

Introduction

- The Jiangmen Underground Neutrino Observatory (JUNO)
 - Primary scientific goal: determination of the neutrino mass ordering
- Data Quality Monitoring (DQM)
 - To ensure taking quality data
 - Find emerging problems, remind the shifter to fix them in time

JUNO DQM Framework

- Job Server
 - Job module, merge module
 - Message system
 - Synchronize histograms periodically
- Web Server
 - Web module (back-end, front-end deployment)
 - Web browsing
 - Accessible from the internet

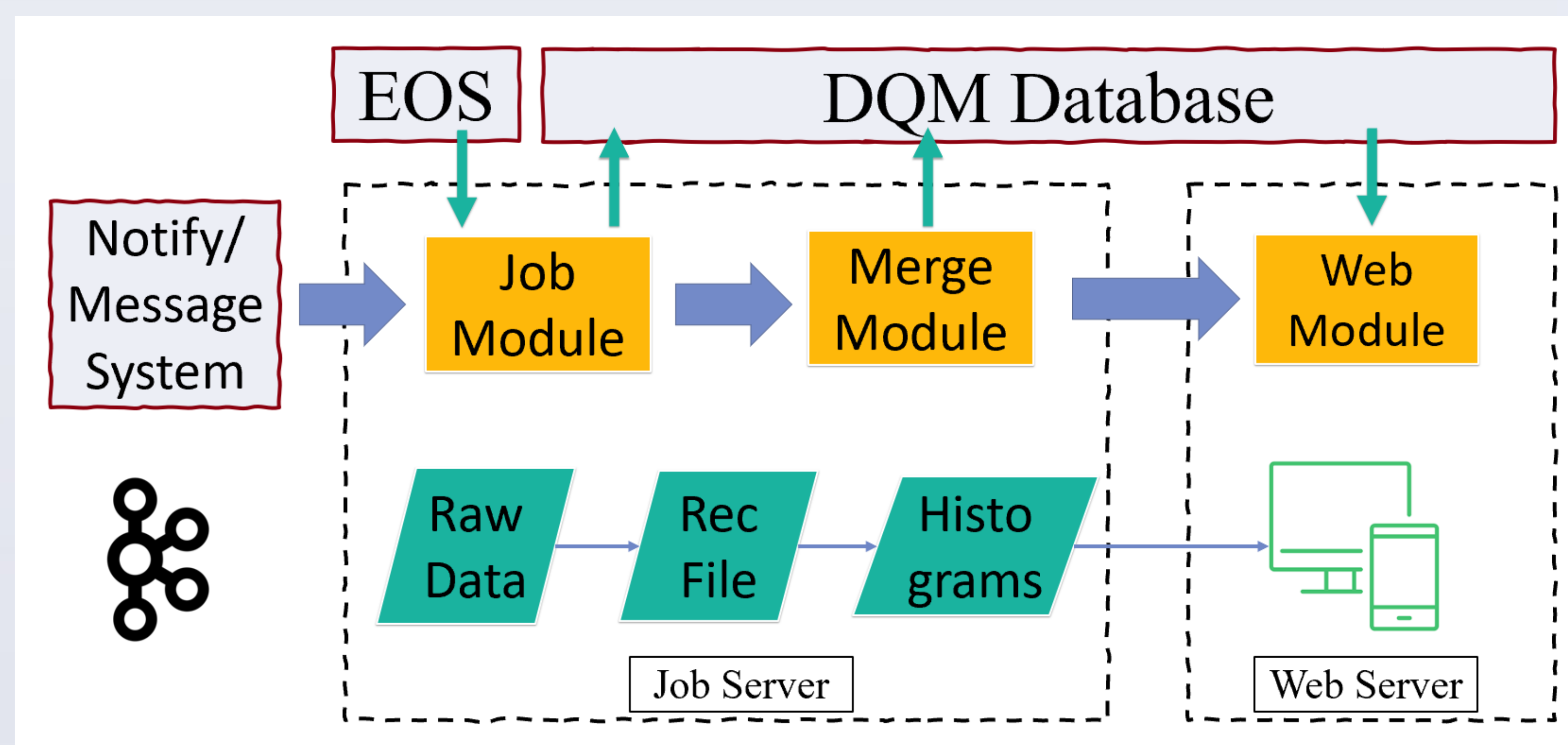


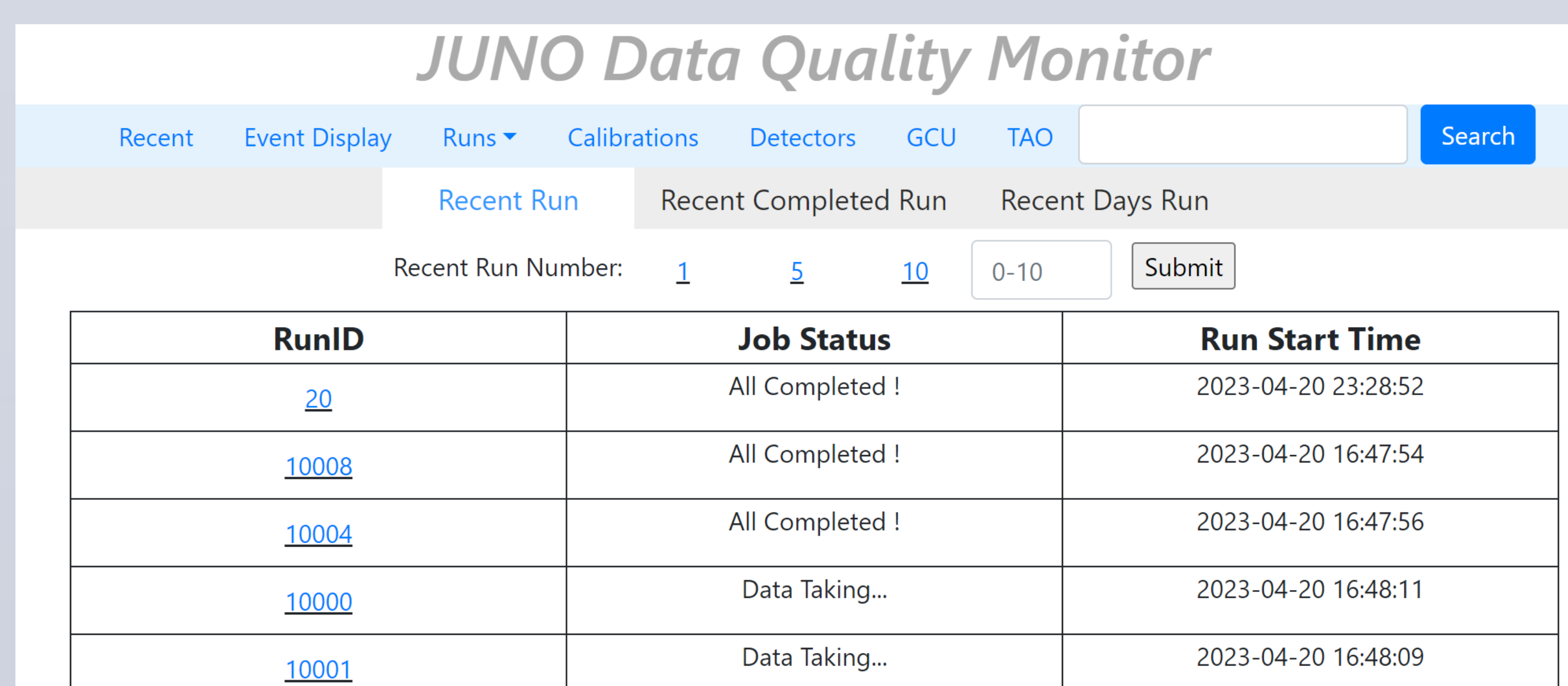
Figure 1: The framework of JUNO DQM system

JUNO DQM Database

- JUNO DQM Database
 - MySQL database, installed on the web server
 - Record file parameters (job name, rec method and so on)
- Interaction with Job Server
 - Job server, inside the firewall, have access to the DB
 - Scripts for adding, deleting, making changes to the database
 - Each job completes specific steps, execute these scripts

JUNO DQM Web Interface

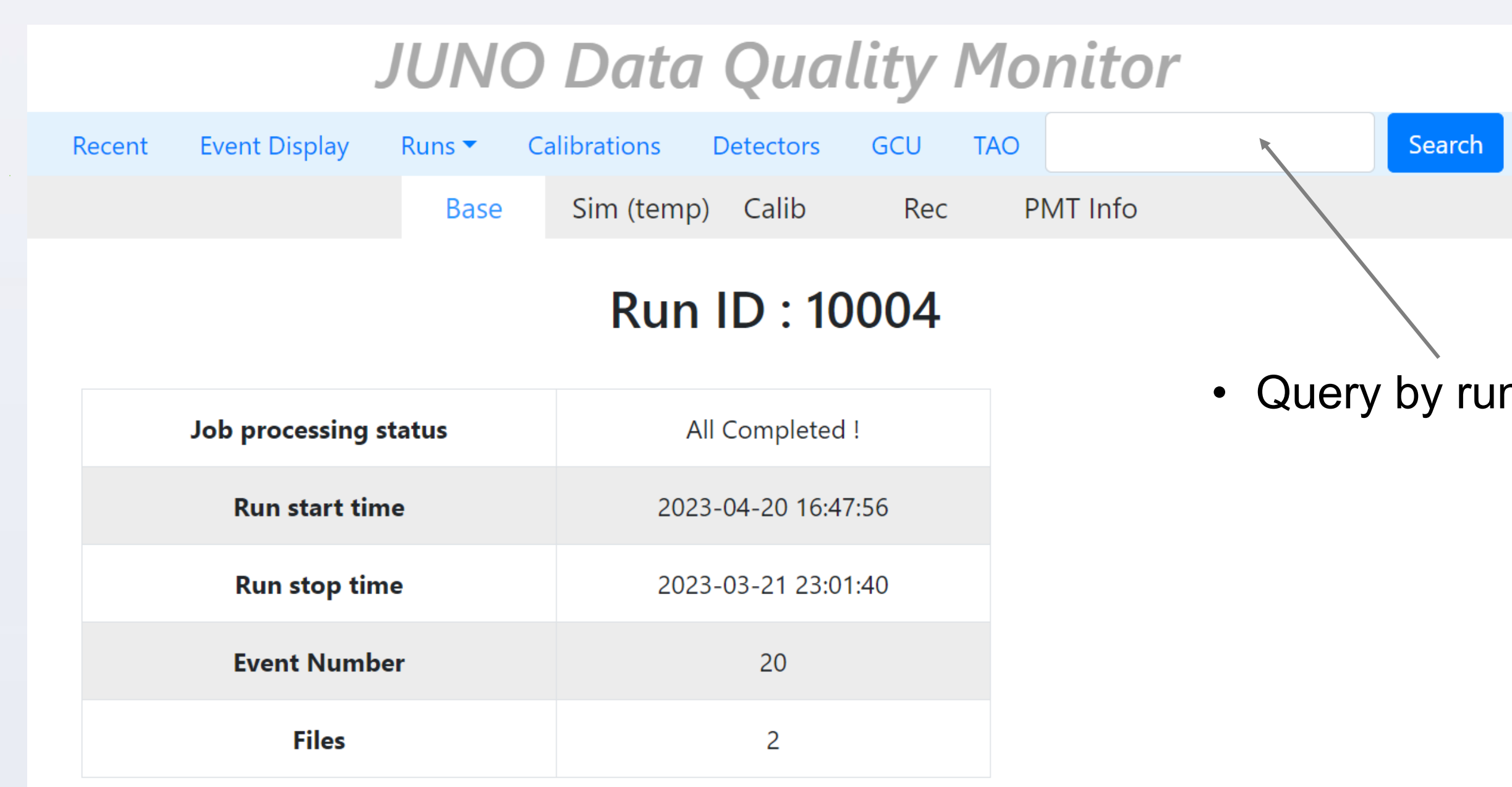
- Recent run web interface
 - Get information from the JUNO DQM database
 - Filter, sort, display by the Run end time
 - Search by
 - (a) Recent Run; (b) Recent Completed; (c) Recent Days Run
 - Run Status:
 - (a) Data Taking; (b) Rec Running;
 - (c) Partly Completed; (d) All Completed



RunID	Job Status	Run Start Time
20	All Completed !	2023-04-20 23:28:52
10008	All Completed !	2023-04-20 16:47:54
10004	All Completed !	2023-04-20 16:47:56
10000	Data Taking...	2023-04-20 16:48:11
10001	Data Taking...	2023-04-20 16:48:09

Figure 2: The recent run webpage of JUNO DQM

- Run ID web interface
 - Display information based on JUNO DQM database
 - Base tab: display run necessary information
 - Run status, run start time and so on
 - Calib, Rec tab: display histograms



JUNO Data Quality Monitor	
Recent	Event Display
Runs	Calibrations
Detectors	GCU
TAO	
Base	Sim (temp)
Calib	Rec
PMT Info	
Run ID : 10004	
Job processing status	All Completed !
Run start time	2023-04-20 16:47:56
Run stop time	2023-03-21 23:01:40
Event Number	20
Files	2

Figure 3: The run ID webpage of JUNO DQM

- PMT Information web interface
 - JUNO Large PMT (17612 LPMT)
 - No identifier module, CSV file (PMT ID to 3D coordinates)
 - Aitoff projection

Dead PMT

- Default hit cut < 1%
- Test hit cut < 6%
- Dead PMT number: 1

Hot PMT

- Default hit cut > 99%
- Test hit cut > 13%
- Hot PMT number: 7

Normal PMT

- Default hit cut 5%~15%
- Test hit cut 9.32%~9.42%
- Normal PMT number: 684

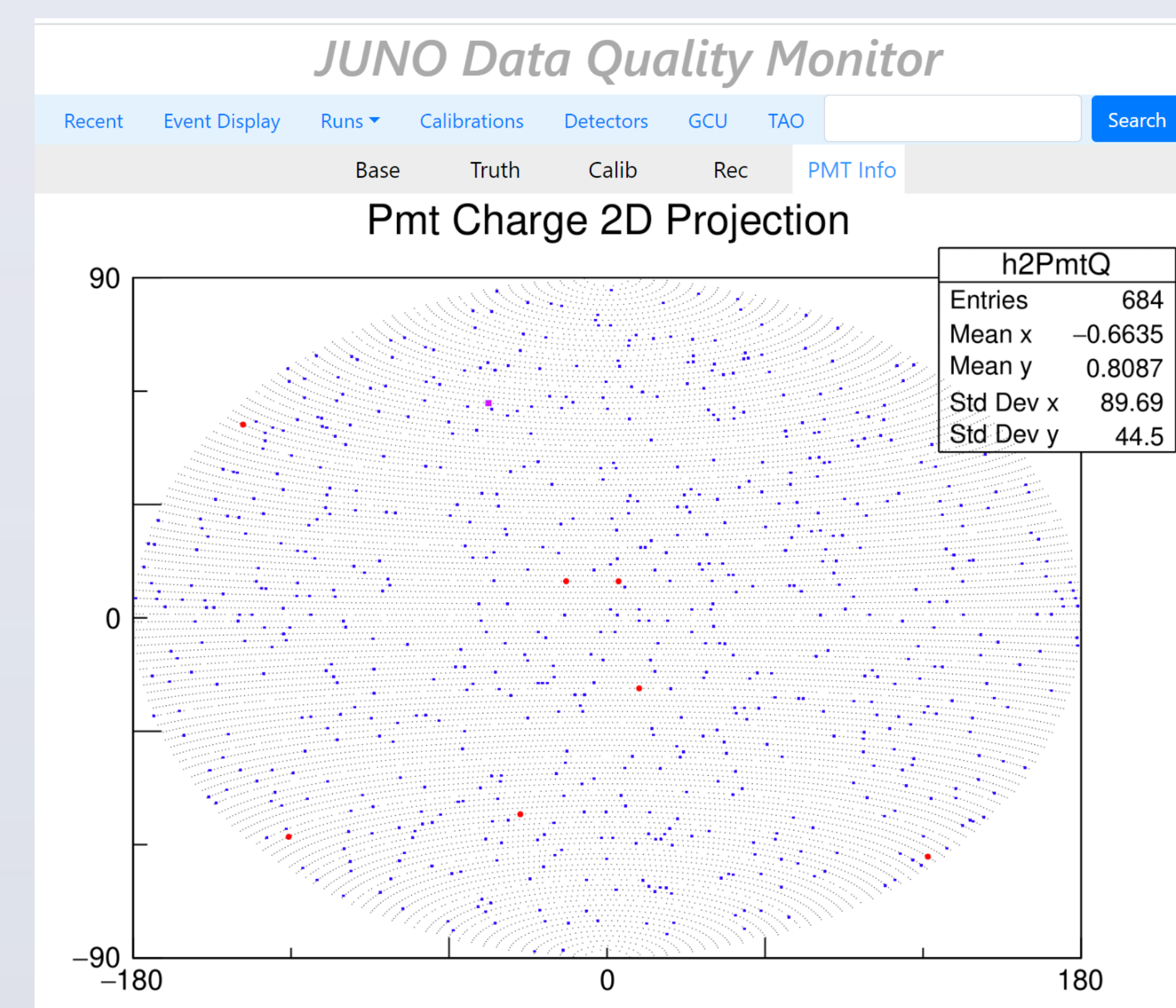


Figure 4: The PMT information webpage of JUNO DQM (Test)

JUNO DQM Message System

- JUNO DQM message system
 - Receive messages from the SPADE system
 - When receive a message, produced a job script based on the message
 - Download files from EOS
 - Calibration, reconstruction, merge, histograms

JUNO DQM Computing

- ~1000 CPU cores and disk storage, network
- Event rate 1 kHz, 60 MB/s, 60 kB/event in raw data
- To reconstruct one file
- 5 GB / raw data file
- ~ 80 k events / file
- ~ 80 s data taking
- To reconstruct one file
 - 1~2 day if single CPU core
 - Multi-thread reconstruction required
 - Event sampling required
- If using 8 threads & sampling 20% events, reconstruct 1 raw data file in ~ 1 hour