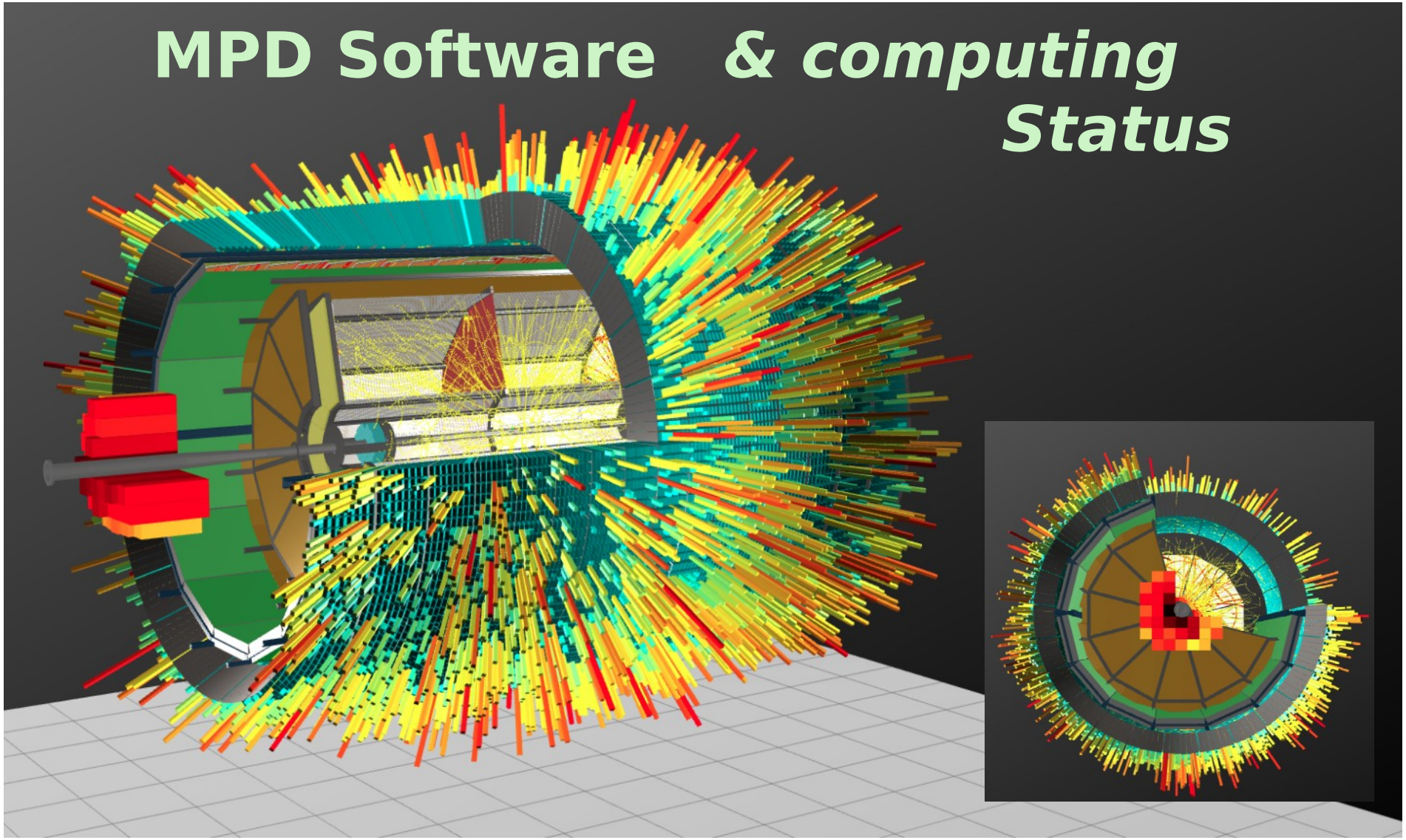
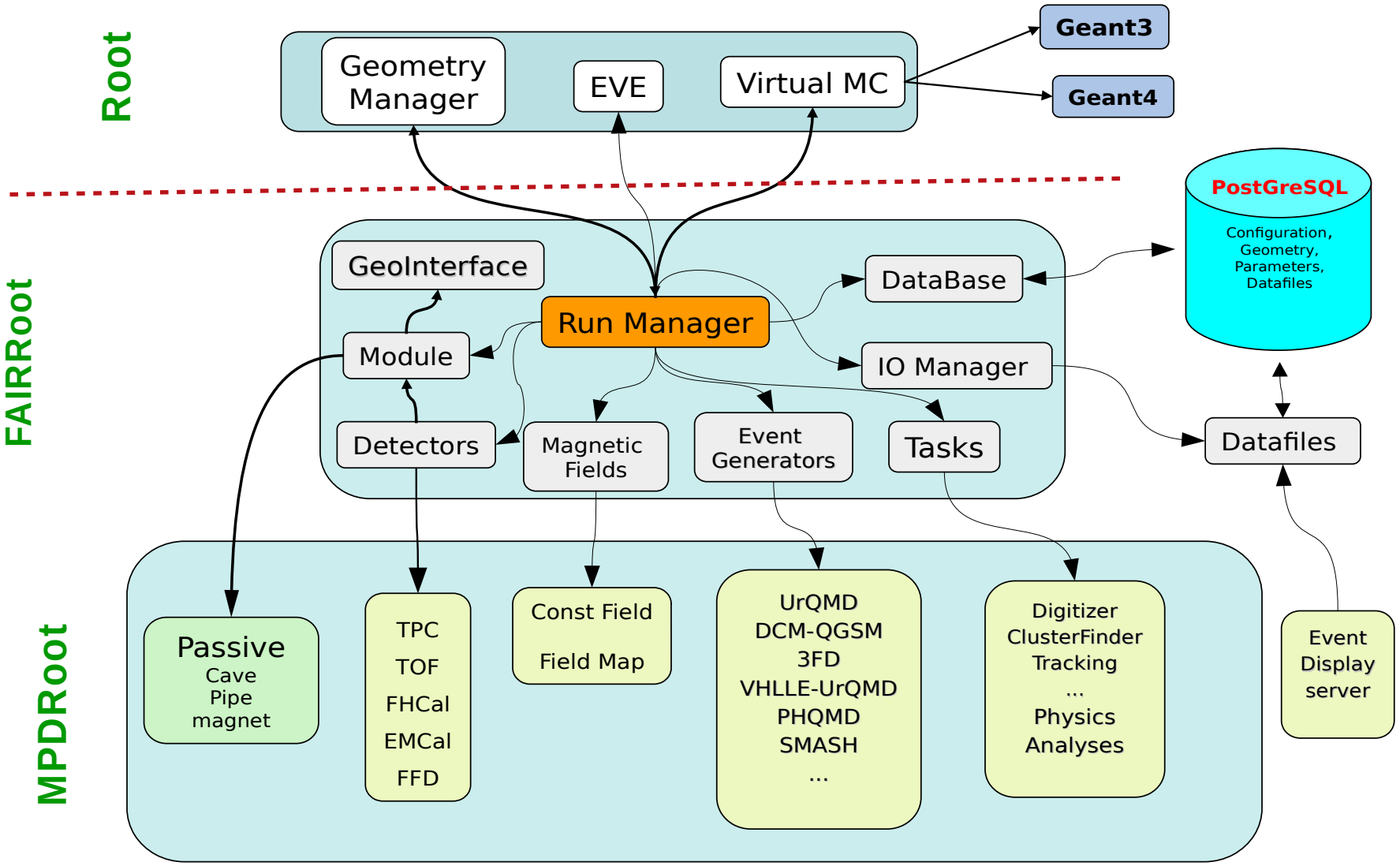
MPD Software & computing Status



Rogachevsky Oleg
for MPD collaboration

X MPD collaboration meeting
9.11.2022
Dubna

MpdRoot structure



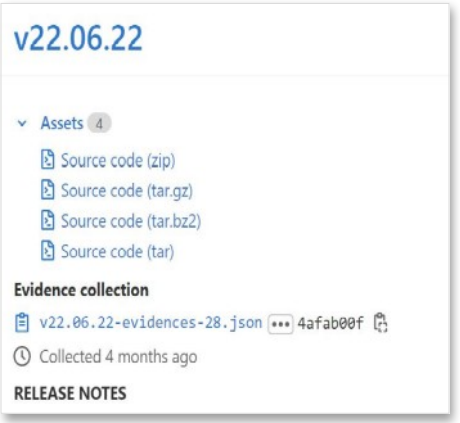
Releases 2022

MOST IMPORTANT CHANGES

git.jinr.ru/nica/mpdroot/-/releases

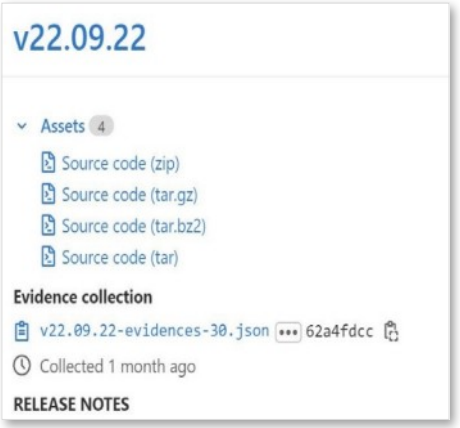
Latest dependencies
- ROOT v6.26/08
- FairRoot v18.6.8
- GEANT4 v11.0.2
- GSL v2.7

Cleanup
- Proof
- Fluka config
- CentOS 8 support (EOL)
- config dir
- old installation method



New features
- Acts library support
- NICA scheduler modularized
- Uninstall option
- GSL in external scripts use
- Website complete overhaul
- FFD, ZDC updates

Development related
- Reconstruction identity test
- 4+ years old memleak bug under control
- critical bug with creation of corrupted root files fix
- URQMD generator build test



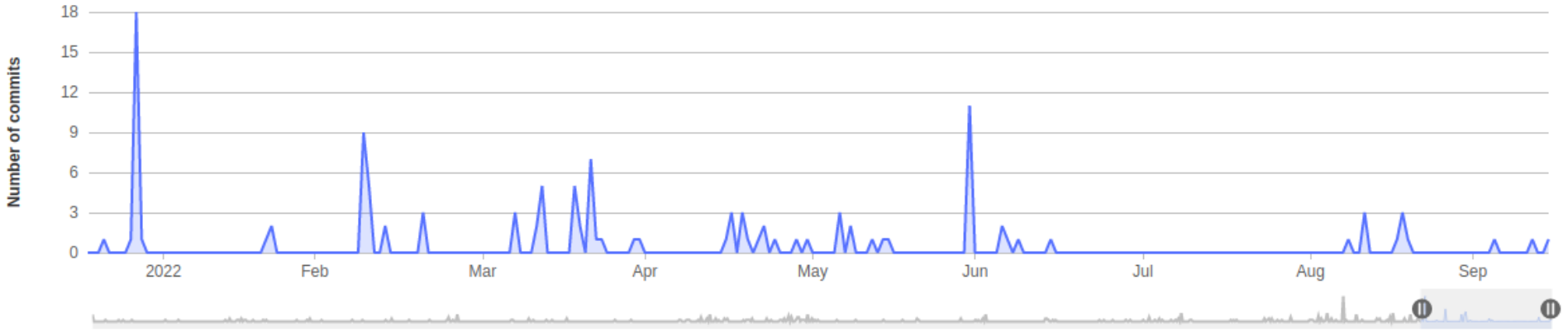
MPD Software status (GIT)

NICA › mpdroot › **Contributors**

dev | History

Commits to dev

Excluding merge commits. Limited to 6,000 commits.



Account	Source	Access granted	Max role	Expiration	
Alexander @akrylov	Direct member	7 months ago by Oleg Rogachevsky	Developer	Expiration date	Remove member
Alexander Bychkov @abychkov	Direct member	6 months ago by Nikita Balashov	Developer	Expiration date	Remove member
Alexander Mudrokh @amudrokh	Direct member	6 months ago by Nikita Balashov	Developer	Expiration date	Remove member
Alexander Zinchenko @zinchenk	Direct member	6 months ago by Nikita Balashov	Developer	Expiration date	Remove member
Alexey Zhemchugov @jemtchou	NICA	2 years ago by Administrator	Maintainer	Expiration date	
Andrey Moshkin @amoshkin1	Direct member	6 months ago by Nikita Balashov	Developer	Expiration date	Remove member

MPDroot code development

Hnatic Slavomir report

SOFTWARE ENGINEERING

PRODUCT DEVELOPMENT

- R&D valid concepts integrated into whole
- Not in conflict with existing development
- User/developer friendliness
- Extensible
- Maintainable
- Not requiring unmanageable (geeky) support
- Compact, modular
- Follows SE principles & best practices

MPDROOT CODING RULES

Basic truths

1. It's harder to read the code, than to write it
2. Capability based approach being the most effective

Focus

- readability
- design
- general rules:

https://mpdroot.jinr.ru/mpdroot-naming-convention/

Test-Driven Development (TDD)

Cluster Hit Finder

Preparatory work

- get rid of geometry singleton
- create **invariant** Base class for geometry

Create interface

- inheriting from FairTask
- interface dependencies should be passed by **injection**
- clusterhitfinder units, candidates for pure virtual methods: findClusters, findHits

Implementation

- current Mlem algorithm to be adapted to interface (reconstruction identity criterion)
- new fast clusterhitfinder to be adapted to interface
- both algorithms are standardized and testable on levels of:
  - implemented pure virtual methods
  - implemented interface
  - reconstruction

MPD deployment

Hnatic S.,
Vala M.,
Busa J.

PREVIOUS DEPLOYMENT PROCEDURE

NEW DEPLOYMENT ARCHITECTURE

SETUP

LOCAL MACHINE
- Toolbox

AliBuild Environment Container

CVMFS Service Container

CVMFS Server
with
MPDRoot modules

CLUSTER
- AliBuild Environment
- CVMFS Service

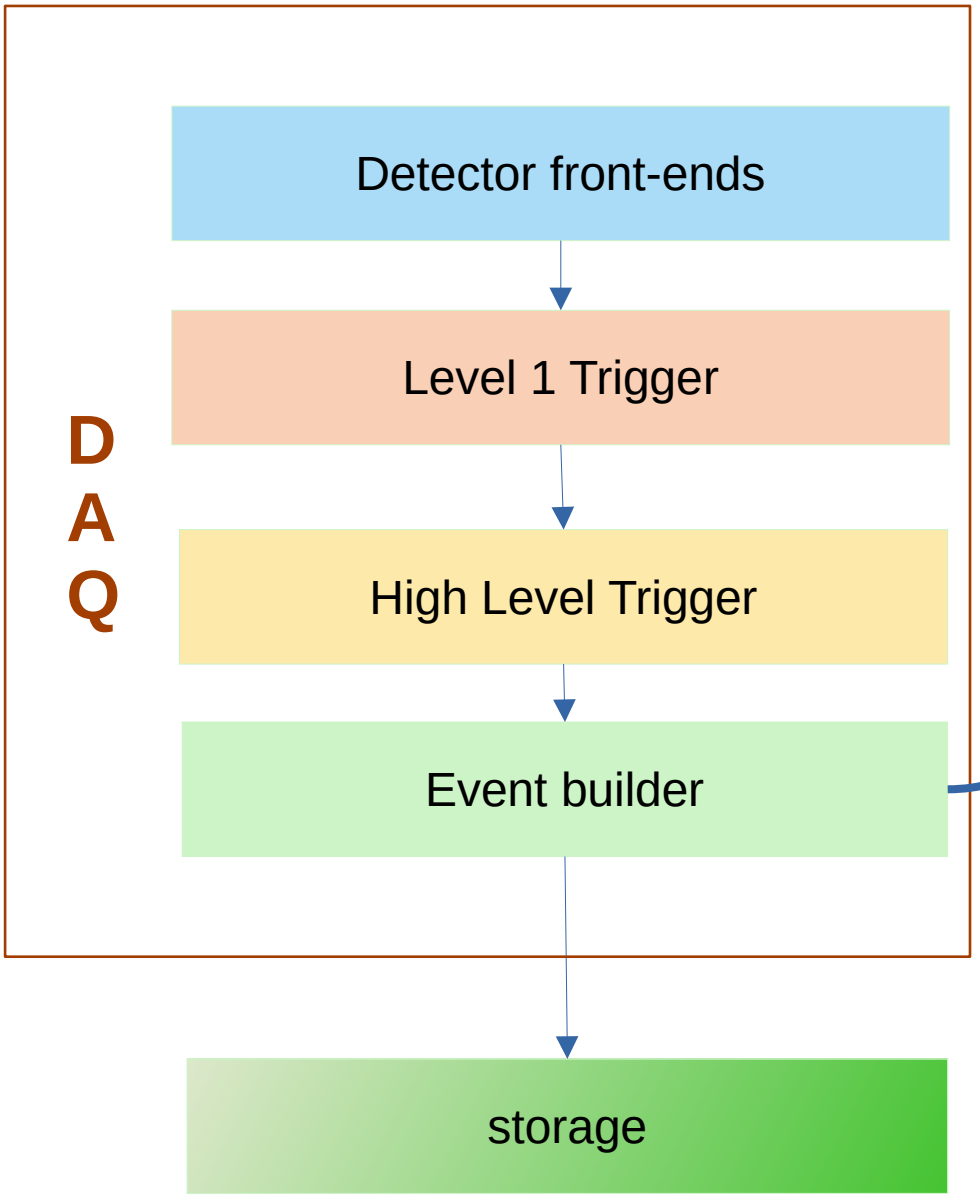
HybriLIT
NICA LHEP
CICC

MLIT JINR (MICC)

Only toolbox package
(with podman dependency)
needed for local deployment

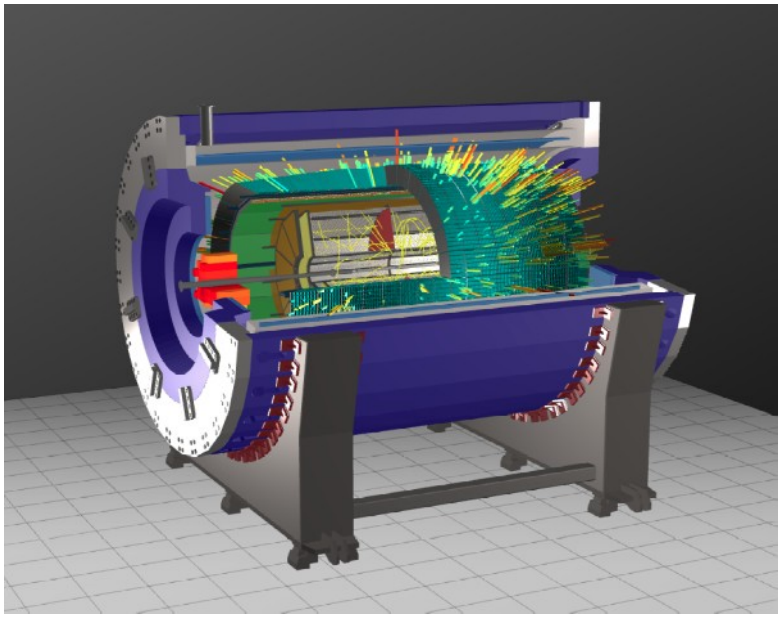
- packages deployed as modules
- multiple versions can coexist
- modules dependencies are stored in crypto hash (similar to NixOS)

MPD dataflow (very raw)



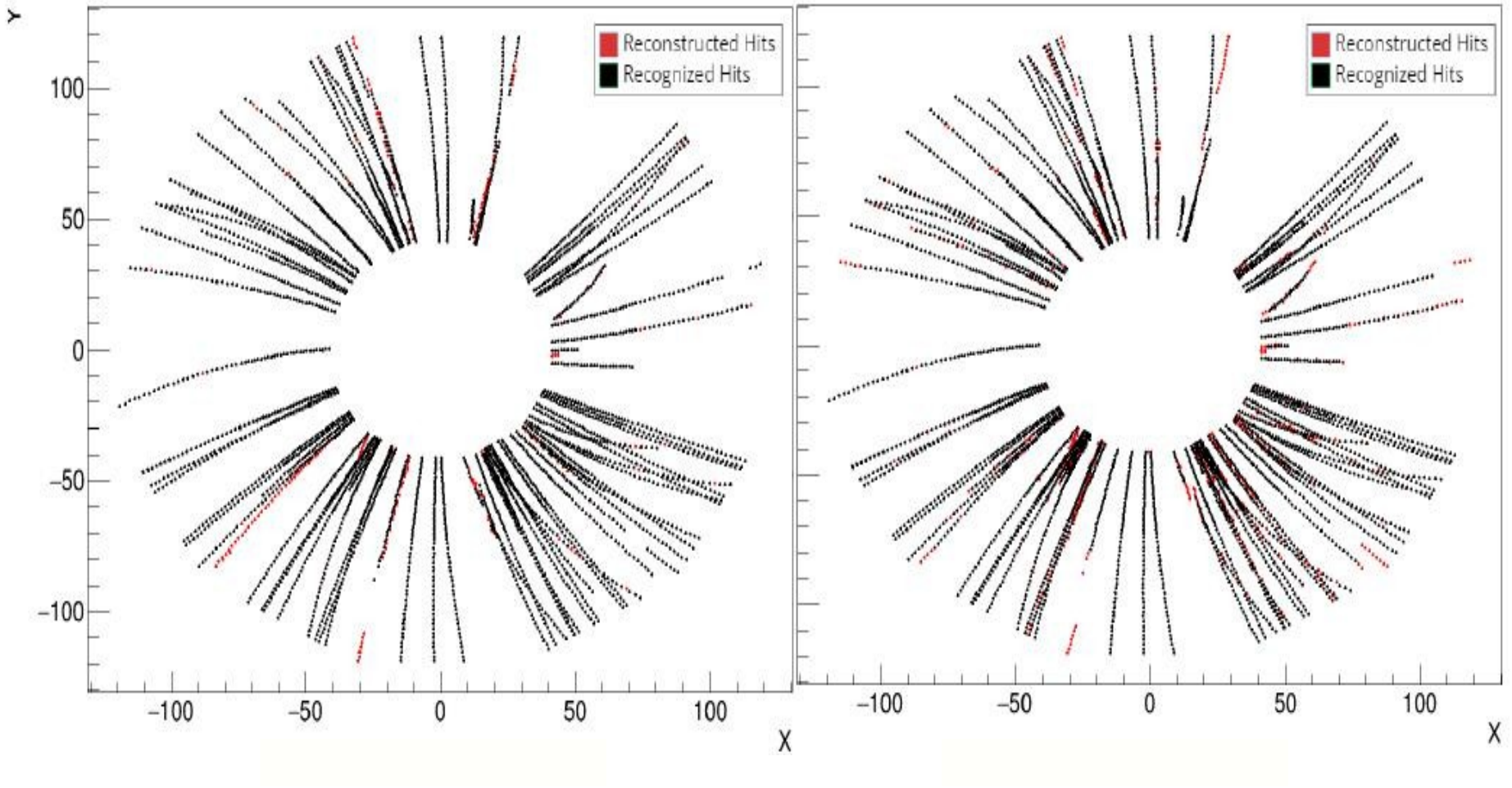
TPC fast clusterfinder

Event display server



Control room & elsewhere in the universe

TPC online fast clustering

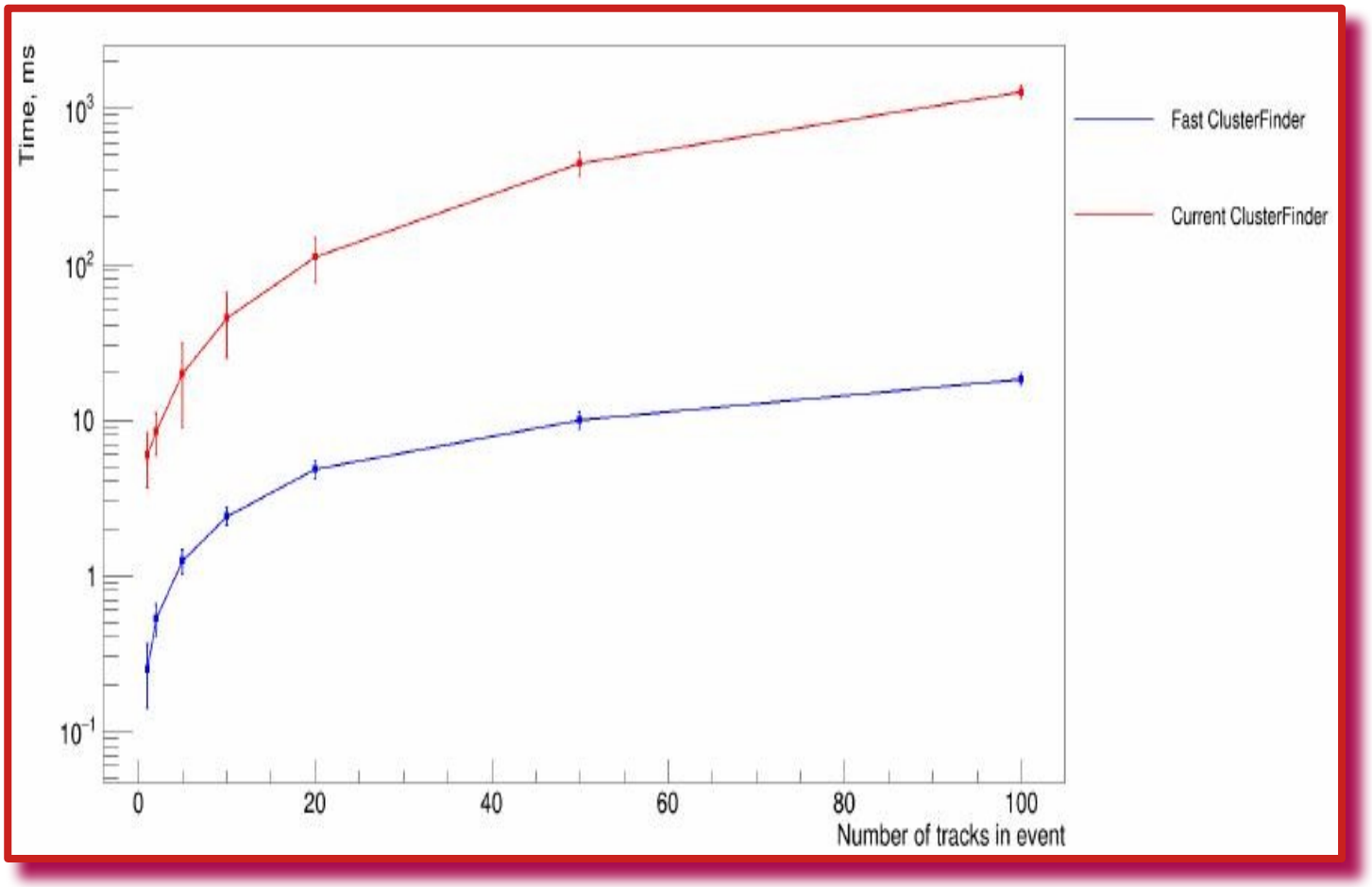


Present cluster finder

Fast cluster finder

TPC online fast clustering

Krylov Alexandr report



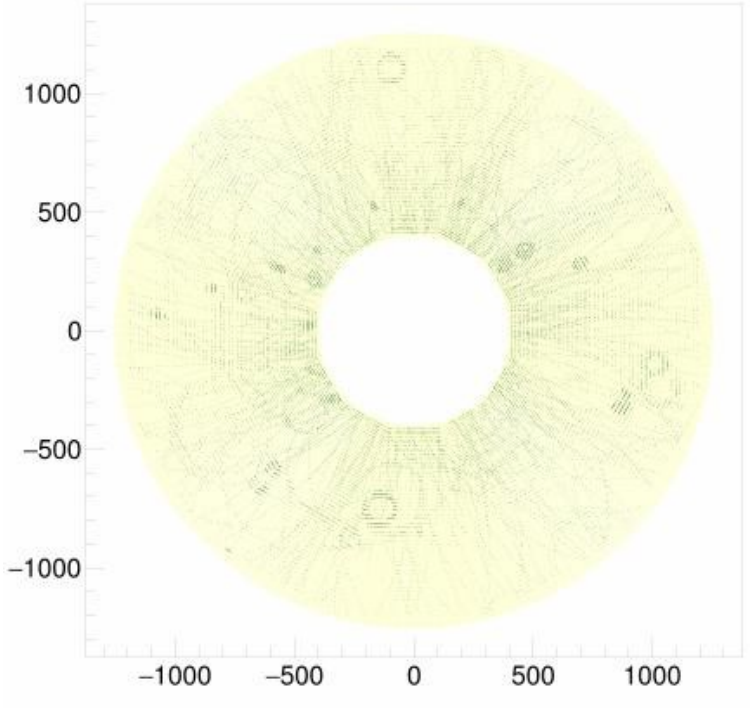
TPC tracking with ACTS (first step)

The A Common Tracking Software (Acts) project is an attempt to preserve and evolve the track reconstruction software of the LHC era towards HL-LHC and beyond.

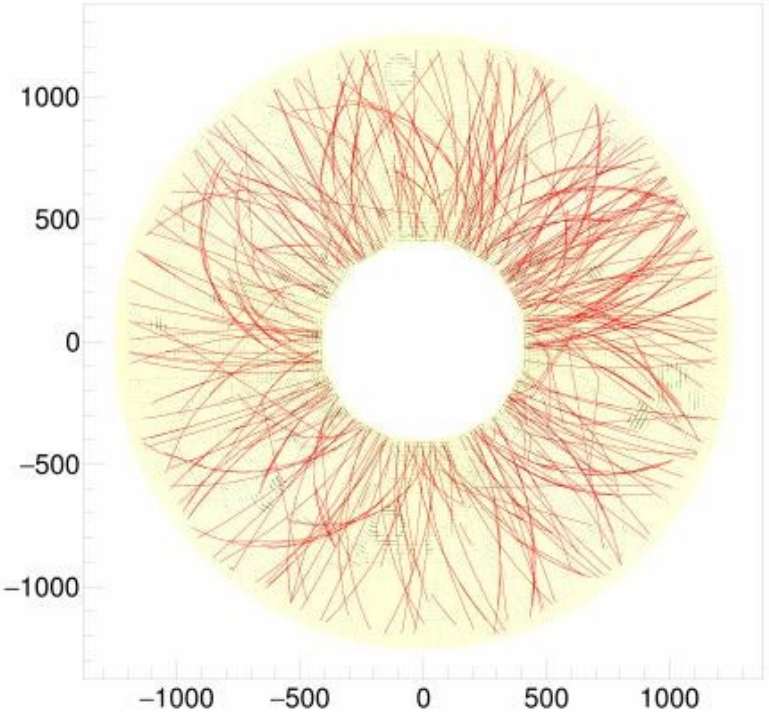
Kamkin Alexander report

UrQMD AuAu
$\sqrt{s} = 9$ GeV

Hits



Tracks



(Software) tasks for TPC commissioning

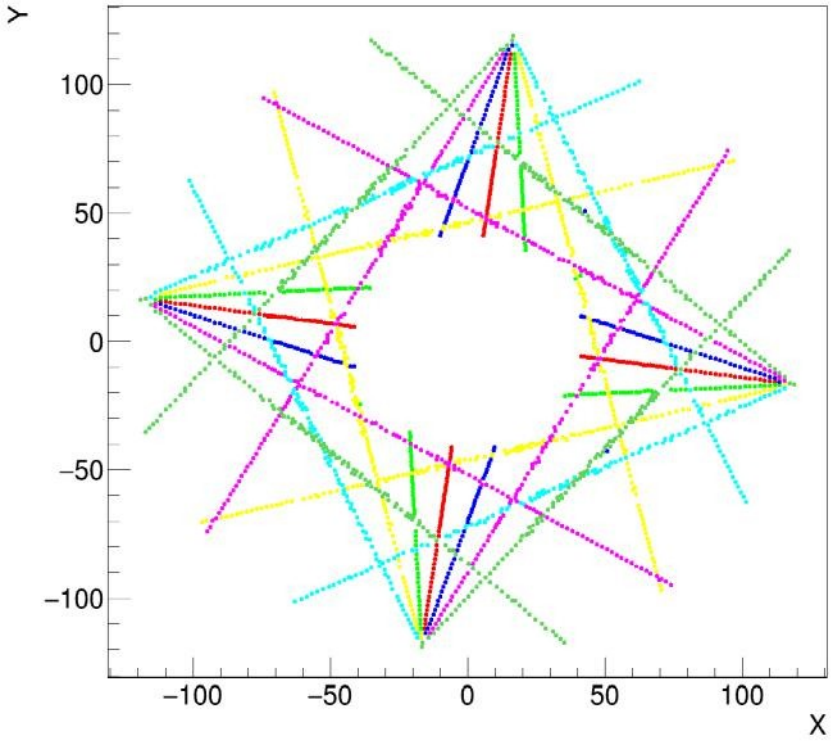
- Alignment
- ExB effect study $\Delta r\varphi$ (B_z)
- Momentum resolution $\Delta p_T(p_T)$
- Drift length dependence σ_y (L_{drift})
- Noise distribution within TPC
- Field of charge distribution in TPC
- ...

TPC laser calibration for electron drift velocity (root version)

Bychkov A.

Space-charge distortion in TPC volume change the electron drift velocity (≤ 1sec.)– corrections are needed.

Reconstructed hits of the laser grids



Reasons:

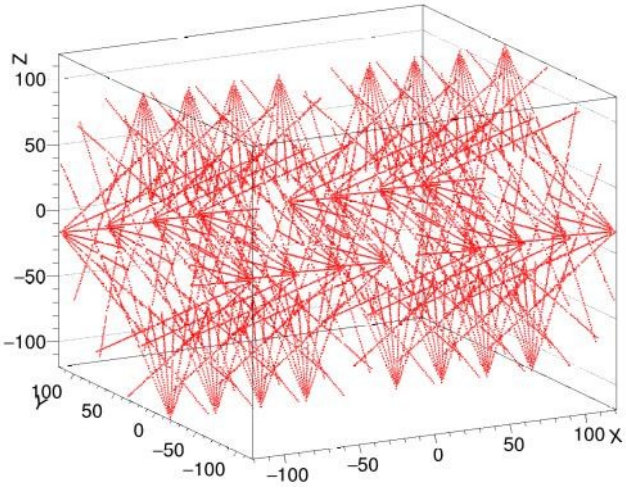
- Variation in drift velocity caused by gas mixture, temperature, pressure and electric field variation.
- Radial inhomogenities of magnetic and electric field.
- Space charge distortions due to high multiplicity in nucleus-nucleus collisions.
- TPC misalignment in the magnet and existence of the global E X B effect.

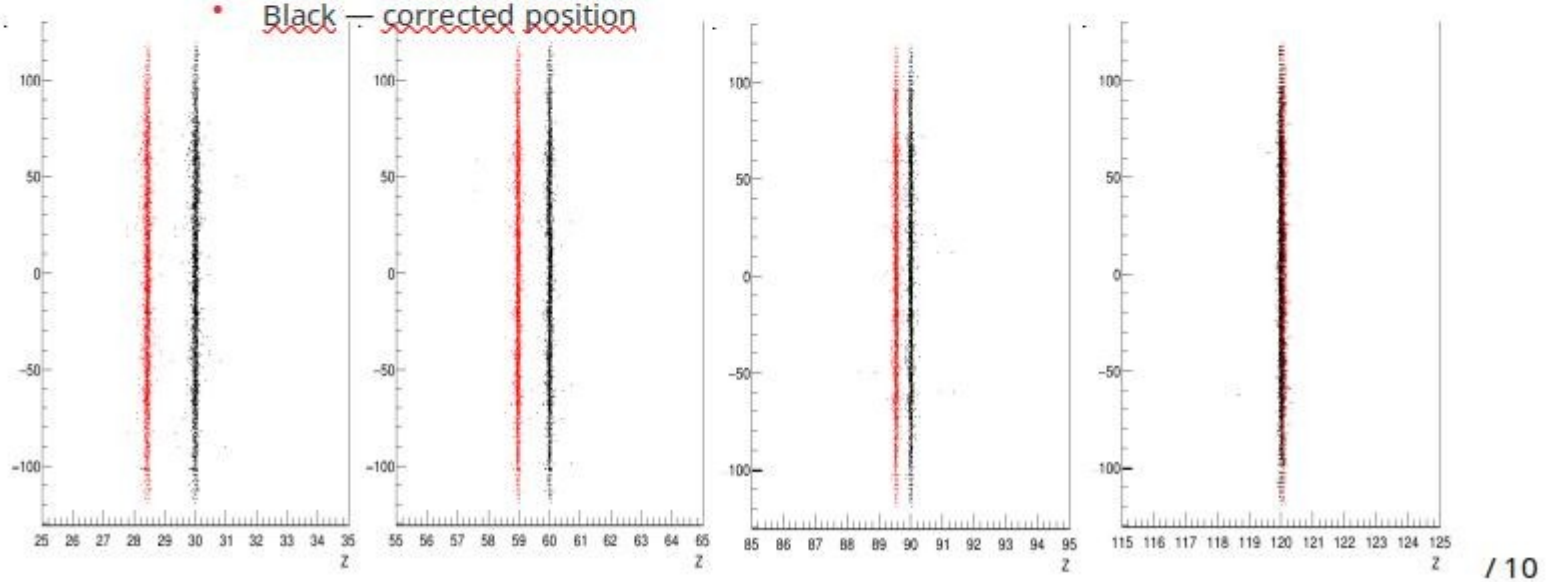
TPC electron drift velocity calibration
(standalone fast version)

Bychkov A.

Test for drift velocity correction

- Source data
  - True drift velosity = 5.5 cm/μs
  - Simulated drift velocity = 5.4 cm/μs
  - Test on laser grid itself
    - Red — measured position
    - Black — corrected position



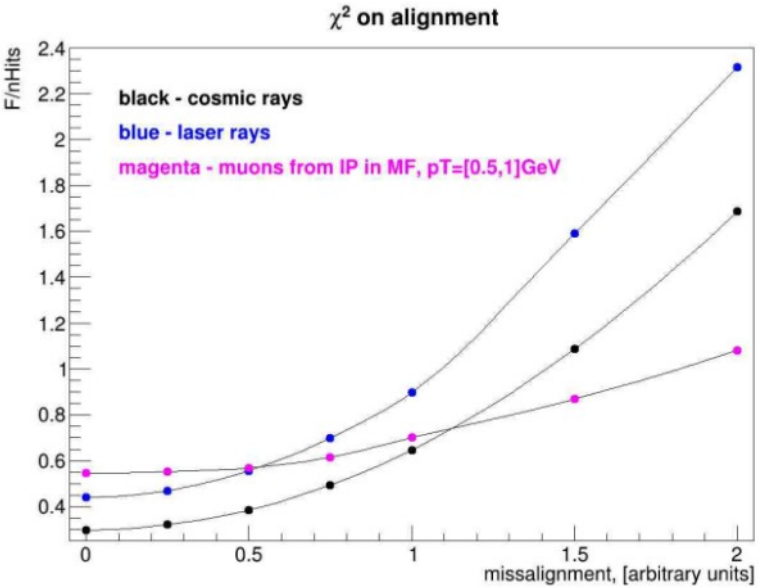


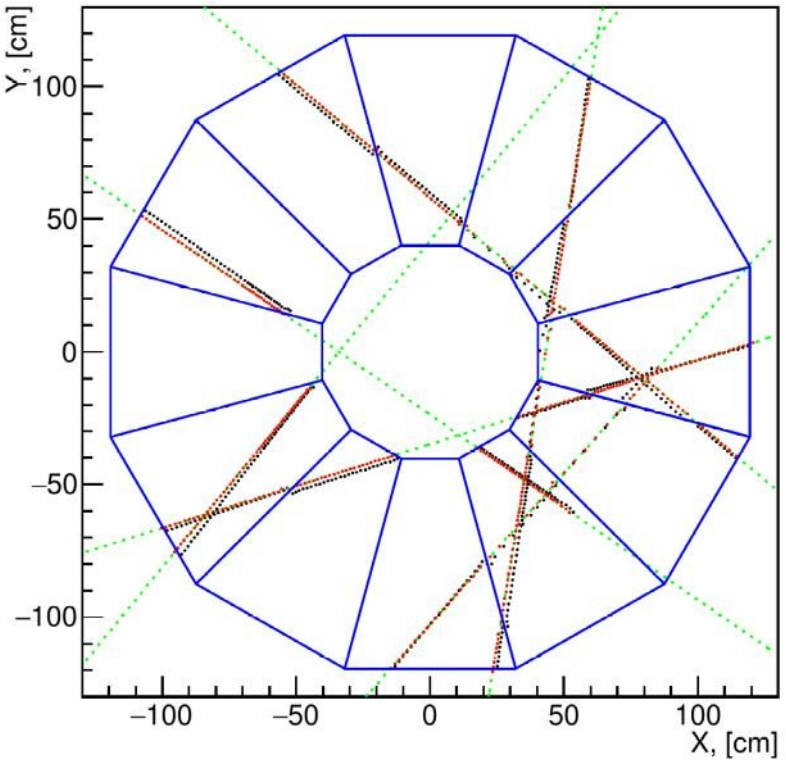
/ 10

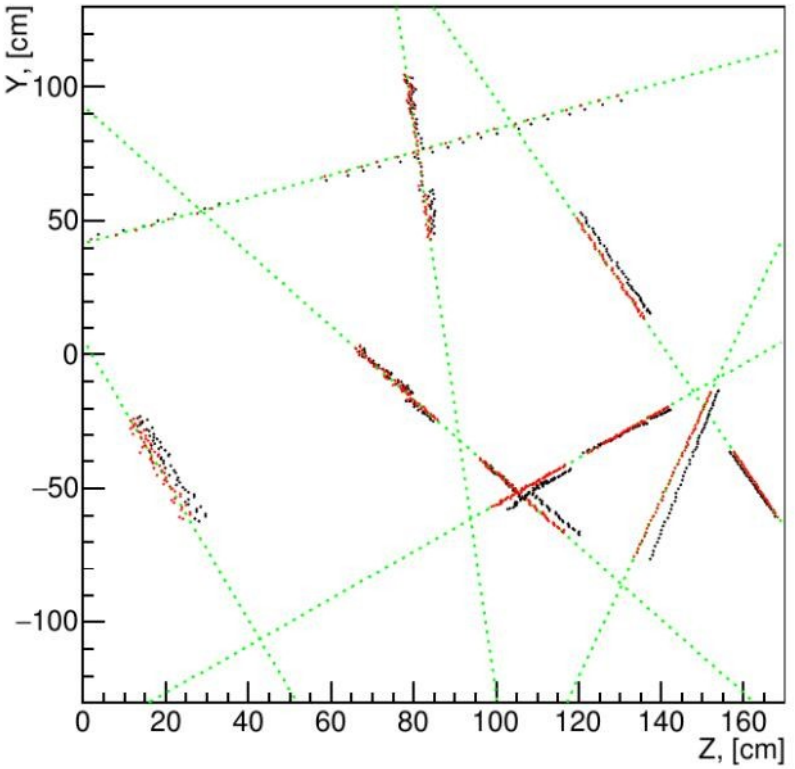
TPC alignment

Kuzmin V. MSU INP

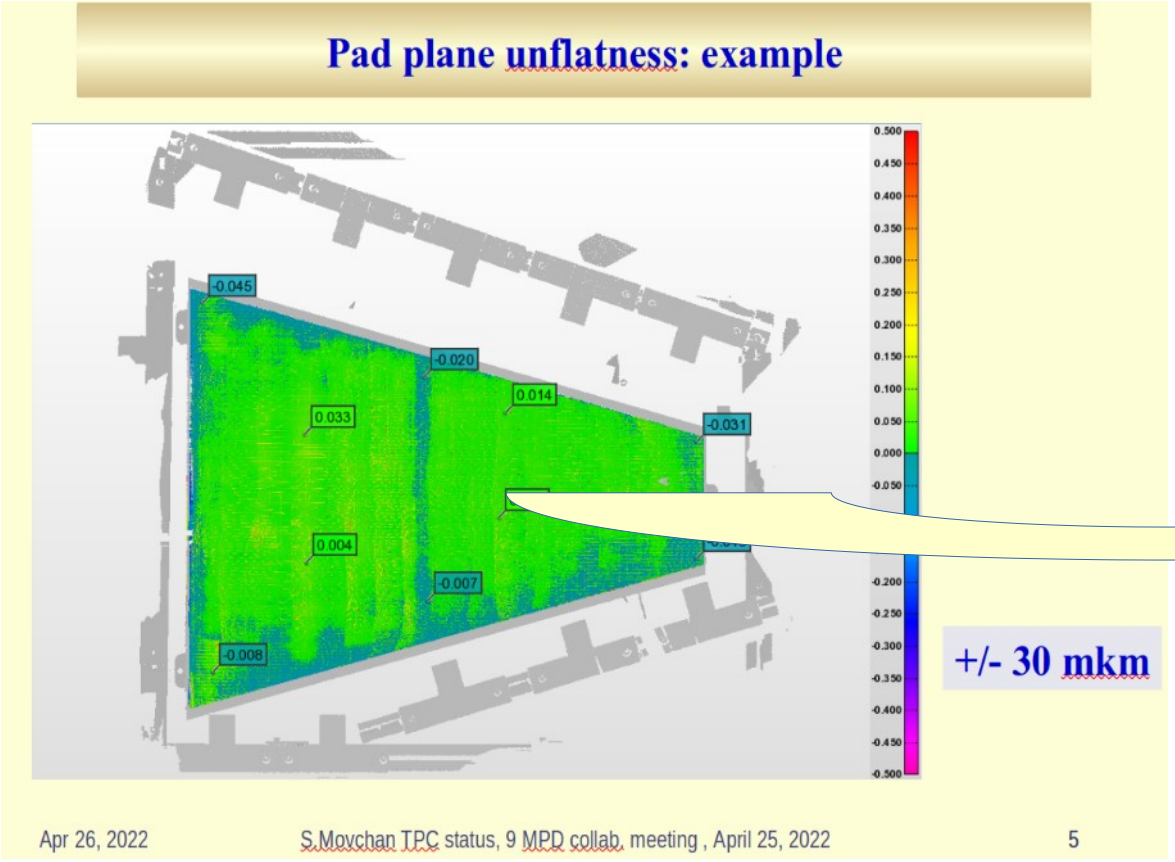
Green points simulated muon tracks
Black points misalignment hits
Red points - hits with alignment







TPC geometry database



TPC geometry database

+

the alignment parameters for TPC

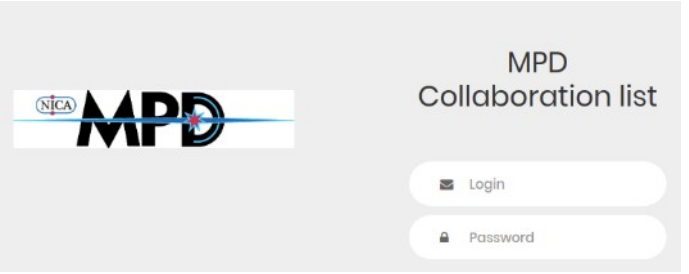
ΔX, ΔY, ΔZ,

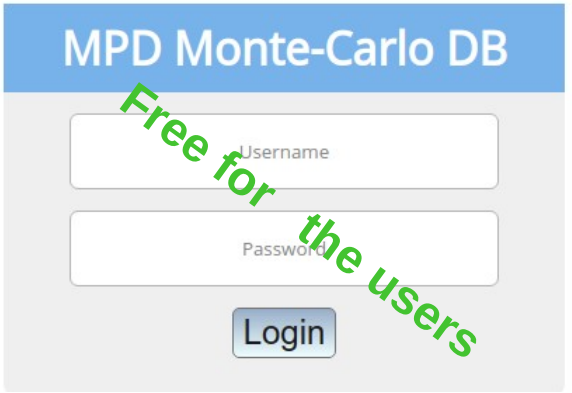
Δφ, Δη ,Δα

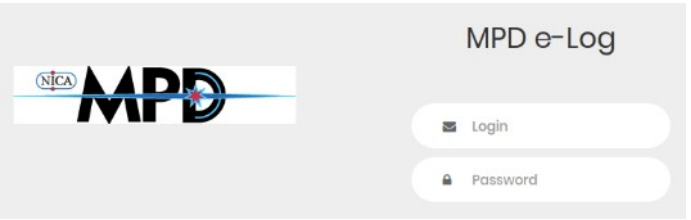
The accuracy of the alignment calculation by muons in the events from the collision of nuclei in the detector will be lower than in the case of cosmic rays or by the rays of the TPC laser system.

MPD databases

- ✔ List of MPD members & authors
- ✔ MC events mass productions
- ✔ ECAL instrumentation
- ✔ TPC instrumentation
- ✔ TPC geometry
- ✔ TOF instrumentation
- ✔ TPC alignment parameters DB
- ✔ LogBook for Experiment
- ✔ ....

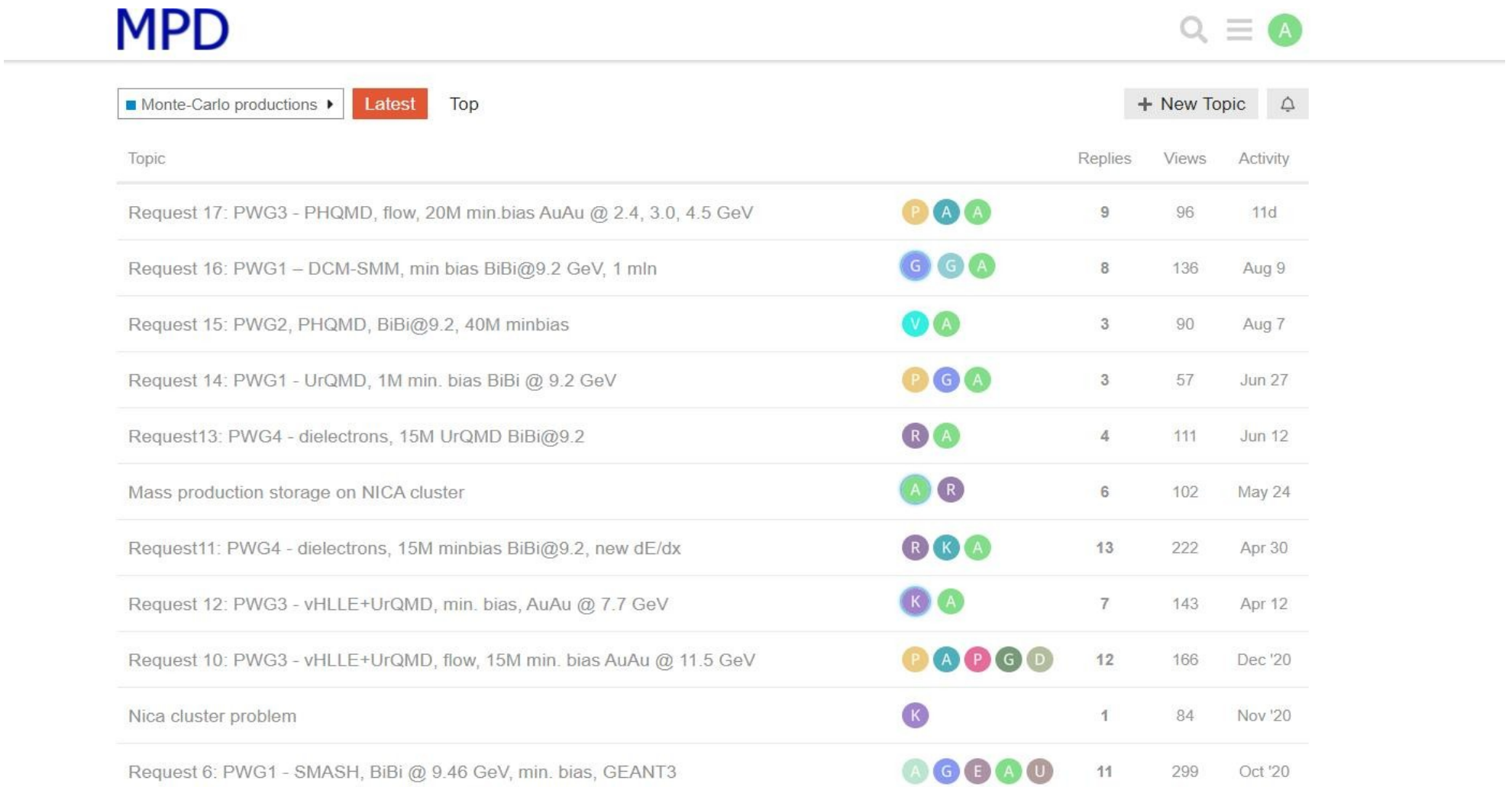






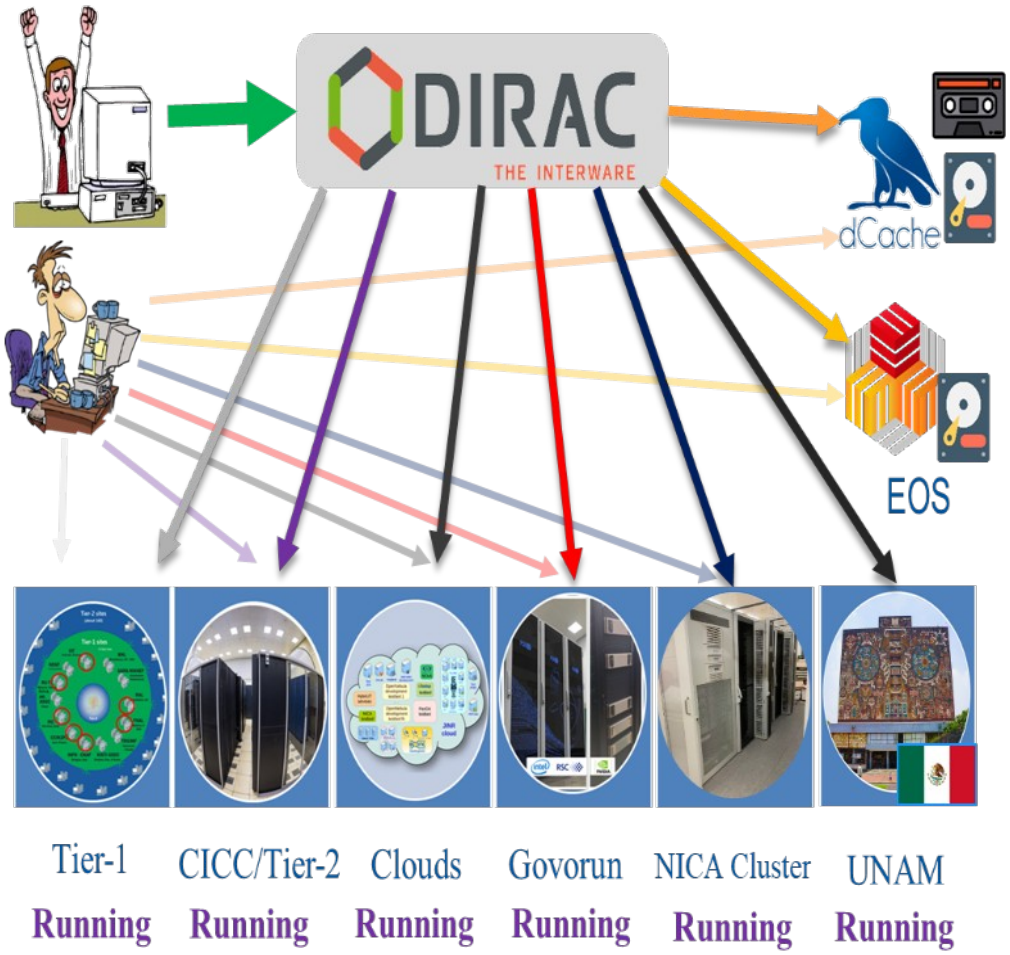
Mass production requests

https://mpdforum.jinr.ru/c/MCProd



Topic	Replies	Views	Activity
Request 17: PWG3 - PHQMD, flow, 20M min.bias AuAu @ 2.4, 3.0, 4.5 GeV	9	96	11d
Request 16: PWG1 – DCM-SMM, min bias BiBi@9.2 GeV, 1 mln	8	136	Aug 9
Request 15: PWG2, PHQMD, BiBi@9.2, 40M minbias	3	90	Aug 7
Request 14: PWG1 - UrQMD, 1M min. bias BiBi @ 9.2 GeV	3	57	Jun 27
Request13: PWG4 - dielectrons, 15M UrQMD BiBi@9.2	4	111	Jun 12
Mass production storage on NICA cluster	6	102	May 24
Request11: PWG4 - dielectrons, 15M minbias BiBi@9.2, new dE/dx	13	222	Apr 30
Request 12: PWG3 - vHLLE+UrQMD, min. bias, AuAu @ 7.7 GeV	7	143	Apr 12
Request 10: PWG3 - vHLLE+UrQMD, flow, 15M min. bias AuAu @ 11.5 GeV	12	166	Dec '20
Nica cluster problem	1	84	Nov '20
Request 6: PWG1 - SMASH, BiBi @ 9.46 GeV, min. bias, GEANT3	11	299	Oct '20

DIRAC resources

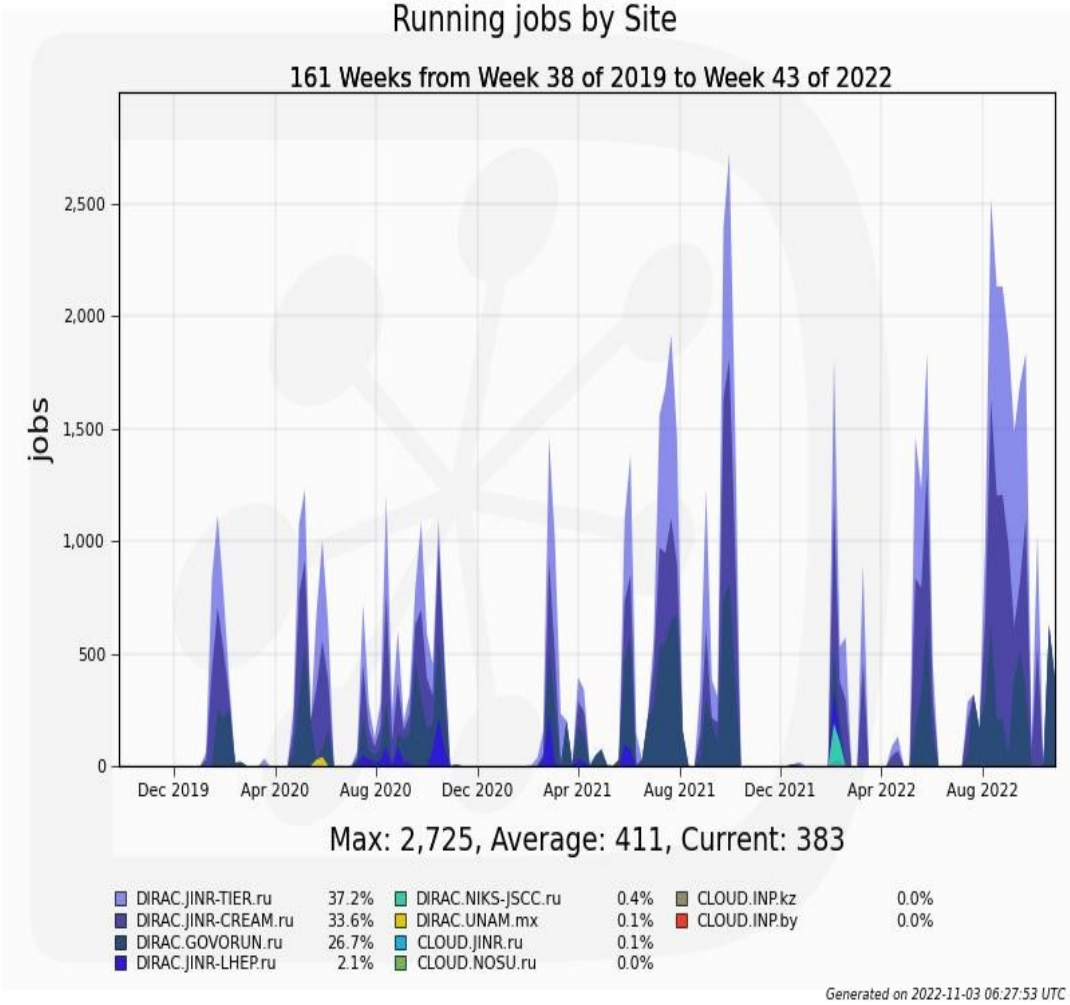


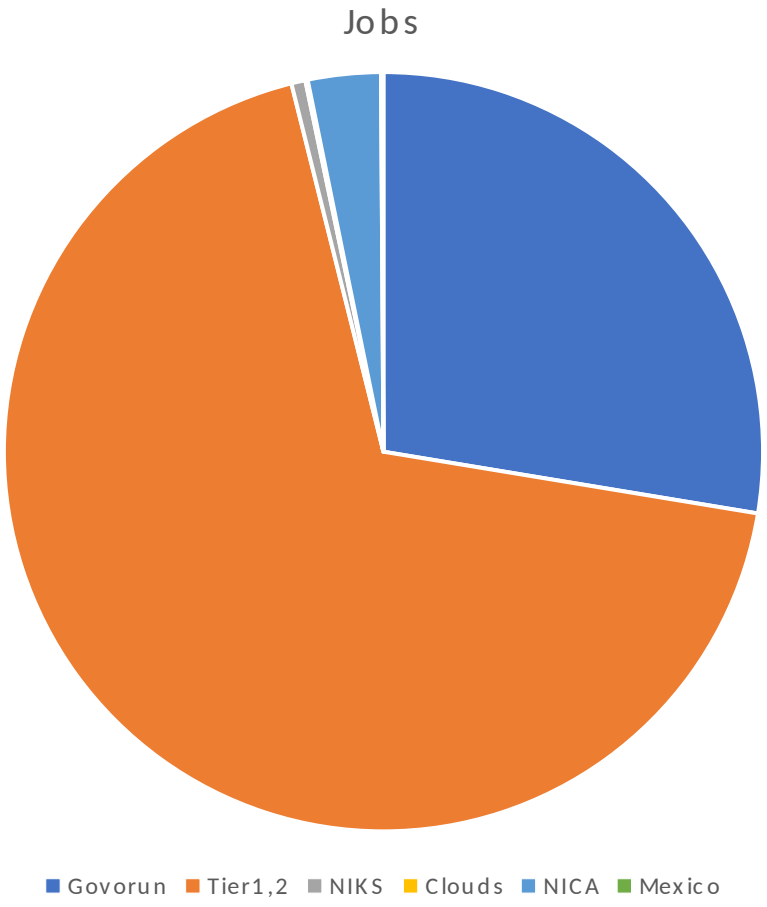
- NICA offline cluster **300** cores
  (limited for the users)
- GOVORUN up to **2256** cores in last production
- Tier1 **920** cores
- Tier2 **1000** cores
- Clouds(JINR and JINR Member States) **70** cores
- UNAM(Mexico University) **100** cores
- National Research Computer Network of Russia (now resources from SPBTU and JSCC) 672 cores – New resource, added in 12.2021.

All software packages are centrally stored in /cvmfs and are available on all computing clusters

Mass production storages integrated in Dirac File Catalog have size **1,7** PB.
We expect another 0.4 PB during the modernization of Govorun

MPD mass production 2019-2022 summary(1):





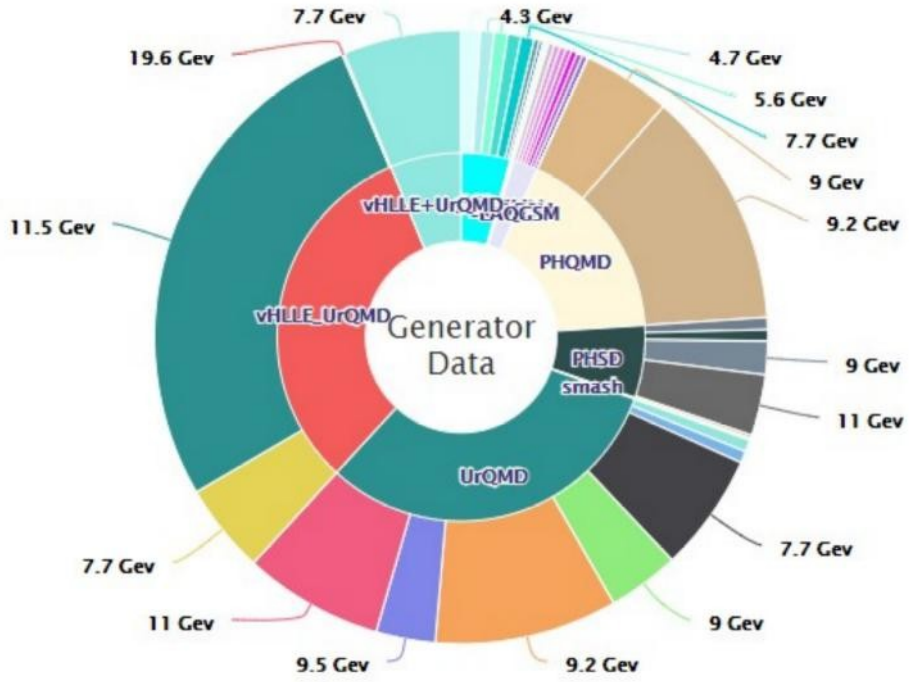
MPD mass production 2019-2022 summary(2):

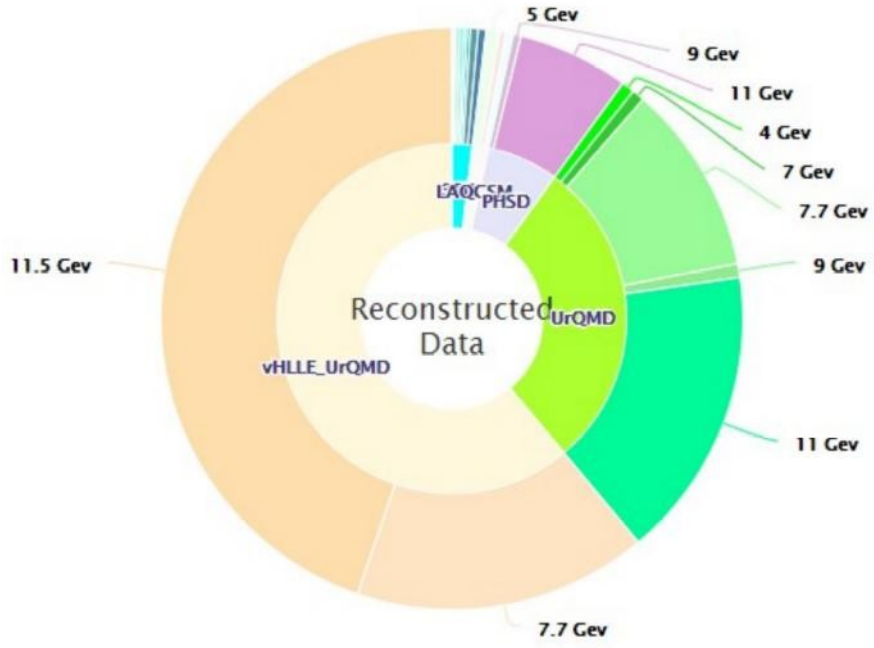
Generator	PWG	Coll.		# of events()	Reco
UrQMD	PWG4	AuAu	11	15	+
		BiBi	9	10	+
			9.46	10	+
			9.2	95	+
	PWG2	AuAu	11	10	+
	PWG3	AuAu	7.7	10	+
		BiBi	7.7	10	+
			9	15	+
		pp	9	10	+
	PWG1	BiBi	9.2	11(50 underway)	+
DCM-SMM	PWG1	BiBi	9.2	1	+
PHQMD	PWG2	BiBi	8.8	15	+
			9.2	41(+20 underway)	+
			2.4/3.0/4.5	10/10/2	-
vHLLE-UrQMD	PWG3	BiBi	11.5	15	+
		AuAu	11.5	15	+
		AuAu	7.7	20	+
Smash	PWG1	BiBi	9.46	10	+
		ArAr	4/7/9/11	20/20/20/20	-
		AuAu	4/7/9/11	20/20/20/22	-
		XeXe	4/7/9/11	20/20/20/20	-
		CC	4/7/9/11	20/20/20/20	-
		pp	4/7/9/11	50/50/50/50	-
JAM	PWG3	AuAu	3/3.3/3.5/3.8/4.0/4.2/4.5/5	40/40/40/40/40/40/40/40	
DCM-QGSM-SMM	PWG3	AuAu	4/9.2	5/5	+
		AgAg	4/9.2	5/5	+
		BiBi	4/9.2	5/6	+
PHSD		BiBi	9/9.2	10/(15 underway)	+
Total				1198(85 underway)	354(85 underway)

MPD mass production database

http://db-nica.jinr.ru/mpdmc/stat.php

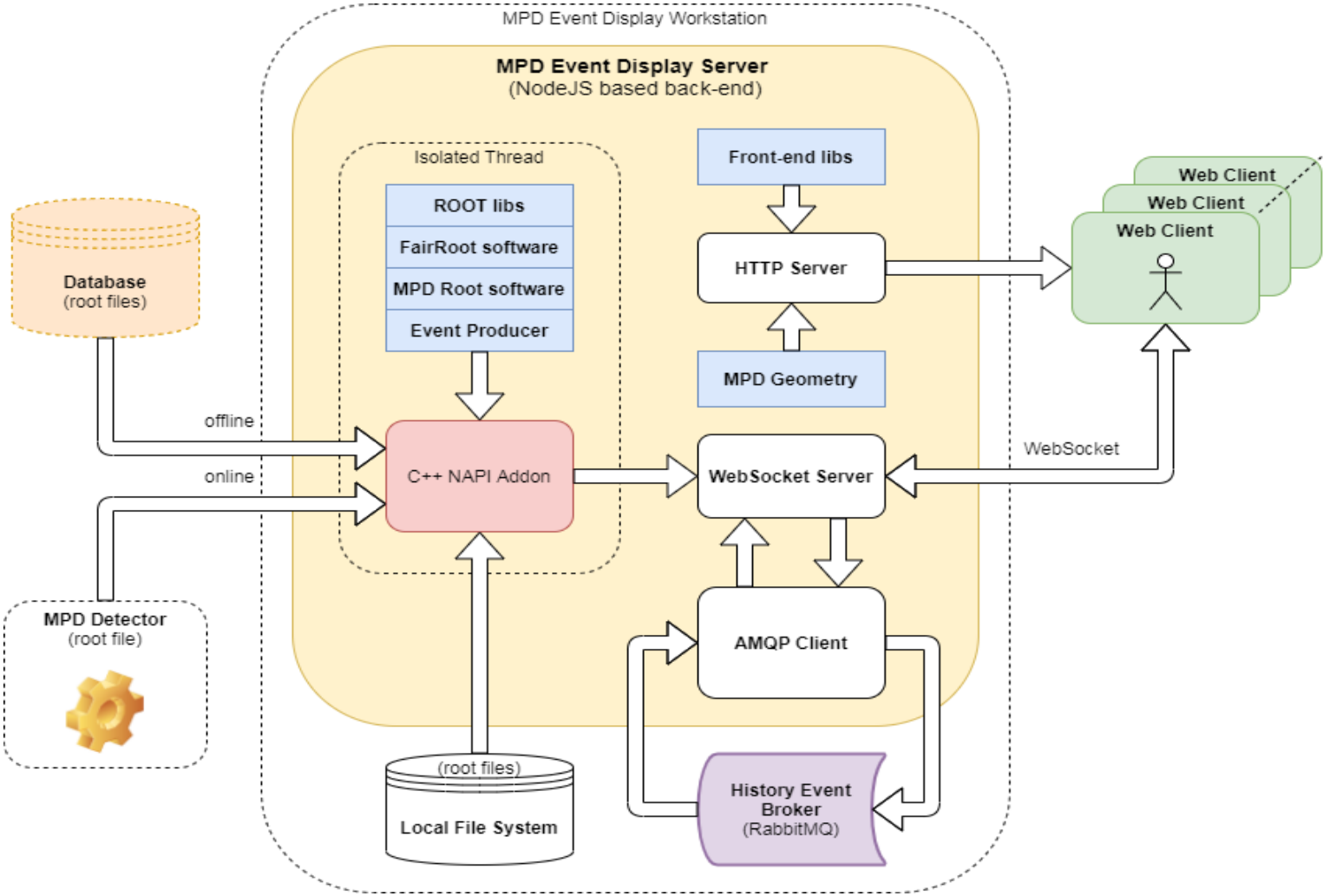
23 mass production requests were done



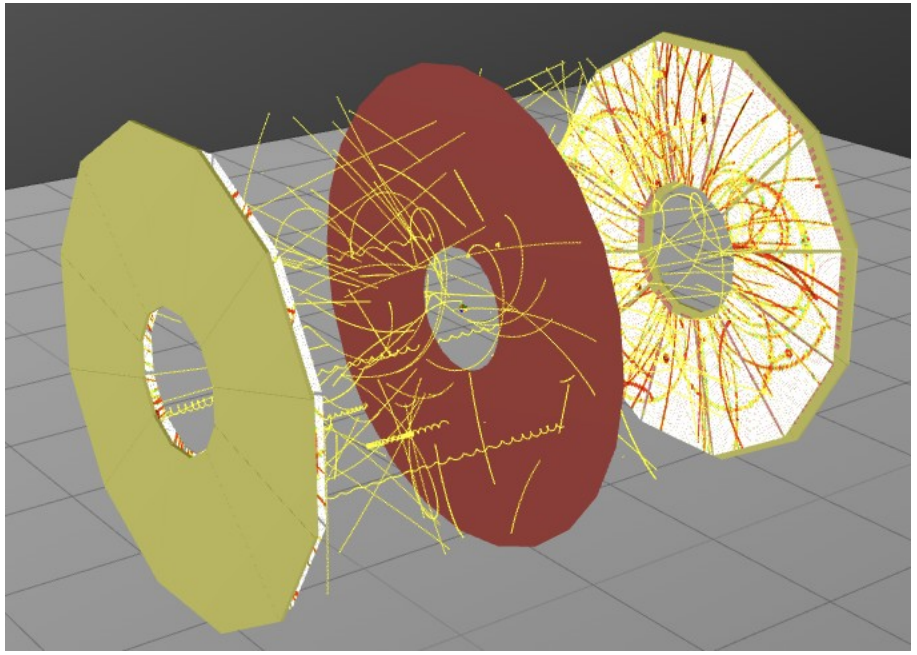


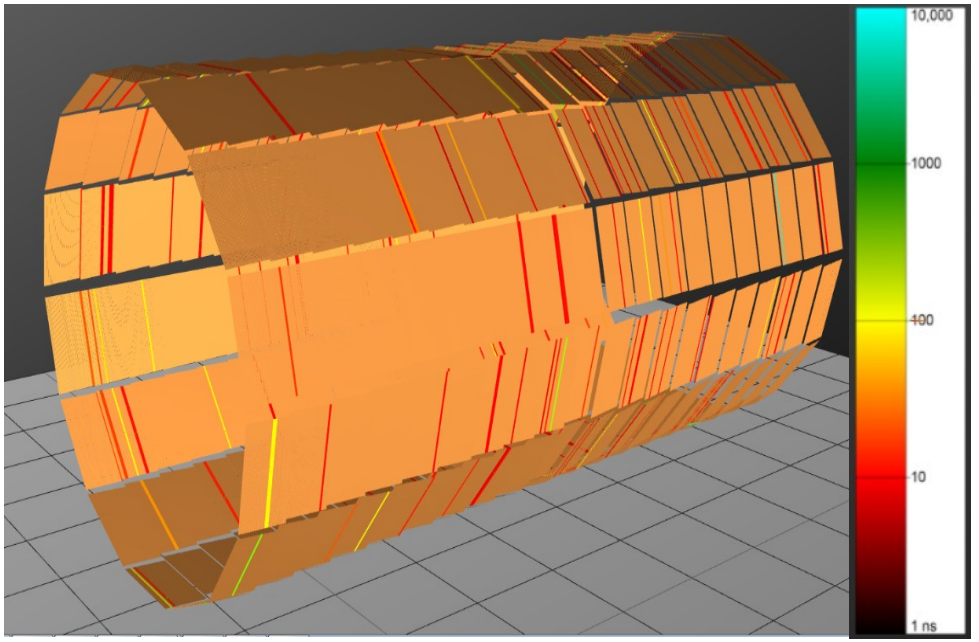
All production data stored in Dirac File Catalog

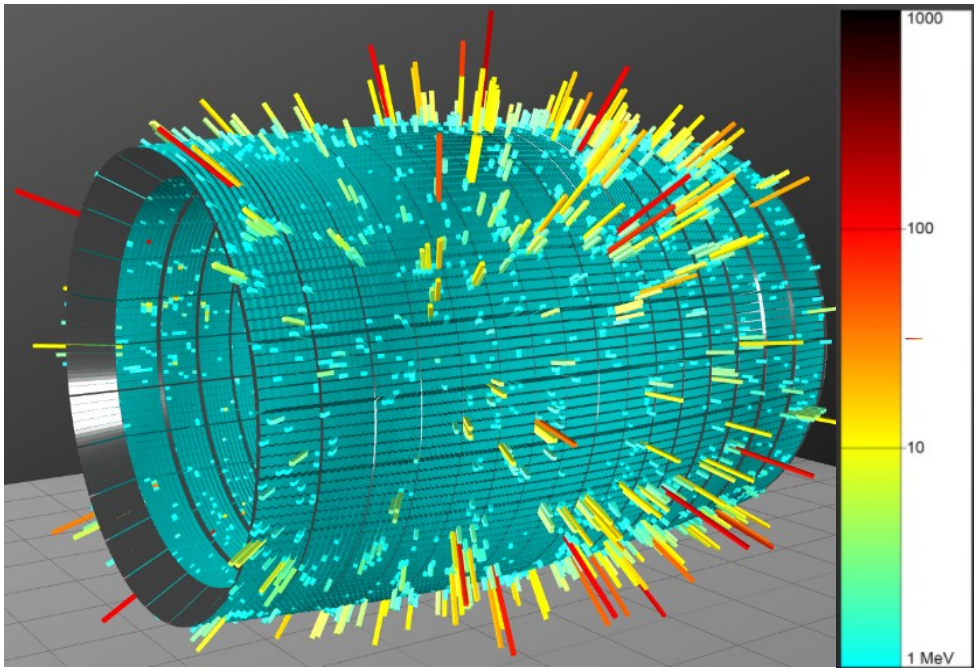
MPD Event Display Server

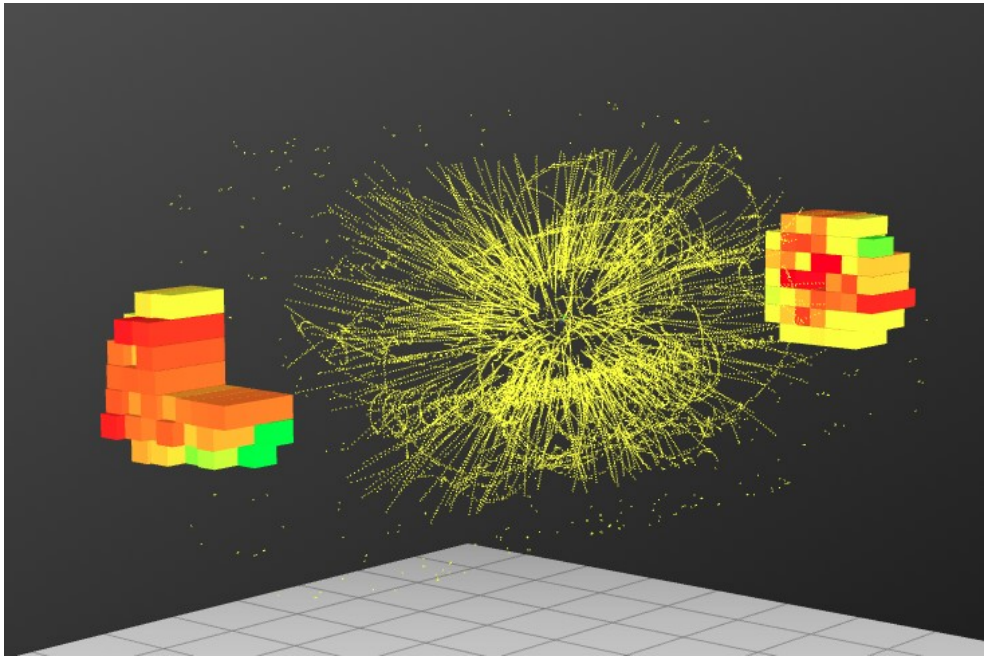


MPD EventDisplay: TPC



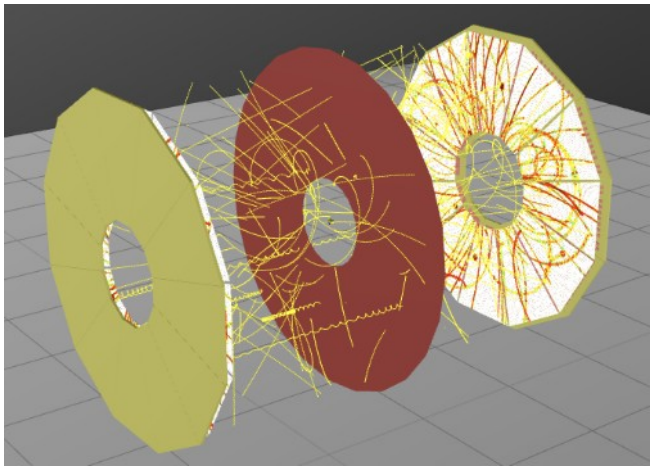






TPC control system (dashboard)

TPC eventdisplay



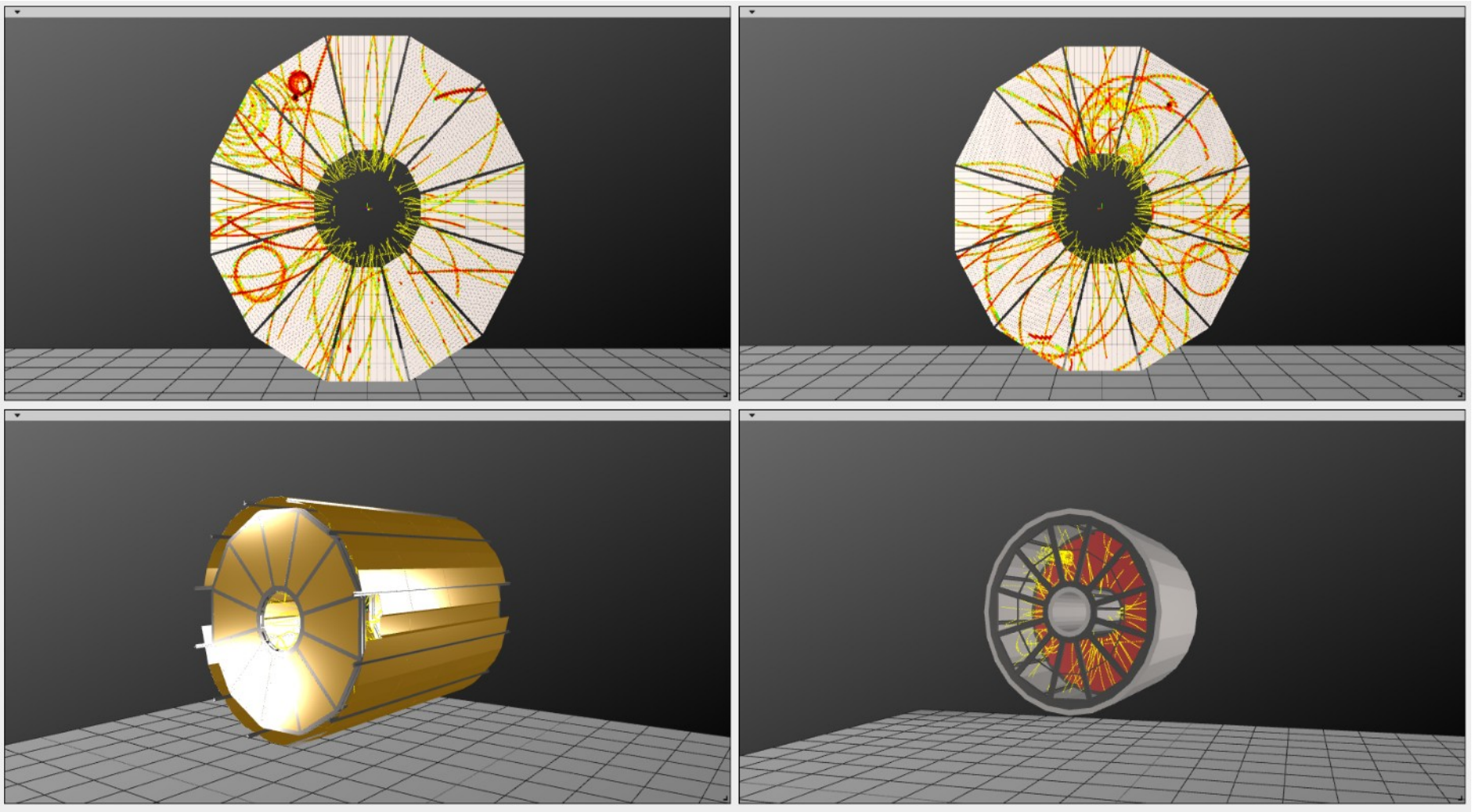
A free open source device-oriented controls toolkit for controlling any kind of hardware or software and building SCADA systems...

TPC control system

TPC online pad planes

West

East

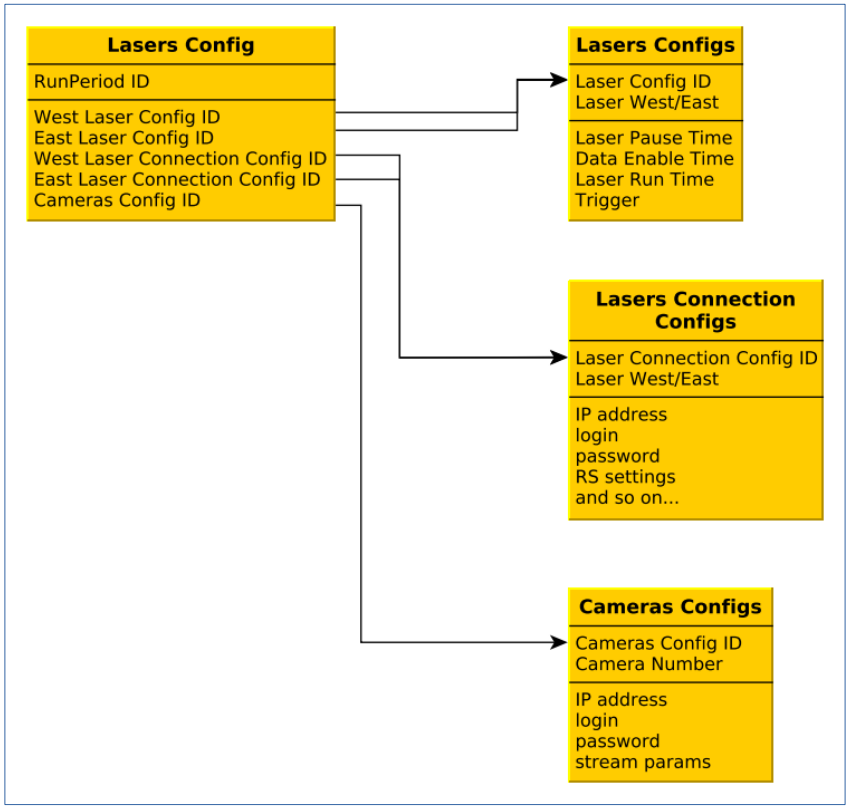


TPC dashboard

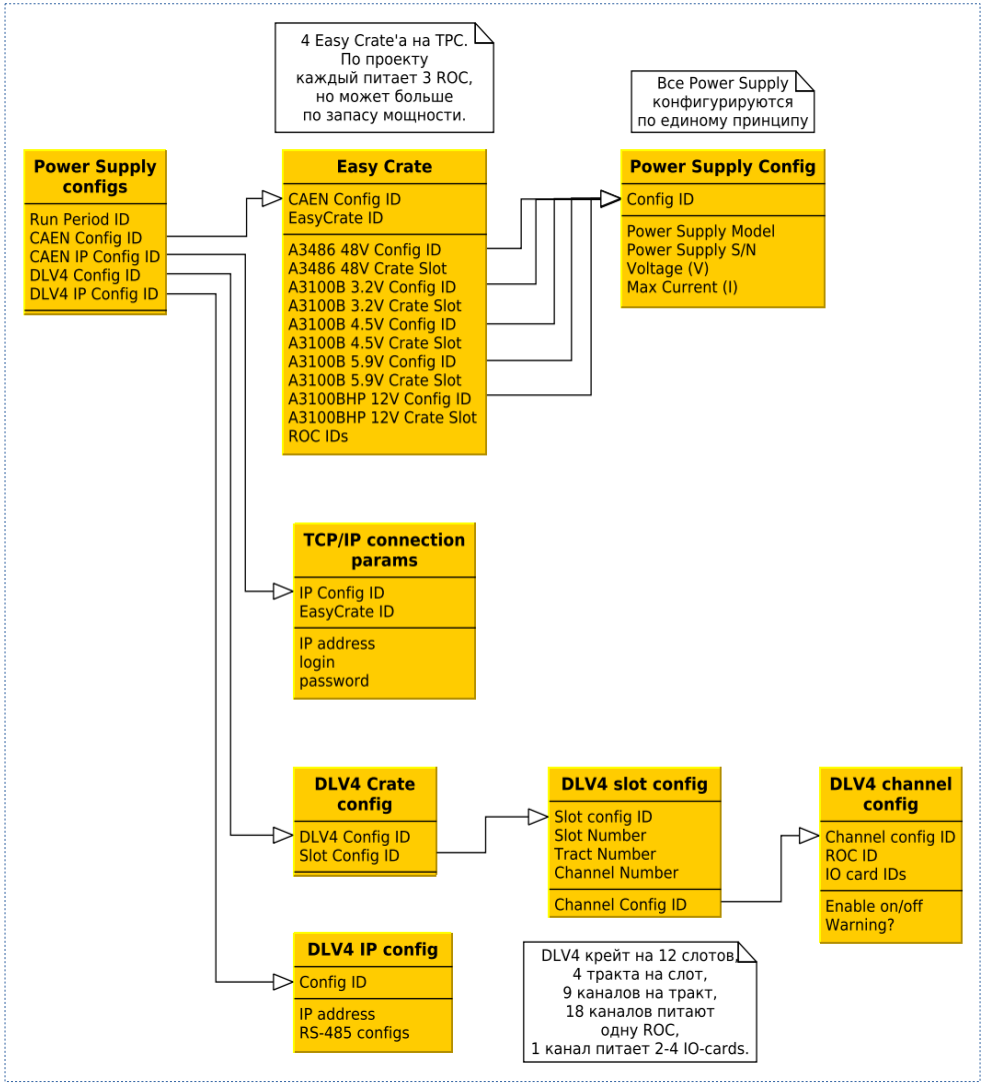
TPC sectors time buckets

TPC control system

Laser control



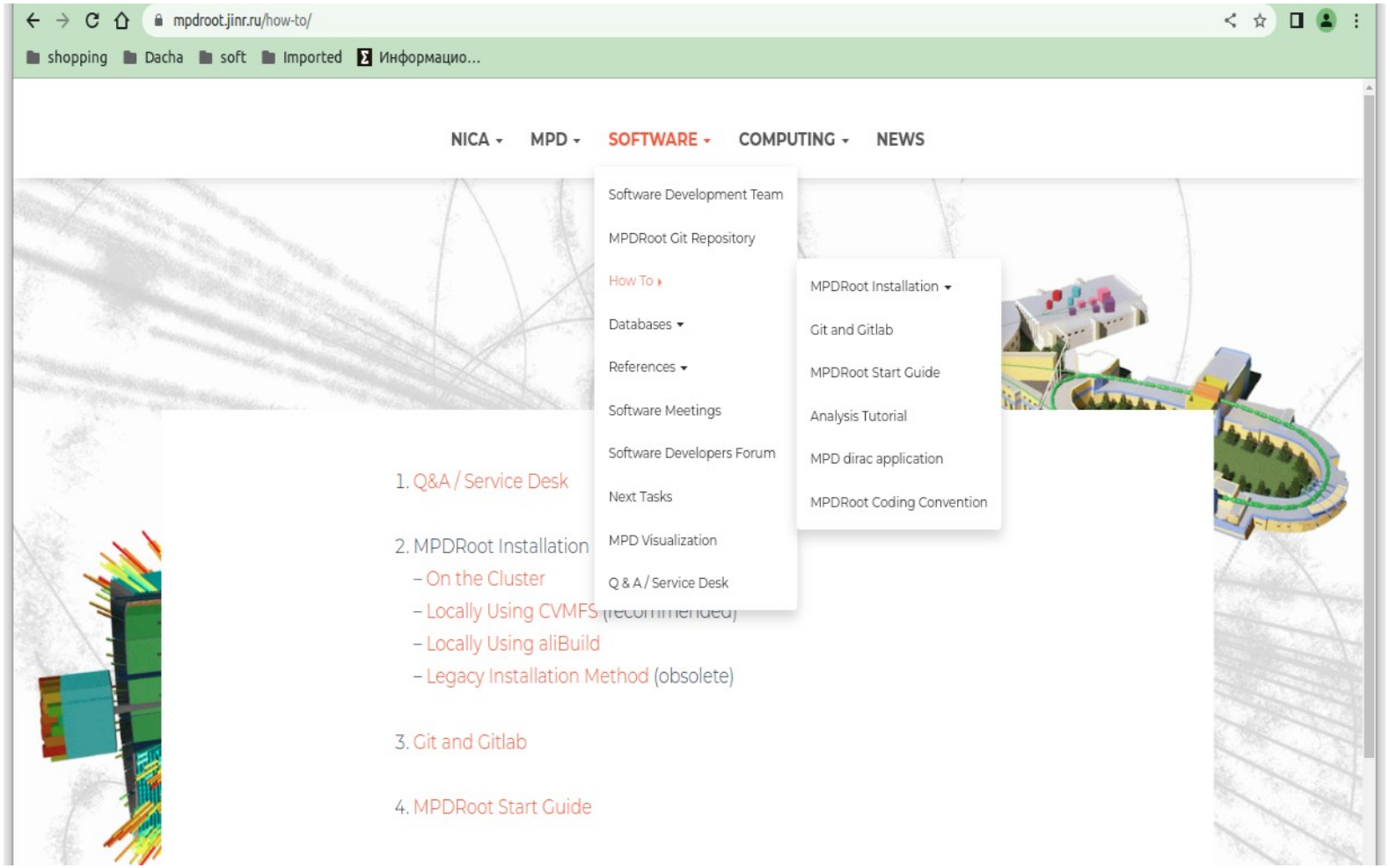
Power supply control



MPD software development team		
LHEP	**LIT**	**OTHER**
Bychkov A. Krylov A. Moshkin A. Myktybekov D. Rogachevsky O.	Alexandrov E. Alexandrov I. Balashov N. Belyakov D. Busa J. Hnatic S. Pelevanyuk I. Podgainy D. Zuev M.	Kuzmin V. Krylov V.

Volunteers Are welcome

Read MPDroot web page, at least!



Thanks for your attention