



National Science Foundation – Nuclear Physics

Outline

- COVID Impacts
- Announcements
- FY21 Budget Info
- Highlights

Allena K. Oppen
MPS/PHY
April 2021

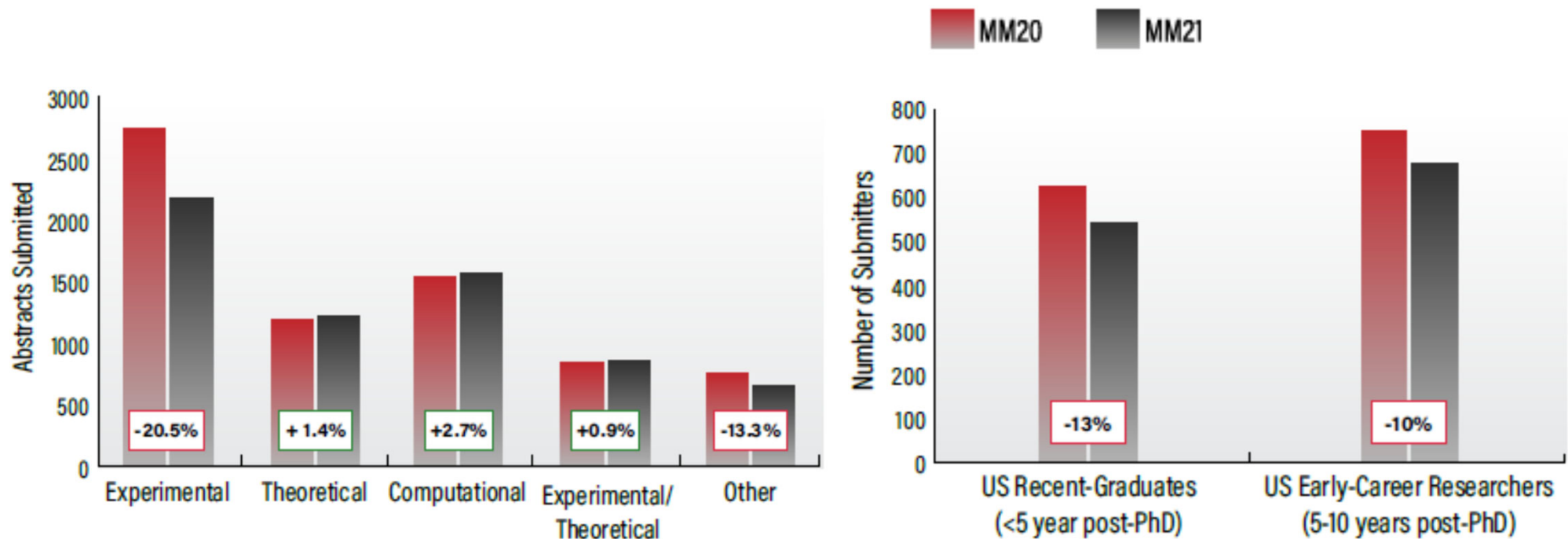
APS Topical Group on Hadronic Physics Workshop April 2021

NOVA

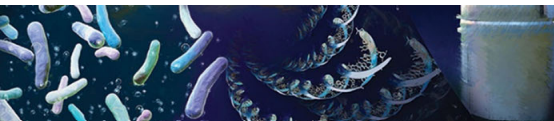
PBS



Covid Impacts: APS March Meeting Abstracts



Impact on Research: NSF Nuclear Physics community quickly pivoted to analysis and simulation work – but we may have exhausted many of those projects.

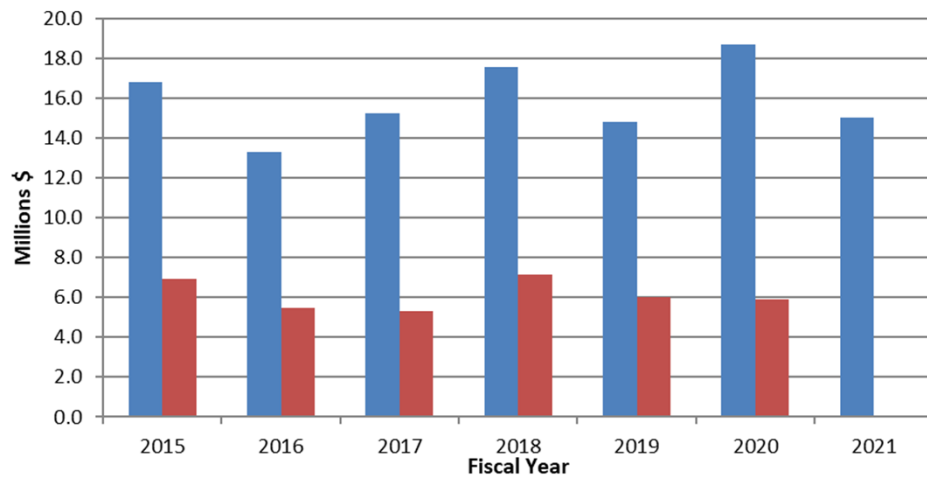




Proposal Trends in Experimental Nuclear Physics

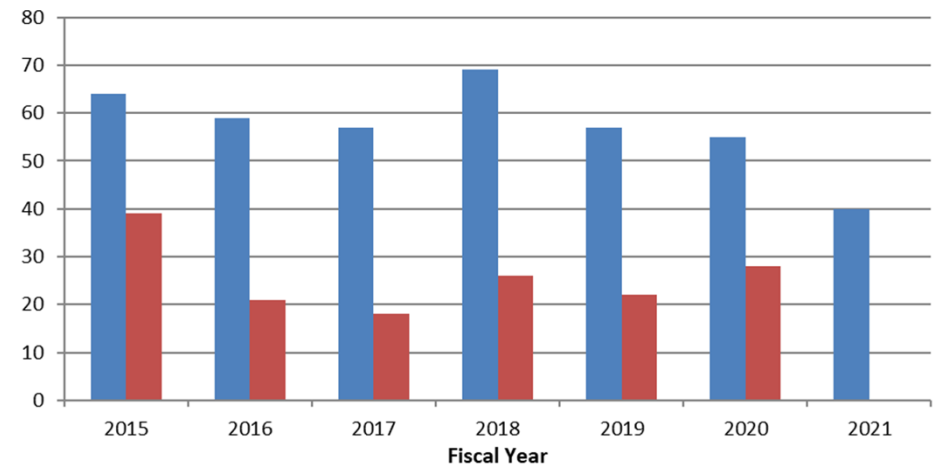
ENP Funding Trends
New awards only

■ Requested funds 1st yr (M\$)
■ Awarded Funds 1st yr (M\$)



ENP Proposal Trends

■ Submitted
■ Awarded





MPS Ascend – NSF 21-573

Ascending Postdoctoral Research Fellowships

- Goal is to support postdoctoral Fellows who will broaden the participation of groups that are underrepresented in Mathematical and Physical Sciences (MPS) fields in the U.S. and prepare them to transition from a postdoctoral position into the first few years of an academic faculty position.
- Fellowships are awards to individuals, not institutions, and are administered by the Fellows.
- \$100k/year for up to 3 years
- **Due date = 15-jun-2021**

Follow the solicitation instructions

Questions: Contact me or other NSF program directors

<https://www.nsf.gov/pubs/2021/nsf21573/nsf21573.htm>



LEAPS-MPS NSF 21-570

Launching Early-Career Academic Pathways in MPS

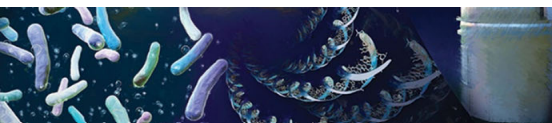


- Designed to launch the careers of pre-tenure faculty in Mathematical and Physical Sciences (MPS) fields at **minority-serving institutions (MSIs), predominantly undergraduate institutions (PUIs), and Carnegie Research 2 (R2) universities**, and with the goal of achieving excellence through diversity
- Aims to broaden participation to include members from groups underrepresented in MPS and welcomes proposals from principal investigators who share NSF's commitment to diversity.
- Awards = 24 months, up to \$250k
- **Due date = 14-jun-2021**

Follow the solicitation instructions

Questions: Contact me or other NSF program directors

<https://www.nsf.gov/pubs/2021/nsf21570/nsf21570.htm>



PHY Investigator Initiated Research NSF 20-580



All proposals submitted to the Division of Physics programs go through this solicitation.

- **Deadlines:** First Tuesday in December for *Experimental & Theoretical Nuclear Physics* FY22 Proposals due \Rightarrow **December 7th, 2021**
- NSF is committed to increasing the participation of traditionally underrepresented groups in all NSF activities and programs. The Nuclear Physics Programs encourage proposals with meaningful actions that address the longstanding underrepresentation of various populations including women, minorities and persons with disabilities, in physics at all levels (K-12, undergraduate, graduate, and postgraduate).

*Annual Reports must include goals and accomplishments of the award's
Intellectual Merits and its Broader Impacts*





Busy Time at NSF/MPS/PHY

- PHY Solicitation Deadline for *Experimental & Theoretical Nuclear Physics*
 - FY21 Proposals were due December 1, 2020 (Annually)
- Major Research Instrumentation NSF 18-513 (Annually)
 - \$100,000 < total request < \$4M
 - FY21 Proposals were due 19-Jan-2021
- Mid-scale Research Instrumentation-1 (MSRI-1) NSF 19-512 (Every other year)
 - Imp. & Des. & Const. < \$20M
 - Des. & Const. \$600,000 < total request < \$20M
 - Preproposals were due 7-jan-2021; full proposals due 23-Apr-2021 (by invitation)
- Mid-scale Research Infrastructure-2 (MsRI-2) NSF 21-537 (Every other year)
 - Total request: \$20M - \$100M;
 - Preproposals were due 5-mar-2021; full proposals due 20-Sep-2021 (by invitation)

Thank you to our many reviewers and panelists!

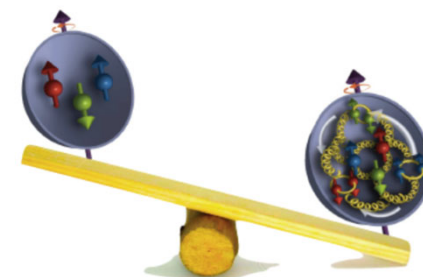
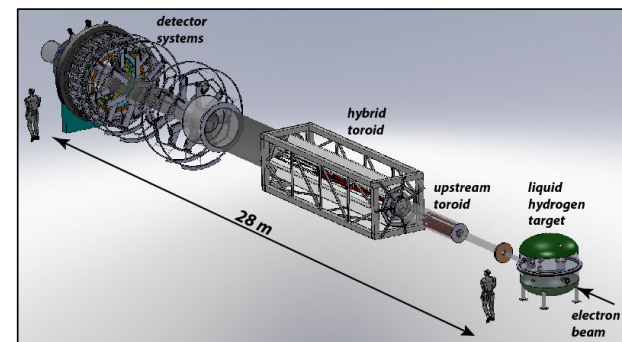




NSF and DOE Coordination in Nuclear Physics

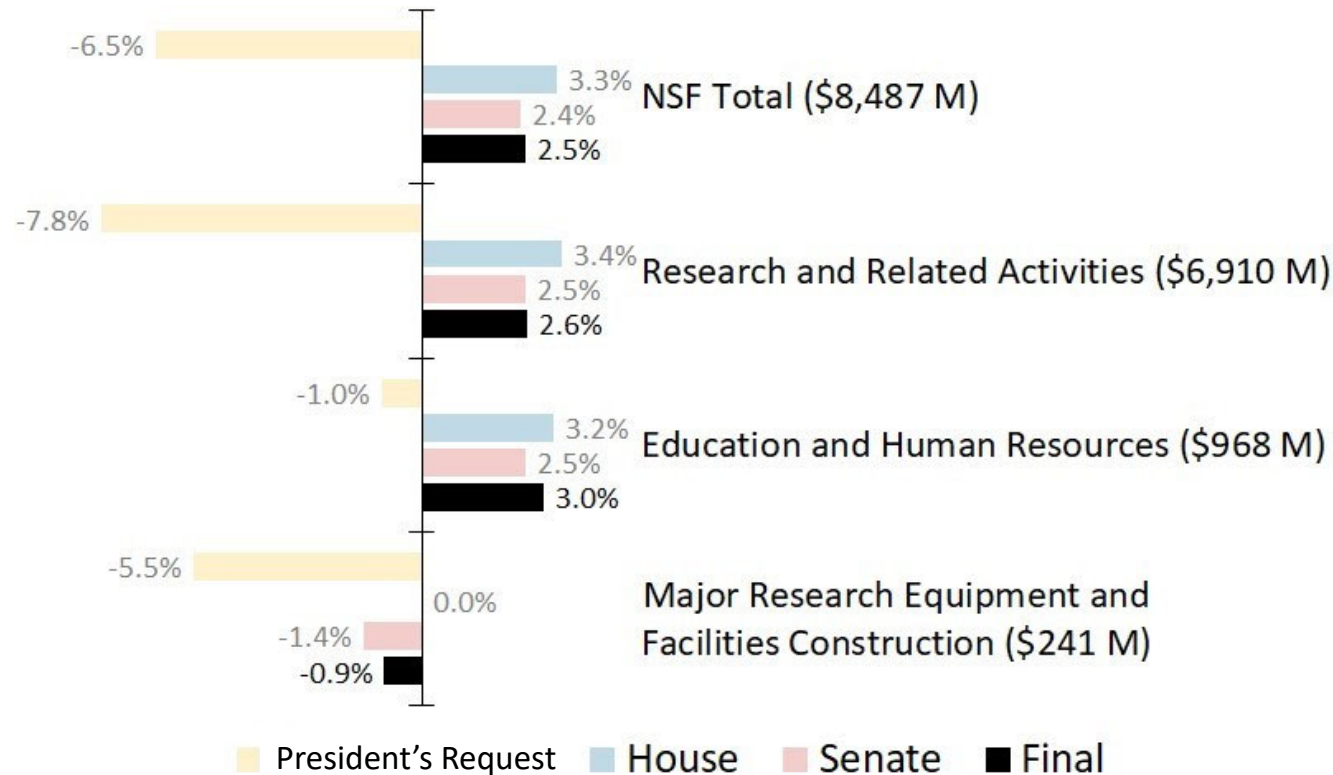


- MOLLER – parity violating Moller (elastic $\vec{e} e$) scattering
 - DOE CD-1 Dec 2020
 - NSF PHY Mid-scale award for specific scope
- EIC – the next “big thing” in US Nuclear Physics
 - DOE CD-0 in Dec 2019; BNL selected for site
 - Project includes EIC + 1 detector
- Next Generation $0\nu\beta\beta$
 - Prior NSF support: CUOREcino, CUORE, MJD, EXO-200, KamLAND-Zen, NEMO, ...
 - LEGEND-200 = GERDA + MJD + new detectors →
200 kg ^{76}Ge & $t_{1/2} = 10^{27}$ year for 1 ton-year exposure
 - DOE $0\nu\beta\beta$ portfolio review



NSF FY21 Budget Appropriations

\$ in () = FY21 amounts



American Institute of Physics | aip.org/fyi



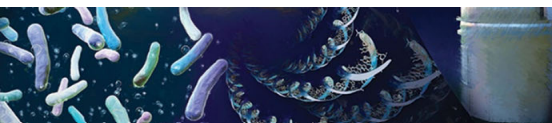


FY22 President's Budget Request:

NSF = \$10,200 M (increase of 20%)

“Skinny” budget = top line spending numbers for defense,
domestic discretionary spending, and top priorities

Full Budget Request expected in May



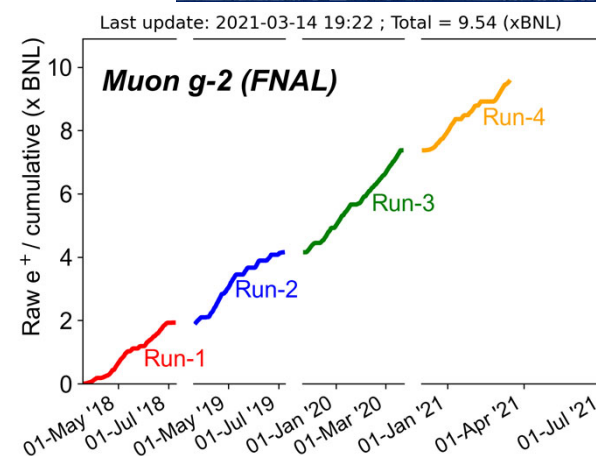
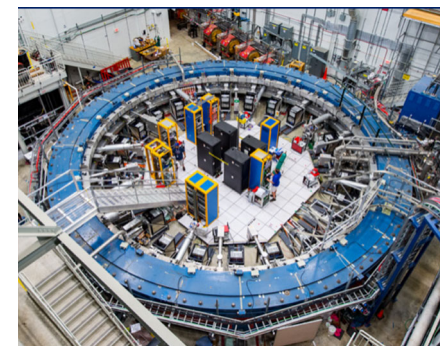


First results from FNAL μ (g-2) April 7



<https://theory.fnal.gov/events/event/first-results-from-the-muon-g-2-experiment-at-fermilab/>

- Precision test of Standard Model and BSM
- Approved in 2012 (CD0)
 - Move magnet from BNL to FNAL
 - Lots of redesign and rebuilding
 - First observation of anomalous precession in 2017 engineering run
- Four data runs (Run-4 currently underway)
- Run-1 analysis complete \lesssim BNL error



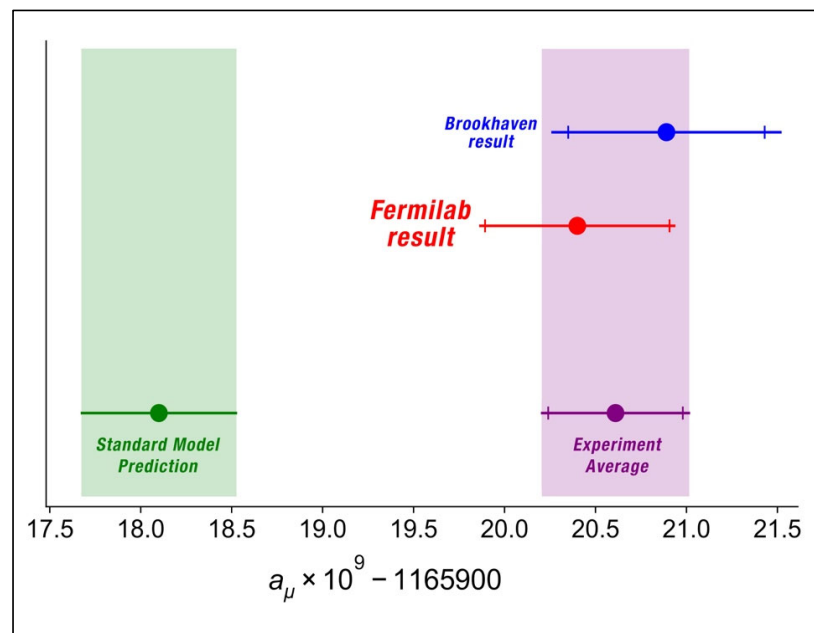
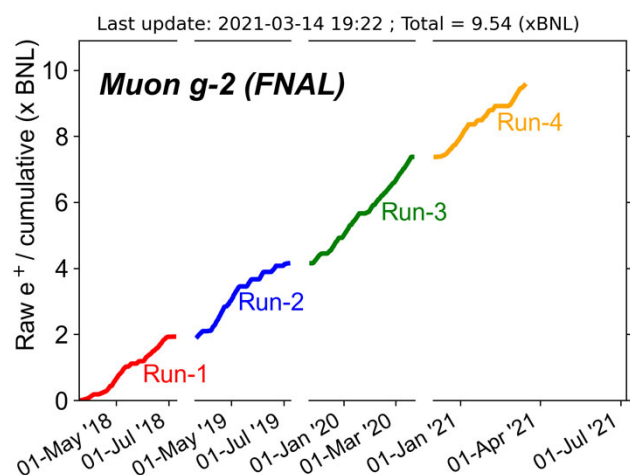


First results from FNAL μ (g-2) April 7



<https://theory.fnal.gov/events/event/first-results-from-the-muon-g-2-experiment-at-fermilab/>

- Theory: $g = 2.00233183620(86)$ $a = 0.00116591810(43)$
- Expt avg: $g = 2.00233184122(82)$ $a = 0.001165920161(41)$
- $\Delta = 4.2 \sigma$



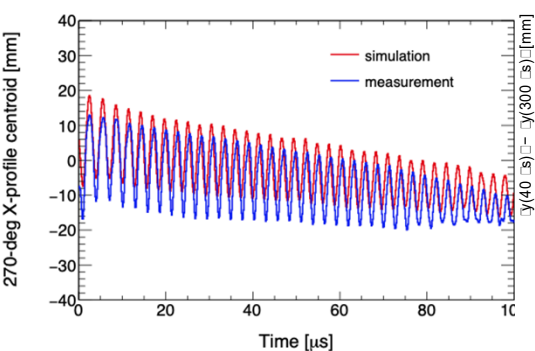


First results from FNAL μ (g-2) coming April 7

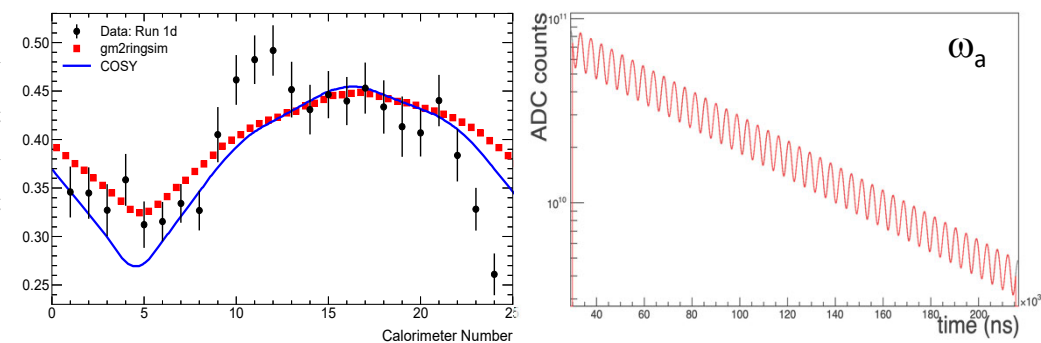


<https://theory.fnal.gov/events/event/first-results-from-the-muon-g-2-experiment-at-fermilab/>

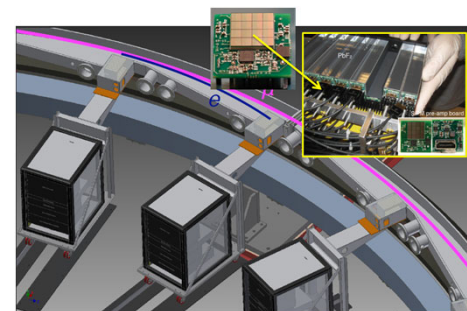
Fiber harps (**RU**)



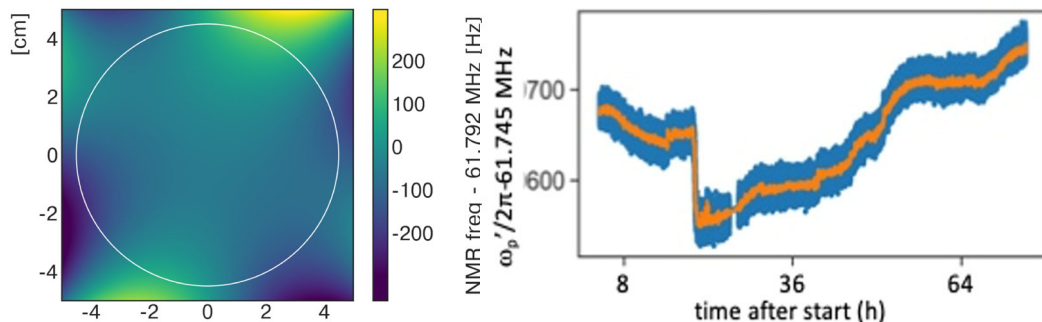
Simulations and Integrated energy analysis(**UKy**)



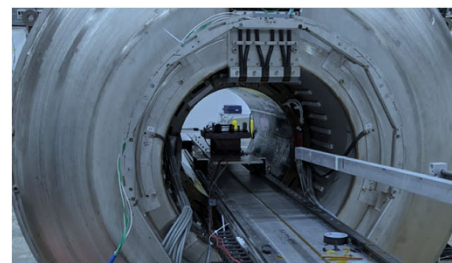
MRI (UW and Cornell)



Field maps and tracking (**JMU**, UM, UVa)



^3He Calibration (UM)



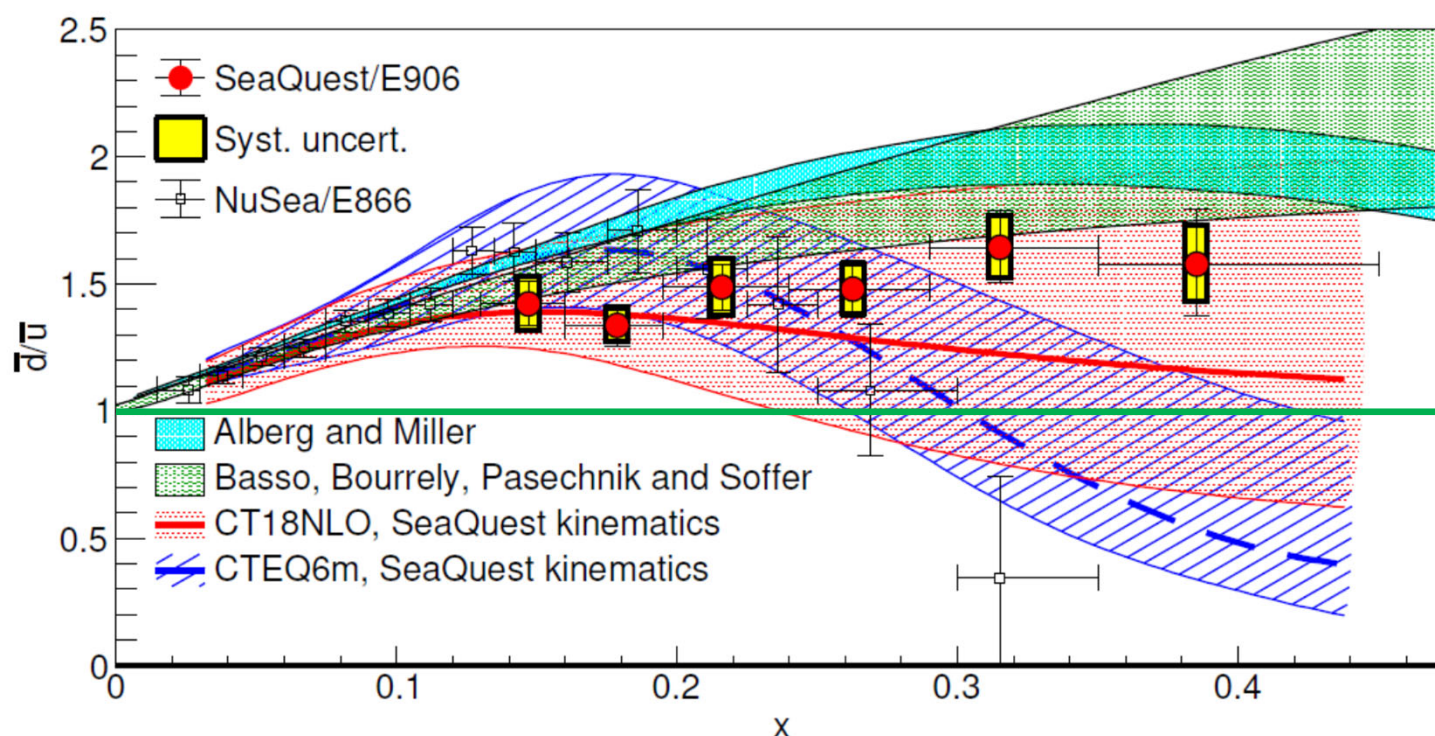
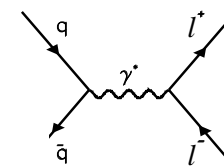
Calorimeter XLs,
SiPMs, electronics, ...





SeaQuest D-Y FNAL– more \bar{d} than \bar{u} in protons

at $x_1 > x_2$: Drell-Yan: $\sigma^{pd} / 2\sigma^{pp} \sim \frac{1}{2}(1 + \bar{d}(x_2)/\bar{u}(x_2))$



Figures from

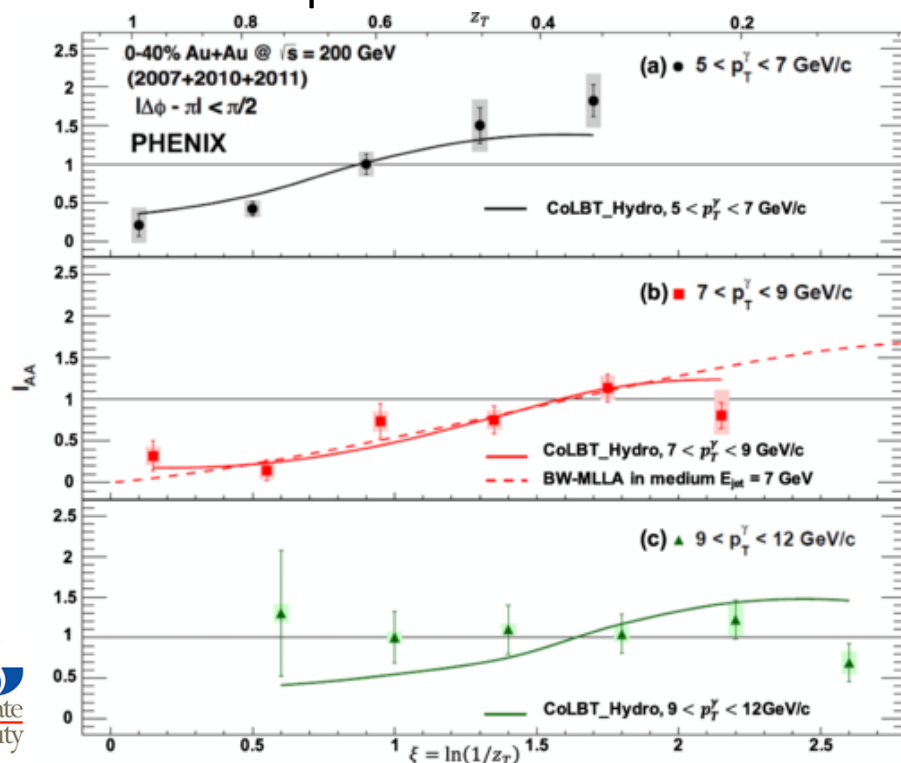
- J-C Peng (UIUC)
- C Aidala & W. Lorenzon (U of Mich)





Jet Measurements and a Novel Hadronic Calorimeter at RHIC

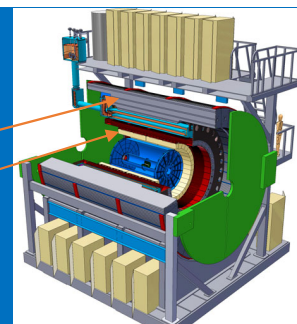
Jet modification in Au+Au collisions
with direct photon-hadron correlations



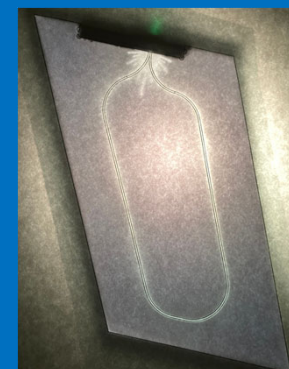
sPHENIX Hadronic Calorimeter

Outer Hcal Tile Testing complete

Inner Hcal Tile production and testing has started



6/16/2020
HCAL Lab
GSU



Inner Hcal Tile
matched to drawing

U. Acharya et al., Phys Rev
C102, 054910 (2020)

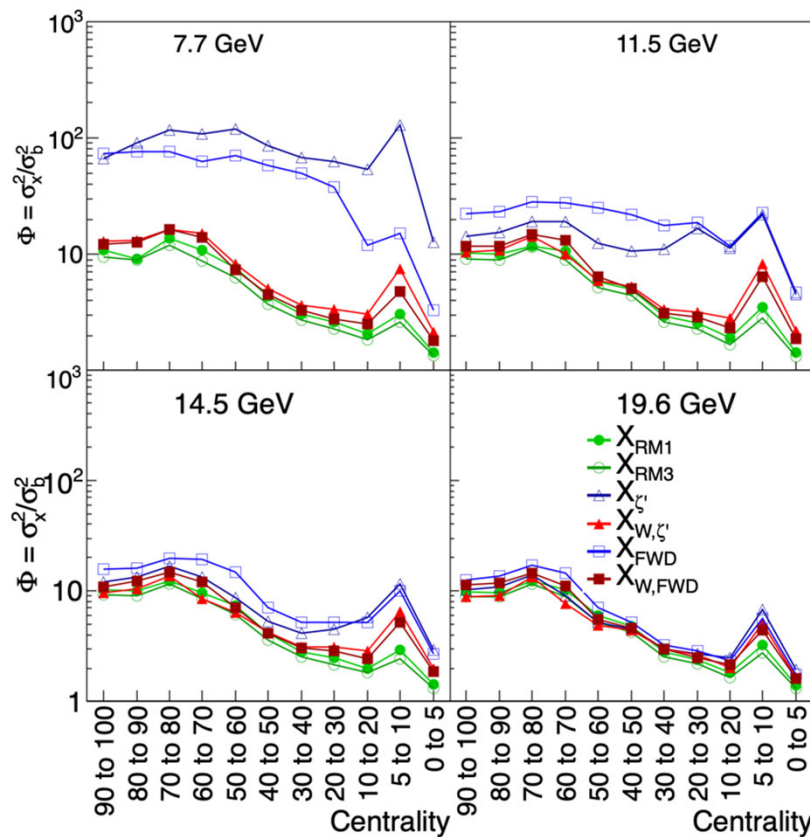
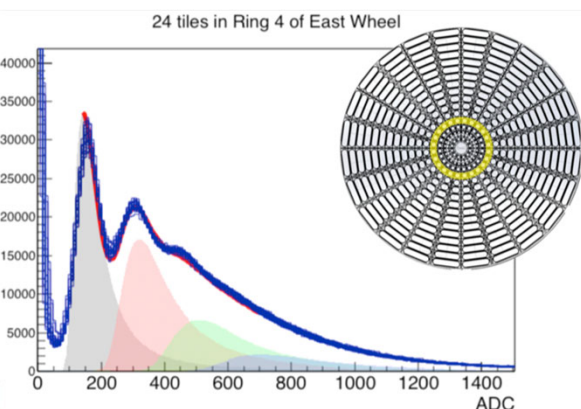




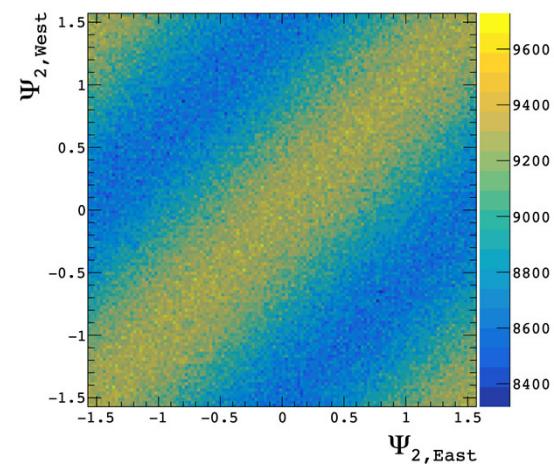
Centrality Determination with Forward Detector – RHIC BES



EPD performance channel by channel



EPD event plane East vs West
– jet v_2 measurement at RHIC



Accepted for publication
in PRC

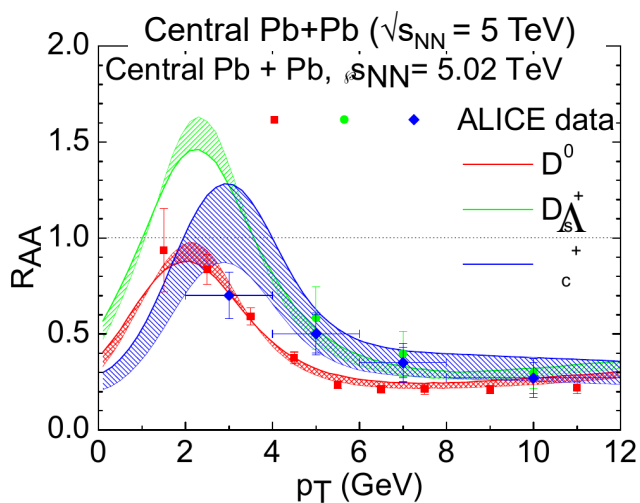
APS Topical Group on Hadronic Physics Workshop April 2021



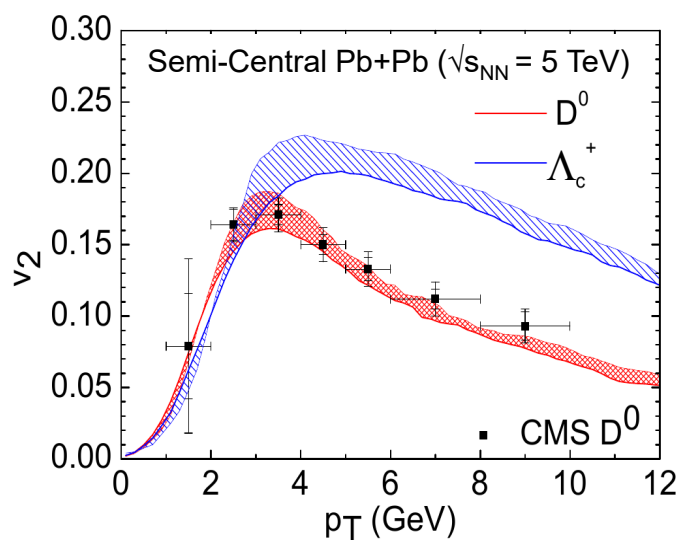
Heavy-Flavor Hadron Observables



Nuclear Modification Factor



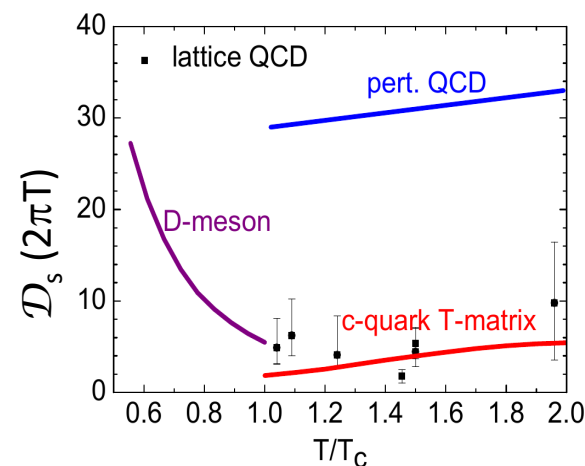
Elliptic Flow



Distinct hierarchy of hadronic species
→ signature of recombination

Large elliptic flow

→ large “drag force” on heavy quarks by expanding QCD medium
⇒ extracted diffusion coefficient, $(2\pi T)\mathcal{D}_s$, near lower quantum bound (~ 1)

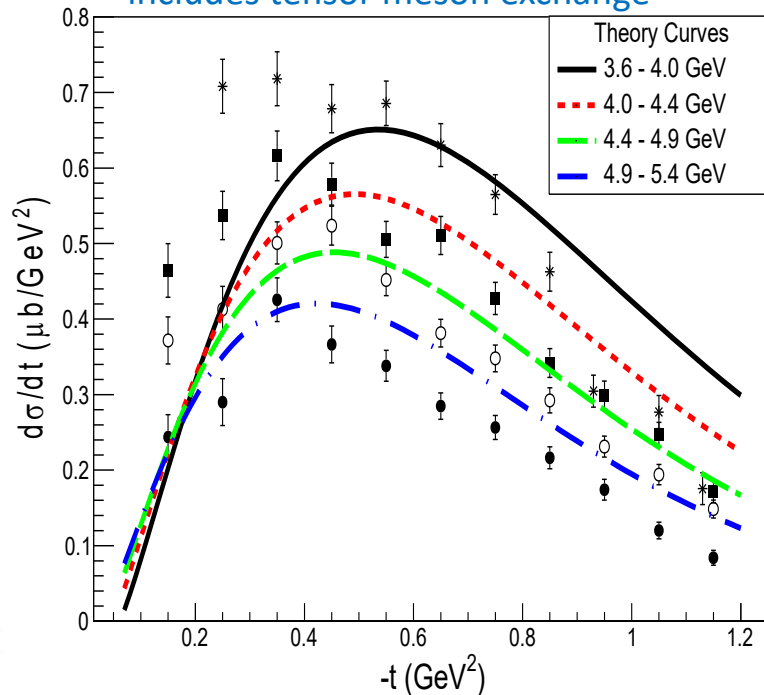


Photoproduction of the f_2 meson from the CLAS Collaboration

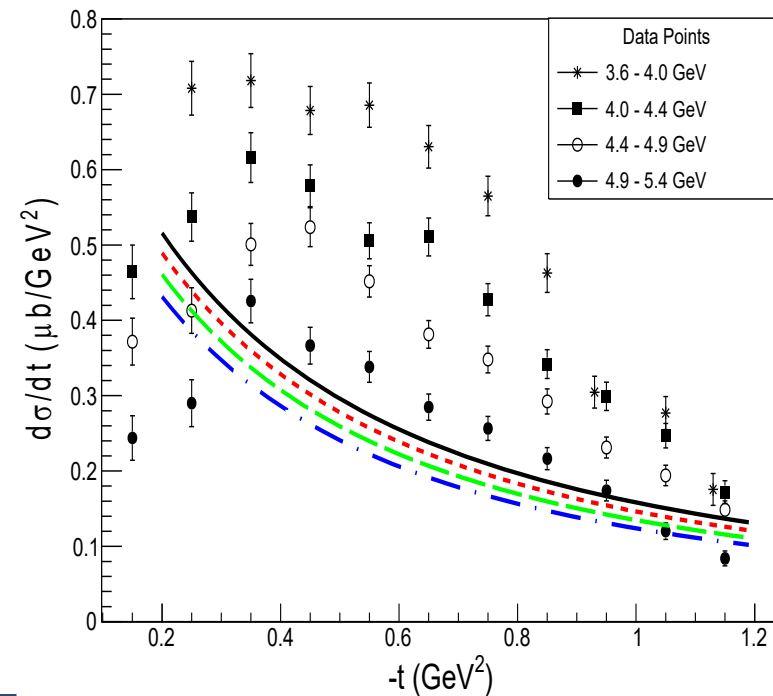


Is the f_2 meson a quark model (q - \bar{q}) state? Or is it a resonance of two ρ -mesons?

CLAS data compared with JPAC model
– includes tensor meson exchange



CLAS data compared with tetra-quark
model of Xie and Oset model



M. Carver et al., PRL
126, 082002 (2021)

APS Topical Group on Hadronic Physics Workshop April 2021



For the latest updates:

<https://www.nsf.gov/physics>

Contact us at:

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- jhthomas@nsf.gov

or call (703)292-2911

- aopper@nsf.gov

or call (703)292-8958



The screenshot shows the NSF Directorate for Mathematical & Physical Sciences (MPS) website. The top navigation bar includes links for HOME, FUNDING, AWARDS, DISCOVERIES, NEWS, PUBLICATIONS, STATISTICS, ABOUT NSF, and FASTLANE. The main header features the NSF logo and the text "National Science Foundation Directorate for Mathematical & Physical Sciences (MPS)". A search bar is located on the right. Below the header, a secondary navigation bar lists MPS HOME, MPS FUNDING, MPS AWARDS, MPS DISCOVERIES, MPS NEWS, and ABOUT MPS. The main content area is titled "Physics (PHY)" and includes a sidebar with links to PHY Home, About PHY, Funding Opportunities, Awards, News, Events, Discoveries, Publications, Career Opportunities, Facilities and Centers, PHY Program Director Jobs, See Additional PHY Resources, and View PHY Staff. The main text area contains two news items: "PHY Replaces DCL with Solicitation NSF 14-576" and "PHY Int'l Activities - Potential Co-Review". A "Special Announcements" section at the bottom lists "MPS Alliances for Graduate Education and the Professoriate - Graduate Research Supplements (AGEP-GRS) Dear Colleague Letter (NSF 13-071)" and "Dear Colleague Letter - Announcement of Instrumentation Fund to Provide Mid-Scale Instrumentation for FY2014 Awards in Physics Division (NSF 13-118)".

