

# Report of the software coordinator

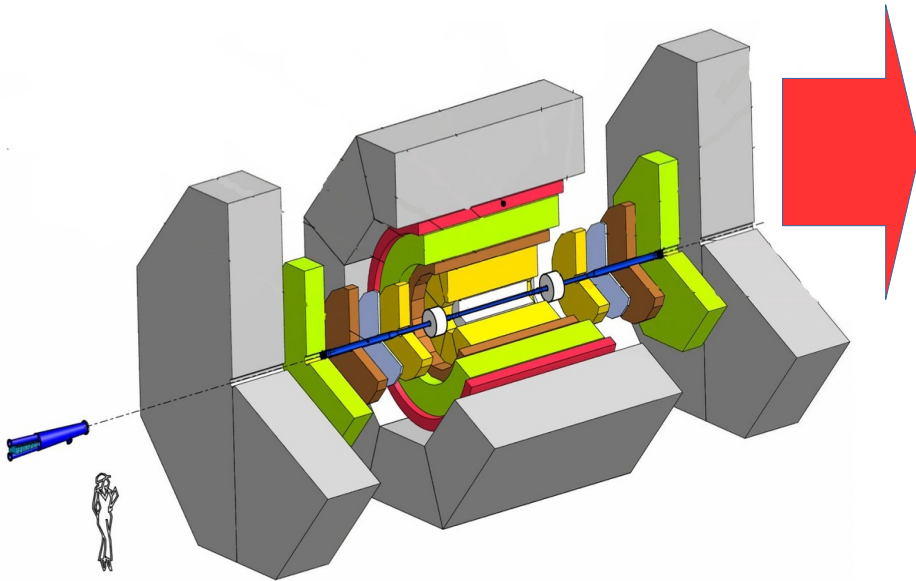
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JINR

SPD Collaboration Meeting  
3 October 2021

# TDR preparation

- TDR chapter on software and computing is essentially ready
- Missing pieces:
  - Online monitoring and DQA
  - Organization and planning
  - Realistic cost estimate

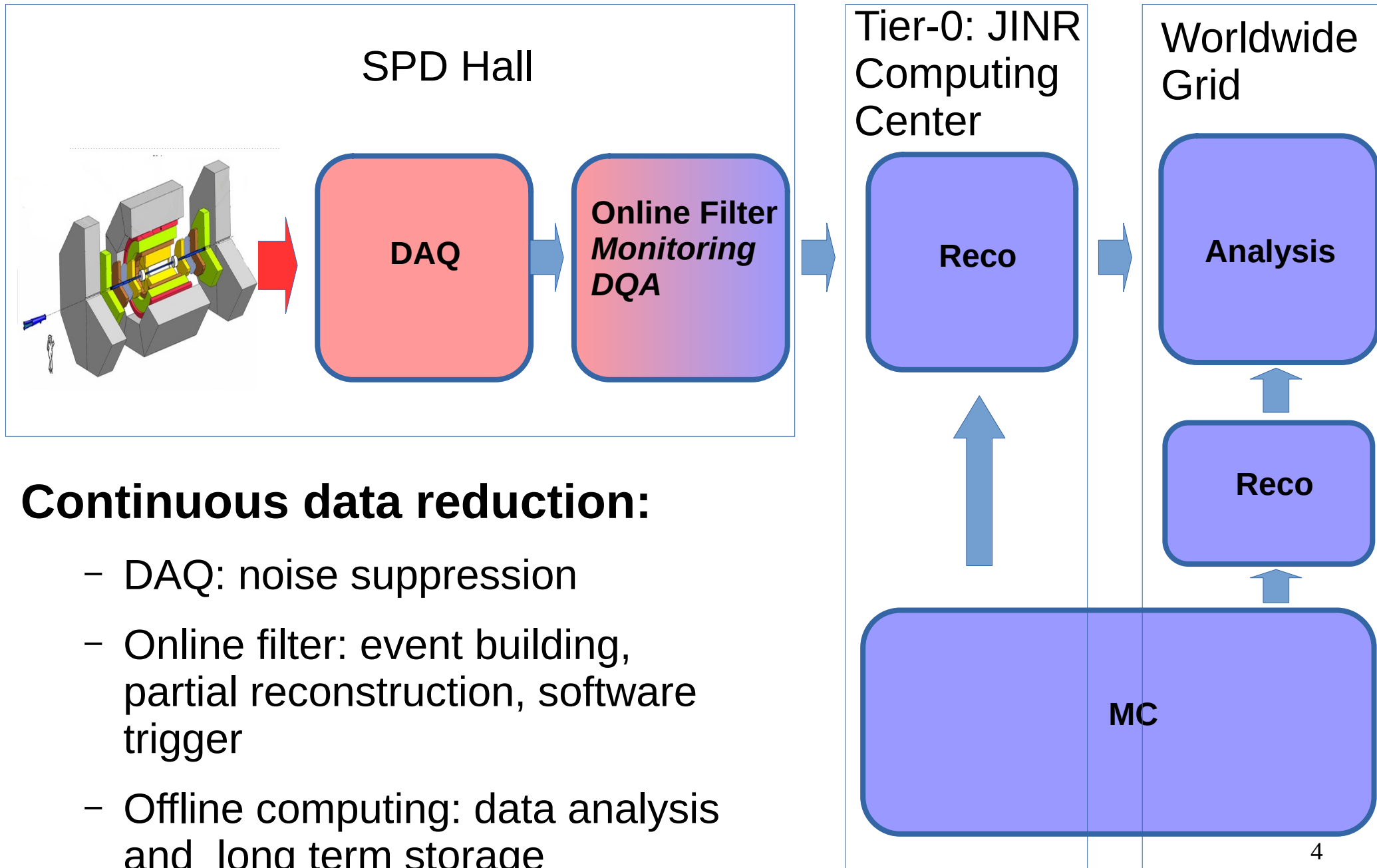
# SPD as a data source



- Bunch crossing every 76 ns = crossing rate 12.5 MHz
- $\sim 3$  MHz event rate (at  $10^{32}$  cm<sup>-2</sup>s<sup>-1</sup> design luminosity) = pileups
- 20 GB/s (or 200 PB/year (raw data),  $3 \cdot 10^{13}$  events/year)
- Selection of physics signal requires momentum and vertex reconstruction  $\rightarrow$  no simple trigger is possible

The SPD detector is a medium scale setup in size, but a large scale one in data rate!

# Data workflow



## Continuous data reduction:

- DAQ: noise suppression
- Online filter: event building, partial reconstruction, software trigger
- Offline computing: data analysis and long term storage

# Offline computing system

All basic components are already available from LHC experiments:

- Workload management: PANDA
- Data management: RUCIO and FTS
- Software distribution: CVMFS + docker/singularity containers
- A prototype of SPD computing system exists, ready to test mass production
  - *dataset organization to be fixed*
  - *transformation scripts for the offline software are needed*

*More details in the talk of Danila Oleynik on Wednesday*

# Resource estimate

<b>NICA SPD</b>	<b>2023</b>	<b>2024</b>	<b>2025</b>	<b>2026</b>	<b>2027</b>	<b>2028</b>	<b>2029</b>	<b>2030</b>
<b>kHS06</b>	10	20	40	200	410	410	410	410
<b>PFlops</b>	0.0383	0.0767	0.1534	0.7669	1.5722	1.5722	1.5722	1.5722
<b>Disk (PB)</b>	0.5	0.5	1	3	10	10	12	14
<b>Tape (PB)</b>	1	1	2	2	10	20	30	40
<b>Network (Gbps)</b>	10	10	100	2x100	2x100	2x100	2x100	2x100

It will be very hard to accommodate all resources in a single institute.  
A number (the more, the better) of contributors is necessary!

# Status of the online filter

- Emulator of raw data stream is prepared
- Prototype of the online framework (Ondatre) exists (but still too simple):
  - multithreaded data unpacking
  - a generic interface to reconstruction algorithms
  - multithreaded output to HDF5 file
- Good progress with the deep learning track recognition
  - simplified SPD geometry, fast simulation
  - C++ implementation is under way to estimate the performance
  - noise robustness study is the next step

# SpdRoot: SPD Offline Software

- Core Framework (FairRoot)
- Detector Description
- Event Generators
- Simulation
- Reconstruction

*Git repository: <http://git.jinr.ru/nica/spdroot>*

*Documentation Wiki:*

*<https://git.jinr.ru/nica/spdroot/-/wikis/home>*



# SpdRoot releases in 2022

## **v 4.1.3 [01.02.2022]**

- Important bugfixes in Pythia8 and SpdTrackFitPar

## **v 4.1.4 [18.06.2022]**

- The update of the detector geometry following the current version of the TDR.
- PID added

# An alternative Gaudi-based framework

SpdRoot remains the main tool for the physics studies in the coming years. However, it requires significant developments before it can be used for the real data processing after SPD starts operation.

A new Gaudi-based framework is an alternative solution.

- **What we gain:**

- Robust multithreaded framework with a good user support
- It is likely we can largely keep and transfer key algorithms from the SpdRoot to the new framework

- **What we lose:**

- Simplicity and smaller size of the SpdRoot
- Existing expertise in the FairRoot internals

More details in the Valery Onuchin's talk on Wednesday

# Gaudi route in SPD: prerequisites

- OS — CentOS7 → 8 → 9 ? Alternative Linux e.g. Ubuntu?
- Compiler — gcc-9 ? -10 ?? -11 ?? other ?
- Python - 3
- Building system - cmake (shipped with the software)
- Distribution:
  - CVMFS
  - Containers (docker/podman, singularity)
  - Source from git repository

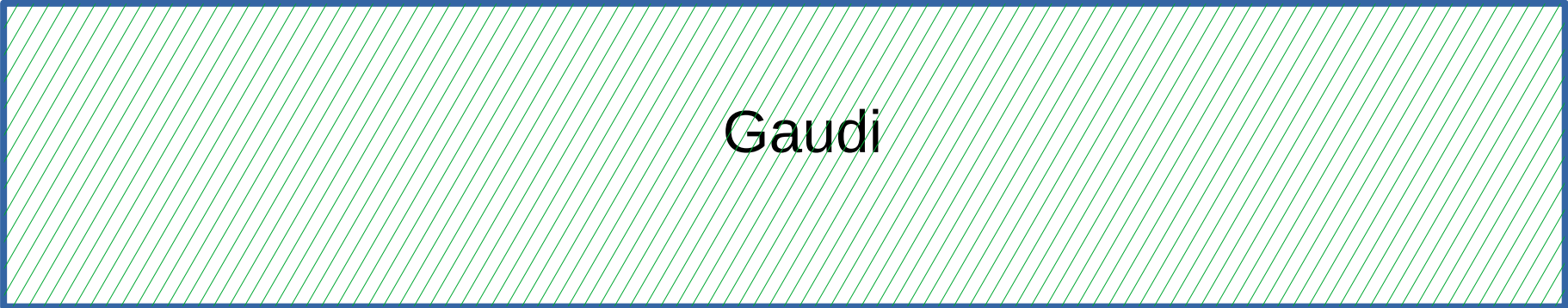
I suggest to discuss these topics in more detail on Wednesday after Andrey Kiryanov's talk

# Gaudi route in SPD

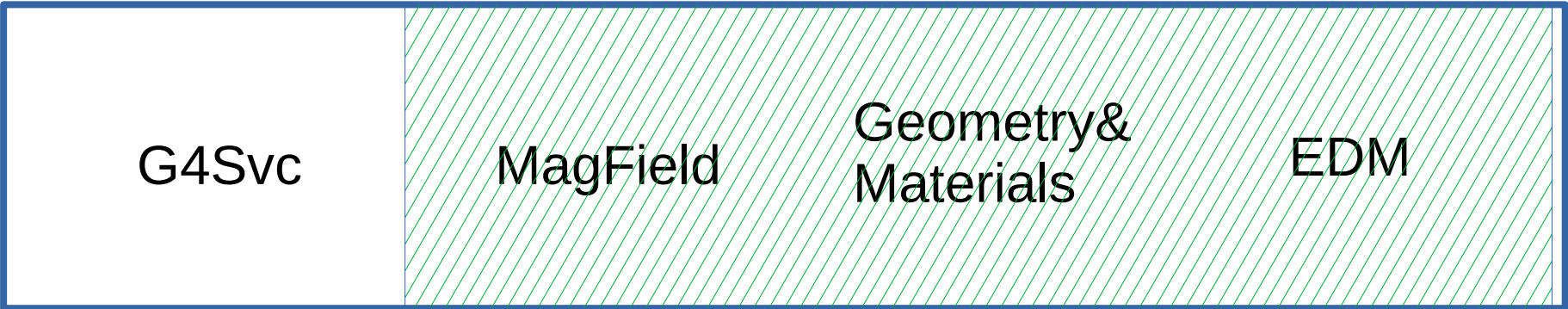
Stage 1



Stage 2



Stage 3



Stage 4

GenInterface

Simulation

McHitProducers

Stage 5

RecHitProducers

Tracking

Ecal  
Clustering

Rs  
Clustering

Stage 6

Vertex

Secondary T0  
Vertex

PID

Database

# Summary

- Computing and software of the SPD experiment is making a good progress.
- A prototype of the online data filter framework exists
- SpdRoot is going to be frozen in a current state. Only bugfix releases in the near future.
- Started developing new Gaudi-based offline software.
  - first public release is expected in spring 2023. [Depends on available manpower!](#)
  - then, a gradual transition from SpdRoot to a new software is expected
- A prototype of the offline computing system is ready for mass production tests
- Software and Computing chapter of the TDR is essentially ready