# Joshua M Grumski-Flores

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## RESEARCH INTERESTS

High Energy Field Theory, Quantum Chromodynamics, Mathematical Physics, Phenomology, String Theory

## EDUCATION

**Arizona State University**, Tempe, Arizona — August 2025 — Present
Doctor of Philosophy in Physics — Cumulative GPA: 4.00/4.00
Specialty: High Energy Field Theory

**Arizona State University**, Tempe, Arizona — August 2021 — May 2025
Bachelor of Science in Physics & Bachelor of Science in Mathematics — Cumulative GPA: 4.00/4.00
Honors Thesis Title: Classical Sudakov Form Factors in Non-Abelian Yang-Mills

## RESEARCH EXPERIENCE

**A Route to Falsify String Theory** — August 2025 — Present
Arizona State University, Tempe, Arizona

- Conducted a literary review of current understanding of mass bounds in bound states of gauge theories.
- Analyzing the feasibility of theories with massless bound states of fermions — such as those required by technicolor theories — and their ability to be represented in a string theory.

**Classical Sudakov Form Factors in Non-Abelian Yang-Mills** — September 2024 — Present
Arizona State University, Tempe, Arizona

- Conducted a literary review of current derivations of the Sudakov form factor in classical abelian field theories and both abelian and non-abelian quantum field theories.
- Analyzed the form factor, demonstrating that both a quantum and classical derivation of bremsstrahlung radiation distributions are the same in QED, differing essentially only by coupling running.

**Form Factor Calculation for $\mathcal{N} = 4$ Super Yang-Mills Theory** — August 2022 — September 2024
Arizona State University, Tempe, Arizona

- Calculated Feynman diagrams to determine Sudakov form factors in $\mathcal{N} = 4$ SYM theory using Mathematica programs such as CANONICA, LIBRA, FIRE, LiteRed, FIESTA, and PolyLogTools.
- Taught my team about the design of CANONICA and LIBRA and the general design of the Laporta algorithm.
- Oversaw usage of ASU's Sol supercomputer for the calculation of these Feynman integrals.

**Designing a Pair Spectrometer for Jefferson Lab** — August 2021 — May 2022
Arizona State University, Tempe, Arizona

- Programmed with GEANT4 in a virtual Linux environment to simulate a beam of electrons, positrons, magnetic fields, and a scintillator.
- Determined the efficiency and accuracy of a pair spectrometer using a Monte Carlo method.
- Compared various designs to determine which reveals the most accurate measurements while cutting down on costs.
- Learned introductory particle physics, how to use Feynman rules, and calculate propagation amplitudes.

## PUBLICATIONS

### Journal paper

- Belitsky, A.V., Bork, L.V., **Grumski-Flores, J.M.**, Smirnov, V.A. Three-leg form factor on Coulomb branch, *J. High Energ. Phys.* **2024**, 169 (2024). [2402.18475].

## HONORS PROJECTS

**Analysis of Lie Groups, Starting With Properties of $SO(3)$** — Spring 2023

- Demonstrated relations between Lie groups and algebras, as well as the general topological structure of common compact groups, starting with $SO(3)$, then $SO(n)$.
- Taught a class discussing these properties

**Construction of the Reals from the Rationals** Fall 2022

- Wrote a 20-page paper meticulously constructing the real numbers from the rational numbers using both the nested intervals and the Dedekind cut constructions
- Demonstrated both the ordered fields properties and completeness of both constructions
- Illustrated both methods are isomorphic and how to prove all complete ordered fields must be isomorphic

**Designing a Generator** Spring 2022

- Designed a generator from scratch, creating 3D models using CAD software and printing the design out
- Worked through the theoretical efficiency of the generator
- Presented to the class my project and my methods of designing

**Exploration of Linear Algebra Without Determinants** Fall 2021

- Created proofs for exercises in Axler's *Linear Algebra Done Right*'s determinant section in order to demonstrate that determinants are not simply arbitrary operations on matrices
- Worked through Axler's *Down With Determinants*, proving all statements up through the Jordan canonical form statements

**Programming a Dice Calculator** Fall 2021

- Created a Java-based dice calculator which predicts how likely certain dice rolls are provided rolling of various assortments and rules for the dice rolls
- Used both a brute-force and a Monte Carlo method to create the data tables in the program

## WORK EXPERIENCES

**Physics Teaching Assistant** August 2025 — Present
Arizona State University, Tempe, Arizona

- Hosted office hours and tutored undergraduates
- Ran labs for Introductory Physics II for Physics Majors
- Graded homework and labs for Introductory Physics II for Physics Majors and Classical Mechanics III

**Physics Learning Assistant** August 2022 — May 2025
Arizona State University, Tempe, Arizona

- Hosted office hours and tutored undergraduates
- Instructed courses Introductory Physics I and II, Math Methods in Physics I and II, and Quantum Mechanics II
- Coordinated multiple reviews regularly for students in order to help them succeed
- Advised professors on the design of their courses in a clear and manageable way, and provided insight on further mathematical theory due to stronger experience in math than the instructor, especially in courses such as Math Methods I and II

**Society of Physics Students Officer** August 2022 — May 2025
Arizona State University, Tempe, Arizona

- Elected as General Officer from August 2022 to May 2023, elected as Public Relations Officer from May 2023 to November 2023, elected as Vice President from November 2023 to the May 2024, and elected as President from May 2024 to the present
- Increased communication amongst the student population and grew the club, doubling the size of the club in the 2021 to 2022 year
- Conducted large events such as our SPS Space Gala, reaching hundreds of students and increasing outreach and awareness of physics as a whole
- Collaborated with grade school teachers to create outreach events, teaching basic physics concepts such as induction, conservation of angular momentum, and EM wave polarization to an audience from ages 5 to 70
- Planned in conjunction with the American Association of Physics Teachers a fundraising event to increase awareness of the issues that modern physics teachers are currently facing, including but not limited to threatening to close down physics programs in grade schools and lack of funding

**Sundial Early Start Facilitator** June 2023 — August 2025
Arizona State University, Tempe, Arizona

- Introduced incoming freshmen to the Physics Department and the School of Earth and Space Exploration at ASU
- Designed curriculum for and taught introductory physics and math to freshmen
- Created a number of events for the freshmen to promote success in their undergraduate careers

**Private Physics and Math Tutor** June 2017 — Present

- Tutored for a wide range of topics, from high school algebra to quantum II.
- Explained complicated concepts to students from a range of different backgrounds, as well as not simply helping these students achieve their understanding, but succeed their course requirements.
- Have tutored about 25 students over the last 4 years alone and helped them gain the understanding they require and achieve above average scores on all their exams.

**Karate Instructor** June 2017 — Present
Sandoval Freestyle Karate Studio, Gilbert, Arizona

- Communicates to large audiences advanced concepts, leading hundreds of students to have a better understanding of martial arts as a whole
- Managed large groups of people and gave tasks to coworkers and subordinates in order to more efficiently and effectively teach the students
- Regularly trained new assistants and instructors and taught teaching theory to these assistants in order to see that they clearly and effectively communicate their ideas to audiences

## AWARDS

**Wexler Prize** Tempe, Arizona
This is an award provided by the School of Math and Statistical Sciences to one graduating math major. It is recognized as the department's highest honor for an undergrad, awarded to their top mathematics student. May 2025

**Outstanding Undergraduate Award** Tempe, Arizona
This is a department award provided to one undergraduate in the Physics Department at ASU for going above and beyond in research and work for the department. April 2024

**Rick and John Jacob Award for Undergraduate Research** Tempe, Arizona
Presented research project of calculating Feynman diagrams using the differential equations method to be used for form factor calculations in $\mathcal{N} = 4$ SYM, and earned this award. March 2024

**Wally Stoelzel Physics Scholarship Recipient** Tempe, Arizona
This scholarship was given in honor of Wally Stoelzel to a promising physics student. May 2023

**Arizona State University Physics Research Award Winner** Tempe, Arizona
Presented research project of designing a pair spectrometer for JLab, and earned the award for best undergraduate speaker in my freshman year. May 2022

**Richard G Stoner Memorial Scholarship Recipient** Tempe, Arizona
This scholarship was to be given to a promising physics student who expressed desire to teach at any level, awarded in honor of Richard G Stoner. May 2022

**New American Scholarship Recipient** Tempe, Arizona
This award is provided to all students who show promise at ASU, essentially waiving their tuition. August 2021 — May 2025

## SELECTED COURSES

**Physics Courses**

- Undergraduate Quantum Physics I, II, and III
- Graduate Classical Physics
- Graduate Electricity and Magnetism
- Graduate Statistical and Thermal Mechanics
- Computational Methods in Physics
- Introduction to General Relativity
- Introduction to Quantum Field Theory

**Mathematics Courses**

- Undergraduate Real Analysis II
- Graduate Function Analysis I
- Graduate Complex Analysis I and II
- Algebraic Topology
- Graduate Topics Course in Homology
- Graduate Differential Geometry
- Graduate ODEs and Dynamical Systems
- Advanced PDE Theory

## EVENTS ATTENDED

**Earth and Space Open House** Tempe, Arizona
Presented physics demonstrations to general public with the Society of Physics Students and gave a no-jargon talk titled 'Our Symmetric Universe' October 24, 2025

**ASU's Homecoming Block Party** Tempe, Arizona
Presented physics demonstrations to general public for the ASU Physics Department November 23, 2023

**ASU vs U of Utah Football Game** Tempe, Arizona
Presented physics demonstrations to general public for the ASU Physics Department October 11, 2024

**Earth and Space Open House** Tempe, Arizona
Presented physics demonstrations to general public with the Society of Physics Students October 4, 2024

**Arizona Science and Engineering Fair** Tempe, Arizona
Presented physics demonstrations and presented research to general public with the Society of Physics Students April 5, 2024

**ASU Physics Department Undergraduate Research Symposium** Tempe, Arizona
Presented my poster of my research on Super Yang-Mills calculations to the ASU Physics Department and earned the Rick and John Jacob Award for Undergraduate Research March 29, 2024

**ASU Open Door** Tempe, Arizona
Presented physics demonstrations to general public for the ASU Physics Department February 24, 2024

**Knox Gifted Academy Science Night** Chandler, Arizona
Presented physics demonstrations at an elementary school with the Society of Physics Students February 1, 2024

**APS Conference for Undergraduate Women in Physics** Oracle, Arizona
Attended with leadership from the Society of Physics Students to learn methods to increase inclusivity within our department January 19 — 21, 2024

**Earth and Space Exploration (ESE) Day** Tempe, Arizona
Presented physics demonstrations to general public with the Society of Physics Students November 4, 2023

**ASU's Homecoming Block Party** Tempe, Arizona
Presented physics demonstrations to general public for the ASU Physics Department October 28, 2023

**Earth and Space Open House** Tempe, Arizona
Presented physics demonstrations to general public with the Society of Physics Students September 22, 2023

**ASU's Homecoming Block Party** Tempe, Arizona
Presented physics demonstrations to general public for the ASU Physics Department November 19, 2022

**Earth and Space Open House** Tempe, Arizona
Presented physics demonstrations to general public with the Society of Physics Students November 4, 2022

**ASU Physics Department Undergraduate Research Symposium** Tempe, Arizona
Presented my poster of my research on my Jefferson Lab pair spectrometer project to the ASU Physics Department and earned the Arizona State University Physics Research Award April 8, 2022

## SKILLS

- **Programming:** Experience in Python, Java, C++, JavaScript. Specific experience in C++ library GEANT4.
- **Software:** Much experience in Mathematica, specifically the packages CANONICA, LIBRA, FIRE, LiteRed, FIESTA, and PolyLogTools. Experience with VMWare and Windows Subsystem for Linux (WSL).

## PROFESSIONAL ORGANIZATIONS

- American Physical Society (APS)
- The National Society of Physics Students (SPS)
- Sigma Pi Sigma (ΣΠΣ)
- American Astronomical Society (AAS)

## REFERENCES

**Prof. Matthew Baumgart**
*Associate Professor, Department of Physics, Arizona State University, Tempe, Arizona*
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**Prof. Cindy Keeler**
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