GUSTAVUS PHYSICS

Physics Department Newsletter | October 2020

Inside this issue:

Important Fall Dates:

Classes Begin	Sep. 2
Last Day to Register for Fall Classes	Sep. 15
Nobel Conference	Oct. 6-7
January Term Registration Begins	Nov. 8
Spring Registration Begins	Nov. 15
Online Instruction Resumes	Nov. 30
Final Exams Begin	Dec. 11

Welcome to Our Newest Faculty Member

The Gustavus Physics Department is pleased and excited to welcome our newest, tenure-track faculty member. Dr. Elizabeth Boatman joins us this fall, and will be working with the department over the next few years to design and implement a new Engineering-Physics major.

Elizabeth (Liz) Boatman received her B.S. in Physics and Applied Chemistry (2007) from Beloit College in Wisconsin and her M.S.-Ph.D. in Materials Science and Engineering (2012) from the University of California-Berkeley. After completing her graduate studies, she spent two years as a AAAS Science & Technology Policy Fellow in Washington, D.C., one at the National Science Foundation and the other at the National Institute of Justice, U.S. Department of Justice, where she developed knowledge of and skills in strategic communication and project management.

After, Liz chose to return to academia, first for two years at the University of Wisconsin-Stout, helping to support the launch of the Engineering and Technology Department's new B.S. Mechanical Engineering program, and then at Wake Forest University in North Carolina,

Dr. Elizabeth Boatman

where she worked as a member of a core team of four faculty to build the university's new Department of Engineering and B.S. Engineering program. Having decided to return to the Midwest to be closer to family, she was excited to find this opportunity at Gustavus Adolphus College to help the Physics Department develop its new Engineering Physics program.

(Continued on page 3)

Other Faculty News

Dr. Darsa Donelan and her summer video-production crew

Darsa Donelan writes, "This summer I attended the American Association of Physics Teachers (AAPT) Virtual Summer Meeting as an invited speaker. My talk on using videos to improve student learning in physics labs was recorded and edited in advance of the conference by my videographer and Gustavus alum (Chemistry and Film) **Ben Easter '19**. Physics majors **Vatsala Adile '20** and **Maheemah Bokhoree '21** also made appearances in the video which was well viewed and received.

"I also co-ran a free virtual workshop with the AAPT/Temple NASA Space Science Education Coalition team. This workshop provided scientific background and professional development for physics educators to integrate space-science contexts into introductory physics. Topics addressed included the kinematics of coronal mass ejections, the geometry of eclipses, planetary magnetism, and energy and magnetic fields of solar flares.

"To prepare for the 20-21 academic year, I participated in several workshops on online and hybrid learning, pandemic-related psychological first aid and recovery, and racial equity. I also began taking ASL lessons so that I can better communicate with students having deaf gain."

Tom Huber had funding to allow him to collaborate this summer with **Zane Michael '22** and **Katelyn Espe '23** on ultrasound research. Zane was funded by a grant from the National Science Foundation, and Katelyn was funded through Gustavus' First Year Research Experience (FYRE) grant. The goal of this project is to use a laser interferometer to visually measure ultrasound waves in water and air. A laser vibrometer directed at a retroreflector measured ultrasonic pulses that were traveling through a water tank. Unlike previous summers, the majority of the research was done with minimal in-lab time. This meant only one person at a time in the lab, and much of the analysis being done remotely.

The major tasks this summer were methods to improve the signal-to-noise ratio of the measured ultrasound signals. One major method was using deep learning for noise reduction. A computational neural network was "taught" what high-resolution, low-noise ultrasound signals looked like, and then applied to noisy signals. The other method was using a sweep-frequency ultrasound technique, similar to the methods that bats use for echolocation. Both techniques appear to be promising, and will continue to be explored.

Tom also spent time this summer investigating pedagogy and technology for online learning, along with issues related to diversity, equity and inclusion in physics programs.

Tom will be continuing as department chair this year. This fall he will be teaching an FTS on Energy, and the second-year Math Methods class.

Steve Mellema, like most people, spent the summer in St. Peter and physically isolated from people, due to the coronavirus pandemic. For the Mellemas, this meant a departure from their annual international travels. Instead, life was filled with daily walks in the Linnaeus Arboretum on the Gustavus campus, and a new appreciation of the prairie wild flowers, whose diversity and beauty he had never before appreciated. Steve is teaching Cosmic Universe and Quantum Mechanics courses this fall, giving him the pleasure of teaching first-year physics majors and graduating seniors in the same semester (in the lowest– and highest-numbered physics-major theory courses in the College Catalog).

It was a strange but busy summer for **Chuck Niederriter**. Travel was limited by the pandemic, so he and his family only got out of town for a quick trip to Pennsylvania to visit relatives. His house was busy as three of his five children were home all the time. Chuck's daughter, Gretchen, graduated from Lawrence University in June with a grand celebration at home instead of with her physics classmates in Appleton, Wisconsin. (Yes, she was a physics major.) Gretchen took advantage of the opportunity to get out of the dorm early and adopted a rescue dog in May. Walking the dog became a twice daily ritual that is helping keep all of us healthier. Unfortunately, Gretchen moved to Madison in September to start a new job.

Chuck worked with three research students this summer. **Anna Teurman '22** and **Ana Zaalishvili '22**

(Continued on page 3)

Faculty Updates

(Continued from page 2)
kept the high altitude muon studies alive by building more detectors (we are up to six now) and flying them twice. The first flight made it to 92,000 feet while the second got to almost 100,000 feet before parachuting back to earth. Both landed in mature cornfields (10 feet tall), so recovery wasn't simple. But we did recover both payloads. In addition to the muon count rates and energies, they collected some great video that I'm sure they will happily share.

Luke Haddorf '22 and Chuck designed and built a system to measure electrical conductivity and thermopower as a function of temperature for a variety of samples (Luke really did all the work). They will use the system to study hydrogenated amorphous silicon that could be used to produce efficient, inexpensive PV solar panels. Luke not only mastered LabView but also learned CAD, vacuum technology, and techniques for making sensitive temperature and electrical measurements.

Chuck and three colleagues from Chemistry were drafted in late August to build a system to test the efficacy of face coverings, based on a design developed at Duke University. It was simple enough, but required a very high powered laser and good video camera to implement. The plan is to test mask samples before the College customizes them and orders thousands for an event.

Chuck will be teaching Experimental Modern Physics lab again this fall, as well as General Physics. He will serve, along with Jeff Jeremiason, as interim director of the Johnson Center for Environmental Innovation. He looks forward to sabbatical leave in the spring to concentrate on research.

Jessie Petricka spent the summer recovering from the online stress of the spring (GAC and kids) by reading the classical mechanics textbook for the fall. He and his family went hiking in Colorado and got the sailboat out of storage and on the lake for the first time in 3 years. He'll

Jessie at the top of Mt. Elbert, the highest point in the Rocky Moun-

teach two new classes this year; Mechanics (fall) and Electronics (spring).

Paul Saulnier is scheduled to teach the Electromagnetic Universe (EMU) course with associated labs and Senior Seminar in the fall and tentatively scheduled to teach Electromagnetic Theory and General Physics II with lab in the spring. Additionally, Paul will serve as pre-engineering advisor and seminar coordinator for the department as well as serve on the college-wide faculty Personnel Committee.

Our New Colleague Helps Us to Envision an Engineering-Physics Major

(Continued from page 1)
As a K-16 liberal arts graduate, Liz deeply embraces the philosophy and value of a liberal arts education, especially for students in the physical sciences. Her research interests focus on understanding the mechanisms of fossilization in extinct species and structure-property relationships in natural structural materials, with a focus on bone. She enjoys cycling, backpacking, kayaking, traveling, gardening, and exploring new parks and trails with her dog, Josie.

The Gustavus physics department is excited that the College has given us the opportunity to create a new Engineering-Physics major, and we are thrilled to have been able to hire Dr. Boatman. Her engineering credentials, combined with a passion for the liberal arts, hands-on expertise in the design and implementation of new engineering programs, teaching experiences, and interdisciplinary research program, make her the perfect fit for our department at this pivotal moment in our history.

During the upcoming January Term 2021, Liz will be introducing a course entitled "Materials and Mechanics" as an opportunity for students with an interest in engineering.

Over the next two years, while she teaches some of our existing courses to help cover the sabbatical leaves of Chuck Niederriter (this year) and Paul Saulnier (next year), we will be working together as a department to create some new courses along with a comprehensive curricular track for an engineering-physics major.

Welcome, Liz!

Student Awards

Departmental Awards for 2020-2021

As we do every year, the department is recognizing a number of returning majors with awards.

Lawrence Hiquiana '21 is the winner of the Milward T. Rodine Memorial Physics Award. This prize is named for the longtime Gustavus professor of physics, who taught here from 1933-1969. It is awarded annually, on the basis of interests and scholarly achievements, to a physics major who has completed the junior year.

In consultation with the Physics Department, the Department of Mathematics/Computer Science has chosen **Zane Michael '22** as the winner of the John Borneman Prize Par Excellence in Mathematics. This award was designated in memory of John Borneman (a 1955 Gustavus graduate) by his family. It is presented annually to an outstanding student in the fields of mathematics and physics.

Mitch Donoughue '21 has received the Gerald and Julia Swanson Scholarship in Physics. This endowed scholarship was established to honor the work of the physics department faculty who provided Gerald Swanson with a background that prepared him for graduate study in physics and for a career with Bendix Corporation. The scholarship is intended to encourage physics students of promise who are enrolled full-time at the College.

Alex Woitas '21 was awarded the John Chindvall Scholarship in Physics. This endowed scholarship was established in memory of 1970 Gustavus graduate John Chindvall by his parents and friends. It is awarded annually to a student majoring in physics.

Maheemah Bokhoree '21 was selected as the winner of the Julian A. Crawford Memorial Prize in Physics. The prize is named in memory of the former chair (1967-69) of the Gustavus physics department and awarded to the student with "the greatest potential for contributing to physics and society."

Katelyn Espe '23 and Grant Hietpas '23 each received the Harold Q. Fuller Memorial Award in Physics, which is given to the first-year students (male and female) who have the highest overall record in physics courses. This award was established in 1997 by Professor Emeritus **Richard M. Fuller** (who taught at Gustavus from 1968-1999) and his wife, Judith. The award honors Richard's late father "HQ" (a researcher in the Manhattan Project, physics professor and Dean at the University of Missouri, Rolla) for his lifetime commitment to the teaching of young people.

Greg Norton '21, Ana Zaalishvili '22, and Matthew Keeley '22 each received a "Positive Derivative Award", as a physics major within their class who showed great improvement during the 2019-20 academic year.

Espen Fredrick '21 and Greg Norton '21 will serve as the Physics Departmental Assistants for Fall Semester 2020. These positions have a nominal expectation of four hours per week in research, course development or other activities that will assist in the work of the department.

Student Wins National Physics Scholarship

Maya and her Service Dog in Training, Anubis

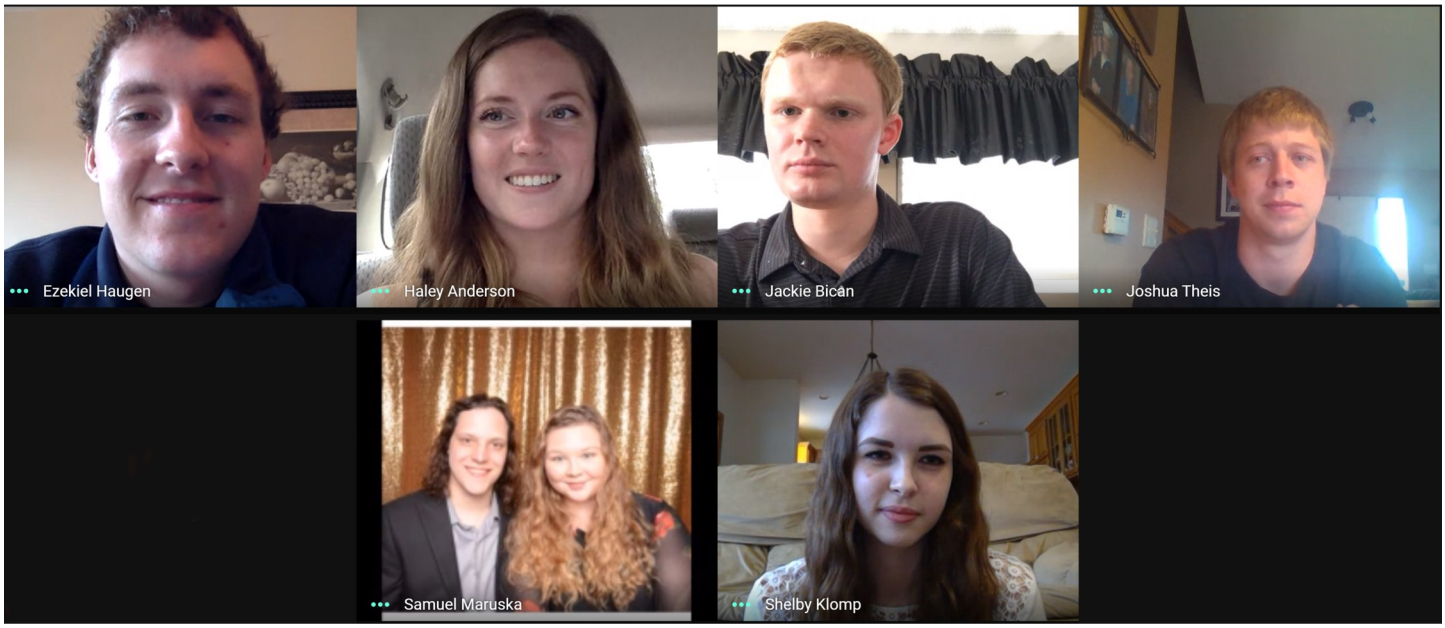
Maya Lengvenis '22 has been named a Rossing Physics Scholar for 2020-21. Maya is one of five students to receive a $5,000, honorable-mention scholarship for this year.

The Thomas D. Rossing Fund for Physics Education awards scholarships annually to exemplary students in physics at colleges and universities affiliated with the Evangelical Lutheran Church in America (ELCA).

Maya is an outstanding student, who took advantage of the College's First Year Research Experience (FYRE) program in summer 2019, when she spent 10 weeks working with **Jessie Petricka** on a wireless power-transfer project.

Congratulations, Maya!

Virtual Induction into the National Physics Honor Society



Inductees Attending the Google Meet Sigma Pi Sigma Banquet:
Back Row (L to R): Zeke Haugen, Haley Anderson, Logan Bican, Josh Theis
Front Row: (L to R) Sam Maruska (with friend), Shelby Klomp

On Saturday, May 2, **Dr. Danielle Berg '08** delivered the keynote lecture at this year's Sigma Pi Sigma banquet, held online for the first time ever. Dr. Berg, who was a 2008 inductee into the same ΣΠΣ chapter, is currently an Assistant Professor of Astronomy at the University of Texas at Austin.

A personalized video introduction to the ceremony was provided to us by Dr. Jim Borgardt , the national President of Sigma Pi Sigma.

ΣΠΣ, the national physics honor society, is a member of the American Institute of Physics and "exists to honor outstanding scholarship in physics; to encourage interest in physics among students at all levels; to promote an attitude of service of its members towards their fellow students, colleagues, and the public; to provide a fellowship of persons who have excelled in physics."

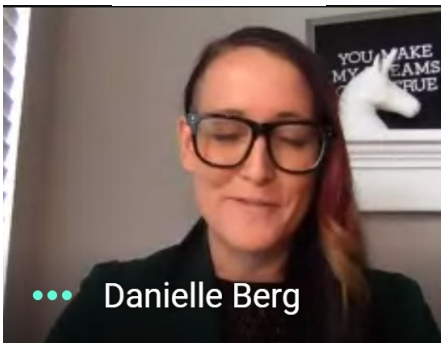
As Dr. Borgardt told us in his introduction, Sigma Pi Sigma will celebrate its 100th anniversary next year. Gustavus has been home to a chapter now for 17 years.

Six graduating seniors from the class of 2020 were inducted into the Gustavus Chapter of ΣΠΣ. They are: **Haley Anderson, Logan Bican, Ezekiel Haugen, Shelby Klomp, Samuel Maruska and Josh Theis**.

At Gustavus, election to membership in the Sigma Pi Sigma chapter requires a minimum 3.0 physics GPA, involvement in the Society of Physics Students, and nomination by two different professors. In addition, each nominee must have fulfilled the requirements for one of three induction tracks: academic, research or departmental service.

Congratulations to all the inductees!

Dr. Jim Borgardt, National President of Sigma Pi Sigma, provided the welcome and introduction



Keynote Speaker Dr. Danielle Berg '08

The (Virtual) Graduating Class of 2020

2020 Gustavus Physics Graduation Virtual Group Photo

Top (L to R): Kyle Krippner, Haley Anderson, Paul Saulnier, Zeke Haugen, Jessie Petricka

Middle (L to R): Steve Mellema, Tom Huber, Shelby Klomp, Chuck Niederriter, Sam Maruska

Bottom (L to R): Logan Bican, Davis Delaram, Vatsala Adile, Darsa Donelan, Kristen Cash

(Not Pictured: Josh Theis)

On Saturday, May 30, the Gustavus Commencement ceremony went "virtual" for the first time. Although the seniors graduating in the class of 2020 have been promised an in-person graduation ceremony once the restrictions of the COVID-19 pandemic are lifted, the physics department did our best to replicate our annual, post-Commencement reception for the physics graduates and their families.

The photo above shows our Google Meet, where we got to hear from each graduate about their immediate plans. All six faculty members were online, together with nine of our 10 graduating physics majors. We've all promised to get together in person once conditions allow, but in the meantime our grads have shared their thoughts about life at Gustavus, their future plans, and their advice to the next generations of Gustie physics majors. Although theirs is (numerically) the smallest physics graduating class in more than two decades, their perseverance and commitment are already paying off in their immediate post-graduation opportunities.

Haley Anderson writes, "My future plans recently developed. I received a job offer earlier this week that I accepted! I will be an engineer for Windstream (in Iowa) starting August 31st. My boyfriend and I bought a house in the Des Moines area where he also works. This is what I was hoping for after graduation and it's finally all coming together! It's been a hectic week since we have been moving out of the old place and into the new house so that explains the tardiness of this reply.

"I would also like to add that the hiring crew loved my physics background and found me to be an excellent fit and resource for the position. This is without engineering experience, only research and a physics education. I was told by an outside recruiter that it would be difficult to land an engineering job without that experience and following that conversation, I got an email for a chance to speak about the position I ended up filling. So my advice is that dedication (and maybe some luck) go a long way, and others will see your intelligence on paper and passion in person."

Logan Bican tells us, "At GAC I had the awesome opportunities of being able to compete on the men's swimming and diving team, participate in SPS events (dodgeball and

(Continued on page 7)

(Continued from page 6)
waterpolo were my favorites), as well as attend school-sponsored events such as Christmas in Christ Chapel. The wide variety of events offered was something that was always interesting to me, as the College seemed to have something for everyone.
"Currently I am studying for the General GRE so that I can get into graduate school for engineering. After graduating with a degree in either civil engineering or mechanical engineering, I plan to work full time somewhere in the west metro area.

"The words of wisdom that I would like to offer up to physics students is to try and stay ahead if possible. It's hard to find the motivation to start the next homework assignment right after you just took a test, but life will be so much easier for you if you do. Doing this and only doing a couple problems a night makes the workload extremely bearable."

Kristen Cash writes, "Gustavus has provided me the resources to grow as a student, an athlete, and a person. From the physics department to the sports teams that I played on, I feel that I have gained many skills to excel in my future career and life. This fall I will be attending the University of Minnesota for a Masters degree in civil engineering, with the hope of becoming a civil engineer one day! A piece of advice that I would give to physics students is to not be afraid to talk to your professors whenever you get stuck with homework, need advice for future career/schools plans, or just want to chat. They are always willing to help and give you the tools you need to succeed as a physics major and beyond. I can't thank them enough for the guidance they have given me to get me where I am today!"

Zeke Haugen says, "I had an amazing experience at Gustavus. What I enjoyed most was my daily rhythm/grind of physics classes, tennis practice, physics homework and growing in my faith. I am now beginning a biomedical engineering PhD program at Vanderbilt University in Nashville, TN, where I will be taking classes and doing research on optical diagnostic imaging systems. I would encourage Gustavus physics students to keep on plugging away after disappointments and perceived failures. Don't give up if it is what you love, because if you get back up you will be stronger and more prepared for the next hurdle!"

Shelby Klomp says, "I'm off to pursue a PhD in Physics at Northwestern University, but my time in the Gustavus Physics Department is something I'll never forget. It was the perfect community to allow me to thrive and reach my potential, both academically and socially. I would advise students still at Gustavus to take advantage of every opportunity that you can. Whether it's running for a position in SPS, applying for an internship or scholarship, asking a professor to let you do research with them, or just showing up to a fun event, the time will go by so fast and you'll wish you had started earlier. Regardless of whether you know what you want to do after graduation (I sure didn't), take the time to experiment and find what you like while you are surrounded by professors and students who want to help you get to where you're going!"

Kyle Krippner is taking part in our 3-2 Engineering program with Washington University. He writes, "I've been staying busy with my internship. The same place I was last year thankfully took me back. Certainly, graduating a year early doesn't really even feel like graduating (especially given our current situation). Heading down to St. Louis this fall will be the biggest change in my life, but I'm ready to give it my all and see what I can do. Gustavus turned out to be much more than anything I expected. I went into my first year thinking that Gustavus would be just an intermediate step towards my educational goal of getting to Wash U. Looking back, that wasn't a great way of looking at it, but that was where my mind was at. In my last year at Gustavus, I finally processed everything GAC had been for me. The physics education – amazing. More than that however, GAC provided me with a community of people who motivated me to grow in my education as well as as an individual. I was lost in that first year. Now, I feel like I'm willing to jump on opportunities and take the path less travelled. I hope to work for/establish an aerospace company that centers on the design of environmentally focused aircraft. Or… go to space. That would be cool, of course. For my words of wisdom… be a maverick. Always keep learning and don't forget about self-care, that's a biggy."

Sam Maruska will be pursuing a Masters degree in Mechanical Engineering at Minnesota State University-Mankato.

Josh Theis is taking a gap year while applying to medical schools.

Student Summer Internships

Despite the COVID-19 situation, a number of our student majors still managed to participate in research experiences this summer.

Anna Teurman '22 and **Ana Zaalishvili '22** did research on campus this summer, under the auspices of the **Richard M. Fuller** Research Endowment Fund. They write, "This summer we have been working with **Chuck Niederriter** studying muons in the upper atmosphere. Specifically we were investigating the dependence of muon detection on altitude as well as the path taken by muons through the atmosphere. We built our own muon detectors using a design from MIT and flew them into the upper atmosphere using a high altitude (or weather) balloon. Much of the summer was spent preparing for our balloon launch. Though we did run into many small setbacks, we did have a successful launch! Doing research

this summer at Gustavus has been super fun and an eye opening to research as a whole."

Luke Haddorf '22 writes, "This summer, I am working with Chuck Niederriter to find a way for making resistivity measurements for various semiconductors. This process includes designing the appropriate apparatus and programming the devices that will measure the resistivity at a wide range of temperatures. These data are a key first step for the much larger project of designing cheaper solar panels. Eventually, we will see if amorphous silicon thin films can be used in solar panels as an economically viable alternative to the crystalline silicon panels used today."

Katelyn Espe '23 says, "This summer I did research with **Tom Huber** on his ultrasound project. We worked on creating a deep-learning model that removes background noise from ultrasound readings. I learned about the transducer and vibrometer we used to take data and also how to program deep machine learning in Python. It was fun being able to think creatively on different ways in which we could alter the parameters of the model to create the best fit Another one of my favorite parts was hanging out with my friends who were doing research on campus and learning about their pro-

New Womxn in Physics Initiative

Professor **Darsa Donelan**, physics major **Kate McGregor '21** and physics/chemistry major **Maheemah Bokhoree '21** have formed a Womxn in Physics Club to increase recruitment and retention and help our students develop scientific communities. We are prioritizing: outreach and inclusion of womxn at Gustavus and the surrounding community; a Womxn in Physics Seminar Series; and a book club. Our first seminar was with Dr. Jennifer Blue of Miami University. Our book club choice for the fall is *Gender and our Brains* by Gina Rippon; for the spring it will be *Inferior* by Angela Saini. These books debunk the myth that there is a biological distinction between male and female brains and discuss the effect of sexism on scientific research, and how that sexism influences social beliefs. We are also hosting a screening of the film "Picture a Scientist" with a panel discussion at the end of October. Passionate, driven, creative, and welcoming are just a few words to describe the womxn in the physics department at Gustavus. Not only are the womxn at Gustavus succeeding, but they are excelling in physics despite well-documented barriers.

This Newsletter is issued at the beginning of the fall semester for the benefit of students, alumni, faculty and others interested in the physics program.

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