MPD Software development
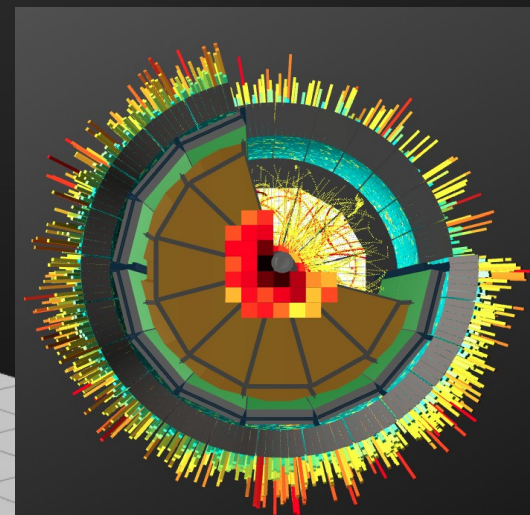## & *computing*
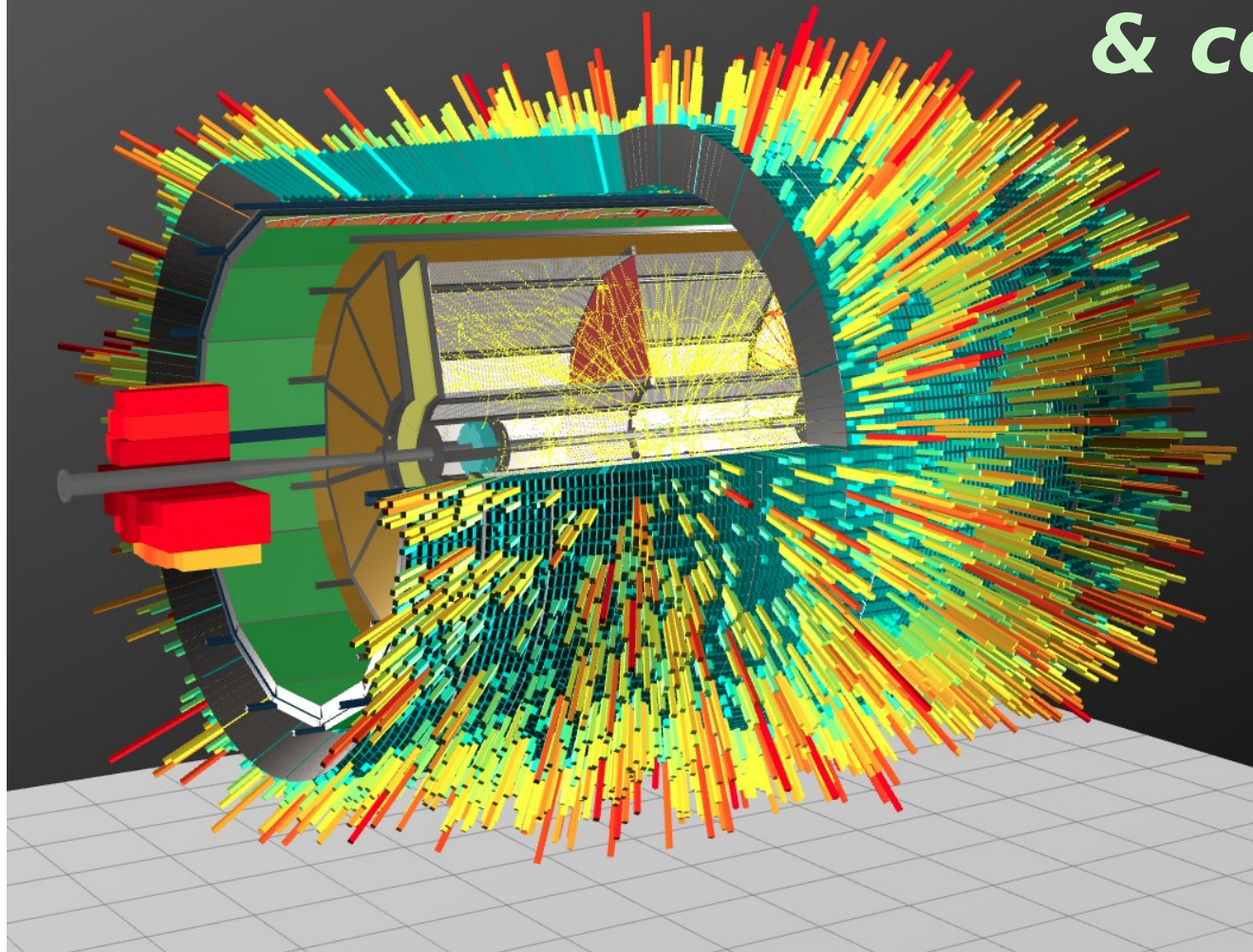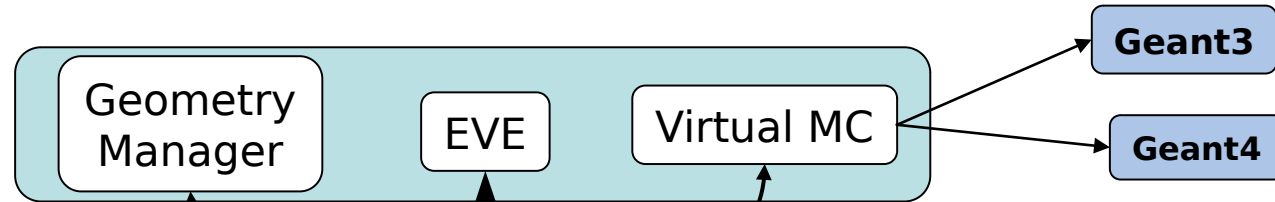

Rogachevsky Oleg
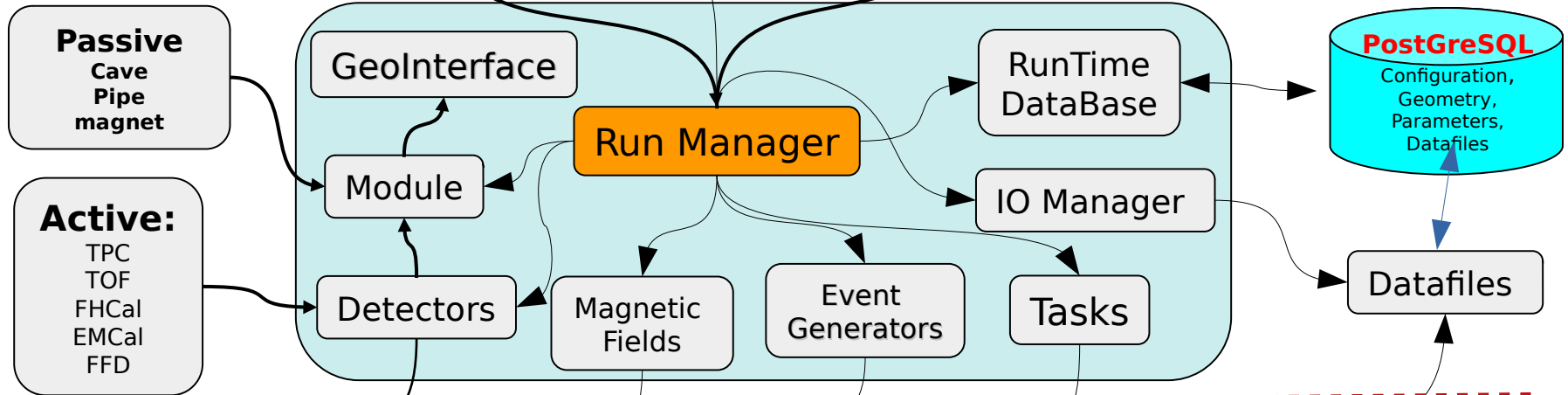**for MPD collaboration**
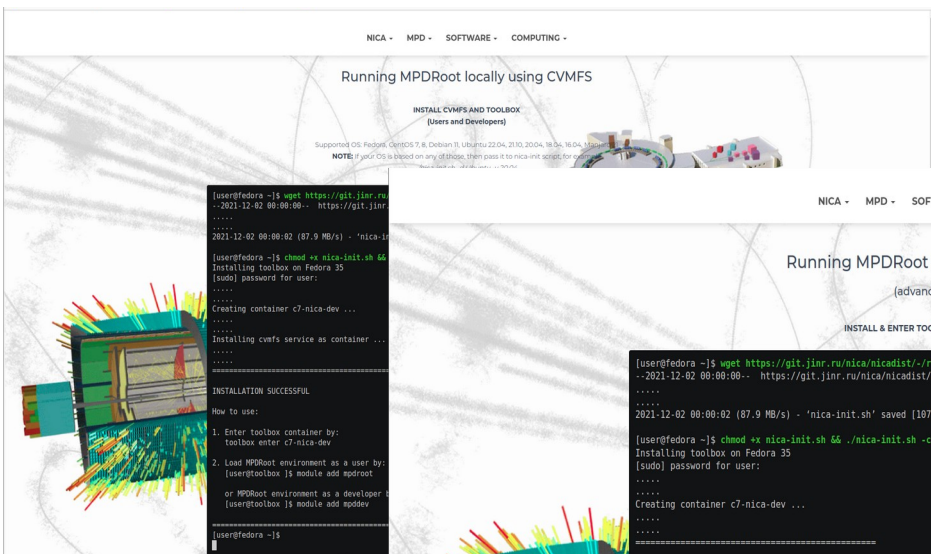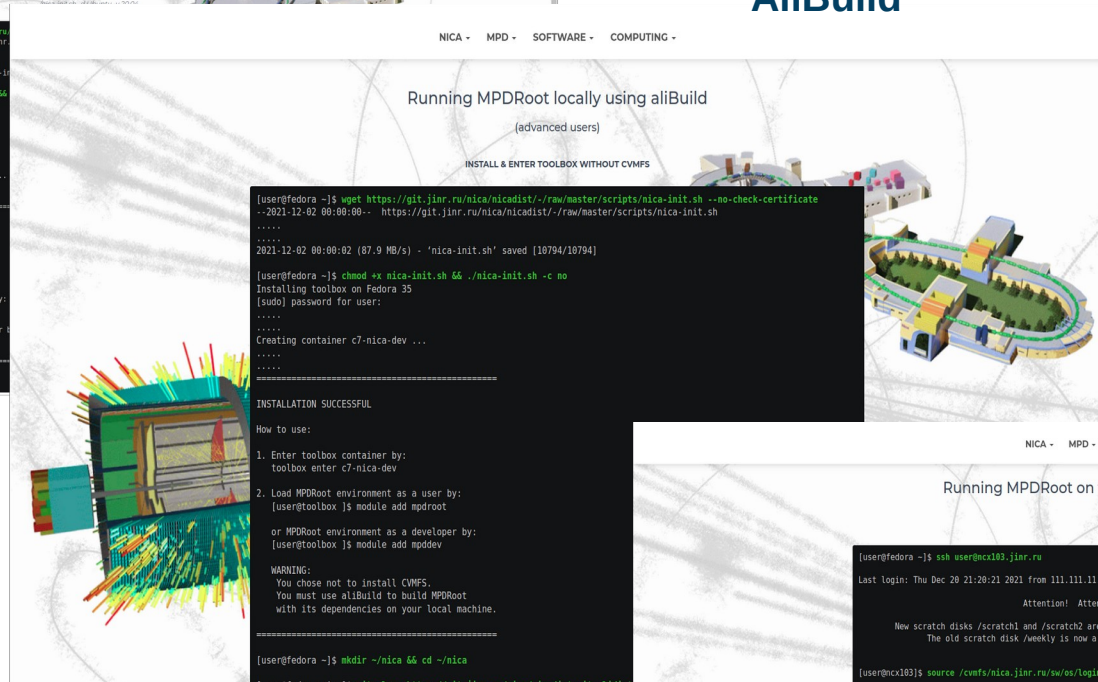
MpdRoot structure
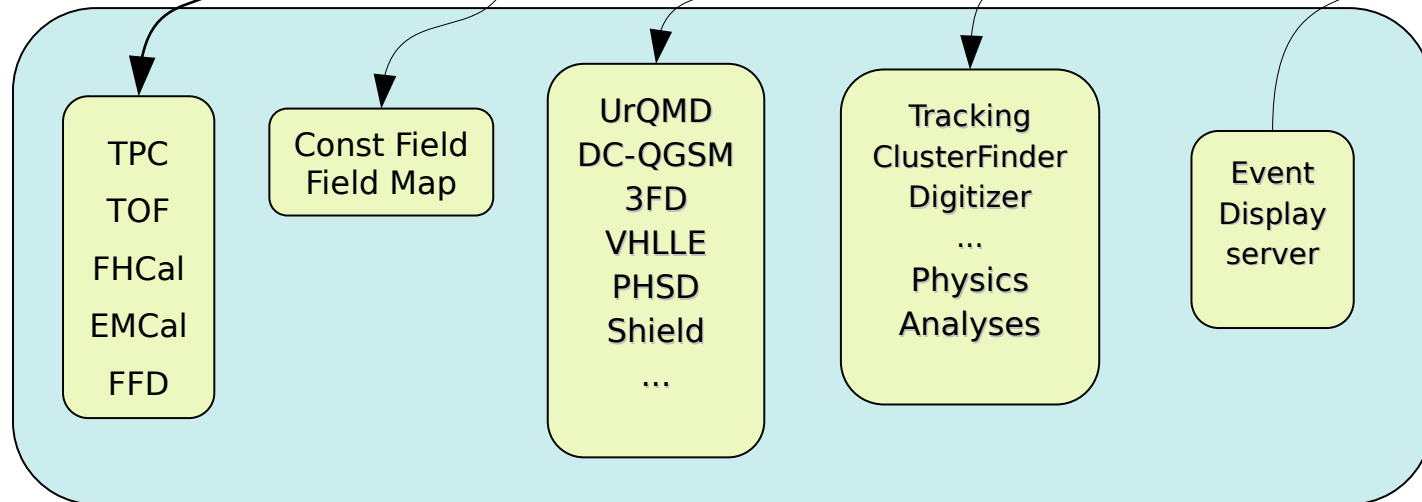
New mpdroot installation & deployment

CVMFS

AliBuild

Hnatic S.,
Vala M.,
Busa J.

Modules
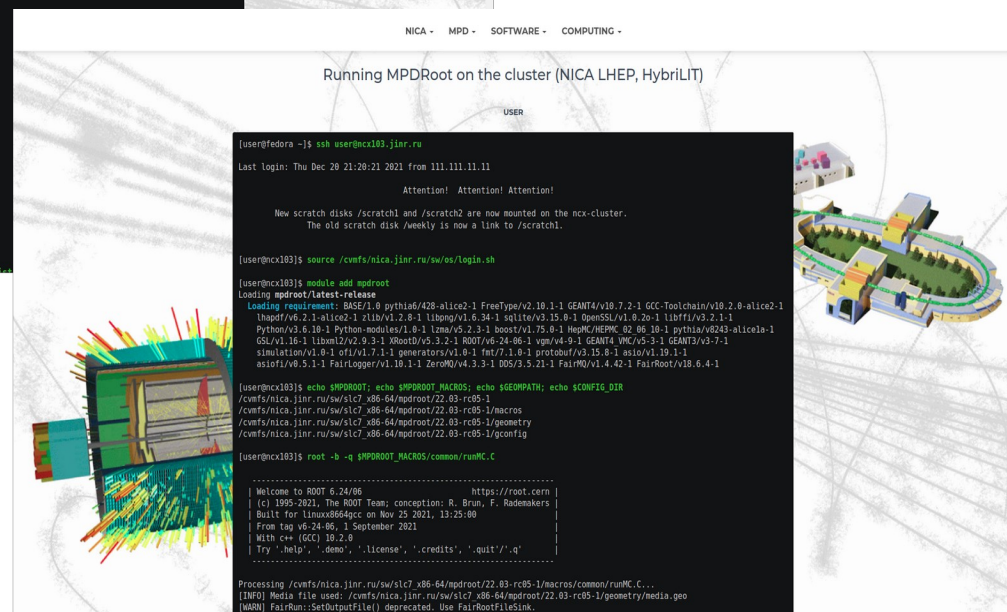
New mpdroot structure

**Hnatic S.,
Vala M.,
Busa J.**

Name	Last commit	Last update
..		
mpdBase	Moved directory ./mcstack ./simulation/mcStack	1 month ago
mpdDst	Moved lhetrack to reconstruction/tracking/lheTrack	1 month ago
mpdField	Fixed formatting of directories core/mpdBase and core/mpdField	1 month ago
mpdPassive	Fixed formatting in mpdPassive	1 month ago
mpdPid	Added Base as a dependency of mpdPid	1 month ago

Name	Last commit	Last update
cmake	Removed shield_pack. Default generator for …	6 days ago
config	moving file eventdisplay.xml where it belong…	3 months ago
core	Fixed formatting in mpdPassive	1 month ago
detectors	Fix of header files not being copied mention…	1 week ago
doxygen	Removed shield_pack. Default generator for …	6 days ago
gconfig	commenting out libraries which do not exist	3 months ago
geometry	Magnet geometry version 6	3 months ago
input	add_new_calibration	1 week ago
macro	Renamed .cxx files to .C to stress that they a…	6 days ago
macros/common	Removed shield_pack. Default generator for …	6 days ago
physics	Moved generators to simulation/generators	1 month ago
reconstruction/tracking	Moved lhetrack to reconstruction/tracking/l…	1 month
scripts	remove old tests from the governor	4 days ago
simulation	Removed shield_pack. Default generator for …	6 days ago
tools	Added check whether ROOT used has been …	6 days ago
.clang-format	add stylefile from cern	4 months ago
.gitignore	Resolve "Add CentOS7 and CentOS8 pipeline…	4 months ago
.gitlab-ci.yml	removing global before script in pipeline	4 days ago
.gitmodules	updating to the last version of the NICA-Sch…	3 months ago
CMakeLists.txt	Resolve "Proper CMake failure during non-SI…	4 months ago
CODEOWNERS	Moved ./kalman to ./reconstruction/tracking…	1 month ago
README.md	Added copying of eventDisplay configuration…	1 week ago
SetEnv.sh	Revert "Added newReadDST.C file which is n…	5 months ago

Name	Last commit	Last update
..		
bbc	Moved directory ./mcstack ./simulation/mcStack	1 month ago
bmd	Moved directory ./mcstack ./simulation/mcStack	1 month ago
emc	Moved ./kalman to ./reconstruction/tracking/kalman	1 month ago
etof	Moved lhetrack to reconstruction/tracking/lheTrack	1 month ago
ffd	Moved directory ./mcstack ./simulation/mcStack	1 month ago
mcord	Moved directory ./mcstack ./simulation/mcStack	1 month ago
sts	Moved directory ./mcstack ./simulation/mcStack	1 month ago
tof	Moved ./kalman to ./reconstruction/tracking/kalman	1 month ago
tpc	Files inside simulation/generators moved to simulation/generators/mpdGen	1 week ago
zdc	Fix of header files not being copied mentioned in #95	1 week ago

Name	Last commit	Last update
..		
ebye	Moved ./kalman to ./reconstruction/tracking/kalman	1 month ago
femto	Moved mpddst with subdirectories to core/mpdDst	1 month ago
nicafemto	Moved generators to simulation/generators	1 month ago
photons	Moved lhetrack to reconstruction/tracking/lheTrack	1 month ago
CMakeLists.txt	Moved ./kalman to ./reconstruction/tracking/kalman	1 month ago
MpdAnalysisEvent.cxx	Analysis manager framework implemented	7 months ago
MpdAnalysisEvent.h	Analysis manager framework implemented	7 months ago
MpdAnalysisManager.cxx	Analysis manager framework implemented	7 months ago
MpdAnalysisManager.h	Analysis manager framework implemented	7 months ago
MpdAnalysisTask.cxx	Analysis manager framework implemented	7 months ago
MpdAnalysisTask.h	Analysis manager framework implemented	7 months ago
MpdPhysicsLinkDef.h	Analysis manager framework implemented	7 months ago
MpdRoInvMassTask.cxx	fixed conflict mcstack with fairroot examples	2 years ago
MpdRoInvMassTask.h	small resctructuring according to the found dependancy errors	3 years ago
README.md	Analysis manager framework implemented	7 months ago

Latest mpdroot release

v22.04.22

⌄ Assets 4

    📄 Source code (zip)
    📄 Source code (tar.gz)
    📄 Source code (tar.bz2)
    📄 Source code (tar)

Evidence collection

📋 v22.04.22-evidences-25.json ••• 0db7acbc ⎘

🕐 Collected 4 days ago

RELEASE NOTES

We encourage users to test new release and report any issues to us on
https://mpdroot.jinr.ru/q-a/

Installation
https://mpdroot.jinr.ru/running-mpdroot-on-local-machine-using-cvmfs/

Your feedback is valuable and makes our software better.

NEW FEATURES

- Added minimal database (BM@N port) #84
- Service Desk created #81
- Website major update https://mpdroot.jinr.ru
- Build on tag #50

MPD Software status (GIT)

Commits to dev

Excluding merge commits. Limited to 6,000 commits.

2022-01-08

Number of commits   **0**

Project members
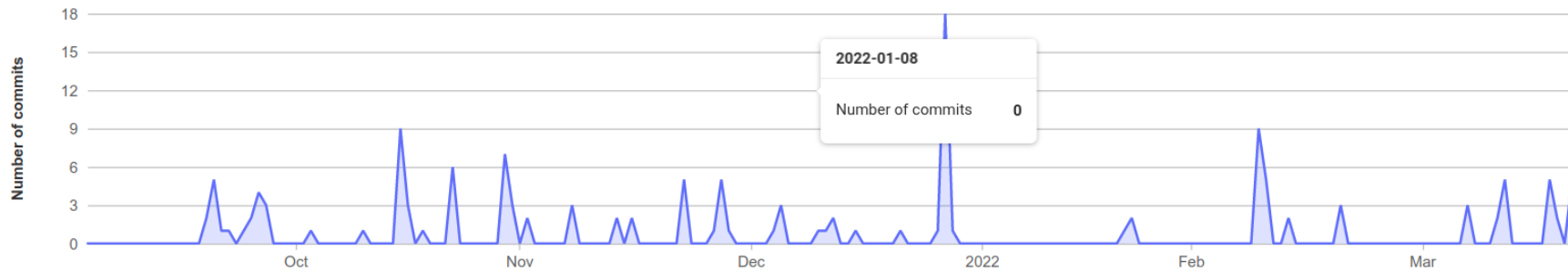
[Import from a project] [Invite a group] [Invite members]

You can invite a new member to **mpdroot** or invite another group.

Members 42   **Access requests** 1

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

6

FairRoot

From Slavomir Hnatic (@hnatics) <git@jinr.ru> ☆

Subject **mpdroot | Upgrade to FairRoot v 18.6.8 along with its latest dependencies (#104)**

Reply to NICA / mpdroot <incoming+dc4099cf4e40433f1c1ab3d9f92aee37@git.jinr.ru> ☆

To Oleg Rogachevsky ⭐

Slavomir Hnatic created an issue: https://git.jinr.ru/nica/mpdroot/-/issues/104

Assignee: Jan Busa

This is last stable version with support of Root v6.26 and Geant4 v11.
The patches https://git.jinr.ru/nica/nicadist/-/tree/master/patches
should be applied to get rid of memory bug https://git.jinr.ru/nica/mpdroot/-/issues/4 and
https://git.jinr.ru/nica/mpdroot/-/issues/89

The FairRoot framework

A simulation, reconstruction and analysis framework that is based on the ROOT system. The user can create simulated data and/or perform analysis with the same framework. Geant3 and Geant4 transport engines are supported, however the user code that creates simulated data do not depend on a particular monte carlo engine. The framework delivers base classes which enable the users to construct their detectors and /or analysis tasks in a simple way, it also delivers some general functionality like track visualization. Moreover an interface for reading magnetic field maps is also implemented.

License

FairRoot is distributed under the terms of the GNU Lesser General Public Licence version 3 (LGPLv3).

Release information

Please see : https://github.com/FairRootGroup/FairRoot/releases

Getting started

Please see : http://fairroot.gsi.de/getting_started for details.

Using the Project template

FairRoot deliver meanwhile a project template that can be used as a starting point for anybody who would like to build simulation and reconstruction on FairRoot. The project Template is in the FairRoot/template/project_template directory

The template demonstrate and implement the following:

General structure of the software (cake config files, VMC/Geant configurations, etc ..)

Example detector with sensitive and passive volumes (NewDetector) and data class

Particle Stack for Geant3/4 with filtering infrastructure

Event generators (Pathia6,8) more are available directly from FairRoot

Passive component implementation (Magnet Yoke, Beam Pipe)

Track visualisation tool (Event display)

A rename script which replace all the generic names to user defined ones

7

FairSoft

Included packages

Package	Version	URL
boost	1.75.0	https://www.boost.org/
clhep	2.4.4.0	http://proj-clhep.web.cern.ch
dds	3.5.10	http://dds.gsi.de
fairlogger	1.9.2	https://github.com/FairRootGroup/FairLogger
fairmq	1.4.33	https://github.com/FairRootGroup/FairMQ
flatbuffers	1.12.0	https://github.com/google/flatbuffers
fmt	6.1.2	https://github.com/fmtlib/fmt
geant3	3-8_fairsoft	https://github.com/FairRootGroup/geant3
geant4	10.7.1	https://geant4.web.cern.ch
geant4_vmc	5-3	https://github.com/vmc-project/geant4_vmc
hepmc	2.06.11	http://hepmc.web.cern.ch
odc	0.18	https://github.com/FairRootGroup/ODC
pythia6	428-alice1	https://github.com/alisw/pythia6
pythia8	8303	http://home.thep.lu.se/~torbjorn/pythia8
root	6.22.08	https://root.cern
vc	1.4.1	https://github.com/VcDevel/Vc
vgm	4-8	https://github.com/vmc-project/vgm
vmc	1-0-p3	https://github.com/vmc-project/vmc
zeromq	4.3.2	https://github.com/zeromq/libzmq

Boost Libraries: Asio, Atomic, Beast, Bind, Container, Core, DLL, Filesystem, GIL, Intrusive, Interprocess, JSON, LexicalCast, Log, Math, Move, Multiprecision, Nowide, Optional, Outcome, Parameter, PFR, PolyCollection, Predef, PropertyTree, Regex, StackTrace, TypeTraits, Variant2.

The Dynamic Deployment System (DDS) - is a tool-set that automates and significantly simplifies a deployment of user defined processes and their dependencies on any resource management system using a given topology.

FairMQ is designed to help implementing large-scale data processing workflows needed in next-generation Particle Physics experiments. FairMQ is written in C++

FlatBuffers is a cross platform serialization library architected for maximum memory efficiency. It allows you to directly access serialized data without parsing/unpacking it first, while still having great forwards/backwards compatibility
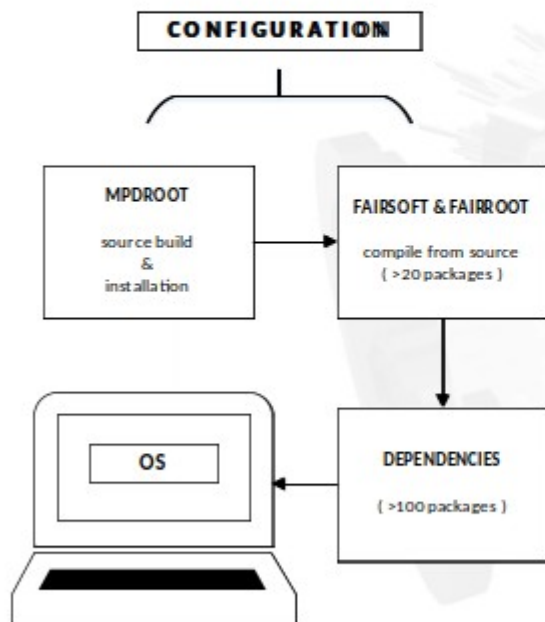
Vc: portable, zero-overhead C++ types for explicitly data-parallel programming

Virtual Geometry Model (VGM) is a geometry conversion tool, actually providing conversion between Geant4 and ROOT TGeo geometry models. Its design allows inclusion of another geometry model by implementing a single sub-module instead of writing bilateral converters for all already supported models.

The Online Device Control project control/communicate with a graph (topology) of FairMQ devices using DDS or PMIx

MPD deployment

NICA

Hnatic S.,
Vala M.,
Busa J.

PREVIOUS DEPLOYMENT PROCEDURE

CONFIGURATION

MPDROOT
source build
&
installation

FAIRSOFT & FAIRROOT
compile from source
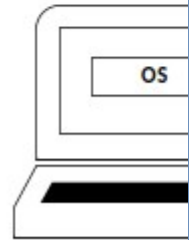(>20 packages)

OS

DEPENDENCIES
(>100 packages)

1. Base dependencies (Fair suite, MPDRoot) installation

2. FairSoft clone, build, install, configure

3. FairRoot clone, build, install, configure

4. MPDRoot, clone, build, install, configure

DISADVANTAGES

- Base dependencies (>100) different versions, potential source of compatibility issues

- Source build taking many hours for each installation
- Complex procedure with many step-by-step commands, increasing probability of mistake. If error was made usually procedure had to be repeated from scratch

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)

TPC alignment

Kuzmin V.

Pad plane unflatness: example

+/- 30 mkm

The position of sector i is determined by the 6 parameters p_{i1}, p_{i2}, p_{i3}, p_{i4}, p_{i5}, p_{i6}, which in the alignment problem are called global, and they need to be found for each sector.

χ^2 on alignment

black - cosmic rays

blue - laser rays

magenta - muons from IP in MF, pT=[0.5,1]GeV
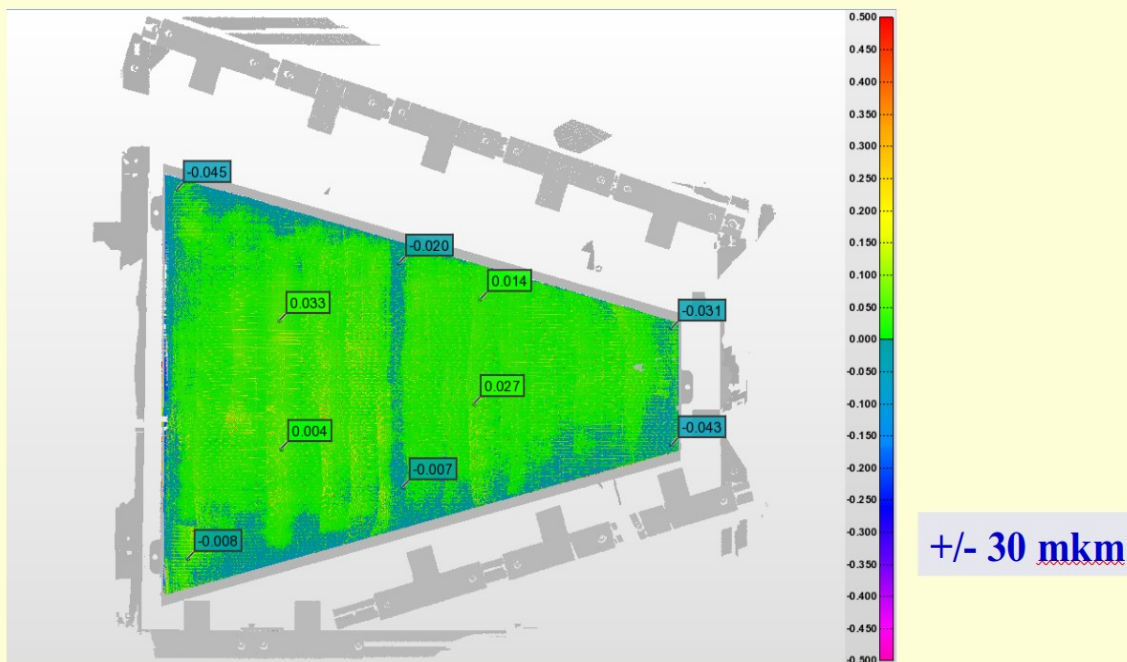
The accuracy of the alignment calculation by muons in the events from the collision of nuclei in the detector will be lower than in the case of cosmic rays or by the rays of the TPC laser system.

11
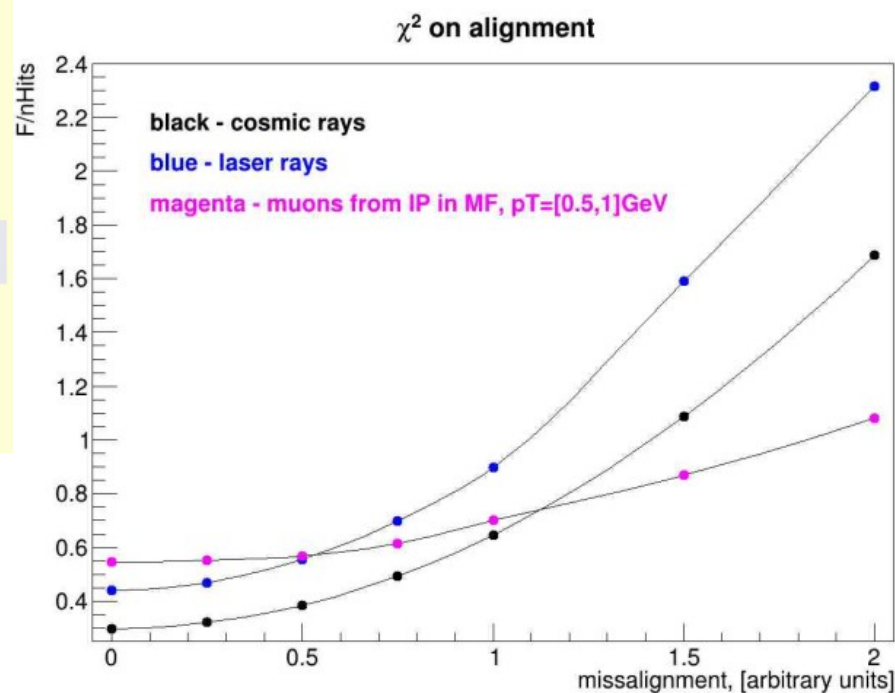
TPC laser calibration for drift velocity

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

Bychkov A.

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.

12
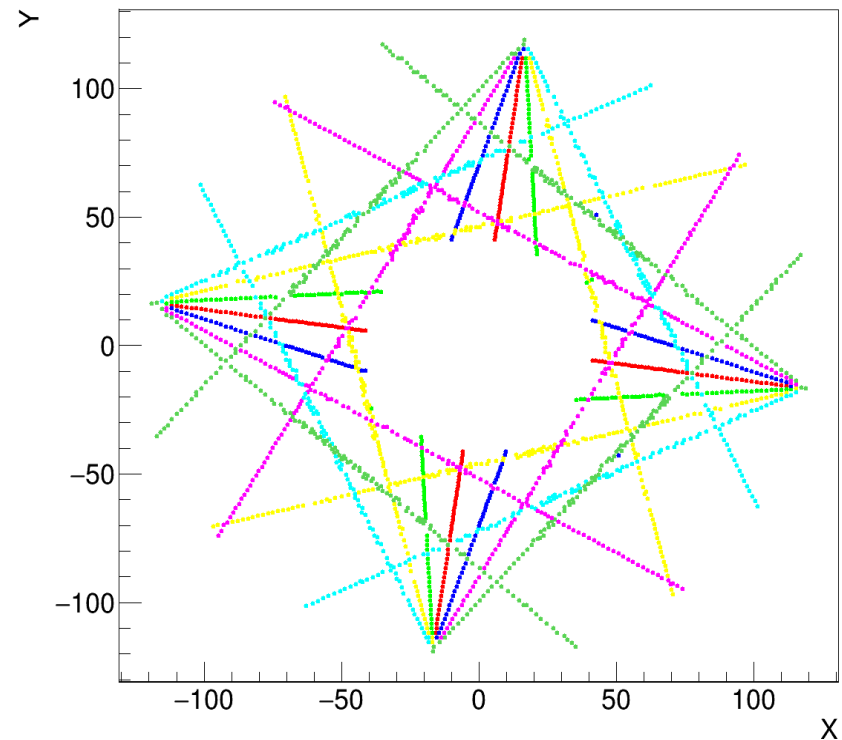
TPC drift velocity calibration

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
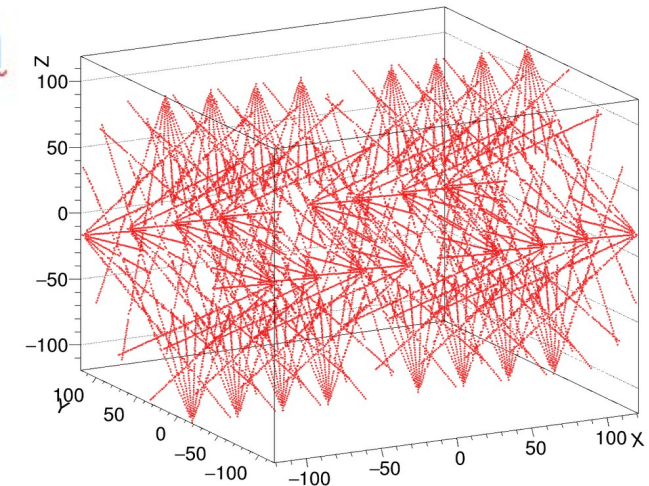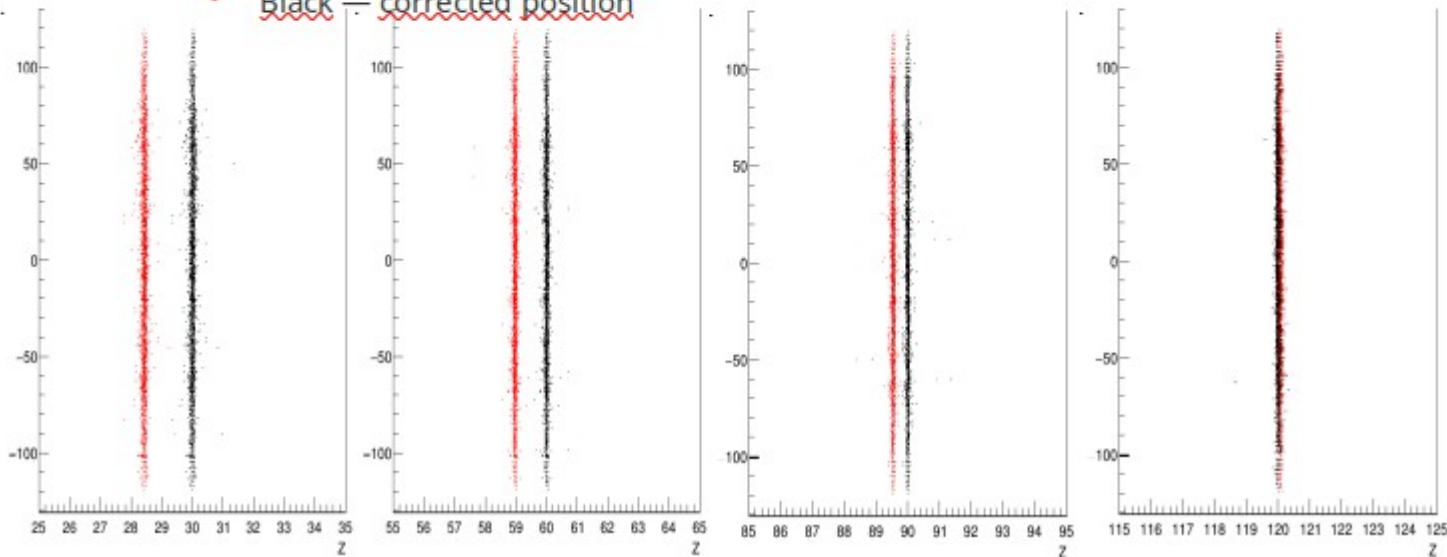
MPD: Online fast clustering

NICA

Krylov Alex
Krylov V.
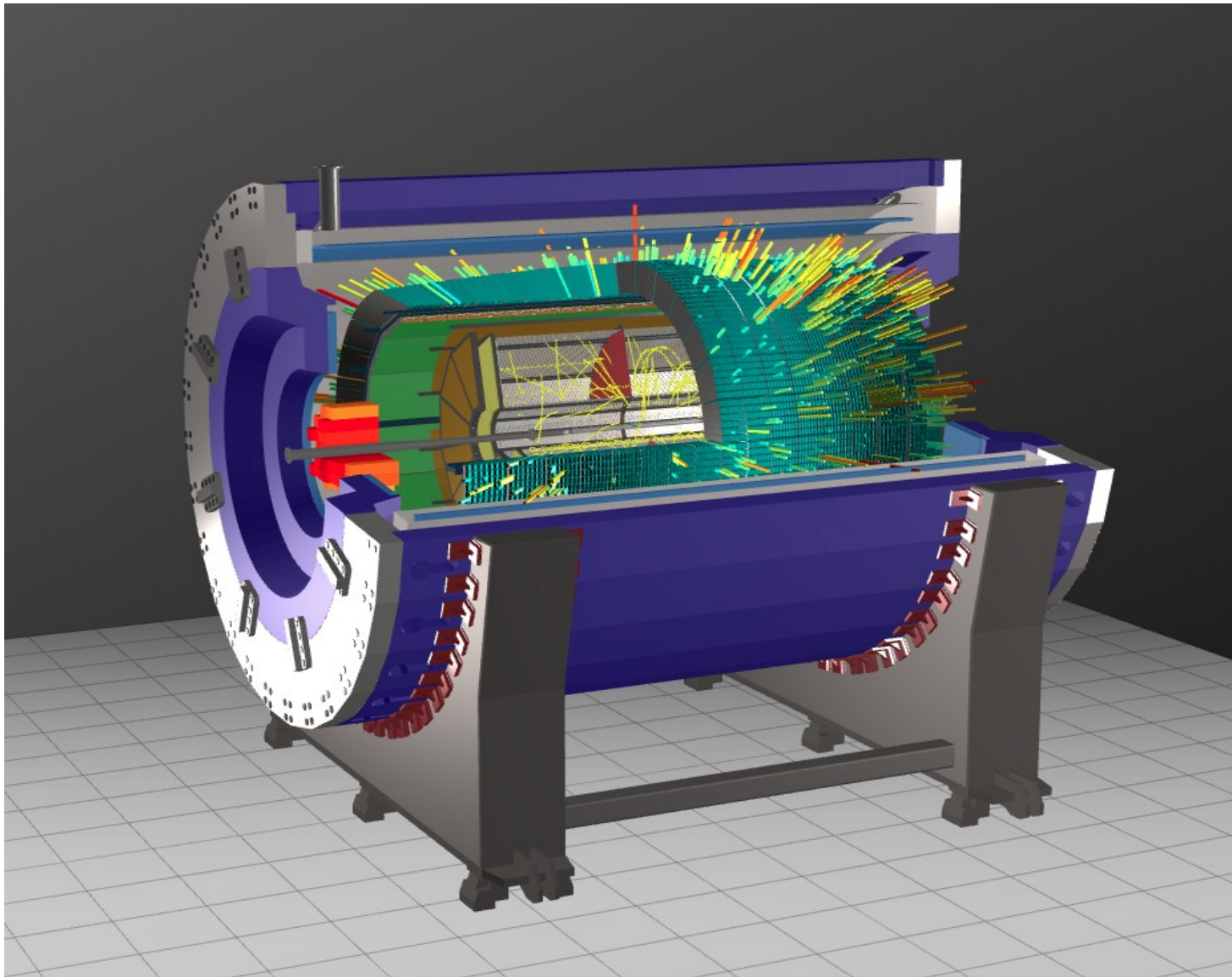
tracking

Fast clustering

MPD web pages

MPD (mpd.jinr.ru)

is unavailable now

Soft (mpdroot.jinr.ru)
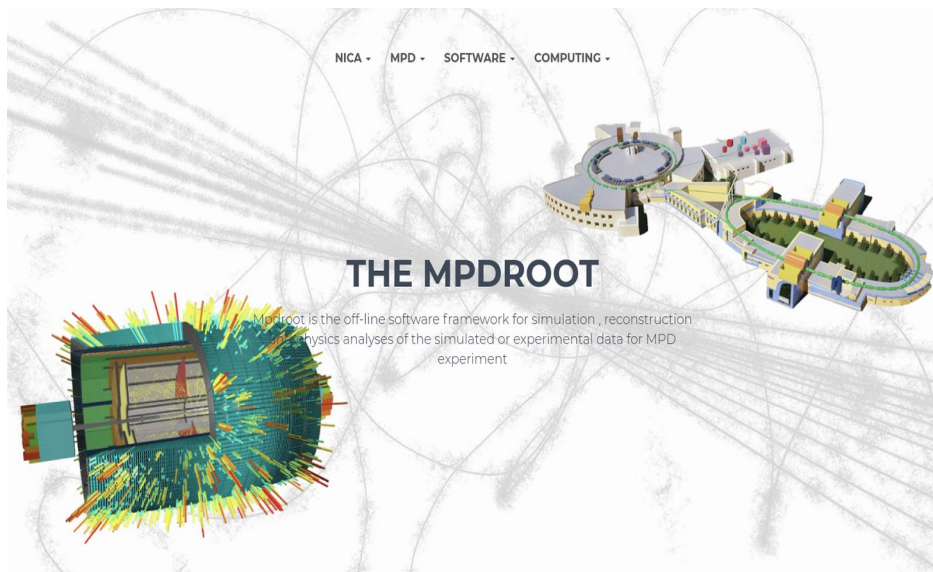
Physics (mpdforum.jinr.ru)

MPD databases

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

Computing resources used for MP

- **NICA offline cluster 250 cores (limit for users)** LHEP
- **GOVORUN 818 cores**
- **Tier1 920 cores**
- **Tier2 1000 cores**
- **Clouds 70 cores**
- **UNAM 100 cores**

LIT

Mexico

JINR computing resources for MPDintegration

Tier-1   CICC/Tier-2   Cloud   Govorun   NICA Cluster

Running   Running   Tests done   Running   To be included
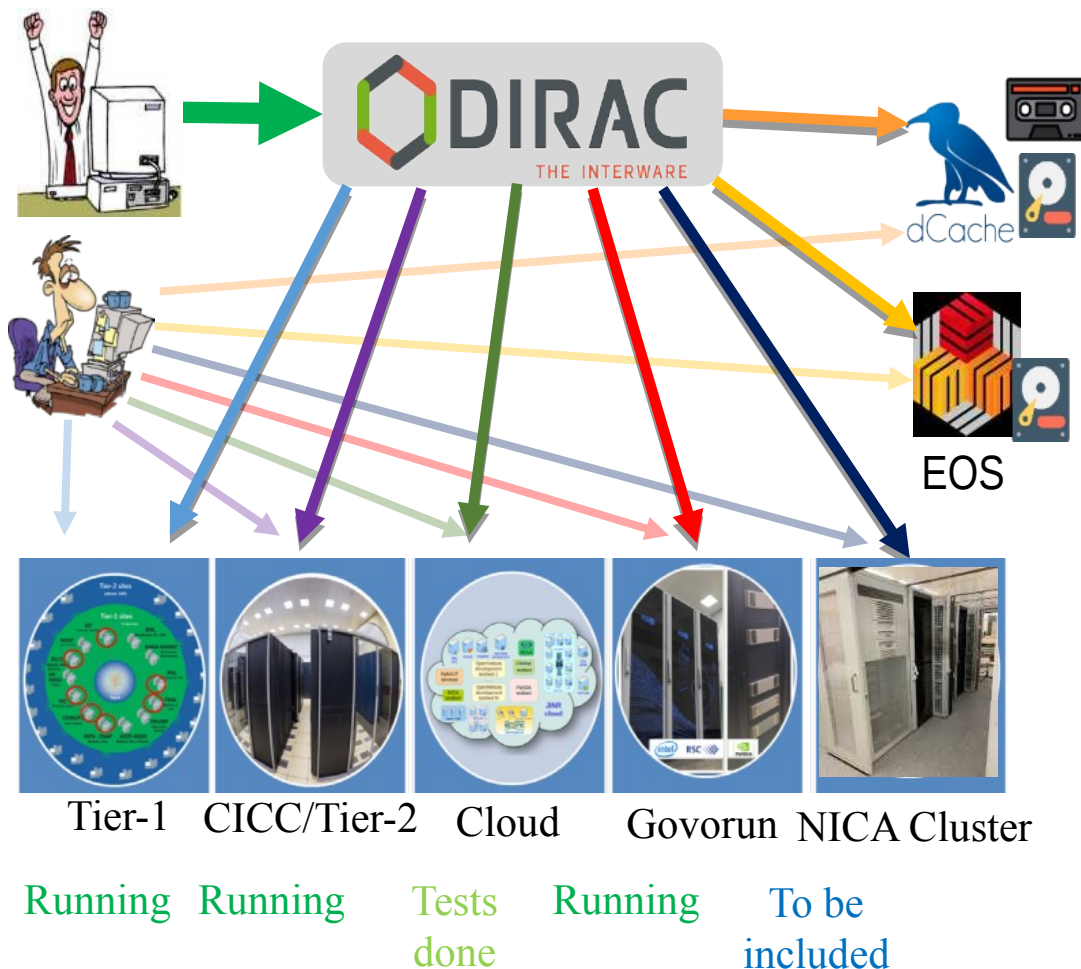
The **DIRAC Interware** is a software which provides various interfaces for the integration of distributed hetero-geneous computing and storage re-sources.

Instead of using all JINR storage and computing resources individually, DIRAC allows processing of large amounts of data through unified sin-gle system.

Monte-Carlo mass production for MPD were successfully performed on the integrated system of Tier-1, Tier-2, Gov-orun and NICA cluster via DIRAC. JINR and Member-States cloud resources have been tested and ready to accept jobs.
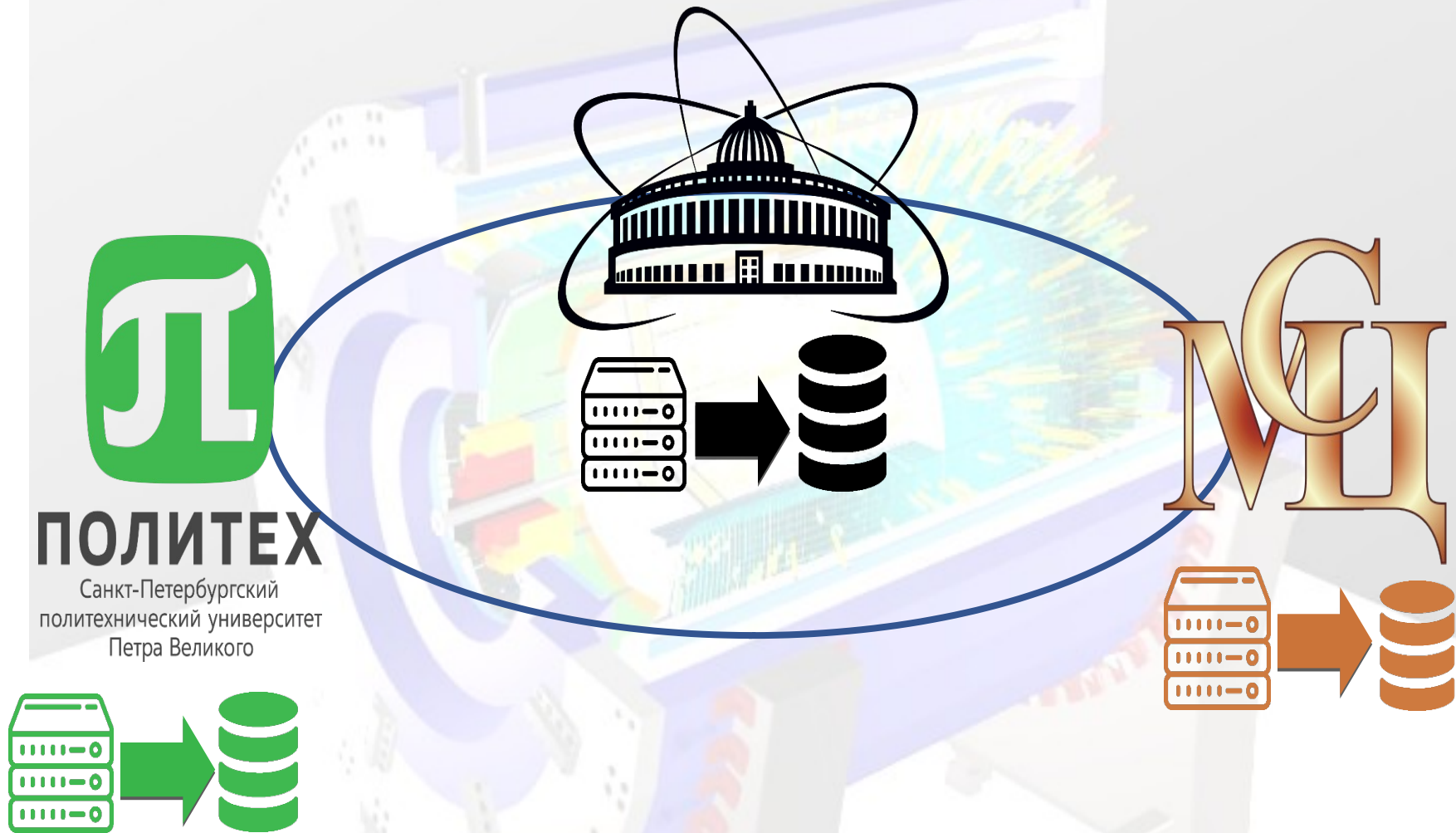
18

Mass production requests

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

MC Event Database

http://mpdroot.jinr.ru -> SOFTWARE -> DataBases -> MPD DataBase
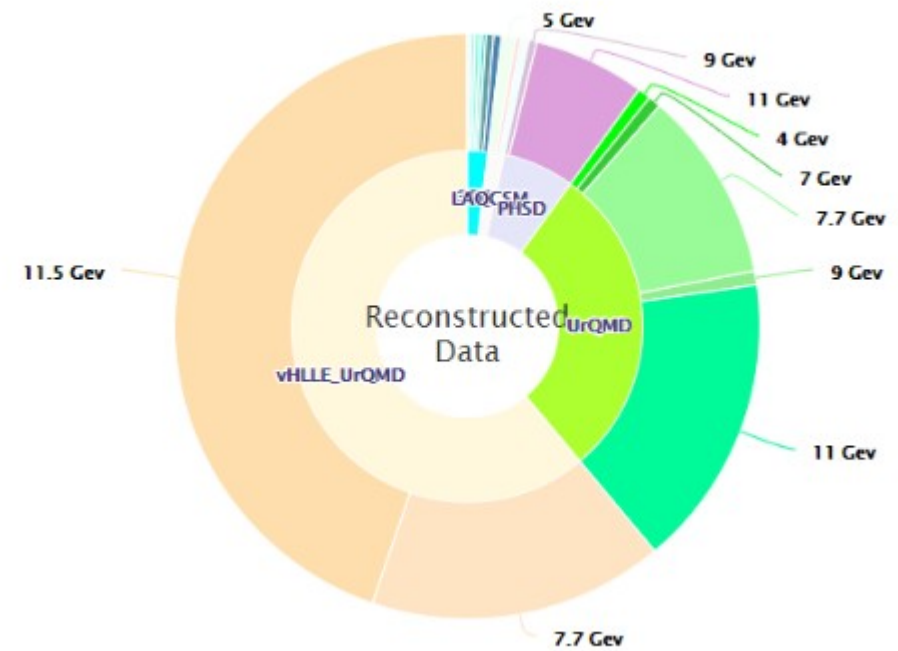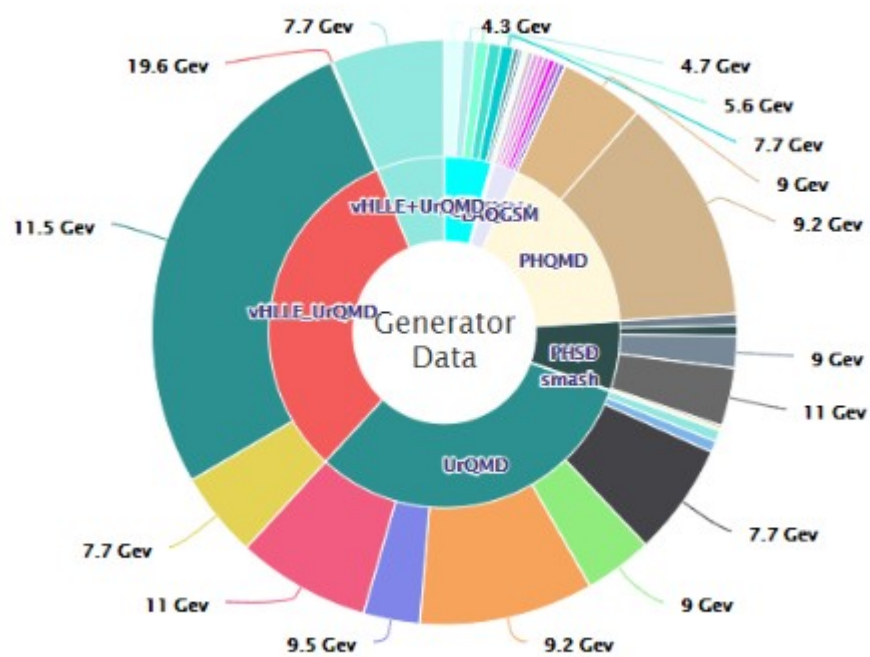
Data generation
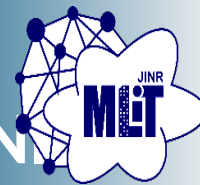
Слияние модельных данных
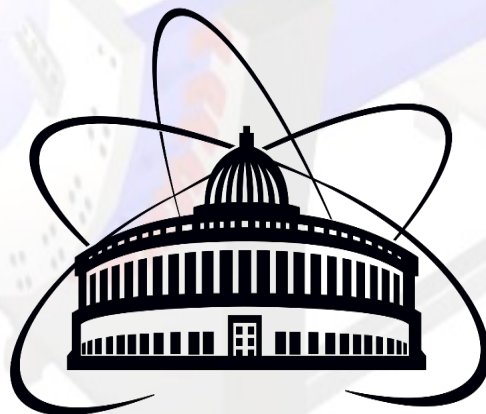
MPD mass production 2019-2022 summary(1) :
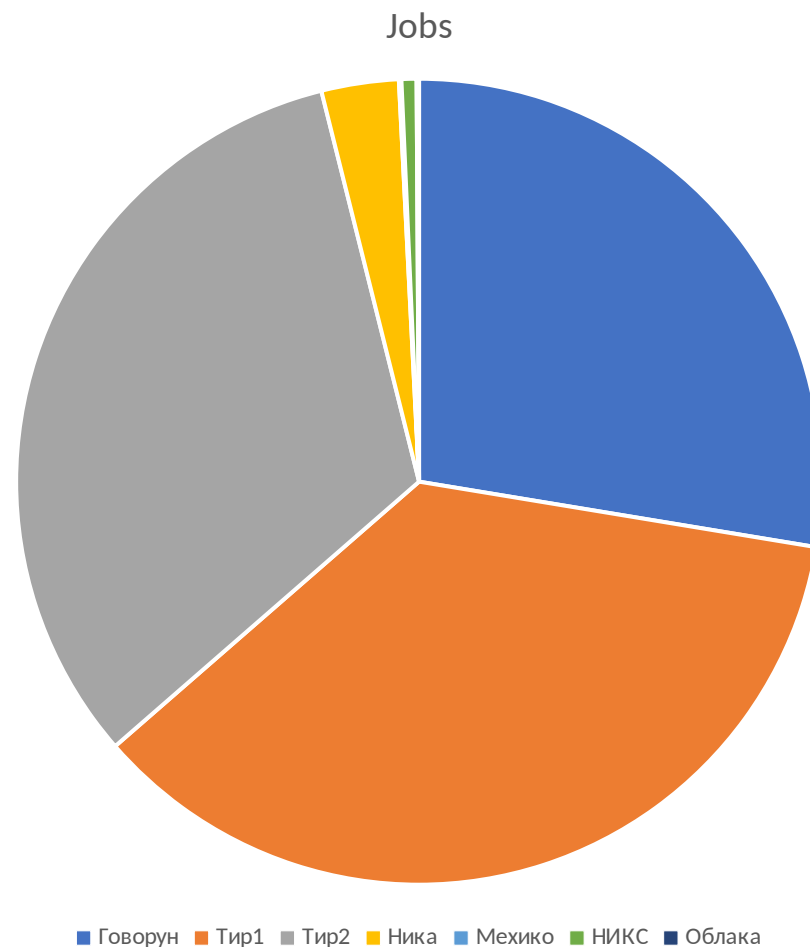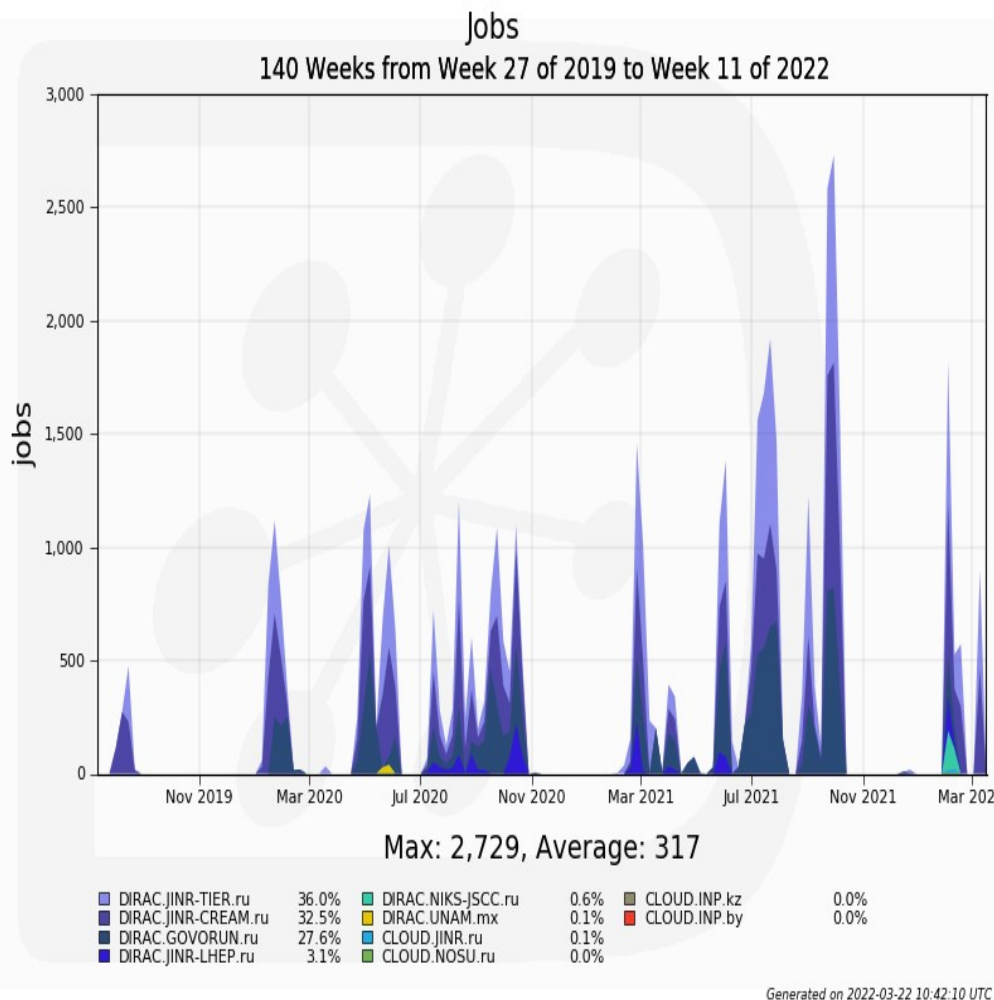
MPD mass production 2019-2022 summary(2) :

Generator	PWG	Coll.		# of events()	Reco
UrQMD	PWG4	AuAu	11	15	+
		BiBi	9	10	+
			9.46	10	+
			9.2	30	+
	PWG2	AuAu	11	10	+
	PWG3	AuAu	7.7	10	+
		BiBi	7.7	10	+
			9	15	+
		pp	9	10	+
	PWG1	BiBi	9.2	1	+
DCM-SMM	PWG1	BiBi	9.2	1	+
PHQMD	PWG2	BiBi	8.8	15	+
			9.2	40	+
			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	5/5	+
PHSD		BiBi	9	10	+
Total				1121	277

Mass production SC centers

https://yadi.sk/i/N1MqbhPo7tIDWw
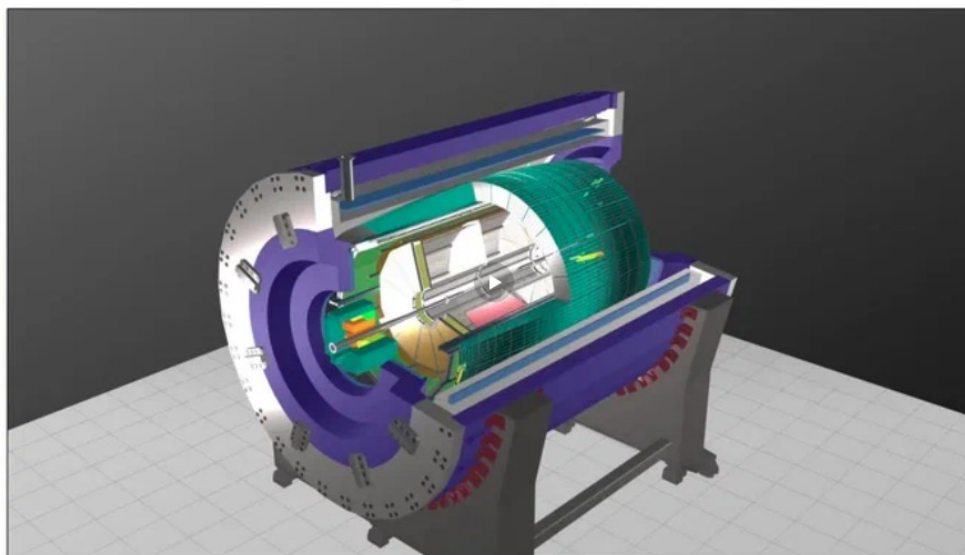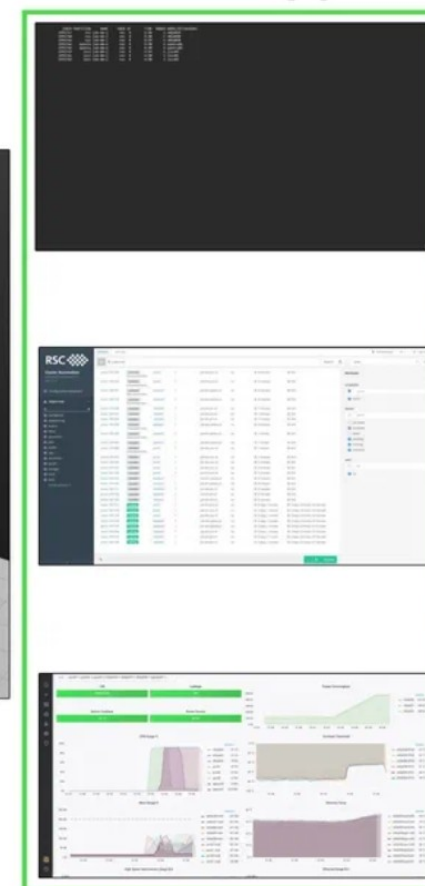
MPD software development team		
LHEP	**LIT**	**OTHER**
Bychkov Alexander Fomenko Kirill Krylov Alexander Moshkin Andrey Myktybekov Demezhan Rogachevsky Oleg	Podgainy D. Zuev M. Pelevanyuk I. Belyakov D. Balashov N. Krylov V. Kadochnikov I. Jan Busa Hnatic Slavomir Alexandrov Eu. Alexandrov I.	Kuzmin V.

Thanks for your attention