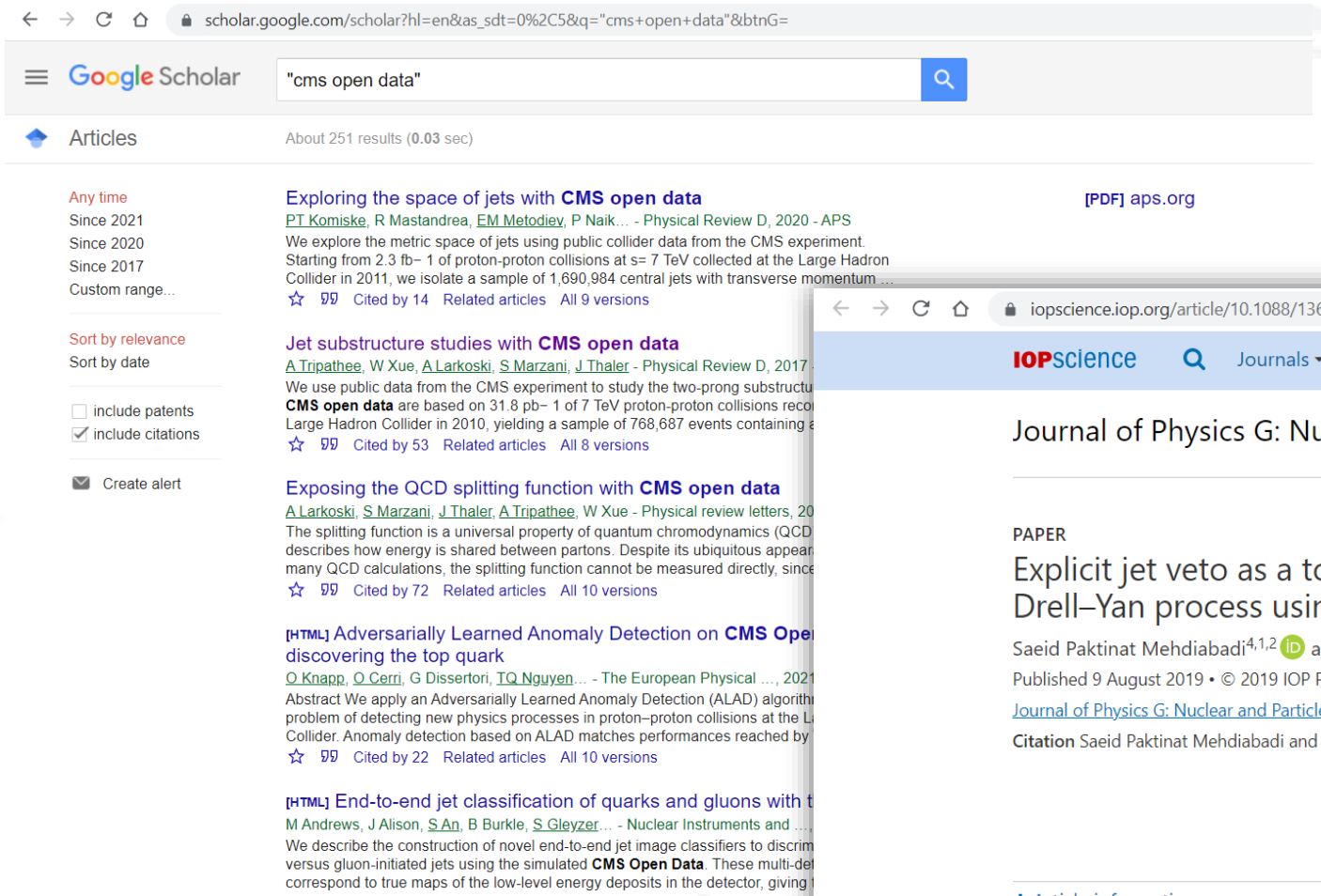
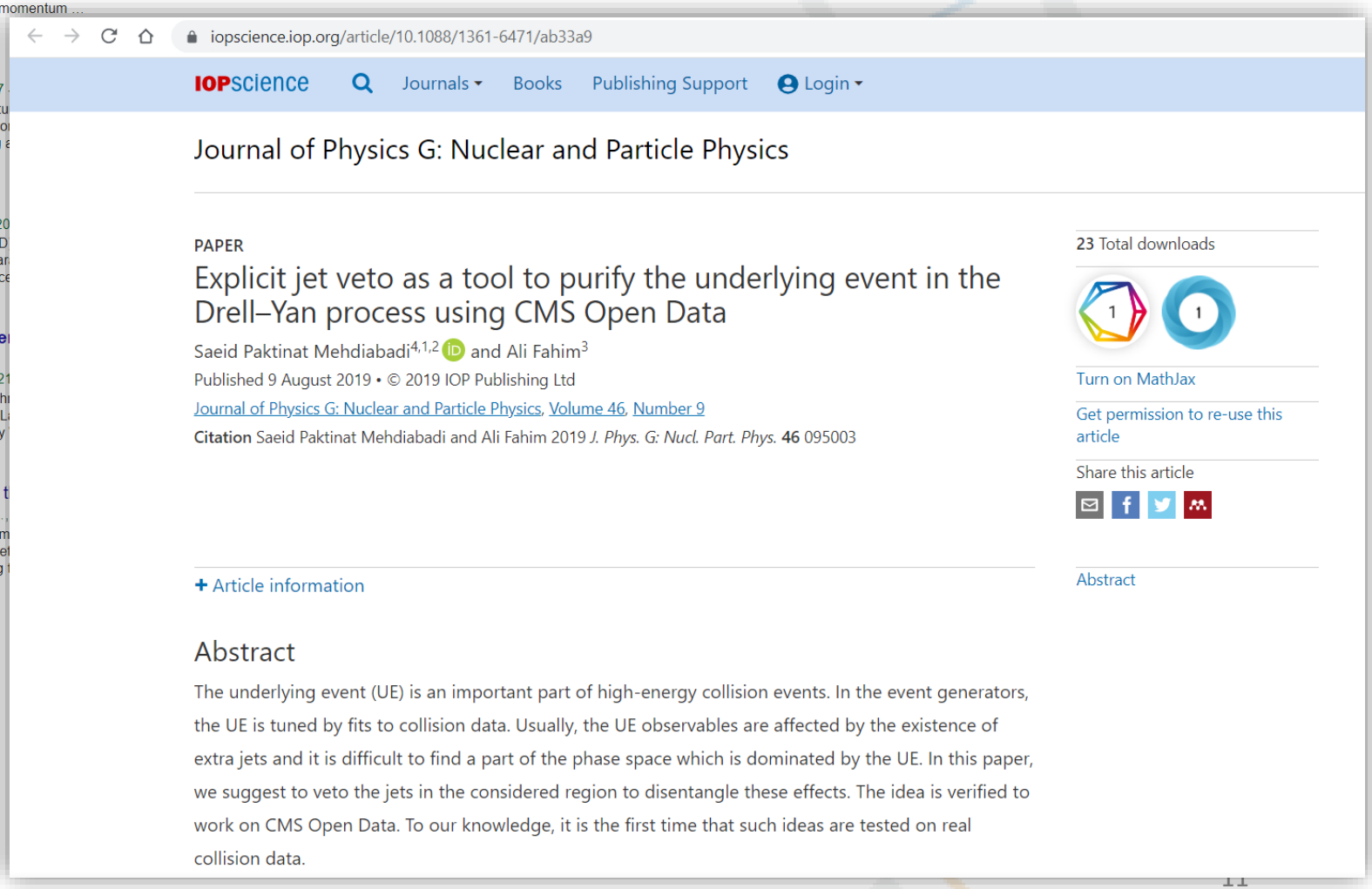
- از افتخارات این پُرتال این است که داده‌های قدیمی نتایج جدیدی را به ارمغان آورده است.
- در سال ۲۰۱۷ اولین مقاله علمی با استفاده از داده‌های LHC توسط محققان خارج از آزمایشگاه منتشر شد.

انتشار مقالات



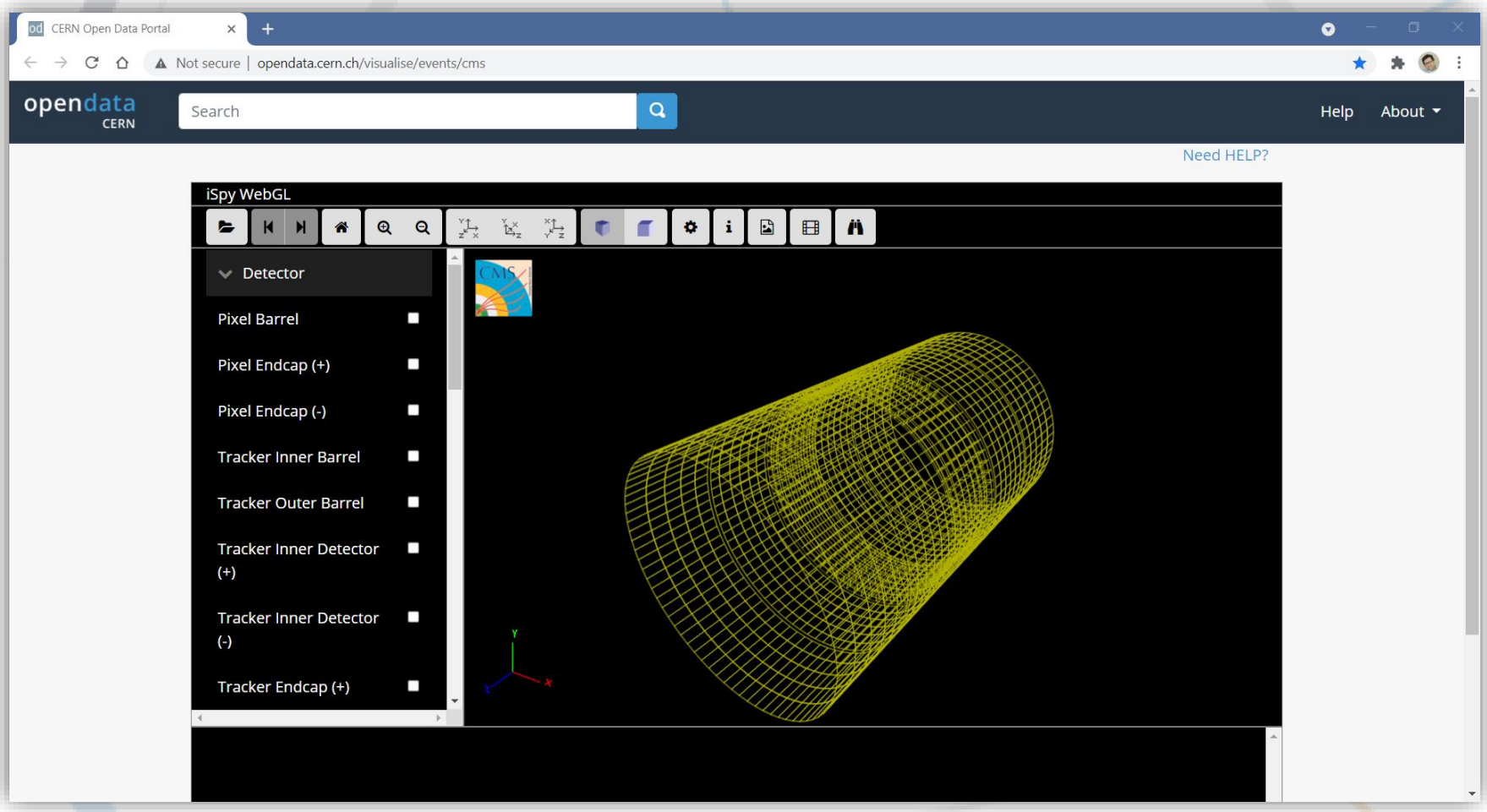


راهنمای استفاده از داده‌های آزاد CMS برای آموزش

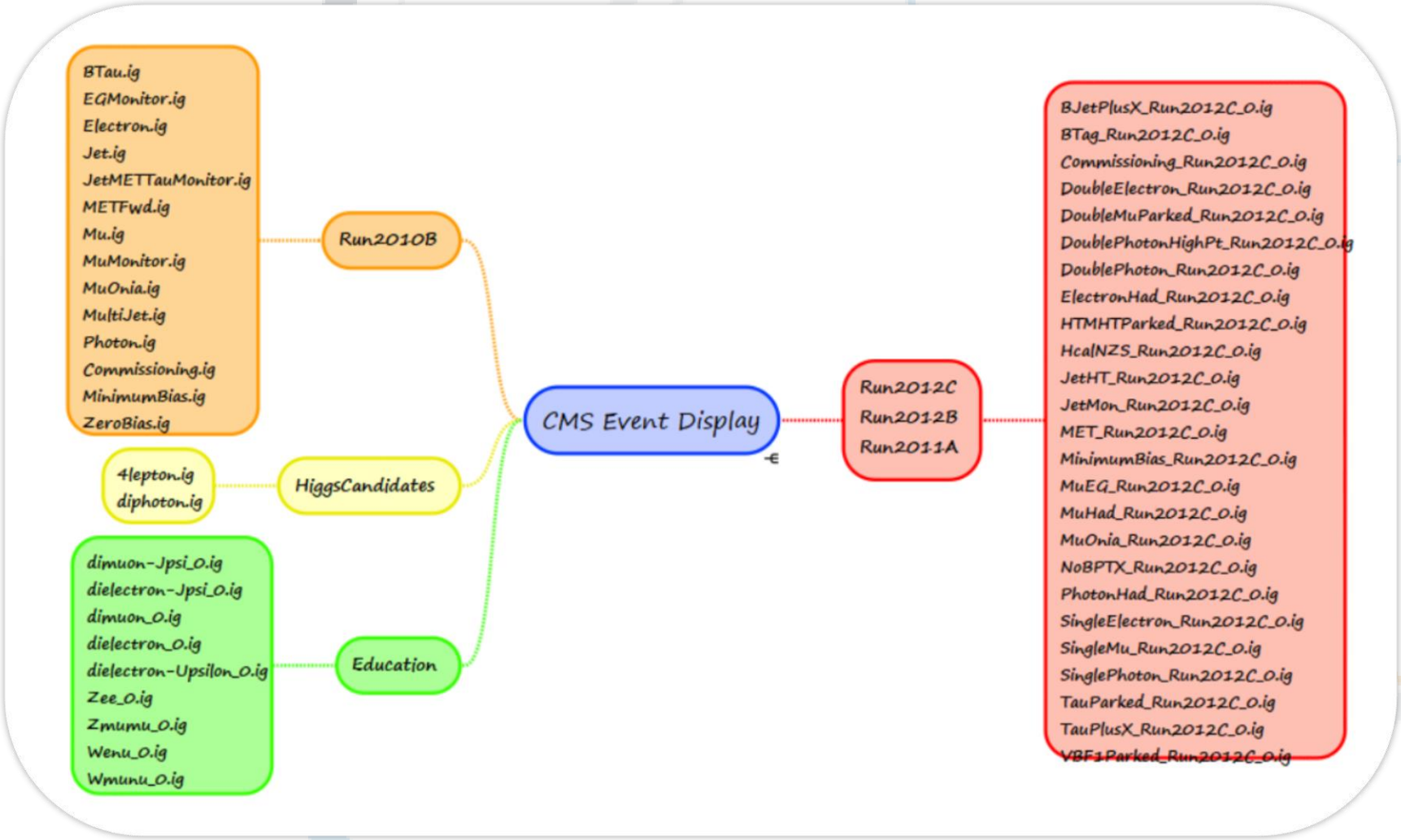
- نمایش برخورد ذرات
- تهیه هیستوگرام با استفاده از داده‌های برخورد ذرات
- ورود عمیق‌تر در داده‌های برخورد

نمایش برخورد ذرات

http://opendata.cern.ch/visualise/events/cms



نمایش برخورد ذرات



نمایش برخورد ذرات

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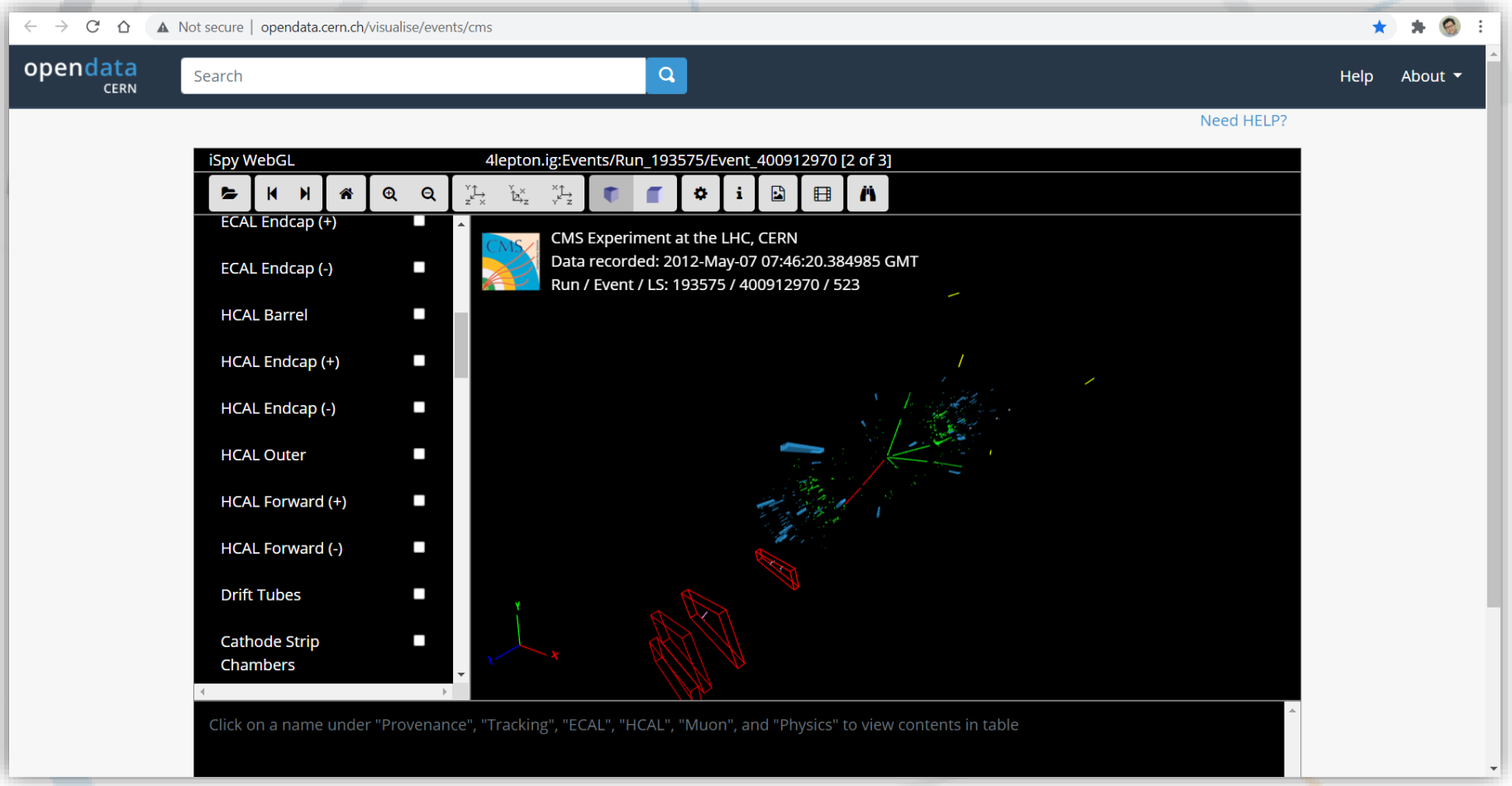

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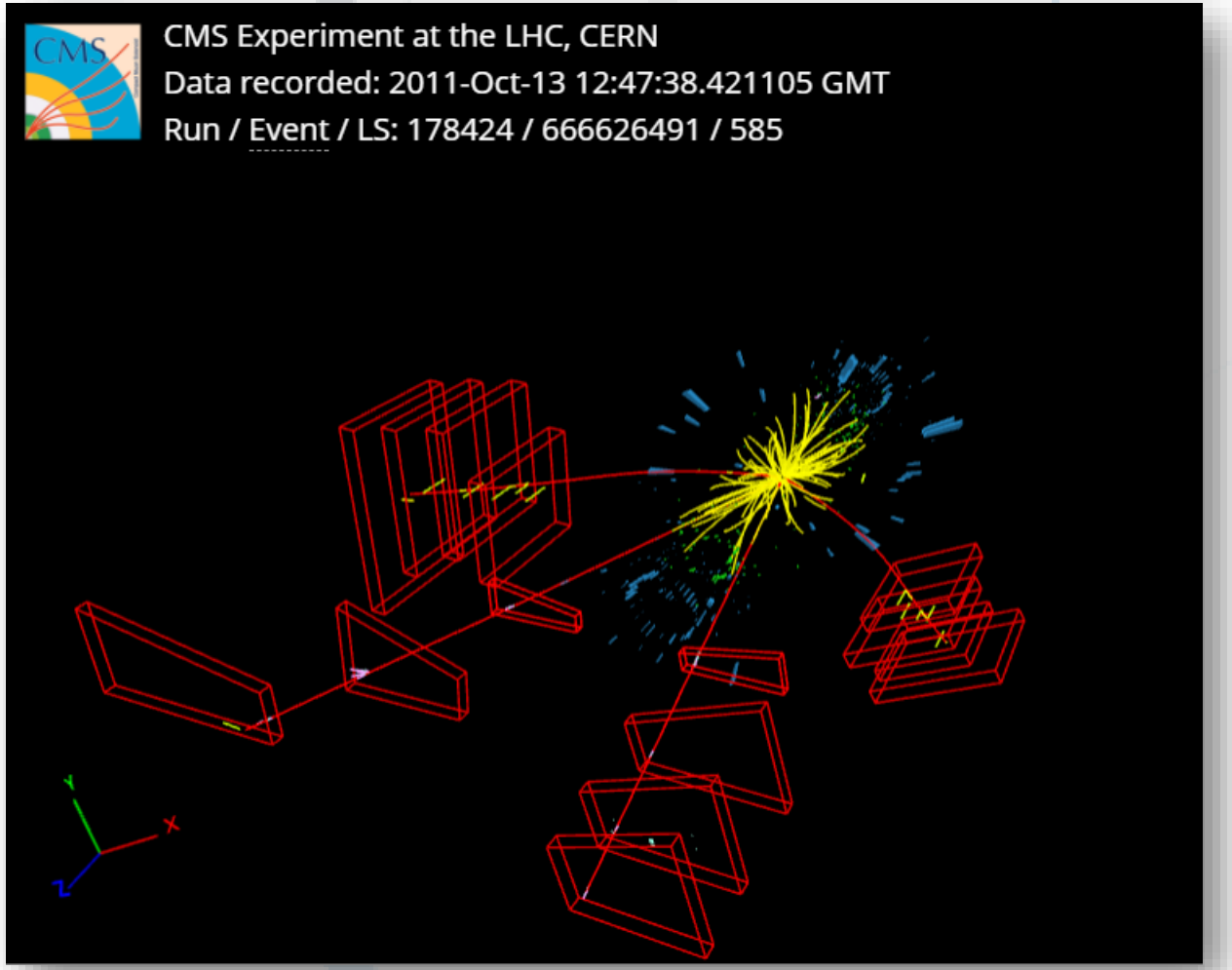


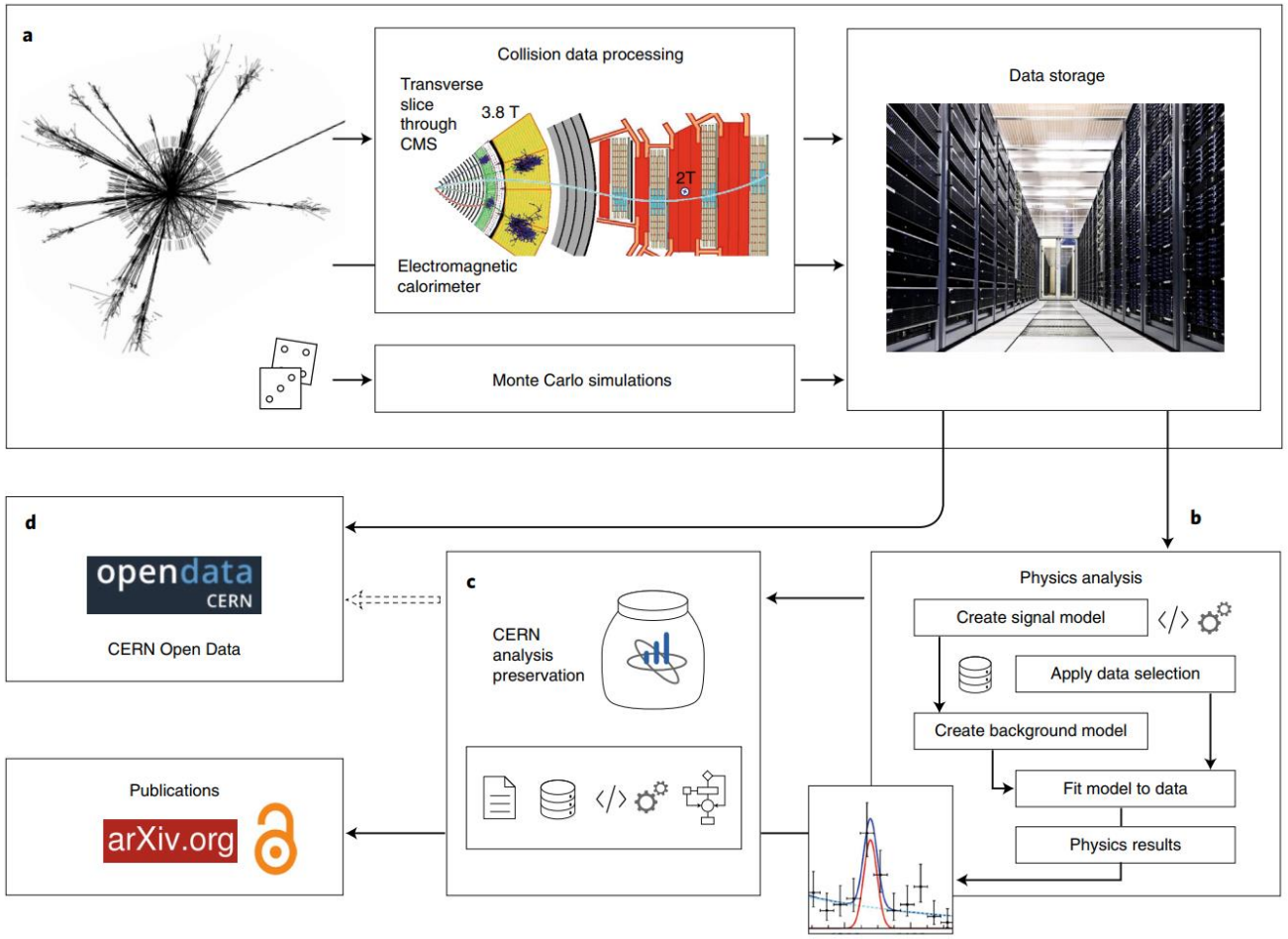
DOI:10.7483/OPENDATA.CMS.N9MJ.QEEC
http://opendata.cern.ch/record/300

این سند شامل رویدادهای نامزد هیگز با جرم ثابت بین 120-130 GeV است که توسط CMS برای استفاده در آموزش و توسعه منتشر شده است:

10 رویداد گاما گاما،
1 رویداد e2mu2،
1 رویداد mu4
1 رویداد e4

این داده‌ها برای استفاده در آموزش و یادگیری انتخاب شده‌اند و حاوی زیرمجموعه‌ای از کل اطلاعات رویداد هستند. آنها برای تجزیه و تحلیل کامل فیزیک مناسب نیستند.

از برخورد تا داده‌ی آزاد



استفاده از ماشین مجازی

CMS VM Image, for 2011 and 2012 CMS open data

CMS Collaboration

Environment VM CMS CERN-LHC

Description

This virtual machine image provides CMS computing environment to be used with the 2011 and 2012 CMS open data. The virtual machine is based on the CernVM (cernvm.cern.ch) and uses Scientific Linux CERN. The image gets the CMS software (CMSSW) from /cvmfs/cms.cern.ch and the jobs running on the CMS open data VM read the condition data from /cvmfs/cms-opendata-conddb.cern.ch. Access to the data is through XRootD.

CMS-OpenData-1.5.3.ova is recommended. It has a 40G virtual hard disk and a 20G cvmfs cache, which is large enough for condition data for full event range for 2012 data (see the CMS guide to the condition database for further details). It has an embedded CERN Scientific Linux 6 (slc6) shell, where all CMS software specific commands should be executed. Additionally, it has a CERN CentOS 7 (cc7) shell, which can be used in the same session.

The versions earlier than CMS-OpenData-1.5.3.ova are deprecated; please use the latest available version.

For known issues and limitations see

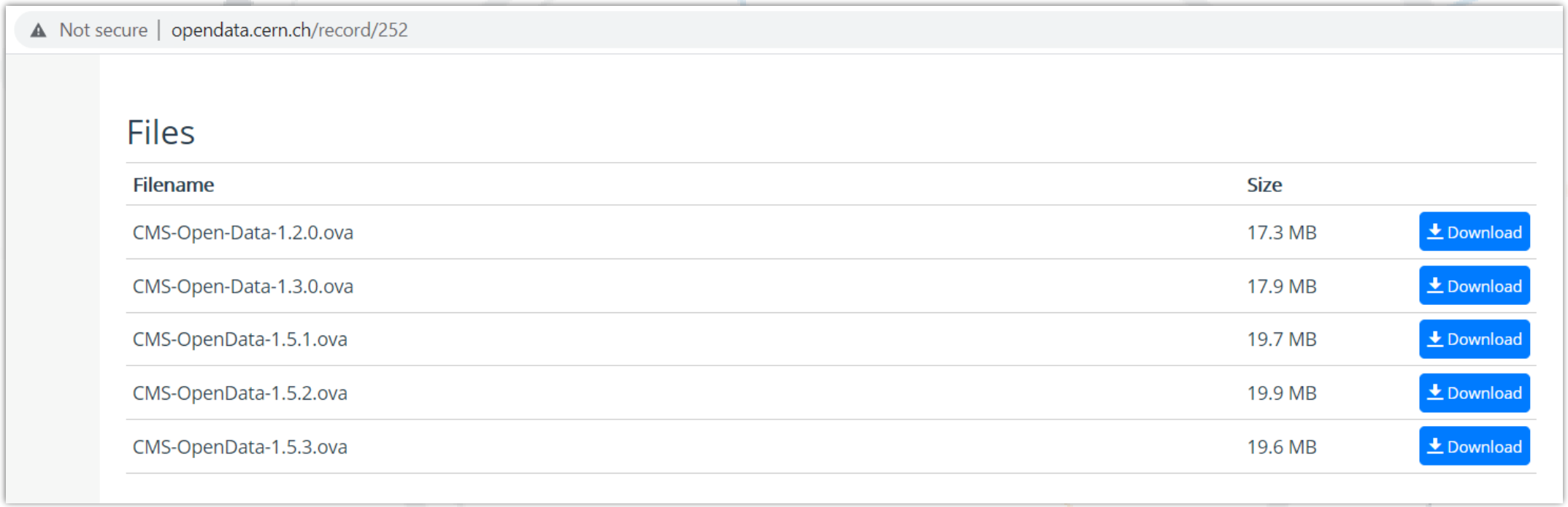
CMS Virtual Machines - Known Issues and Limitations

Characteristics

5 files. **98.9 MB** in total.

http://opendata.cern.ch/docs/cms-virtual-machine-2011
http://opendata.cern.ch/docs/cms-virtual-machine-2010

استفاده از ماشین مجازی

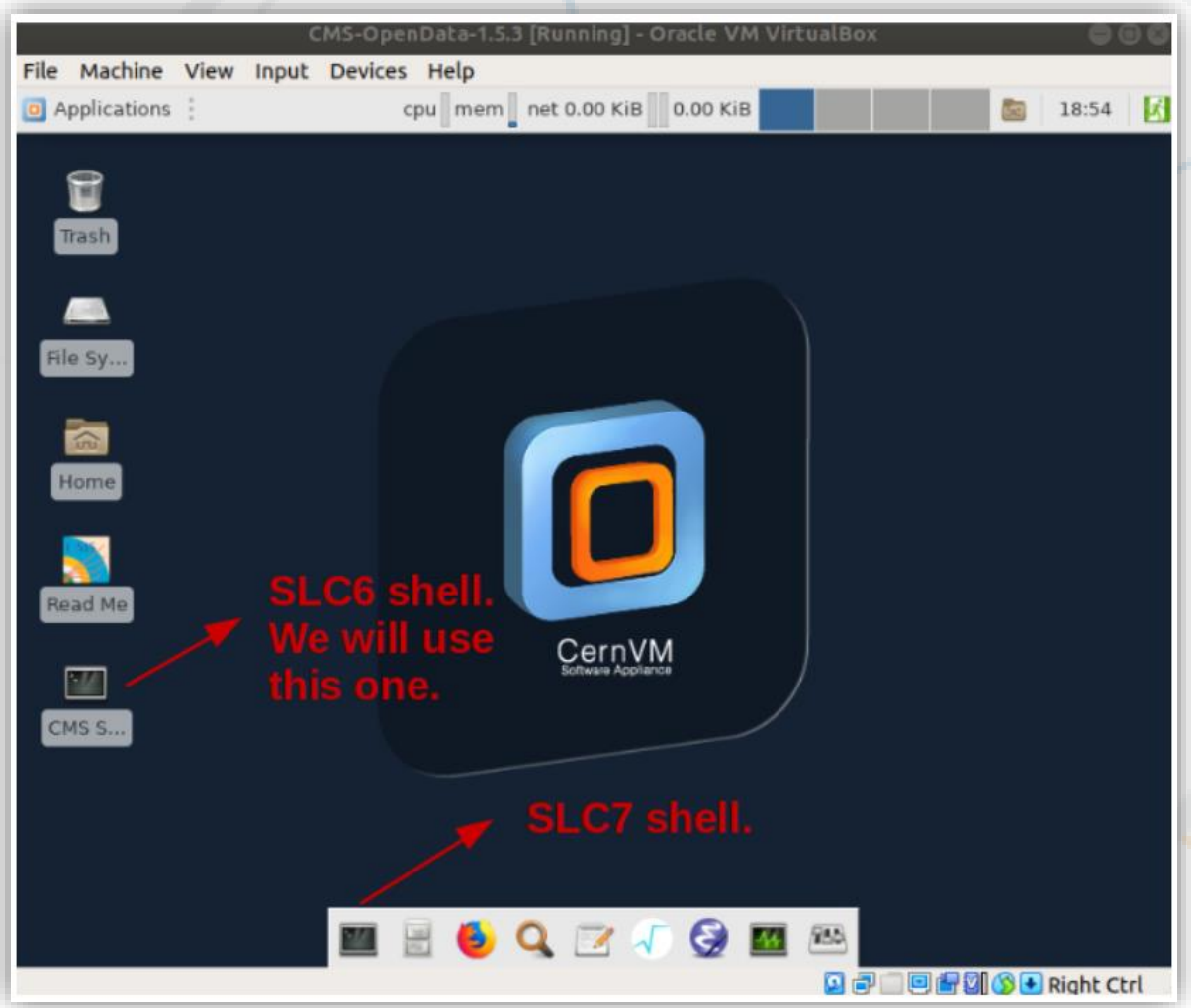


Downloading the CMS-specific CernVM image

Download the 2011 CMS-specific CernVM image as OVA file from the official record in the Cern Open Portal site. We recommend using version 1.5.3, i.e., CMS-OpenData-1.5.3. This VM Image can be used for data from 2011 and 2012, which are the data we will use in this workshop.

Make sure to download version of the *ova* file, `1.5.3`. Other versions are deprecated.

استفاده از ماشین مجازی



استفاده از داکر

These pre-exercises are designed to prepare you for using Docker in the context of the CMS Open Data Workshop. This is *not* a full introduction to Docker, however we do take time to explain some key concepts that should make your experience a smooth one.

Note that you can also use virtual machines (VMs) to interface with the CERN Open Data Portal and this workshop, and there is a separate pre-exercise for that.

You should definitely take time to go through either this *or* the VM exercise before participating in the workshop.

If you run into problems with any of these steps, please reach out to the organizers through the dedicated Mattermost channel.

استفاده از داکر

Download the docker image for CMS open data and start a container

The first time you start a container, a docker image file gets downloaded from an image registry. The CMS open data image is large and it may take some time to download, even as long as 20-30 minutes, depending on the speed of your internet connection. After the download, a container created from that image starts. The download needs to be done only once. Afterwards, when starting a container, it will find the downloaded image on your computer, and it will be much faster.

Please follow the instructions below, depending on the operating system you are using.

Linux | Windows WSL2 | MacOS

Start the image download and open the container with

Bash

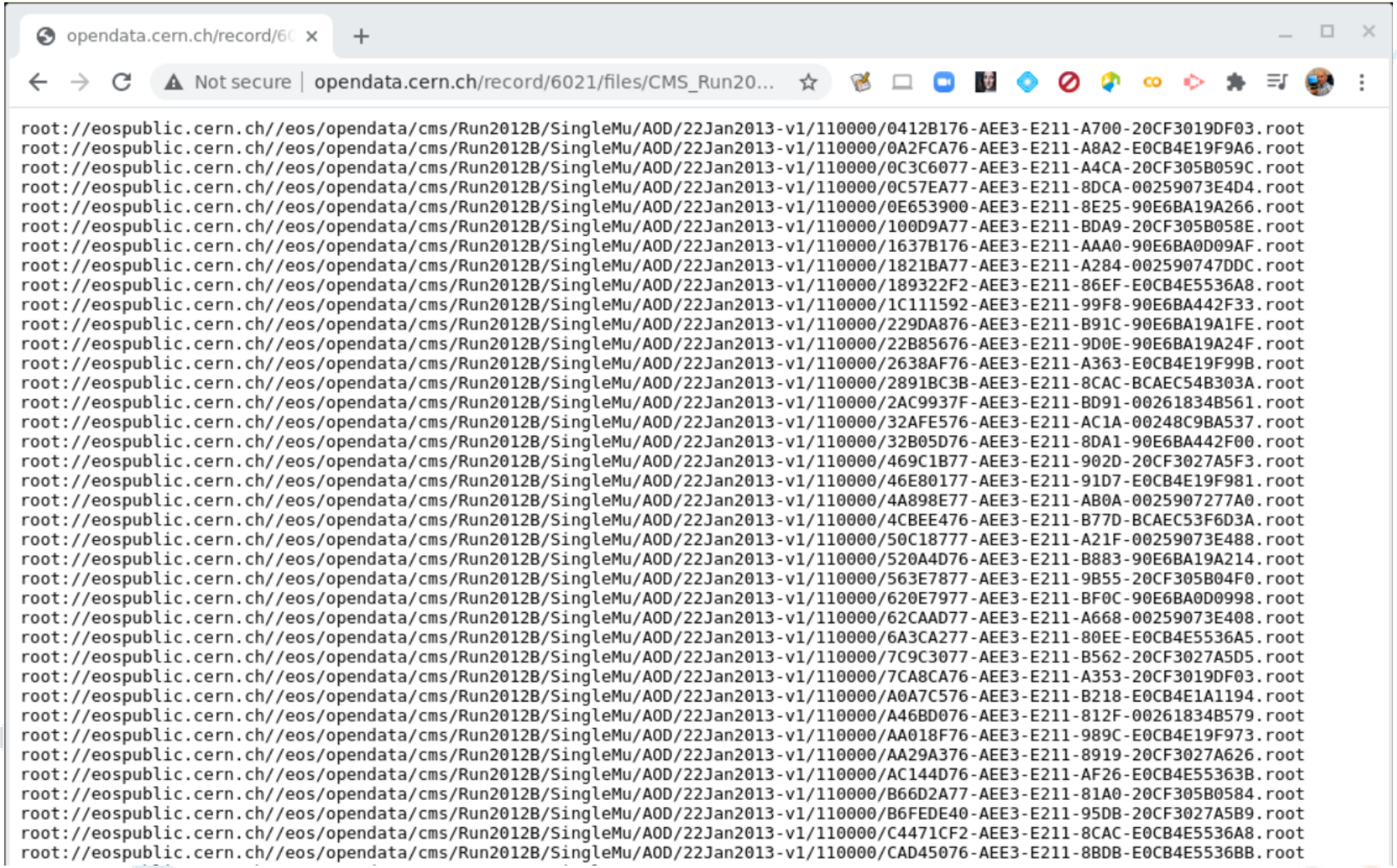
```
docker run -it --name my_od -P -p 5901:5901 cmsopendata/cmssw_5_3_32_vnc:latest /bin/bash
```

Output

```
Setting up CMSSW_5_3_32
CMSSW should now be available.
~/CMSSW_5_3_32/src $
```

This is now a bash shell in the CMS open data environment in which you have access to a complete CMS software release that is appropriate for interfacing with the 2011 and 2012 7 and 8 TeV datasets.

آدرس داده‌ها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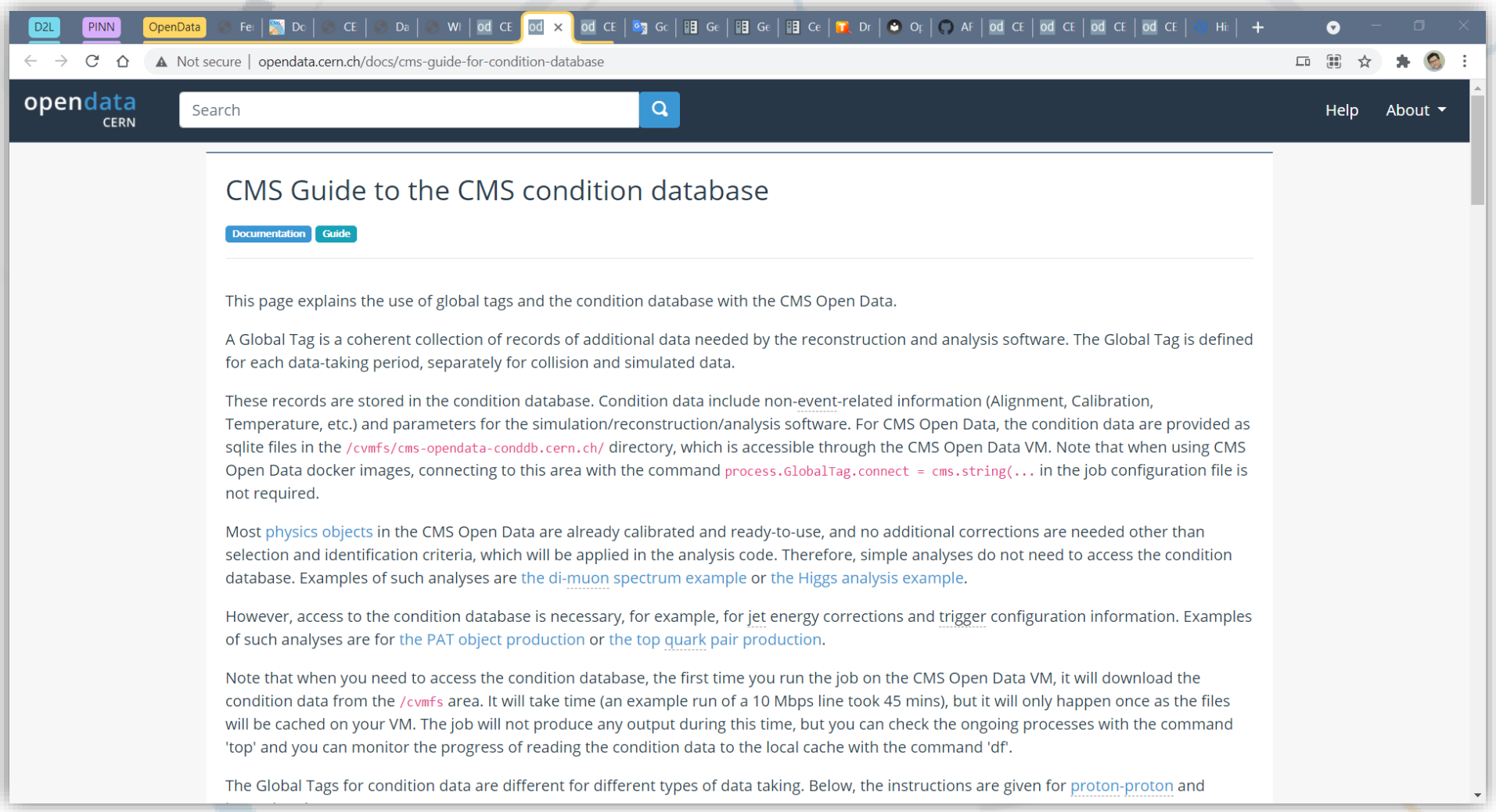

http://opendata.cern.ch/docs/cms-guide-for-condition-database

نصب ای.اف.اس

Installation on Debian/Ubuntu

(prepared by V. Olsen - 2017-12-06)

Tested on Debian Stretch

Install Packages

```
$ sudo apt install openafs-client openafs-modules-dkms openafs-krb5 krb5-user krb5-config
```

Configure AFS and Kerberos

1. Use "cern.ch" as default AFS cell

```
$ echo "cern.ch" | sudo tee /etc/openafs/ThisCell
```

2. Set up Kerberos authentication

Add the following lines to file `/etc/krb5.conf`:

```
# settings for CERN.CH realm are taken from file
#   lxplus.cern.ch:/etc/krb5.conf

[libdefaults]
  default_realm = CERN.CH

[realms]
  CERN.CH = {
  default_domain = cern.ch
  kpasswd_server = cerndc.cern.ch
  admin_server = cerndc.cern.ch
  kdc = cerndc.cern.ch
  }

[domain_realm]
  cern.ch = CERN.CH
  .cern.ch = CERN.CH
```

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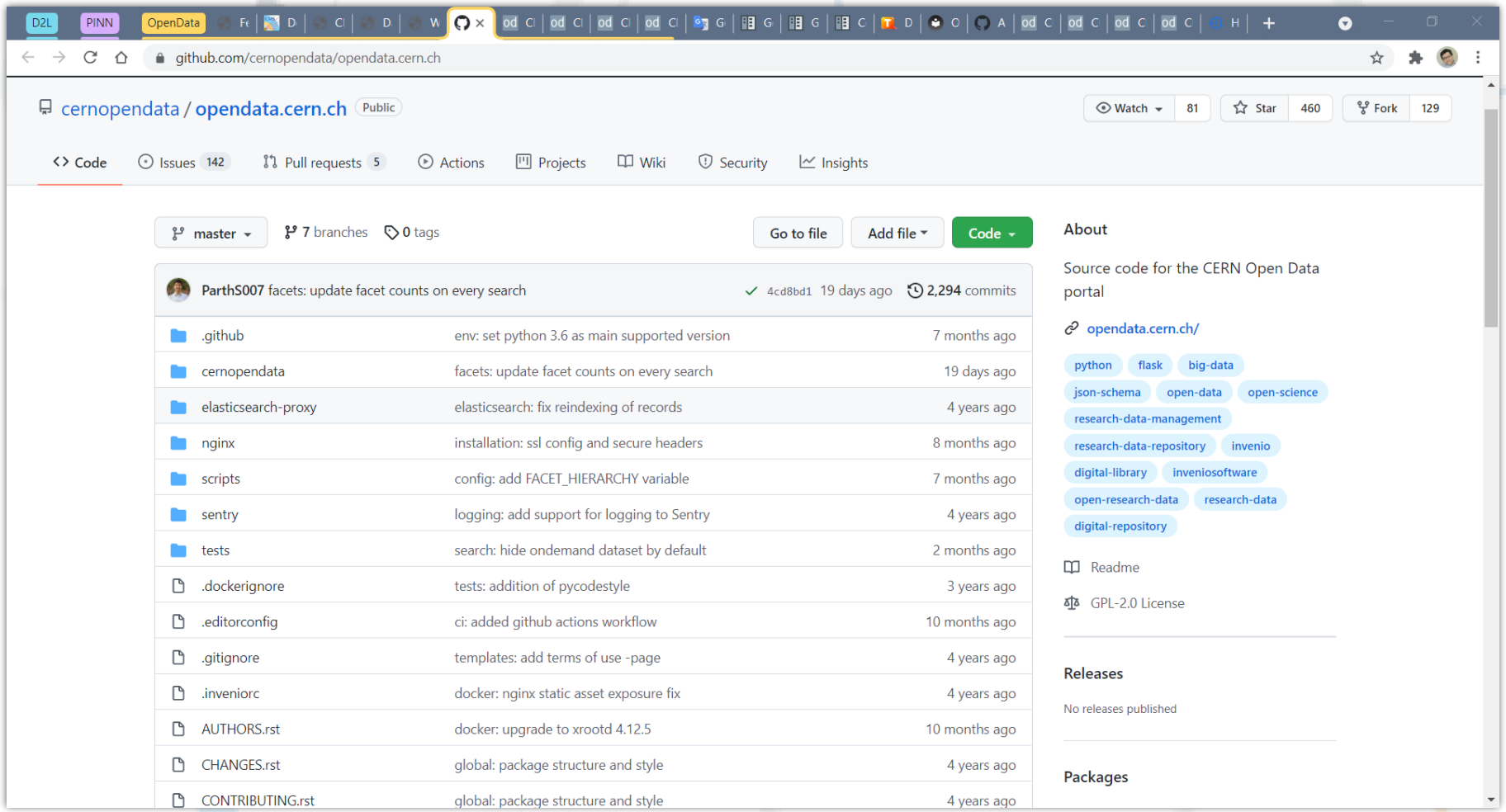
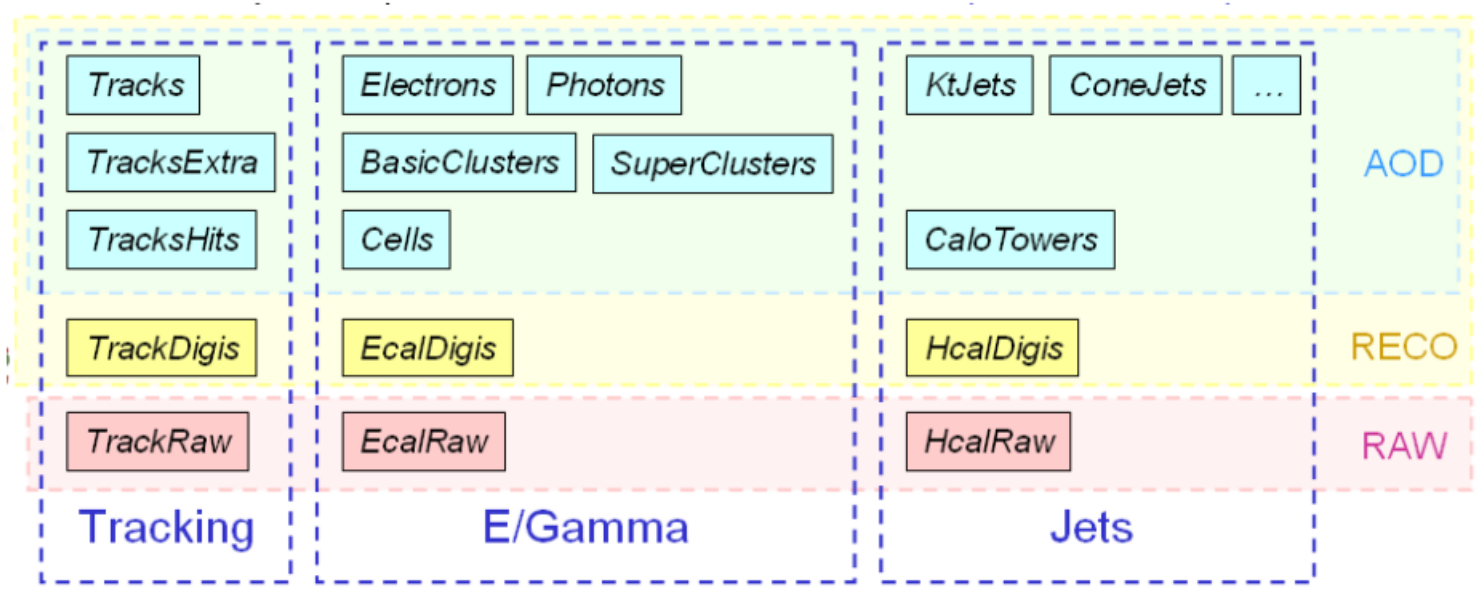
https://cvmfs.readthedocs.io/en/stable/index.html

مثال‌ها و نمونه کدها در «گیت‌هاب»



https://github.com/cernopendata/opendata.cern.ch

انواع و محتویات داده‌ها

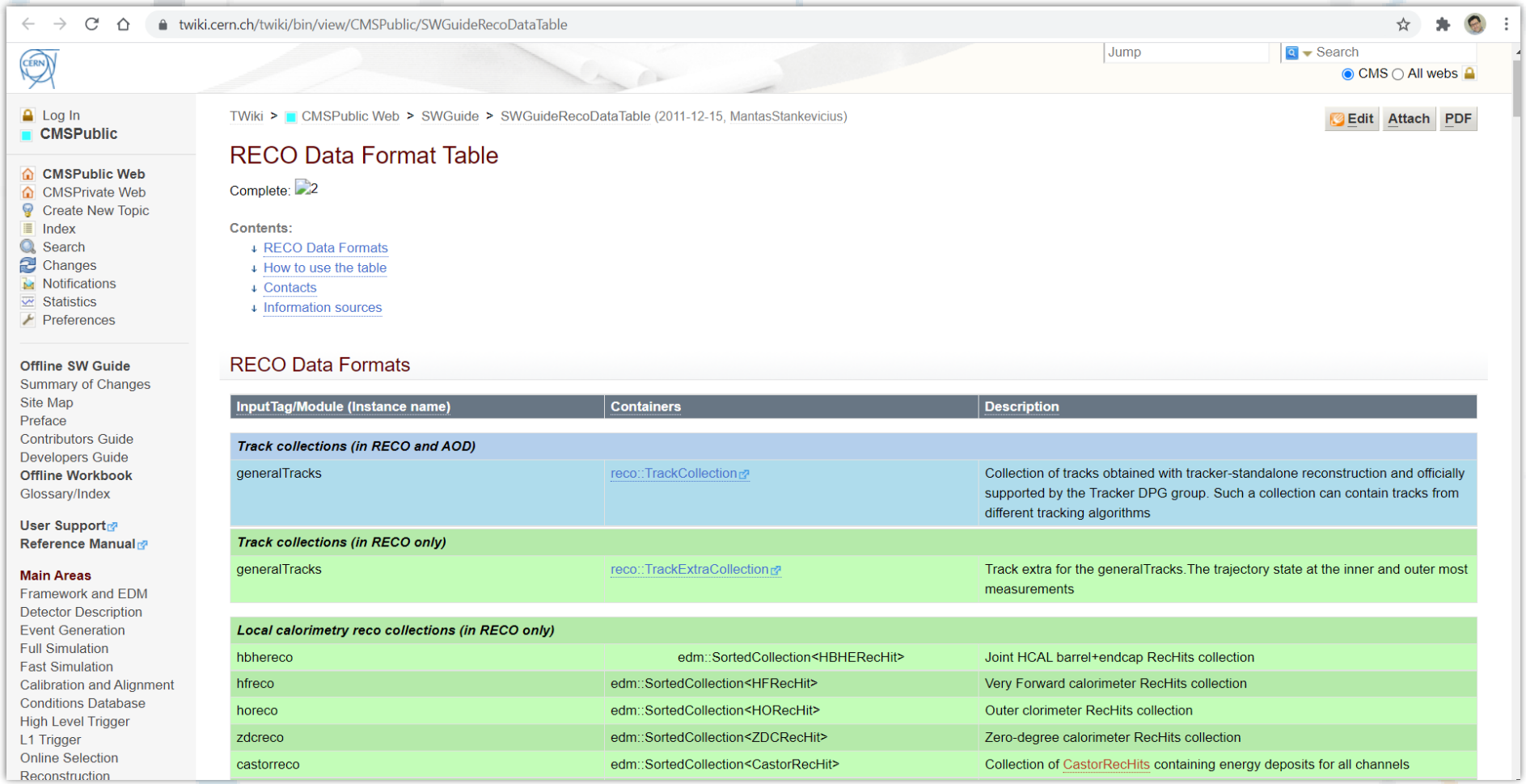


Physics Analysis Toolkit, or PAT.

Group and user skims: RECO, AOD and PAT-tuples

محتوای داده‌های رویدادهای بازسازی شده

https://twiki.cern.ch/twiki/bin/view/CMSPublic/SWGuideRecoDataTable



twiki.cern.ch/twiki/bin/view/CMSPublic/SWGuideRecoDataTable

Jump | Search | CMS ○ All webs

Log In
CMSPublic

CMSPublic Web
CMSPrivate Web
Create New Topic
Index
Search
Changes
Notifications
Statistics
Preferences

Offline SW Guide
Summary of Changes
Site Map
Preface
Contributors Guide
Developers Guide
Offline Workbook
Glossary/Index

User Support
Reference Manual

Main Areas
Framework and EDM
Detector Description
Event Generation
Full Simulation
Fast Simulation
Calibration and Alignment
Conditions Database
High Level Trigger
L1 Trigger
Online Selection
Reconstruction

TWiki > CMSPublic Web > SWGuide > SWGuideRecoDataTable (2011-12-15, MantasStankevicius)

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RECO Data Format Table

Complete: 2

Contents:
- RECO Data Formats
- How to use the table
- Contacts
- Information sources

RECO Data Formats

InputTag/Module (Instance name)	Containers	Description
Track collections (in RECO and AOD)		
generalTracks	reco::TrackCollection	Collection of tracks obtained with tracker-standalone reconstruction and officially supported by the Tracker DPG group. Such a collection can contain tracks from different tracking algorithms
Track collections (in RECO only)		
generalTracks	reco::TrackExtraCollection	Track extra for the generalTracks.The trajectory state at the inner and outer most measurements
Local calorimetry reco collections (in RECO only)		
hbhereco	edm::SortedCollection<HBHERecHit>	Joint HCAL barrel+endcap RecHits collection
hfreco	edm::SortedCollection<HFRecHit>	Very Forward calorimeter RecHits collection
horeco	edm::SortedCollection<HORecHit>	Outer clorimeter RecHits collection
zdcreco	edm::SortedCollection<ZDCRecHit>	Zero-degree calorimeter RecHits collection
castorreco	edm::SortedCollection<CastorRecHit>	Collection of CastorRecHits containing energy deposits for all channels

متشکرم