# Caleb Levy

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## EDUCATION

**Colgate University**, Hamilton, NY
Bachelor of Arts, Physics; GPA: 4.15/4.00 (Major GPA: 4.20)                    Expected May 2023

*Relevant Coursework*: Calculus III, Ordinary Differential Equations, Functions of a Complex Variable, Linear Algebra, Math Methods for Physics, Thermodynamics and Statistical Mechanics, Intro. to Quantum Mechanics and Special Relativity, Intro. to Mechanics, Intro. to Electricity and Magnetism

## MEMBERSHIP

National Society of Black Physicists                                        May 2021 – Present
American Physical Society - Inclusion, Diversity, and Equity Alliance (APS-IDEA)        June 2020 – Present

## HONORS AND AWARDS

**Dec 2021, Sigma Pi Sigma Physics Honor Society** – *Elected for attaining high standards of general scholarship and outstanding achievement in physics.*

**Nov 2021, Beth Brown Memorial Award** – *Awarded for the best undergraduate oral presentation at the annual meeting of the National Society of Black Physicists.*

**April 2021, Charles A. Dana Scholar** – *Selected in recognition of superior academic achievement and demonstrated leadership in the college community.*

**Nov 2020, Phi Eta Sigma National Honor Society** – *Elected for attaining a minimum GPA of 3.5 at the end of freshman year.*

**May 2020, Edwin Foster Kingsbury Prize in Physics** – *Awarded to those students whose performance and promise is judged by the department to be the most outstanding during the year of the award.*

**Fall 2019 - Present, Dean's Award with Distinction for Academic Excellence** - *Awarded to students who receive a term grade point average of 3.6 or higher while completing at least three course credits.*

**June 2017, Caribbean Advanced Proficiency Examination (CAPE), Physics** – *Attained the highest score out of 3000+ students sitting the exam across the Caribbean.*

**June 2017, Caribbean Advanced Proficiency Examination (CAPE), Computer Science** – *Attained the highest score out of 1000+ students sitting the exam across the Caribbean.*

## RESEARCH EXPERIENCE

*SIST Research Intern (Remote),* **Fermi National Accelerator Laboratory, Batavia, IL**        May 2021- Aug 2021
Advisor: Alex Drlica-Wagner (PhD), Scientist
Developed a pipeline for detecting low surface-brightness galaxies (LSBGs) in the Dark Energy Survey (DES) data release two (DR2) using the instance segmentation and object detection algorithm Mask R-CNN. Successfully identified over 20 very large LSBGs (>20 arcsecs) that went undetected by the traditional algorithms employed in the DES pipeline.

- Designed a pre-processing pipeline to remove compact sources and exaggerate low-surface-brightness features in DES coadd image tiles by manipulating NumPy image arrays using slicing and convolution.
- Developed a deep learning model for detecting LSBGs by pre-processing 1% of the DES DR2 coadd tiles with injected LSBG simulations and training the Mask R-CNN algorithm on these images.
- Devised and executed a discovery pipeline on 11,000 DES coadd image tiles which led to the identification of over 20 very large LSBGs.

*Research Fellow,* **Physics and Astronomy Dept., Colgate University, Hamilton, NY**          July 2020 - Present
Advisor: Cosmin Ilie (PhD), Assistant Professor of Physics and Astronomy
Dark Matter capture is the process through which dark matter (DM) particles become gravitationally bound by astrophysical objects after colliding with their constituents. The first generation of stars provides an ideal environment to study this effect and, through limits on their luminosity, can be used to place upper bounds on the DM-proton scattering cross-section.

- Developed a novel formalism for calculating the capture of DM particles by objects composed of an arbitrary number of components.
- Utilized computational techniques in Python, such as multiprocessing, to implement the novel formalism and calculate DM capture rates in the first generation of stars, composed of hydrogen and helium.
- Formulated analytic equations for calculating capture rates in a multi-component context to alleviate computational load.
- Placed competitive bounds on the DM-proton scattering cross-section through the potential observation of the first generation of stars.

## COMPUTATIONAL SKILLS

Python (NumPy, SciPy, Matplotlib, multiprocessing), Mathematica, MATLAB, Latex, Bash/zsh.

## PUBLICATIONS

C. Ilie, C. Levy, J. Pilawa, and S. Zhang. *Constraining dark matter properties with the first generation of stars*. 2021. *Phys. Rev. D **104**, 123031.*

C. Ilie and C. Levy. *Multicomponent multiscatter capture of dark matter*. 2021. *Phys. Rev. D **104**, 083033*.

## PRESENTATIONS

National Society of Black Physicists: Innovate Seminar Series, Remote, Dec 2021. Levy, C. "Multicomponent multiscatter capture of dark matter" (Invited talk).

Machine Learning and the Physical Sciences Workshop at the 35th Conference on Neural Information Processing Systems (NeurIPS), Remote, Dec 2021. Levy, C., Drlica-Wagner, A., et al. "Detecting Low Surface Brightness Galaxies with Mask R-CNN" (Poster and Conference Paper).

National Society of Black Physicists 2021 Conference, Remote, Nov 2021. Levy, C. "Multicomponent multiscatter capture of dark matter" (Parallel talk).

The XXVIII International Conference on Supersymmetry and Unification of Fundamental Interactions (SUSY 2021), Remote, Aug 2021. Levy, C. "Multicomponent multiscatter capture of dark matter" (Parallel talk).

The 24th International Conference on Particle Physics and Cosmology (COSMO'21), University of Illinois (Remote), Aug 2021. Levy, C. "Multicomponent multiscatter capture of dark matter" (Parallel talk).

Rochester Symposium of Physics Students, Rochester, NY, March 2021. Levy, C. "Constraining dark matter properties with population III stars" (Parallel talk).

## TEACHING AND MENTORSHIP EXPERIENCE

*Teaching Assistant – PHYS131/112,* **Physics and Astronomy Dept., Colgate University**          Aug 2020 – Present
*Student Mentor,* **Physics and Astronomy Dept., Colgate University**          Aug 2020 – Present