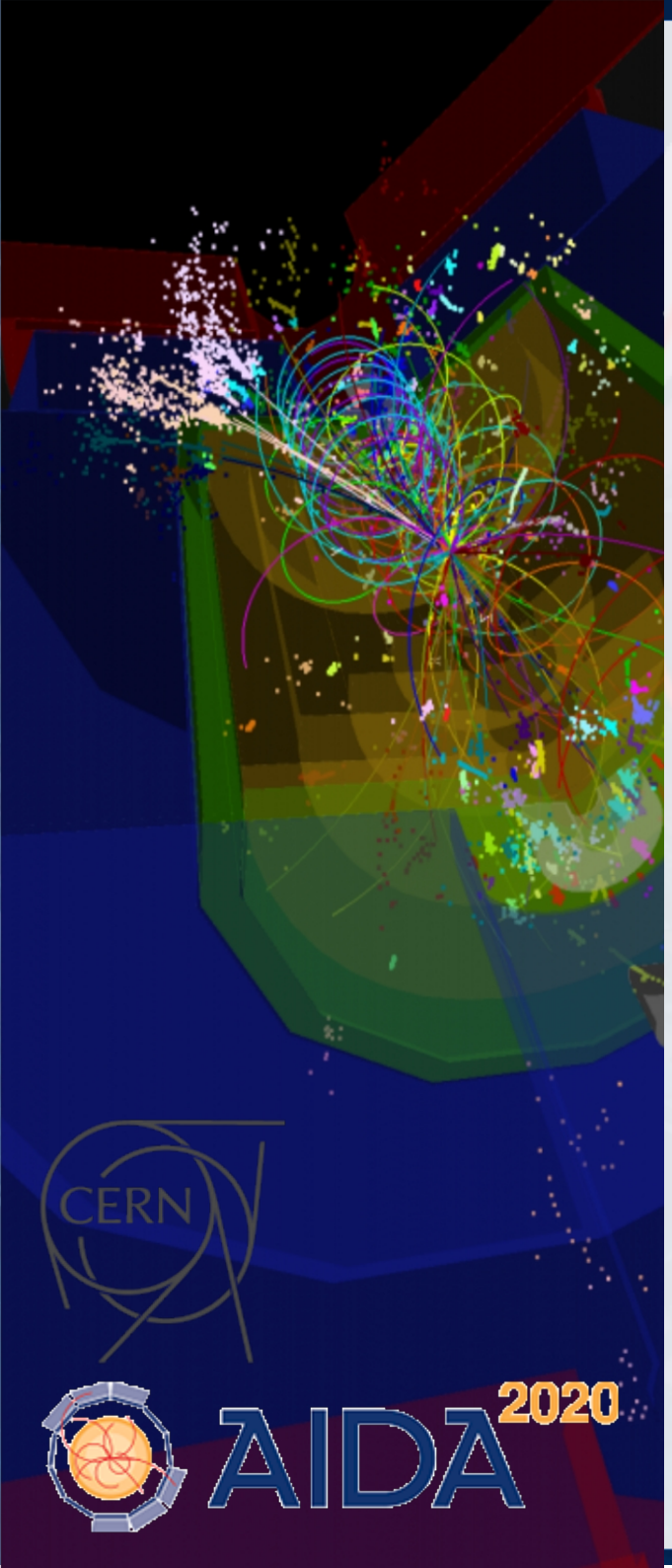


DD4hep Status

HEP detector description supporting the full experiment life cycle

M.Frank, F.Gaede, M.Petric, A.Sailer

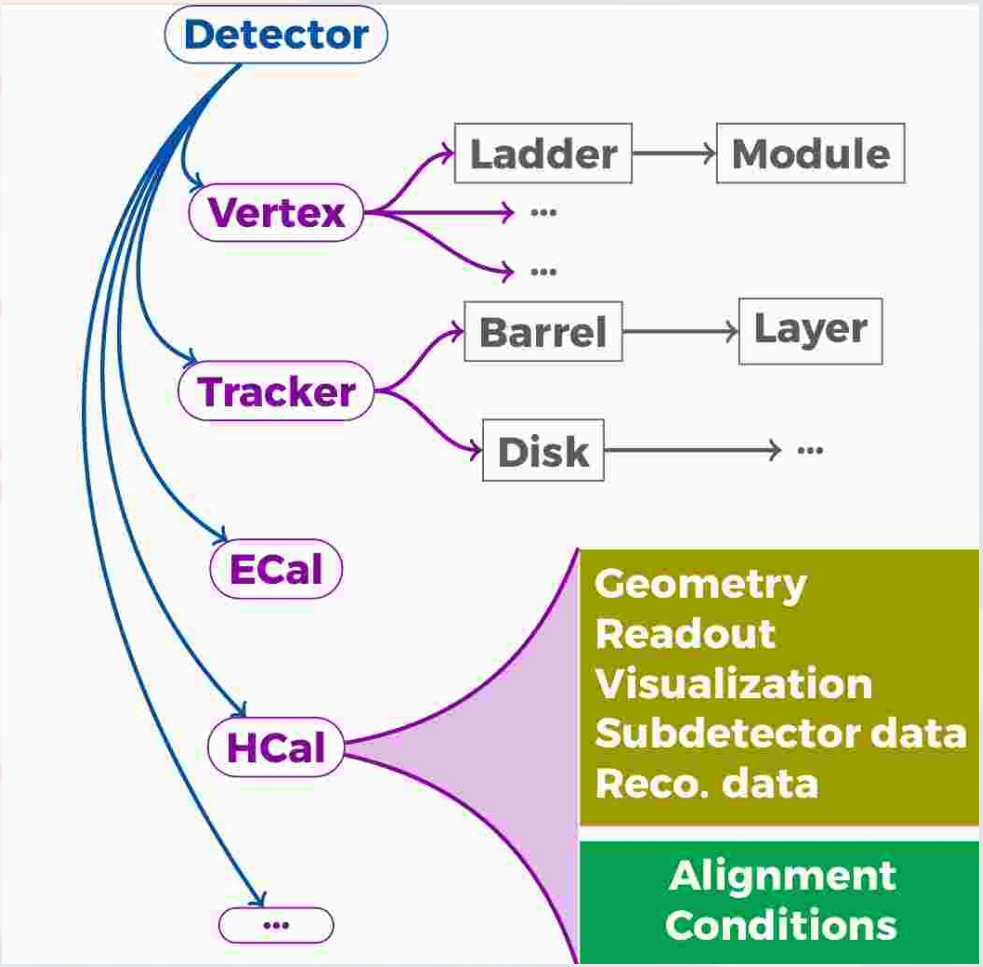
- **Motivation and Goals**
- New Developments
- Conditions and Alignment support
- Miscellaneous
- Summary

Motivation and Goal

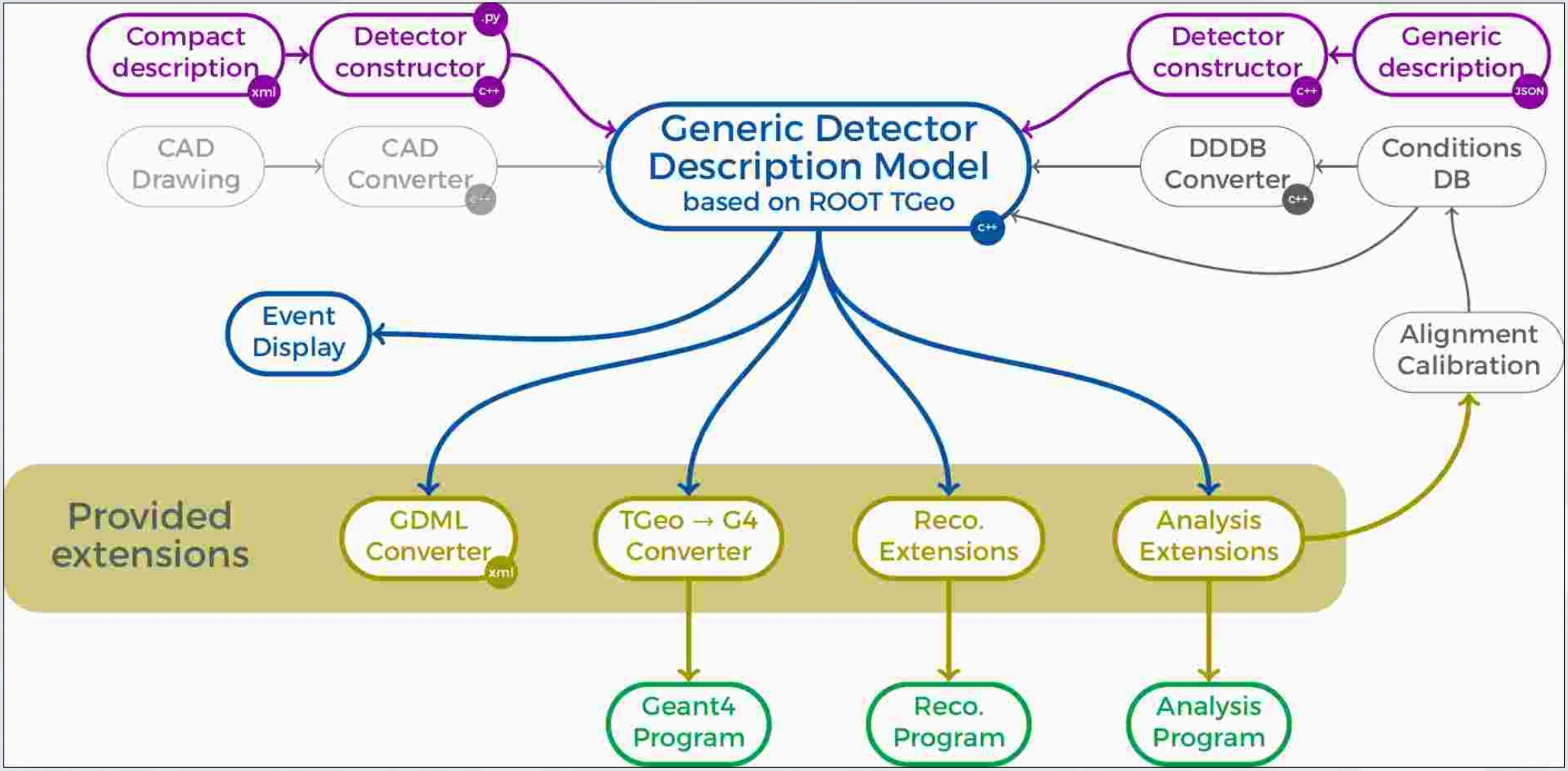
- **Develop a detector description**
  - **For the full experiment life cycle**
    - **detector concept development, optimization**
    - **detector construction and operation**
    - **“Anticipate the unforeseen”**
  - **Consistent description, with single source, which supports**
    - **simulation, reconstruction, analysis**
  - **Full description, including**
    - **Geometry, readout, alignment, calibration etc.**

What is Detector Description ?

- Tree-like hierarchy of "detector elements"
  - Macroscopic (ie. not a strip)
  - Subdetectors or parts of subdetectors
- Detector Element
  - Geometry
  - Facilitate access to data necessary to process events
    - Environmental data
    - Alignments
    - Derivatives of these
  - Optionally experiment, sub-detector or activity specific data



DD4Hep - The Big Picture



- Motivation and Goals
- **New Developments**
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- Summary

NEW: Support for Optical Surfaces

- Requests from LHCb, FCC and SCTF
  - Placeholder concept developed by TGeo
  - Integration and validation in DD4hep ongoing
- Changes to
  - Surface objects => newly created in D4hep
  - Materials => added material properties
  - DDG4 => propagate surfaces and material properties to Geant4
- Iterative development collaboration between DD4hep and ROOT TGeo
- Ongoing development

- Motivation and Goals
- New Developments
- **Conditions and Alignment support**
- Miscellaneous
- Summary

DDCond: Conditions Data

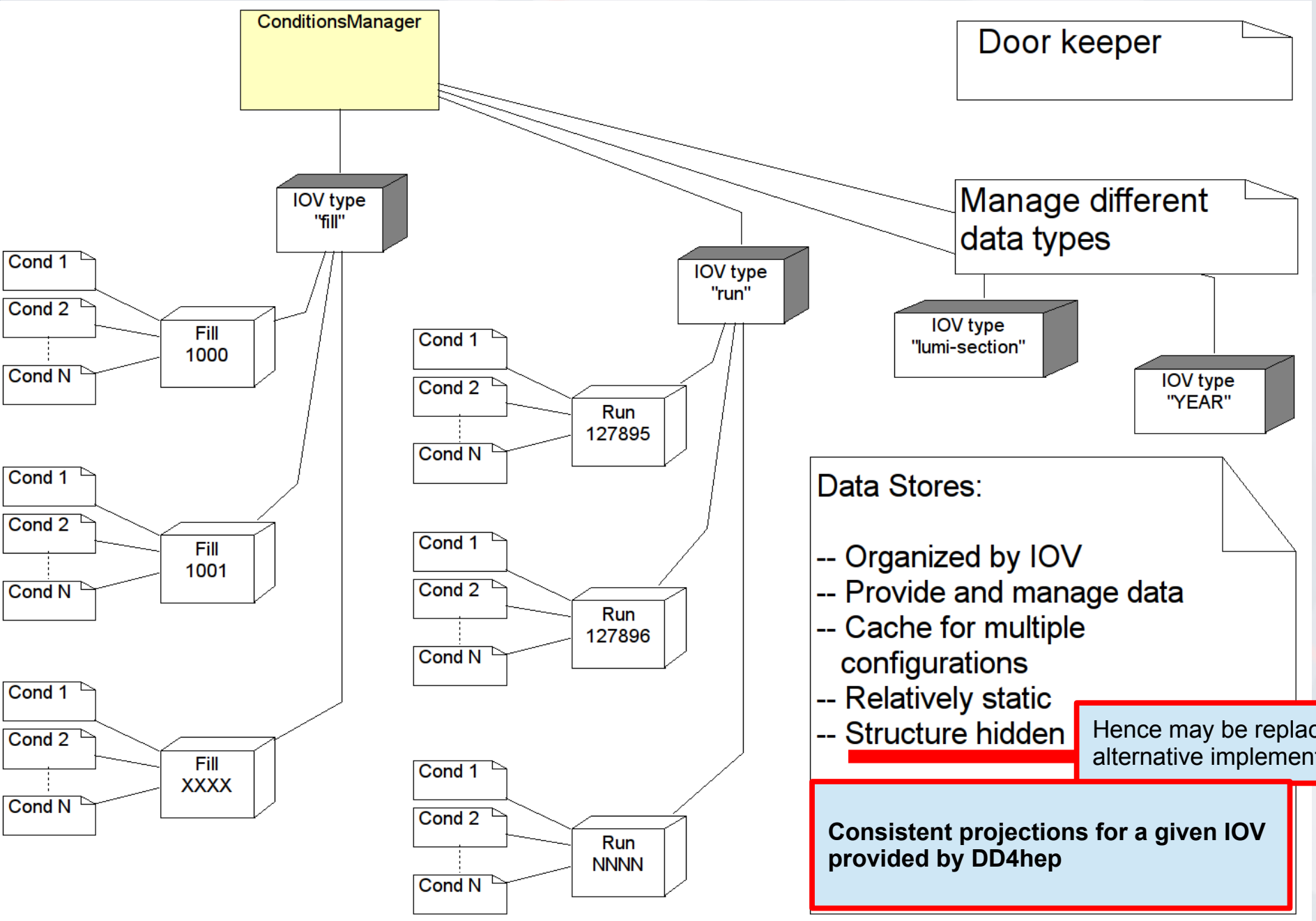
- Time dependent data necessary to process the detector response [of particle collisions]
- Provide access to a consistent set of values according to a given time
  - Data typically stored in a database
- Support multi-threading at it's best
  - Fully transparent processing, minimal barriers
  - Rely on some support from the experiment framework
- Derived conditions as a result of computation(s)
  - Other conditions data applied to a functional object

Basic Assumptions (Restrictions)

(when used by reasonable users)

- Conditions change slowly and in batches
  - e.g. every run O(1h), lumi section O(30 sec), etc.
  - Interval of validity is same for a group (needs discipline)
- Since conditions in existing pools still can be shared while preparing new IOV depending conditions
  - No locking strategy necessary
- Users use a coherent 'conditions slice' valid for a defined time interval (intersection)
  - Once created it is read-only: no locking necessary

DDCond: The Data Cache

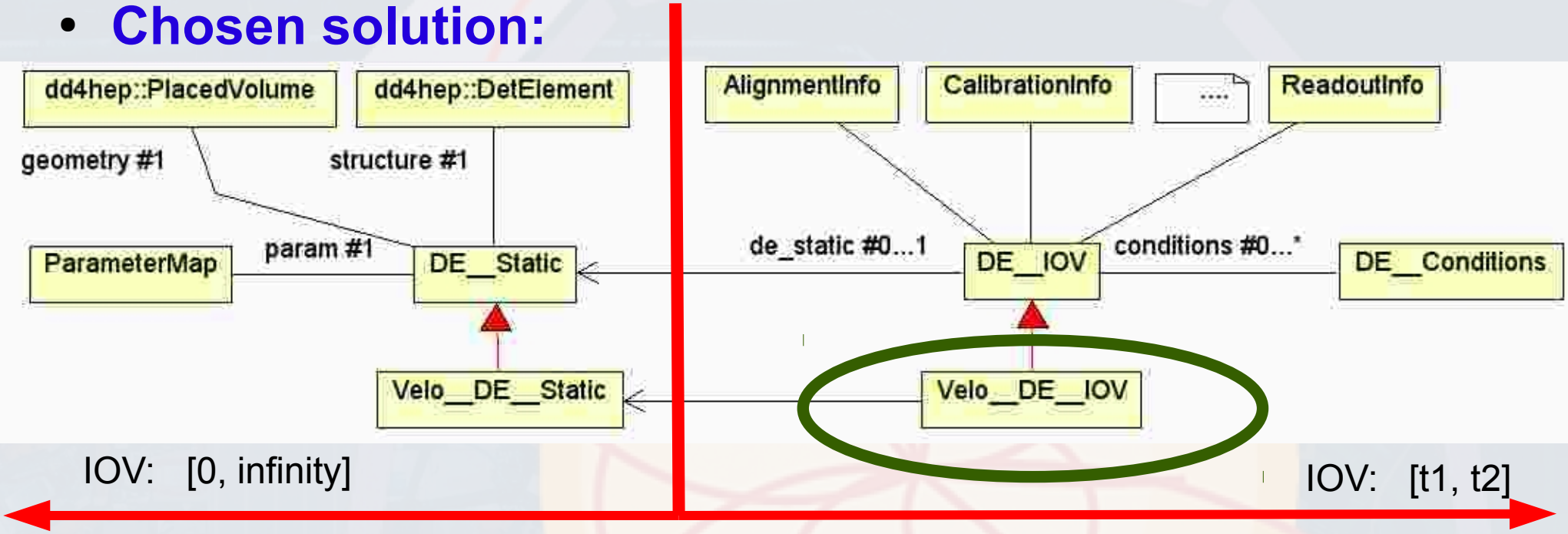


Real World Case: LHCb Velo Detector

- The work of the last year
- Separation between quasi-static and time dependent conditions is idealistic
  - In the real world a detector element used in reconstruction, HLT, etc has a lot of information
  - Static stuff (partially deduced from geometry etc)
  - IOV dependent stuff (possibly several IOVs) conditions, alignments, measurements, etc.
- Consequently aggregate by reference the required 'simple' conditions data to the desired object
- Create facade over this new 'dd4hep handle' to provide the desired functionality

Real World Case: LHCb Velo Detector

- **Chosen solution:**



- **IOV dependent projection is our new "detector element"**
  - **Facade provides functionality**
- ***Backwards* and *forward* compatible**
  - **Any number of facades possible on the same data**

Real World Case: LHCb Velo Detector

- Achieved a nearly 100 % backwards compatibility
- Support multi-threaded event processing without locking
  - Conditions are no longer updated

- Clarification:

  In GAUDI these detector elements and other conditions are accessed using ‘data handles’. This is the only connection to the Framework Extension WP

- Motivation and Goals
- New Developments
- Conditions and Alignment support
- **Miscellaneous**
- Summary

Toolkit Users

Increasing interest in the HEP community

- **ILC** F. Gaede et al.
- **CLICdp** A. Sailer et al.
- **SiD** D. Protopopescu et al.
- **FCC-eh** P. Kostka et al.
- **FCC-hh** A. Salzburger et al.
- **FCC-ee** O. Viazlo (CLD design), N. Alipour, G. Voutsinas
- **SCTF** Super-Tau-Charm Factory designs (Novosibirsk, Bejing)
- **EIC** Evaluation considered/started (W. Armstrong et al.)

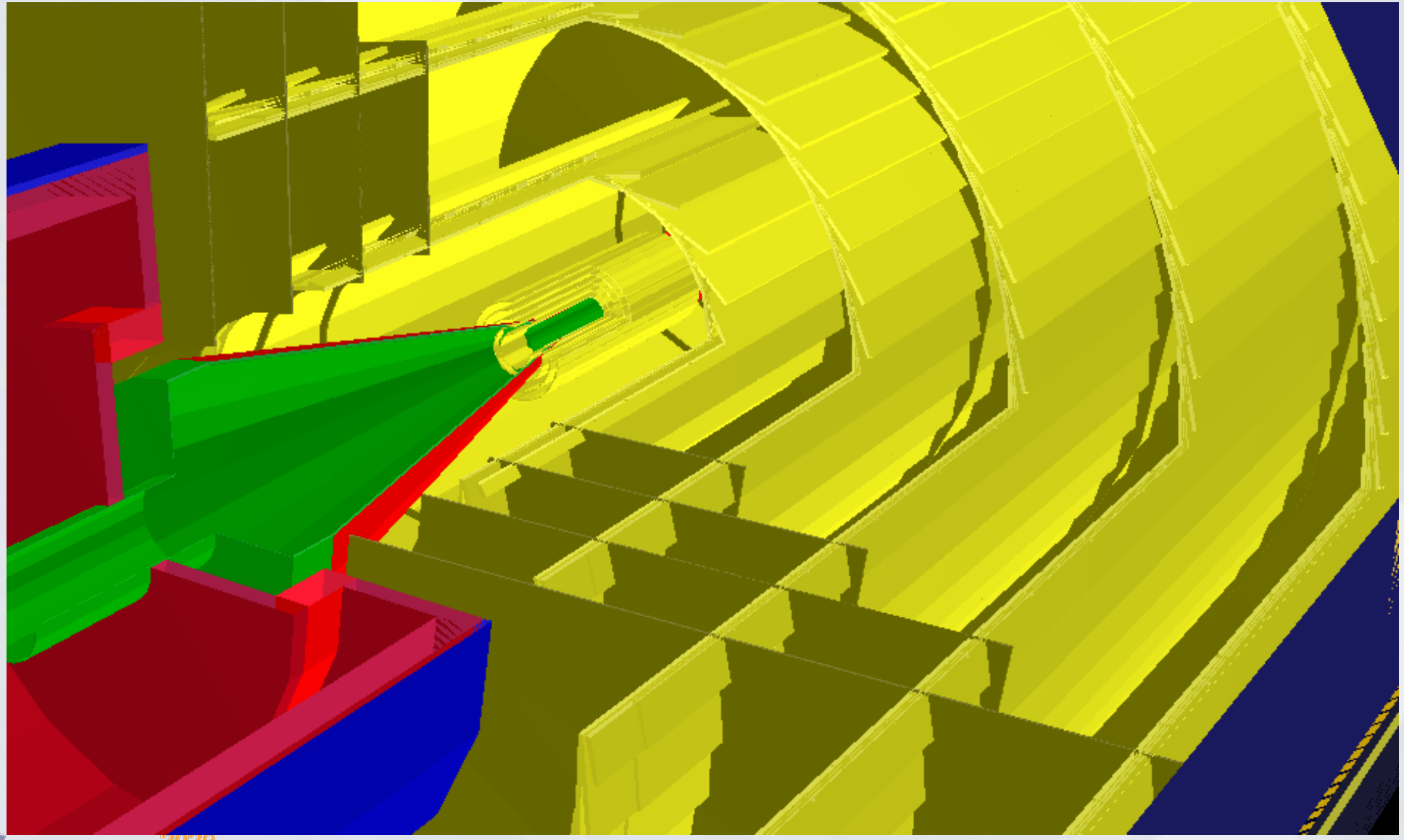
- **LHCb** LHCb Upgrade for Run III (B.Couturier et al.)
- **CMS** Evaluation for upgrade started (202x) (Y.Osborne et al.)
- **CALICE** Calorimeter R&D, started

- Motivation and Goals
- New Developments
- Conditions and Alignment support
- Miscellaneous
- **Summary**

Summary

- The DD4hep core was further consolidated and enhanced
  - Deployed by various customers
  - Support for optical surfaces ongoing
- High level conditions usage level was developed within the LHCb upgrade project
- CMS so far saw no show-stopper to use DD4hep for the upgrade
- New users were welcomed:
  SCTF groups from Novosibirsk and Bejing

Questions and Answers

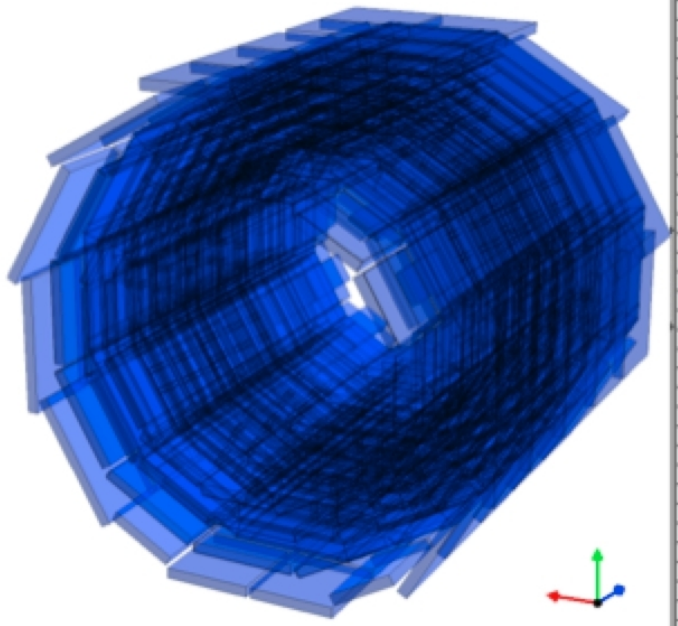


CMS Transition

Courtesy: Ianna Osborne / CMS

Full DT Geometry: DD4hep Source

The source for both Sim and Reco geometry



Name	Color	Opcty	RnrSelf	RnrChildren	Material
muonBase:MB_1 [33]		50	-	On	materials:M_B_Air
muonBase:MBWheel_2N_1 [302]		50	-	On	materials:M_B_Air
mbCommon:MBCablesBox_Int_1 [1]		50	-	-	materials:M_B_Air
mbCommon:MBCablesBox_Int_2 [1]		50	-	-	materials:M_B_Air
mbCommon:MBCablesBox_Int_3 [1]		50	-	-	materials:M_B_Air
mbCommon:MBCablesBox_Int_4 [1]		50	-	-	materials:M_B_Air
mbCommon:MBCablesBox_Int_5 [1]		50	-	-	materials:M_B_Air
mbCommon:MBCablesBox_Int_6 [1]		50	-	-	materials:M_B_Air
mbCommon:MBCablesBox_Int_7 [1]		50	-	-	materials:M_B_Air
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mbCommon:MBCablesBox_Int_9 [1]		50	-	-	materials:M_B_Air
mbCommon:MBCablesBox_Int_10 [1]		50	-	-	materials:M_B_Air
mbCommon:MBCablesBox_Int_11 [1]		50	-	-	materials:M_B_Air
mbCommon:MBCablesBox_Int_12 [1]		50	-	-	materials:M_B_Air
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mb1:MB1SuperLayerPhi_1 [23]		50	On	On	materials:Air
mb1:MB1SLPhiAlPlateOuter_1 [0]		50	On	On	materials:Aluminium
mb1:MB1SLPhiAlPlateOuter_2 [0]		50	On	On	materials:Aluminium
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mb1:MB1SLPhiAlPlateInner_3 [0]		50	On	On	materials:Aluminium
mb1:MB1SLPhiLayer_49Cells_1 [51]		50	On	On	materials:Aluminium
mb1:MB1SLPhiElectronics_49Cells_1 [0]		50	On	On	materials:M_Electronics a
mb1:MB1SLPhiElectronics_49Cells_2 [0]		50	On	On	materials:M_Electronics a
mbCommon:MBSLPhiGas_1 [0]		50	On	On	materials:M_DTBX Gas
mbCommon:MBSLPhiGas_2 [0]		50	On	On	materials:M_DTBX Gas
mbCommon:MBSLPhiGas_3 [0]		50	On	On	materials:M_DTBX Gas
mbCommon:MBSLPhiGas_4 [0]		50	On	On	materials:M_DTBX Gas
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mbCommon:MBSLPhiGas_6 [0]		50	On	On	materials:M_DTBX Gas
mbCommon:MBSLPhiGas_7 [0]		50	On	On	materials:M_DTBX Gas
mbCommon:MBSLPhiGas_8 [0]		50	On	On	materials:M_DTBX Gas
mbCommon:MBSLPhiGas_9 [0]		50	On	On	materials:M_DTBX Gas
mbCommon:MBSLPhiGas_10 [0]		50	On	On	materials:M_DTBX Gas
mbCommon:MBSLPhiGas_11 [0]		50	On	On	materials:M_DTBX Gas
mbCommon:MBSLPhiGas_12 [0]		50	On	On	materials:M_DTBX Gas
mbCommon:MBSLPhiGas_13 [0]		50	On	On	materials:M_DTBX Gas

Simulation Meeting, CMS Week
February, 5th, 2019

Ianna Osborne, FNAL

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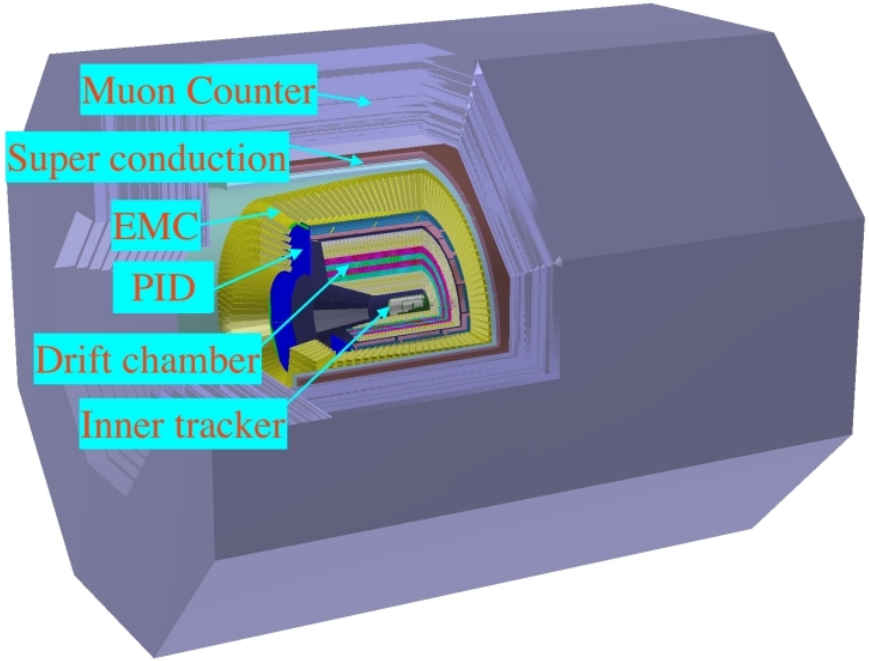
SCTF - Bejing

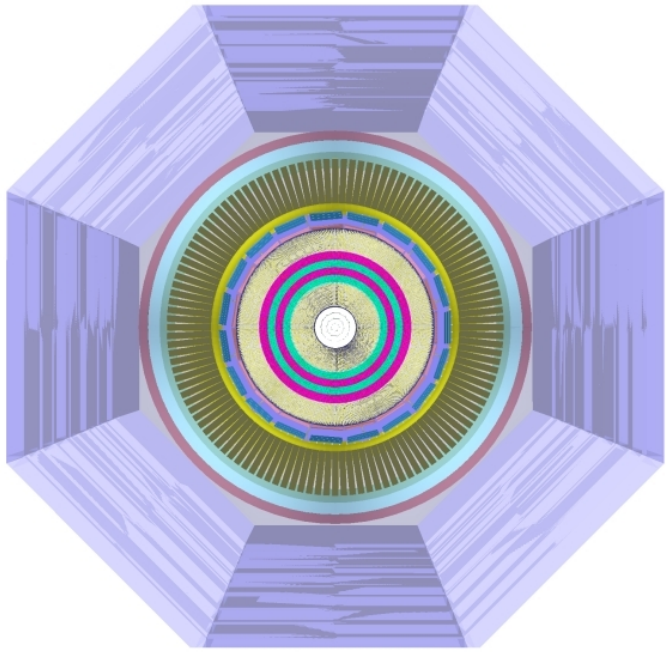
Xiaorong Zhou
State Key Laboratory of Particle Detection and Electronics
University of Science and Technology of China

Joint Workshop on Future Tau-Charm Factory
2018.12.4-2018.12-7, Paris

Progress on detector simulation

- STCF software team has been formed.
- OSCAR: Offline Software of Super Tau-Charm Facility.
- Detector geometry with DD4hep.





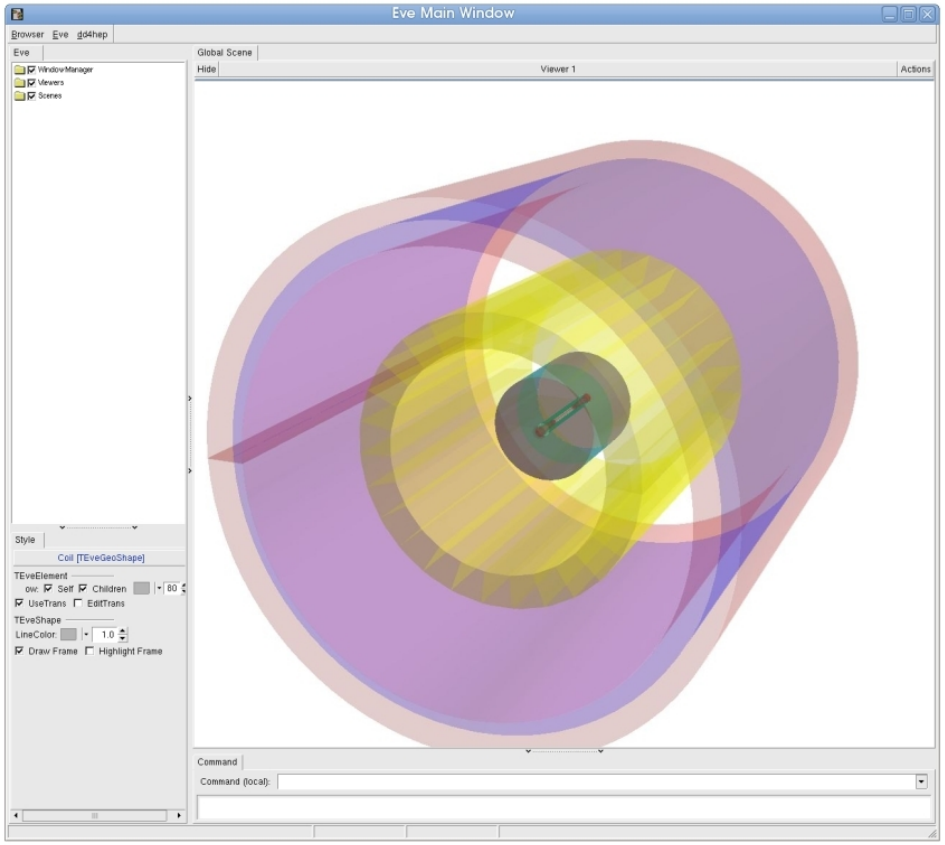
SCTF - Novosibirsk

A.Sukharev
Budker Institute of Nuclear Physics (BINP)

Joint Workshop on Future Tau-Charm Factory
2018.12.4-2018.12-7, Paris

Status of the software

Detector/Event Display

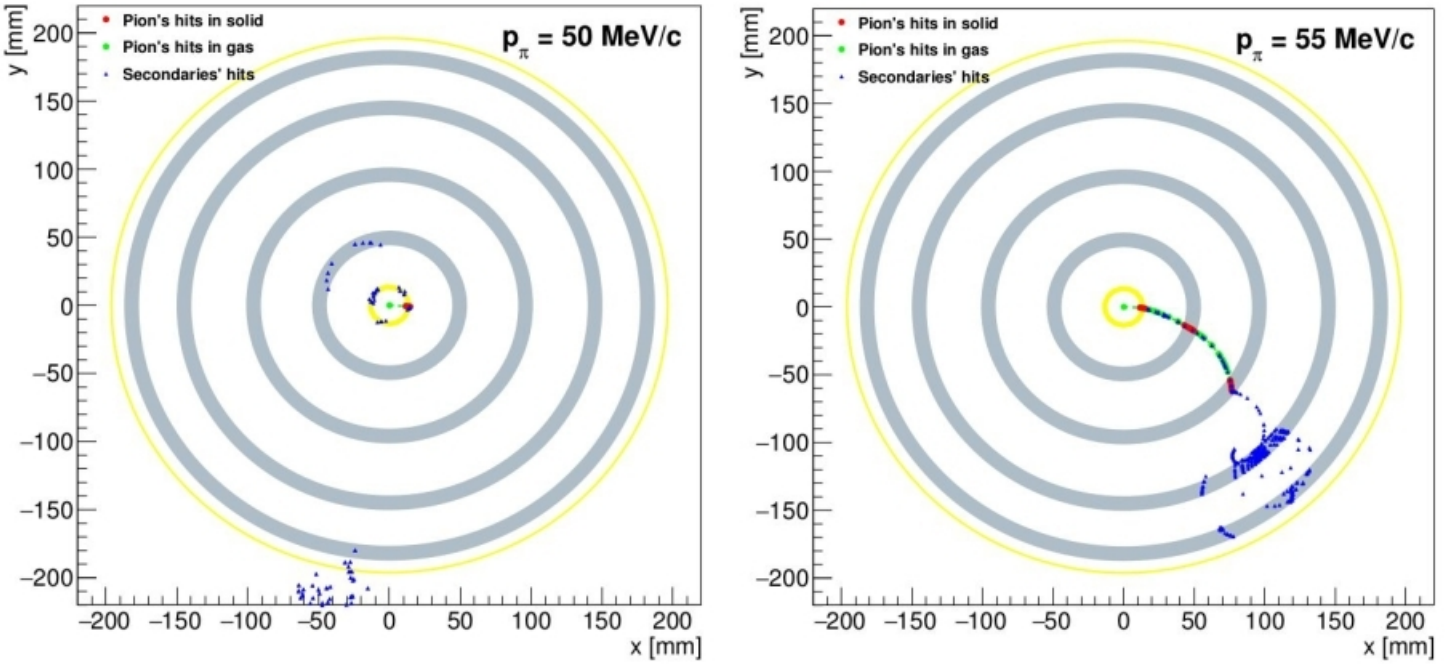


SCTF - Novosibirsk

L. Shekhtman, A. Sokolov, Vijayanand KV, T. Maltsev
Budker Institute of Nuclear Physics (BINP)

Joint Workshop on Future Tau-Charm Factory
2018.12.4-2018.12-7, Paris

Inner Tracker — DD4hep simulation — CGEM



- Pions with momenta less than 50 MeV/c do not pass through the beampipe
- Starting from p_π = 55 MeV/c two layers can be reached by pions

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Implementation: Geometry