# IEEE Tech Talk

# Clean Energy Fusion

# January 24, 2023, 4 pm PST

## *Live Stream Seattle Washington*

## The Sheared-Flow-Stabilized Z-Pinch Approach to Fusion Energy

The sheared-flow-stabilized (SFS) Z-pinch concept is on a path to commercialization at Zap Energy. Recent experiments on the Fusion Z-pinch Experiment (FuZE) device corroborate expected plasma stability and thermonuclear fusion reaction rates. Experimental campaigns are underway to increase the pinch current, the stable plasma duration, and DD fusion neutron production. The next generation device FuZE-Q is currently undergoing commissioning and will begin operation at current levels where scientific breakeven-equivalent conditions are expected in the near future. The Z-pinch configuration offers the promise of a compact fusion device owing to its simple geometry, unity beta, and absence of external magnetic field coils. In addition to a robust experimental program pushing plasma performance towards breakeven conditions, Zap Energy has parallel programs developing power handling systems suitable for future power plants. Technologies under development include high-average-power repetitive pulsed power, high-duty-cycle cathodes, and liquid metal wall systems.

**Matthew Thompson** is Vice President of Systems Engineering at Zap Energy, a company seeking to commercialize sheared-flow stabilized Z-pinch technology for fusion energy production. In that capacity he built and runs a 30-person division tasked with increasing the technology readiness level of fusion power plant technologies including liquid metal first wall and blanket, durable cathodes, and repetitive pulsed power. Dr. Thompson completed a bachelor's degree with honors in physics from Stanford University, and both a MS and PhD in experimental plasma physics from the University of California, Los Angeles. After graduating, he spent two years at Lawrence Livermore National Laboratory working on inertial-confinement-fusion-related laser matter interaction physics. Dr. Thompson transitioned to private industry in 2007 with his first Senior Scientist position at Tri Alpha Energy working on energy conversion and magnetic sensor technologies. He rose through the ranks to become Director of Physics at TAE Technologies, Inc., a diversified company working on nuclear fusion, related power handling and particle accelerator technologies, and new medical devices for cancer treatment. He led the 50 scientists and technical personnel of TAE's Physics Division in their work on experimental operations, pulsed power systems, high-power neutral beams, plasma diagnostics, data acquisition, analysis, and data science. After leaving TAE in 2019, Dr. Thompson spent two years developing sensors and embedded data processing systems for DARPA programs and advanced aerospace applications at BAE Systems, Inc. In 2021 he returned to fusion research and development to lead Systems Engineering at Zap Energy, Inc. Dr. Thompson is also a Fellow of the American Physical Society (APS), past Chair of the APS Forum on Industrial and Applied Physics, and a past Chair of the APS Committee on Careers and Professional Development. He has personally mentored dozens of STEM students with diverse backgrounds on professional issues, made many career-oriented speaking appearances, co-founded a major mentoring program called IMPact (https://impact.aps.org/), and writes about career issues for physical scientists on his website http://www.prosperousphysicist.com/ and in his books http://amazon.com/author/mcthompson.

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Mike Brisbois | 708.668.5488 | mike.brisbois@ieee.org

**Clean Energy Fusion**

This talk aims to provide the members of the IEEE with guidance on where they could contribute to the tremendous challenge of energy production from fusion. A brief overview will showcase the different approaches to attaining fusion energy production. The fundamental physics driving these hypothetical machines will be discussed. Aspects of these technologies that are often glossed over will be highlighted. A brief discussion may challenge some people's understanding of what " clean " means. The audience will be provided with a glimpse into the technical challenges at the heart of the matter from a nuclear engineer's perspective. The talk will conclude with preliminary figures to start the conversation around electricity production and power distribution.

**Andrew Franklin**

Andrew Franklin is a practicing nuclear engineer in the nuclear power industry. He earned a bachelor of science in nuclear engineering with minors in mathematics and radiological health engineering from Texas A&M in 2014. He studied nuclear engineering in graduate school at Texas A&M, emphasizing scientific computing and thermal hydraulics. During this time, he held internships at Sandia and Idaho National Labs. While at Sandia National Labs, he worked in the severe accident analysis group, where he was exposed to the challenges of modeling and simulating severe accidents such as the Fukushima Daiichi. While working at Idaho National Labs, he worked in the multiphysics modeling and simulation group. This work focused on developing new software to model design basis accidents and to aid in the design of conceptual microreactors. In the summer of 2020, he completed a master's thesis on the implementation of surface-to-surface black body radiation heat transfer within a multiphysics framework. Currently, he works as a thermal hydraulics engineer supporting the design of advanced fission nuclear reactors.

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