

Science Undergraduate Laboratory Internships (SULI)

Summer 2022 - Application for: George Evans

APPLICANT PROFILE

General Applicant Information

First Name: George

Middle Name:

Last Name: Evans

Previous Last Name(s):

Primary Email Address: georgesevans1@gmail.com

Alternate Email Address 1: george@evanse.com

Alternate Email Address 2:

ORCID: [0000-0001-7612-9490](https://orcid.org/0000-0001-7612-9490)

Current Address

Primary Phone Number: 804-350-0637

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:

Recent Graduate

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:

Idaho

College/University Name: Brigham Young University-Idaho

College/University Address: 525 S Center St

College/University City: Rexburg

College/University Zip Code: 83460-1650

Expected/Declared Major: Physical Sciences - Physics

Minor and/or Concentration Expected/Declared:

Mathematics

Expected Degree From This College/University:

Bachelor's

Expected/Completed Graduation Date:

April / 2022

Transcript: Unofficial Transcript of George Evans Redacted.pdf

Does this institution provide grades? Yes

GPA Scale: 4.0

Total Attempted Credits: 122.00

Total Earned Credits: 115.00

Total Quality Points: 454.40

GPA: 3.95

Overall Cumulative GPA: 3.95

Science, Technology, Engineering and Mathematics (STEM) Courses

Course Title: Engineering Statistics

Course Number: MATH 330

Enrollment Status: Currently Enrolled

Course Title: Special Topics in Physics

Course Number: PH 390R

Enrollment Status: Currently Enrolled

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Awards or Honors

Award Title: Scholarship: Thomas E. Ricks Grant

Month & Year Received: September / 2020

Awarding Institution: Brigham Young University - Idaho

High School Graduation or GED

Date of High School Graduation or GED: May / 2015

Country: United States

City: Goochland

State/Province/Territory: VA

Graduate School Information

Have you applied to graduate school? Yes

Country of Graduate School: United States and U.S. Territories

State of Graduate School: Utah

Name of Graduate School: Brigham Young University

Planned Area of Graduate Studies: Physical Sciences - Physics - Theoretical and Mathematical Physics

Country of Graduate School: United States and U.S. Territories

State of Graduate School: Massachusetts

Name of Graduate School: Massachusetts Institute of Technology

Planned Area of Graduate Studies: Physical Sciences - Physics - Theoretical and Mathematical Physics

Country of Graduate School: United States and U.S. Territories

State of Graduate School: Arizona

Name of Graduate School: Arizona State University

Planned Area of Graduate Studies: Physical Sciences - Physics - Theoretical and Mathematical Physics

Country of Graduate School: United States and U.S. Territories

State of Graduate School: New York

Name of Graduate School: City University of New York Graduate Center

Planned Area of Graduate Studies: Physical Sciences - Physics - Theoretical and Mathematical Physics



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WORK EXPERIENCE & SKILLS

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Work Experience

Name of Place of Employment or Activity:	Idaho National Laboratory
Dates of Employment or Activity:	From 5/24/2021 To Present
Hours Per Week:	40.0
Primary Duties:	<p>Summer 2021:</p> <ul style="list-style-type: none"> * Set up a coincidence doppler broadening (CDB) system in a radiologically hot facility. * Set up a CDB system in a radiologically cool facility. * Set up a system for filling the Dewars of the High Purity Germanium (HPGe) detectors used for the CDB system in the radiologically cool facility. * Tested, troubleshooted errors in, and fixed the aforementioned systems as needed. <p>Fall 2021:</p> <ul style="list-style-type: none"> * Expanded the functionality of the data analysis program HyPAT (Hydrogen Permeation Analysis Tool). * Prepared HyPAT for publication to GitHub. * Prepared accompanying documents for publication with HyPAT. * Continued to test, troubleshoot errors in, and fix the systems set up in Summer 2021 as needed. <p>Winter 2022 (Anticipated duties):</p> <ul style="list-style-type: none"> * Expand the functionality of HyPAT to handle absorption experiments. * Prepare the expanded HyPAT for publication to GitHub. * Write a manual to accompany HyPAT. * Prepare HyPAT's manual for publication in an academic journal. * Run permeation experiments and analyze the resulting data. * Run absorption experiments and analyze the resulting data. * Continue to test, troubleshoot errors in, and fix the systems set up in Summer 2021 as needed.
Tasks Performed:	<p>Summer 2021</p> <p>Became resident expert in coincidence doppler broadening (CDB) systems by thoroughly studying the manuals of the various hardware and software used in the system. This way, I could set up, calibrate, and test the CDB systems, along with troubleshoot/fix errors as they come up.</p> <p>Assembled two Canberra high purity Germanium (HPGe) detectors with multi-attitude cryostats into a CDB system in a radiologically cool lab. This involved connecting the detectors to TechnoAP modules which supplied the requisite high voltage (HV), preamplifier power, and digital spectrum analyzer (DSA). This also involved cooling both HPGe detectors with liquid nitrogen (LN2).</p> <p>Assembled Teragon LN2 products into a system designed to automatically and safely keep both aforementioned detectors cooled with LN2. This involved filling both pressurized and unpressurized Dewars with LN2, along with carefully hooking up hoses throughout the system.</p> <p>Assembled two Ortec HPGe detectors with PopTop cryostats into a CDB system in a radiologically hot lab. This involved connecting the detectors to TechnoAP modules which supplied the requisite HV, preamplifier power, and DSA. This also involved assembling aluminum platforms to allow for proper alignment of the detectors, along with assembling each detector in the first place.</p> <p>Fine-tuned and calibrated the Canberra HPGe detectors with each other and the Ortec HPGe detectors with each other. This involved using an oscilloscope to appropriately adjust the digital and analog signal characteristics, along with other settings on TechnoAP's software. This also involved running test CDB and DBS (Doppler Broadening Spectroscopy) experiments on the system using sealed sources of beta particles.</p> <p>Fall 2021</p> <p>Became acquainted with permeation and absorption experiments through reading various published works my mentors recommended. This also included reviewing and editing an upcoming internal document outlining how to run the permeation and absorption experiments.</p> <p>Expanded the functionality of the data analysis program HyPAT (Hydrogen Permeation Analysis Tool). This included making the tool more intuitive and less prone to bugs. In particular, I added a way to adjust how the program reads data from Excel files while within the application. This enables researchers with a variety of experimental setups to use the application without needing to edit the code.</p> <p>Prepared HyPAT for publication to GitHub. This included cleaning up many cosmetic errors, making the code more</p>

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understandable, and testing HyPAT extensively. HyPAT has since been published to GitHub and can be found here: <https://github.com/IdahoLabResearch/HyPAT>

Prepared the README for HyPAT and started on other documentation. This included gaining knowledge on what a README should be like and writing various drafts of the README, collaborating closely with my mentor throughout the whole processes.

Troubleshooted problems with the CDB systems as they came up. This included using voltmeters, oscilloscopes, scales, and an infrared thermometer to monitor various parts of the system.

Winter 2022 (Anticipated tasks)

Expand the functionality of HyPAT to handle absorption experiments. This will include adding another tab to HyPAT, along with all the testing that will accompany such an addition. This will likely also include adding features that were left out of the first version due to lack of time.

Prepare the expanded HyPAT for publication to GitHub. This will require more testing, cleaning up of the code, and preparation of documents.

Write a manual to accompany HyPAT. This will include preparing the manual for publication in an academic journal, then publishing it in that journal.

Run permeation experiments and analyze the resulting data. This will include loading samples into the apparatus and operating the experiments via a digital interface, or sometimes manual valves and switches when necessary. This will also include using HyPAT to analyze the resulting data.

Run absorption experiments and analyze the resulting data. This will include loading samples into the apparatus and operating the experiments via a digital interface, or sometimes manual valves and switches when necessary. This will also include using HyPAT to analyze the resulting data.

Troubleshoot problems with the CDB systems as they come up. This will likely include using voltmeters, oscilloscopes, scales, and an infrared thermometer to monitor various parts of the system. This will also likely include expanding a previously published CDB analysis program to easily accept data from the current setup.

Name of Place of Employment or Activity:	Brigham Young University
Dates of Employment or Activity:	From 6/8/2020 To 9/14/2020
Hours Per Week:	40.0
Primary Duties:	<ul style="list-style-type: none"> * Expanded the functionality of a Julia-based program for plotting model manifolds. * Developed procedures for categorizing chemical networks according to their model manifolds. * Connected the manifold structure of mass action models to the structure of various chemical networks.
Tasks Performed:	<p>Expanded the functionality of a Julia-based program for plotting model manifolds. This included making it easily adaptable to many types of arbitrary chemical networks and expanding the number of parameters that could be used. Doing so enabled users to visualize model manifolds far more easily and quickly than they could otherwise. I also discovered several shortcomings of such visualization software, such as symmetries that caused a misleading cross-section of the manifold to be displayed. I mitigated this problem by making it possible to break time-based and initial-conditions-based symmetries.</p> <p>Created a Mathematica script that could solve many semi-arbitrary mass action models. This involved several upgrades to the script to handle more and more complex models. Users could thus get algebraic solutions to many reduced mass action models rather than relying on pen and paper or intuition alone.</p> <p>Found many of our initial assumptions to be incorrect by devising or discovering counterexamples. This involved extensive use of the Julia and Mathematica programs mentioned before to visualize the manifolds and algebraically solve mass action models. This also required lots of pattern recognition and intuition regarding what was likely to be a counterexample. Much of this pattern recognition and intuition took place using pen and paper to describe ideas, then prove them.</p> <p>Devised a systematic way to create new network structures which have a known model manifold structure from network structures for which we have derived the model manifold structure already. This included much of what went into devising or discovering counterexamples, such as use of computational tools and pattern recognition.</p> <p>Noticed several consistent ways in which model manifold structures behave when created out of chemical network</p>

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	<p>structures and used these ways to categorize chemical networks according to their resulting model manifold. This included much of what went into devising or discovering counterexamples, such as use of computational tools and pattern recognition.</p> <p>Connected the manifold structure of mass action models to the structure of various chemical networks. This included generating such hypotheses as "all simple path chemical networks with no reactants generated as a product will have a hypercubic model manifold" and "any chemical network that has a reaction produce its reactants and along with at least one additional product will have a boundary at infinity." These and other hypotheses were devised through extensive use of the computational tools, pattern recognition, and other methods described earlier. As of now, these hypotheses are thought to be true, even if they haven't yet been proven.</p>
Name of Place of Employment or Activity:	Brigham Young University - Idaho
Dates of Employment or Activity:	From 4/23/2020 To 5/28/2021
Hours Per Week:	10.0
Primary Duties:	<ul style="list-style-type: none"> * Helped students become more able to do their physics homework. * Raised awareness of the Physics Drop-In Tutoring Lab * Remained available in case of an emergency that needed handling; kept the lab running smoothly.
Tasks Performed:	<p>Tutored any student who came to the lab desiring help with homework. This involved quickly assessing what needed to be done for a variety of lower level physics problems, explaining physics and math concepts simply, and overall helping students learn how to solve the problems themselves. Such tutoring enabled professors to have more time to focus on their work and allowed students access to help outside of normal office hours.</p> <p>Reached out to students and professors to help them be aware of how the Physics Drop-In Tutoring Lab ("the lab") could help them. This involved working closely with the physics department secretary and my coworkers to send out emails to the students with information regarding the lab. This also involved reaching out to each physics professor and assisting them in helping their class be aware of the lab, such as by coming to classes to present on the benefits of accepting the help of or volunteering for the lab.</p> <p>Kept the lab running smoothly by being patient and calm despite potentially stressful situations. This often involved lightening the mood of a student who was having a bad day or helping another tutor who was stuck with some problem. This also involved staying on call in case a more serious situation arose.</p>
Professional Associations	
Are you a member of any professional organizations?	No

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Computer Skills

Computer related skills:

Python:

- Expanded the functionality of and worked extensively on the application HyPAT (Hydrogen Permeation Analysis Tool). Helped publish the code for HyPAT to GitHub (see <https://github.com/IdahoLabResearch/HyPAT>)
- Modeled a variety of systems, e.g., a rope with mass, a solar system with arbitrarily many gravitationally interacting planets, and a (chaotic) driven, damped pendulum.
- Performed a variety of mathematical operations, such as solving eigenvalue equations, performing integrals, and using the Monte Carlo method.
- Performed error analysis

Proficient in Microsoft Office, including Microsoft Word, Microsoft Excel, Microsoft OneNote, Microsoft PowerPoint, Microsoft Outlook, and Microsoft Teams

Proficient in Google Workspace, including Gmail, Google Drive, Google Docs, Google Sheets, Google Slides, and Google Colab

Mathematica

- Linear algebra
- Error analysis
- Upper division math (including partial differential equations and complex analysis)

Latex

- Written many reports, including my senior thesis, in Latex

Experience with the programming languages Julia, C++, and BASIC256

Other experience:

- Zoom
- Logger Pro
- Adobe Acrobat
- Discord

Laboratory/Technical Skills

Experience with advanced laboratory techniques or equipment:

INL Radiation Worker II certified, which I was told can transfer to other DOE laboratories. This certification is required to enter INL High and Very Radiation Areas, Contamination and High Contamination Areas, or Airborne Radioactivity Areas, or for an employee who develops detailed Radiological Work Plans involving radioactivity or radioactive materials.

Filled pressurized and unpressurized Dewars with liquid nitrogen.

Set up High Purity Germanium (HPGe) Detectors in coincidence to perform Coincidence Doppler Broadening (CDB), a form of Positron Annihilation Spectroscopy (PAS). This was done in both radiologically hot and cool labs.

Performed Positron Annihilation Lifetime Spectroscopy (PALS) and Doppler Broadening Spectroscopy (DBS) experiments (both of which are forms of PAS), along with CDB experiments.

Experience with Arduinos and using them to create instruments for high-altitude balloons.

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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? Yes

Program: Other

DOE Laboratory or Site: Idaho National Laboratory (INL)

Year: 2021

Availability

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

When do you need to complete your
internship? 9/2/2022

First Choice Host DOE Laboratory

DOE Laboratory: Brookhaven National Laboratory (BNL)

First Choice Research Area: Computational Sciences

Second Choice Research Area: Mathematics

Third Choice Research Area: High Energy Physics

Second Choice Host DOE Laboratory

DOE Laboratory: Thomas Jefferson National Accelerator Facility (TJNAF)

First Choice Research Area: Accelerator Physics/Science

Second Choice Research Area: Mathematics

Third Choice Research Area: High Energy Physics

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:

Research Assistant from May 2021 – Present

Idaho National Laboratory in Idaho Falls, ID, and the Materials & Fuels Complex, ID

- Assembled, fine-tuned, and calibrated a pair of high purity Germanium (HPGe) detectors into a Coincidence Doppler Broadening (CDB) system in a radiologically hot facility
- Assembled, fine-tuned, and calibrated another pair of HPGe detectors into a CDB system in radiologically cool facility.
- Assembled a system designed to automatically and safely keep the second pair of detectors cooled with LN₂
- Presented a poster on the project (see internpostersession.inl.gov/PosterImages2021/Evans.George.jpg)
- Expanded the functionality of the python-based data analysis application HyPAT (Hydrogen Permeation Analysis Tool).
- Prepared HyPAT for publication to GitHub (see github.com/IdahoLabResearch/HyPAT)
- Work in the radiologically cool lab was usually done by a small group. Otherwise, except for a daily check-in, I worked independently

Research Assistant from June 2020 – September 2020

Brigham Young University in Provo, UT

- Expanded the functionality of a Julia-based program for plotting model manifolds
- Developed procedures for categorizing chemical networks
- Connected the manifold structure of mass action models to the network structure of various chemical networks
- Published my Senior Thesis on this project (search for my name at www.byui.edu/physics/student-resources/senior-thesis/all-theses)
- Except for a daily check-in, I worked independently

Mathematical Modeling Team Lead from September 2018 – September 2020

BYU-I Positron Annihilation Spectroscopy Research Team in Rexburg, ID

- Led efforts to accurately describe the path of positrons through arbitrary materials with mathematical equations
- Obtained and analyzed data on surface defects of shot-peened copper using positron annihilation spectroscopy
- Produced training materials on etching, computational analysis of data, and lab safety
- This work was done as part of a team

Scientific Instrument Developer from September 2018 – December 2018

BYU-I High Altitude Research Team in Rexburg, ID

- Designed and built a device capable of measuring linear and angular acceleration on 3-axes while attached to the string of a high-altitude balloon
- Found the string's acceleration at the balloon's burst to exceed 16 g's, far surpassing previous expectations
- Pioneered a new instrument design capable of withstanding considerably more acceleration than previous designs
- This work was done as part of a team

Research Interests:

At Brookhaven National Laboratory (BNL):

Computational sciences is my first choice for BNL because I enjoy programming and think the projects being done at the Computational Science Laboratory sound particularly interesting (such as the Quantum Computing Group and the Center for Computational Design of Functional Strongly Correlated Materials and Theoretical Spectroscopy).

Mathematics would have been my first choice, but I couldn't tell what projects counted as mathematics. I talk about my love of mathematics in the "Personal Experience" essay, but I'll mention here that I particularly enjoy combinatorics, proofs, and statistics.

Thermal and Statistical Mechanics was my favorite physics class in college, which is why I selected High Energy Physics as my third choice. DUNE sounds particularly interesting, although anything on the design/modeling side of

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physics would probably be fun. The HET (High Energy Theory) Group also looks interesting.
Also, many of the things the Quantum groups are doing, in particular Quantum Algorithms, sound enjoyable.

At Thomas Jefferson National Accelerator Facility (JLab):

Accelerator Physics/Science quickly caught my eye. Specifically, I'd like to work with CASA (the Center for Advanced Studies of Accelerators). Out of the projects they work on, the "development of advanced theoretical calculations for predicting beam behavior for a wide variety of physical arrangements" and anything with "design" interest me the most.

It was difficult to find projects that are clearly mathematics, which is why, like with BNL, I didn't place math as my first choice. That said, Henry Mills' project "Determining Uncertainty in Parton Distribution Functions using Bayesian Methods" got my attention because I particularly enjoy statistics. I also saw several papers published by the Theory Center involving topology, which is another of my favorite math subjects. For more about what I love in math, see my "Personal Experience" essay.

High energy also sounds interesting, especially since my Thermal and Statistical Mechanics class was my favorite strictly-physics class. It has also been hard to find High Energy projects at JLab, but I know that a different intern's project, "Modeling Magnetic Flux Expulsion in SRF Cavities" by Owen Meilander, got my attention. Things like that, which are more on the modeling/design side, excite me.

Remote opportunities preferred but not expected.

Personal Experience:

Through my experiences, I have been able to explore many types of research. I've appreciated each of them, in part because I've been able to learn the following about myself.

I find it fascinating to see real life phenomena described by math. As part of that, some of the most enjoyable research I've ever done involved studying the models of chemical reaction networks. First off, note that it was studying the models, not the networks. Furthermore, I was working with graph theory, topology, and mathematical proofs in this study of models. Each of those things have consistently been interesting to me. I particularly love pattern recognition -- trying to find a pattern, then trying to find a counterexample, etc. In another experience, when I was on my school's Positron Annihilation Spectroscopy research team, my favorite task was trying to derive equations from theory. In this case, we were trying to model how far a positron would go into a generic material. Finally, I've really enjoyed abstract algebra, combinatorics, and statistics whenever they come up.

I really enjoy studying and learning about complex systems in general. This is a lot of why physics is such a good fit for me; I can find almost anything involving physics interesting because there's likely a complex system involved. I love seeing how the different parts interact.

I've also consistently found myself enjoying most programming things I've done. I coded as a hobby for a bit as a teenager, then took a C++ class as a freshman and loved it. I've taken two python classes that I enjoyed, worked with Julia/Mathematica for my first internship, and have programmed extensively in my current internship. After several months of spending 30+ hours a week coding a python application, I think I can safely say that it's the sort of thing I could see myself doing long term.

At some point, I'd love to incorporate my love of game design into my day job, but that's not a high priority. In particular, I dream of someday enabling the public to do publishable scientific research while seemingly playing games. Zooniverse and similar websites is a good step in that direction, but I'm imagining more just cataloguing images.

I'd also like to incorporate machine learning into my studies at some point. I'm especially interested in the prospect of using machine learning to discover new physics.

Professional Goals:

Frankly, I don't know what I want for a career, but I know I want to do it well. I also know that I want to attend graduate school and get a Ph.D., most likely in a subdiscipline of physics. After all, there is still so much more I want to learn. Also, a Ph.D. would open paths to the sort of research-based jobs I hope to have someday.

There are lots of possible career paths, and it can be difficult to know which to choose. Thankfully, my various experiences have helped me see what some of them are like. I got a glimpse of what it's like to be a professor at a research-driven university when I interned at BYU. At INL, I've been able to interact with dozens of people in a variety of positions, from the electricians keeping the lights on to the department head. It has been great to discover and get to know these different possibilities, and I expect participating in the SULI program to help me continue my exploration of what is available.

Furthermore, meeting people in national labs will help me continue to grow my network of friends and acquaintances. Time and time again, I've seen opportunities arise that wouldn't have had I or someone else not known someone. Solid networks help research go more smoothly and innovation to happen more frequently. I hope that participating in the SULI program will help me meet new people with whom I can collaborate both now and for years to come.

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Finally, in order to pick a career, I also need to continue to increase my knowledge of who I am. For example, my experience interning at BYU helped me realize that I really like trying to find patterns using math. Similarly, my internship with INL has taught me that I can spend the majority of my workweek coding and still be happy. I believe participating in the SULI program will give me opportunities to discover new skills and come to know what things I truly enjoy.

RECOMMENDATIONS

Recommendation 1:	First Name: Evan Last Name: Hansen Email: hansenev@byui.edu Status: Not Received
Recommendation 2:	First Name: Mark Last Name: Transtrum Email: mkt24@byu.edu Status: Received 1/12/2022
Recommendation 3:	First Name: Thomas Last Name: Fuerst Email: Thomas.Fuerst@inl.gov Status: Received 1/11/2022

UNOFFICIAL ACADEMIC RECORDS
Brigham Young University - Idaho

Name: George Steven Evans	Date of Birth: [REDACTED]	Academic Status: Eligible
Student ID: [REDACTED]		Class: Senior
Citizenship: USA	Marital Status:	Track: FW Subprogram: DAY
Home City/St: Glen Allen	VA	Admitted Stats: ADMT
Advising Center:		Current Enroll Stat: CONT
Advisor:		
Major: Physics	Minor:	Degree: Bachelor of Science
Emphasis: Mathematical	Cluster:	

----- Fall Semester 2015 -----							----- Winter Semester 2020 (cont.) -----							
FDENG101	86	LC Writing & Reasoning Fo	3.00	A			PH 374	01	LC Astrophysics	3.00	A			
FDMAT112	03	LC Calculus I	4.00	A			PH 385	01	LC Numerical Modeling in	2.00	A			
FDREL130	06	F1 LC Missionary Preparation	2.00	A			PH 390R	01	LB Special Topics in Phys	1.00	W			
FDSCI101	16	LC Science Foundations	2.00	B-			REL 234	04	LC Preparing for Eternal	2.00	A			
PH 121	06	LC Principles of Physics	3.00	A			04/09/2020 COVID-19: Pass or W allowed							
PH 150	03	LB Beginning Physics Lab	1.00	A										
		attempt	earn	pass	quality	points	gpa		attempt	earn	pass	quality	points	gpa
ses	15.00	15.00	0.00	15.00	57.40	3.826		ses	15.00	14.00	0.00	14.00	54.20	3.871
cum	15.00	15.00	0.00	15.00	57.40	3.826		cum	91.00	90.00	0.00	90.00	354.70	3.941
----- Winter Semester 2016 -----							----- Spring Semester 2020 -----							
CS 124	04	LC Intro to Software Deve	3.00	A			PH 398R	01	IN Physics Internship	1.00	A-			
PDCIV101	05	LC Foundations of Civil S	3.00	A										
FDREL275	07	LC Teachings of Book of M	2.00	A					attempt	earn	pass	quality	points	gpa
MATH 215	04	LC Multivariable Calculus	4.00	A			ses	1.00	1.00	0.00	1.00	3.70	3.700	
PH 123	01	LB Principles of Physics	3.00	A-			cum	92.00	91.00	0.00	91.00	358.40	3.938	
		attempt	earn	pass	quality	points	gpa	----- Fall Semester 2020 -----						
ses	15.00	15.00	0.00	15.00	59.10	3.940		MATH 441	01	LC Abstract Algebra I	3.00	A		
cum	30.00	30.00	0.00	30.00	116.50	3.883		MUSIC158A	01	LB Piano Lessons	1.00	A		
----- Fall Semester 2018 -----							----- Winter Semester 2021 -----							
ENG 100	01	LC Reading Comprehension	2.00	A			MATH 463	01	LC Complex Analysis	3.00	A			
FDREL250	30	LC Jesus Christ Everlasti	2.00	A			MATH 495R	01	LC Topics in Mathematics	3.00	A			
IDS 297R	02	OL Applied Learning Proje	1.00	A			MUSIC158D	01	LB Voice Lessons	1.00	A			
MATH 316	03	LC Diff Equations w/ Line	4.00	A			PH 390R	01	LB Special Topics in Phys	1.00	A			
MATH 341	01	LC Linear Algebra	3.00	A			PH 473	01	LC Atomic Physics	3.00	A			
PH 220	01	LC Principles of Physics	3.00	A			PH 488	01	LC Senior Thesis	1.00	A			
PH 250	01	LB Intermediate Physics L	1.00	A										
		attempt	earn	pass	quality	points	gpa	----- Winter Semester 2022 -----						
ses	16.00	16.00	0.00	16.00	64.00	4.000		MATH 330	01	LC Engineering Statistics	3.00	IP		
cum	46.00	46.00	0.00	46.00	180.50	3.923		PH 390R	01	LB Special Topics in Phys	1.00	IP *R		
----- Winter Semester 2019 -----							-----							
FDENG301	28	LC Advanced Writing and R	3.00	A					attempt	earn	pass	quality	points	gpa
FDHUM110	19	LC Foundations of Humanit	3.00	A			ses	12.00	12.00	0.00	12.00	48.00	4.000	
MATH 301	01	LC Foundations of Math	3.00	A			cum	116.00	115.00	0.00	115.00	454.40	3.951	
PH 279	01	LC Modern Physics	3.00	A										
PH 295	01	LC Math and Computational	3.00	A										
		attempt	earn	pass	quality	points	gpa	-----						
ses	15.00	15.00	0.00	15.00	60.00	4.000		MATH 330	01	LC Engineering Statistics	3.00	IP		
cum	61.00	61.00	0.00	61.00	240.50	3.942		PH 390R	01	LB Special Topics in Phys	1.00	IP *R		
----- Fall Semester 2019 -----							-----							
FDINT215	01	LC China	3.00	A					attempt	earn	pass	quality	points	gpa
MUSIC104	02	LC Group Vocal Instructio	2.00	A			ses	6.00	0.00	0.00	0.00	0.00	0.000	
PH 228	01	LB Physics Career Develop	1.00	A			cum	122.00	115.00	0.00	115.00	454.40	3.951	
PH 332	01	LC Classical Mechanics	3.00	A										
PH 333	01	LC Electricity & Magnetis	4.00	A										
REL 200C	61	OL The Eternal Family	2.00	A										
		attempt	earn	pass	quality	points	gpa	-----						
ses	15.00	15.00	0.00	15.00	60.00	4.000		12/01/2014 ACT						
cum	76.00	76.00	0.00	76.00	300.50	3.953		ENG	MATH	READ	SCI	COMP		
							03/01/2015 COMP							
							MATH/ALGB READ							
							99.0 99.0							
----- Winter Semester 2020 -----							-----							
MATH 472	01	LC Intro to Partial Diff	3.00	B+										
MUSIC106	01	LC Group Organ Instructio	2.00	A										
PH 336	01	LB Advanced Physics Lab	2.00	A										
----- continued -----							-----							

UNOFFICIAL ACADEMIC RECORDS
Brigham Young University - Idaho

Name: George Steven Evans

Student ID: [REDACTED]

----- End of Transcript Statistics -----
attempt earn pass quality points gpa
res 122.00 115.00 0.00 115.00 454.40 3.951
cum 122.00 115.00 0.00 115.00 454.40 3.951
----- End of Transcript -----

*R May not be eligible to earn additional credit. See
Academic Records policies in the University Catalog.

SULI PROGRAM APPLICATION RECOMMENDATION FOR GEORGE EVANS

Recommender Contact Information

- **First Name:** Thomas
- **Last Name:** Fuerst
- **Title:** Staff Scientist
- **Department:** Irradiated Fuels and Materials
- **Institution/Organization:** Idaho National Laboratory
- **Telephone:** 978-771-5271
- **Email:** Thomas.Fuerst@inl.gov

Applicant Information

Association

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

It is my pleasure to recommend George Evans for the SULI internship. I have mentored George for his Idaho National Laboratory internship since August 2021. His excellent work led us to extend his contract for this current semester with a planned completion date of May 2022. From August to December 2021, George was a remote intern for our group where he developed python-based experimental data analysis tools. As of January 2022 to May 2022, George will be assisting me onsite to run hydrogen permeation experiments where he will employ the tools he developed in the previous semester to analyze data.

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.

George has excelled academically with a GPA of 3.94 with a major in physics and minor in mathematics at Brigham Young University - Idaho. His exemplary background as the mathematical modeling team lead for the BYU-I Positron Annihilation Spectroscopy (PAS) research team and experience as a research assistant in mathematical modeling at BYU led us to hire him as an intern for our program. He also completed a summer internship at INL working on a PAS system under the guidance of Jagoda Urban-Klaehn of which he continues to assist.

Under my guidance, George has developed a python-based graphical user interface for rapid analysis of hydrogen permeation data to extract hydrogen transport properties in metals. He has excellent communication skills and has given several spur-of-the-moment presentations on the code at informal meetings. He is self-reliant and has required minimal supervision on my end while continually producing a high quality of work.

George's positive attitude coupled with excellent organization skills, attention to detail, and intelligence encouraged us to extend his contract with INL and bring him onsite for an experimental based internship this current semester. Between his mathematically modeling experience, and experimental research with PAS and current work, George is and will be a very capable researcher. His experience and attitude will make him an excellent contribution to the SULI program and any researcher will be lucky to have George as a member of there group.

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 GEORGE EVANS

Recommender Contact Information

- **First Name:** Mark
- **Last Name:** Transtrum
- **Title:** Associate Professor
- **Department:** Physics and Astronomy
- **Institution/Organization:** Brigham Young University
- **Telephone:** 801-422-5377
- **Email:** mkt24@byu.edu

Applicant Information

Association

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

During summer 2020, George Evans worked as an undergraduate research assistant in my group as part of a summer REU program. In the past eight years, I have mentored nearly 40 undergraduate students from various backgrounds, including Physics, Mathematics, Computer Science, and the life sciences, including about half a dozen summer REU students. Because of Covid-19, the REU program was conducted remotely, and I interacted with George primarily through video calls and Slack messaging. Through these interactions, I have a reasonable assessment of George's research potential.

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.

My research program (in which George contributed) studies the mathematical properties of multi-parameter models using techniques of information theory and differential geometry. The work is highly interdisciplinary. I collaborate with experts in material science, life sciences, computer science, and various branches of engineering. George's project applied our group's methods to study the properties of mass-action models common in systems biology. Our group recently proved a theorem that applied to linear compartment models. I conjectured that a similar result may hold for nonlinear mass-action models and asked George to investigate through a combination of numerical and analytic techniques. I introduced George to the project well before the REU program began, and he used the advanced notice to do background reading related to the project. Once the program began, he quickly showed that the conjecture did not hold for most nonlinear models, and we spent the rest of the summer exploring ways the theorem could be generalized. By the end of the project, George was working nearly autonomously. He independently formulated his own conjecture that the original conjecture holds for "independent" groups of parameters. Although unproven, he has collected considerable numerical evidence in support of his conjecture.

George has many qualities that will contribute to his future success. In terms of skillset, he is proficient at scientific computing and visualization. He has also demonstrated the ability to quickly learn advanced concepts related to new fields. He quickly picked up the basics of differential geometry (on the analysis side) and mass action modeling (on the application side), both of which were new

topics for him going into the REU. He is passionate about research; he is curious and loves learning.

By way of comparison, I would rank George as one of the top 2 undergraduate REU students I have worked with and among the top 15% of all undergraduates that I have mentored. I have not interacted with George in the classroom, but from his REU application, I know his grades are excellent. I believe he approaches his coursework with the same diligence he showed in research and that is reflected in his grades. Overall, I believe that George is at the beginning of a promising career; he is bright, motivated, and has much potential. I would not hesitate to work with him again in my own group. I highly recommend him for your 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	