



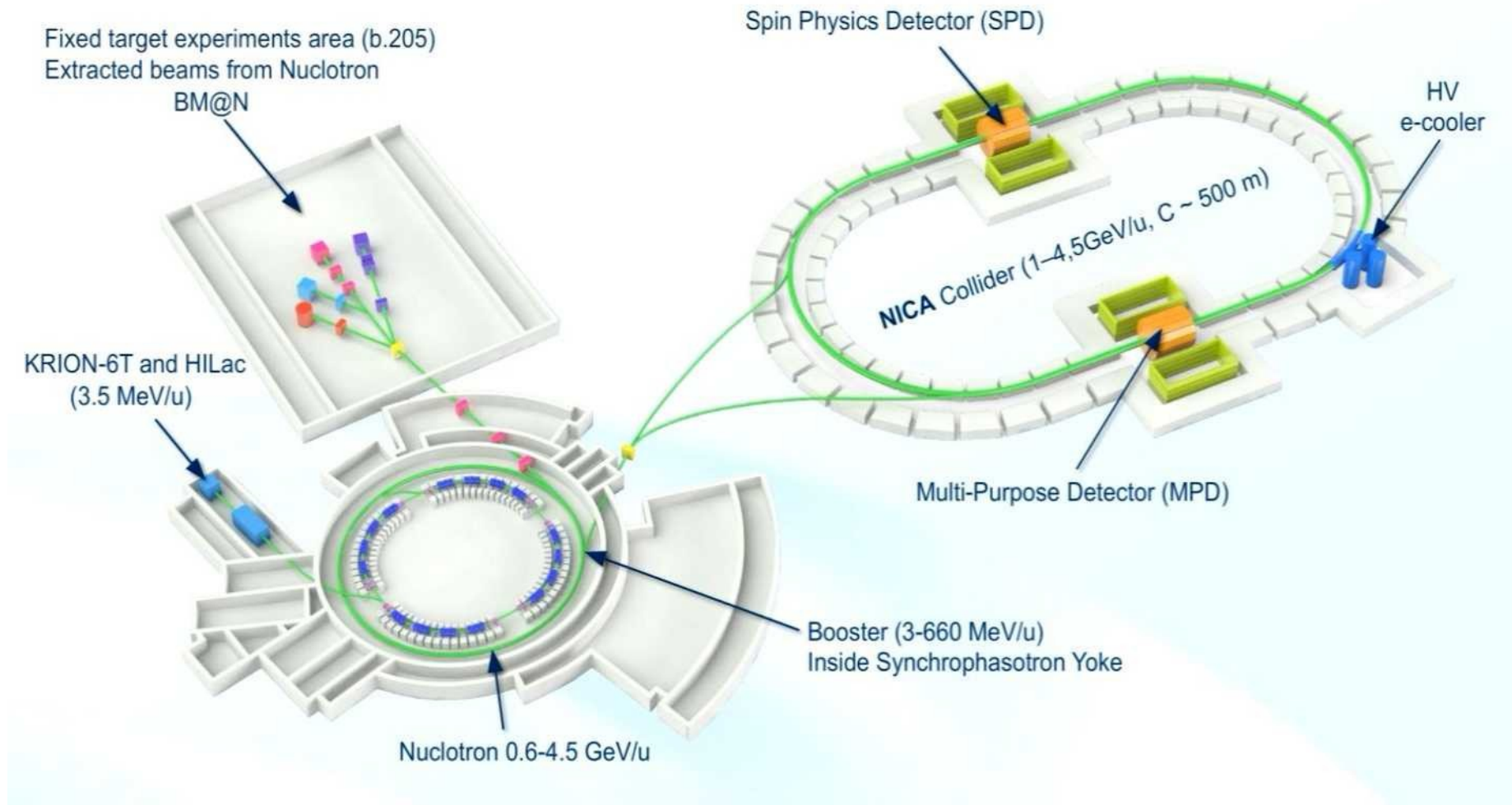
MPD

**Software
&
computing
development
status**

ROGACHEVSKY Oleg
for MPD collaboration

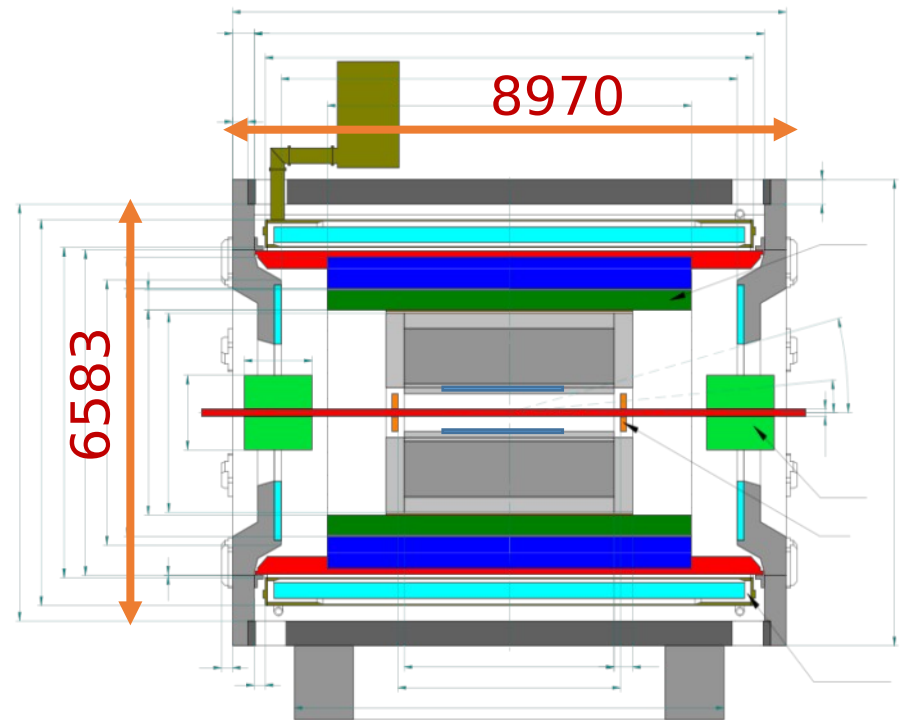
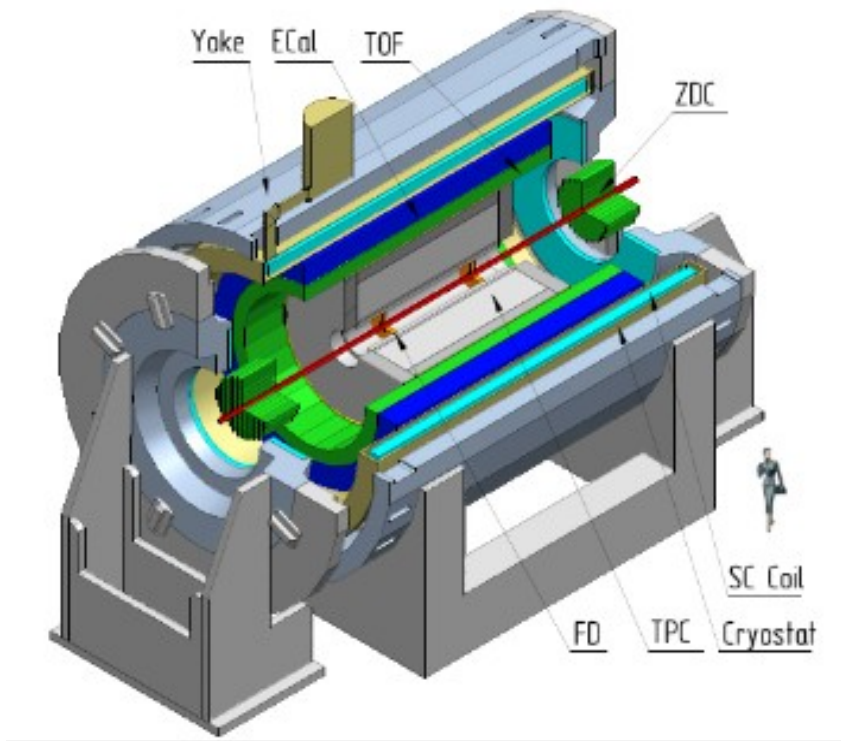
MPD Coll. meeting
April 24, 2020
Dubna

Nuclotron based Ion Collider fAility



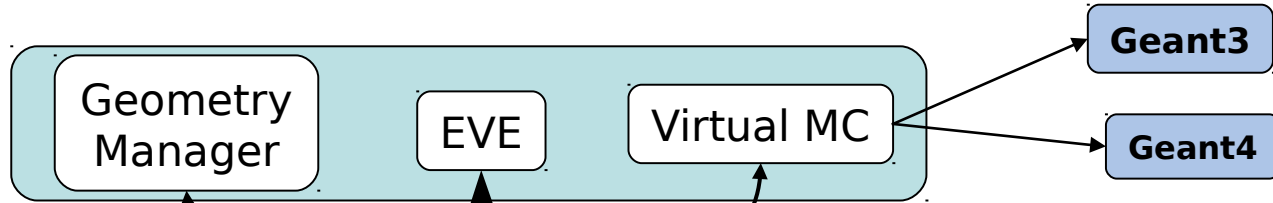
- Beams: from p to Au^{79+}
- Luminosity: $10^{27} \text{ cm}^{-2} \text{ s}^{-1}$ (Au), 10^{32} ($p\uparrow$)
- Collision energy: $\sqrt{s_{NN}} = 4 - 11 \text{ GeV}$ $E_{lab} = 1 - 6 \text{ AGeV}$

MPD experiment: 1 stage

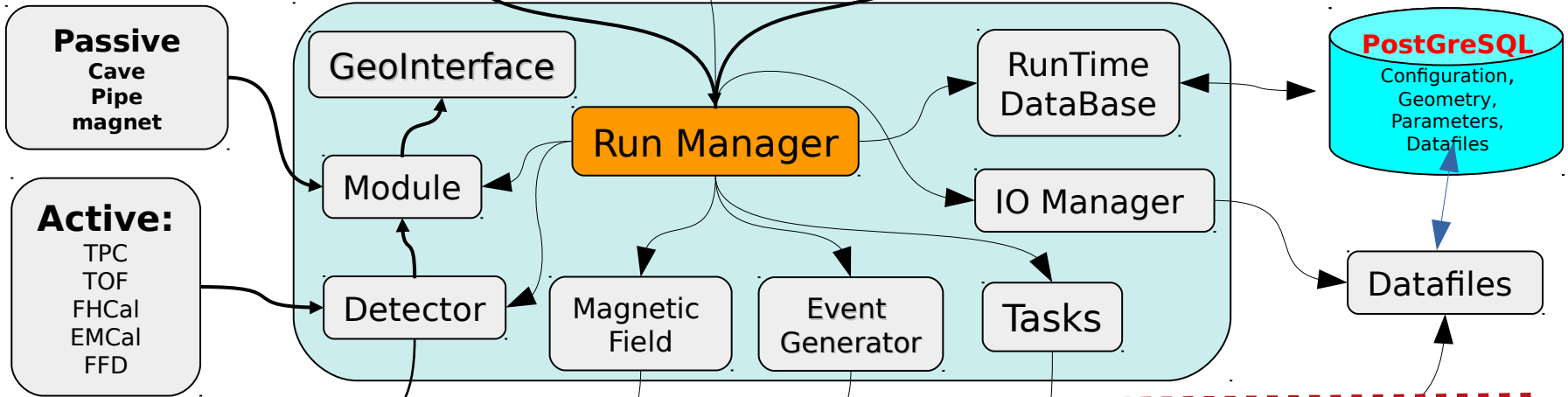


MpdRoot structure

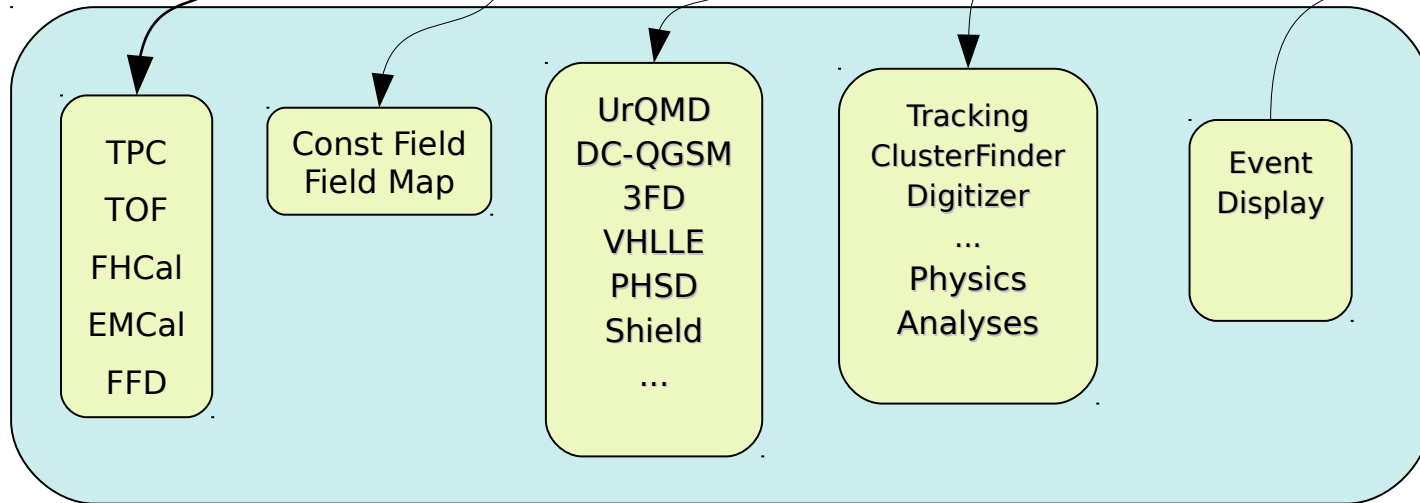
Root

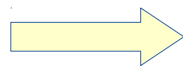


FAIRRoot

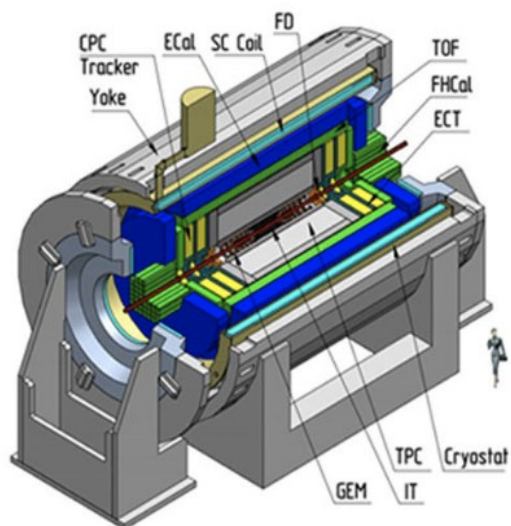


MPDRoot





MAIN - DOCUMENTS - ACCOMPANYING EXPERIMENTS - SOFTWARE - COMPUTING -

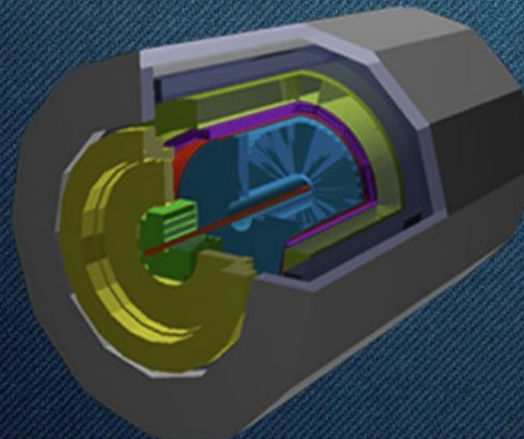


THE MPD EXPERIMENT

MPD (Multi-Purpose Detector) experiment on ion collisions will operate at the storage rings of the NICA facility.

THE MPDROOT

MpdRoot is the off-line software framework for simulation, reconstruction and physics analyses of the simulated or experimental data for MPD experiment. It is based on the FairRoot and ROOT packages and uses their capabilities for building all necessary applications.



mpdroot.jinr.ru → Software → Mpdroot → Git access



The screenshot shows the GitLab interface for the 'mpdroot' repository. The left sidebar contains navigation options: Project overview, Repository (selected), Files, Commits, Branches, Tags, Contributors, Graph, Compare, Issues (2), Merge Requests (2), CI/CD, Operations, Analytics, Wiki, and Settings. The main content area shows the repository path 'NICA > mpdroot > Repository' and a commit titled 'Adding ffd detector' by Oleg Rogachevsky, authored 1 week ago, with commit ID 33fdc271. Below this is a table of repository contents.

Name	Last commit	Last update
bbc	new FairSoft release; FairRoot was separated from MpdRoot	2 years ago
bmd	fixed conflict mcstack with fairroot examples	3 months ago
clustering	new FairSoft release; FairRoot was separated from MpdRoot	2 years ago
cmake	Nicafemto update1	3 months ago
config	change branch name cbmsim->mpdsim	5 months ago
cpc	fixed conflict mcstack with fairroot examples	3 months ago
dch	new FairSoft release; FairRoot was separated from MpdRoot	2 years ago
emc	fixed conflict mcstack with fairroot examples	3 months ago
etof	fixed conflict mcstack with fairroot examples	3 months ago
eventdisplay	fixed conflict mcstack with fairroot examples	3 months ago
ffd	Adding ffd detector	1 week ago
fsa	new FairSoft release; FairRoot was separated from MpdRoot	2 years ago

mpdroot.jinr.ru → Software → Mpdroot → Git access



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THE MPD EXPERIMENT

Software Developers

[Index](#) [News](#) [Rules](#) [Register](#) [Login](#)

You are not logged in. Please login or register.

NICA EXPERIMENTS

Forums	Topics	Posts	Last post
 Software	57	213	2019-03-19 16:52:43 by zinchenk
 Computing	4	34	2017-11-09 16:09:40 by gertsen

Что-то накопело

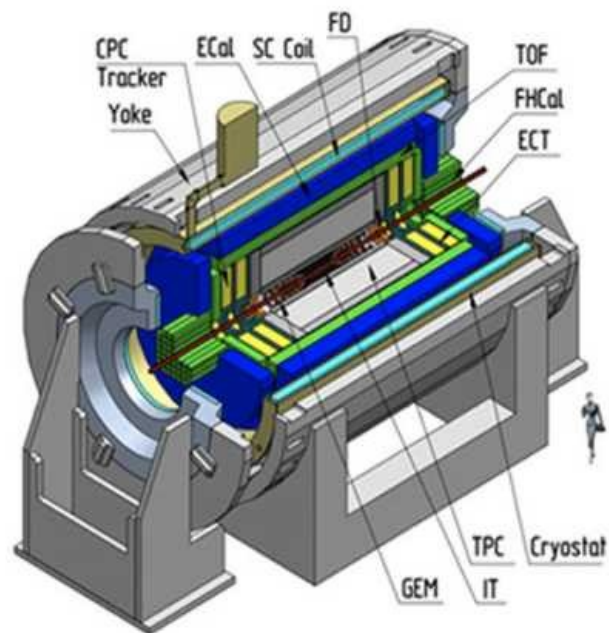
Total number of registered users: **25**
Newest registered user: **romanov_av**

Total number of topics: **61**
Total number of posts: **247**

Currently online: **1** guest, **1** registered user roleg

Powered by PunBB, supported by Informer Technologies, Inc.

Software ▼



THE MPD EXPERIMENT

MPD (Multi-Purpose Detector) experiment on ion collisions will operate at the storage rings of the NICA facility.

DOCUMENTS - ACCOMPANYING EXPERIMENTS - SOFTWARE - COMPUTING -

NICA cluster ▾

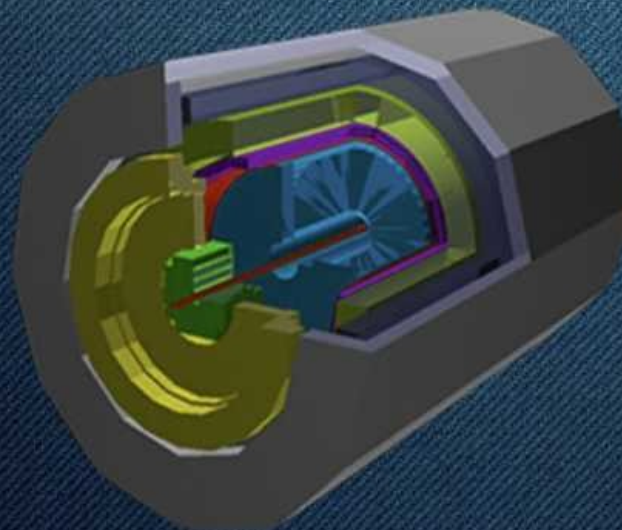
LIT Clusters ▾

Parallelization ▾

Computing TDR

THE MPDROOT

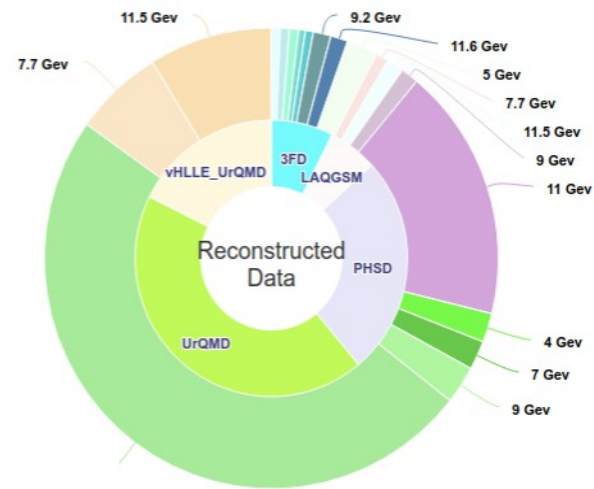
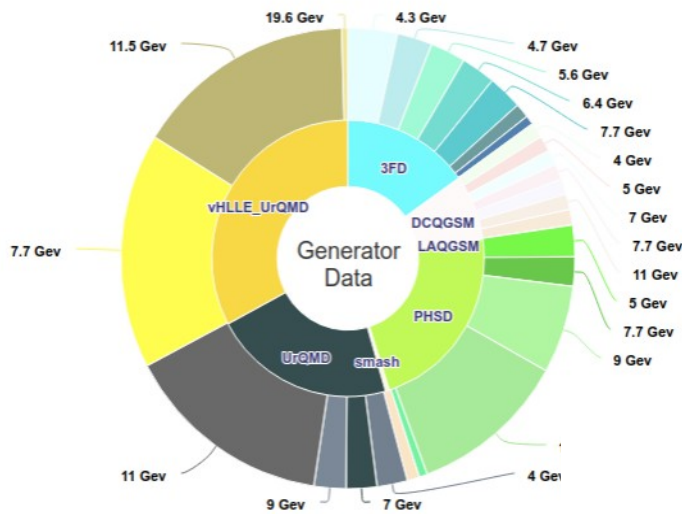
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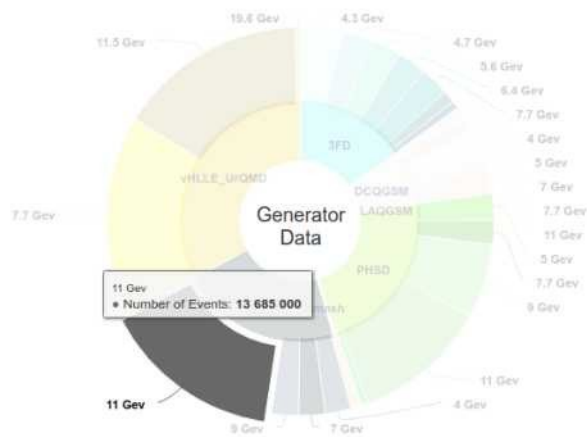
mpdroot.jinr.ru → Software → Databases → MPD database



Records Statistic Find



LHEP NICA cluster
LIT EOS file system



Event generators & reco data databases in HybriLIT farm

MPD Monte-Carlo DB, Page 1 of 4										Generator	# of events M
Generator	Beam	Target	Energy, GeV	Centrality	Number of Events, Ev	Generator mod.	Reconstruction mod.	Generator comment	Path		
3FD	Au	Au	4.3	02_0_02.0fm	505000	3fd-2018-03-17-bc2a06d-mix-urqmdOFF			/eos/hybrilit.jinr.ru/nica/models/3FD/AuAu/04.3GeV-02_0_02.0fm/3fd-2018-03-17-bc2a06d-mix-urqmdOFF	QGSM	4
3FD	Au	Au	4.3	02_0_02.0fm	505000	3fd-2018-03-17-bc2a06d-tp-urqmdOFF			/eos/hybrilit.jinr.ru/nica/models/3FD/AuAu/04.3GeV-02_0_02.0fm/3fd-2018-03-17-bc2a06d-tp-urqmdOFF	UrQMD	~ 15
3FD	Au	Au	4.7	02_0_02.0fm	505000	3fd-2018-03-17-bc2a06d-mix-urqmdOFF			/eos/hybrilit.jinr.ru/nica/models/3FD/AuAu/04.7GeV-02_0_02.0fm/3fd-2018-03-17-bc2a06d-mix-urqmdOFF	PHSD	4
3FD	Au	Au	4.7	02_0_02.0fm	505000	3fd-2018-03-17-bc2a06d-tp-urqmdOFF			/eos/hybrilit.jinr.ru/nica/models/3FD/AuAu/04.7GeV-02_0_02.0fm/3fd-2018-03-17-bc2a06d-tp-urqmdOFF	vHLLÉ_UrQMD	~ 4
3FD	Au	Au	5.6	02_0_02.0fm	505000	3fd-2018-03-17-bc2a06d-mix-urqmdOFF			/eos/hybrilit.jinr.ru/nica/models/3FD/AuAu/05.6GeV-02_0_02.0fm/3fd-2018-03-17-bc2a06d-mix-urqmdOFF	3FD(Theseus)	5
3FD	Au	Au	5.6	02_0_02.0fm	505000	3fd-2018-03-17-bc2a06d-tp-urqmdOFF			/eos/hybrilit.jinr.ru/nica/models/3FD/AuAu/05.6GeV-02_0_02.0fm/3fd-2018-03-17-bc2a06d-tp-urqmdOFF	Hybrid UrQMD	3
3FD	Au	Au	6.4	02_0_02.0fm	505000	3fd-2018-03-17-bc2a06d-mix-urqmdOFF			/eos/hybrilit.jinr.ru/nica/models/3FD/AuAu/06.4GeV-02_0_02.0fm/3fd-2018-03-17-bc2a06d-mix-urqmdOFF		
3FD	Au	Au	6.4	02_0_02.0fm	505000	3fd-2018-03-17-bc2a06d-tp-urqmdOFF			/eos/hybrilit.jinr.ru/nica/models/3FD/AuAu/06.4GeV-02_0_02.0fm/3fd-2018-03-17-bc2a06d-tp-urqmdOFF		

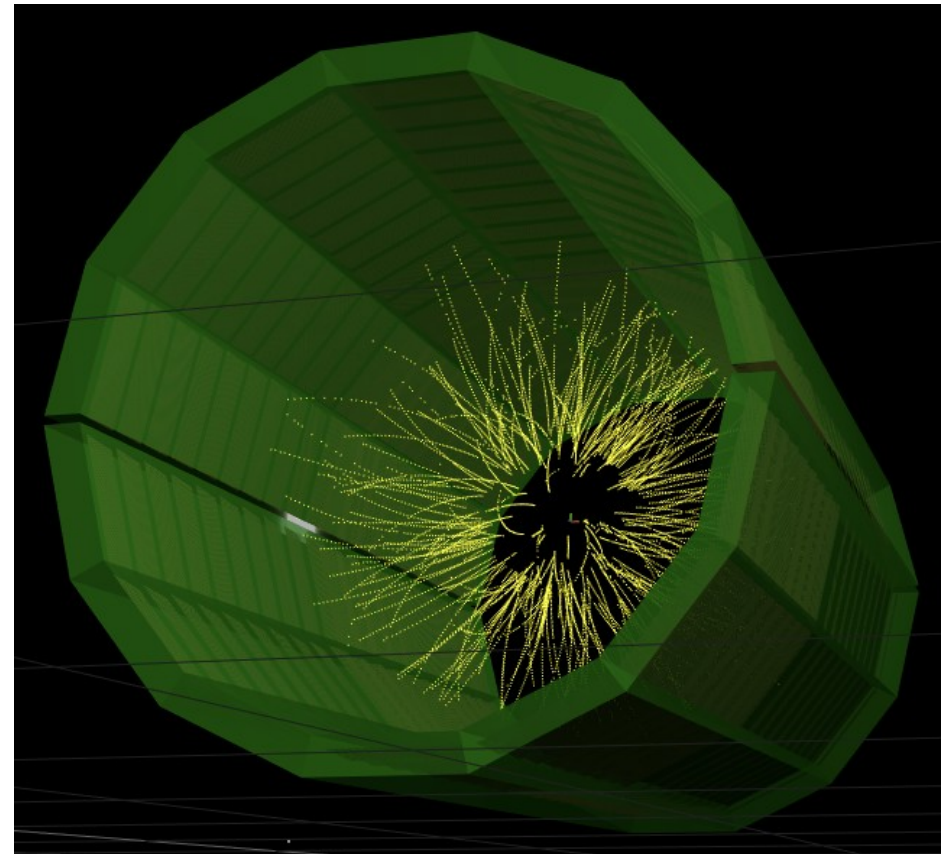
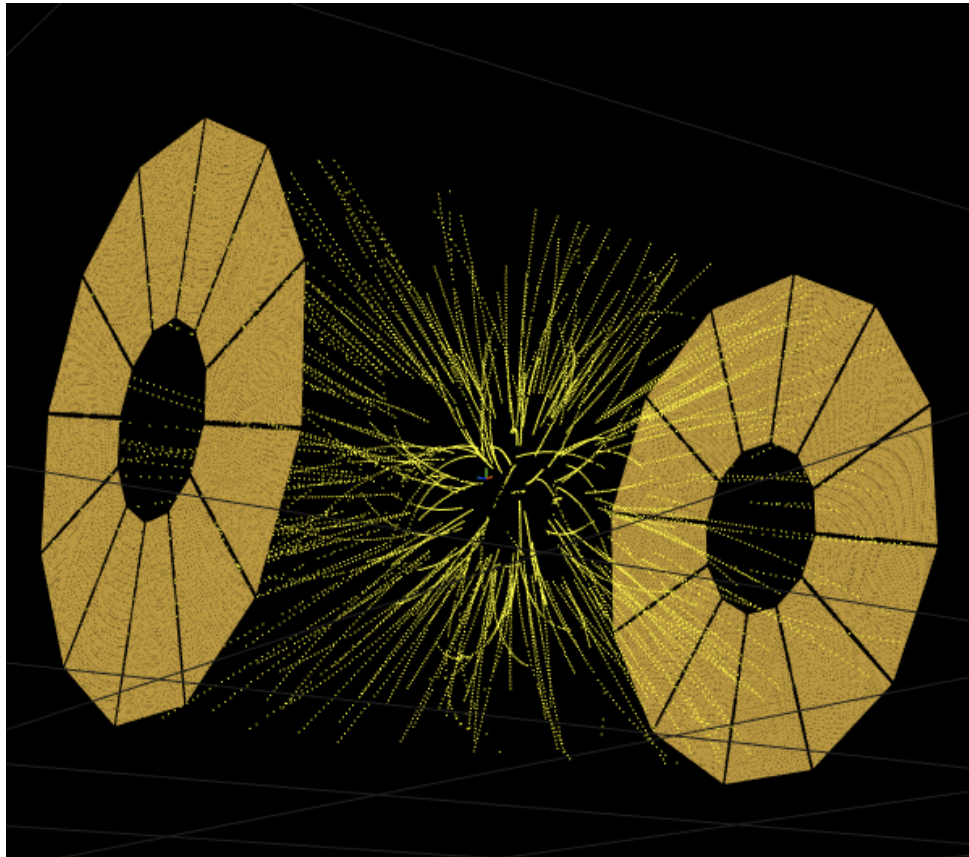
Detectors simulation status



GitLab repository: <https://git.jinr.ru/nica/mpdroot>

Detector	MC Geometry	Hits/digits
TPC	Ver. 8 (2018)	hitproducer
TOF	Ver. 7 (2016)	hitproducer
ECAL	Ver. 8 (2018)	hitproducer
FHCal	Ver. 2 (2018)	hitproducer
ITS	Ver. 3 (2015)	hitproducer
FFD	Ver. 6 (2020)	hitproducer
BBC	Ver. 2 (2019)	MC points

Event Displays v.0.4 for Run Control System & Detectors Control System

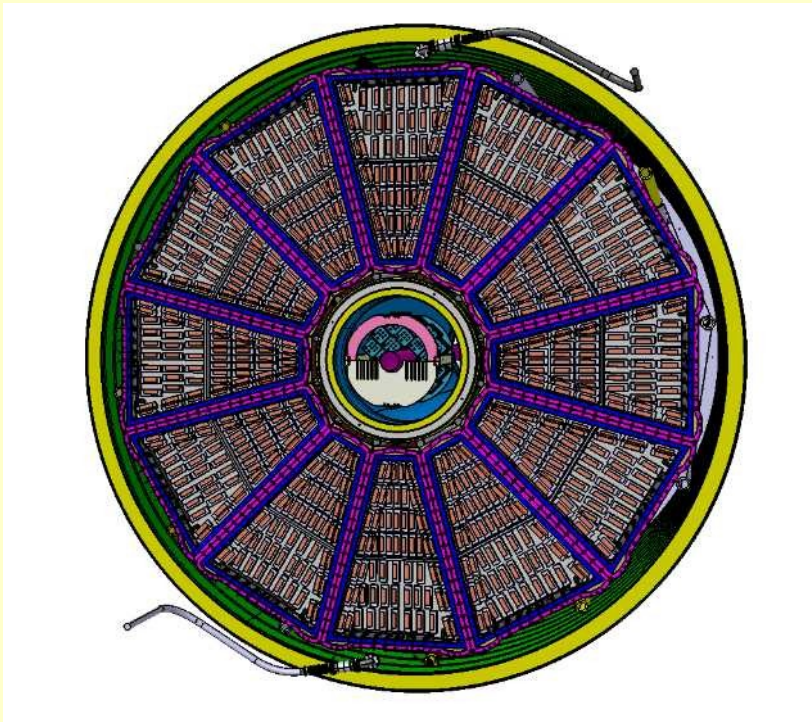


based on:

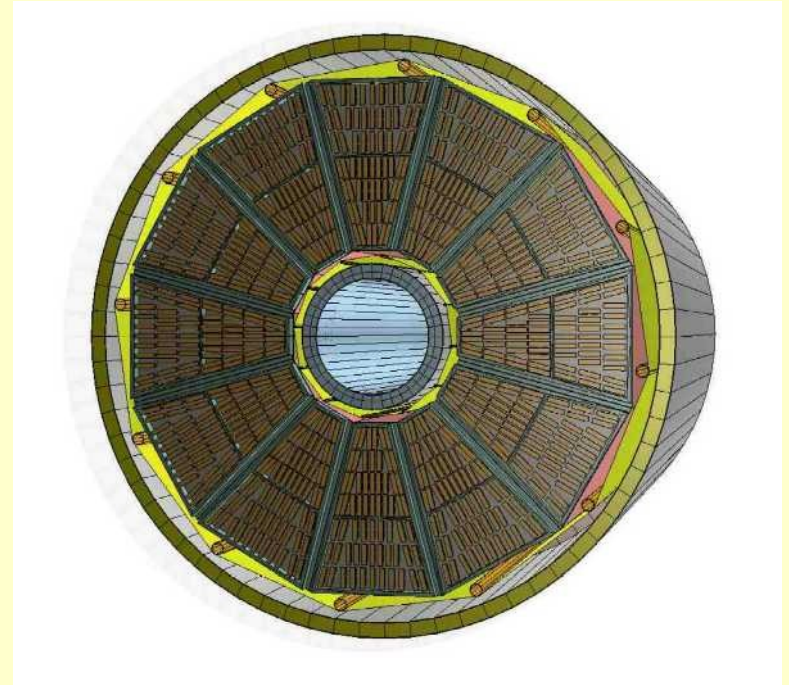


TPC geometry ver.8

- Drawing



- Root geometry



35 000 nodes

TPC Electronics Simulation

Each board:

2+1 mm Copper

3,5 mm Textolite

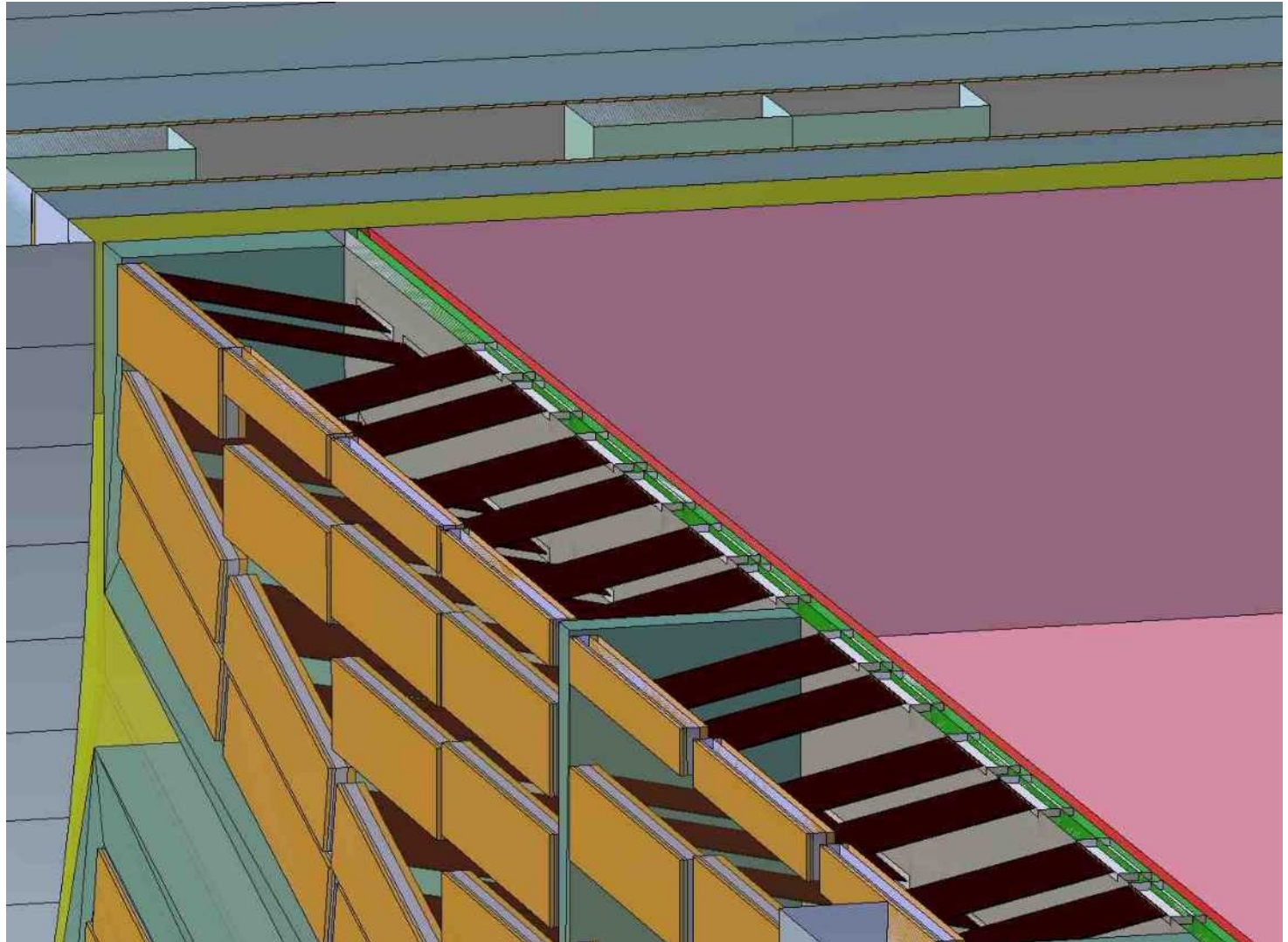
Flat cable:

0,1+0,1 mm
Polypropylene
Insulation

0,15 mm
Copper wire

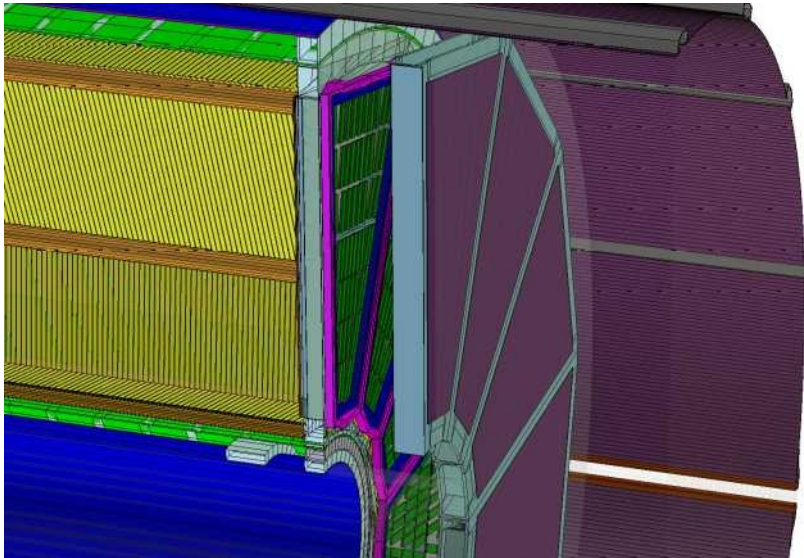
Connector to Pads plane:

Plastic + Air gap

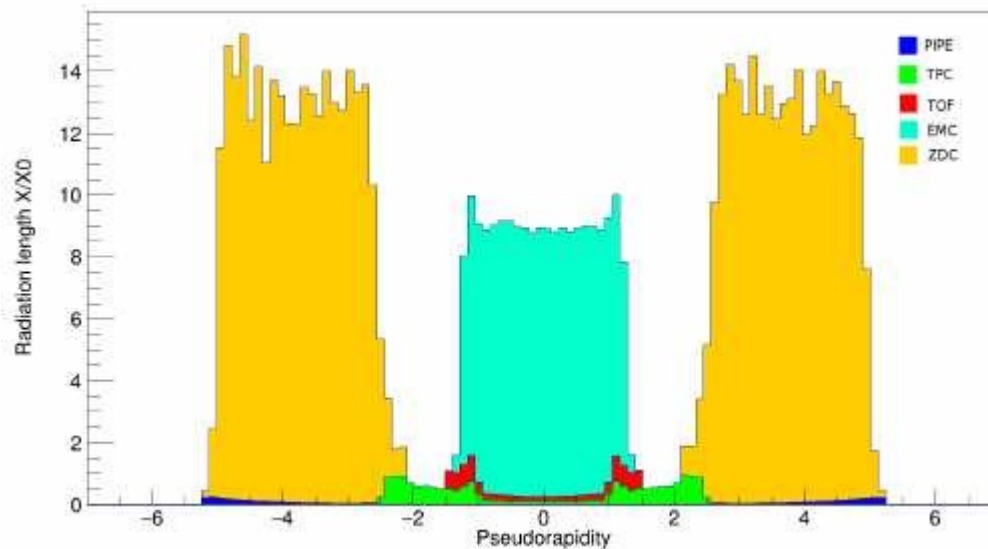
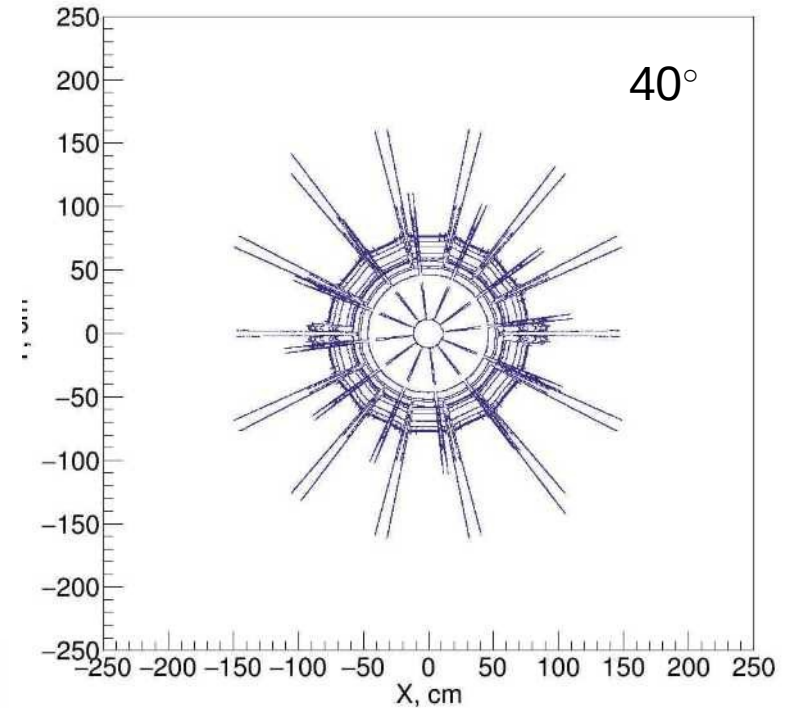


TPC material budget

Looking in TPC detector with geantino

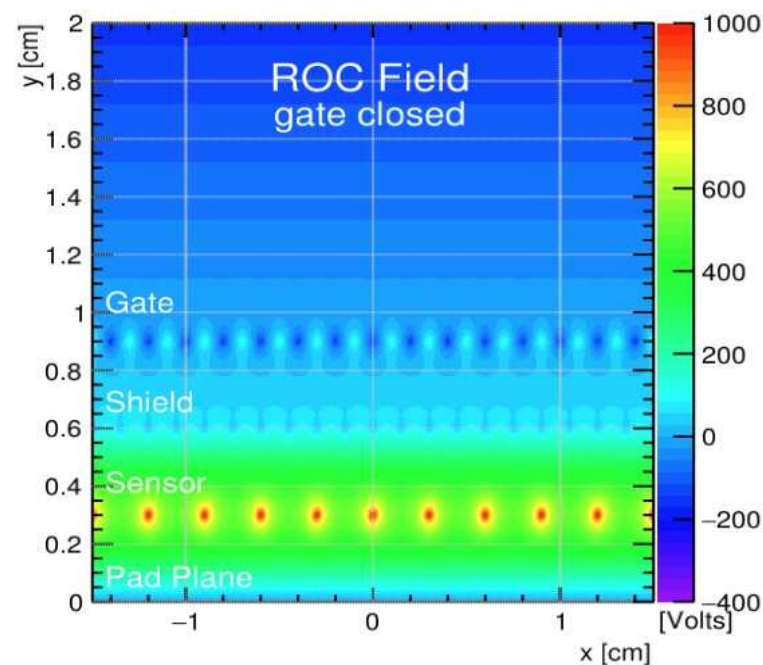
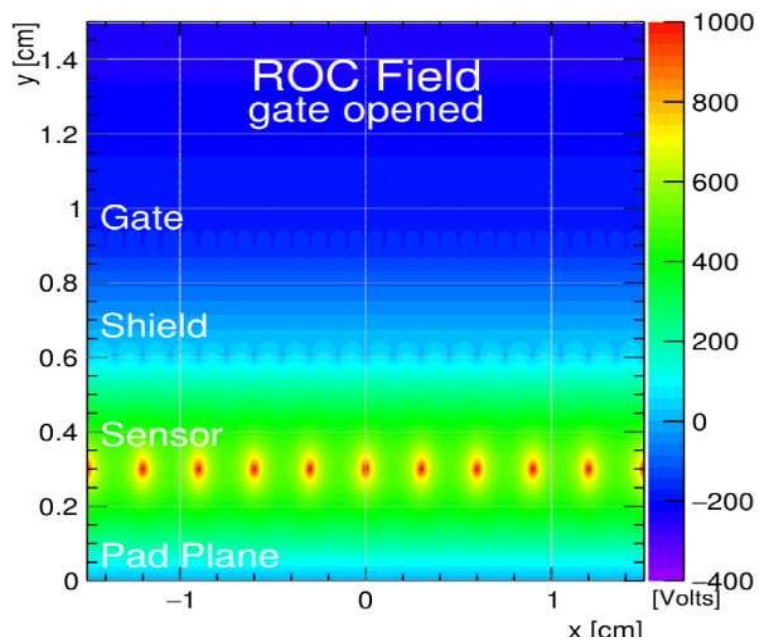


Material budget for TPC



Material budget for all MPD detectors

TPC gas and ROC properties



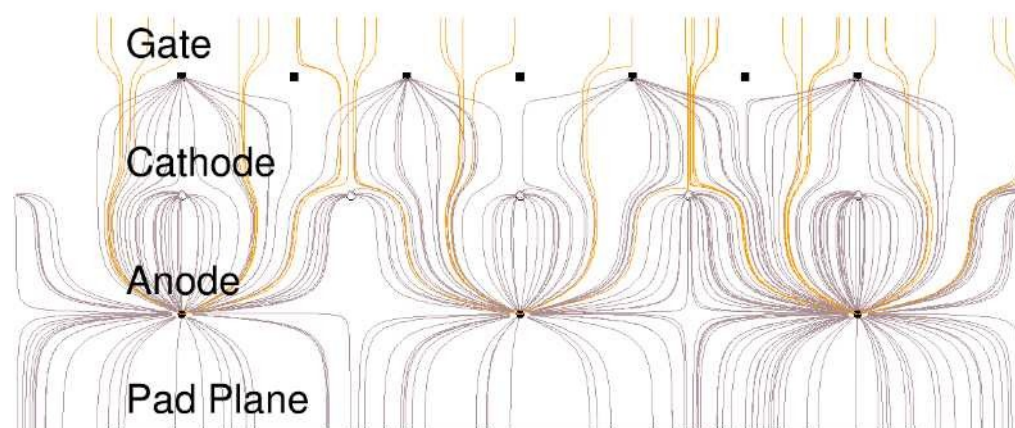
Garfield++

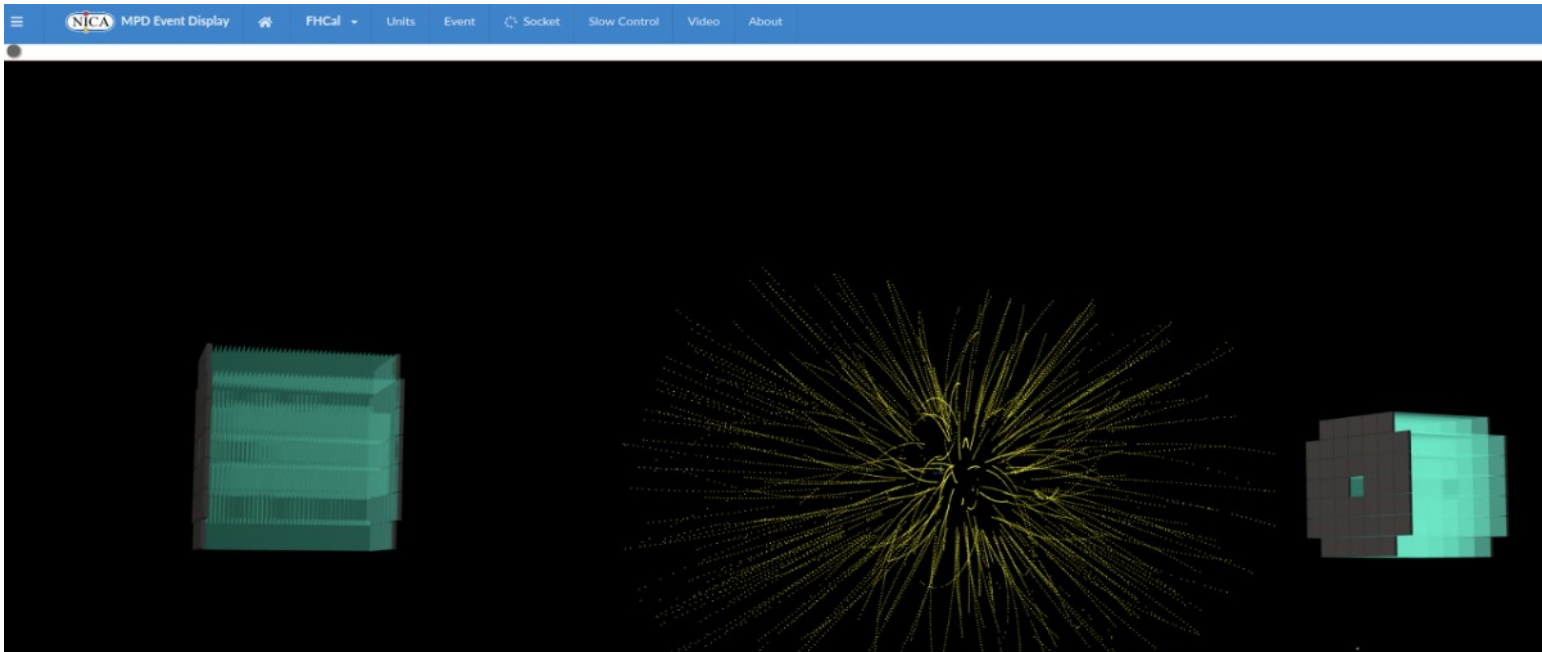
Version 2019.3



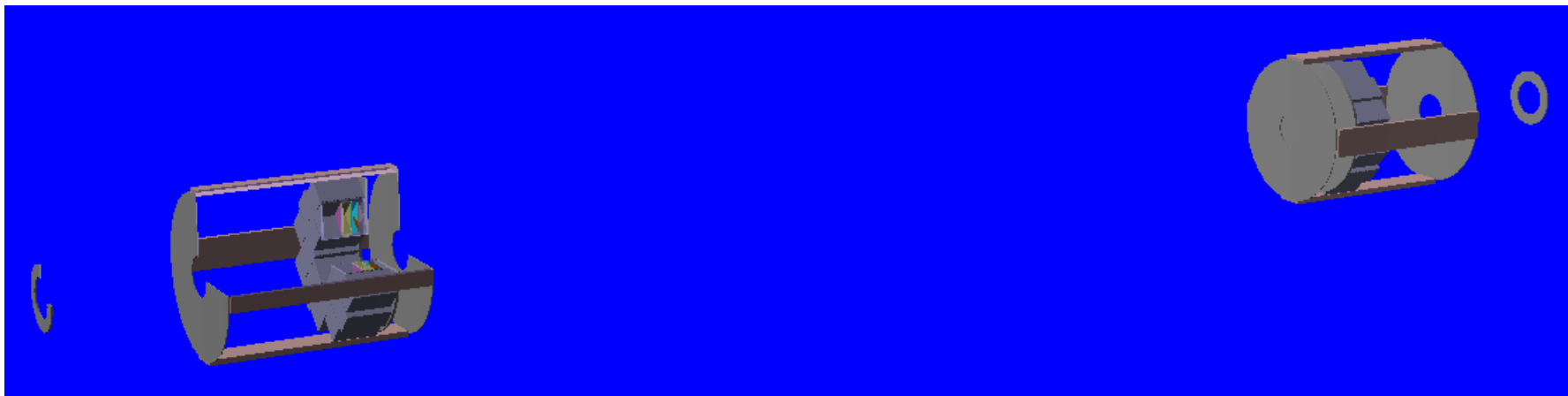
Drift view
ROC chamber

— e⁻
— ion⁺





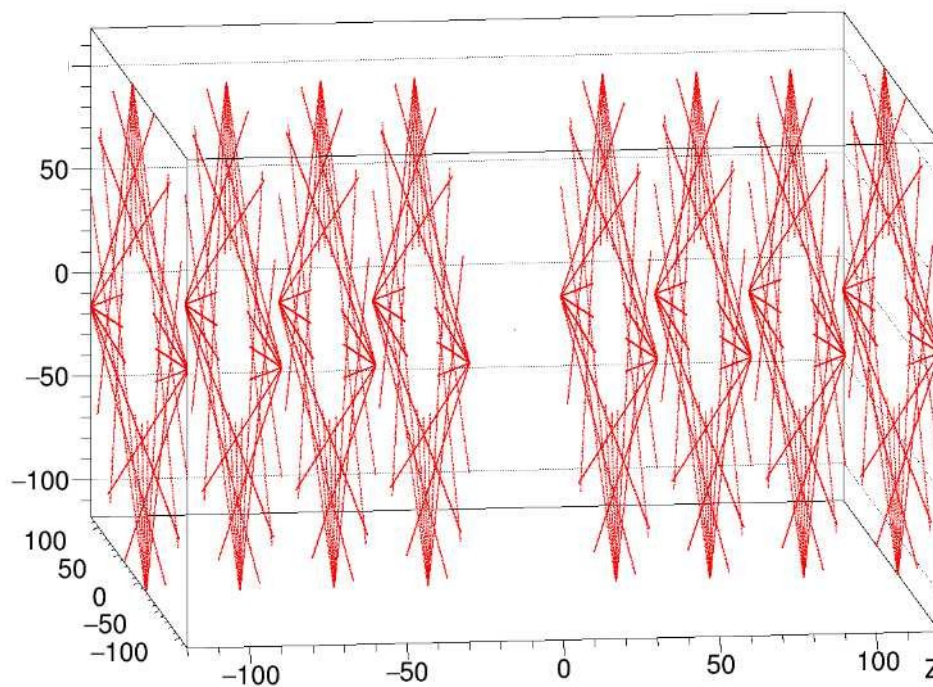
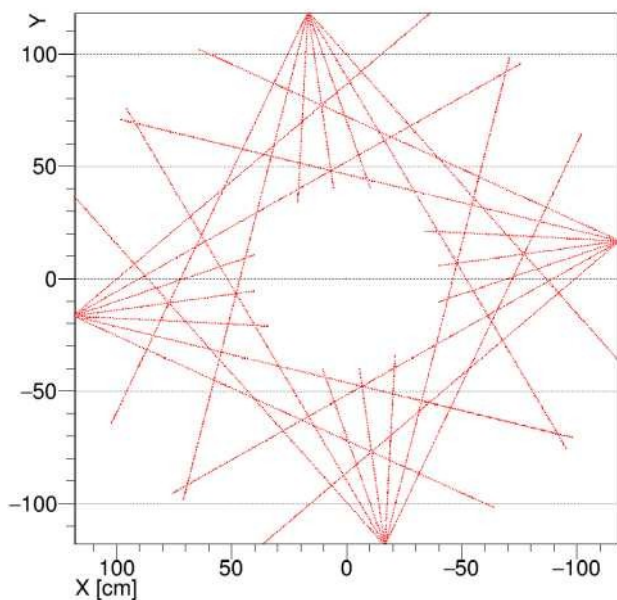
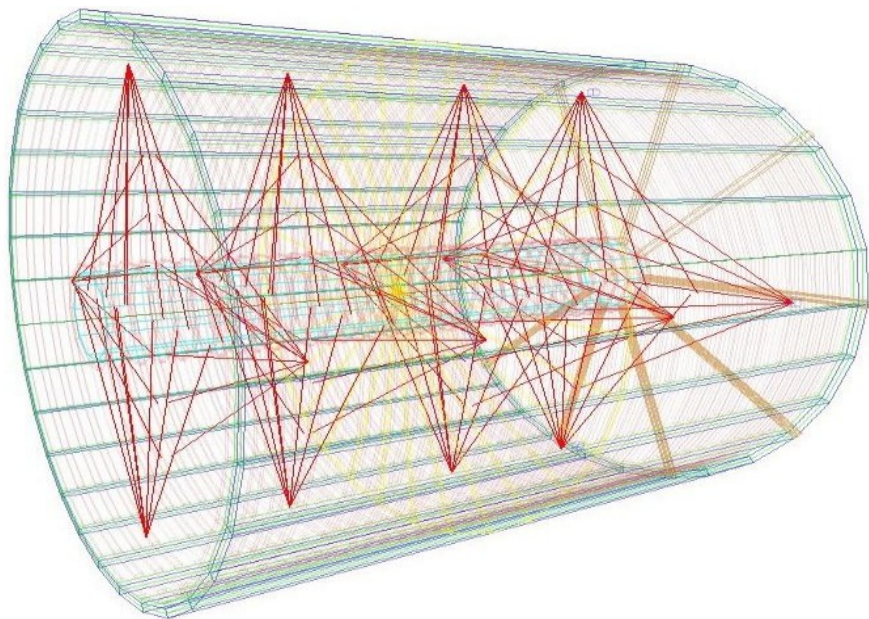
FFD



TPC laser calibration

Half of TPC

Laser "planes"	4
Micro-mirrors bundles per plane	4
Beams from micro-mirrors bundle	7
Laser "tracks"	224

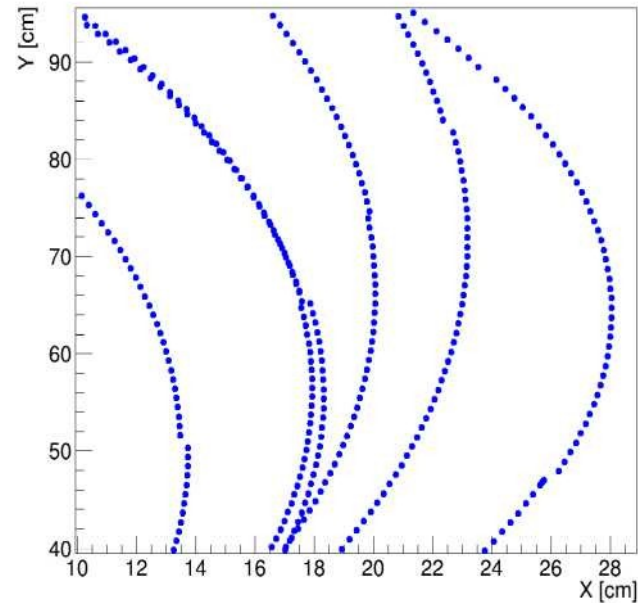


TPC alignment (preliminary)

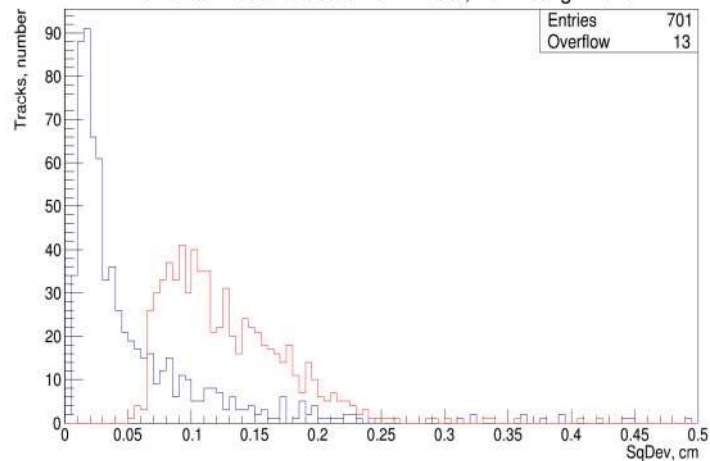
MC points on the border of sectors

```

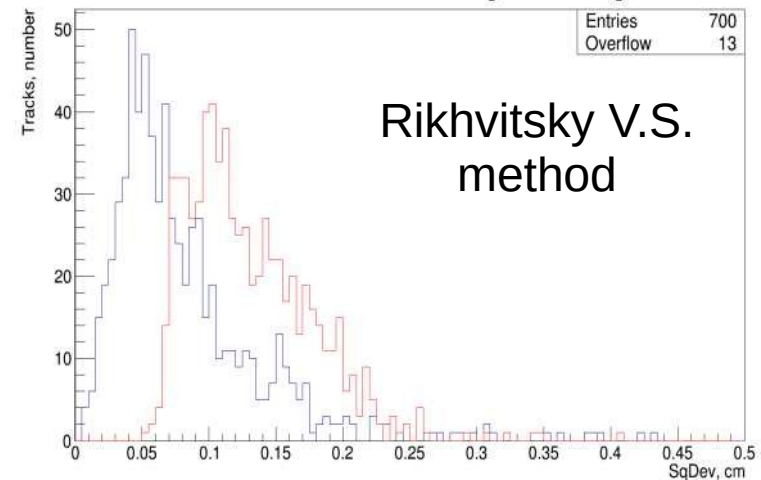
A <TpcSector n="0">
  <ShiftX unit="cm">0.10995</ShiftX>
  <ShiftY unit="cm">0.0648</ShiftY>
  <ShiftZ unit="cm">-0.0096</ShiftZ>
  <RotationX unit="deg">-0.04505</RotationX>
  <RotationY unit="deg">0.0009</RotationY>
  <RotationZ unit="deg">0.03625</RotationZ>
</TpcSector>
<TpcSector n="1">
  <ShiftX unit="cm">0.0504</ShiftX>
  <ShiftY unit="cm">-0.1194</ShiftY>
  <ShiftZ unit="cm">0.01785</ShiftZ>
  <RotationX unit="deg">0.03215</RotationX>
  <RotationY unit="deg">-0.04435</RotationY>
  <RotationZ unit="deg">0.0297</RotationZ>
</TpcSector>
  
```



Square Deviation MC points (blue) and TPC hits (red) from track reconstructed helix. Ideal, no misalignment.

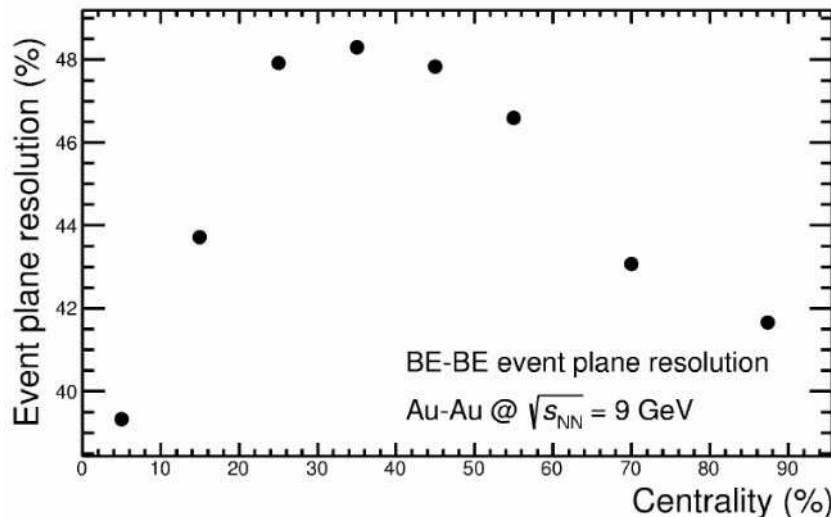
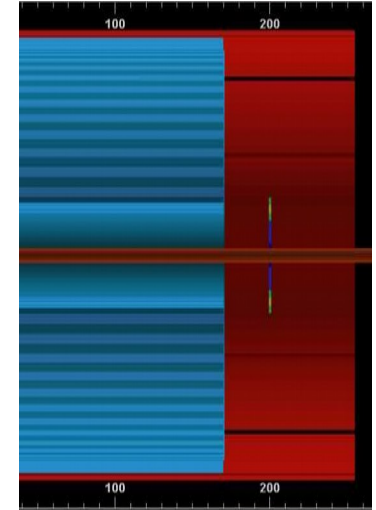
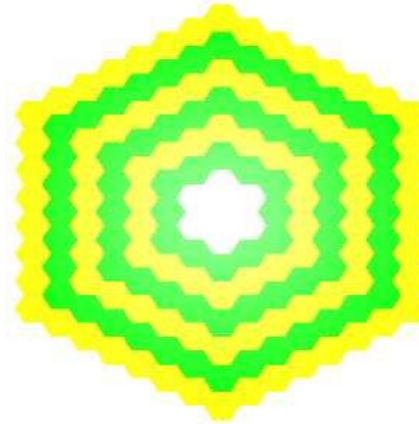
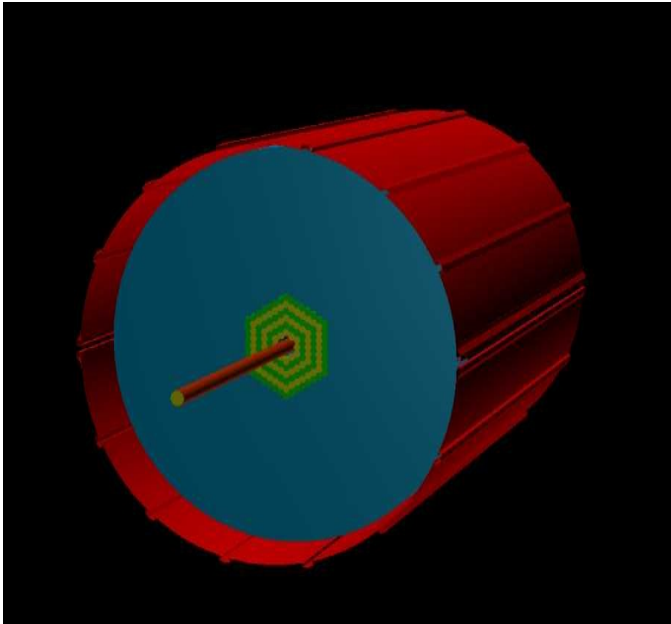


Square Deviation MC points (blue) and TPC hits (red) from track reconstructed helix with misalignment and alignment.



Beam Beam monitoring

ArXiv:1809.10553

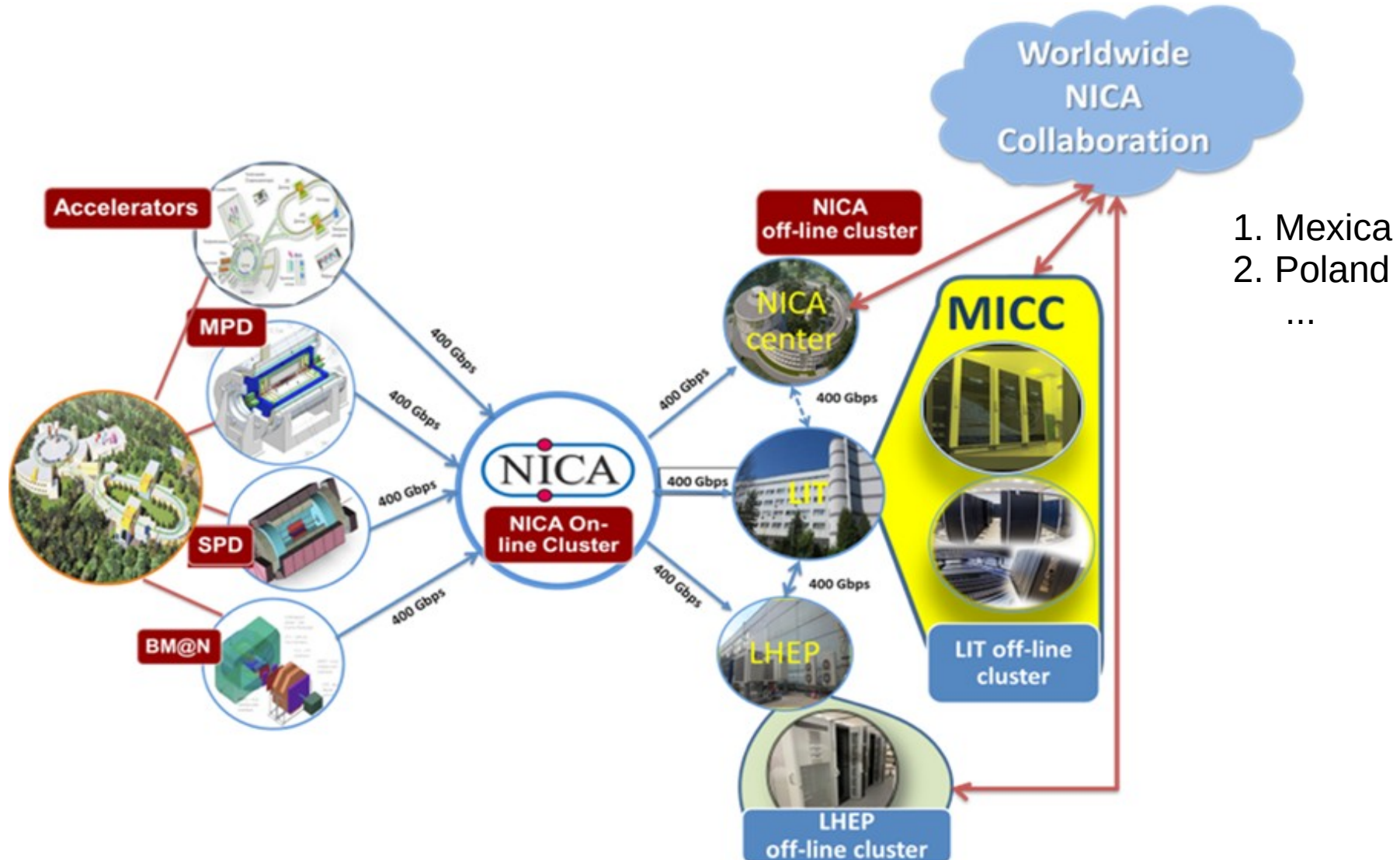


Estimated event plane resolution using the BE-BE

The MPD beam-beam monitoring system is considered as a part of level-0 trigger. Its time resolution is expected to be around 30 ps. To fulfill the trigger requirements the BE-BE geometry consists of two hodoscope detectors, each located 2 meters away from the interaction point, at opposite sides. Each detector consists of an array of 162 hexagonal plastic scintillator cells arranged in six concentric rings. It covers a pseudorapidity range of $1.9 < |\eta| < 3.97$.

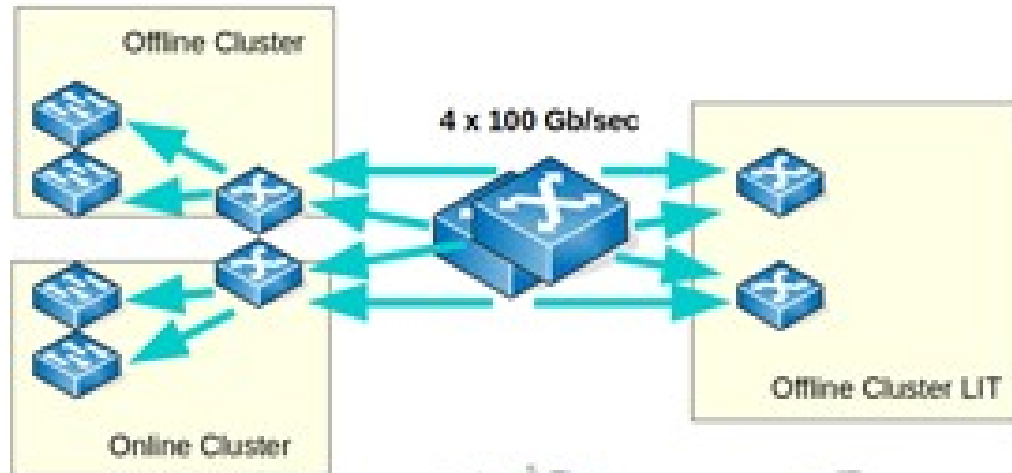
The BE-BE's trigger signal will be useful to generate a trigger logic to identify and discriminate beam-beam events, either for minimum bias or with a given centrality, from background and beam-gas interactions.

Computing structure of NICA complex



Example communication LHEP and LIT sites of the NICA complex on two independent optical line

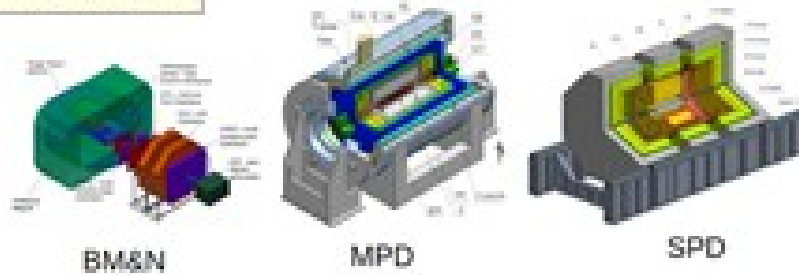
Multi-Site Cluster Network



The core of the network system, switching will be performed on the

Cisco Nexus 9504

4 x 100Gbps



LHEP clusters



NICA on-line cluster

Mean data flow 10 Gb/c

Disk space 0,5 PB for 24 h.

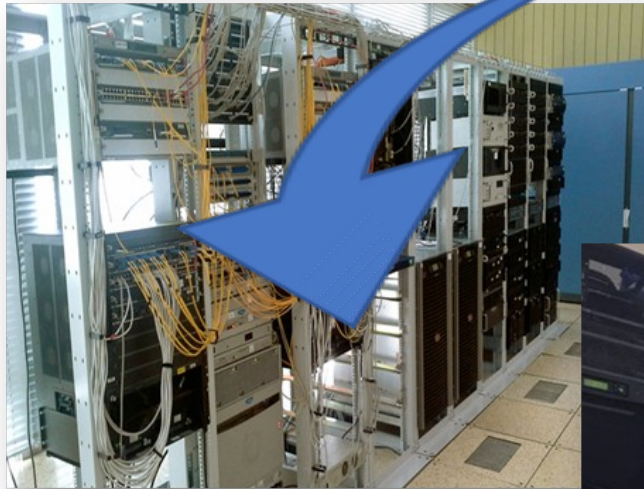
100 Gbps



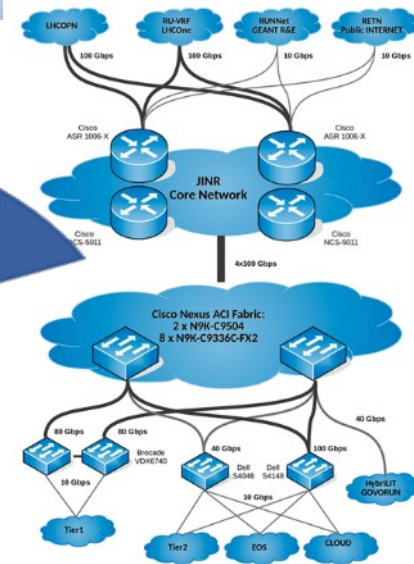
10 PB Disk space
5K CPU

LIT : off-line cluster for NICA

LIT Network center



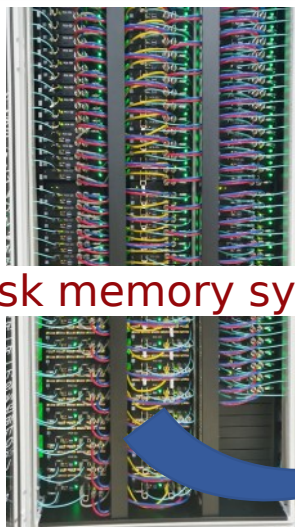
Up to 10 PB /year



Supercomputer
"GOVORUN"

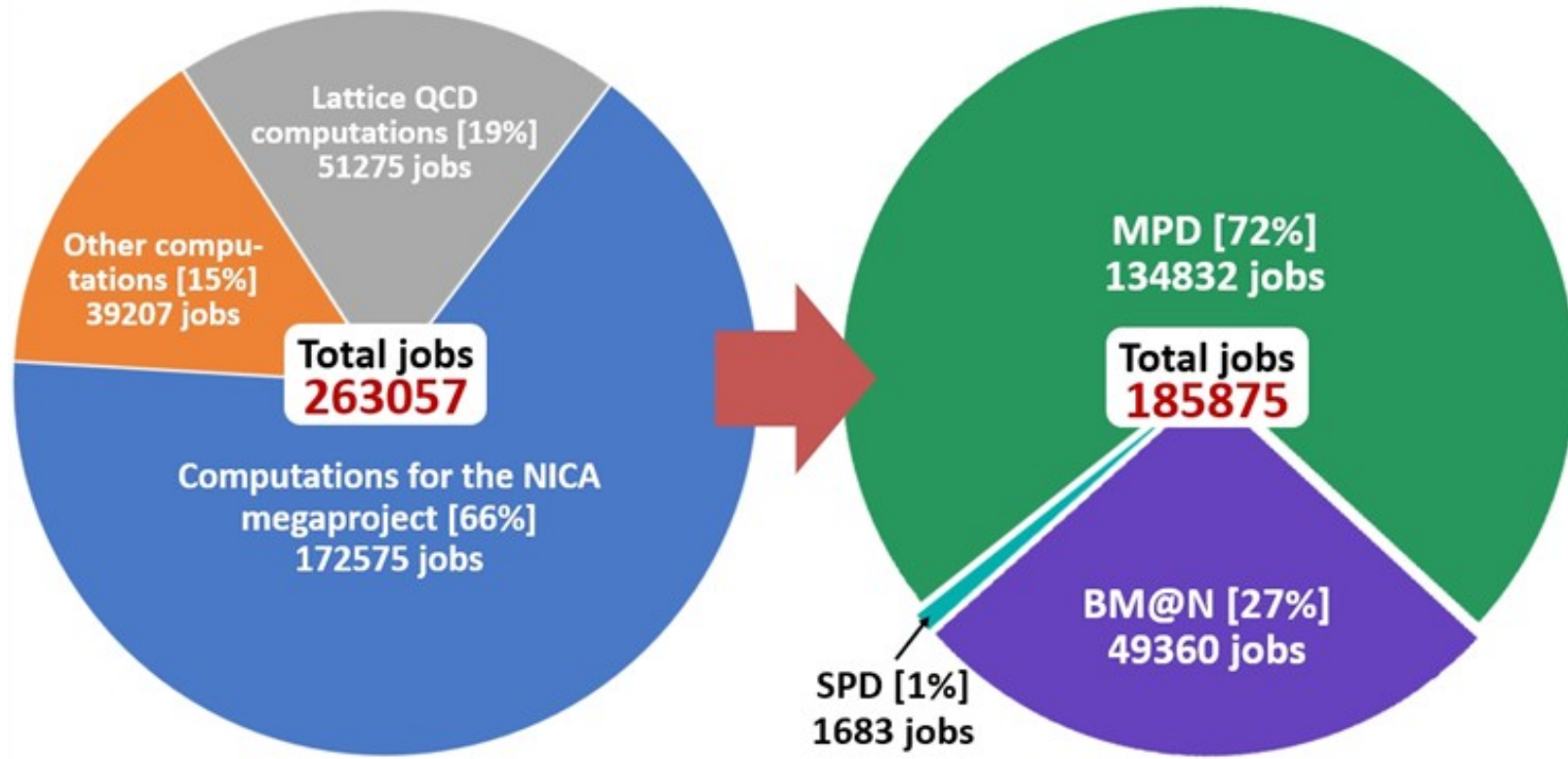


ultrafast disk memory system



LIT type robot

Super computer GOVORUN



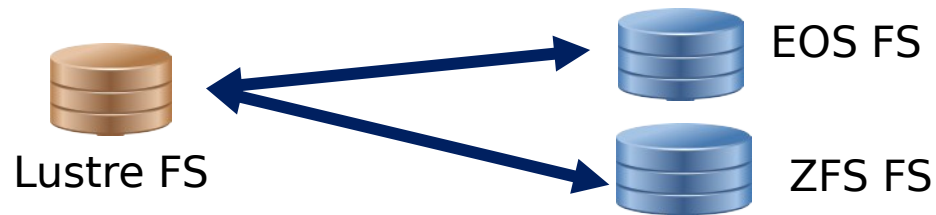
GOVORUN tasks distributions for NICA

Computing for MPD in HybriLIT

Data storage organization

“Hot” Data Storage

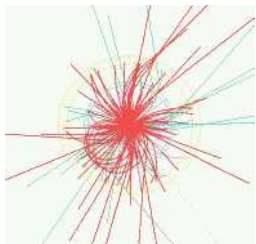
“Cold” Data Storage



Data flow organization

Particles Generator

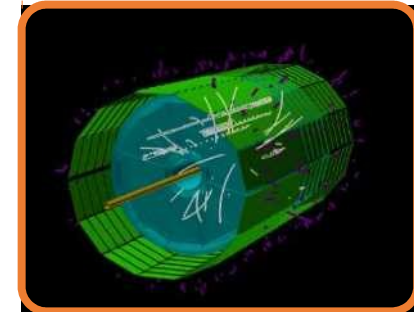
- internal
- external



Experiment

MpdRoot

Simulation & reconstruction
framework



DIRAC
THE INTERWARE
Data Management System

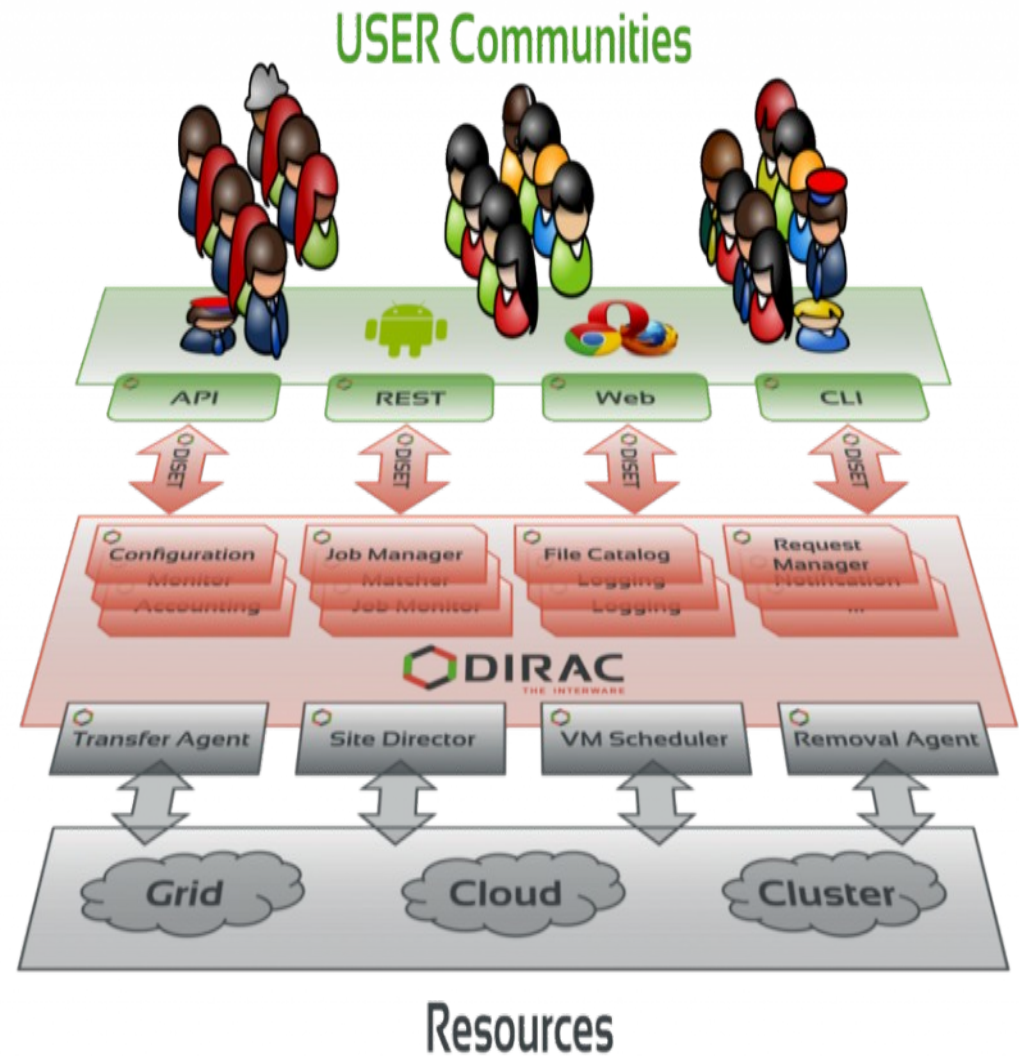
DIRAC Interware

The DIRAC Interware is an **open source** software which provides various interfaces, services and tools for the integration of distributed heterogeneous computing and storage resources.

DIRAC is “**All in one**” tool. It provides:

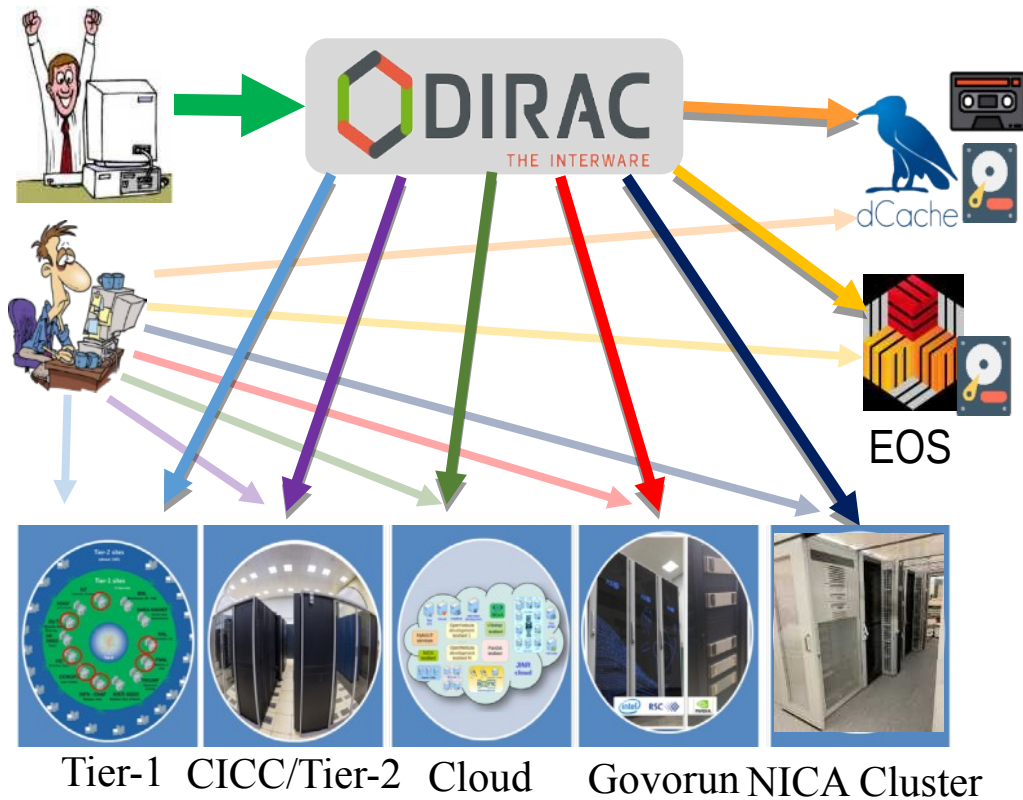
- Workload Management
- Data Management
- Workflow management
- Resource management
- Accounting
- Monitoring

DIRAC development was originally started by LHCb experiment. Later it became open source general purpose tool developed by **international consortium** of developers from: LHCb, Belle2, BES-III, CLIC, ILC, and others.



DIRAC is installed and studied in JINR since 2016

JINR computing resources integration

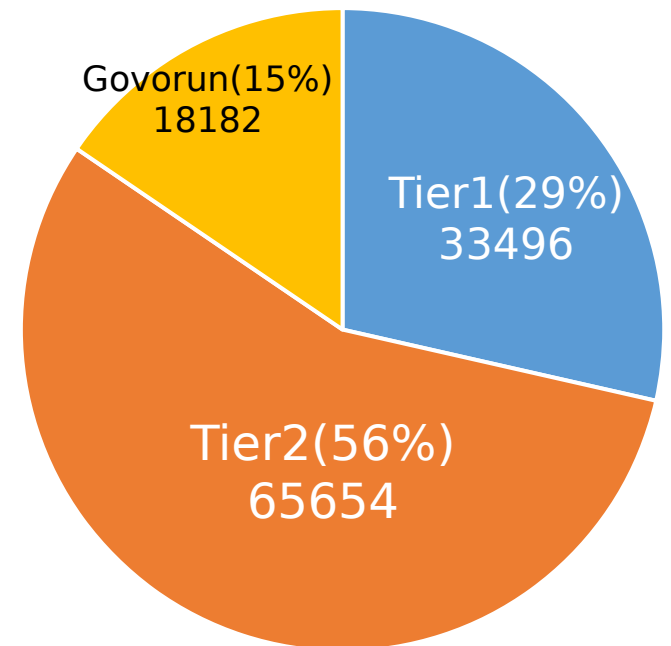


Running Running Tests done Running To be included

Monte-Carlo for MPD were successfully performed on the integrated system. It works right now. Jobs use Tier-1, Tier-2 and Govorun via DIRAC. Govorun was added recently to DIRAC. JINR and Member-States cloud resources have been tested and ready to accept jobs. **NICA Cluster is the next** on the list.

The DIRAC Interware is a software which provides various interfaces for the integration of distributed heterogeneous computing and storage resources. Instead of using all JINR storage and computing resources individually, DIRAC allows processing of large amounts of data through unified single system.

~120000 MPD Jobs done using DIRAC



Current & Future Tasks



- Manpower
- Boost clustering in detectors,
- Boost tracking,
- Detectors alignment and calibrations,
- Cloud computing for the MPD experiment,
- Virtual organisation for MPD in GRID,
-

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**Thank for
your attention**



**You are
welcome**