Integration / Magnet / Material Budget
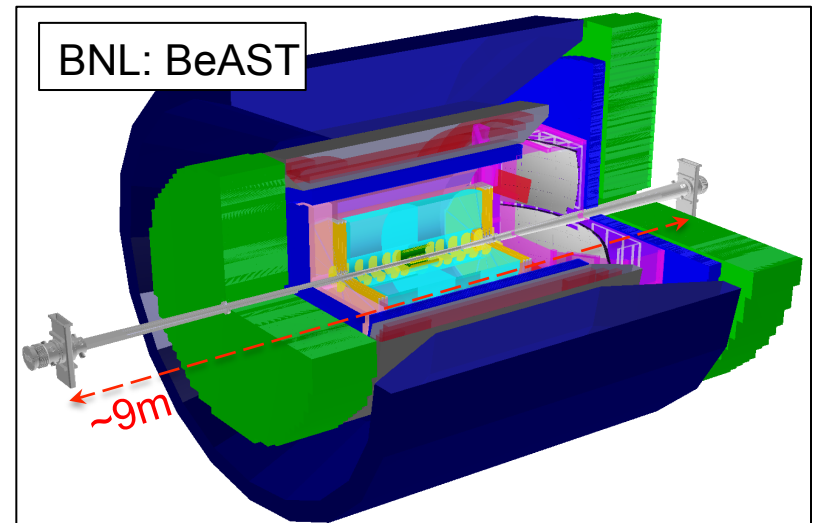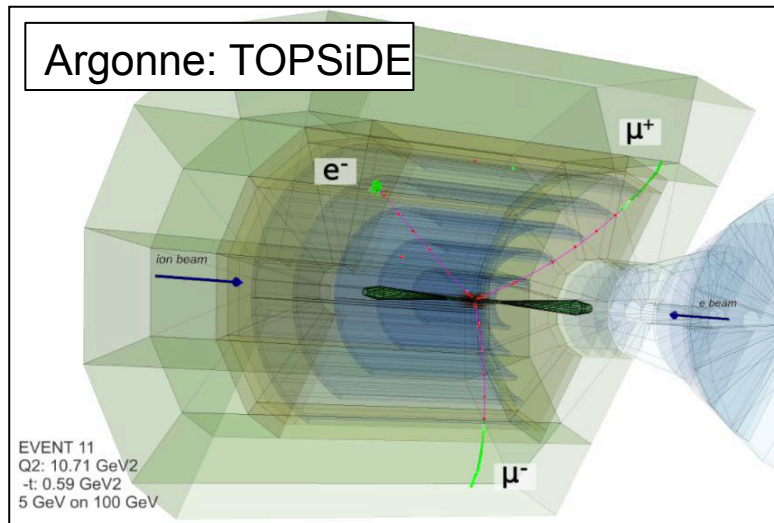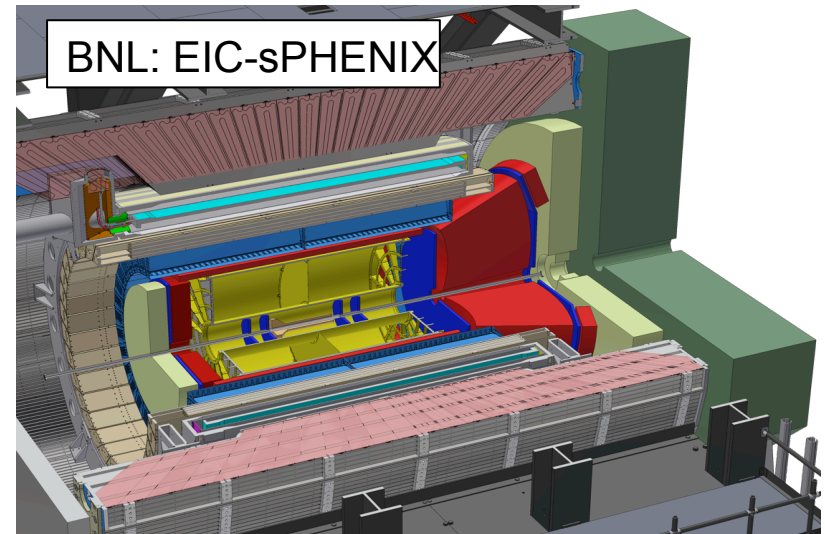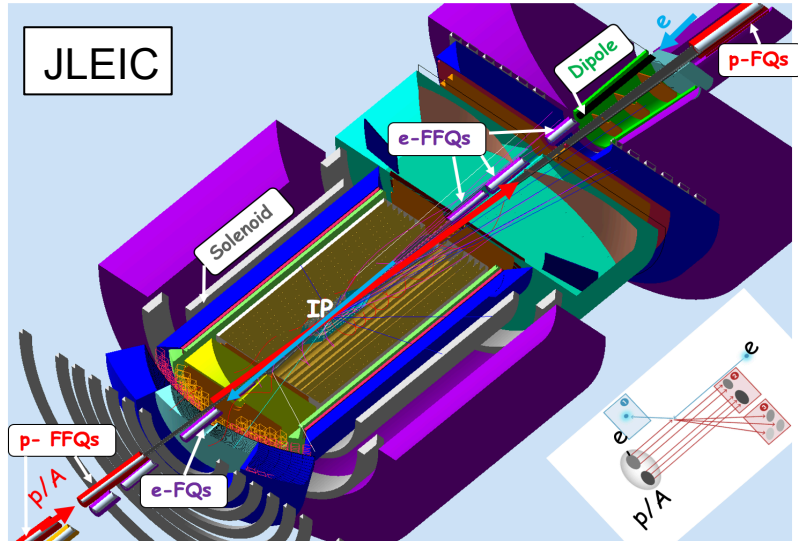
Session conveners: William Brooks and Alexander Kiselev

EICUG "Miami" Zoom Meeting   July 17 2020

Session outline

- AK: Central Detector integration topics + EicToyModel
- Yulia: Material budget + Far Forward detectors integration
- Renuka: Central Detector Solenoid design

- Discussion

EIC detector concepts

-> need to converge to a couple of well-defined configurations!

What goes into an EIC YR detector model?

- **The concept driven by a set of physics goals**

- **The boundary conditions**
  ‣ Accelerator-driven ones (available space, vacuum system, *other*)
  ‣ A particular solenoid model (geometry, field map & strength)

- **A particular set of ancillary detector models in the IR region**

- **Individual sub-detector studies in GEANT (and/or beam tests)**

- **A particular set of the central detector components (or placeholders)**
  ‣ Tracker, Calorimetry, PID: GEANT4 geometry and codes, test beam data
- **Fast smearing parameterizations** *for this particular model*
  ‣ eic-smear, *other*

- **...**

What goes into an EIC YR detector model?

- …

- **Physics studies *for this particular model***
  ‣ using fast smearing tools (most likely)
  ‣ using full GEANT simulations (less likely, but we will see)

- **Other ingredients**
  ‣ DAQ concept, dead material description, …

- **A *matching* engineering model (to some level of detail)**

  -> apparently all these ingredients & efforts better be in sync

Integration WG meetings: joint discussions

- **PID & Tracking WGs**
  - ‣ What are the PID detector requirements for tracking?
  - ‣ How should they be formulated (together?) in the fast smearing tools?
  - ‣ https://indico.bnl.gov/event/8520/

- **PID & Calorimetry WGs**
  - ‣ Electron ID: how PID detectors can complement Calorimetry below 4 GeV/c?
  - ‣ How PID detector material affects EmCal energy resolution?
  - ‣ https://indico.bnl.gov/event/8896/

  + a complementary effort in the Complementarity WG

Integration WG meetings: topical discussions

- **Crossing angle:**   **-> all this is still in a wish list phase**
  - Kinematics
  - High $|\eta|$ acceptance asymmetry of the solenoid field
  - Fiducial volume cut close to the beam pipe

- **Time of Flight:**
  - t_0 counter needed?
  - *Combined* ToF detectors preferred (LGAD tracker, LAPPD mRICH, …)?
  - Finite bunch length effects: are they different at $\eta \sim 0$ and for the RPs?

- **Detector projectivity of a 4π collider experiment**
  - Detector performance (mRICH, …)
  - Construction limitations (calorimetry, …)
  - Space limitations if "flat" and projective equipment is mixed in the endcaps
  - What about ~4m long DIRC bars?

The actual topics and *priorities* should better be defined by the community!

How to connect some of the other "dots"?

- Despite a tremendous amount of work done within the WGs …
- … one can easily identify a number of places with a lack of sync

|	
escalate & fun4all; migration process	Physics simulations & engineering design
Tracker, PID & Calorimetry detectors in GEANT	Ideal detectors & services / support
1-st & 2-d IR	$|\eta|$<4.5 & reality
EIC detector & greenfield solenoid design	Space available for detectors & IR vacuum chamber

-> establishing a unified "environment backbone" must be important

EIC Toy Model

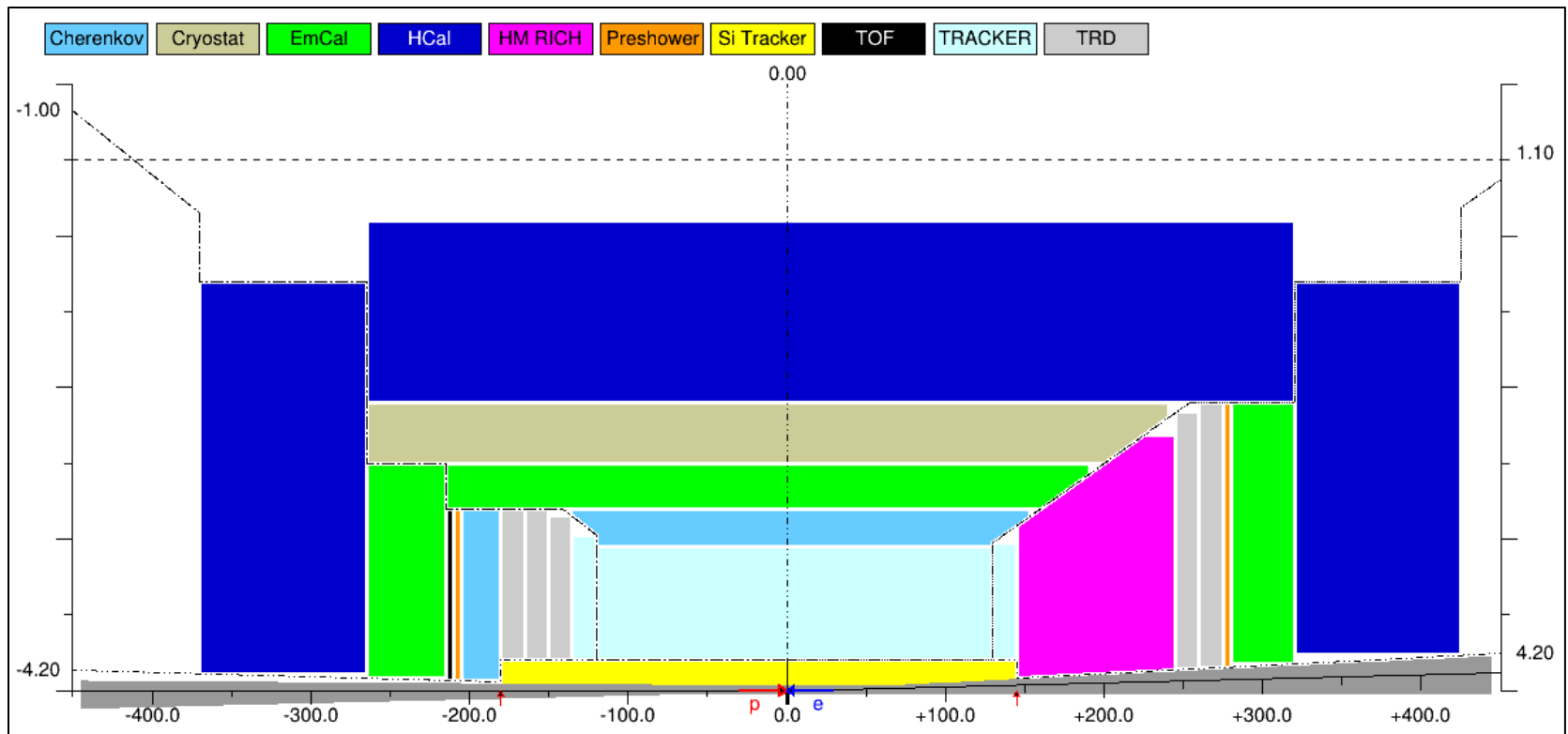- A tool to model & generate EIC Central Detector "templates"
- https://github.com/eic/EicToyModel/
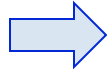
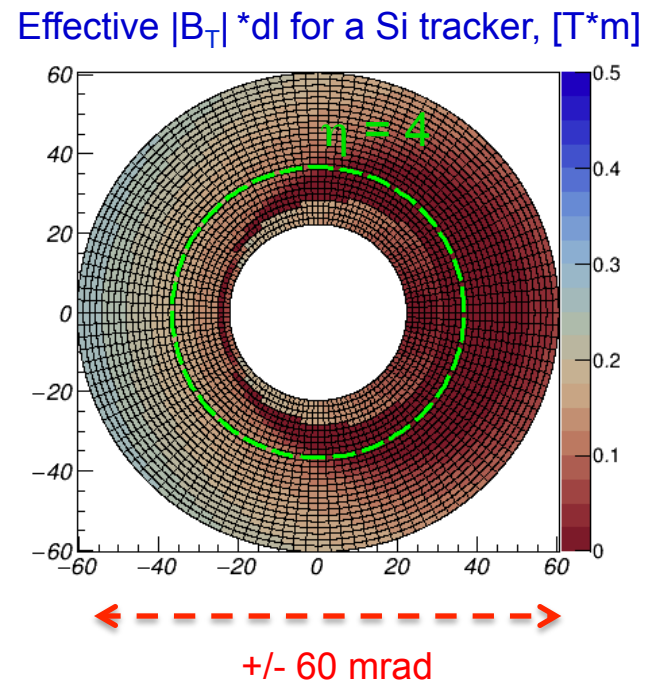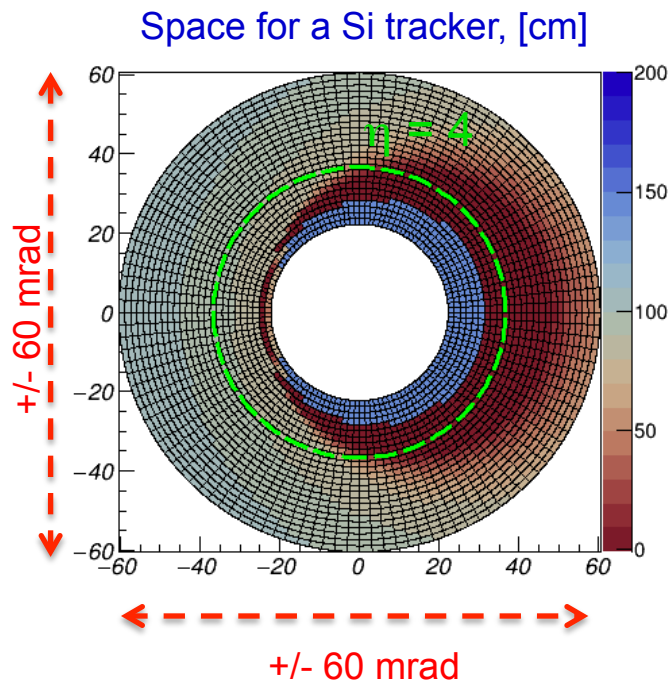**Create a model** ➡ **Save it as a .root file** ➡ **Import in GEANT**

- GEANT application: import .root file and **create volumes on the fly**
- Engineering effort: use the same CAD model exported as a STEP file

A couple of valid questions to this cartoon

- If nominal IP stays at 0.0, is 1.0 m space for the RICH really ok?
- If solenoid axis is aligned with the electron beam line, is the high $|\eta|$ azimuthal asymmetry in the **hadron endcap** acceptable?

$\lvert\eta\rvert$ = 3.00	$\lvert\eta\rvert$ = 3.50	$\lvert\eta\rvert$ = 4.00	$\lvert\eta\rvert$ ~ 4.38	$\lvert\eta\rvert$ = 4.50
~99.5 mrad	~60.4 mrad	~36.6 mrad	25.0 mrad	~22.2 mrad

Space for a Si tracker, [cm]

Effective $|B_T|$ *dl for a Si tracker, [T*m]


+/- 60 mrad

+/- 60 mrad

+/- 60 mrad

10

EIC Toy Model: quick start

- Minimal overhead to create and modify a 2D cartoon (ROOT scripting)
- If your system has *git*, a *C++ compiler*, a modern *cmake, X11* and a *working ROOT installation*, grab the following lines and execute them in a terminal:

```
# Make sure thisroot.(c)sh was sourced!
git clone https://github.com/eic/EicToyModel.git
cd EicToyModel && mkdir build && cd build
# You may also need to replace 17 by 11 in the below line
cmake -Wno-dev -DCMAKE_CXX_STANDARD=17 ..
make -j2
root -l ../scripts/EIC-IR1-XX-v00.C
```
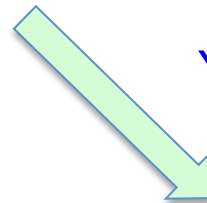
- Chances are you will see a TCanvas similar to the one on the previous slide

NO   YES
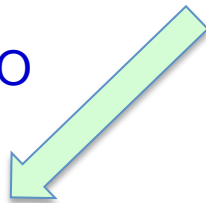
Help the EIC software environment - send us your bug report

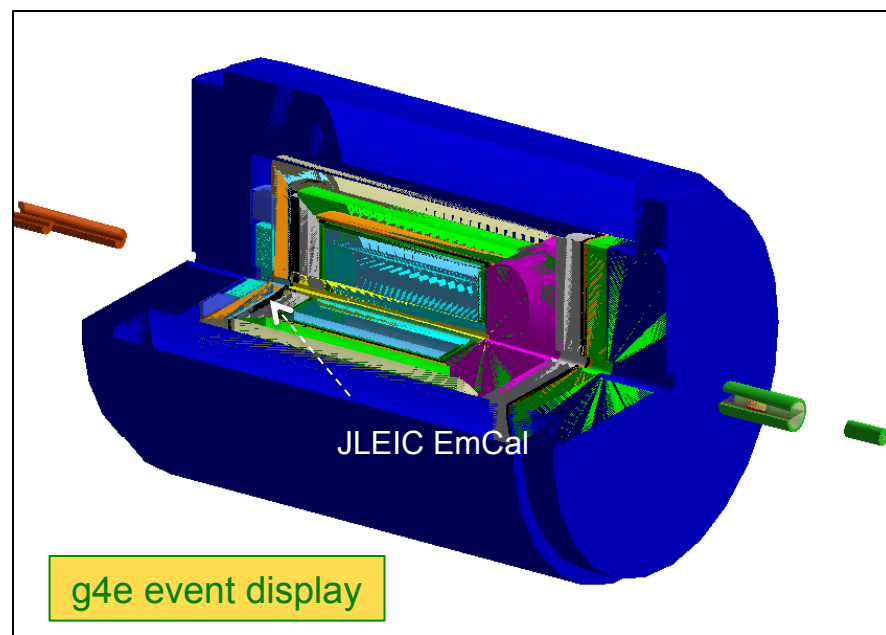**Edit EIC-IR1-XX-v00.C according to your preferences, re-run, tune the configuration, see next slide**
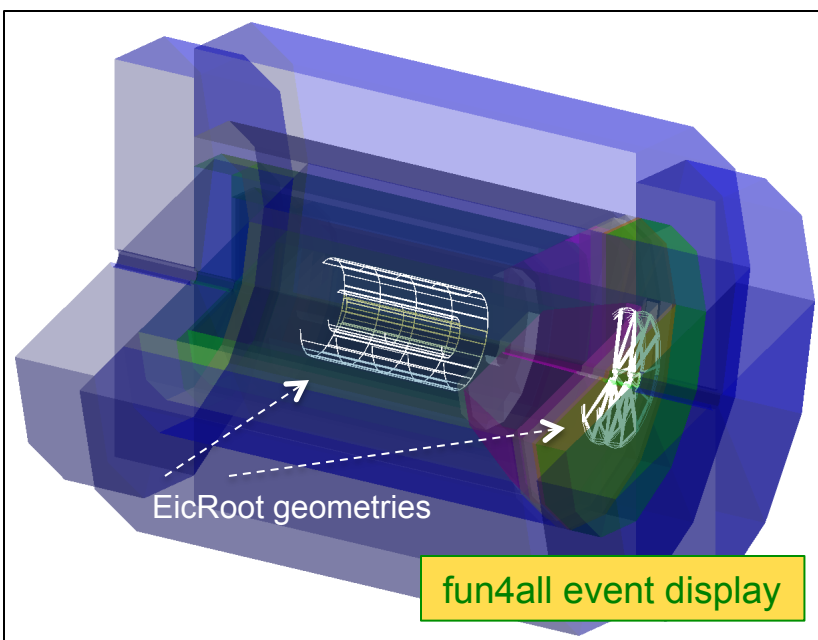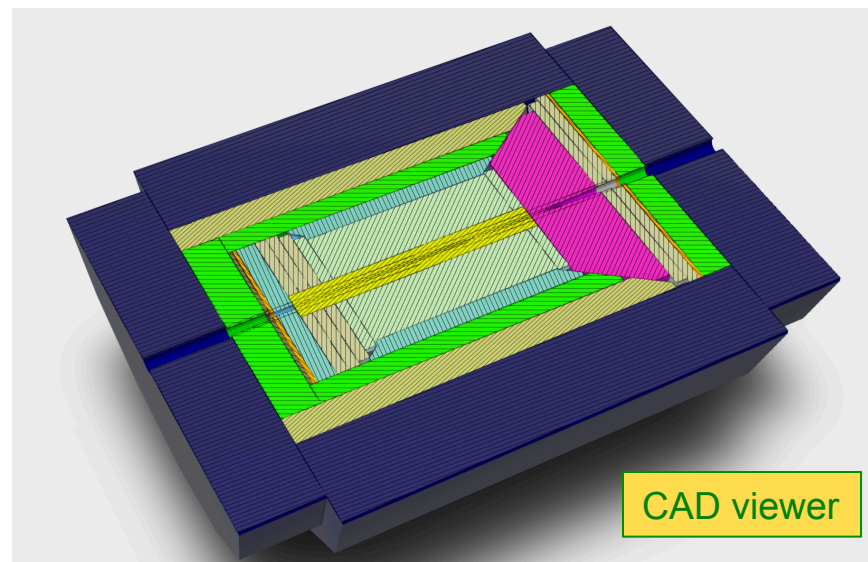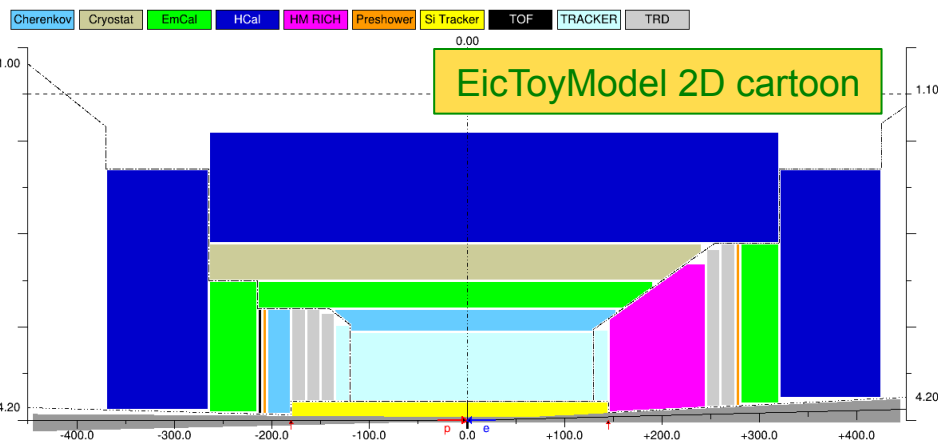
EIC Toy Model: quick finish

-> can we find a few dozens of volunteers, willing to participate in the decision on the YR EIC detector configuration(s):
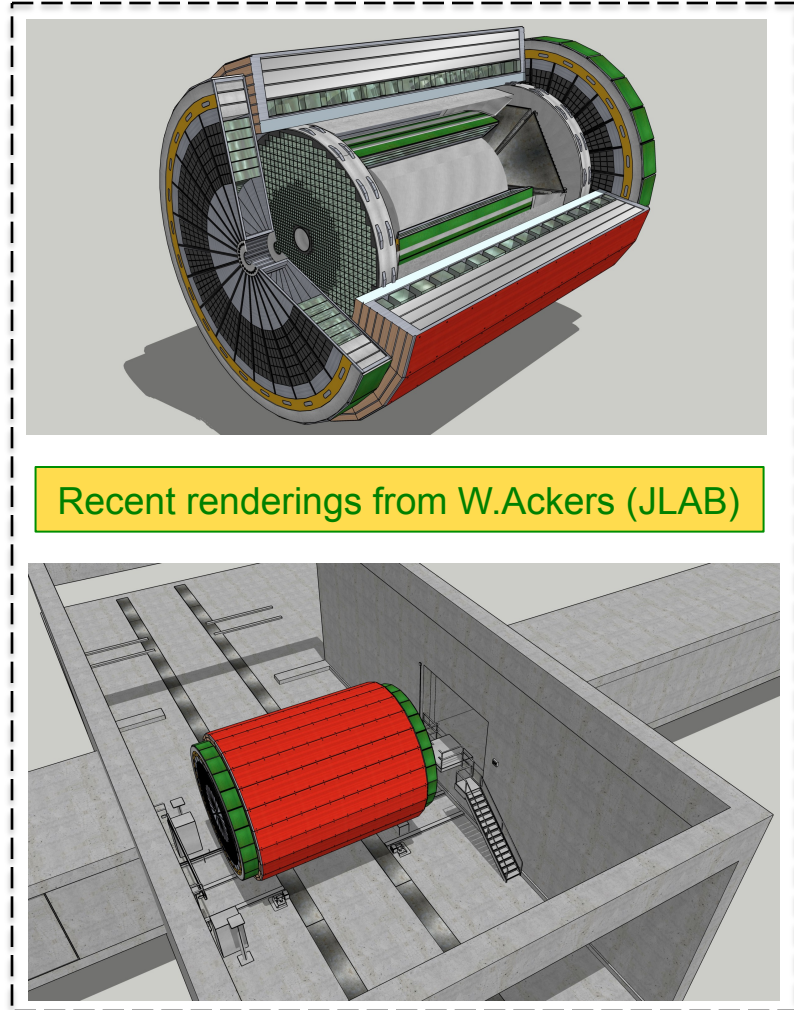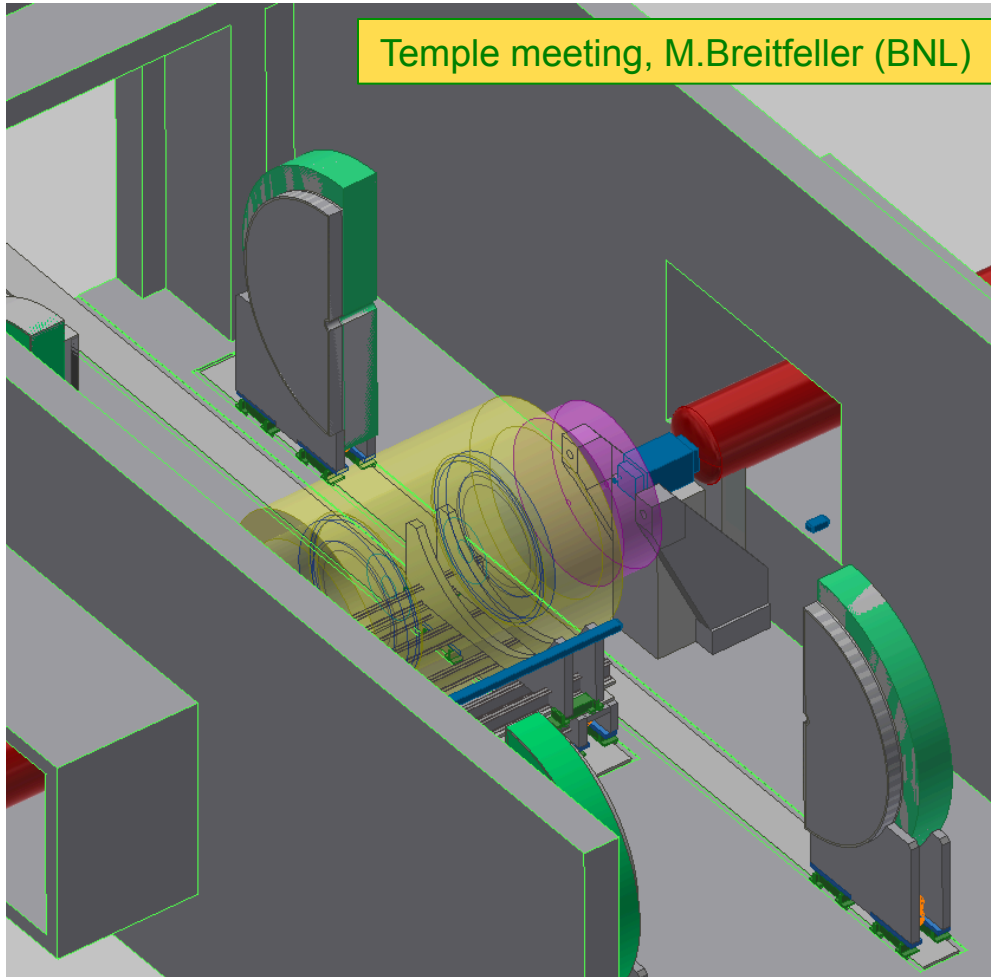
- Try the five lines from the previous slide out, while this boring talk goes on

- Play around with the vertex / barrel / endcap composition (make sure you understand the boundary conditions; ask if not sure)

- Send your configurations (.root + .png) to the YR conveners

- We digest the proposals, make yet another round through the WGs, and say by August,1 we *fix* a couple of configurations for the YR purposes

EIC Central Detector partitioning

- The same model in all cases

| Cherenkov | Cryostat | EmCal | HCal | HM RICH | Preshower | Si Tracker | TOF | TRACKER | TRD |

EicToyModel 2D cartoon

CAD viewer

EicRoot geometries

fun4all event display

JLEIC EmCal

g4e event display

Engineering effort: from Temple to Berkeley

Temple meeting, M.Breitfeller (BNL)

Recent renderings from W.Ackers (JLAB)

These renderings will be in sync with the 2D cartoons and the GEANT detector shown on the previous slide