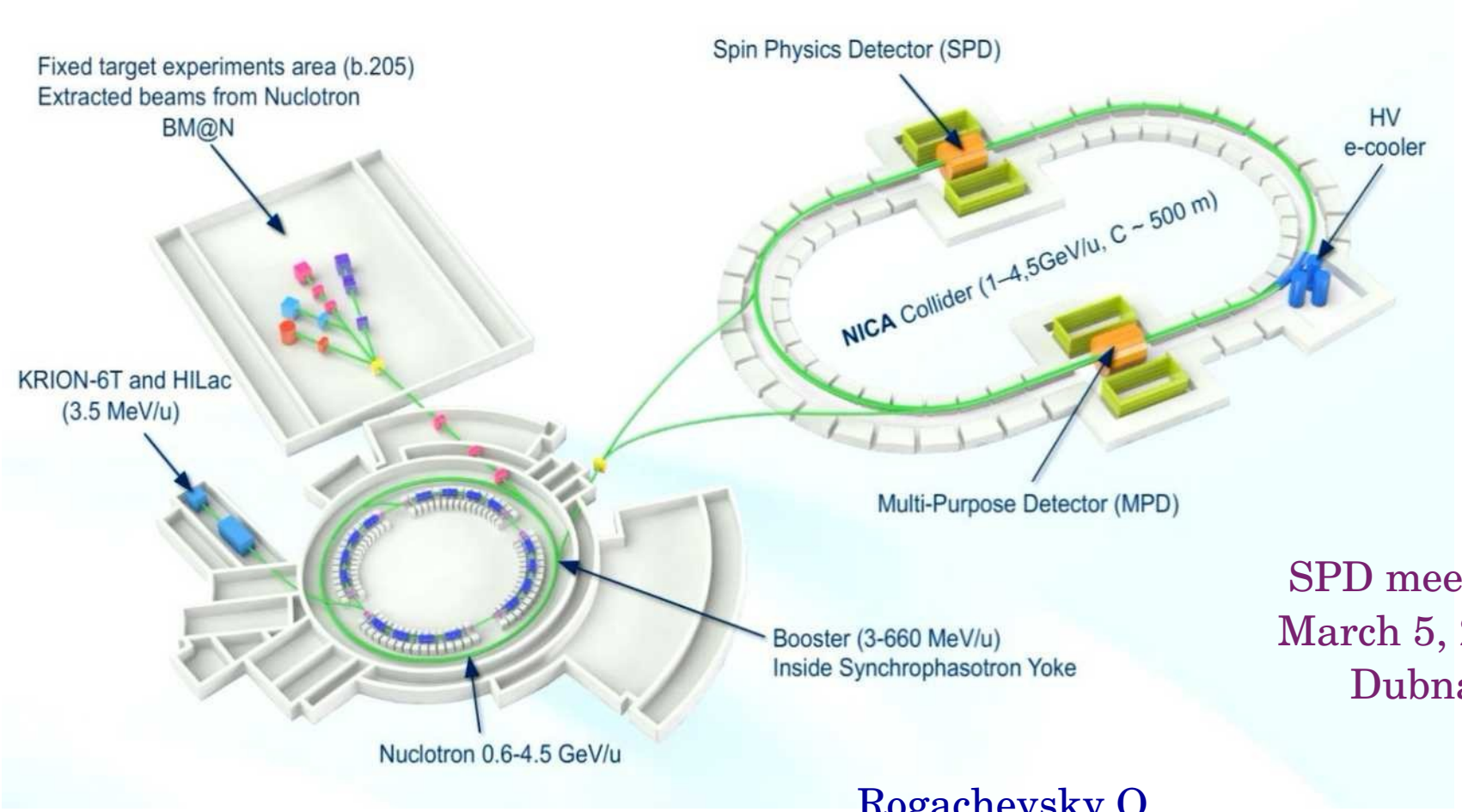
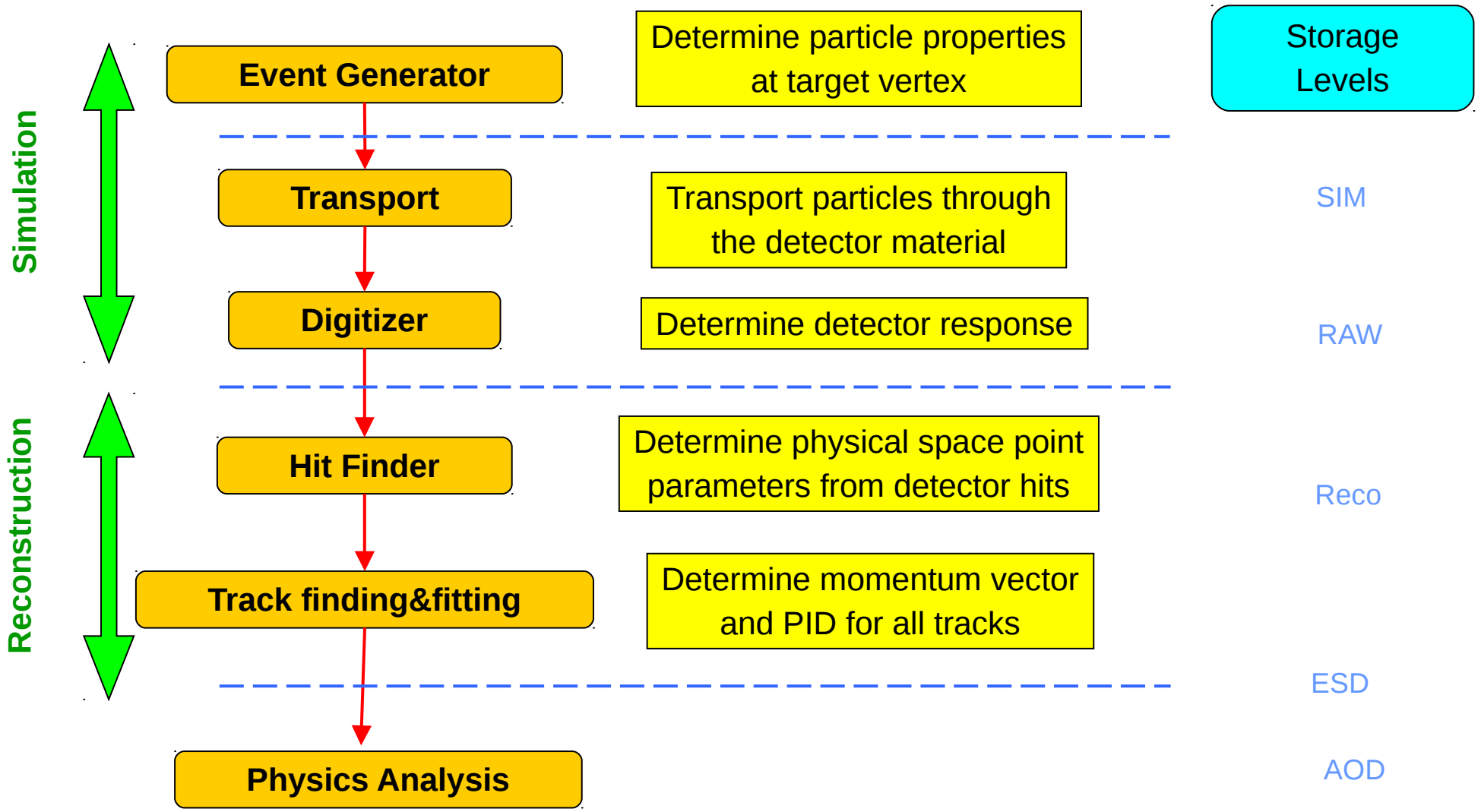
Software development for the NICA experiments



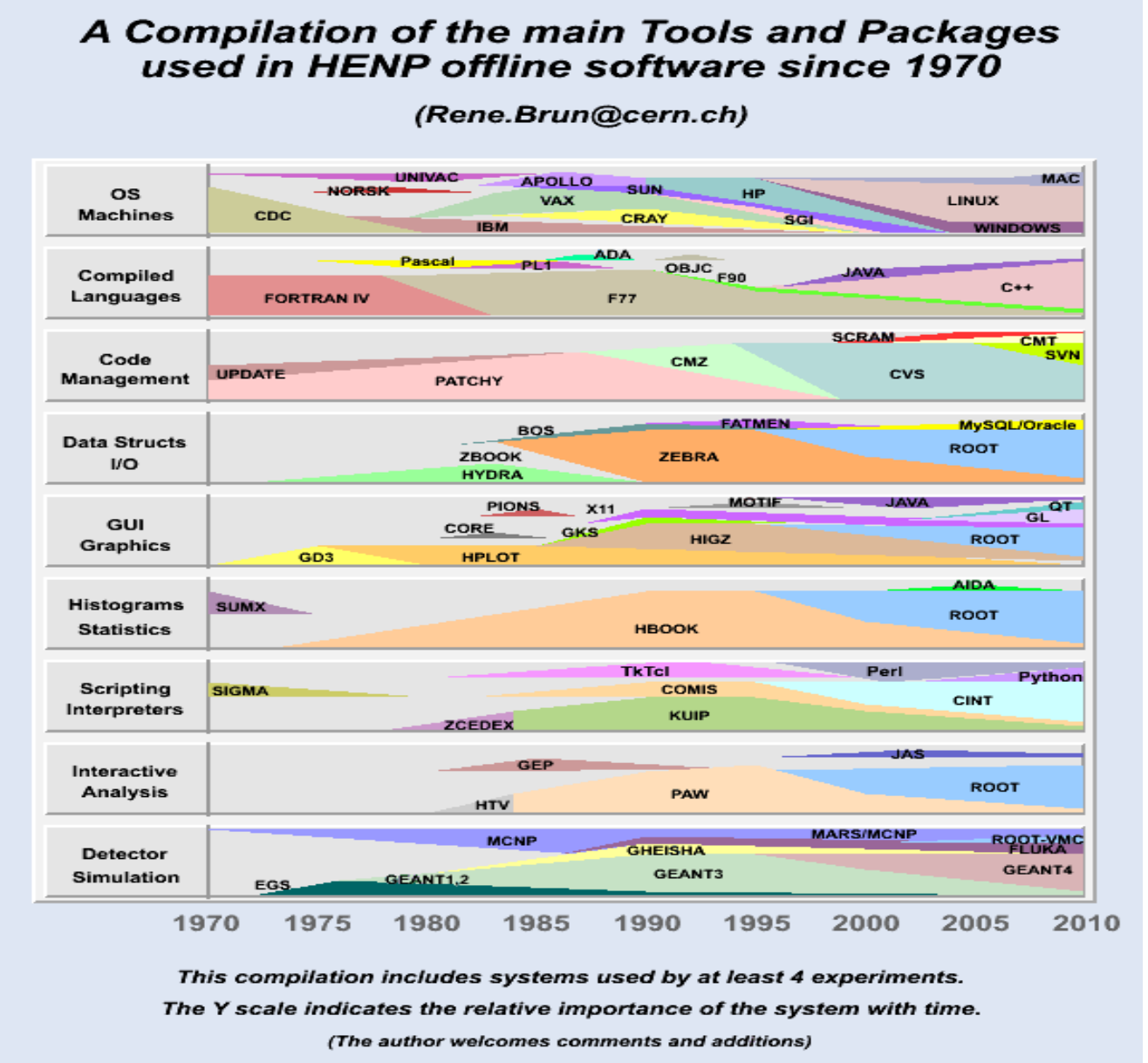
SPD meeting
March 5, 2018
Dubna

Rogachevsky O.

HEP experiments data flow

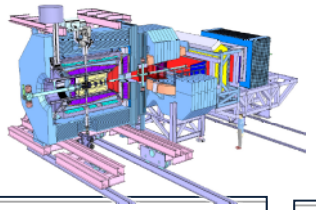


"In the beginning there was only Chaos." Then out of the void appeared ROOT



FairRoot

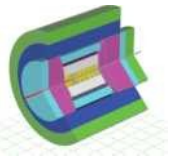
Start testing the VMC concept for CBM



Panda decided to join->

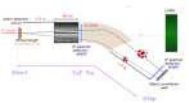
FairRoot: same Base package for different experiments

R3B joined

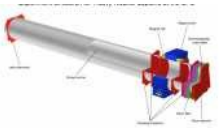


EIC (Electron Ion Collider BNL)

EICRoot



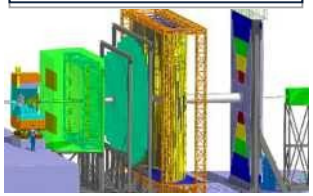
SOFIA (Studies On Fission with Aladin)



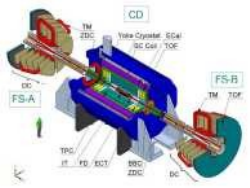
SHIP - Search for HIdden Particles

2004 2006 2010 2011 2012 2013 2014 2015

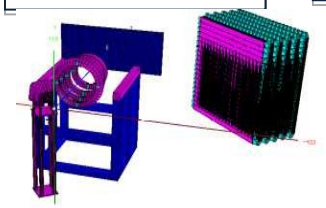
First Release of CbmRoot



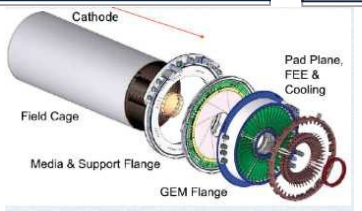
MPD (NICA) start also using FairRoot



ASYEOS joined (ASYEOSRoot)



GEM-TPC seperated from PANDA branch (FOPIRoot)



ENSAR-ROOT

Collection of modules used by structural nuclear phsyics exp.

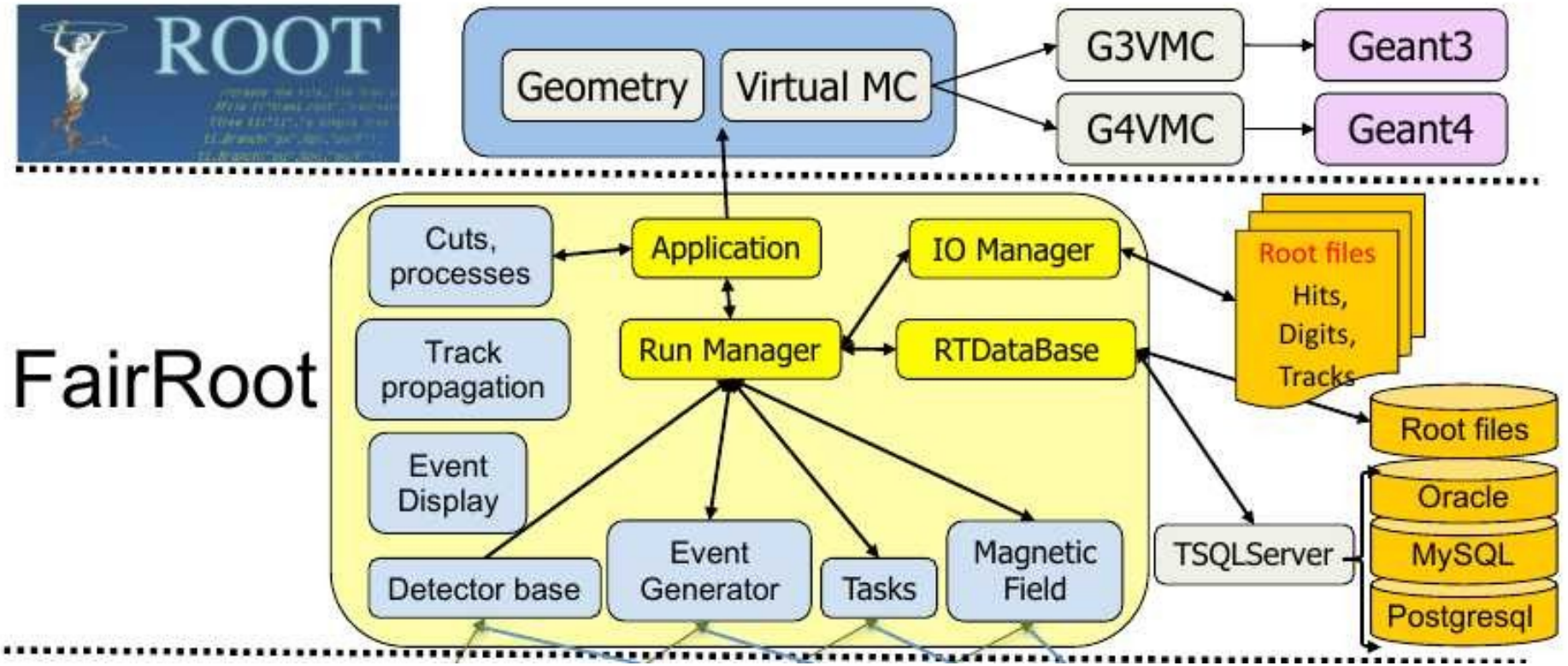
ALFA

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.

FairRoot structure



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.

mpd.jinr.ru

NICA EXPERIMENTS

TECHNICAL WEBSITE

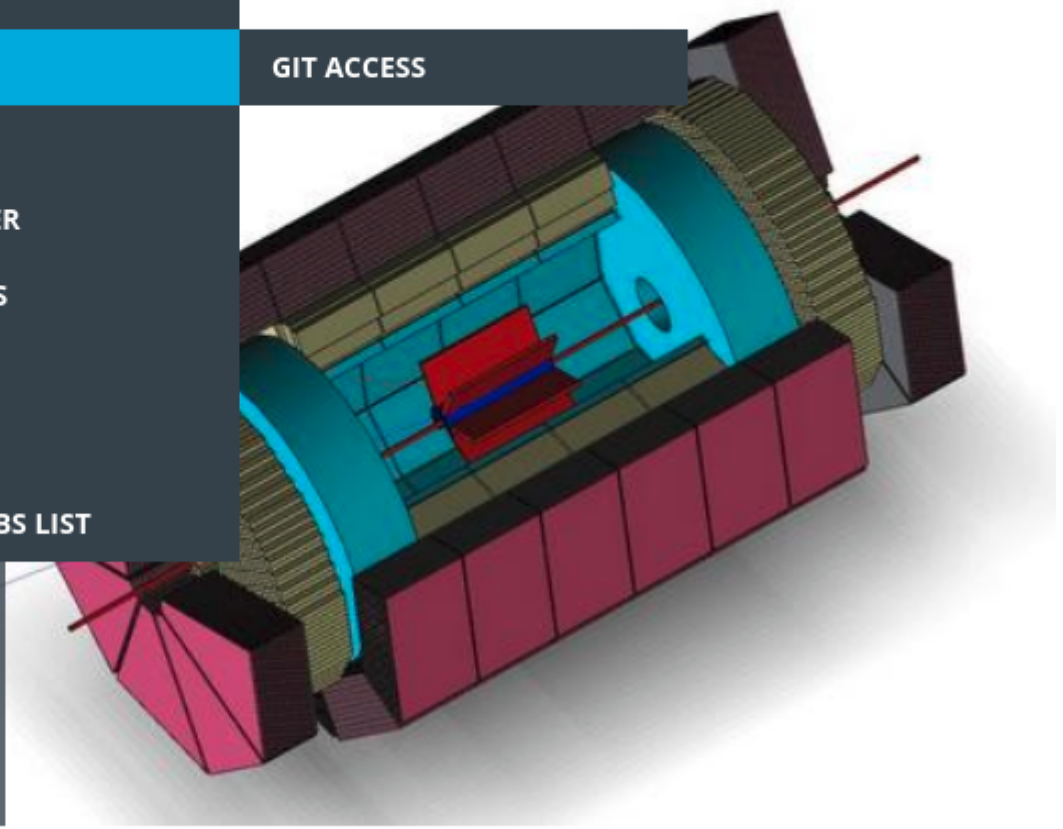
MAIN | DOCUMENTS | COMPUTING | FORUM | REFERENCES | BM@N | SPD | VIDYO

- BMNROOT
- MPDROOT
- SPDROOT
- TDR
- NICA CLUSTER
- LIT CLUSTERS
- DATABASES
- HOW TO
- CURRENT JOBS LIST

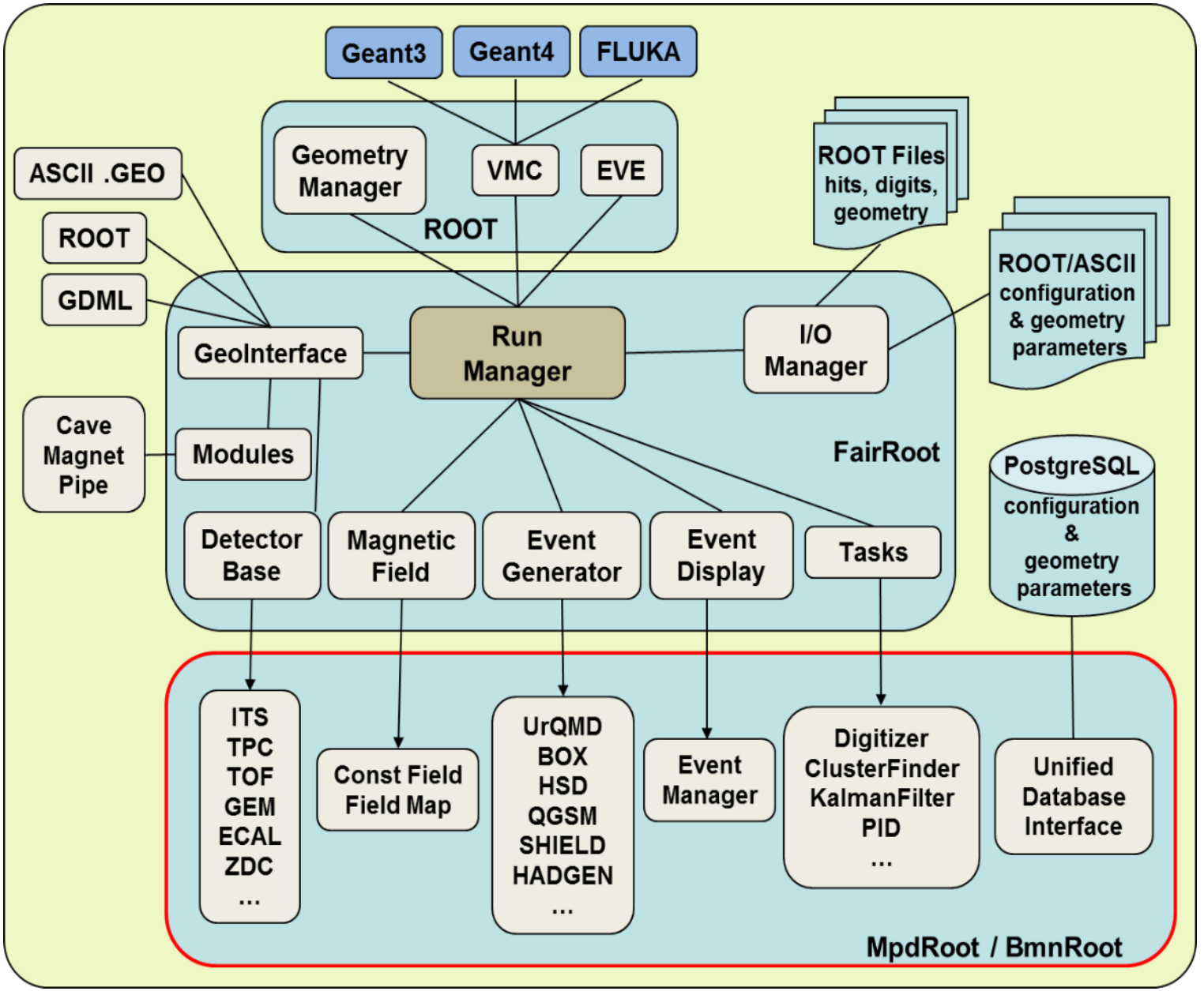
GIT ACCESS

Spin Physics Detector (SPI

Measurements of asym
the lepton pair (Drell-Ya
production in collisions
polarized, longitudinally
transversally polarized
deuterons beams are su
be [...]



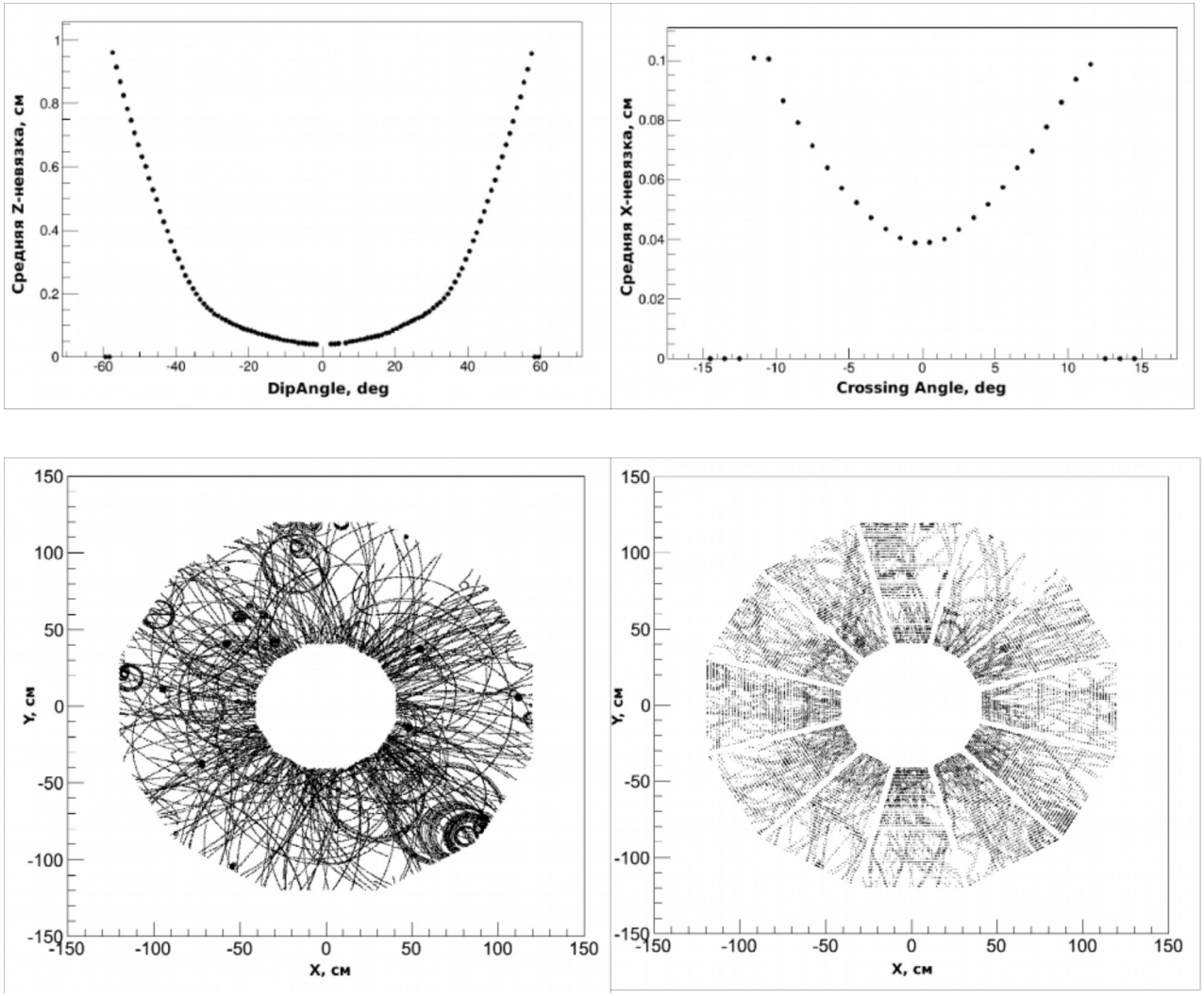
MPD/BM@N/SPDRoot design



Clustering in MPD TPC

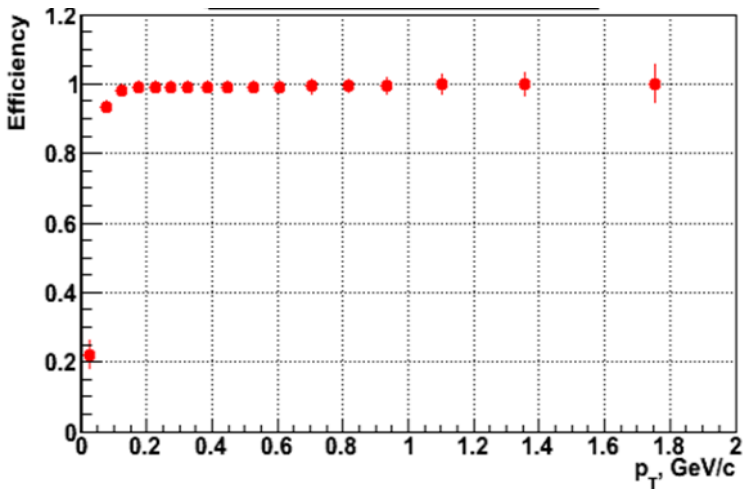
The hit reconstruction algorithm contains the following main steps:

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.

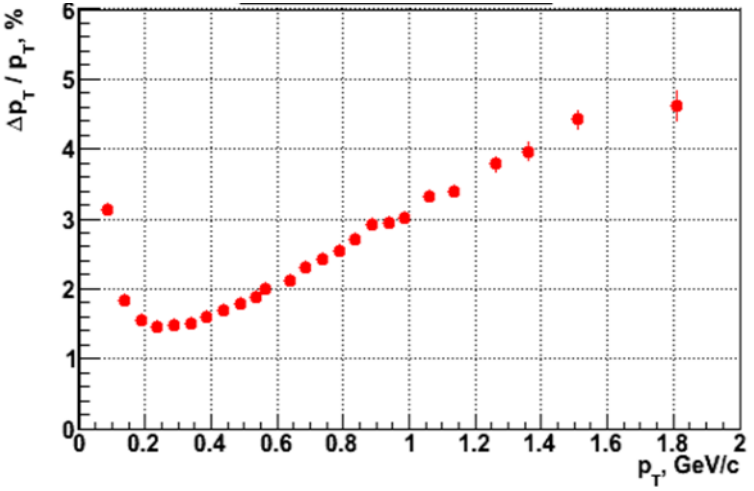


Tracking in MPD TPC

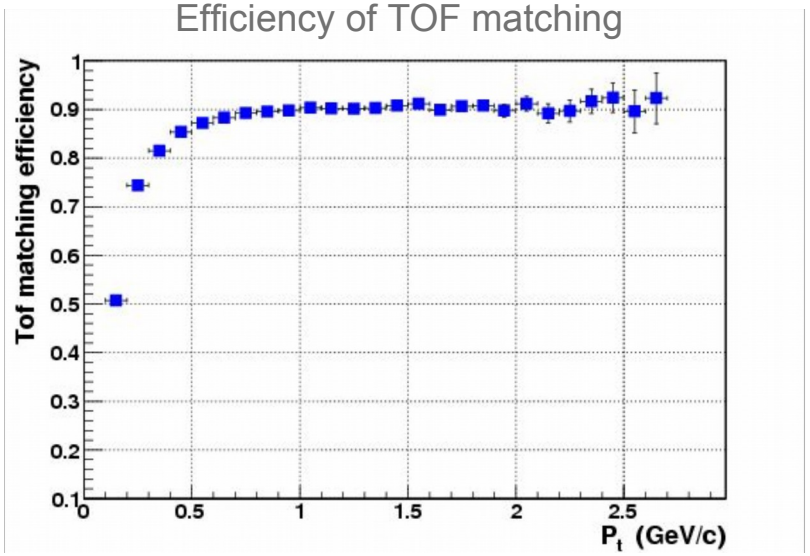
TPC tracking efficiency



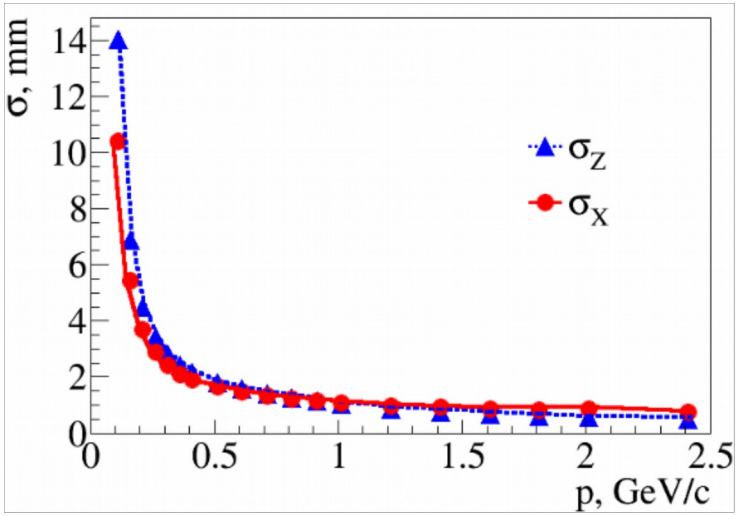
Momentum resolution



Efficiency of TOF matching

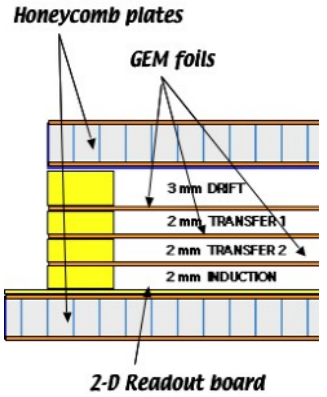


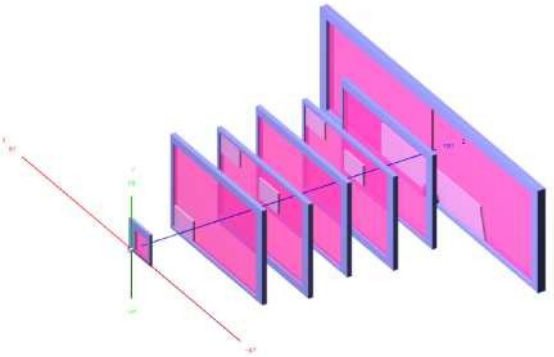
Primary vertex resolution



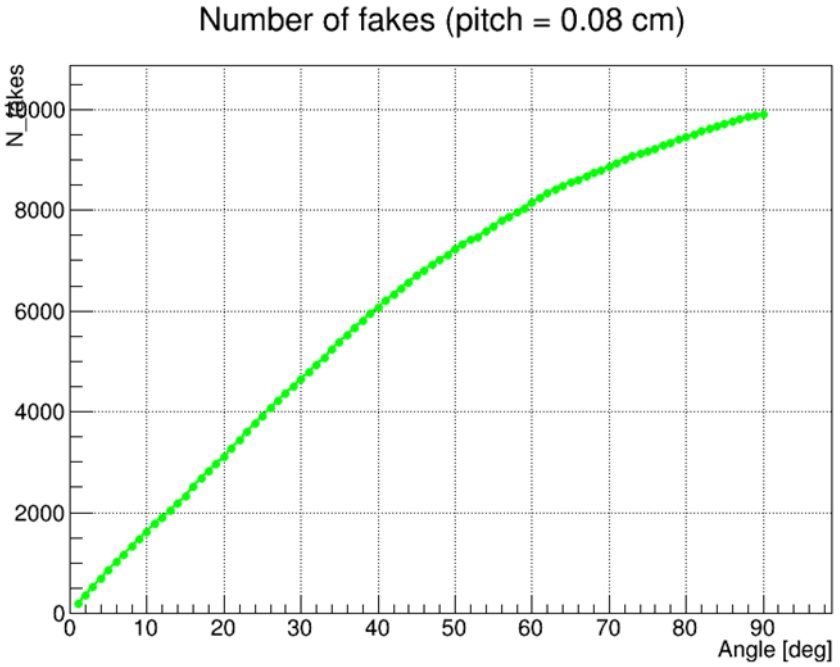
Clustering in GEM

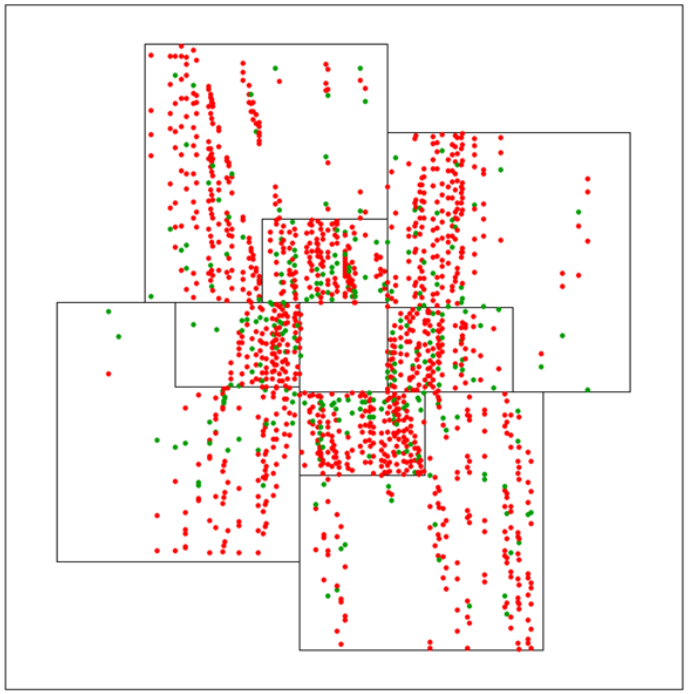
- There are realistic hit finder in GEMs
- For the GEM stations procedure of the fake hits production is implemented





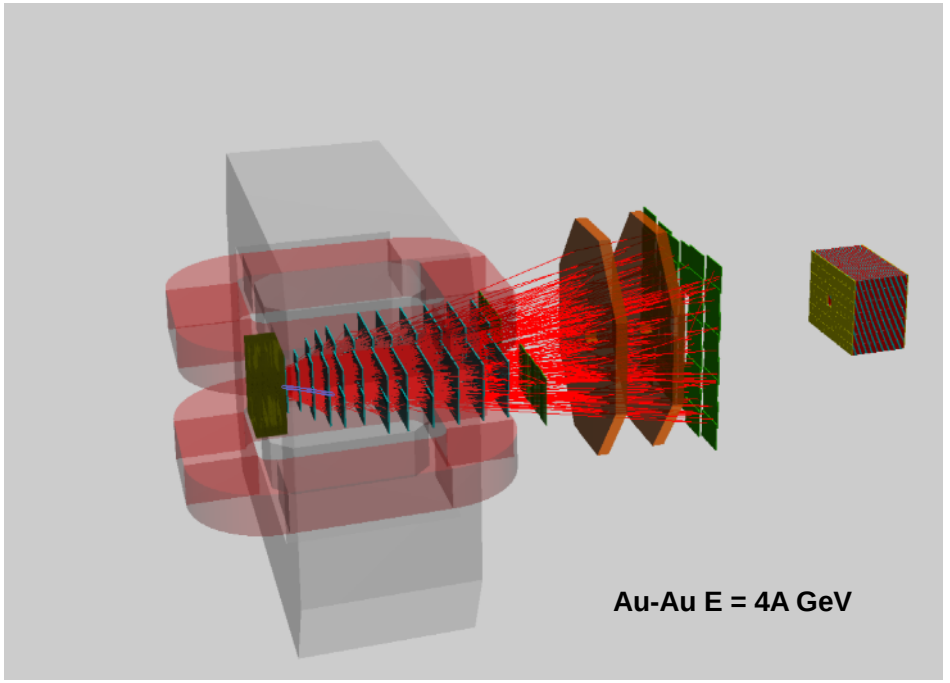
Station 0 (what is it)





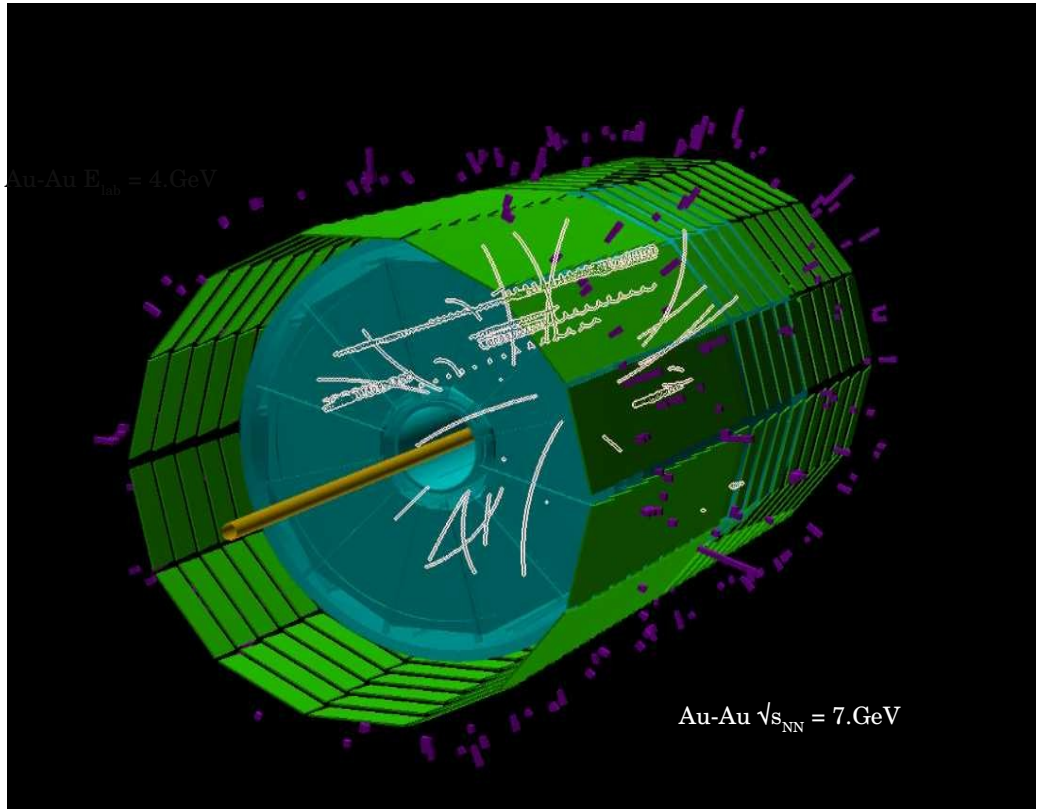
Event Display for the NICA experiments

based on EVE package



BM@N event data:
GEM points and reconstructed tracks

MPD event data:
TPC hits and EMC towers



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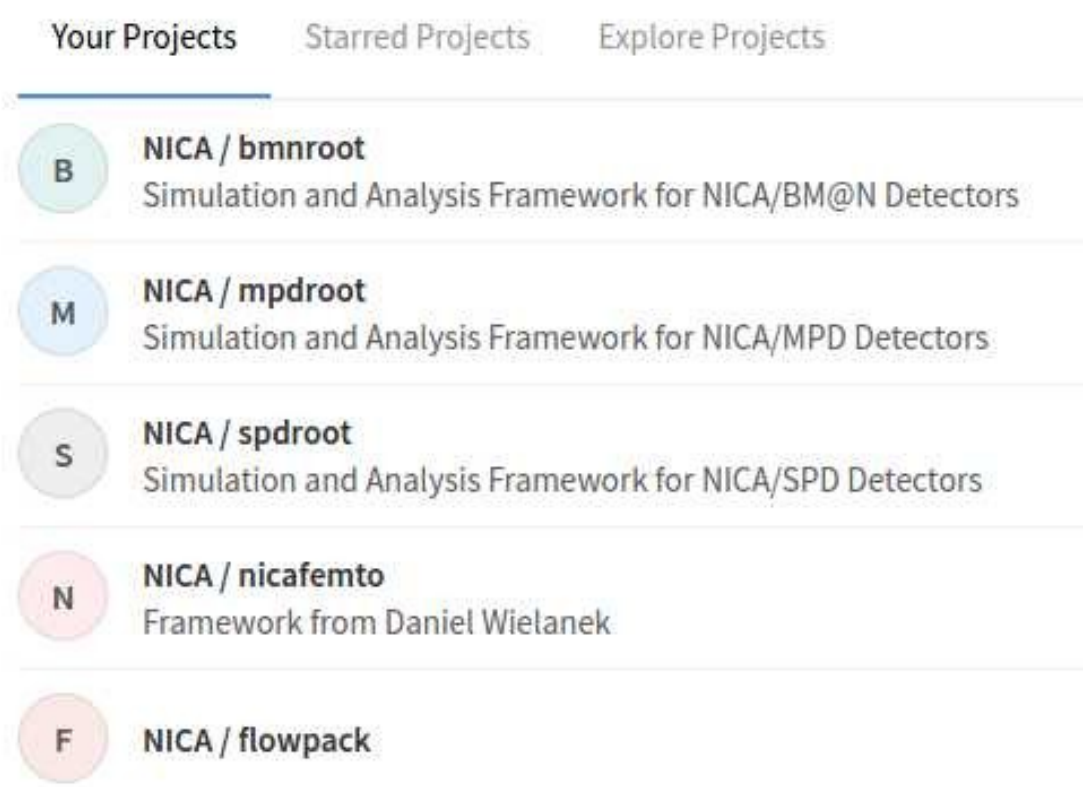
GIT repository for NICA experiments

https://git.jinr.ru/



GITEVERYDAY(7) Git Manual GITEVERYDAY(7)

NAME

giteveryday - A useful minimum set of commands for Everyday Git

SYNOPSIS

Everyday Git With 20 Commands Or So

Examples

Clone the upstream and work on it. Feed changes to upstream.

```
$ git clone git://git.kernel.org/pub/scm/.../torvalds/linux-2.6 my2.6
$ cd my2.6
$ git checkout -b mine master (1)
$ edit/compile/test; git commit -a -s (2)
$ git format-patch master (3)
$ git send-email --to="person <email@example.com>" 00*.patch (4)
$ git checkout master (5)
$ git pull (6)
$ git log -p ORIG_HEAD.. arch/i386 include/asm-i386 (7)
$ git ls-remote --heads http://git.kernel.org/.../jgarzik/libata-dev.git (8)
$ git pull git://git.kernel.org/pub/.../jgarzik/libata-dev.git ALL (9)
$ git reset --hard ORIG_HEAD (10)
$ git gc (11)
```

1. checkout a new branch mine from master.
2. repeat as needed.
3. extract patches from your branch, relative to master,
4. and email them.
5. return to master, ready to see what's new
6. git pull fetches from origin by default and merges into the current branch.
7. immediately after pulling, look at the changes done upstream since last time we checked, only in the area we are interested in.
8. check the branch names in an external repository (if not known).
9. fetch from a specific branch ALL from a specific repository and merge it.
10. revert the pull.
11. garbage collect leftover objects from reverted pull.

The Unified Database for offline data processing

raw data processing
event reconstruction
physical analysis

BmnRoot / MpdRoot

reading and
changing data

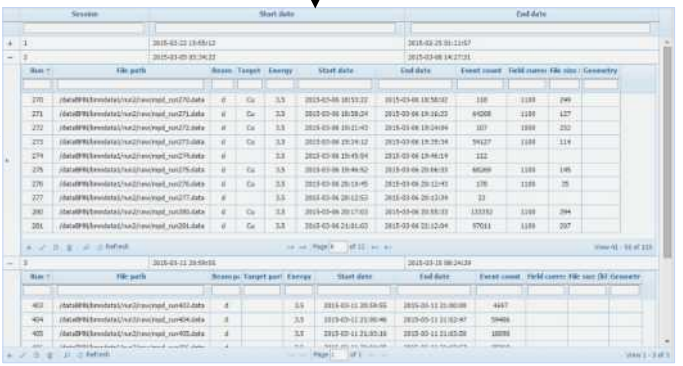
users

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

ROOT

unified database

PHP



Web interface is required

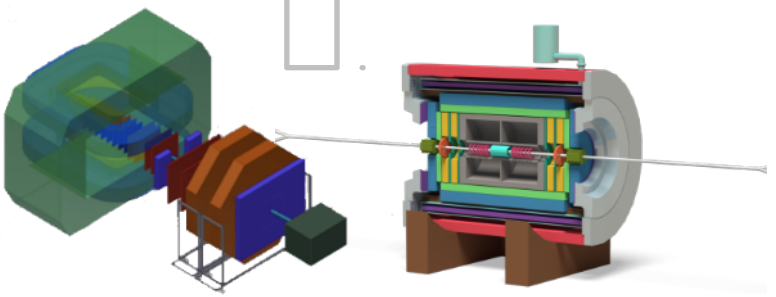
UniDbTango interface

PostgreSQL
automatic backup

configuration, calibration, parameter
and algorithm data

Tango

Slow Control System



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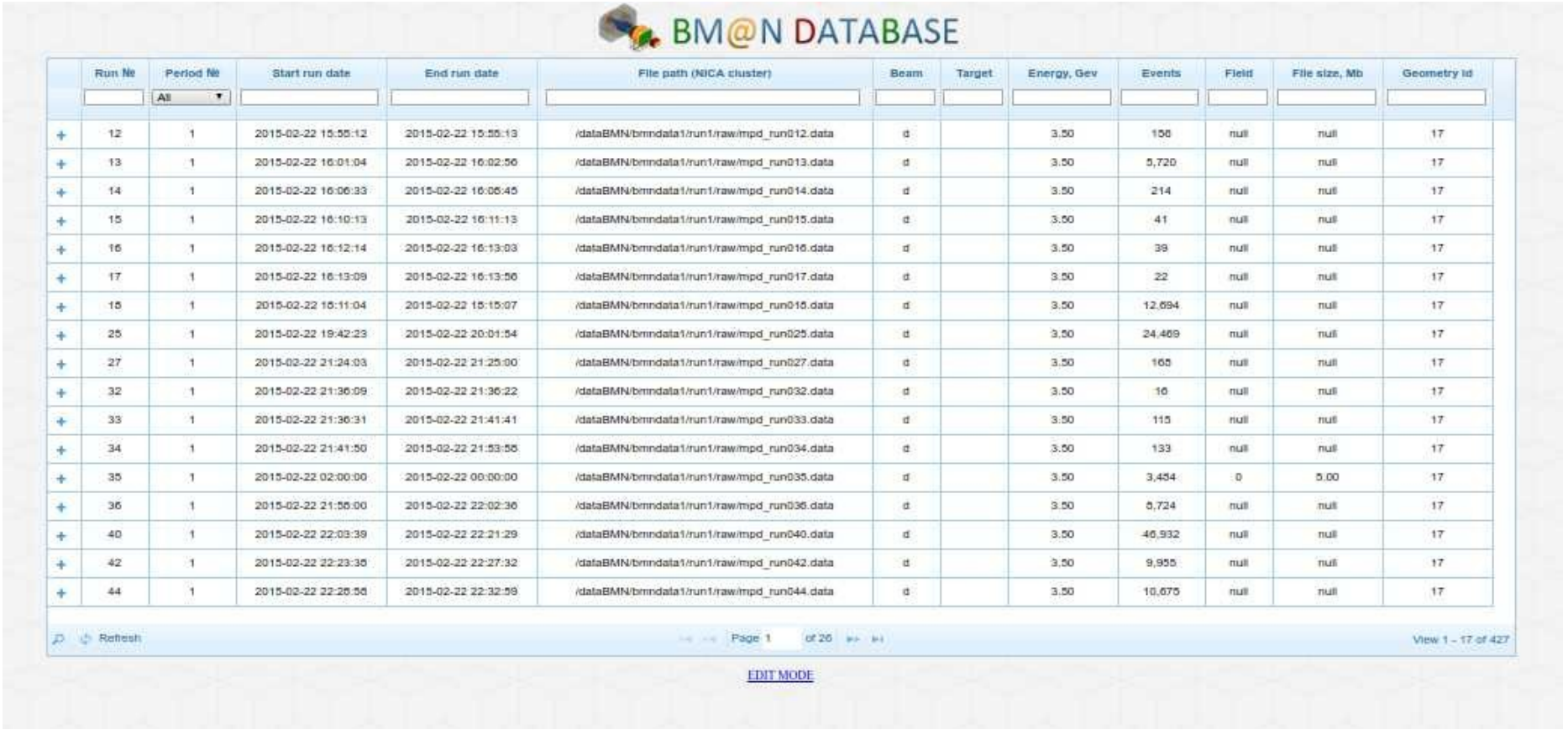
Detectors databases



BM@N DATABASE

	Run №	Period №	Start run date	End run date	File path (NICA cluster)	Beam	Target	Energy, Gev	Events	Field	File size, Mb	Geometry Id
		All										
+	12	1	2015-02-22 15:55:12	2015-02-22 15:55:13	/dataBMN/bmndata1/run1/raw/mpd_run012.data	d		3.50	156	null	null	17
+	13	1	2015-02-22 16:01:04	2015-02-22 16:02:56	/dataBMN/bmndata1/run1/raw/mpd_run013.data	d		3.50	5,720	null	null	17
+	14	1	2015-02-22 16:06:33	2015-02-22 16:06:45	/dataBMN/bmndata1/run1/raw/mpd_run014.data	d		3.50	214	null	null	17
+	15	1	2015-02-22 16:10:13	2015-02-22 16:11:13	/dataBMN/bmndata1/run1/raw/mpd_run015.data	d		3.50	41	null	null	17
+	16	1	2015-02-22 16:12:14	2015-02-22 16:13:03	/dataBMN/bmndata1/run1/raw/mpd_run016.data	d		3.50	39	null	null	17
+	17	1	2015-02-22 16:13:09	2015-02-22 16:13:56	/dataBMN/bmndata1/run1/raw/mpd_run017.data	d		3.50	22	null	null	17
+	18	1	2015-02-22 16:11:04	2015-02-22 16:15:07	/dataBMN/bmndata1/run1/raw/mpd_run018.data	d		3.50	12,694	null	null	17
+	25	1	2015-02-22 19:42:23	2015-02-22 20:01:54	/dataBMN/bmndata1/run1/raw/mpd_run025.data	d		3.50	24,469	null	null	17
+	27	1	2015-02-22 21:24:03	2015-02-22 21:25:00	/dataBMN/bmndata1/run1/raw/mpd_run027.data	d		3.50	165	null	null	17
+	32	1	2015-02-22 21:36:09	2015-02-22 21:36:22	/dataBMN/bmndata1/run1/raw/mpd_run032.data	d		3.50	16	null	null	17
+	33	1	2015-02-22 21:36:31	2015-02-22 21:41:41	/dataBMN/bmndata1/run1/raw/mpd_run033.data	d		3.50	115	null	null	17
+	34	1	2015-02-22 21:41:50	2015-02-22 21:53:56	/dataBMN/bmndata1/run1/raw/mpd_run034.data	d		3.50	133	null	null	17
+	35	1	2015-02-22 02:00:00	2015-02-22 00:00:00	/dataBMN/bmndata1/run1/raw/mpd_run035.data	d		3.50	3,454	0	5.00	17
+	36	1	2015-02-22 21:56:00	2015-02-22 22:02:36	/dataBMN/bmndata1/run1/raw/mpd_run036.data	d		3.50	5,724	null	null	17
+	40	1	2015-02-22 22:03:39	2015-02-22 22:21:29	/dataBMN/bmndata1/run1/raw/mpd_run040.data	d		3.50	46,932	null	null	17
+	42	1	2015-02-22 22:23:35	2015-02-22 22:27:32	/dataBMN/bmndata1/run1/raw/mpd_run042.data	d		3.50	9,955	null	null	17
+	44	1	2015-02-22 22:28:56	2015-02-22 22:32:59	/dataBMN/bmndata1/run1/raw/mpd_run044.data	d		3.50	10,675	null	null	17

Refresh Page 1 of 26 View 1 - 17 of 427

EDIT MODE

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 — Logou

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)

Event generators → exp. data databases

Protected: Simulation DB

Recent data on Wednesday 5th of October 2016 | Report mistake

Data simulation DB for MPD

Gen	Beam1	Beam2	Energy	Trigger	Path	Descr.
3FD	Au	Au	10	mb	/nica/data4mpd1/3FD/hydro/2PT/elab_10AGeV/AuAu_elb10gev_hydroON_EoS2PT_urqmdON_6fm_1000ev_22.roo	
3FD	Au	Au	10	mb	/nica/data4mpd1/3FD/hydro/2PT/elab_10AGeV/AuAu_elb10gev_hydroON_EoS2PT_urqmdON_6fm_1000ev_23.roo	
3FD	Au	Au	10	mb	/nica/data4mpd1/3FD/hydro/2PT/elab_10AGeV/AuAu_elb10gev_hydroON_EoS2PT_urqmdON_6fm_1000ev_24.roo	
3FD	Au	Au	10	mb	/nica/data4mpd1/3FD/hydro/2PT/elab_10AGeV/AuAu_elb10gev_hydroON_EoS2PT_urqmdON_6fm_1000ev_25.roo	
3FD	Au	Au	10	mb	/nica/data4mpd1/3FD/hydro/2PT/elab_10AGeV/AuAu_elb10gev_hydroON_EoS2PT_urqmdON_6fm_1000ev_26.roo	
3FD	Au	Au	10	mb	/nica/data4mpd1/3FD/hydro/2PT/elab_10AGeV/AuAu_elb10gev_hydroON_EoS2PT_urqmdON_6fm_1000ev_27.roo	
3FD	Au	Au	10	mb	/nica/data4mpd1/3FD/hydro/2PT/elab_10AGeV/AuAu_elb10gev_hydroON_EoS2PT_urqmdON_6fm_1000ev_28.roo	
3FD	Au	Au	10	mb	/nica/data4mpd1/3FD/hydro/2PT/elab_10AGeV/AuAu_elb10gev_hydroON_EoS2PT_urqmdON_6fm_1000ev_29.roo	
3FD	Au	Au	10	mb	/nica/data4mpd1/3FD/hydro/2PT/elab_10AGeV/AuAu_elb10gev_hydroON_EoS2PT_urqmdON_6fm_1000ev_2.root	
3FD	Au	Au	10	mb	/nica/data4mpd1/3FD/hydro/2PT/elab_10AGeV/AuAu_elb10gev_hydroON_EoS2PT_urqmdON_6fm_1000ev_30.roo	
3FD	Au	Au	10	mb	/nica/data4mpd1/3FD/hydro/2PT/elab_10AGeV/AuAu_elb10gev_hydroON_EoS2PT_urqmdON_6fm_1000ev_31.roo	
3FD	Au	Au	10	mb	/nica/data4mpd1/3FD/hydro/2PT/elab_10AGeV/AuAu_elb10gev_hydroON_EoS2PT_urqmdON_6fm_1000ev_32.roo	
3FD	Au	Au	10	mb	/nica/data4mpd1/3FD/hydro/2PT/elab_10AGeV/AuAu_elb10gev_hydroON_EoS2PT_urqmdON_6fm_1000ev_33.roo	
3FD	Au	Au	10	mb	/nica/data4mpd1/3FD/hydro/2PT/elab_10AGeV/AuAu_elb10gev_hydroON_EoS2PT_urqmdON_6fm_1000ev_34.roo	
3FD	Au	Au	10	mb	/nica/data4mpd1/3FD/hydro/2PT/elab_10AGeV/AuAu_elb10gev_hydroON_EoS2PT_urqmdON_6fm_1000ev_35.roo	
3FD	Au	Au	10	mb	/nica/data4mpd1/3FD/hydro/2PT/elab_10AGeV/AuAu_elb10gev_hydroON_EoS2PT_urqmdON_6fm_1000ev_36.roo	
3FD	Au	Au	10	mb	/nica/data4mpd1/3FD/hydro/2PT/elab_10AGeV/AuAu_elb10gev_hydroON_EoS2PT_urqmdON_6fm_1000ev_37.roo	
3FD	Au	Au	10	mb	/nica/data4mpd1/3FD/hydro/2PT/elab_10AGeV/AuAu_elb10gev_hydroON_EoS2PT_urqmdON_6fm_1000ev_38.roo	
3FD	Au	Au	10	mb	/nica/data4mpd1/3FD/hydro/2PT/elab_10AGeV/AuAu_elb10gev_hydroON_EoS2PT_urqmdON_6fm_1000ev_39.roo	
3FD	Au	Au	10	mb	/nica/data4mpd1/3FD/hydro/2PT/elab_10AGeV/AuAu_elb10gev_hydroON_EoS2PT_urqmdON_6fm_1000ev_3.root	

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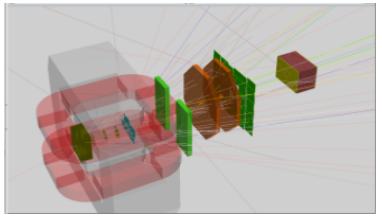
Edit table

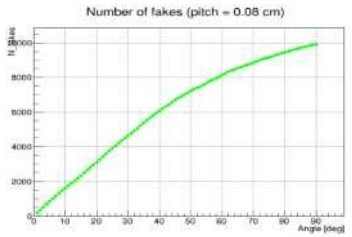
- ✔ UrQMD
- ✔ QGSM
- ✔ PHSD

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

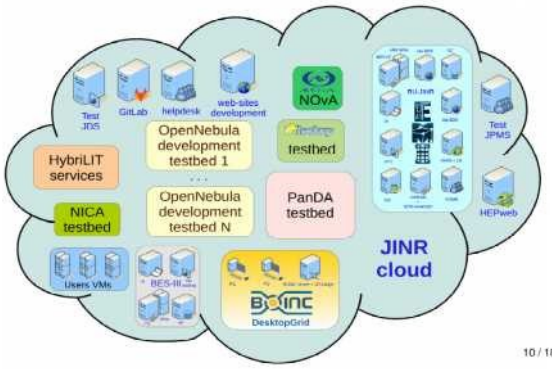
32902 files
~ 10^6 events
for each
interaction

MPD Run Control System

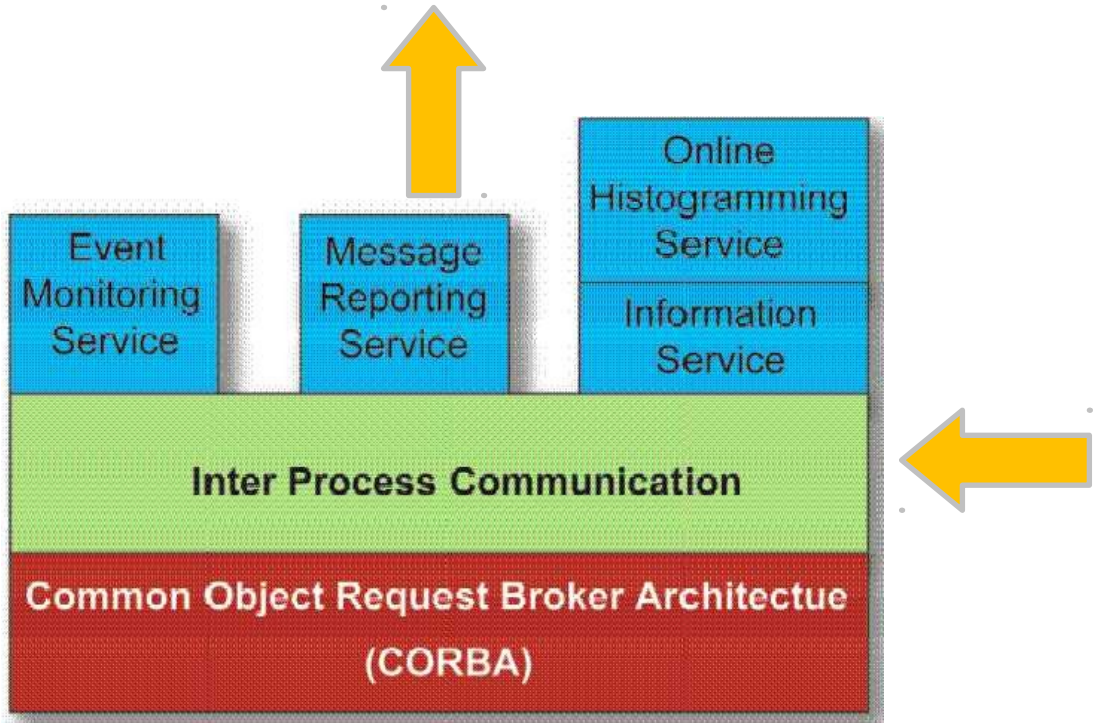




Displays		Analysis	Archiving	
Event Display	Information Monitors	Data Quality Monitoring	Monitoring Data Archiving	Archive Browser
Histogram Presenter	Web Monitoring			



first prototype is developed on LIT Virtual Machines



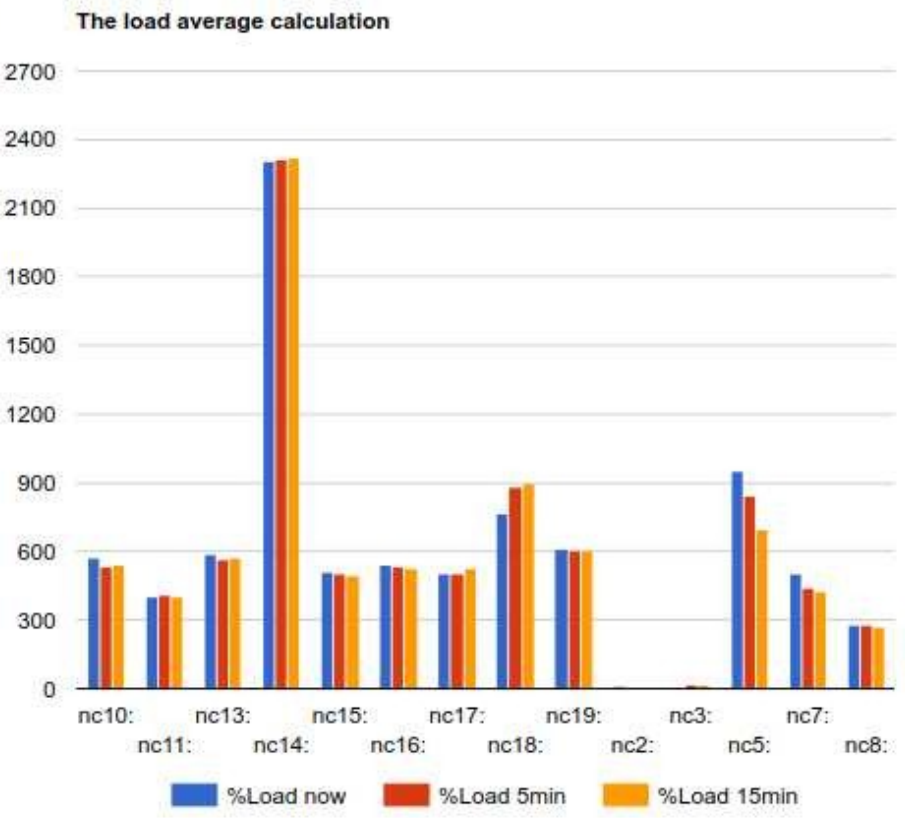
ATLAS TDAQ Online Components

Computing resources: LHEP

Protected: Cluster monitoring

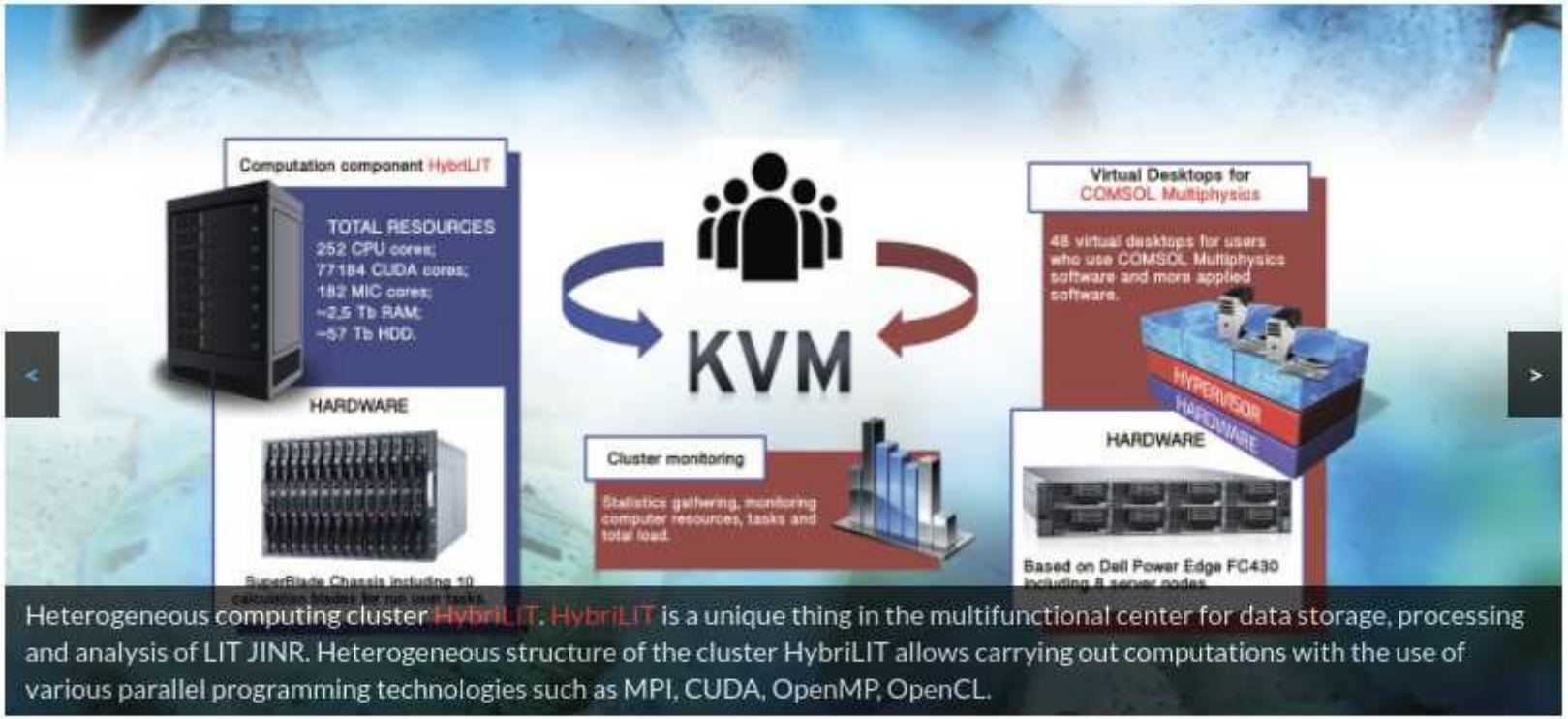
ONLINE cluster nodes

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: LIT

Гетерогенный кластер «HybriLIT»



Heterogeneous computing cluster HybriLIT. HybriLIT is a unique thing in the multifunctional center for data storage, processing and analysis of LIT JINR. Heterogeneous structure of the cluster HybriLIT allows carrying out computations with the use of various parallel programming technologies such as MPI, CUDA, OpenMP, OpenCL.

Гетерогенный кластер «HybriLIT» является частью Многофункционального информационно-вычислительного комплекса (МИВК), Лаборатории информационных технологий ОИЯИ, г. Дубна. Гетерогенная структура вычислительных узлов позволяет разрабатывать параллельные приложения для решения широкого круга математических ресурсоемких задач с использованием всех возможностей многоядерной компоненты и ускорителей вычислений: **графических процессоров NVIDIA и сопроцессоров Intel Xeon Phi.**

Thank for your attention