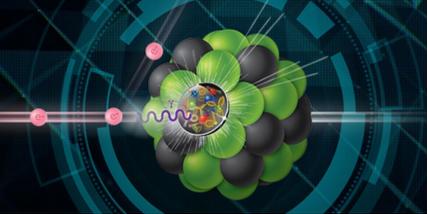




Giornata Nazionale EIC\_NET  
Catania, 30/6-1/7/2022

# Toward Detector 1 (also with EIC\_NET perspectives)

S. Dalla Torre



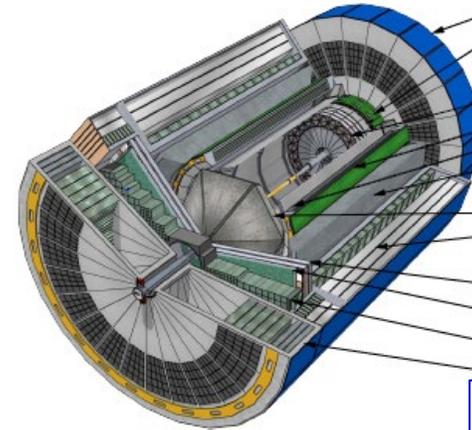
# Toward Detector 1

(also with EIC\_NET perspectives)

- The context
- The formation of the NEW collaboration
- The ongoing activity for the detector design
- Summarizing

# HISTORICAL RECAP

The **Yellow Report** and its reference detector



2020

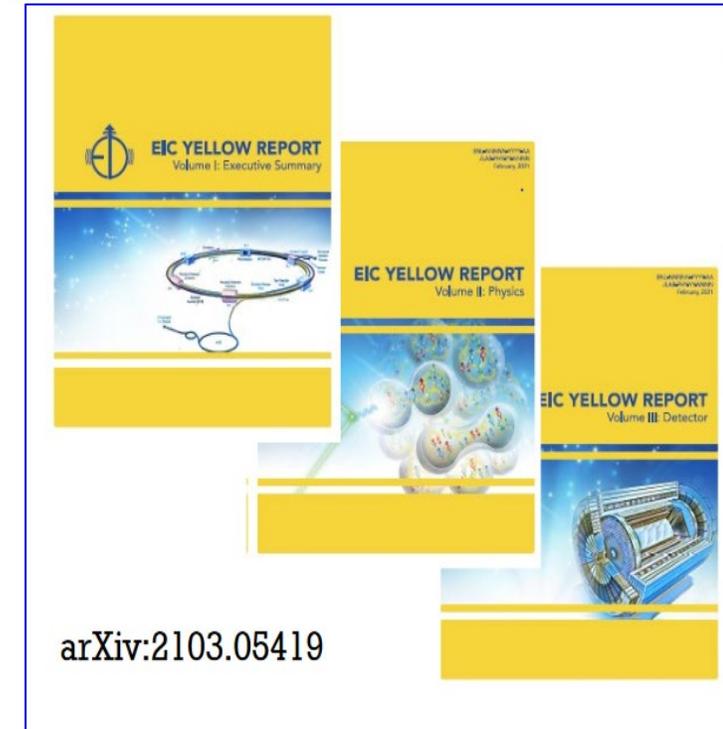
➤ A global effort of the EIC-User Group

## INFN in the YR effort

- **Physics Group**
  - **1 sub-convener:** Barbara Pasquini (Pavia)
- **Detector Group**
  - **1 convener:** Silvia Dalla Torre (Trieste)
  - **2 sub-conveners:** Andrea Celentano (Genova), Domenico Elia (Bari)
- **SOFTWARE Group** (support for PWG & DWG)
  - **1 convener:** Andrea Bressan (Trieste)

& a number of contributors active in the different subgroups

In total: **57** (/414) **entries in the Author List** (14 %)



# HISTORICAL RECAP

2020

## Expressions of interest

- Call May-November 2020 ( <https://www.bnl.gov/eic/EOI.php> )

## INFN & EIC:

- A single Expression of Interest INFN (EOI INFN)
  - 4 sectors: **PID, Vertexing, Streaming Read-out, Software and Simulations**
  - First indication (non-binding) of INFN contribution to EIC
  - First (preliminary) projection of INFN timelines in terms of workforce and finances

## INFN EOI includes

- the **proposal**, 15 p (max allowed)
- 3 appendices:
  - About INFN
  - INFN groups and Physics at the EIC
  - The INFN theoretical contribution to the EIC physics program

Expression of interest of the INFN community for the Electron Ion Collider

## Expression of Interest (EOI) Questionnaire

# HISTORICAL RECAP

## Call for Proposals (2021: 6 May- 1 Dec)

### Response to the call for Detector Proposals:

#### **ATHENA** (<https://sites.temple.edu/eicatip6/>)

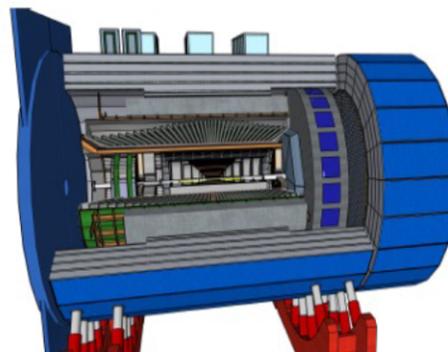
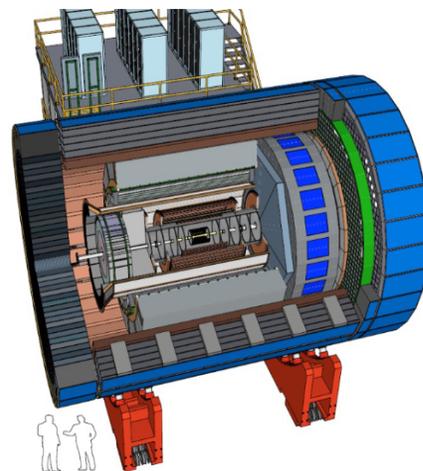
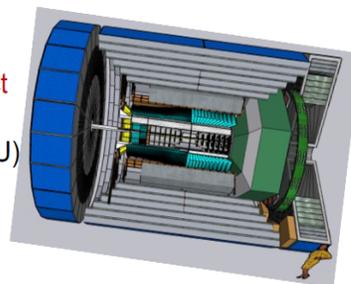
- Focus on becoming the “**project detector**”@IP6
- **New 3 T magnet** and the YR Reference Detector
- Leadership: S. Dalla Torre (INFN Trieste), B. Surrow (Temple)
- ~117 collaborating institutions from Armenia, Canada, China, Czech, France, Germany, Italy, India, Poland, Romania, UK

#### **CORE** (<https://eic.jlab.org/core/>)

- An EIC Detector proposal based on a **new 3 T compact magnet** for the **2<sup>nd</sup> EIC detector @ IP8**
- Contacts: Ch. Hyde (ODU) and P. Nadel-Turonski (SBU)
- Smaller-scale effort, ~20-30 active collaborators

#### **ECCE** (<https://www.ecce-eic.org>)

- **Project detector @IP6 or the 2<sup>nd</sup> EIC detector @ IP8** using existing 1.5T “Babar” solenoid
- Leadership: O. Hen (MIT), T. Horn (CUA), J. Lajoie (Iowa State)
- ~98 collaborating institutions from Armenia, Canada, Chile, China, Croatia, Czech, France, Germany, Israel, Japan, Senegal, Korea, Russia, Slovenia, Taiwan, UK



## Call for Collaboration Proposals for Detectors at the Electron-Ion Collider

Brookhaven National Laboratory (BNL) and the Thomas Jefferson National Accelerator Facility (JLab) are pleased to announce the Call for Collaboration Proposals for Detectors to be located at the Electron-Ion Collider (EIC). The EIC will have the capacity to host two interaction regions, each with a corresponding detector. It is expected that each of these two detectors would be represented by a Collaboration.

**Detector 1** is within the scope of the EIC project and should be based on the “reference” detector described by the EIC User Group (EICUG) in the Yellow Report (YR) and included in the EIC Conceptual Design Report (CDR). This detector must satisfy the requirements of the EIC “mission need” statement based on the EIC community White Paper and the National Academies of Science (NAS) 2018 report. US Federal funds are expected to support most but not all of the acquisition of Detector 1. It is currently planned to be located at Interaction Point 6 (IP6) on the Relativistic Heavy-Ion Collider.

**Detector 2** could be a complementary detector that may focus on optimizing particular science topics or address science topics beyond those described in the White Paper and the National Academies of Science (NAS) 2018 report. Detector 2 would reside at a different Interaction Point from Detector 1 and is currently not within the EIC project scope. Routes to make Detector 2 and a second interaction region possible are being explored.

Collaboration proposals made in response to this call could relate to either Detector 1 or Detector 2. Proposals should consider the siting scenario for the detectors described in the CDR. Other options are welcome but proposals that deviate from the CDR will need to address the implications to the EIC project. For reference, proposals should utilize information in the CDR, EICUG YR, and the posted Expressions of Interest as background information. References are listed below.

The separate guidance for each detector is as follows:

- **Detector 1 Collaboration Proposals:** Experiments must address the EIC White Paper and NAS Report science case. The collaboration should propose a system that meets the performance requirements described in the EIC CDR and EICUG YR. The design should be compatible with that of the accelerator and interaction region layout of the CDR. Completion of detector construction must be achieved by Critical Decision (CD)-4A, the start of EIC accelerator operations.

# HISTORICAL RECAP

## Call for Proposals (2021: 6 May- 1 Dec)

### Response to the call for Detector Proposals:

#### **ATHENA** (<https://sites.temple.edu/eicatip6/>)

- Focus on becoming the **“project detector”@IP6**
- **New 3 T magnet** and the YR Reference Detector
- Leadership: S. Dalla Torre (INFN Trieste), B. Surrow (Temple)
- ~117 collaborating institutions from Armenia, Canada, China, Czech, France, Germany, Italy, India, Poland, Romania, UK

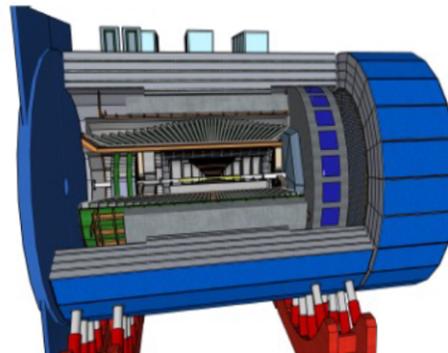
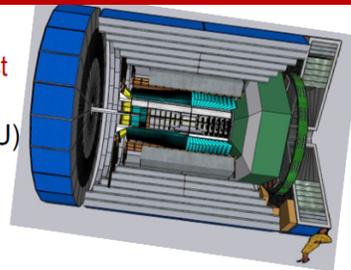
EIC\_NET compactly  
at work within ATHENA

#### **CORE** (<https://eic.jlab.org/core/>)

- An EIC Detector proposal based on a **new 3 T compact magnet** for the **2<sup>nd</sup> EIC detector @ IP8**
- Contacts: Ch. Hyde (ODU) and P. Nadel-Turonski (SBU)
- Smaller-scale effort, ~20-30 active collaborators

#### **ECCE** (<https://www.ecce-eic.org>)

- **Project detector @IP6 or the 2<sup>nd</sup> EIC detector @ IP8** using existing 1.5T “Babar” solenoid
- Leadership: O. Hen (MIT), T. Horn (CUA), J. Lajoie (Iowa State)
- ~98 collaborating institutions from Armenia, Canada, Chile, China, Croatia, Czech, France, Germany, Israel, Japan, Senegal, Korea, Russia, Slovenia, Taiwan, UK



## Call for Collaboration Proposals for Detectors at the Electron-Ion Collider

Brookhaven National Laboratory (BNL) and the Thomas Jefferson National Accelerator Facility (JLab) are pleased to announce the Call for Collaboration Proposals for Detectors to be located at the Electron-Ion Collider (EIC). The EIC will have the capacity to host two interaction regions, each with a corresponding detector. It is expected that each of these two detectors would be represented by a Collaboration.

**Detector 1** is within the scope of the EIC project and should be based on the “reference” detector described by the EIC User Group (EICUG) in the Yellow Report (YR) and included in the EIC Conceptual Design Report (CDR). This detector must satisfy the requirements of the EIC “mission need” statement based on the EIC community White Paper and the National Academies of Science (NAS) 2018 report. US Federal funds are expected to support most but not all of the acquisition of Detector 1. It is currently planned to be located at Interaction Point 6 (IP6) on the Relativistic Heavy-Ion Collider.

**Detector 2** could be a complementary detector that may focus on optimizing particular science topics or address science topics beyond those described in the White Paper and the National Academies of Science (NAS) 2018 report. Detector 2 would reside at a different Interaction Point from Detector 1 and is currently not within the EIC project scope. Routes to make Detector 2 and a second interaction region possible are being explored.

Collaboration proposals made in response to this call could relate to either Detector 1 or Detector 2. Proposals should consider the siting scenario for the detectors described in the CDR. Other options are welcome but proposals that deviate from the CDR will need to address the implications to the EIC project. For reference, proposals should utilize information in the CDR, EICUG YR, and the posted Expressions of Interest as background information. References are listed below.

The separate guidance for each detector is as follows:

- **Detector 1 Collaboration Proposals:** Experiments must address the EIC White Paper and NAS Report science case. The collaboration should propose a system that meets the performance requirements described in the EIC CDR and EICUG YR. The design should be compatible with that of the accelerator and interaction region layout of the CDR. Completion of detector construction must be achieved by Critical Decision (CD)-4A, the start of EIC accelerator operations.

# HIGHLIGHTS of the ATHENA PROPOSAL

## *A personal analysis*

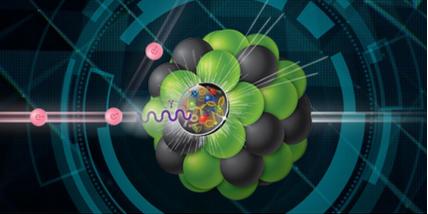
- Making use of the whole space available in IP6
- The large field, large bores solenoid: high B, light-weighted, space for future upgrades
- Accurate, realistic and advanced design of the tracking (fully aligned with Silicon C.)
- A true effort for a realist integration of the dRICH
- A new, simplified concept for the backward RICH
- The innovate concept for the hybrid (=imaging + sampling) barrel ECal
- The modern structure and tools for the software approach



# Report from the Detector Proposal Advisory Panel

Abhay Deshpande, 6/20/2022

- All three proposals received high marks
- Concluded that both ATHENA and ECCE satisfied the requirements
- Recommended **ECCE proposal as the reference detector: lower risk and cost**
  - Many collaborators are involved in multiple proposals and none of the proto-collaborations strong enough to build the project detector
  - Strongly encouraged the three proto-collaborations to merge and build the project detector starting from ECCE's reference design
- Expects the integration of new collaborators and new experimental concepts & technologies to improve physics capabilities & realize the EIC project detector
- Enthusiastically supported a **second detector**
  - EIC User Community should support of the project detector & **a second detector**



# Toward Detector 1

(also with EIC\_NET perspectives)

- The context
- The formation of the NEW collaboration
- The ongoing activity for the detector design
- Summarizing

# TOWARDS DETECTOR1

ECCE and ATHENA came together to charter the path towards DETECTOR-1

This includes:

- The formation of a NEW scientific Collaboration
- Progressing towards the technical design of the Project Detector (provisionally called DETECTOR-1)

In the following, we will analyze both aspects, separately

## **IMPORTANT NOTE**

- *Collaborators having as background the two different proposal (as well as novel collaborators) have the same relevance and dignity, as well their technology proposals → different comments sometimes heard are wrong, a part being also stupid*

# FORMATION OF A NEW COLLABORATION

- *So far, the project has asked the representatives of ATHENA and ECCE, to guide both the collaboration formation and the initial activity towards the detector technical design*

→ *pro-tempore Steering Committee (SC):*

*Silvia Dalla Torre, Or Hen, Tanja Horn, John Lajoie, Bernd Suro*

*From the ATHENA side:*

- *SDT&BS participation to the DETECTOR-1 effort endorsed by the ATHENA IB on 17/3/2022*

# FORMATION OF A NEW COLLABORATION



## Vision of Collaboration Forming Process

17

- Vision for a collaboration forming process:
  - Institutional Survey: Next slide!
  - Formation of a ~~prelim. IB~~ (inst. representatives)
  - Nomination & Formation of Bylaws/Charter Committee
  - Formulation & Adoption of Bylaws/Charter
  - Nomination & Election Process of Detector 1 Leadership

Elected  
at the  
same  
time!

- Finalization of IB and Election of IB Chair
- Election of Spokesperson(s)

EIC Detector 1 Institutional Survey, Eo

Timescale:

Done

ASAP

Now -> JULY

EICUG Meeting Discussion (approval following mtg)

Set by adoption of bylaws – perhaps Sept/Oct?

NOW

End JULY

End AUG

End SEP /15 Oct

TIMELINES

# INSTITUTIONAL SURVEY

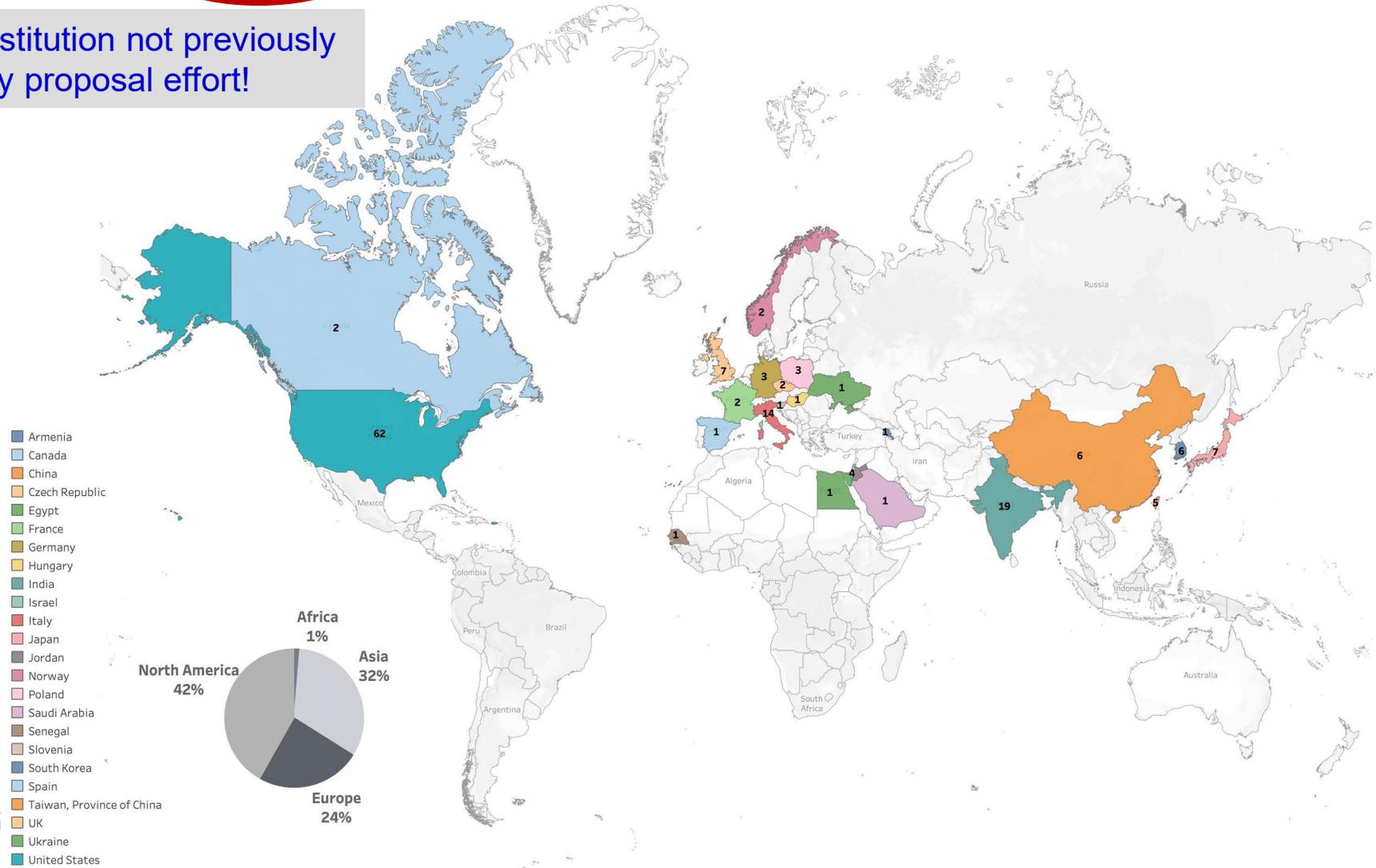
## Detector-1 - A global pursuit for a new EIC experiment at IP6 at BNL

**Detector-1 Institutions**  
153

Detector-1 Countries  
24

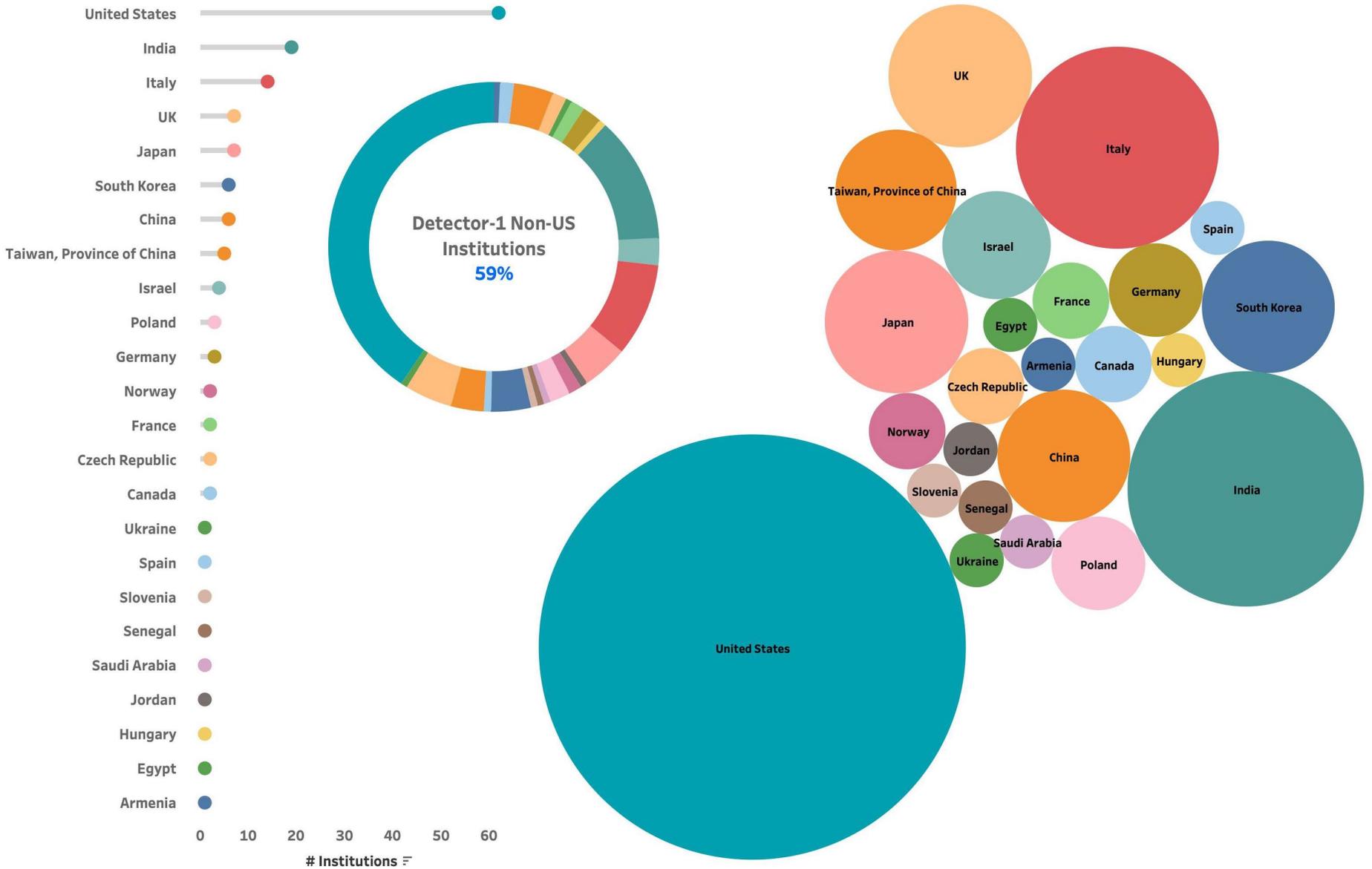
Detector-1 World Region  
4

17 Institution not previously in any proposal effort!



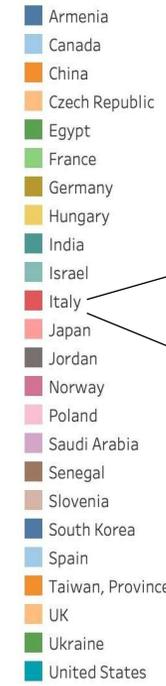
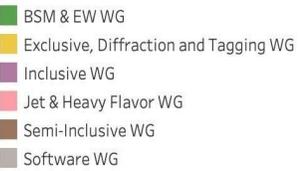
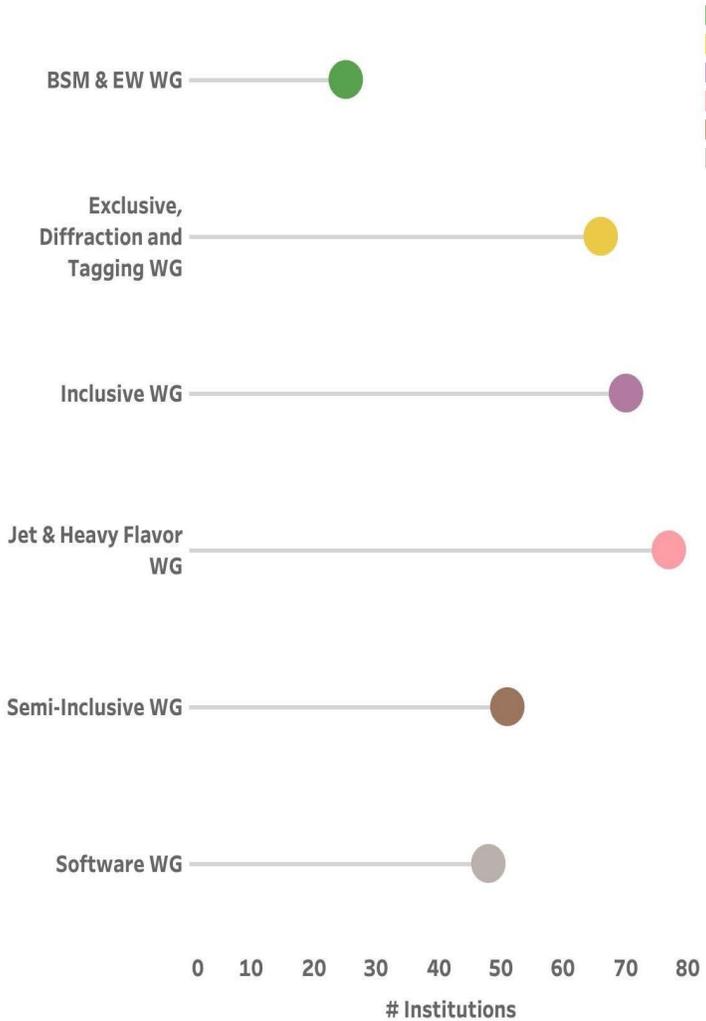
# INSTITUTIONAL SURVEY

## Detector-1 - A global pursuit for a new EIC experiment at IP6 at BNL



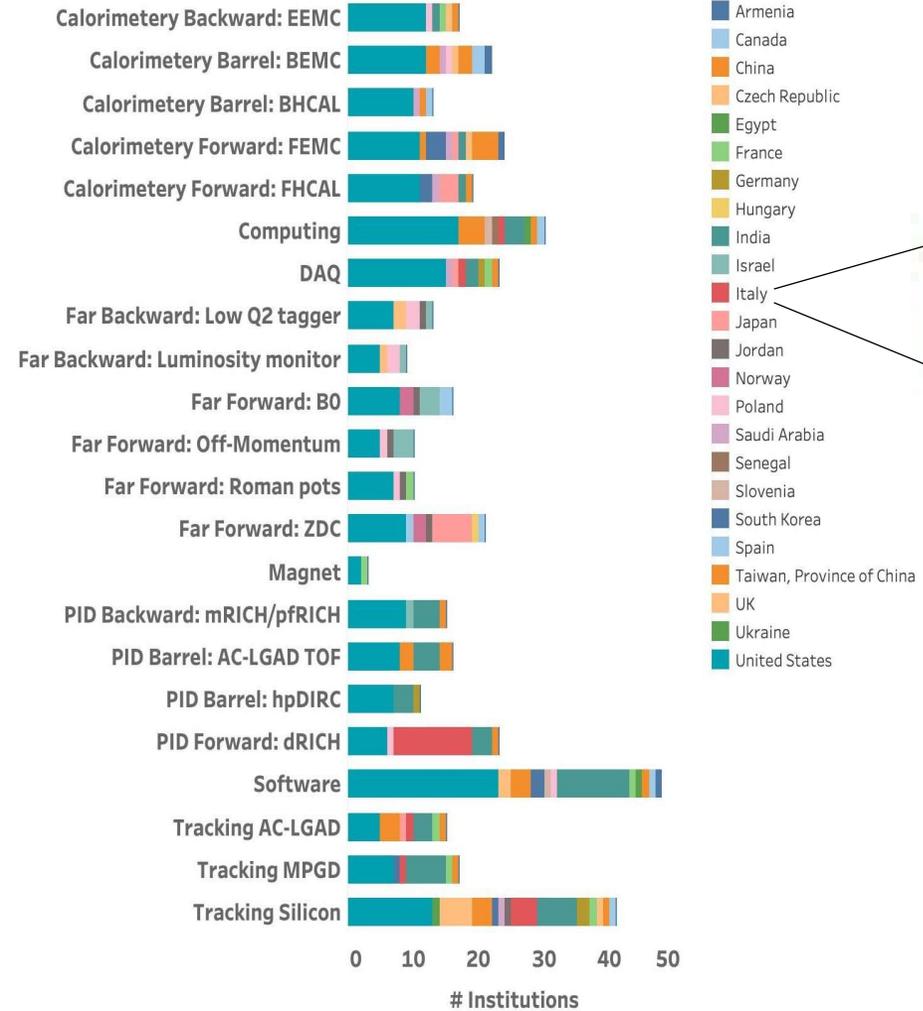
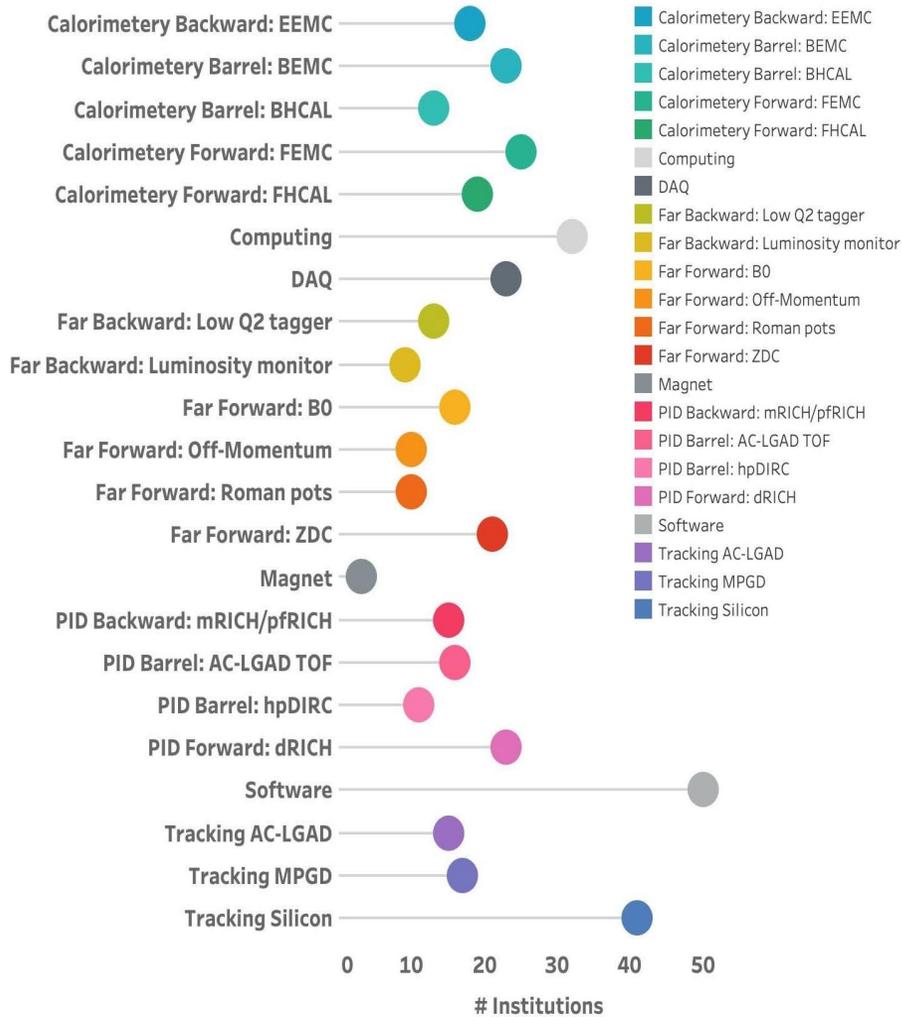
# INSTITUTIONAL SURVEY

## Detector-1 - A global pursuit for a new EIC experiment at IP6 at BNL / Physics Interests



# INSTITUTIONAL SURVEY

## Detector-1 - A global pursuit for a new EIC experiment at IP6 at BNL / Sub-System Interests



# INSTITUTIONAL SURVEY, NEXT STEPS

The Institution Representatives will be prompted to provide a list of the members in their own group



- To form a phone book
- To have an initial list of Collaboration members

# INSTITUTIONAL REPRESENTATIVES (IR)

- One per Institution for all the Institutions which submitted the survey form
- A first meeting of the IRs in 1-max 2 weeks

## Goals:

- Prepare the formation of the collaboration Bylaws/Charter;
- Prepare and conduct the Bylaws/Charter approval process.

## Envisaged timelines:

- Formation of a bylaws/charter committee at the beginning of July
- Bylaws/charter committee meets 1/more times in July in order to present initial ideas at the end of July meeting ☐  
Input for the discussion on 7/27

## IMPORTANT:

- the SC will in no way steer the IRs: it is a green field  
on which the IRs themselves will build-up
- 2 experienced Colleagues have kindly accepted to facilitate  
the organization of the IR meetings:

Victoria Greene (Vanderbilt U.)

Franck Sabatié (CEA/Saclay)

THANK YOU!



# DETECTOR-1 MEETING at the end of JULY

reminder: in the week of the EIC-UG annual meeting (26-30 July), nevertheless a **distinct meetings**

EICUG Annual Meeting week

July 26-30, 2022

Early Career meeting July 24-25

Detector 1 Dedicated sessions:

July 26<sup>th</sup> (half day), 27<sup>th</sup>

- Scientific program focused on Det1  
Be prepared for WG presentations
- Collaboration formation:  
Institution Representative Meeting Session  
including: Open discussion on bylaws/charter

**attend in-person as much as possible !!!**

## Electron-Ion Collider User Group Meeting - 2022

CFNS, Stony Brook University, July 26 - 30, 2022

### Detector-1 Meeting at EICUG Meeting July 26-27, 2022

#### Tuesday: July 26

- Tuesday morning Part 1: 08:30AM – 10:30AM – EICUG
- Tuesday morning Break: 10:30AM – 11:00AM
- Tuesday morning Part 2: 11:00AM – 12:30PM – Introduction Detector 1
- Tuesday Lunch: 12:30PM – 02:00PM
- Tuesday afternoon: 02:00PM – 03:30PM WG part 1 (Detector)
- Tuesday afternoon Break: 03:30AM – 04:00PM
- Tuesday afternoon: 04:00PM – 05:30PM WG part 2 (Detector)

#### Wednesday: July 27

- Wednesday morning Part 1: 09:30 AM – 10:30 AM – [IB meeting](#)
- Wednesday morning Break: 10:30 AM – 11:00 AM
- Wednesday morning Part 2: 11:00 AM – 12:30 PM – [IB meeting](#)
- Wednesday Lunch: 12:30 PM – 02:00 PM
- Wednesday afternoon: 02:00 PM – 03:30 PM WG part 3 (Physics)
- Wednesday afternoon Break: 03:30 PM – 04:00 PM
- Wednesday afternoon Part 2: 04:00PM – 05:30PM GD/I Detector-1 Summary & Discussion

**Note:** No parallel session since the focus of the meeting is the formation of a new collaboration

# A NAME FOR THE NEW COLLABORATION

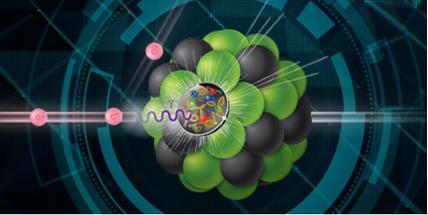
- You (all of you Collaboration members) are prompted to propose names for the new Collaboration
    - A dedicated e-mail will recall this
- One single restriction:* Names of previous or existing collaboration (or proto-collaborations) will not be accepted. In addition, suggested names should be in good taste, and not offensive.
- Electronic form at : <https://forms.gle/Db17T5jZMfKmd1YG6>

A voting exercise to select the 3 most popular ones

A second voting for the final choice among the 3 most popular names

**GOAL: the name will be announced at the July meeting**

- **Timelines in view of this goal**
  - July 4th - submission of suggested names closes
  - July 11th - close first-round voting
  - July 25th - close of second-round voting



# Toward Detector 1

(also with EIC\_NET perspectives)

- The context
- The formation of the NEW collaboration
- The ongoing activity for the detector design
- Summarizing

# THE JOINT WGs

	WG	Conveners			
<b>Transversal WGs</b>	Global Detector Optimization	Richard Milner	Jin Huang	Thomas Ullrich	Silvia Dalla Torre
	Simulation production and QA	Joe Osborn	Wenliang (Bill) Li	Zhoudunming (Kong) Tu	Wouter Deconinck
	Computing and Software	Cristiano Fanelli	David Lawrence	Sylvester Joosten	Andrea Bressan
	DAQ / Electronics / Readout	Chris Cuevas	Jo Schambach	Alexandre Camsonne	Landgraf Jeff
<b>Detector WGs</b>	Tracking	Xuan Li	Kondo Gnanvo	Laura Gonella	Francesco Bossu
	Calorimetry	Friederike Bock	Carlos Munoz Camacho	Oleg Tsai	Paul Reimer
	PID Cherenkov	Xiaochun He	Grzegorz Kalicy	Tom Hemmick	Roberto Preghenella
	PID ToF	Wei Li	Constantin Loizides	Franck Geurts	Zhenyu Ye
	Far Forward	Michael Murray	Yuji Goto	Jentsch Alex	John Arrington
	Far Backward	Igor Korover	Nick Zachariou	Krzysztof Piotrkowski	Adam Jaroslav
<b>Physics WGs</b>	Inclusive Physics	Tyler Kutz	Claire Gwenlan	Barak Schmookler	Paul Newman
	Jets and Heavy Flavor	Cheuk-Ping Wong	Wangmei Zha	Miguel Arratia	Page Brian
	Exclusive, Diffraction, & Tagging	Axel Schmidt	Rachel Montgomery	Spencer Klein	Daria Sokhan
	Semi-Inclusive Physics	Ralf Seidl	Charlotte Van Hulse	Anselm Vossen	Marco Radici
	BSM & precision EW	Xiaochao Zheng	Sonny Mantry	Furletova Yulia	Ciprian Gal

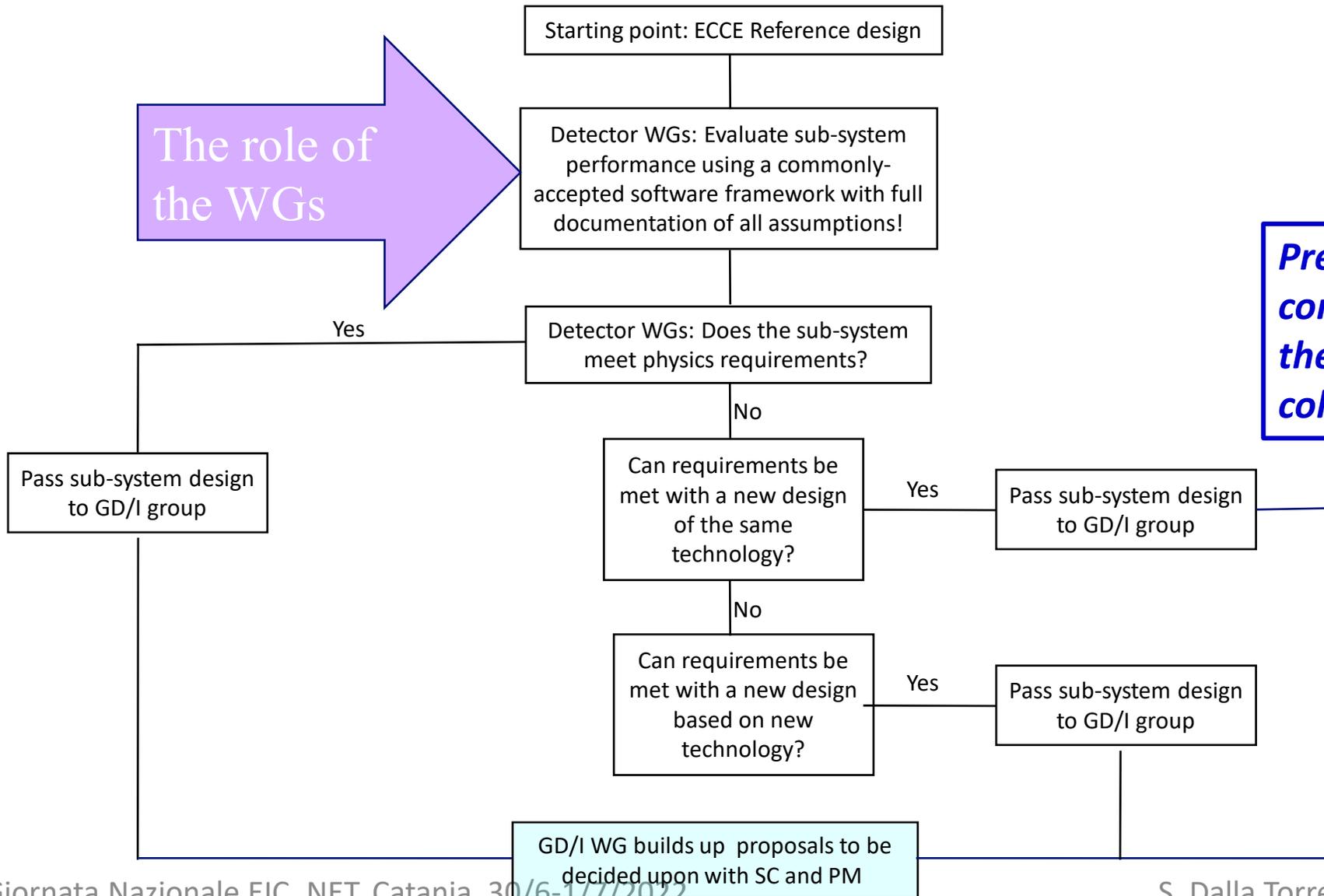
Thanks to Domenico and Salvatore  
For stepping back in view at letting the process start !

# THE JOINT WGs - Charges

***Contribute to detector consolidation (= choice of technologies) and optimization (= layout for a given technology) to baseline DETECTOR-1***

- ***Technology analysis (DWGs)***
- ***Physics requirements (PWGs)***
- ***Support for DETECTOR-1 baselining from the transversal WGs***

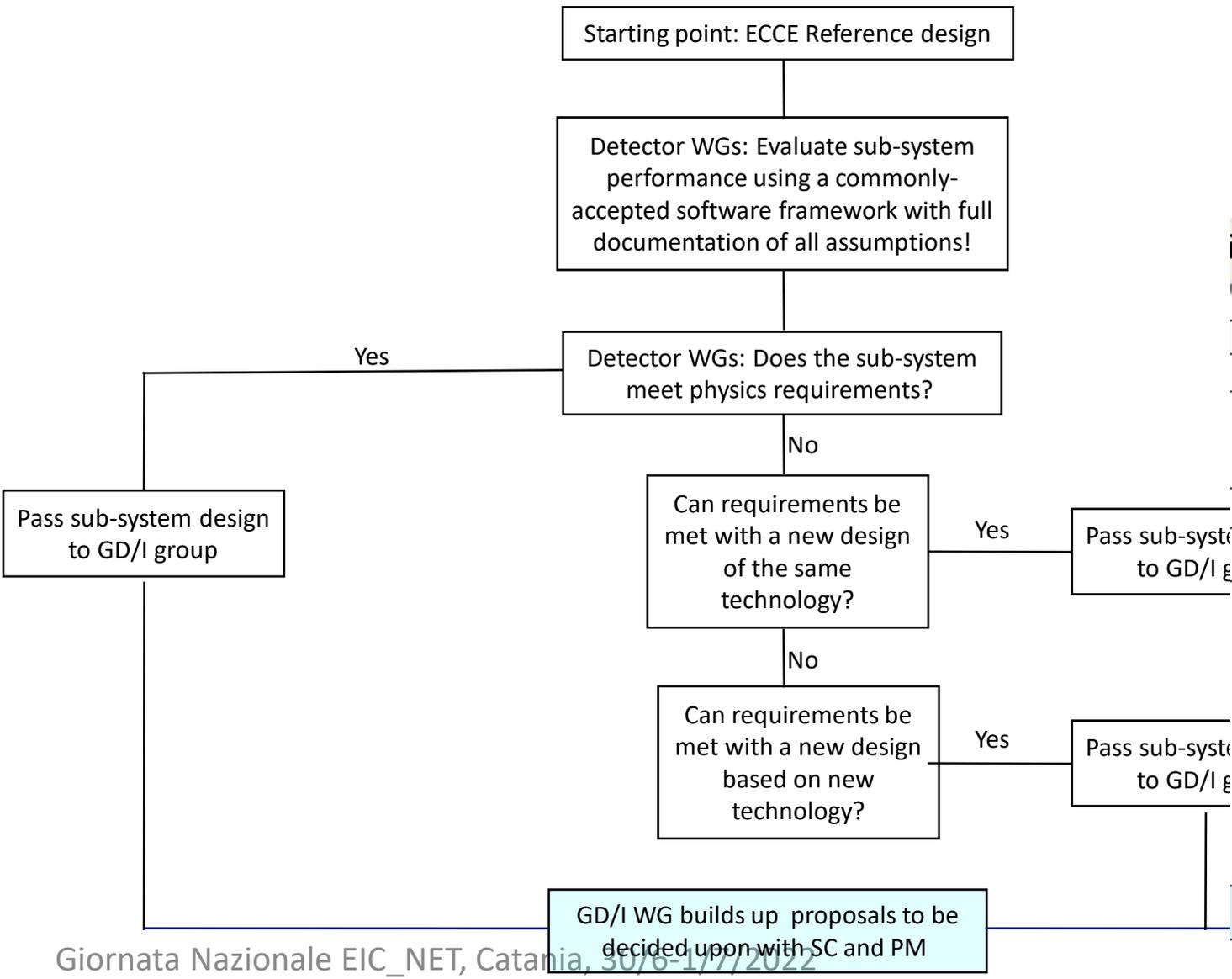
# THE CONSOLIDATION PROCESS



***Preliminary decisions:  
consolidated decisions only after  
the formation of the structured  
collaboration***

# THE CONSOLIDATION PROCESS – a concrete example

## Calorimeter WG invited to the 6/27 GD/I WG



From GD/I email to Calo WG: (6/11/2022)  
...we request from you some specific points of information:

- Details on the work done to provide the necessary input for your decision making process. This includes both collection of existing information and any new studies your WG initiated to establish the expected system performance.
- The full pro/con list that was used to inform your recommendations. This should include any and all considerations that helped the WG form your recommendations.
- A presentation of your recommendations and reasoning for them based on the information presented in the points above.
- Your view of how these recommendations fit with the global detector. e.g. did you ensure the system fits within the geometrical constraints.
  - Have you considered how service routing might work?
  - What is the assumption of performance and material distribution of other subsystems that were relevant for your study?
  - Do you see any potential challenges integrating your recommended solution within the global detector?
- Further, we would like to see simulations that validate the performance of the proposed configuration.

# KEY ITEMS UNDER CONSIDERATION for DETECTOR1-CD

- ❑ Optimization of barrel tracking
  - Achieving a realistic, low-mass design with good performance
  - MPGD selection (mRWell or MM)
- ❑ Reference design did not include a backwards HCAL
  - Is there a strong physics justification?
- ❑ ECCE and ATHENA barrel EMCAL solution imply a different physics emphasis
- ❑ AC-LGAD s are new, unproven technology
  - Potential for risk-reduction
- ❑ PID in backwards region (competing technologies)

- *This process must be driven by the physics performance based on a holistic approach*
- *Integration aspects also to be considered*
- *Iterative process toward optimization*

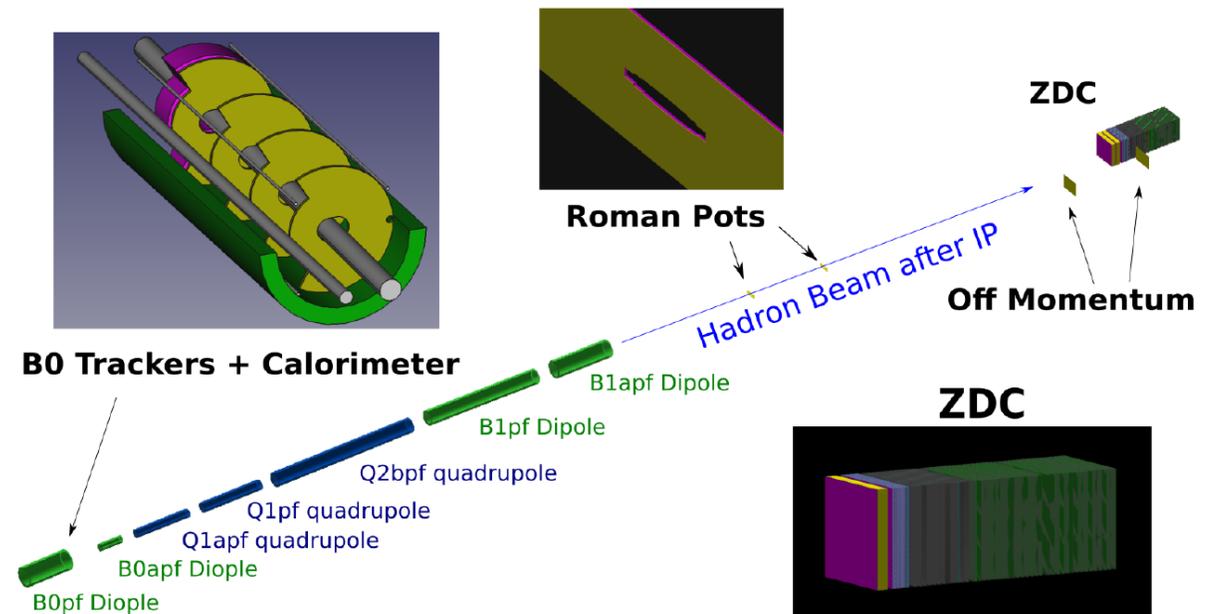
# TECHNOLOGY CHOISES ALSO FOR FAR FARWD

## Far Forward

- Instrumentation in the B0 magnet (B0 design not final!)
- Roman Pots and Off Momentum detectors
- Zero degree Calorimeter

## TECHNOLOGIES (including alternatives)

- $\text{PbWO}_4$  Cal
- W/Si sensors
- AC-LGADs
- MAPS & LGADs
- W/SciFi
- Pb/Sci



# TECHNOLOGY CHOISES ALSO FOR FAR BACKWD

## Far Backward

- Low- $Q^2$  tagger
- Luminosity monitor (electron-ion bremsstrahlung )

## TECHNOLOGIES (including alternatives)

- AC-LGAD
- PbWO<sub>4</sub> Cal
- Spaghetti W-calorimeter with radiation-hard scintillating fiber, read out with fast PMTs
- Cherenkov-radiating quartz fibers read out by SiPMs

Figure: Luminosity detector

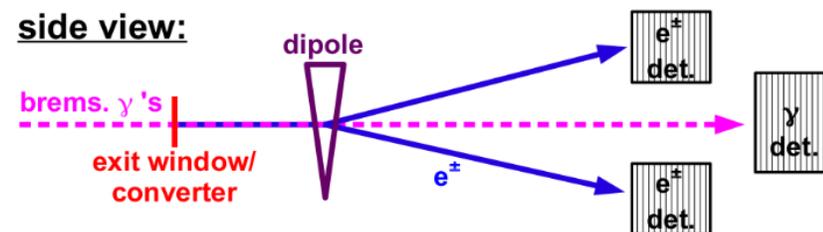
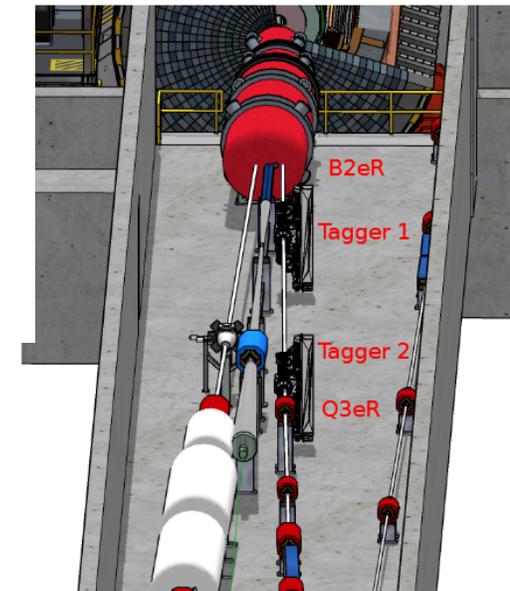
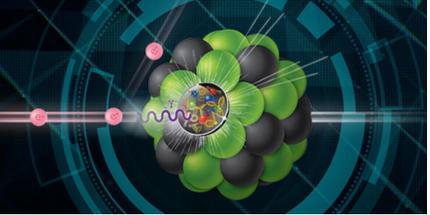


Figure: Low- $Q^2$  taggers





# Toward Detector 1

(also with EIC\_NET perspectives)

- The context
- The formation of the NEW collaboration
- The ongoing activity for the detector design
- Summarizing

- **Towards DETECTOR-1**
  - Historically, in 3 steps: YR, Proposal, DETECTOR-1 effort and Collaboration
- **DETECTOR-1 Collaboration**
  - Under formation,
  - Charter/bylaws & election expected by October
    - Critical: the composition of the charter/bylaws committee
- **DETECTOR-1 design**
  - Activity progressing
  - No major decision taken, yet
  - Progress and decisions in the software sector are/will play a major role
- **INFN & DETECTOR-1**
  - Important INFN contributions
  - Thanks to previous work, expertise, dedication, and **INFN compact action** → this work has been/is recognized within the EIC community
    - This prepares the right context for our positioning in the collaboration

**MAIN FACTS**

# APPENDIX

## *Useful PRACTICALITIES*

- **DETECTOR-1 General meeting be-weekly**
  - **Alternating: Friday at 10.30 am ET, Thursday at 9.30 pm ET (attendance from ASIA)**
- Other major appointments:
  - **Convener meetings**, every second week (alternated to general meeting), Friday at 10.30 am ET
  - **GD/I meetings**, weekly Monday at 9.00am ET (when Monday is a holiday, Thursday at 12.30 pm ET)
- **Global Calendar in Indico:**
  - <https://indico.bnl.gov/category/402/>
  - Easy also to import the calendar into your own!
- **Detector-1 information at [https://wiki.bnl.gov/eic-project-detector/index.php/Main\\_Page](https://wiki.bnl.gov/eic-project-detector/index.php/Main_Page)**
- **Subscribe to the e-mail list of your interest (found them in the wiki page)**
  - **In particular, subscribe to:** Eic-projdet-collab-l@lists.bnl.gov