

Science Undergraduate Laboratory Internships (SULI)

Summer 2022 - Application for: Rachel Xiao Xi Anderson

APPLICANT PROFILE

General Applicant Information

First Name: Rachel

Middle Name: Xiao Xi

Last Name: Anderson

Previous Last Name(s):

Primary Email Address: rachel.x.anderson@stonybrook.edu

Alternate Email Address 1: rachelx.anderson24@gmail.com

Alternate Email Address 2:

ORCID: [0000-0001-7379-3644](https://orcid.org/0000-0001-7379-3644)

Current Address

Primary Phone Number: 267-272-1815

Alternate Phone Number:

Citizenship/Languages/Eligibility Information

I will be 18 years of age or older by the time the internship begins: Yes

Are you a U.S. Citizen? Yes

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EDUCATIONAL BACKGROUND

Academic Information

Are you currently attending a community college or 2-year college?

No

Current academic status:

Sophomore

If you are selected as a participant in this DOE program, will you receive academic credit from your university/college for participating?

No

Undergraduate Institution Information

College/University Country: United States and U.S. Territories

College/University State/Province/Territory:

New York

College/University Name: Stony Brook University

College/University Address: 100 Nicolls Rd, Stony Brook, NY 11794

College/University City: Stony Brook

College/University Zip Code: 11794-0001

Expected/Declared Major: Physical Sciences - Physics

Minor and/or Concentration Expected/Declared: Engineering - Materials - Nanoscience and Nano-engineering

Expected Degree From This College/University: Bachelor's

Expected/Completed Graduation Date: May / 2025

Transcript: SSR_TSRPT.pdf

Does this institution provide grades? Yes

GPA Scale: 4.0

Total Attempted Credits: 15.00

Total Earned Credits: 15.00

Total Quality Points: 53.69

GPA: 3.58

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Science, Technology, Engineering and Mathematics (STEM) Courses

Course Title: Classical Physics B

Course Number: PHY 126

Enrollment Status: Recently Completed

Course Title: Classical Physics II: Honors

Course Number: PHY 142

Enrollment Status: Planning to Enroll

Course Title: Classical Physics Laboratory I

Course Number: PHY 133

Enrollment Status: Recently Completed

Course Title: Classical Physics Laboratory II

Course Number: PHY 134

Enrollment Status: Planning to Enroll

Course Title: Differential Equations with Linear Algebra

Course Number: MAT 308

Enrollment Status: Planning to Enroll

Course Title: Materials of the Modern World

Course Number: ESM 150

Enrollment Status: Recently Completed

Course Title: Multivariable Calculus and Linear Algebra

Course Number: MAT 307

Enrollment Status: Recently Completed

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Summer 2022 - Application for: Rachel Xiao Xi Anderson

Awards or Honors

Award Title: AP Capstone Diploma

Month & Year Received: July / 2021

Awarding Institution: College Board

Award Title: AP Scholar with Distinction

Month & Year Received: July / 2021

Awarding Institution: College Board

Award Title: National AP Scholar

Month & Year Received: July / 2020

Awarding Institution: College Board

Award Title: Deans List

Month & Year Received: December / 2021

Awarding Institution: Stony Brook University

High School Graduation or GED

Date of High School Graduation or GED: June / 2021

Country: United States

City: Quakertown

State/Province/Territory: PA

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WORK EXPERIENCE & SKILLS

Work Experience

Name of Place of Employment or Activity:	Generations Senior Center
Dates of Employment or Activity:	From 5/7/2019 To 5/31/2019
Hours Per Week:	5.0
Primary Duties:	Taught the art of figure drawing by explaining and showing examples of realistic human anatomy.
Tasks Performed:	I began by showing an example of how a part of the body is drawn by first drawing it myself, and I allowed students to try on their own as I add more detail to my drawing. I examine their work and offer praise and suggestions to better their drawing. I also used a PowerPoint and note papers to visually and verbally explain shading techniques for different surfaces such as skin, hair, fabric, and eyes.

Professional Associations

Are you a member of any professional organizations?	Yes
Professional associations you are affiliated with:	Society of Physics Students

Computer Skills

Computer related skills:	<ul style="list-style-type: none"> • Proficient using Microsoft Office • Some basic knowledge of Python
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PROGRAM INFORMATION

Eligibility

Have you previously participated in 2
SULI appointments? No

Previous DOE Internship/Fellowship Experience

Have you ever had an
internship/fellowship with the
Department of Energy or any of its
National Laboratories? No

Availability

What is the earliest date you can
begin your internship? 5/1/2022

When do you need to complete your
internship? 9/30/2022

First Choice Host DOE Laboratory

DOE Laboratory: Brookhaven National Laboratory (BNL)

First Choice Research Area: Nanoscience

Second Choice Research Area: High Energy Physics

Third Choice Research Area: Condensed Matter Physics

Second Choice Host DOE Laboratory

DOE Laboratory: Thomas Jefferson National Accelerator Facility (TJNAF)

First Choice Research Area: High Energy Physics

Second Choice Research Area: Materials Sciences

Third Choice Research Area: Engineering Materials

Relatives Employed at DOE Laboratories

Are you a relative of an employee at
the proposed host DOE laboratories? No

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ESSAYS

Research Experience:

- AP Capstone Diploma during high school in 2 years (each project included writing a formal research paper and giving a correlating presentation with oral defense)
 - Year 1 (AP Seminar): Researching with a group investigating mandatory vaccination in public schools
 - Year 2 (AP Research): Independently examining secondary students' knowledge of climate change
- *CentriSeed Innovations'* SolarCom project at Stony Brook

During the first course, we examined the question: should public schools enforce vaccination for attending students? We learned how to read research papers written by credible authors and to synthesize these sources to examine our research question. For example, other papers concluded that 95% of a community vaccinated theoretically stops the spread of contagious viruses, which contributed to our conclusion that vaccinations should be mandatory for 95% of the population.

In the second course, I researched the extent to which high school students in developed nations understand climate change. Upon finding a positive correlation between student age and their understanding of climate change, I concluded that mandatory climate change education for younger students (age 15-16) may be necessary. The skills I gained in the first course helped me use other research to create a survey designed to test student knowledge of climate change. I distributed this survey to students ages 15 - 18 and scored each survey on a scale from 0 - 21 points. I used the mean and standard deviation of each age range to compare each age's level of knowledge, and then I used multiple independent sample T - tests to determine if there were significant differences in scores between each age group. While this research is more subjective than research I hope to contribute to in a physics lab, it helped develop my understanding of various statistical tests and how to interpret their results. I also gained experience writing formal papers to explain the implications of my research and defending my thesis after presenting it to an audience.

SolarCom's most recent project is to build a phone charging station powered by solar panels. Although our senior project lead is building the circuit connecting the panels, charge controller, battery, and USB hub, I have been helping present the project's progress to the *CentriSeed* general body meetings. Next semester, my project lead will teach me how he and Professor Fang Luo (our advisor) built the circuit.

Research Interests:

BNL

- QPress
- RHIC
- STAR
- sPHENIX

JLab

- CEBAF
- MOLLER experiment

I chose Stony Brook University because it is affiliated with Brookhaven Lab. Since the beginning of high school I have been interested in subatomic particles, which morphed into an interest in nanoscience and high energy physics.

Some of the most interesting modern nanoscience research attempts to understand electron behavior in a thin film only a few atoms thick. Brookhaven's Qpress is designed to do just that; it builds and studies 2d films and heterostructures. I understand heterostructures to be flat nanoscale substrates with layers of two dimensional films. The Qpress employs unique deposition methods and includes a catalogue which scans the microscopic flakes to obtain relevant information. I want to work with researchers to study quantum effects that occur in heterostructures. Using BNL's QPress, I hope to advance my knowledge of computational science, quantum sensing, or information science.

BNL and JLab's high energy experimental physics is also interesting, as it researches some of the biggest questions in modern physics. One notable discrepancy in modern physics is between the spin of a proton and the spin of its constituent quarks. The two up quarks and one down quark only contribute to about 30% of a proton's spin, and

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Brookhaven is using the RHIC to investigate why. I want to learn how BNL uses the decay products produced from RHIC collisions to study gluons' contribution to spin. As an intern, I could use accelerator simulations to optimize beam conditions. For most collisions, the optimal beam would be a cooled proton beam with polarized spin. At BNL's RHIC or Jlab's CEBAF I can learn how magnets accelerate particles to ~99% the speed of light. An intersection of quantum physics and accelerator science is superconductor technology. I would love to work with BNL's sPHENIX superconducting solenoids which generate magnetic fields used in spectroscopy.

Jlab has a history of studying the weak force and its CP violation. The Q weak experiment measured the parity violation of electron scattering from a proton. Today, Jlab's MOLLER experiment interests me because it also explores parity violation, this time with electron electron scattering. While I will not understand the mathematics behind it, I hope to work with the accelerators used in this experiment.

Personal Experience:

I have always loved art, specifically creating art depicting the human body. Understanding all the angles of the human body has made me a spatial thinker, and it has even helped me visualize vectors and surfaces in three dimensions. I would even say it has the potential to help me visualize the spin, magnetic fields, or decay product scattering patterns that I aspire to study in a laboratory. Whether or not it will help me get an internship now, it certainly landed me my first job.

At 16, I was hired to teach a figure drawing class for senior citizens. I had organized a Google Slides presentation and several papers to explain proportions, texture, and shading. I even packed some candies as a finishing touch.

On the first day I quickly realized I had no idea what I was doing. One person only wanted to draw faces, while another person thought it was a cartoon drawing class. As I was rummaging through the materials that I meticulously packed, I realized that I did not have a single writing utensil that anyone could see from where I was standing.

Glancing around the room, there happened to be a sharpie marker and some large, elementary school style paper. I took those and just started drawing. The hum of conversation faded as I started to explain how eyes have a watery texture, causing light to reflect off of them more than light reflects off of skin (they have a higher index of refraction). I talked about the eyelid and how different eye shapes cause different shadows to fall over the cheekbones. I taught my students to think spatially and to picture the human body in three dimensions. Only then could they use two dimensional paper to capture the human figure. Giving them resources was not enough. They needed feedback. They needed my examples. They needed me to explain every stroke I made. Eventually, I felt proud to see that these seniors, who had so much more life experience than I, could respect my techniques and use them to become satisfied by their own work.

I learned the importance of demonstrating different techniques to illustrate a realistic figure. The class only lasted a month, but it taught me communication, leadership, and problem solving skills that will translate well to a laboratory setting where I will need to find the best method to obtain a desired outcome. Whether it be building heterostructures, optimizing beam conditions, or calibrating simulations, I hope to put these skills to good use.

Professional Goals:

As a first year student I have some time to decide my professional goals. A SULI internship could be the beginning of a career in any of the following topics:

- Nanotechnology

Within the next year I plan to declare a minor in nanotechnology studies which I intend to use for engineering strong materials, hydrogen cells, computer chips, or sensors. Working with BNL's QPress or JLab's superconductors would shed light on this interest.

- Quantum physics

My interest in nanoscience also involves quantum physics. In my academics I plan on doing research which is why I am majoring in pure physics as opposed to engineering physics. If I choose this path, I hope to contribute to the worldwide race to build a quantum computer. Quantum information science relies on quantum superposition, the capability of a particle to occupy multiple quantum states at once. At SBU and

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SULI's internship, I hope to learn more about information science and computational science, and combined with an understanding of quantum physics I will be able to work with qubits.

- Nuclear theory

In the realm of the very small, particle physics has also been one of my greatest interests because it explores the least known fundamental forces: the weak and strong nuclear forces. If I choose to concentrate my career in this field, one of my goals would be to understand why the weak force violates CP symmetry, and starting to study these at BNL or JLab would be my first steps in doing so. (This is why I am so interested in JLab's MOLLER experiment which is currently studying parity symmetry breaking with electron pairs).

- Accelerator science

The study of tiny particles and their forces lead me to an interest in accelerator physics. As data science is becoming an increasingly prominent tool for managing colossal amounts of information, I plan to learn the theory behind it as well as the programming language R. The accelerator physicists at BNL and JLab must use data analysis to collect the most relevant data from particle collisions, and experience with this would be extremely valuable in learning about this field.

Working with BNL or JLab researchers would help me build skills to achieve any of these goals and most importantly help me find a field of physics to spend more of my life working on.

RECOMMENDATIONS

Recommendation 1: **First Name:** Andrew
Last Name: Hanlon
Email: andrew.hanlon@stonybrook.edu
Status: Received 1/6/2022

Recommendation 2: **First Name:** Dennis
Last Name: Auger
Email: dauger@qcsd.org
Status: Received 1/9/2022

Unofficial Transcript

Name: Rachel Anderson
Student ID: 114267609

Institution Info: State University of New York
Print Date: 12/29/2021

Transfer Credits

Transfer Credit from Lehigh University
Applied Toward Arts and Sciences Program

		Fall 2021		Attempted	Earned	Grade	Points
Course		Description					
ESG	1XX	Need Dept Eval-Engineering Sci		1.000	1.000	A	0.000
Course Trans GPA:		0.000	Transfer Totals:	1.000	1.000		0.000

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Test Credits

Test Credits Applied Toward Arts and Sciences

		Fall 2021		Attempted	Earned	Grade	Points
Course		Description					
CHE	131/AP	AP CHE 131		4.000	4.000	T	0.000
CHE	133/AP	AP Waiver CHE 133		0.000	0.000	T	0.000
CHE	L3	Chemistry Placement Level 3		0.000	0.000	T	0.000
CHI	212/AP	AP CHI 212		3.000	3.000	T	0.000
CHI	LVL4	Chinese Placement Level 4		0.000	0.000	T	0.000
MAT	131/AP	AP MAT 131		4.000	0.000	T	0.000
Repeated:		No Credit Earned					
MAT	131/AP	AP MAT 131		4.000	4.000	T	0.000
Repeated:		Credit Earned with passing grade					
MAT	132/AP	AP MAT 132		4.000	4.000	T	0.000
PHY	SNW/AP	AP Physics 1		3.000	3.000	T	0.000
PHY	127/AP	AP Physics C: Electrical & Mag		3.000	3.000	T	0.000
PHY	125/AP	AP Physics C: Mechanics		3.000	3.000	T	0.000
PSY	103/AP	AP Psychology		3.000	3.000	T	0.000
WRT	LVL4	Writing Placement Level 4		0.000	0.000	4	0.000
Test Trans GPA:		0.000	Transfer Totals:	27.000	27.000		0.000

Test ID	Test Component	Test Date	Test Scores	Data Source
PLMNT	Writing	06/15/2021	4.00	PLC

Beginning of Undergraduate Record

Fall 2021

Program: Arts and Sciences
Plan: Physics Major
Plan: Honors College Requirement Plan Honors

Unofficial Transcript

Name: Rachel Anderson
Student ID: 114267609

Session: Full Fall Semester Session (08/23/2021 - 12/16/2021)

<u>Course</u>	<u>Description</u>	<u>Attempted</u>	<u>Earned</u>	<u>Grade</u>	<u>Points</u>
ESM 150	Materials of the Modern World	3.000	3.000	A	12.000
Course Attributes:	TECH Understand Technology				
HON 101	Introduction to Stony Brook	1.000	1.000	S	0.000
HON 105	Modes of Knowledge	3.000	3.000	A	12.000
Course Attributes:	CER_PART Practice & Respect Critical/Ethical Rsng				
	HUM_PART Use Critical Analysis &Methods Humanities				
	SBS_PART Observe/Analyze Human Behavior & Society				
MAT 307	Multivariable Calc Linear Alg	4.000	4.000	A-	14.680
Course Attributes:	STEM+ Science, Technology, Engineering & Math				
PHY 126	Classical Physics B	3.000	3.000	A-	11.010
Req Designation:	DEC E. Required grade: A through D				
Course Attributes:	SNW Study the Natural World				
PHY 133	Classical Physics Laboratory I	1.000	1.000	A	4.000
Course Attributes:	Controlled Access				

		<u>Attempted</u>	<u>Earned</u>	<u>GPA Units</u>	<u>Points</u>
Term GPA	3.840 Term Totals	15.000	15.000	14.000	53.690
Cum GPA	3.840 Cum Totals	15.000	43.000	14.000	53.690
Term Honor:	Dean's List				
Academic Standing Effective 12/29/2021: Academic Standing: GOOD					

Winter 2022

Program: Arts and Sciences
Plan: Physics Major
Plan: Honors College Requirement Plan Honors

Session: Winter (01/04/2022 - 01/22/2022)

<u>Course</u>	<u>Description</u>	<u>Attempted</u>	<u>Earned</u>	<u>Grade</u>	<u>Points</u>
ARH 209	Arts of the United States	3.000	0.000		0.000
Req Designation:	DEC K. Required grade: A through D				
Course Attributes:	ARTS Explore & Understand the Fine & Perf. Arts				
	USA Understand the History of the United States				

Spring 2022

Program: Arts and Sciences
Plan: Physics Major
Plan: Honors College Requirement Plan Honors

Unofficial Transcript

Name: Rachel Anderson
Student ID: 114267609

Session: Full Spring Semester Session (01/24/2022 - 05/18/2022)

<u>Course</u>	<u>Description</u>	<u>Attempted</u>	<u>Earned</u>	<u>Grade</u>	<u>Points</u>
ARH 202	Arts of the Ancient World	3.000	0.000		0.000
Req Designation:	DEC D. Required grade: A through D				
Course Attributes:	ARTS Explore & Understand the Fine & Perf. Arts				
HON 106	Modes of Being	3.000	0.000		0.000
Course Attributes:	CER_PART Practice & Respect Critical/Ethical Rsng				
	HUM_PART Use Critical Analysis &Methods Humanities				
	SBS_PART Observe/Analyze Human Behavior & Society				
HON 112	Honors Topics	1.000	0.000		0.000
Course Topic:	Diversity and Inclusion				
MAT 308	Differential Eq. w/ Linear Alg	4.000	0.000		0.000
Course Attributes:	STEM+ Science, Technology, Engineering & Math				
PHY 134	Classical Physics Lab II	1.000	0.000		0.000
Course Attributes:	Controlled Access				
WRT 102	Intermediate Writing Workshop	3.000	0.000		0.000
Req Designation:	D.E.C. A2 & Skill 2. Required grade: A through C				
Course Attributes:	WRT Write Effectively in English				

Undergraduate Career Totals

Cum GPA:	3.840 Cum Totals	15.000	43.000	14.000	53.690
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End of Unofficial Transcript

SULI PROGRAM APPLICATION RECOMMENDATION FOR RACHEL XIAO XI ANDERSON

Recommender Contact Information

- **First Name:** Andrew
- **Last Name:** Hanlon
- **Title:** Research Assistant Professor
- **Department:** Mathematics
- **Institution/Organization:** Stony Brook University and Simons Center for Geometry and Physics
- **Telephone:**
- **Email:** andrew.hanlon@stonybrook.edu

Applicant Information

Association

Describe your relationship to the applicant, including how long you've known the applicant, where, and in what capacity.

I had Rachel as a student in my multivariable calculus with linear algebra course (30 students) in Fall 2021 at Stony Brook University. As a result, I have known Rachel for about 6 months. Rachel was among the top 10 students and received a grade of A-. This was a very fast paced course covering both the foundations of linear algebra and all the content of a standard first course in multivariable calculus. In addition, the course is analogous to an "honors" course, and the material was approached with more rigor than the standard linear algebra and multivariable calculus courses. In particular, students were introduced to basic mathematical proofs and had to develop their abilities in mathematical reasoning.

Applicant Comments

Please provide substantive comments about the applicant's education, training, aptitude, or promise relevant to the SULI program. Include any relevant additional detail or perspective regarding the applicant's research experience or equivalent experience on complex projects, including the level of independence or other factors that would contribute to the applicant's ability to make an excellent contribution to the SULI program.

Rachel Anderson is an excellent candidate for the Science Undergraduate Laboratory Internships program, and I am happy to be writing a letter of recommendation for her. She is one of the most dedicated and persistent undergraduates that I have taught at Stony Brook. With these qualities, I believe that she will produce meaningful results in an internship if given the opportunity. Exposure to research at this stage could also be very beneficial to her future STEM career.

I gave many challenging homework and exam problems that Rachel routinely worked hard to solve. She regularly attended my office hours and always had substantial questions demonstrating her effort and ability to work independently. On several occasions, she even asked me questions from the textbook and other sources on material or problems that were not assigned. It was clear to me that Rachel does not give up easily and had a strong desire to master the material in the course. She also exhibited her ability to communicate effectively and go back and forth in a discussion on a difficult mathematical concept or problem. Therefore, I firmly believe Rachel has the necessary ability and determination to succeed in the SULI program and strongly recommend her.

Applicant Rating

In comparison to other undergraduate students, please rate the applicant relative to his/her peers on the following qualifications:

	Do Not Know	Below Average	Average	Above Average	Superior
Analytical and Mathematical				X	
Experimental Research	X				
Overall Academic				X	
Initiative and Self Reliance					X
Motivation toward Scientific Career					X
Originality of Thought				X	
Emotional Maturity				X	
Ability to Work with Others				X	
Potential for Leadership				X	
Oral Communication Skills				X	
Written Communication Skills				X	

SULI PROGRAM APPLICATION RECOMMENDATION FOR RACHEL XIAO XI ANDERSON

Recommender Contact Information

- **First Name:** Dennis
- **Last Name:** Auger
- **Title:** AP Physics Teacher
- **Department:** Science
- **Institution/Organization:** Quakertown Community School District
- **Telephone:** 215-272-3199
- **Email:** dauger@qcsd.org

Applicant Information

Association

Describe your relationship to the applicant, including how long you've known the applicant, where, and in what capacity.

I've known Rachel for about 1.5 years. She was a student in two of my courses; AP Physics 2 and AP Physics C Mechanics and E&M. She worked virtually last year using Google Meets daily, online book and AP resources and virtual office hours. I provided guidance as she progressed through the courses virtually and provided resources for her success.

Applicant Comments

Please provide substantive comments about the applicant's education, training, aptitude, or promise relevant to the SULI program. Include any relevant additional detail or perspective regarding the applicant's research experience or equivalent experience on complex projects, including the level of independence or other factors that would contribute to the applicant's ability to make an excellent contribution to the SULI program.

Rachel Anderson is a strong independent learner. Last year, she worked virtually on AP Physics 2, AP Physics C: Mechanics and AP Physics C: Electricity and Magnetism. During a challenging time to be a student, she rose to the occasion and surpassed my expectations of an AP student. She attended class for both APC and AP2 daily through Google Meet and would also meet individually with any questions.

It was entirely up to Rachel to keep up with the workload and content. Rachel could often answer questions that other students had during class just from her research and studying. She would join lab groups virtually and still contribute to the group's procedure, analysis and overall understanding of the content.

Rachel worked extremely well with her classmates and was always respectful and appreciative of any help or guidance she received from me. She proved to be successful in both courses under non-ideal circumstances. I highly recommend Rachel to your program. She will be a positive contributor to any science and research program.

Applicant Rating

In comparison to other undergraduate students, please rate the applicant relative to his/her peers on the following qualifications:

	Do Not Know	Below Average	Average	Above Average	Superior
Analytical and Mathematical					X
Experimental Research				X	
Overall Academic				X	
Initiative and Self Reliance					X
Motivation toward Scientific Career					X
Originality of Thought				X	
Emotional Maturity				X	
Ability to Work with Others				X	
Potential for Leadership					X
Oral Communication Skills					X
Written Communication Skills					X