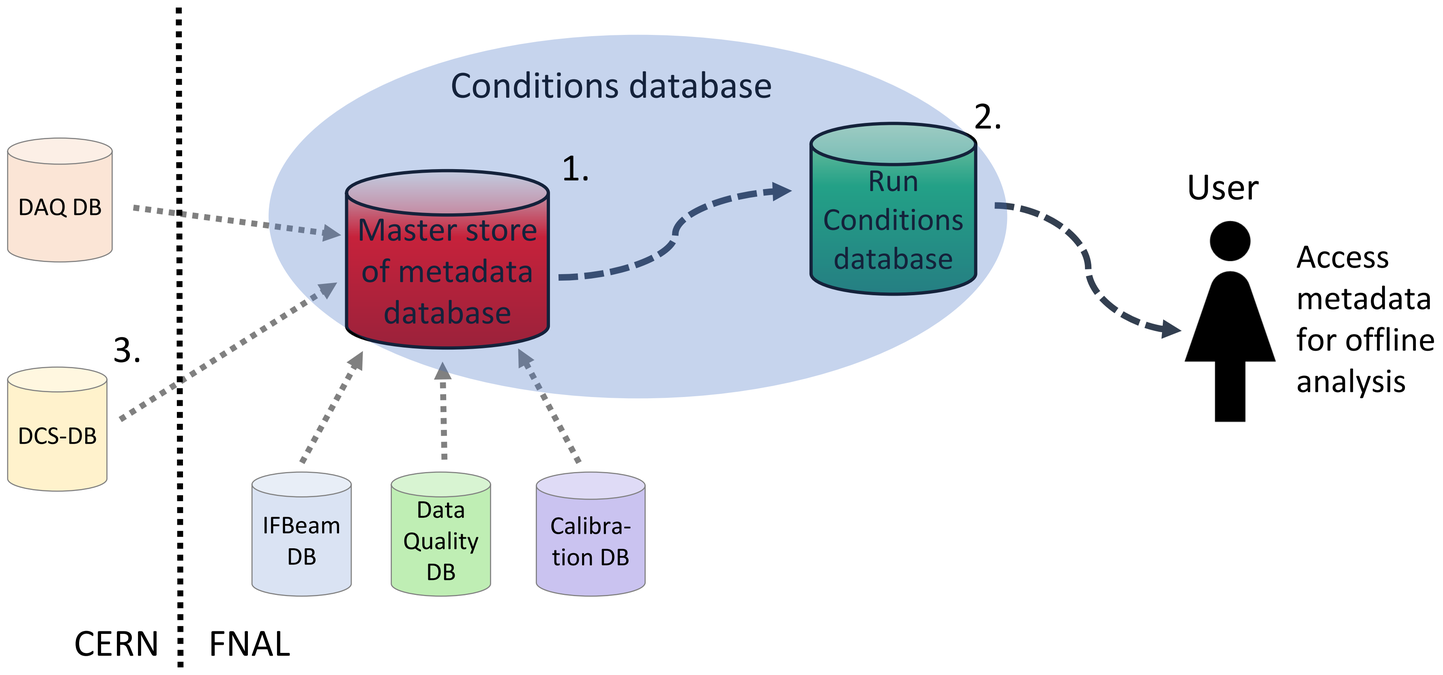
ProtoDUNE Run Conditions Database

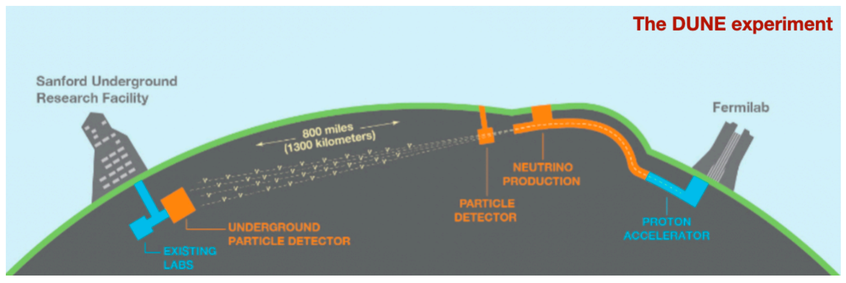
Ana P. Vizcaya Hernández[1], Nilay Bostan[2], and Michael Kirby[3] for the DUNE collaboration
[1]Colorado State University (CSU), [2]University of Iowa (US) & TENMAK (TR), [3]Brookhaven National Laboratory
ana.vizcaya_hernandez@colostate.edu, nilay.bostan@cern.ch, mkirby@bnl.gov

Database (DB) architecture of ProtoDUNE's metadata



Introduction

- **The Deep Underground Neutrino Experiment (DUNE)** is a long-baseline experiment which aims to study neutrino oscillations and Astroparticle physics amongst other things.
- DUNE will consist of two neutrino detectors (the near and the far detectors) placed on the path of the **most intense neutrino beam** in the world [1].



- **ProtoDUNE** is the largest scale prototype of the far detector Liquid Argon Time Projection Chamber (LArTPC) and it is currently deployed at CERN.
- DUNE will produce vast amounts of **metadata**, which describe the data coming from the read-out of the primary DUNE detectors. Various databases will make up the overall DB architecture for this metadata.
- To write robust and reproducible physics results, to carefully monitor the experimental conditions, and to make the relevant metadata accessible to all users, a physics-oriented database was designed for ProtoDUNE metadata.

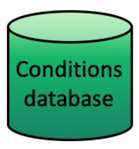
Conditions DB

The subset of all metadata that is accessed during offline data reconstruction and analysis is referred to as **conditions data.** It is stored in a dedicated database, known as **the conditions database**, which has the following characteristics.

- It contains metadata, uploaded daily via cron jobs from several parts of the experiment, such as: DAQ configurations, slow control parameters, beam instrumentation, data quality, and calibration parameters.
- The database allows the stored metadata to be index by time (like slow controls), or by run (like DAQ run configurations).

It consists of the following two PostgreSQL relational databases:

1. The **master store of metadata (UConDB)** database is the centralized place where all the information is stored as blobs.



2. The **run conditions database** stores the metadata in tables. This facilitates querying the metadata to get all the runs with certain characteristics, like runs with HV = 175 kV.

Users can interact with the later database via the following interfaces: python rest API, C++ API, Art interface, and Metacat which is ProtoDUNE's metadata file catalog.

The ProtoDUNE run conditions table has the following characteristics:

- It lives in the conditions database
- It contains the experimental conditions needed for offline analysis, reconstruction, and monitoring
- It uses run numbers to index the metadata
- Studies have been done to upload the metadata in the needed granularity
- Detailed user documentation, with information on the user interfaces and on the table metadata (table 1) can be found in [3]

Table 1. Information of the run conditions metadata. The full version can be found in [3]

Metadata	tv	tr	data_type	...
Unit	N/A	Unix timestamp	N/A	...
Example	25033	1713497099	np02_coldbox or np04_hd	...
Comment	Run Number	Used for versioning	Detector being used	...

Slow Controls

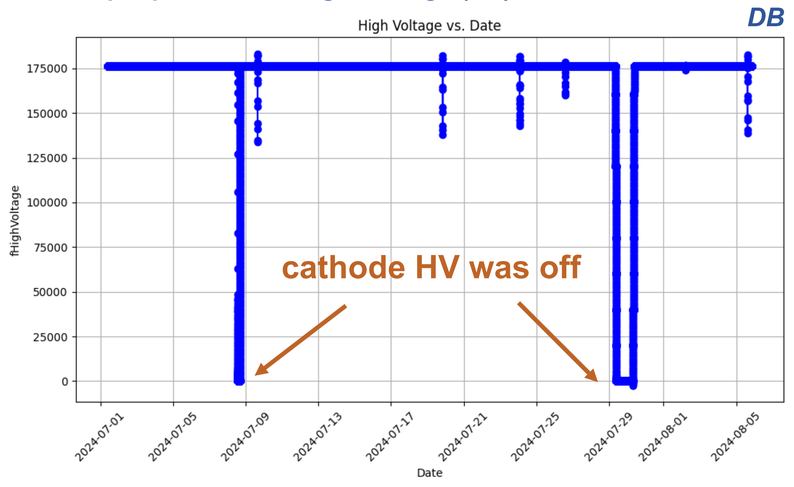
The slow control metadata, unique to the condition of the detectors before, during, and after the data collection period, is contained in the

3. 'Detector Control System Database (DCS-DB)' [2] where each slow control device has a corresponding sensor ID.

Time stamps are used to index the data, which is then kept in DCS-DB

- ***The DCS-DB has all components — hardware and software — necessary for the appropriate operation of the detector.*** Liquid Argon temperature & purity, power supply voltage, and current measurements are a few instances of **slow controls metadata.**
- The DCS-DB stores sensor values at a high rate, producing $\mathcal{O}$ (10GB)/day, a deep understanding of the sensors is important to migrate just a subset of its data to the conditions database.

Example plot for the High Voltage (HV) values from the DCS-DB



In the plot for the HV values the cathode HV was off during some time periods. This explains the lack of cosmic data detected at that time.

- The mean and standard deviation of selected sensors from the DCS-DB will be taken and uploaded to the run conditions table in the conditions database.

Conclusion

The conditions metadata from sources such as DAQ, Slow Control, and Beam databases is stored in the ProtoDUNE Run Conditions Database, which is a PostgreSQL relational database. A python, C++, and an art interfaces were developed to facilitate user interaction with the database. Furthermore, it was integrated into Metacat, the metadata file catalog.

A fragment of the slow controls data was studied in order to store the needed subset in the conditions database. We depict the process of retrieving, analyzing, and storing the slow controls data in a proper format.

Acknowledgments

The ProtoDUNE detector was constructed and operated on the CERN Neutrino Platform. We gratefully acknowledge the support of the CERN management, and the CERN EP, BE, TE, EN and IT Departments for NP04/NP02. This document was prepared by the DUNE collaboration using the resources of the Fermi National Accelerator Laboratory (Fermilab), a U.S. Department of Energy, Office of Science, HEP User Facility. Fermilab is managed by Fermi Research Alliance, LLC (FRA), acting under Contract No. DE-AC02-07CH11359. We acknowledge the support of the U.S. Department of Energy, through the grants DE-SC0010113 and DE-SC0022271.

References

[1] DUNE Collaboration, main web-page (2020), https://www.dunescience.org
[2] DUNE Offline Computing Conceptual Design Report, arXiv:2210.15665.
[3] https://wiki.dunescience.org/wiki/Run_Conditions_Table