APS March Meeting 2020:
Undergraduate-friendly research in Soft Matter and Beyond

by Vianney Gimenez-Pinto, Ph.D.

Abstract: The in-person APS March Meeting 2020 taking place in Denver during March 02-06, 2020 was canceled in the last minute out of Covid-19 concerns for the well-being of the scientific community as well as the population of the city of Denver and the state of Colorado. Nevertheless, well-planned logistics by the physics community and the APS leadership, allowed attendants to share their findings, presenting their research works to their peers, and continuing the work towards the advancement of science. Given the historical and on-going under-representation of students of color in science and technology at all academic levels, there is a need to build opportunities for our students to develop scientific skills and mastery by getting involved in research. This report summarizes undergraduate-friendly research in the field of Soft Matter that I found presented in this virtual APS March Meeting 2020. Also, I include other interesting findings that can be useful for serving our students, including lectures on Physics Education Research and other resources for Minority Serving Institutions.

Why Science and Undergraduate Research matter?

An important aspect fueling the current status-quo of structural racism and exclusion in American Society is the reduced participation of people of color in science and technology. The majority of high-paying jobs require solid scientific skills and background. Skills that are particularly hard to nurture when the K12 system under-serves communities of color. In general, competing for those high-paying jobs also requires a graduate education in the form of a Master and/or Doctorate degree. Here at Lincoln, we are in the middle of a student's path from the deeply under-serving K12 towards (hopefully) a highly demanding graduate program/job. Speaking from my personal commitment to equality in society, my role as HBCU faculty member as well as a woman of color in Physics and Chemistry, it is crucial to build and maintain bridges to position our students within the science and technology community.

About the American Physical Society (APS) March Meeting 2020, Covid-19 cancellation and a self-organized physics community tackling logistics problems to present their research findings live

The APS March Meeting is a Major Annual Conference for the Physics Community. This year, more than 10K physicists and researchers, ranking from Undergraduate Students up-to University Professors and/or Industry Researchers, were attending the APS March Meeting 2020 at Denver during March 02-06, 2020.

Given concerns regarding the increase of Covid-19 cases in Italy and other European countries with registered attendants for the event, APS decided to cancel the in-person meeting on the night of Feb-29-2020. I learned about the in-person cancellation, during the early afternoon of March 1, 2020, just after checking-in my accommodations and setting up to work on my talk.

Fortunately, a self-organized initiative from the APS Division of Soft Matter Physics (DSOFT), allowed soft matter scientists and engineers to present their work and interact in a virtual conference. Sessions were hosted by individual researchers that served as chairs. Section titles were flexible and served as sorting categories. Presenters just had to find a feasible session related to their research work and sign-up for a 12 minute time-slot to present. The virtual session program was organized in a shared spreadsheet file and offered links to the official APS program abstract.

I had the opportunity to present a virtual talk live to an audience of 26 scientists and researchers on my work as a postdoctoral research scientist at Columbia University. My talk titled: ***Ordering hard-sphere particle suspensions by medium crystallization: Effect of size and interaction strength,*** covers an under-graduate friendly simulation model. The main objective of the presentation was to analyze how order-templating in particle dispersions by a growing crystal depends on particle size, solvent size and other system-specific characteristics.

In addition to the DSOFT initiative, APS provided an official meeting repository with posters, presentation slides, audio, and videos, for the public to access in an asynchronous manner. My

presentation's abstract and corresponding slides can be found by clicking here (abstract) [1] and here (slides) [2].

Interesting Research Sessions within DSOFT virtual APS

The DSOFT program offered several virtual sessions aligned with my research interests. Among those, I could attend to the following: *Soft Mechanics via Geometry I*; *Soft Mechanics via Geometry II*; *Directed/Self-assembly*; *The Physics of Foams*; *Liquid Crystals, Phases, Chirality and Activity*; *Machine Learning in Soft Matter*; *Self-limiting assemblies in Biology*, *Programmable Assemblies*.

While many of these session titles can appear overwhelming for an undergraduate science student just starting to gain research experience, I was happily surprised to find outstanding undergraduate research being presented among these sessions. I can cite the work presented by Nicole Voce [3], an undergraduate Physics major at James Madison University. She conducted experiments to study the deformation of paper sheets folded in a cylindrical shape and then compressed along the cylinder length axis. From an Applied Mathematics, Materials Science and Soft Matter perspective, she was analyzing the distribution of Gaussian curvature upon uni-axial compression of a surface with initial zero Gaussian curvature but non-zero mean curvature (a cylindrical surface). In terms of Elasticity, these bucking paper deformations are plastic (not reversible), given the elastic properties of paper itself. However, I do not see why this type of study can not be transferred to materials with different elastic properties. Listening to her lecture inspired me to build more varied research opportunities and capabilities for our students pursuing science majors at Lincoln University. Making an effort to involve our students in diversified research projects builds their problem solving skills as scientists and engineers, preparing them for a highly competitive scientific job/graduate school market.

Another interesting set of talks was given by Monica Ripp [4] and Zachariah Schrecengost [5], both graduate students at Syracuse University working on Biomaterials. They were analyzing the actuation of a highly-flexible elastic film of polymer floating on a curved liquid surface (a meniscus). After a quick zoom chat with their research advisor Prof. Joseph Paulsen, I learned about their Interactive Biomaterials Research Experience for Undergraduates (REU) Program at the Syracuse Biomaterals

Institute. The program is tailored for students in Physics, Chemistry, Chemical Engineering and Bio-engineering, interested in biomaterials research. Given that our STM Department at Lincoln serves students from multiple disciplines, this could be a very good opportunity for interested students. More information about the program can be found here [6].

Physics Education findings at the APS March Meeting 2020 talk repository

Among the official APS talk repository, I found an interesting talk on Physics Education "***Transform and Thrive: Large Scale Change in Introductory Physics for the Life Sciences,"*** by Laurie McNeil, Department of Physics and Astronomy, University of North Carolina at Chapel Hill. Lecture slides can be found here [7].

The lecture guides towards a content and delivery transformation on Physics for Biology Majors and Pre-Health Students, according to their career-specific professional needs. **After the transformation, they report happier students that feel supported, have a better sense of the value of physics to them and succeed in the MCAT exams**. **The reformed Introductory Physics curriculum they propose is as follows:**

Reformed First Semester

- Kinematics
- Forces
- Mechanical Energy
- Impulse and Momentum
- Torque
- Oscillations
- Thermodynamics
- Scaling and Allometry
- Stress and Strain, including non-linear materials
- Non-linear Accelerations
- Diffusion

Reformed Second Semester

- Electric Forces and Fields
- Electric Potential
- Capacitance
- DC Resistive Circuits
- RC Circuits
- Magnetic Forces and Fields
- Faraday's and Lenz' Law
- Geometrical and Physical Optics
- Atomic Physics
- Nuclear Physics
- Viscous fluid dynamics
- Cell membrane potential
- Nerve signal propagation
- DNA diffraction

The **reformed curriculum is paired with**:

- A pedagogy transformation that increases the amount of active learning
- Creating course materials that promote active-learning
- Training faculty and teaching assistants in active-engaging pedagogy

They report the implementation of a **Lecture/Studio (New Studio) teaching model**. Studio-Physics is an "ideal" teaching model where lectures are significantly reduced or eliminated, and students perform different types of activities in one session related to an specific learning goal. However, they report better results with a "more realistic" Lecture/Studio model that maintain lectures (interactive lectures) and combines them with studio sessions. In the studio sessions, student perform tutorials, cooperative group problem solving, lab experiments, simulations, etc.

Their corresponding instructional materials for Life Science majors are available upon request by contacting paer@unc.edu and/or http://paer.unc.edu/projects/ipls

This information is particularly relevant given my role teaching General Physics I, General Physics II and co-advising Lincoln's Pre-Med club. While my courses are calculus-based and tailored for scientists/engineers, I must note that Bio-medical engineering, Physics and Chemistry are among the majors and career paths that my students could pursue towards a Health Profession. As a result, modifying my courses to include relevant topics in this reformed curriculum and continue to align my delivery with the Lecture/Studio model are among my take-home lessons in course design.

Resources found beyond the APS Scientific Program

Hunting resources on the web during the virtual conference, I found several useful APS resources for Minority Serving Institutions in the Physics Community.

1. The APS Bridge Program , Enhancing Diversity in Physics Graduate Education, is a free program for Institutions to join. The program comprehends a variety of resources for research opportunities, mentoring for applying to grad school, induction to the academic research culture, student professional development, among other services for physics majors. More information about the program can be found here [8]

2. National Mentoring Community for Minorities is an initiative that builds and facilitates mentoring relationships between African-American, Hispanics and Native American Physics Majors with nearby mentors. The program is free for both mentors and mentees. For more information, click here [9]

3. Brochures for recruiting minority students towards a Physics Major. The pdf brochure can be found here [10]. An Spanish version (useful for Hispanic students discussing career choices with non-English speaking parents) can be found here [11]

4. Poster designed to motivate minority students to learn Physics - click here [12]

Overall, the APS March Meeting Denver 2020, despite taking place online due to Covid-19 concerns, provided plenty intellectual stimulation and ideas to interested attendants. Attending this type of conferences is vital for Lincoln University's Faculty Members. It allows them to remain active in research while innovating in the classroom, network with other scholars and professors, advertise the university within the scientific community, get exposure to scholar activity in other institutions of higher learning across the country, as well as build opportunities for our students in the science and technology community.

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References

[1] Link to webpage - https://meetings.aps.org/Meeting/MAR20/Session/G32.1
[2] Link to webpage - https://absuploads.aps.org/presentation.cfm?pid=17081
[3] Link to webpage - http://meetings.aps.org/Meeting/MAR20/Session/P30.4
[4] Link to webpage - http://meetings.aps.org/Meeting/MAR20/Session/M30.12
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