

Earth, Planetary & Space Sciences Institute
(EPSSI)

Annual Report

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2021

Mission Statement

The Earth Planetary and Space Sciences Institute (EPSSI) will continue to focus on interdisciplinary activities in earth, atmospheric, oceanographic, and space sciences at Michigan Technological University. The EPSSI mission is to enable its members to offer programs and pursue research opportunities in those disciplines that go beyond the scope of individual academic departments.

As stated in the previous annual report for the fiscal year of 2020 the EPSSI continues to:

- Support and enable large, multi-PI proposals;
- Contribute to the University's research infrastructure enhancement efforts;
- Support and oversee the graduate program in Atmospheric Sciences;
- Recruit and support graduate students;
- hold its long-standing, successful seminar series.

Summary of FY Activities and Highlights

The institute governance structure is described in the renewal application from 2018 and quoted below. The EPSSI has two governance bodies, the Advisory Council and the Director.

*Every department represented within the EPSSI is entitled to representation on the **Advisory Council**. Members of EPSSI who are in the same department shall choose amongst themselves who will represent their department on the Advisory Council. If not a department representative, the Director of the Atmospheric Sciences program, which EPSSI oversees, shall be an additional member of the Advisory Council. The term of a member of the Advisory Council is two years.*

*The **Director** of the Institute, who reports to the Vice President for Research, is selected from the members of EPSSI by the Advisory Council. The term of the Director shall be three years. A Director may be recommended for re-appointment by the Advisory Council. Duties of the Director include (but are not limited to) oversight of the day-to-day operations of the Institute, coordination of the seminar series, oversight of EPSSI support of the Atmospheric Sciences PhD program, and coordination of multi-PI proposals supported by the EPSSI. Additionally, the Director is responsible for the yearly report to the Vice President for Research. In the interest of transparency and accountability, the Director shall also prepare and distribute a yearly report to the Advisory Council of the Institute's finances. The report shall include an accounting of expenditures greater than \$3000. The Institute provides funding for secretarial/administrative assistance for the Director.*

The criterion for EPSSI membership is that the research interests of the individual align with the Institute. New members are approved by the director. In FY 2021, no new members have joined.

The weekly seminar series on Mondays continues to be the primary mechanism that EPSSI uses to involve members, foster and maintain broad participation, and incubate collaborations on potential future projects. One of the EPSSI members, typically an early or mid-career researcher, is asked to coordinate the series. In FY 2021, Kathryn Perrine, Assistant Professor in the Department of Chemistry, coordinated the seminar series, soliciting nominations/proposals for speakers from members of the institute. Due to the COVID-19 pandemic the FY 2021 series was

fully online, and Dr. Perrine worked with IT to reserve the zoom room for the presentations and coordinated the announcement via Tech Today. Lucille Zelazny, EPSSI coordinator, sent announcements to appropriate e-mail lists including EPSSI, Atmospheric Sciences, and GLRC faculty and students. The campus-wide advertisement of EPSSI talks ensures that a broad spectrum of individuals is provided with the opportunity to attend and interact with nationally and internationally recognized speakers.

Over the past year, the EPSSI has built member capability to pursue external sponsored funding mainly by investing in instruments and infrastructure on campus, providing membership fees in international collaborations, and graduate student support. This has helped to attract external interest in the research pursued here on campus, and enabled cooperation with world-renown institutes and facilities across the country and globe (see section Budget Overview below for details).

Please see Appendix A for the EPSSI member list.

Budget Overview

The overhead generated by grants associated with EPSSI through the last four quarters (2020-2021) totaled \$386,207. [\$82,652; \$59,928; \$69,563; \$174,064]. There were 36 active external grants in FY2021, and 2 active internal grants. Nine of them were closed or closing. The proposals submitted in FY2021 including (#,\$) requested and awarded are listed in Appendix B.

There are currently 8 graduate students in the Atmospheric Sciences program, which EPSSI oversees. One student in the program, Subin Thomas, graduated in the fiscal year.

Major expenditures are summarized in Appendix C. Usually significant items like the seminar series funding and travel assistance are still listed, even though in FY 2021 there were no expenditures because of the COVID-19 pandemic. Investments in graduate student assistantships, facility access (to the Pierre-Auger-Observatory), and facility support on campus directly enhance EPSSI member capacity to compete for externally sponsored awards and/or form external cooperation. This is for example confirmed by a recent external email to EPSSI members about testing instruments in the cloud chamber, saying *[T]o that end, it seems the Pi chamber might be an ideal environment for [...] testing and validation, since it is a well-instrumented and controlled environment with potential to generate a variety of drop and ice regimes.*

Appendix D contains the budget projection table and chart created from the ASPIRE database that include the five-year forecasts.

Future Plans and Goals

The goal for the next year and for the next five years is to make further progress on the items listed under the *Mission Statement* section. In particular, it is planned to apply strategies to increase the number of multi-PI proposals across and beyond campus. In addition to continued investments in areas listed in the previous section, the EPSSI will explore the possibility of

- initiating a dedicated fellowship and/or travel award, to which EPSSI graduate students may apply,
- hiring a coordinator who would support faculty with proposal preparation,
- and entering MoUs with other Institutes/Centers on campus that will enhance the ability of EPSSI members to participate in large proposals.

The EPSSI director will discuss these items at the next Advisory Council meeting (Spring 2022).

The EPSSI will also highly encourage and support member participation in national and international scientific community surveys through white papers. These surveys typically result in reports that identify scientific priorities and opportunities, and make funding recommendations to agencies like NSF, NASA, and DoE. A recent instance of this is the latest decadal survey by the National Academy of Sciences, Engineering, and Medicine, *Pathways to Discovery in Astronomy and Astrophysics for the 2020s* (<https://www.nap.edu/catalog/26141/pathways-to-discovery-in-astronomy-and-astrophysics-for-the-2020s>), in which EPSSI-associated researchers took part. This consensus study report endorses for example the international Southern Wide-Field Gamma-Ray Observatory (SWGGO) project (for which the NSF currently supports R&D work at Michigan Tech and partner institutions), and recommends NSF funding for SWGGO at the level of ~\$20M over the next decade.

Whenever possible, the EPSSI will continue to provide cost share and other forms of support to funded projects. It is quite difficult to secure funds from agencies to pay for instrumentation unless PIs specifically apply to programs like the NSF MRI or similar. EPSSI participation in the acquisition of new instruments are an important contribution to funded project and a big factor in subsequent successful applications for funding.

No space/facility needs or financial gaps in meeting the above goals have been identified.

Challenges and Barriers

Nothing to report.

Appendix A: Current EPSSI Member List

College	Department	Member	
Engineering	CEGE	Eugene Levin	
		Judith Perlinger	
		Noel Urban	
	GMES	Dave Watkins	
		Roohollah Askari	
		Simon Carn	
		Snehamoy Chatterjee	
		Chad Deering	
		James DeGraf	
		John Gierke	
		Kenneth Hinkel	
		Thomas Oommen	
		Wayne Pennington	
		Bill Rose	
		Aleksey Smirnov	
		Gregg Waite	
		Shiliang Wu	
		Xin Xi	
		FRES	FRES
Mike Hyslop			
Ann Maclean			
Sciences and Arts	Biological Sciences	Charles Kerfoot	
		Chemistry	Sarah Green
			Lynn Mazzoleni
			Kathryn Perrine
	Physics	Will Cantrell	
		Brian Fick	
		Petra Huentemeyer	
		Claudio Mazzoleni	
		Robert Nemiroff	
		David Nitz	
Raymond Shaw			

Appendix B: List of Submitted Proposals and Awards

Tech Grant No.	PI	Agency	Title	Requested \$	Awarded \$
1708002P2	Will H. Cantrell	NSF	INTERN: Supplemental funding for ASM Shawon		23,951
1911057P2	Simon Carn	NASA	Tracking volcanic gases from magma reservoir to the atmosphere: identifying precursors and optimizing models and satellite observations for future major eruptions WoU-MMA: The Southern Wide-Field Gamma-Ray Observatory (SWGRO): R&D for a Next-Generation Ground-Based Survey Instrument for VHE Gamma-Ray Astronomy		467,794
1912006P2	Petra H. Huentemeyer	NSF	Astronomy	860,003	860,003
2001041P2	Raymond A. Shaw	NSF	Collaborative Research: Experiment of Sea Breeze Convection Aerosols Precipitation and Environment (ESCAPE)	270,735	270,735
2006061P1	Thomas Oommen	NSF	SCC-CIVIC-PG Track B: Helping Rural Counties to Enhance Flooding and Coastal Disaster Resilience and Adaption	49,999	49,999
2007028P1	Xinfeng Xie	Koppers Inc	Preliminary Laboratory Tests of Creosote-Based Wood Preservative Formulations (2007) CAREER: Deciphering Cavitation in Fluid-Filled Cracks and its Induced Seismicity through Integrated Physical Modeling	76,000	76,000
2007033P1	Roohollah Askari	NSF		699,558	

2007047P1	Snehamoy Chatterjee	Alpha Foundation for the Improvement of Mine Safety and Health Inc	Mine Health and Safety Management System: A Big data and Machine Learning-based tool	469497	
2008027P1	Luke J. Bowman	NASA	Equitable Access to NASA and NGSS-aligned Remote Learning for Middle School Student: a Remote Opportunity	139,298	
2009026P1	Xin Xi	NASA	Rapid Response to COVID-19	346,084	
2010041P1	Raymond A. Shaw	Mesa Photonics	Benchmarking the climatic sensitivity of aeolian dust variability from a multi-observation and multi-model perspective		
2010075P1	Raymond A. Shaw	NSF	Cloud Chamber characterization of an airborne cloud droplet imaging system	46,590	
2011019P1	Kate M. Nelson	U of M-MSGC	CIF: Making the Pi Convection-Cloud Chamber Available to the Community for Aerosol-Cloud-Turbulence Research	5,000	5,000
2011025P1	Ryan M. Klida	U of M-MSGC	Measurements CO2 fertilization of tropical forests from volcanic soil gas emissions using remote sensing: Volcan Rincon de la Veija Costa Rica	5000	5,000
			Satellite Based Synthetic Aperture Radar (SAR) Techniques for Earth Dam Monitoring and Failure Prediction		

2011026P1	Brock Howell	U of M-MSGC	Effective Optimization of Groundwater Extraction through the Development of Computational tools	5,000	5,000
2011037P1	Luke J. Bowman	U of M-MSGC	Career Connection Explorations: Enriching Middle School STEM Curriculum using NASA Resources	10,000	10,000
2011043P1	Abilynn Raetz	U of M-MSGC	Stimulating Groundwater Pollutant Transport for Remediation Design Antrim County Michigan	5,000	
2011053P1	Gabriel C. Ahrendt	U of M-MSGC	Investigation into the paleomagnetic properties and positioning of rhyolite volcanics deformed by the Keweenaw Fault	5,000	
2011054P1	Ian M. Gannon	U of M-MSGC	Critical Mineral Potential in the Vulcan Quadrangle and Adjoining Areas Dickinson County Upper Peninsula of Michigan	5,000	5,000
2011055P1	Kathryn A. Perrine	NSF	Mechanistic Studies of Water Disinfectants on Iron Interfaces	258537	258537
2011056P1	Kassidy R. O'Connor	U of M-MSGC	Using Satellite Aperture Radar to Improve Wildfire-Causing Debris Flow mapping on the West Coast	5,000	5,000
2011057P1	Diana Bullen	U of M-MSGC	Using a Biologically Enhanced Silica Recovery System to Retrieve Valuable Non-Renewable Resources from Waste Material	5,000	5,000
2011088P1	David Nitz	NSF	WoU-MMA: Enhancing the Neutrino Sensitivity of the Pierre Auger Observatory	249,804	249,804

2012001P1	Brian E. Fick	NSF	Search for Exotic Particles in Ultra-High-Energy Cosmic-Ray Collisions Using the Pierre Auger Observatory	301,722	
2012005P1	Simon Carn	NSF	Collaborative Research: NSFGEO-NERC: A new global framework for integrating observations of volcanic deformation gas and thermal emissions Keweenaw Fault Geometry Related Structures and Slip Kinematics along the Mohawk-Hancock Segment Michigan	210,497	
2012021P1	James M. DeGraff	US Dept of the Interior	Mid-scale RI-1 (M1:DP): A Community Laboratory Facility for Exploring and Sensing of Aerosol-Cloud-Drizzle Processes: The Convection Cloud Chamber Consortium	50,000	50,000
2101009PP	Raymond A. Shaw	NSF	Laboratory Investigations of Aerosol-Cloud Interactions in an Entraining Turbulent Environment	2,826,063	
2101042P1	Will H. Cantrell	US DOE	Reconciling hyperspectral and LiDAR observations with ground-based tropical forest response to geogenic CO2 seeps from fracture-bound volcanic streams	578,610	185,285
2102001P1	Chad D. Deering	NASA	Insights into pre-eruptive volcanic degassing from merged UV and IR satellite measurements of SO2 emissions	135,000	
2102002P1	Simon Carn	NASA		135,000	

2102035P1	Simon Carn	NASA	Near real-time volcanic SO2 height retrievals from SNPP and N20 OMPS using machine learning	247,287	
2102038P1	Claudio Mazzoleni	Nikira Labs Inc	Open-Path Drift Corrected QEPAS System for Multi-Wavelength Optical Absorption Measurements	97,740	
2102066P1	Roohollah Askari	NSF	Development of Remote Sensing of Seismological Signals via the Enhanced Moire Technique	498,300	
2103030P1	Robert Nemiroff	NASA	Support for Astronomy Picture of the Day	788,106	
2103040P1	Gregory P. Waite	Soc. of Exploration Geophysicists	Empowering Citizens in the Monitoring of Guatemala's Volcanoes	99,984	
2104052P1	Roohollah Askari	NSF	Collaborative Research: Deciphering Dynamics of Ferrofluids in Heterogeneous Porous Media Through Integrated Physical and Numerical Models	296,535	
2105003P1	Raymond A. Shaw	NSF	A Community Laboratory Facility for Exploring and Sensing of Aerosol-Cloud-Drizzle Processes: The Aerosol-Cloud-Drizzle Convection Chamber	2,903,682	1,888,381
2106020P1	Chad D. Deering	NASA	Remote sensing of subsurfaces change by enabling detection and tracking of ecological responses to passive volcanic flank carbon dioxide emissions into overlaying forests	546,094	

2106061P1	Nathan D. Manser	NSF	ERI: Biologically Decarbonized Lithium Extraction from Hard Rock and Clay Sources	197,185
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Appendix C: Major Expenditures

ITEM/CATEGORY	AMOUNT (\$)
Graduate Student Assistantships & Bridging Funds	
Olivia Barbee (Deering)	3,882
Chakrapani Lekha Vishnu (Oommen)	4,520
Thusitha Divisekara (L. Mazzoleni)	4,262
Sadi Hamed Fahandezh (Shaw)	2,430
Nurun Nahar Lata (Cantrell)	2,636
Atmos. Sci. GRA Line Deficit	1,191
Subtotal Grad Assistantships	18,922
Travel Assistance	
No travel due to COVID-19 Restrictions	0
Subtotal Travel Assistance	0
Facility Access	
Personal membership- Karlsruhe Institute of Technology (Fick)	3,989
Subtotal Facility Access	3,989
Facilities Support	
Repair magnetometer (Smirnov)	1,500
Contribution for service contracts for scanning electron microscopes (multiple users)	3,000
Subtotal Facilities Support	4,500
EPSSI Seminar Series	
All seminars were virtual due to COVID-19 restrictions.	0
Subtotal EPSSI Seminar Series	0
Total Large Ticket Items	27,412

Appendix D: Five-Year Projections

Table: ASPIRE Data from EPSSI NET ICR projection report

	2022	2023	2024	2025	2026	2027	2028	Total
Awarded Remaining Balance:	1,228,690	614,737	120,482	20,222	15,031	2,129	-	\$2,001,292
Anticipated Awards:	38631	47403	8578	0	0	0	0	\$94,612
Proposal in Progress:	41656	72114	60518	32824	3846	0	0	\$210,957

Projected IRAD return for remainder of Fiscal Year (FY)

