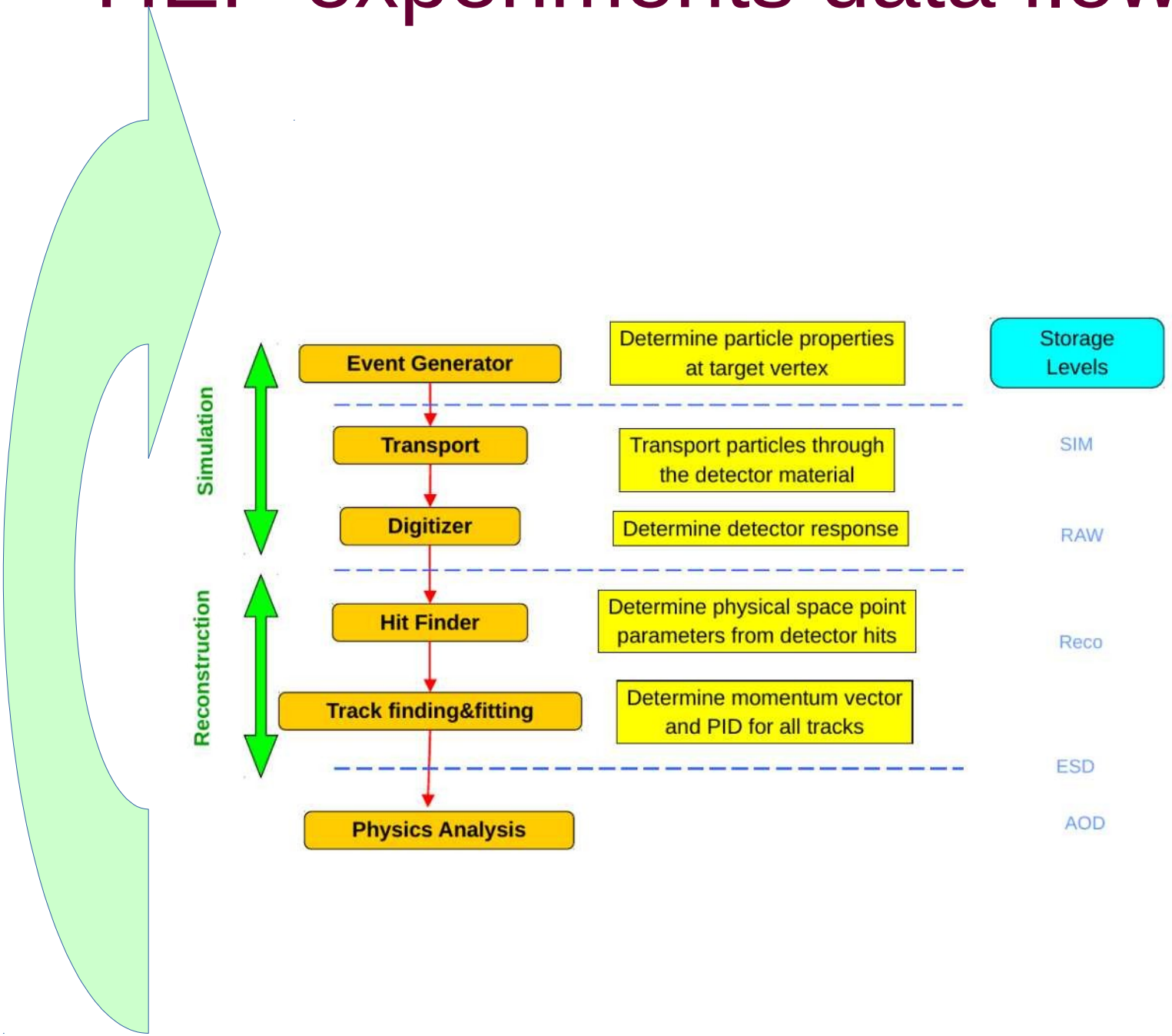
Software development for the NICA experiments

First collaboration meeting of the NICA experiments

HEP experiments data flow



FairRoot

https://fairroot.gsi.de/

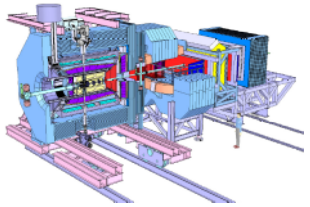
The FairRoot framework is an object oriented simulation, reconstruction and data analysis framework based on ROOT. It includes core services for detector simulation and offline analysis. The framework delivers base classes which enable the users to easily construct their experimental setup in a fast and convenient way. By using the Virtual Monte Carlo concept it is possible to perform the simulations using either Geant3 or Geant4 without changing the user code or the geometry description.

The basic idea of FairRoot is to provide a unified package with generic mechanisms to deal with most commonly used tasks in HEP. FairRoot allow the physicist to:

- ✗ Focus on physics deliverables while reusing pre-tested software components.
- ✗ Do not submerge into low-level details, use pre-built and well-tested code for common tasks.
- ✗ Allows physicists to concentrate on detector performance details, avoiding purely software
- ✗ engineering issues like storage, retrieval, code organization etc.

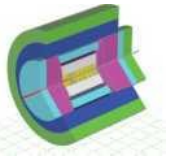
FairRoot

Start testing the VMC concept for CBM

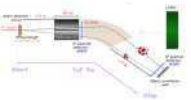


Panda decided to join->
FairRoot: same Base package for different experiments

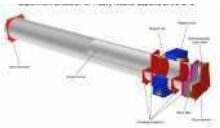
R3B joined



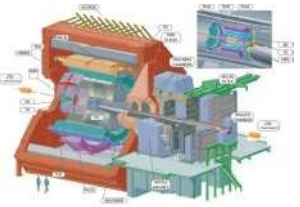
EIC (Electron Ion Collider BNL)
EICRoot



SOFIA (Studies On Fission with Aladin)



SHIP - Search for HIdden Particles



2004 2006 2010 2011 2012 2013 2014 2015

ALICE
FAIR

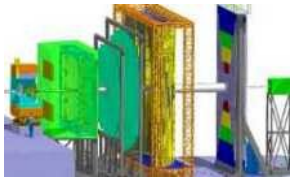
First Release of CbmRoot

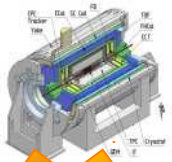
MPD (NICA) start also using FairRoot

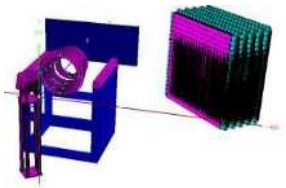
ASYEOS joined (ASYEOSRoot)

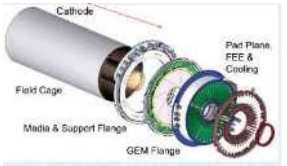
GEM-TPC seperated from PANDA branch (FOPIRoot)

ENSAR-ROOT
Collection of modules used by structural nuclear phsyics exp.



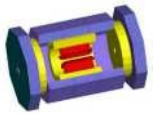




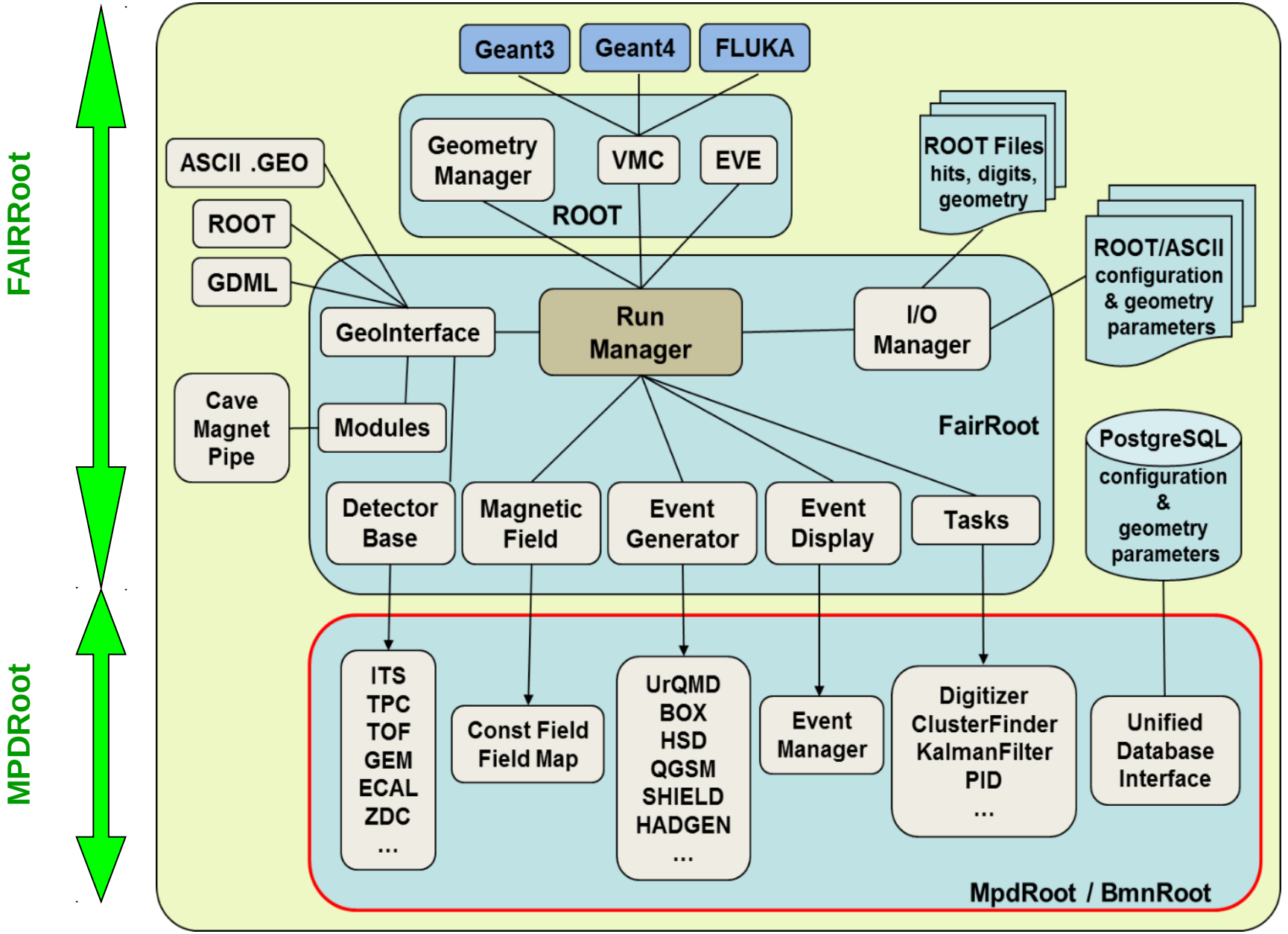


BM@N

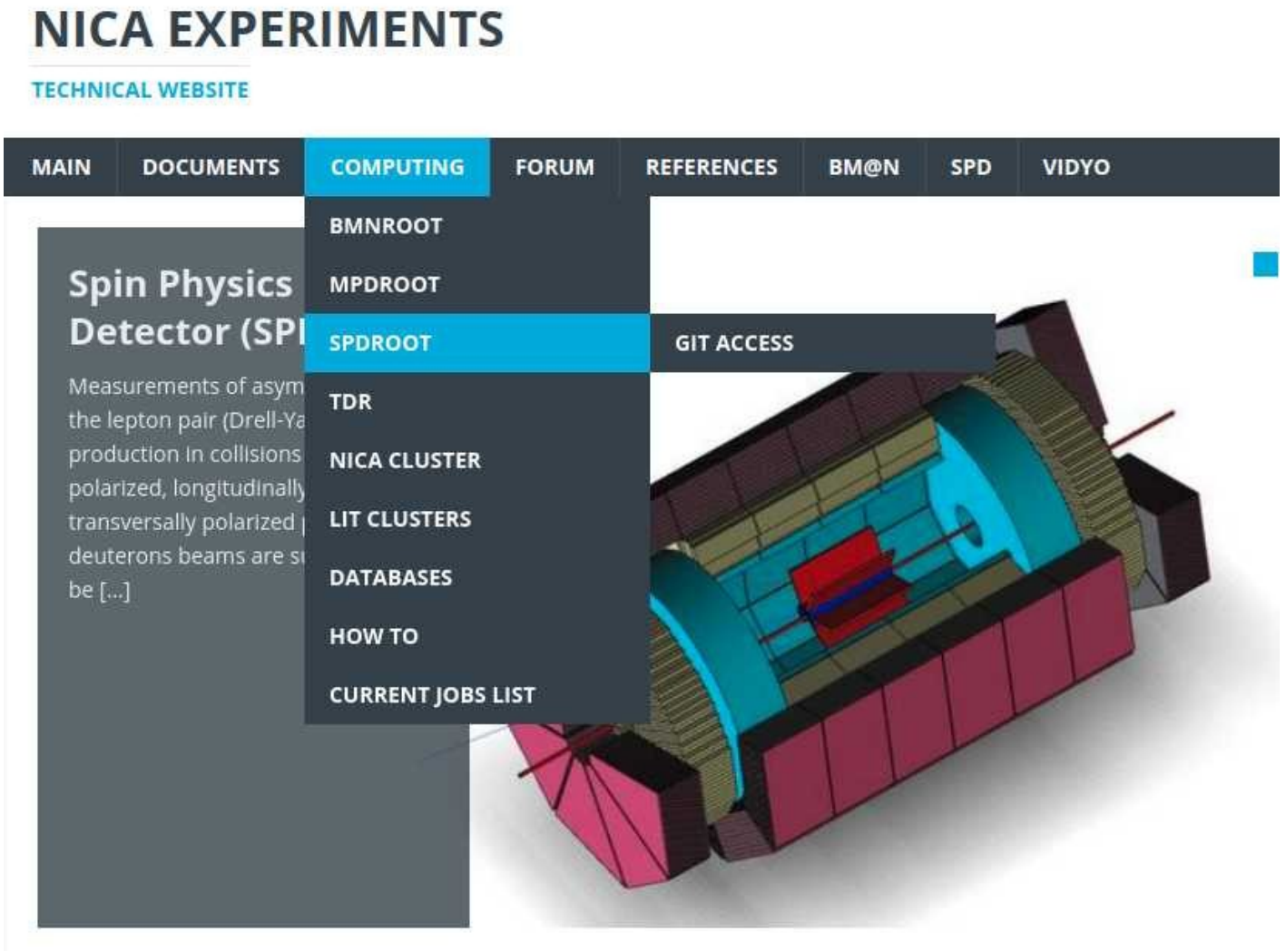
SPD



MPD/BM@N/SPDRoot design



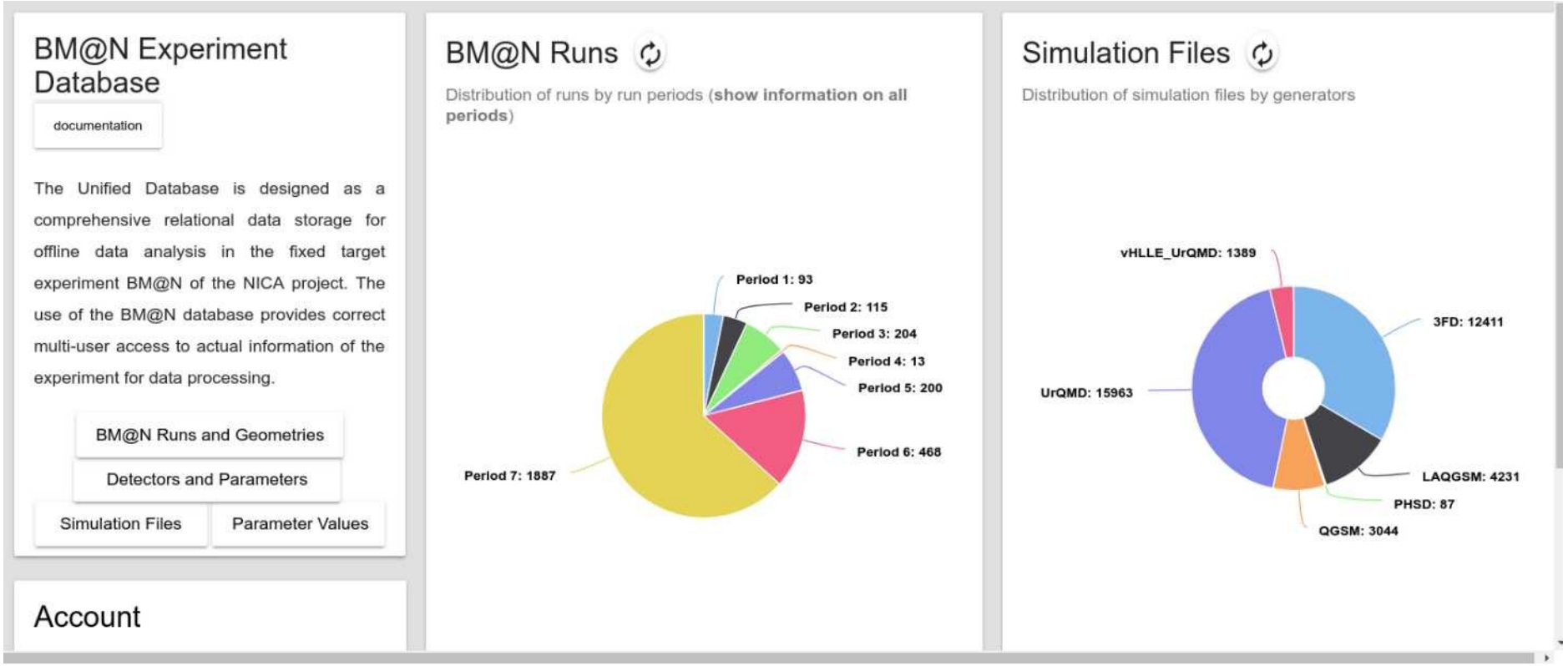
mpd.jinr.ru



NICA experiments GIT repository

https://git.jinr.ru/

Event generators + exp. data databases



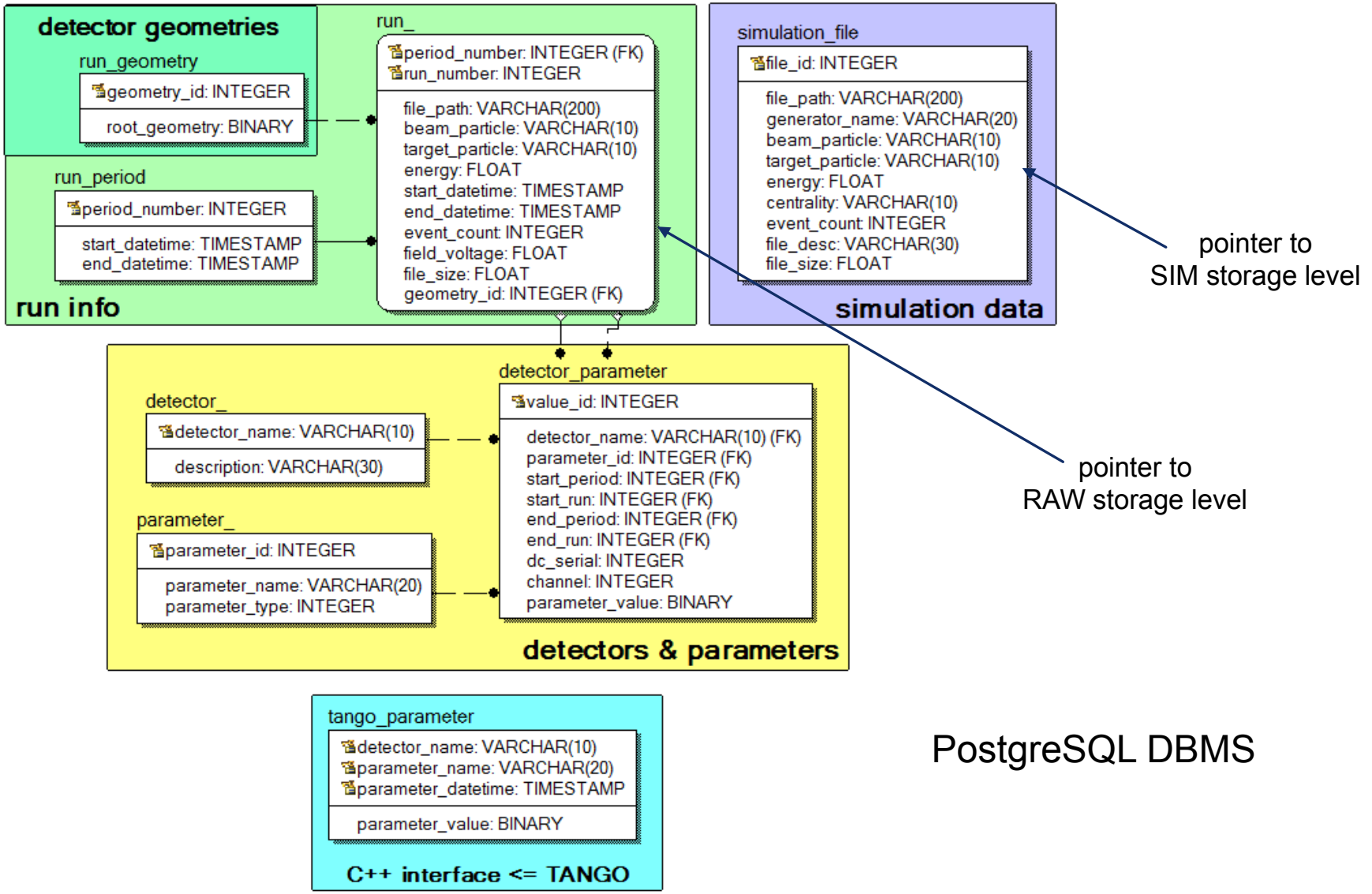
- ✔ UrQMD
- ✔ QGSM
- ✔ PHSD

- ✔ Hybrid UrQMD
- ✔ vHLLE_UrQMD
- ✔ 3FD(Theseus)

Exp. data

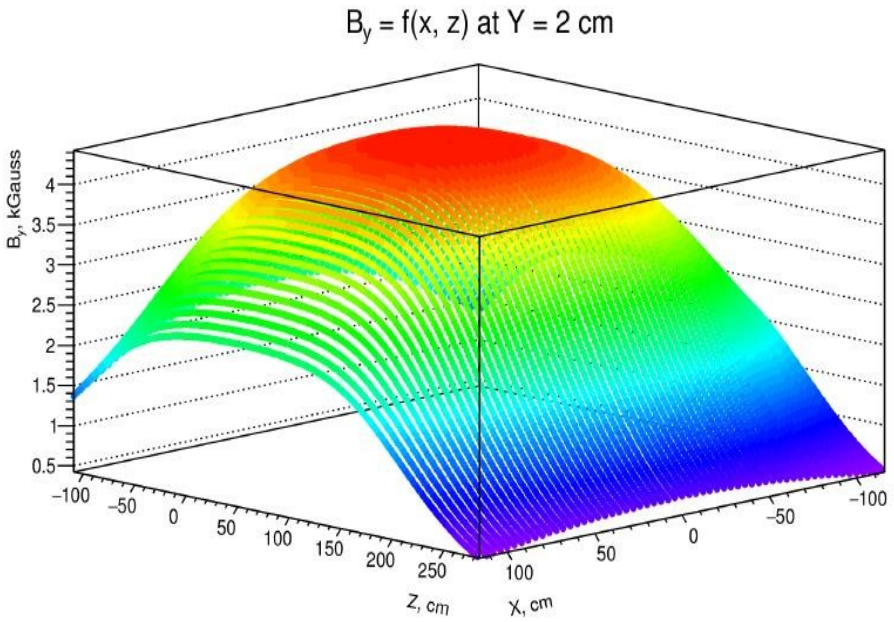
- d + C,Al, Cu, Pb E = 4 GeV, 3.5 GeV
- C + C, C_2H_4, Al, Cu, Pb E = 4 GeV
- Ar + C, Cu, Sn, Pb E = 3.2 GeV
- Kr + Cu, Sn, Pb E = 2.94

exp. data DB

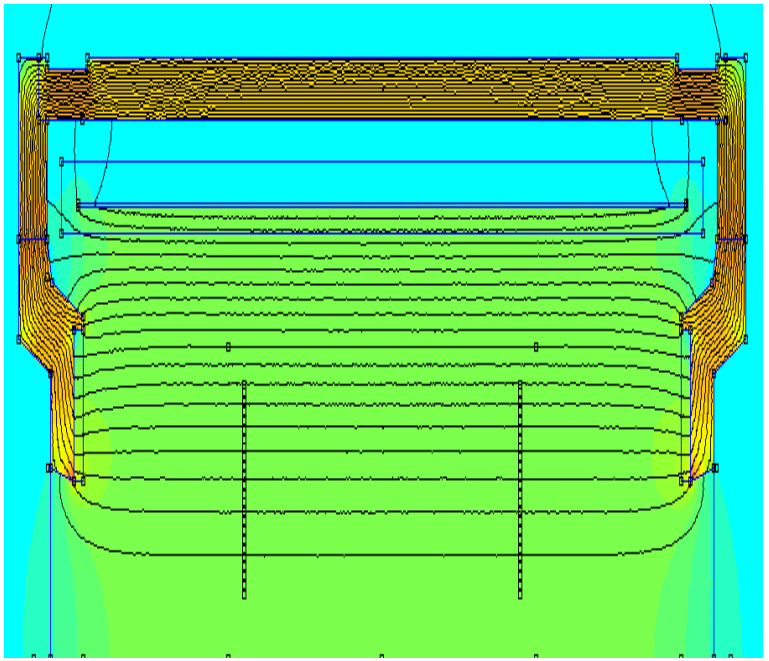

detector geometries
run_geometry
geometry_id: INTEGER
root_geometry: BINARY
run_period
period_number: INTEGER
start_datetime: TIMESTAMP
end_datetime: TIMESTAMP
run info
run_
period_number: INTEGER (FK)
run_number: INTEGER
file_path: VARCHAR(200)
beam_particle: VARCHAR(10)
target_particle: VARCHAR(10)
energy: FLOAT
start_datetime: TIMESTAMP
end_datetime: TIMESTAMP
event_count: INTEGER
field_voltage: FLOAT
file_size: FLOAT
geometry_id: INTEGER (FK)
simulation_file
file_id: INTEGER
file_path: VARCHAR(200)
generator_name: VARCHAR(20)
beam_particle: VARCHAR(10)
target_particle: VARCHAR(10)
energy: FLOAT
centrality: VARCHAR(10)
event_count: INTEGER
file_desc: VARCHAR(30)
file_size: FLOAT
simulation data
pointer to
SIM storage level
detector_parameter
value_id: INTEGER
detector_name: VARCHAR(10) (FK)
parameter_id: INTEGER (FK)
start_period: INTEGER (FK)
start_run: INTEGER (FK)
end_period: INTEGER (FK)
end_run: INTEGER (FK)
dc_serial: INTEGER
channel: INTEGER
parameter_value: BINARY
detector_
detector_name: VARCHAR(10)
description: VARCHAR(30)
parameter_
parameter_id: INTEGER
parameter_name: VARCHAR(20)
parameter_type: INTEGER
detectors & parameters
pointer to
RAW storage level
tango_parameter
detector_name: VARCHAR(10)
parameter_name: VARCHAR(20)
parameter_datetime: TIMESTAMP
parameter_value: BINARY
C++ interface <= TANGO
PostgreSQL DBMS

Magnetic field for experiments

BM@N

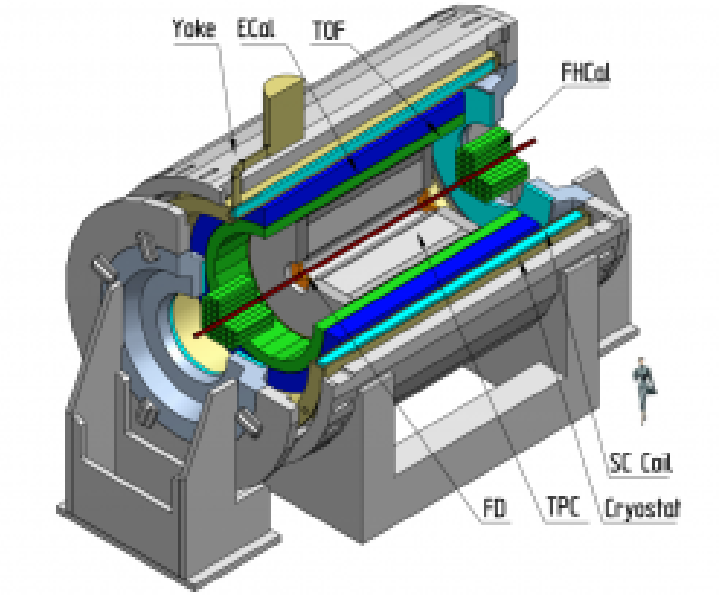


MPD

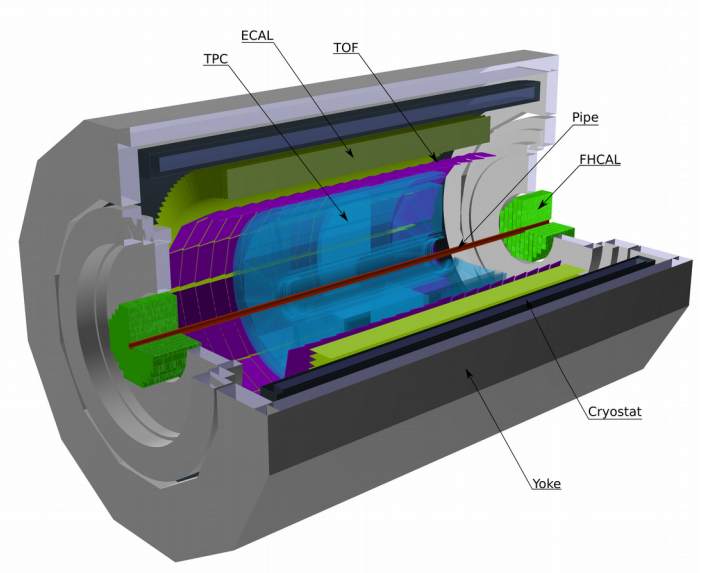


MPD detectors geometry

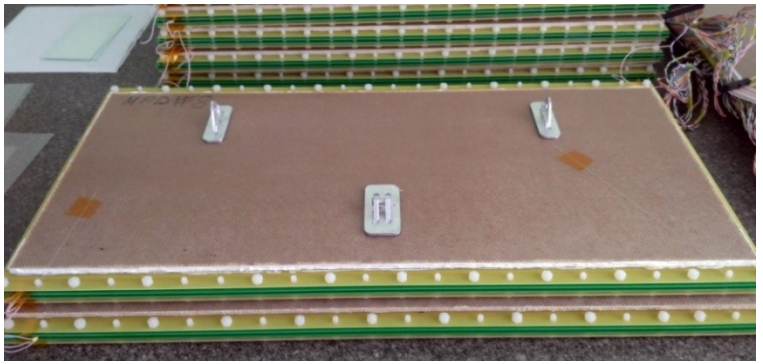
Artistic



GEANT



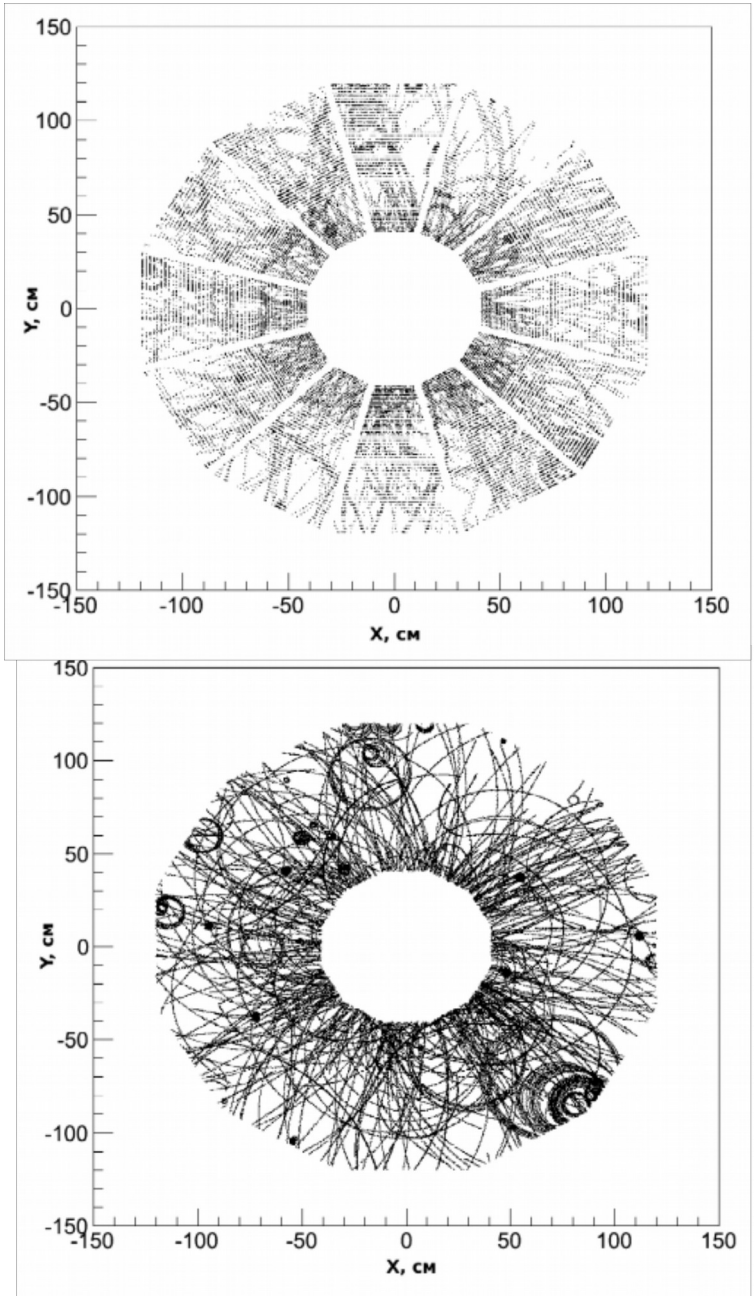
Present day



Realistic clustering in MPD TPC

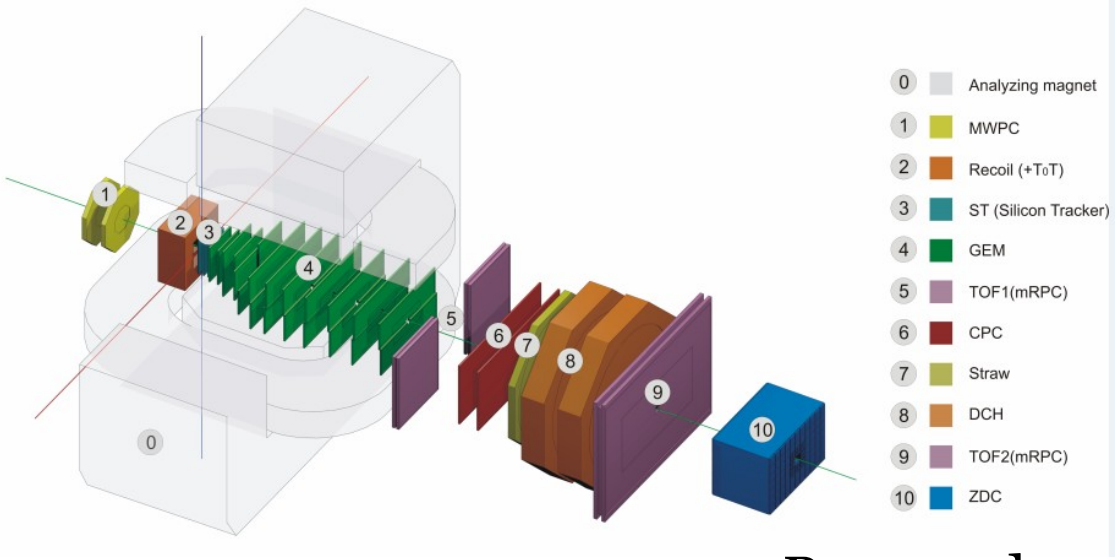
The hit reconstruction algorithm contains the following main steps:

1) Searching for extended clusters in (Pad-Time) for each pad raw.
2) Searching for peaks in time-profile for each pad in the found extended cluster.
3) Combining the neighboring peaks into resulting hits.

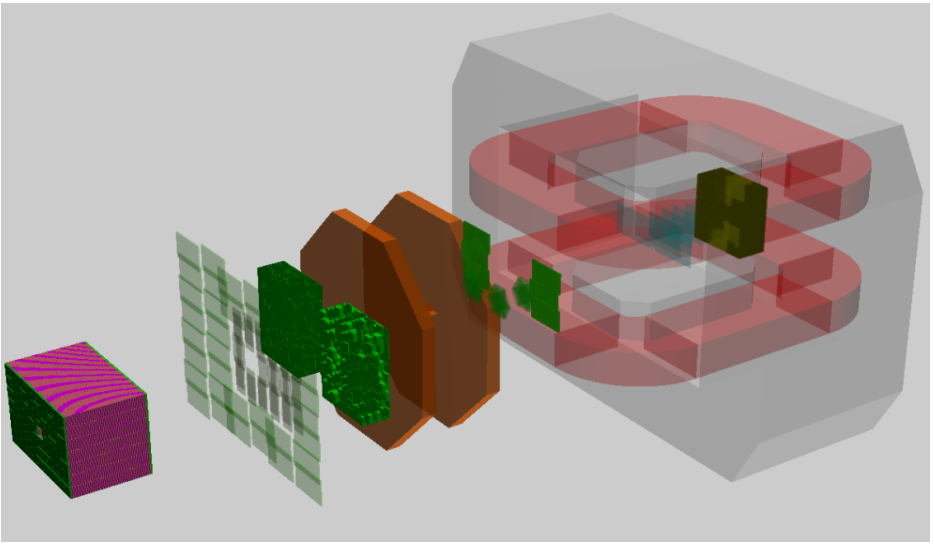


BM@N detectors geometry

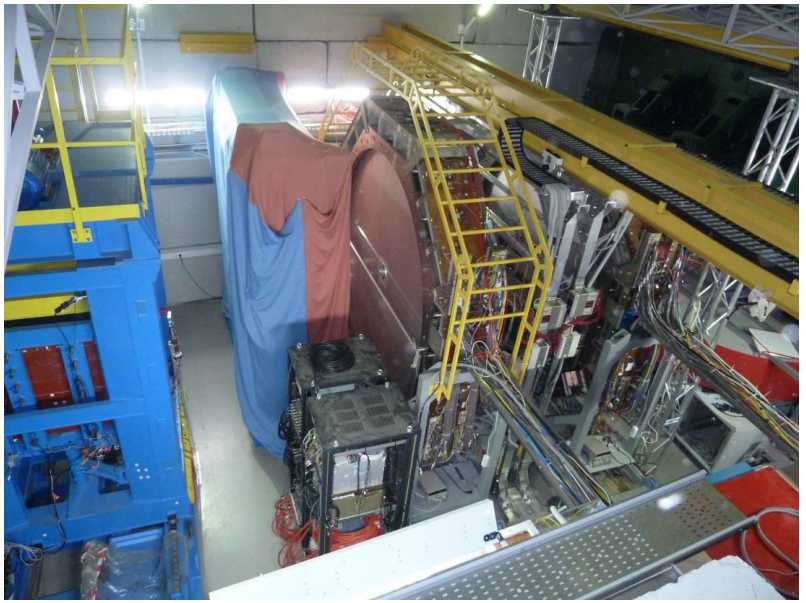
Artistic



GEANT

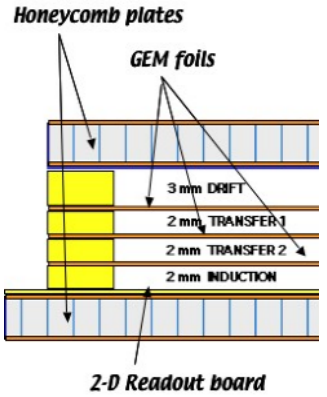


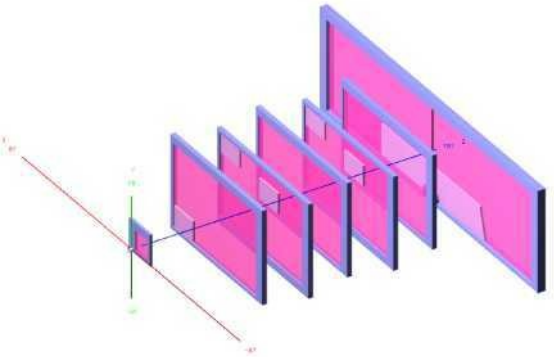
Present day



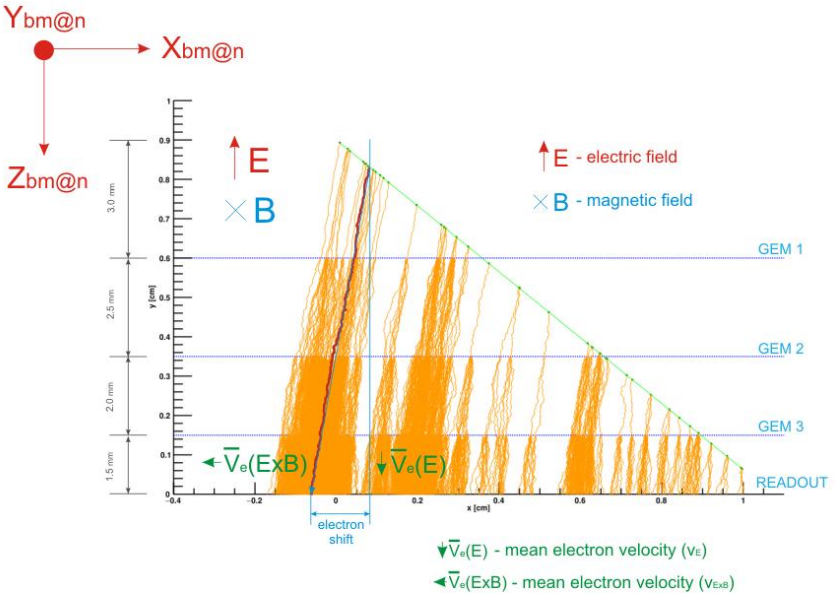
Realistic clustering in GEM

- There are realistic hit finder in GEMs
- For the GEM stations procedure of the fake hits production is implemented

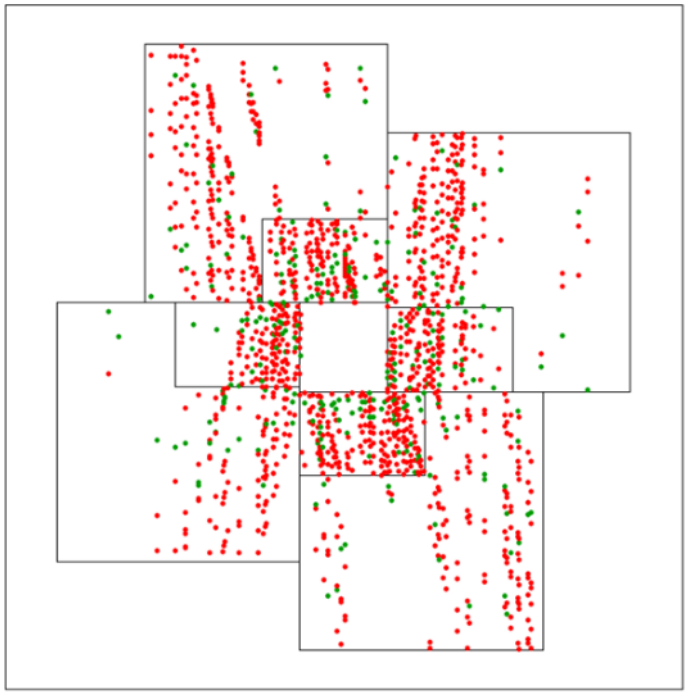




Station 0 (what is it)

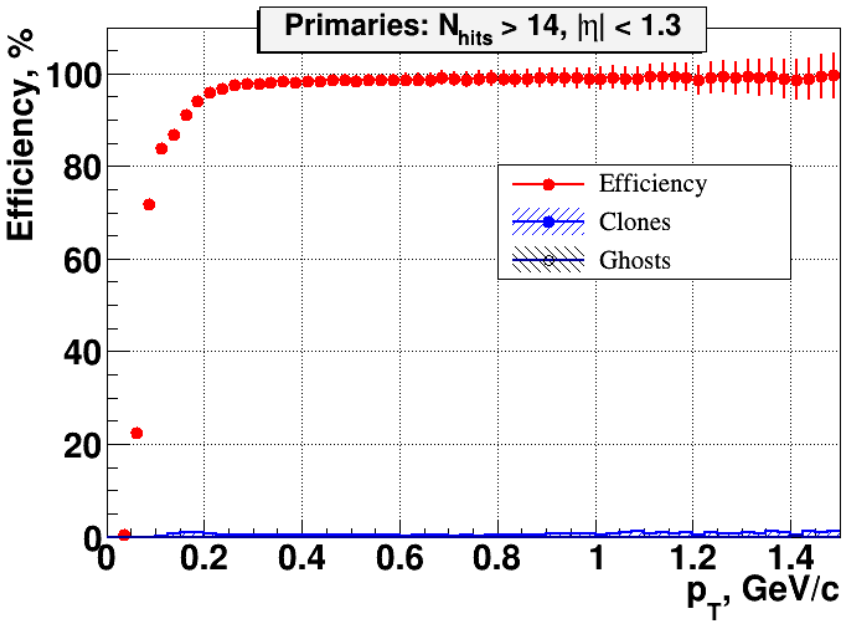


electron avalanches in the BM@N GEM chamber

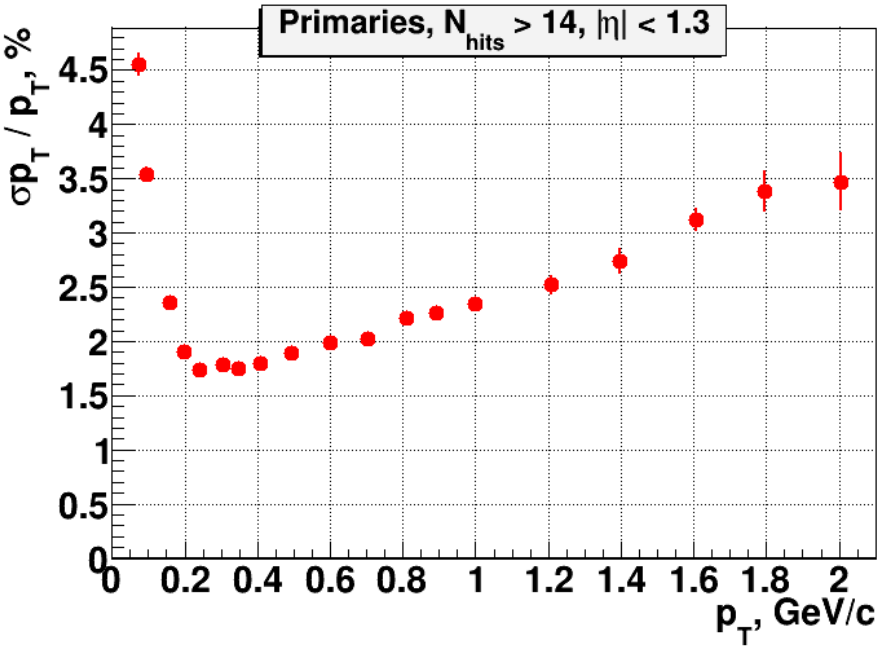


Tracking in MPD TPC

Primaries

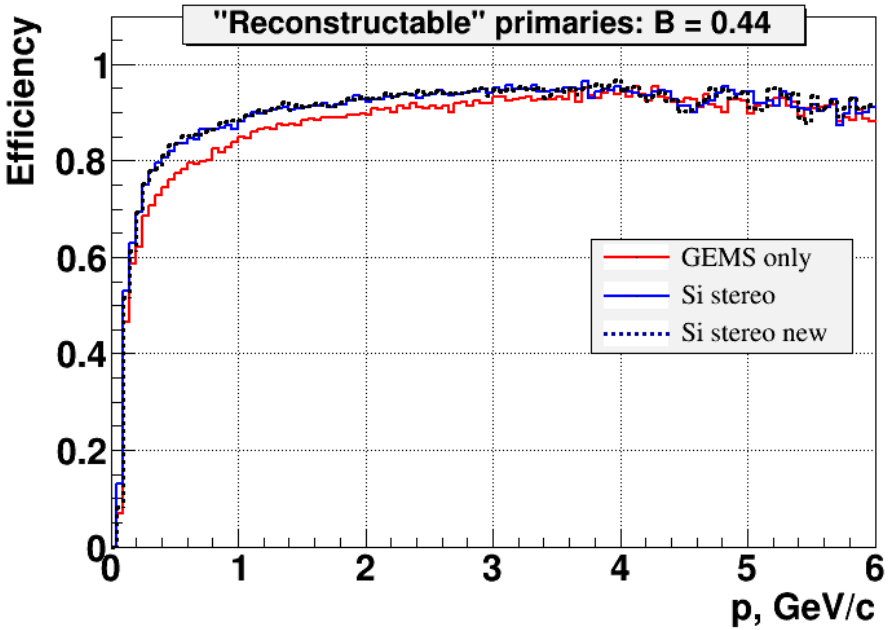


efficiency

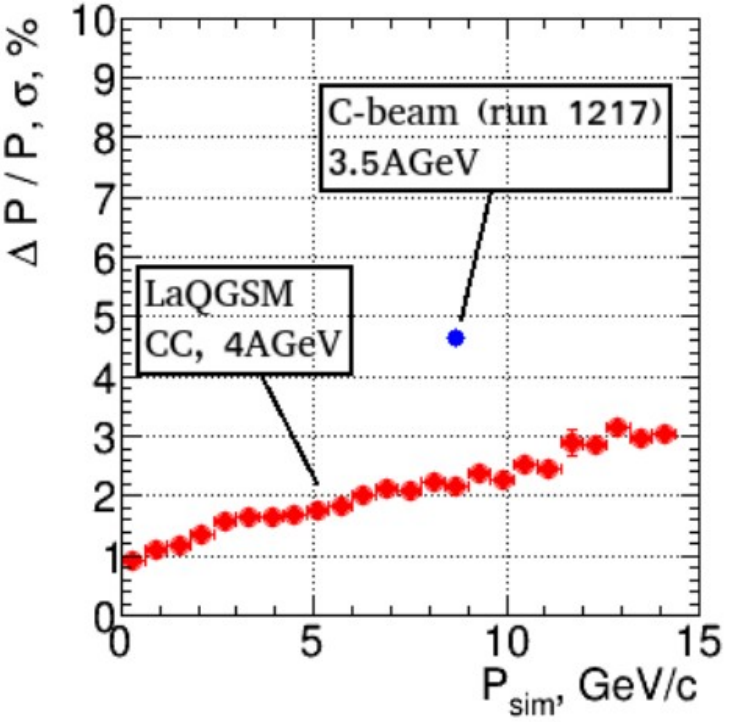


Transverse momentum resolution

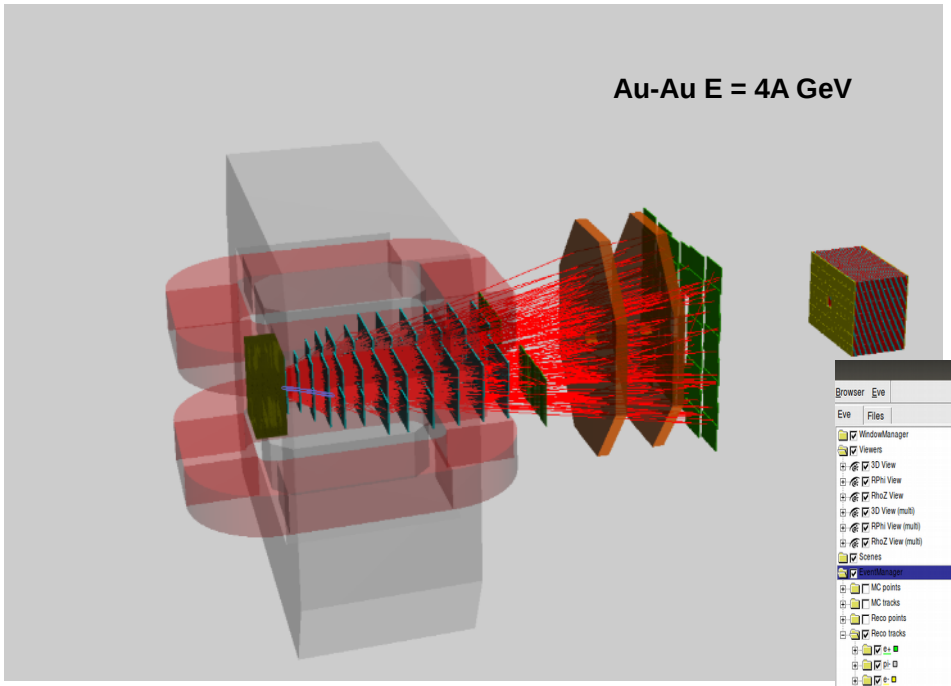
Tracking in GEM tracker



Reconstruction efficiency in 12 GEM stations (red) and in 12 GEM + 2 two coordinate silicon planes with the stereo angle of 2.5 degree (blue).



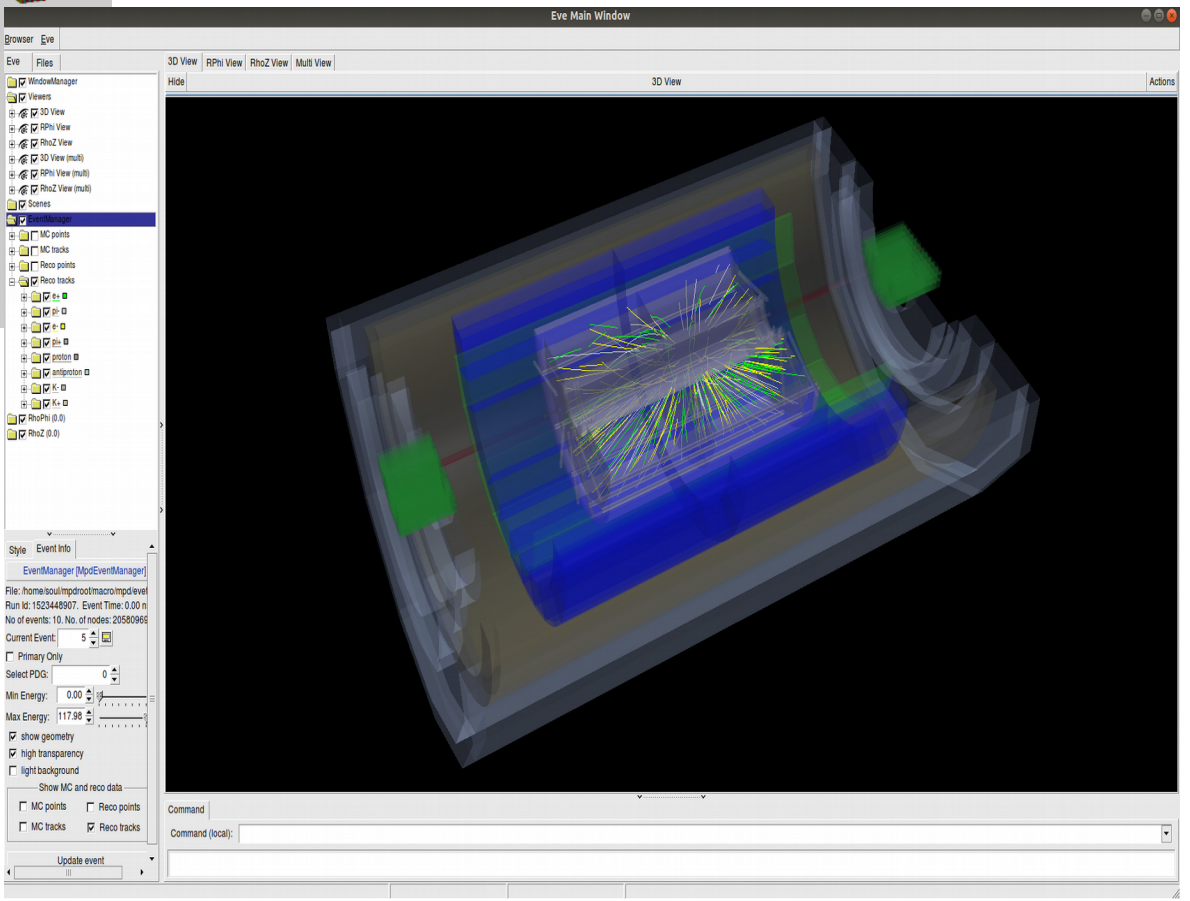
Event Display for the NICA experiments



based on EVE package

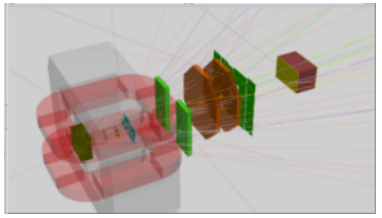
MPD event display:
TPC reconstructed tracks

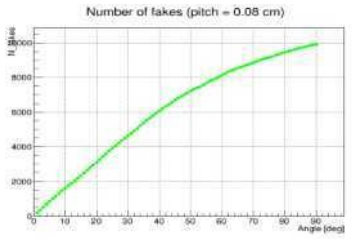
Au-Au √s =11 GeV



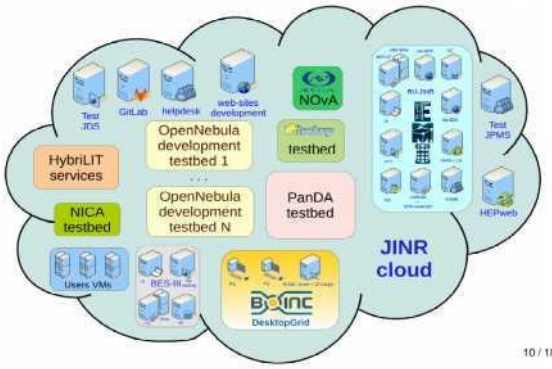
BM@N event data:
GEM points and reconstructed tracks

MPD Run Control System

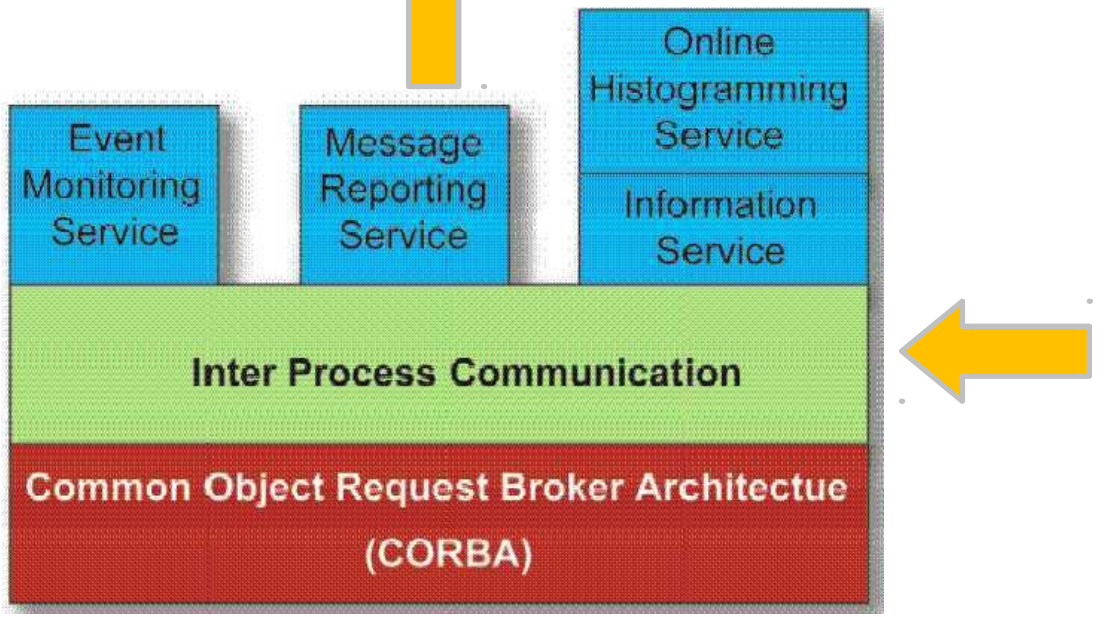




Displays		Analysis	Archiving	
Event Display	Information Monitors	Data Quality Monitoring	Monitoring Data Archiving	Archive Browser
Histogram Presenter	Web Monitoring			



first prototype is developed on LIT Virtual Machines



ATLAS TDAQ Online Components

17

The Unified Database for offline data processing

raw data processing
event reconstruction
physical analysis

BmnRoot / MpdRoot

reading and
changing data

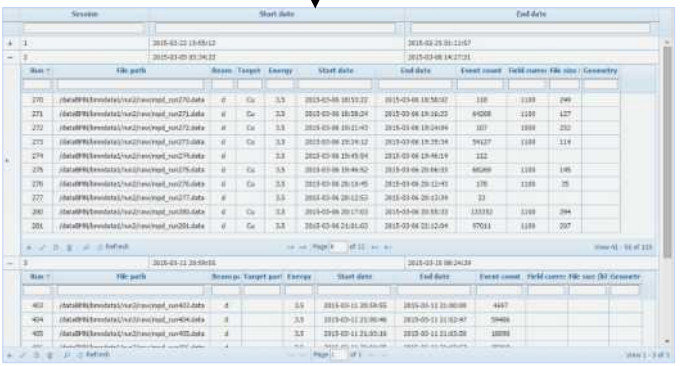
users

C++ database interface
(connect, SQL I/O)

ROOT

unified database

PHP



Web interface is required

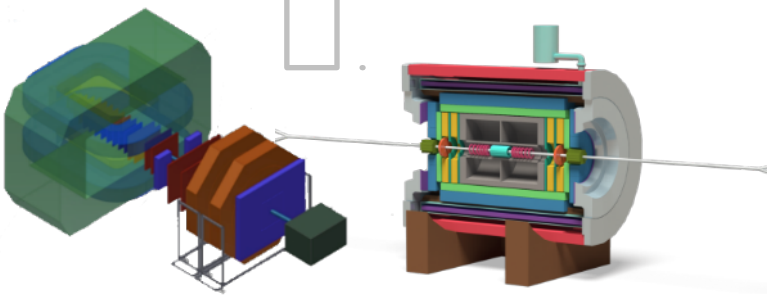
UniDbTango interface

PostgreSQL
automatic backup

configuration, calibration, parameter
and algorithm data

Tango

Slow Control System



18

E-log database

BM@N common e-log, Page 1 of 106 — **Logged in as shift**

Home Find Last day — Number of items per page: 10 — Logo

1 2 3 4 5 6 7 8 9 10 11 ... 106 > >>

Date	Shift Leader	Type	№ Run	Trigger	DAQ Status	SP-41, A	SP-57, A	VKM2, A	Beam	Energy, GeV	Target	Comment
2018-03-07 08:14:09	Dryablov	New Run	2487 per.7	SRCT2 Full Trigger = IT & (X1 & Y1) & (X2 & Y2)	All in except ECal and CSC	1800	0	0	C	3.17	H2 (300 mm)	IT=BC1&BC2&VC&SRC(AND), beam 2x10^5 beam duration 2-3 sec, Live time:~100%, #N:50kEvents, decrease the TQDC threshold for new BC4 to 10.
2018-03-07 07:49:29	Dryablov	New Run	2485 per.7	SRCT2 Full Trigger = IT & (X1 & Y1) & (X2 & Y2)	All in except ECal and CSC	1800	0	0	C	3.17	H2 (300 mm)	IT=BC1&BC2&VC&SRC(AND), beam 2x10^5 beam duration 2-3 sec, Live time:~100%, #N:50kEvents, decrease the TQDC threshold for new BC4 to 10.
2018-03-07 07:31:40	Dryablov	New Run	2484 per.7	SRCT2 Full Trigger = IT & (X1 & Y1) & (X2 & Y2)	All in except ECal and CSC	1800	0	0	C	3.17	H2 (300 mm)	IT=BC1&BC2&VC&SRC(AND), beam 2x10^5 beam duration 2-3 sec, Live time:~100%, #N:50kEvents, decrease the TQDC threshold for new BC4 to 10.
2018-03-07 07:05:41	Dryablov	New Run	2483 per.7	SRCT2 Full Trigger = IT & (X1 & Y1) & (X2 & Y2)	All in except ECal and CSC	1800	0	0	C	3.17	H2 (300 mm)	IT=BC1&BC2&VC&SRC(AND), beam 3x10^5 beam duration 3-4 sec, Live time:~100%, #N:50kEvents, decrease the TQDC threshold for new BC4 to 10.
2018-03-07 04:46:18	Dryablov	New Run	2481 per.7	SRCT2 Full Trigger = IT & (X1 & Y1) & (X2 & Y2)	All in except ECal and CSC	1800	0	0	C	3.17	H2 (300 mm)	IT=BC1&BC2&VC&SRC(AND), beam 2x10^5 beam duration 3-4 sec, Live time:~100%, #N:50kEvents, decrease the TQDC threshold for new BC4 to 10.
2018-03-07 04:20:02	Dryablov	New Run	2480 per.7	SRCT2 Full Trigger = IT & (X1 & Y1) & (X2 & Y2)	All in except ECal and CSC	1800	0	0	C	3.17	H2 (300 mm)	IT=BC1&BC2&VC&SRC(AND), beam 2x10^5 beam duration 3-4 sec, Live time:~100%, #N:50kEvents, decrease the TQDC threshold for new BC4 to 10.
2018-03-07 03:52:47	Dryablov	New Run	2479 per.7	SRCT2 Full Trigger = IT & (X1 & Y1) & (X2 & Y2)	All in except ECal and CSC	1800	0	0	C	3.17	H2 (300 mm)	IT=BC1&BC2&VC&SRC(AND), beam 2x10^5 beam duration 3-4 sec, Live time:~100%, #N:50kEvents, decrease the TQDC threshold for new BC4 to 10.
2018-03-07 03:23:23	Dryablov	New Run	2478 per.7	SRCT2 Full Trigger = IT & (X1 & Y1) & (X2 & Y2)	All in except ECal and CSC	1800	0	0	C	3.17	H2 (300 mm)	IT=BC1&BC2&VC&SRC(AND), beam 2x10^5 beam duration 3 sec, Live time:~100%, #N:50kEvents, decrease the TQDC threshold for new BC4 to 10. Ratio of BC2/BC1~0.4 & VC/BC1~0.44, no contact with Rukoyatkin Pavel started at run #2474
2018-03-07 02:56:01	Dryablov	New Run	2477 per.7	SRCT2 Full Trigger = IT & (X1 & Y1) & (X2 & Y2)	All in except ECal and CSC	1800	0	0	C	3.17	H2 (300 mm)	IT=BC1&BC2&VC&SRC(AND), beam 1.5x10^5 beam duration 3 sec, Live time:~100%, #N:51kEvents, decrease the TQDC threshold for new BC4 to 10.
2018-03-07 02:24:48	Dryablov	New Run	2475 per.7	SRCT2 Full Trigger = IT & (X1 & Y1) & (X2 & Y2)	All in except ECal and CSC	1800	0	0	C	3.17	H2 (300 mm)	IT=BC1&BC2&VC&SRC(AND), beam 1x10^5 beam duration 3 sec, Live time:~100%, #N:18kEvents, decrease the TQDC threshold for new BC4 to 10.

1 2 3 4 5 6 7 8 9 10 11 ... 106 > >>

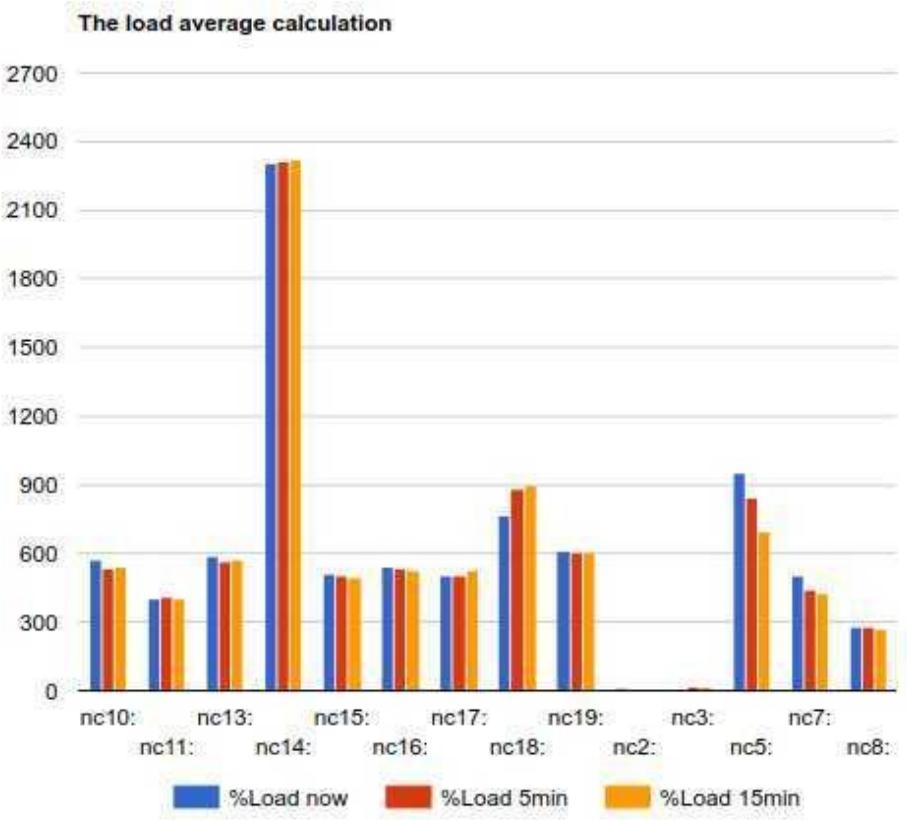
2018 - software team (contact e-mail: gertsen@jinr.ru)

Computing resources: LHEP

Protected: Cluster monitoring

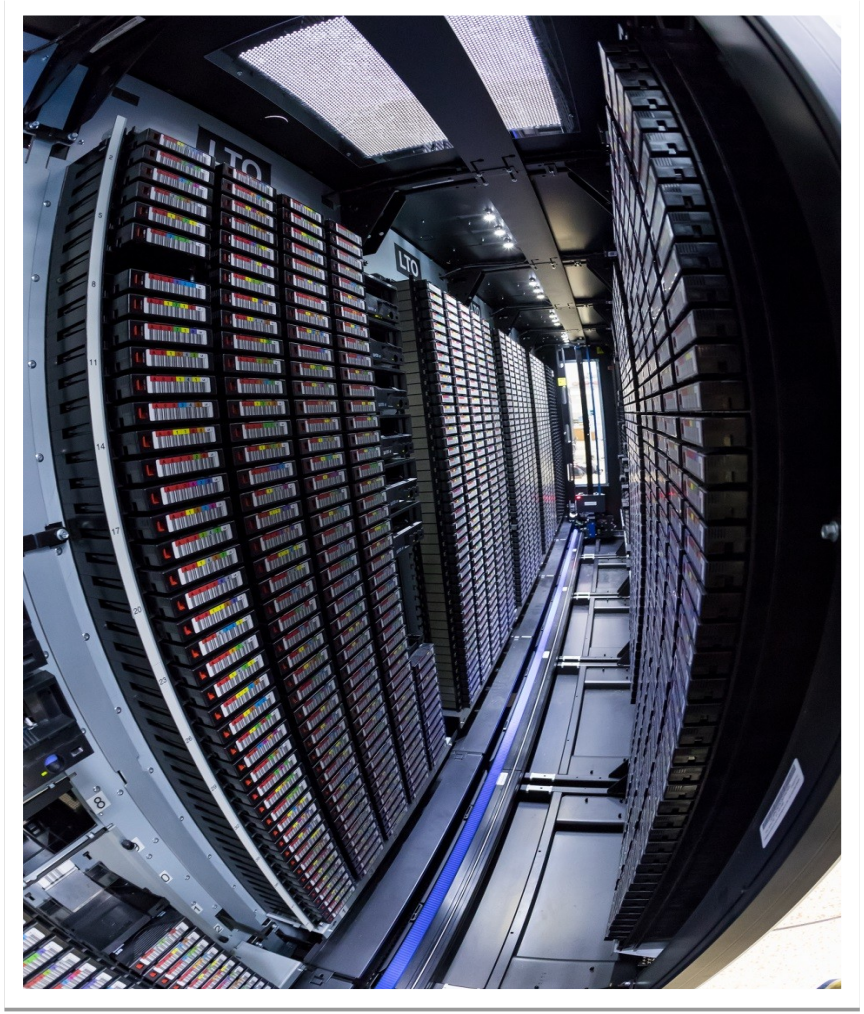
ONLINE cluster nodes

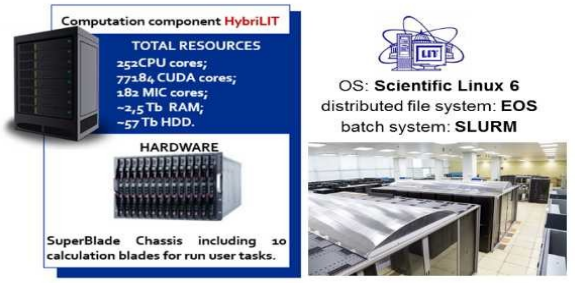
Node	%Load now	%Load 5min	%Load 15min	Users	Uptime(days)	Time
nc10:	585	535	540	7	9	14:30:51
nc11:	407	407	405	0	44	14:30:45
nc13:	600	570	572	0	34	14:33:02
nc14:	2302	2312	2321	0	44	14:30:45
nc15:	500	500	495	0	15	14:29:45
nc16:	552	531	525	1	15	14:30:04
nc17:	506	502	523	0	41	14:30:45
nc18:	774	891	901	1	27	14:30:03
nc19:	607	606	600	1	42	14:30:45
nc2:	1	2	5	4	9	14:29:53
nc3:	5	19	17	9	27	14:28:23
nc5:	956	838	696	2	35	14:26:38
nc7:	424	422	417	1	51	14:25:54
nc8:	285	277	271	11	15	14:30:19



Computing resources for NICA @ LIT

CMS TIER1





HybriLIT

GOVORUN

Thank for your attention