# Experiment Operations

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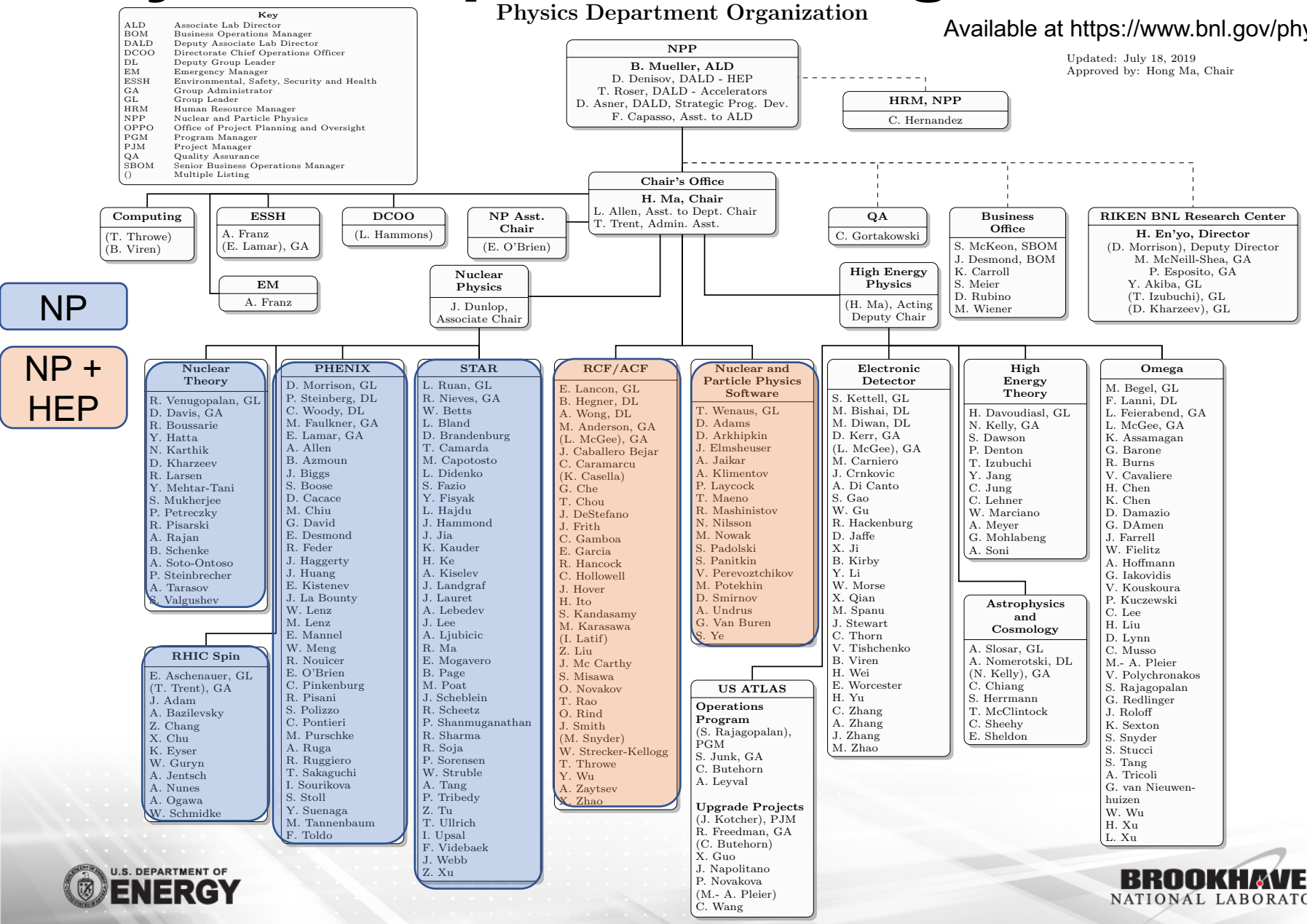
BROOKHAVEN NATIONAL LABORATORY

U.S. DEPARTMENT OF ENERGY

BROOKHAVEN SCIENCE ASSOCIATES

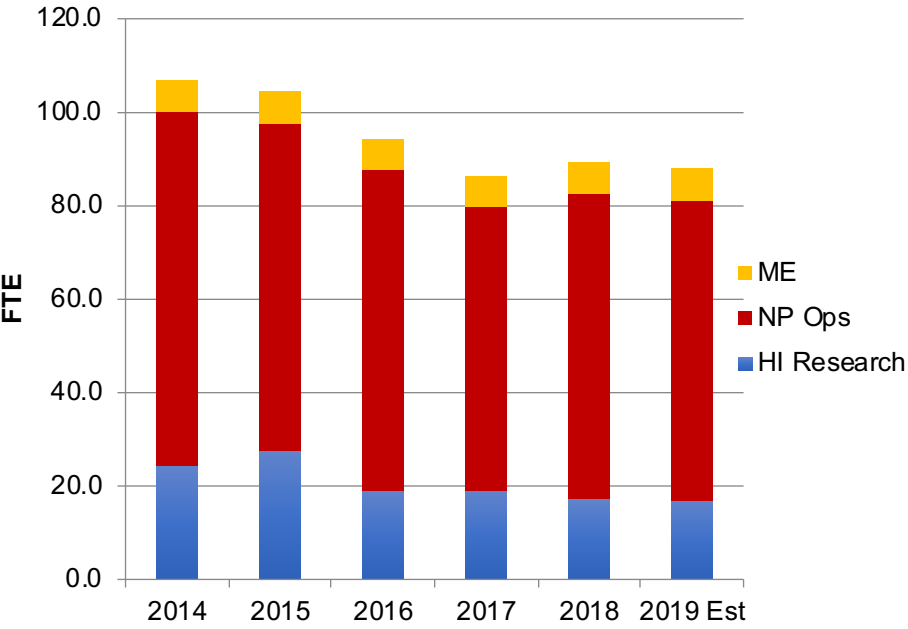
# Physics Department Organization

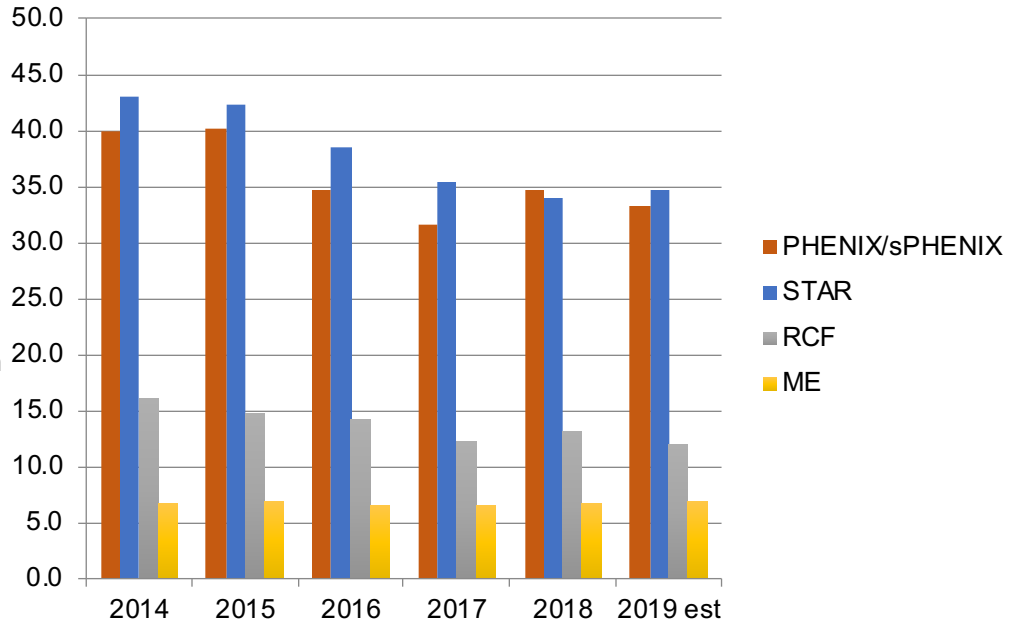



U.S. DEPARTMENT OF ENERGY

BROOKHAVEN NATIONAL LABORATORY

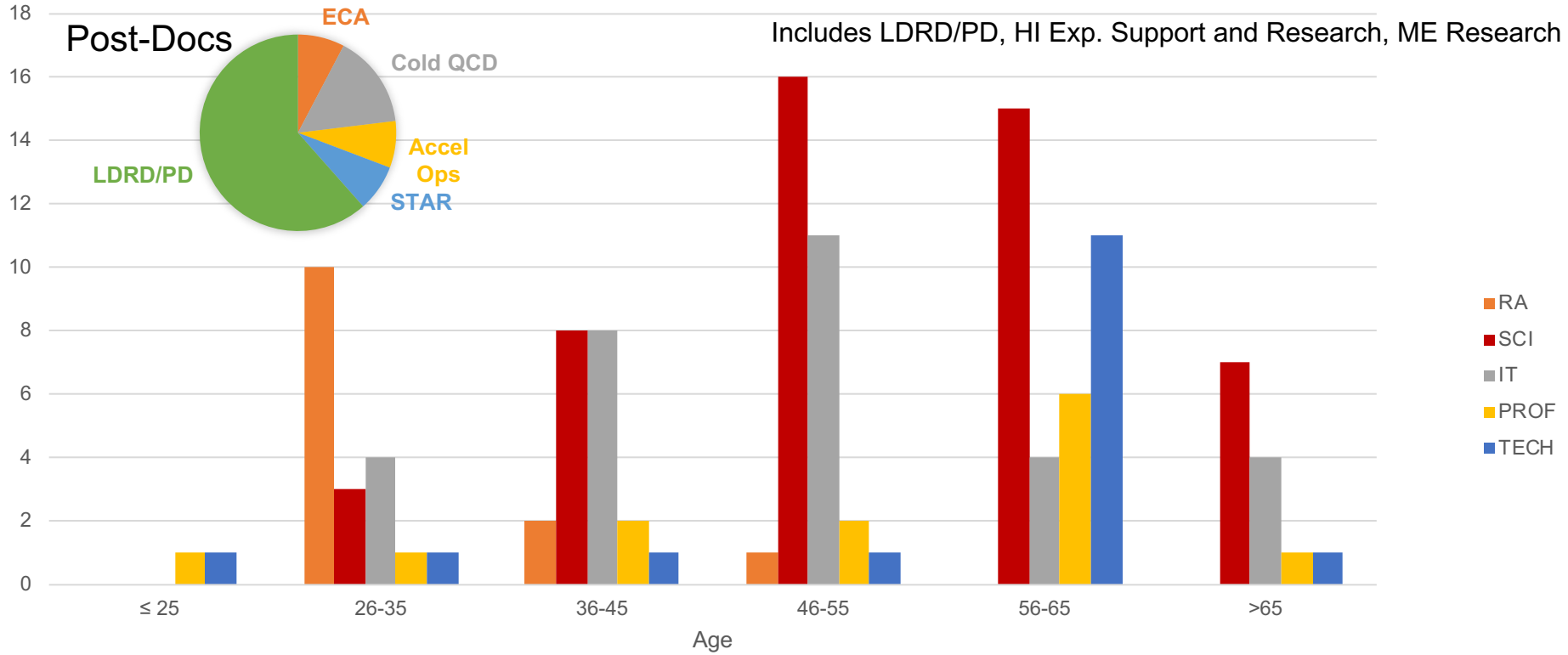
# Physics Dept. Exp. NP Workforce




- 15% workforce decrease necessary 2014-2016
  - Reduced junior staff, ATLAS participation, PHENIX analysis
- Workforce 2017-2019 focused on highest priority items
  - Technical staff: as necessary for project needs
  - Limited junior staff: few directly funded post-docs, few junior scientists

# Workforce Demographics




Post-docs: majority funded by LDRD/PD

Low number (3) of tenure-track scientists

Technical and professional staff: lack of early and mid-career population

- Challenge but also an opportunity to modify skillset to match needs in the future
- NPP-wide initiatives to build the pipeline for technical workforce

# Diversity and Inclusion

- Leadership: 2 of 3 NP Exp. Group Leaders female
- Physics department Diversity Working Group: 2017
  - Focus on improving environment, recruitment process
  - First action was Leona Woods Award
- Infrastructure investments: local QOL for employees, guests
  - Lactation room in 510, Gender-Neutral bathroom

Established 2017

**BNL Physics Department**
**Leona Woods**
**Distinguished Postdoctoral Lectureship Award**
to celebrate the scientific accomplishments of outstanding female physicists, physicists from under-represented minority groups, and LGBTQ physicists

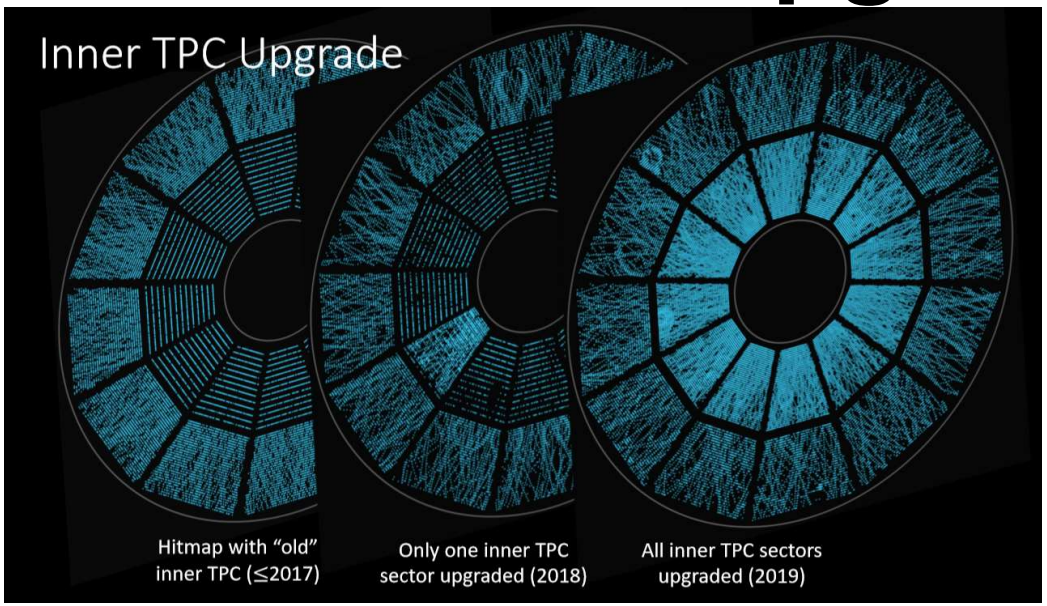
**Recipients:**
2019 Vivian Miranda
(University of Arizona)
2018 María Moreno Llácer
(CERN)
2018 Tammy Walton
(FNAL)
2017 Elena Petreska
(NIKHEF)

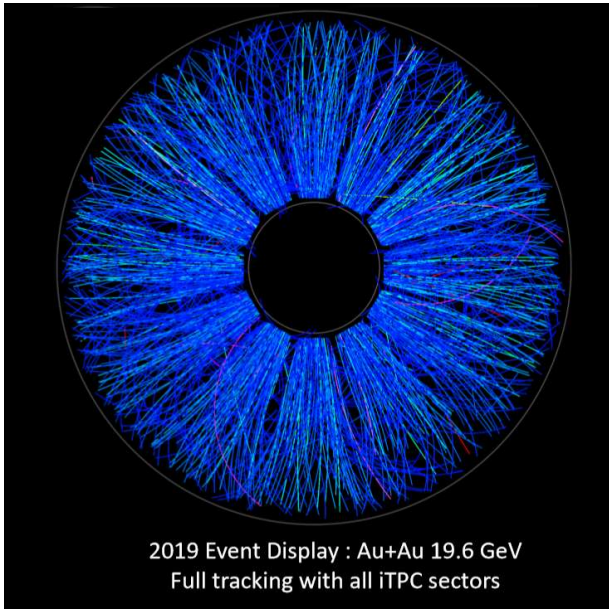
https://leonawoodsbnl.phy.bnl.gov/

# Successes of Upgrades: Heavy Flavor Era

- Producing results for which they were built
  - PHENIX VTX: Published $e_c$ vs. $e_b$
    - Published Run 11 Au+Au, Run 15 p+p
    - Full statistics through Run 16 in preparation
  - PHENIX FVTX: Published B $\rightarrow$ J/$\Psi$ in p+p, Cu+Au
    - Multiple other results, including flow in small systems
  - STAR HFT: Published $D^0$ $v_2$, $R_{AA}$
    - In the pipeline: $D^0$ $v_1$, $D_s$, $\Lambda_c$…
  - STAR MTD: 2 J/$\Psi$ papers accepted for publication
    - In the pipeline: Y, with 1S vs 2S+3S separation

# Successes of Upgrades: iTPC

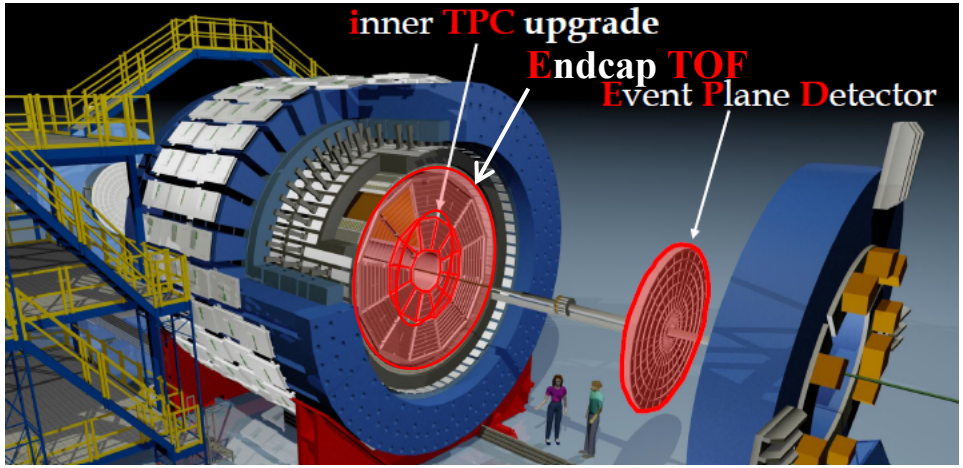



- iTPC: Capital Equipment Project 2016-2018
  - Officially completed May 2, 2019, on schedule and below cost
  - Scope: $3.6M for US, 6.9M RMB from China
    - Unspent funds of $770k returned to BNL CE at end of project
- Smooth transition to operations
  - Helped greatly by 2018 commissioning run, following recommendation of 2016 Detector Ops Task Force:
    - "Time for detector commissioning with a sufficiently long prototype/commissioning period, up to and including an entire RHIC run, should be added appropriately to any new detector construction project."

See H. Caines' Talk

# Leveraging of Community Resources: STAR BES-II Upgrades




DOE Funding:

iTPC: Exp Support CE

$3.6M total, evenly split FY16/FY17/FY18

Integration costs from STAR operations budget for all three upgrades

External Funding:

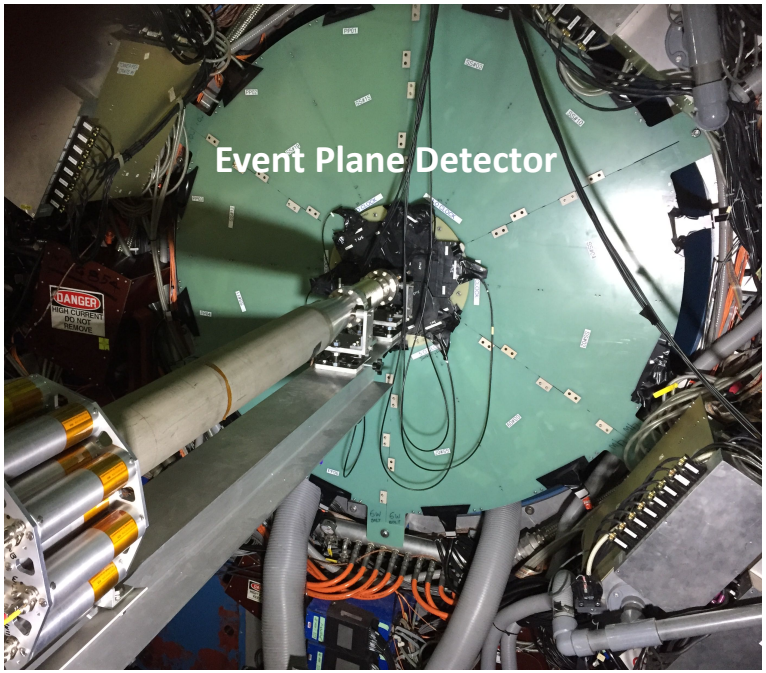
- iTPC: 6.9M RMB from China

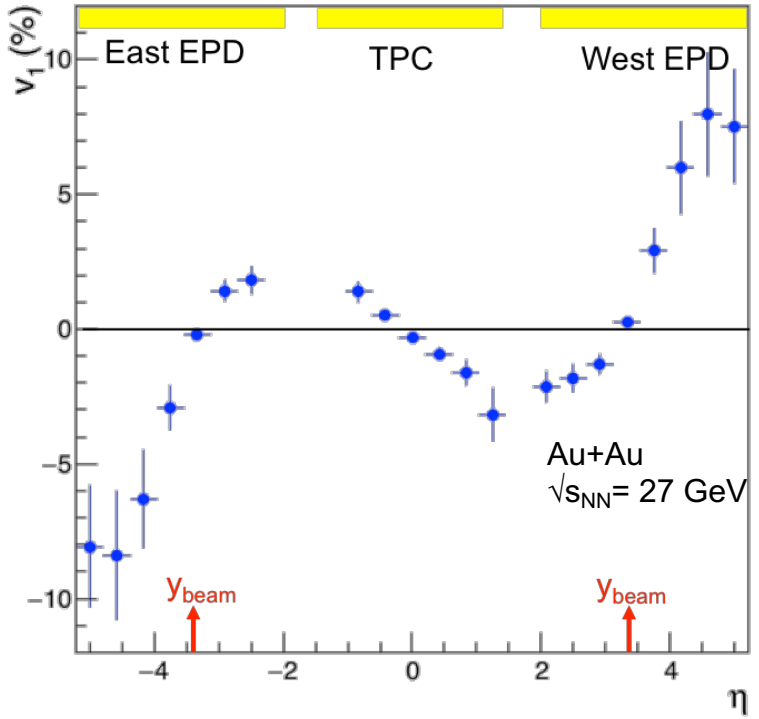
  2M RMB from MoST 973 key project for high energy nuclear physics (2014-2018), PI: Yugang Ma (SINAP)

  3.4M RMB from NSFC key project for international cooperation (2016~2020), PI: Qinghua Xu(Shandong U.)

  1.5M RMB Shandong University in-kind contributions
- EPD: contribution of 4.1M RMB from Chinese MoST, US workforce via NSF/DOE
- eTOF: contribution from Germany, FAIR “Phase 0” program, along with 3.5M RMB from Chinese MoST; US workforce DOE (Rice)

# Successes of Upgrades: EPD



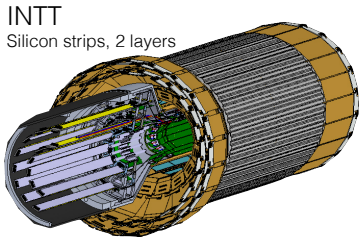

https://drupal.star.bnl.gov/STAR/starnotes/public/sn0666

- Event Plane Detector: improve event plane resolution
  - US Workforce: built, commissioned, and operated by OSU, Lehigh
  - 13 students and post-docs trained (and an early career professor)
    - one of whom is now at BNL, taking on other critical operational needs (TPC)
- Partial installation commissioned 2017, fully installed 2018
- Smooth transition to operations
  - Critical to 2018 (esp. 27 GeV); first results have been presented, more at QM

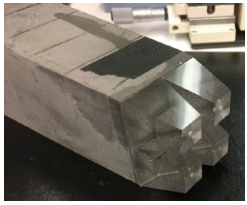
See H. Caines' Talk

# Leveraging of community resources: Future Upgrades

- sPHENIX INTT: Japan, in-kind contribution

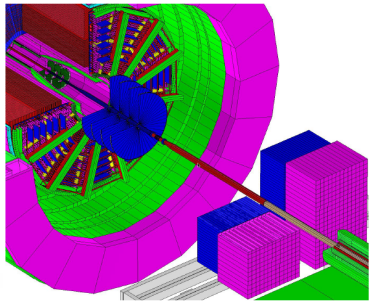



- sPHENIX EMCal: China (Fudan), high η blocks



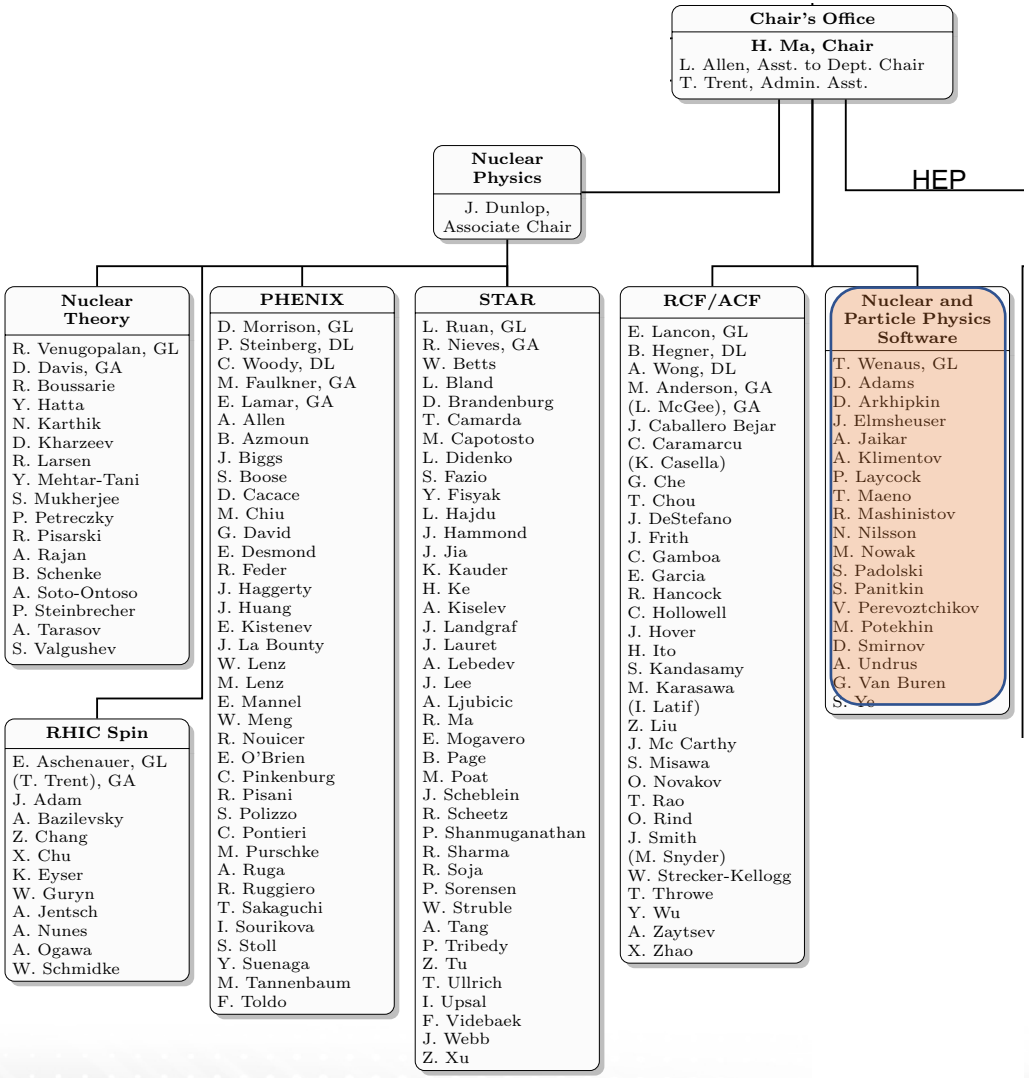
See G. Roland's Talk

- STAR Forward Upgrade: US NSF, China, Taiwan
  - Calorimeters: $1.95M NSF MRI, starts Sep. 2019
  - sTGC: China (Shandong University)
  - Si: Mechanics (NCKU), electronics (Shandong)



See Z. Xu's Talk

# Software effort: Structure




Nuclear and Particle Physics Software (NPPS) group

- Formed May 7, 2019
- Combines software effort across and among HEP and NP
  - Idea: flexibility to share ideas and resources across experiments
  - Recent success: PHENIX Simulation Coordinator identified as need during 2019 PAC, 0.5 FTE retasked in July from effort in HEP to this effort in NP
- Management:
  - Responsibility by FTE for area of work, assessed at least annually in negotiation between NPPS Group Leader and relevant group leader/ resource manager
  - Experiment representatives (not necessarily in NPPS) in leadership team

See T. Wenaus' Talk

# Data Preservation

Using PHENIX as a test case

- Panel formed within PHENIX, report 8/2019
  - Primary data to continue physically at RCF
  - Development needs:
    - Metadata system: locate and access all types of data
    - Knowledge management: infrastructure and analysis
    - Containerizing software to level sufficient for data preservation
- Resources needed currently under discussion
- At BNL will take place mainly within NPPS+RCF, leverage synergy with HEP (e.g. DPHEP)

# sPHENIX Software and Computing

- sPHENIX drives substantial investment in computing resources needed by 2023
- Scale of the need has driven intense work in collaboration incorporating recent developments worldwide

  For more details, see G. Roland's talk
- Reviews of sPHENIX S&C: 6/18/2018, 9/5-6/2019

9/2018 review closeout :

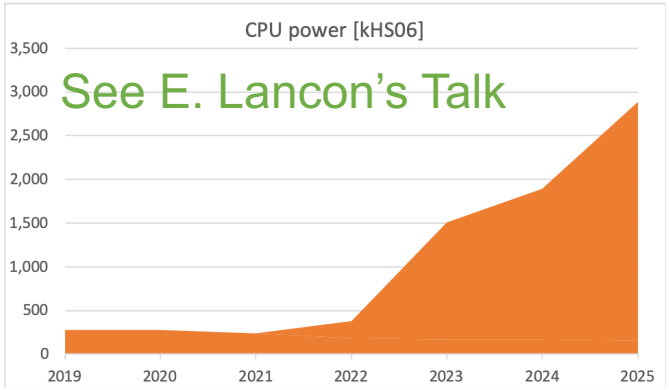
1. Are the resources required to transmit and store the data adequately understood?

   Yes
2. Are the resources required to process the data to a form suitable for physics analyses adequately understood?

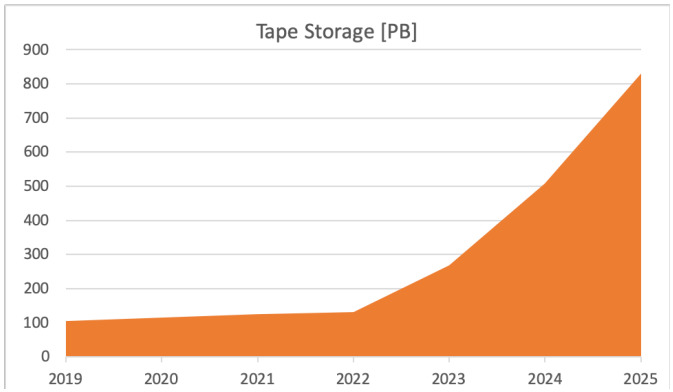
   In progress but not complete (should be further evaluated with alternate scenarios)
3. Is the plan for developing software processes and framework adequately understood?

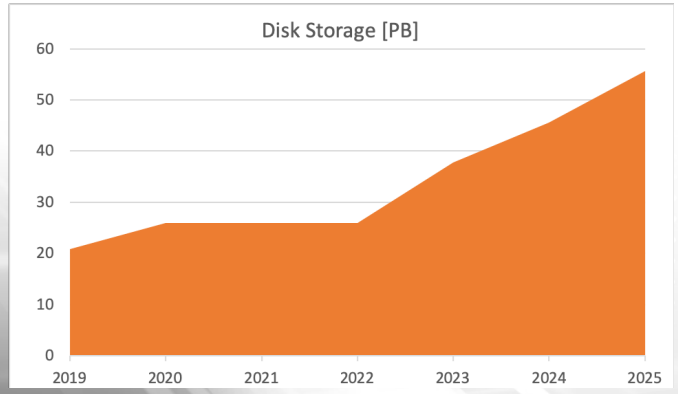
   Mostly, labor profile needs to be further developed

# RCF: Capacity Planning




See E. Lancon's Talk




To enable detector upgrades, RCF capacity held constant from 2016-present

- Allocation at CORI/NERSC mitigated shortfall in processing 2016 STAR dataset
- Datasets 2017-2022 smaller, due to physics-driven choice of species and energy

sPHENIX physics program requires large datasets → increase in computing

Planning underway to ensure RCF capacity sufficient to process sPHENIX data

- Details of the plan will change based on evolution of sPHENIX S&C model and hardware options

# Summary

- Experimental workforce
  - Stable since reduction required in 2016
  - Demographic challenges also an opportunity
- Recent upgrades successful, highly leveraged with community
  - Leveraging planned to continue with future upgrades
- NPPS formed: synergy of software effort across HEP and NP
  - Structure for developments needed for new initiatives (sPHENIX, data preservation, EIC)
- Substantial increase in computing resources planned in 2023
  - Close coupling and iteration between sPHENIX computing model and budgeting for RCF upgrades