



# US-R&D towards $e^+e^-$ future collider(s) Status

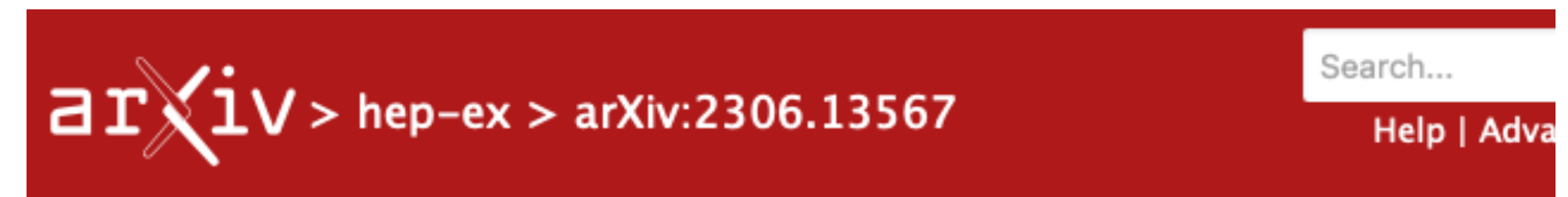
**George Iakovidis, Marcus Hohlmann, Bing Zhou**

# What happened until now

- The Snowmass process highlighted the critical need for constructing a future  $e^+e^-$  collider
- Building on the Snowmass efforts, a bottom-up community driven process was launched to communicate the need for a coherent and focused U.S. effort.
- A joint effort between Circular and Linear collider communities

## U.S. Coordination group during P5 process

- The efforts of the coordinators during the P5 process must be commended, they put in significant work and engaged the community in the process:
  - Solid State: A. Apresyan, C. Haber, C. Vernieri
  - Calorimeter: H. Chen, C. Tully, A. White
  - Gaseous Detector: M. Hohlmann, G. Iakovidis, B. Zhou
  - Readout/ASICs: J. Gonski, J. Hirshchauer
  - Trigger/DAQ: Z. Demiragli, J. Zhang
  - Particle ID: M. Artuso, G. Wilson, Z. Ye
  - Quantum: M. Demarteau, C. Pena, S. Xie
  - Software: H. Gray, O. Gutsche, J. Strube
  - ex-officios: J. Brau, A. Canepa, D. Denisov, S. Eno, P. Grannis, K. Jakobs, A. Lankford
    - plus representation from DOE and CPAD.
  - Chair: S. Rajagopalan



### High Energy Physics – Experiment

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## Detector R&D needs for the next generation $e^+e^-$ collider

A. Apresyan, M. Artuso, J. Brau, H. Chen, M. Demarteau, Z. Demiragli, S. Eno, J. Gonski, P. Grannis, H. Gray, O. Gutsche, C. Haber, M. Hohlmann, J. Hirschauer, G. Iakovidis, K. Jakobs, A.J. Lankford, C. Pena, S. Rajagopalan, J. Strube, C. Tully, C. Vernieri, A. White, G.W. Wilson, S. Xie, Z. Ye, J. Zhang, B. Zhou

The 2021 Snowmass Energy Frontier panel wrote in its final report "The realization of a Higgs factory will require an immediate, vigorous and targeted detector R&D program". Both linear and circular  $e^+e^-$  collider efforts have developed a conceptual design for their detectors and are aggressively pursuing a path to formalize these detector concepts. The U.S. has world-class expertise in particle detectors, and is eager to play a leading role in the next generation  $e^+e^-$  collider, currently slated to become operational in the 2040s. It is urgent that the U.S. organize its efforts to provide leadership and make significant contributions in detector R&D. These investments are necessary to build and retain the U.S. expertise in detector R&D and future projects, enable significant contributions during the construction phase and maintain its leadership in the Energy Frontier regardless of the choice of the collider project. In this document, we discuss areas where the U.S. can and must play a leading role in the conceptual design and R&D for detectors for  $e^+e^-$  colliders.

# P5 Recommendation

## Our organization and efforts during the P5 process paid off!

### ❖ Recommendation 2c:

[Plan and start] an off-shore Higgs factory, realized in collaboration with international partners, in order to reveal the secrets of the Higgs boson. The current designs of FCC-ee and ILC meet our scientific requirements. The US should actively engage in feasibility and design studies. Once a specific project is deemed feasible and well-defined (see also Recommendation 6), **the US should aim for a contribution** at funding levels commensurate to that of the US involvement in the LHC and HL-LHC, while maintaining a healthy US on-shore program in particle physics.

### ❖ Recommendation 6a

[Convene a targeted panel that would consider] the level and nature of US contribution in a specific Higgs factory including an evaluation of the associated schedule, budget, and risks once crucial information becomes available.

# U.S. – CERN Statement of Intent

The Government of the United States and CERN, as an intergovernmental organization, signed a Statement where – among the topics – the U.S. and CERN intend to:

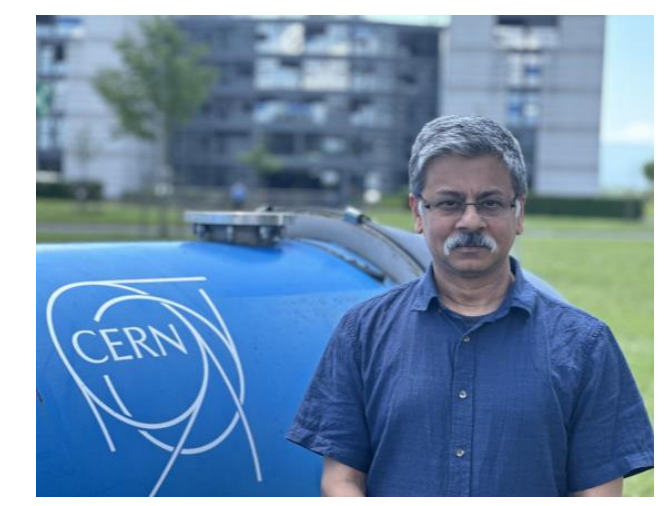
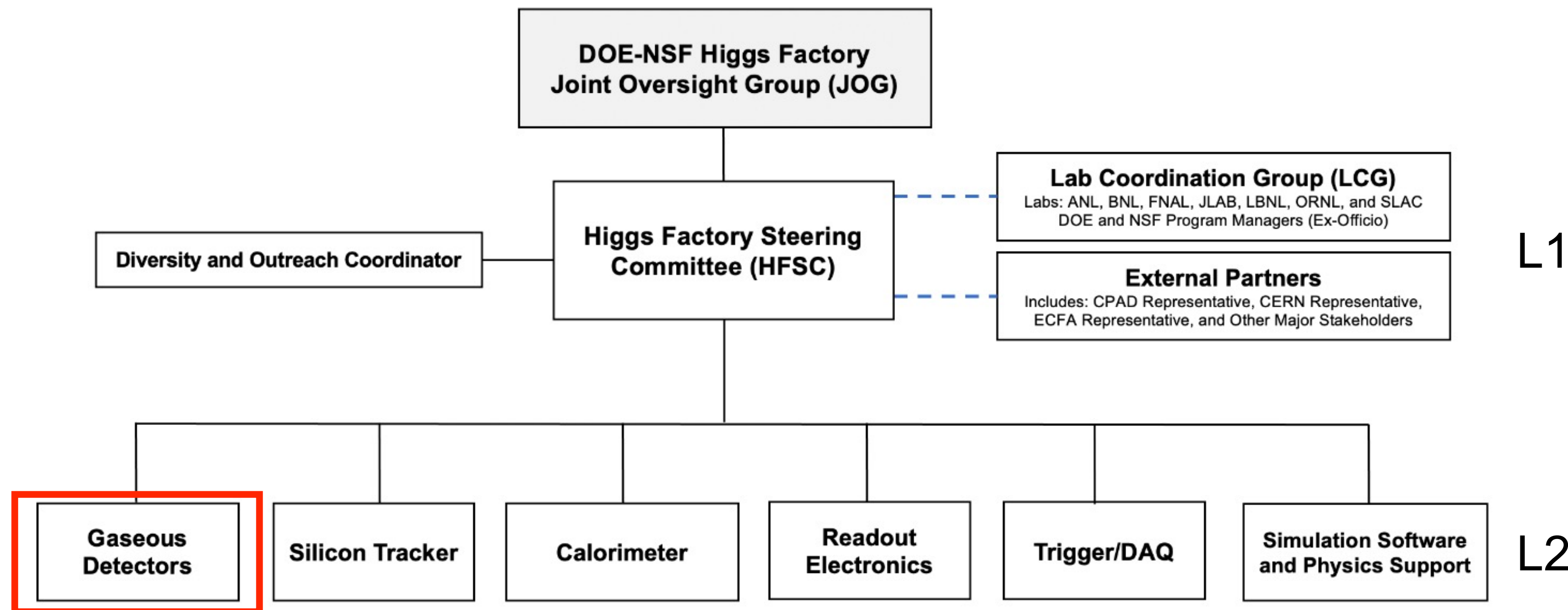
- Enhance collaboration in future planning activities for large-scale, resource-intensive facilities.
- Continue to collaborate in the feasibility study of Future Circular Collider Higgs Factory (FCC-ee)

Should the CERN member states determine the FCC-ee is likely to be the next world-leading research facility following HL-LHC, the U.S. intends to collaborate on the construction and physics exploitation, subject to appropriate domestic approvals.

This SOI represents a major step to enhance cooperation and collaboration between U.S. and CERN.



# DOE/NSF Actions



FCC



ILC

- Sridhar Rajagopalan (*Chair*), Sarah Eno
- Ritchie Patterson (*Deputy Chair*), Marcel Demarteau

The U.S. HFCC is to coordinate efforts in the following areas:

- (1) Physics and technical feasibility studies, including any associated design and R&D efforts, to advance various experiment detector concepts at a future Higgs factory;
- (2) Prioritization and stewardship of the national R&D efforts should funds be identified by DOE and/or NSF;
- (3) Development of the pre-project detector R&D scope that will be required prior to DOE and/or NSF initiating any detector project at a future  $e^+e^-$  collider;
- (4) Conceptualization of the software and computing framework that will be needed to advance physics studies and R&D efforts; and to collect, store, and analyze the large volumes of physics data at future collider experiments;
- (5) In consultation with DOE and NSF program managers, develop various funding models that will be required to support the R&D efforts described in items (3) and (4) above; and
- (6) Ensure collaborations by the U.S. with our partners are cost-effectively carried out to advance the future Higgs factory initiatives. Such partner efforts include, but are not limited to, those being undertaken by a) the U.S. Coordinating Panel for Advanced Detectors (CPAD); b) the CERN-hosted Detector R&D (DRD) initiative; c) the European Committee for Future Accelerators (ECFA); and d) other major stakeholders.

- A call for nominations will be shortly circulated
- The gaseous detectors will probably split in a more application specific scope
  - Muon Spectrometer (L2)
  - Tracker (L3) (incl. FE)