Exponent®
Engineering & Scientific Consulting

Tom Celenza, Ph.D.

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Professional Profile

Dr. Celenza is a consultant with extensive experience in many facets of mechanical engineering including heat transfer, fluid dynamics, photophoresis, machine design, composites, vacuum systems, and nanotechnology. He also has experience in mechanical systems from a commercial construction perspective.

Dr. Celenza has developed thermal and fluid theoretical models through simulations, using ANSYS Fluent and COMSOL, and has fabricated thin-film metamaterials through semiconductor fabrication methods for vacuum system tests for aerospace and atmospheric science applications. Since joining Exponent, Dr. Celenza has contributed to projects including those related to aviation, combustion, HVAC, electrical and plumbing equipment.

Before joining Exponent, Dr. Celenza received his PhD in Mechanical Engineering from the University of Pennsylvania, where he studied photophoretic levitation, or light-induced flight, of macroscale structures made of microscale metamaterials and composites in collaboration with NASA through a NASA Space Technology Graduate Research Fellowship for atmospheric science applications in the mesosphere. The goal was to create a structure capable of flight with no moving parts, using only light, in rarefied gas environments. Through this work, he performed ANSYS Fluent and COMSOL simulations in combination with MATLAB parametric studies to predict payloads and flight altitudes based on photophoresis, heat transfer modes and low-Re flow fundamentals. The structures were built in a nanotechnology facility with deposition, etching, and lithography techniques and tested in a custom-made vacuum chamber and LED array & electrical circuit set up for flight capabilities. He also studied thermionic energy conversion and photovoltaics/solar power.

Before graduate school, Dr. Celenza worked in construction management, supervising, coordinating, and budgeting all types of installation ranging from carpentry to mechanical and plumbing equipment. He also worked with interdisciplinary teams of designers, engineers, and construction workers to solve client issues. Before working in construction, Dr. Celenza received his bachelor's degree in mechanical engineering from the University of Delaware with an aerospace engineering concentration. He studied topics including wind power and robotics and worked with expert machinists in a machine shop.

Academic Credentials & Professional Honors

Ph.D., Mechanical Engineering and Applied Mechanics, University of Pennsylvania, 2024

B.S.E., Mechanical Engineering, University of Delaware, 2018

NASA Space Technology Graduate Research Opportunity, 2020-2024

W. Francis Lindell Mechanical Engineering Award to the Distinguished Senior, 2018

W. Francis Lindell Mechanical Engineering Achievement Award, 2017

Professional Affiliations

American Institute of Aeronautics and Astronautics, 2024

Tau Beta Pi Engineering Honor Society, 2018

Publications

Celenza, T, Eskenazi, A, Bargatin, I. Three-dimensional photophoretic aircraft made from ultralight porous materials can carry kilogram-scale payloads in the mesosphere. Physical Review Applied 2024, 22(5), 054081.

Celenza T, Eskenazi A, Lu Z, Mann A, Yao-Bate L, Bargatin I. Knudsen Pump-and Solar Buoyancy-Based Propulsion for Atmospheric and Martian Exploration. AIAA SciTech 2024 Forum; 1811.

Lu Z, Stern M, Li J, Candia D, Yao-Bate L, Celenza T, Azdi M, Campbell M, Bargatin I. Minimizing the Ground Effect for Photophoretically Levitating Disks. Physical Review Applied 2023; 19.4:044004.

Campbell M, Celenza T, Schmitt F, Schwede J, Bargatin I. Progress toward high power output in thermionic energy converters. Advanced Science 2021; 8.9:2003812.

Cha W, Kasper L, Campbell M, Celenza T, Popov G, Wang J, Sung C, Yim M, Bargatin I. Carbon fiber–aluminum sandwich for micro-aerial vehicles and miniature robots. MRS Advances 2021; 6.19:477-481.

Presentations

Celenza T, Eskenazi A, Lu Z, Mann A, Yao-Bate L, Bargatin I. Knudsen Pump-and Solar Buoyancy-Based Propulsion for Atmospheric and Martian Exploration. AIAA SciTech Forum, Orlando, FA, 2024

Celenza T, Eskenazi A, Lu Z, Yao-Bate L, Bargatin I. Mechanical Metamaterials Enabling Knudsen-Pump-Based Propulsion for Novel Sensor-Based Mesosphere Exploration. MRS Fall Meeting, Boston, MA, 2023

Celenza T, Campbell M, Popov G, Kasper L, Cha W, Sung C, Yim M, Bargatin I. Selective Curing of Carbon Fiber Reinforced Plastics to Fabricate Deployable Folding Structures. MRS Spring Meeting, Virtual, 2021

Celenza T, Lu Z, Campbell M, Azadi m, Bargatin I. Enhancing Photophoretic Lift Force at Low Reynolds Numbers using Three-Dimensional Porous Structures. 1st International Conference on Micromachines and Applications, Virtual, 2021

Posters

Celenza T. Knudsen-Pump-Based Propulsion for Atmospheric and Martian Exploration. CEDAR Workshop, San Diego CA, 2023

Celenza T, Eskenazi A, Lu Z, Yao-Bate L, Campbell M, Bargatin I. Simulation, Fabrication and Experimentation of Levitating Three-Dimensional Structures. ASME IMECE, Columbus OH, 2022

Celenza T, Eskenazi A, Lu Z, Yao-Bate L, Azadi M, Campbell M, Bargatin I. Simulation and Fabrication of 3D Structures for Photophoretic Levitation. SPIE Optical Trapping and optical micromanipulation XIX, San Diego, CA, 2022