Thermionic energy converters (TECs) convert heat to electricity through vacuum electron emission from a hot cathode onto a colder anode. Building an efficient converter has proven to be extremely challenging, however. An ultra-low work function anode is important for operation, and it must coexist in the device with a high-flux electron emitter. By default, electron emission will cause a large space charge barrier to form, which must be mitigated in a manner that consumes little energy; solutions include plasmas or very small gaps. This short course will give an overview of TECs, the theory behind them, and the primary solutions to low work function collectors, high-flux emitters, and space charge mitigation. The course will also discuss approaches to modeling TEC performance, including the use of modern high-performance computing.

Peter Scherpelz is a senior computational physicist at Modern Electron, where he has experience in particle-in-cell modeling of thermionic converters, thermionic converter theory, and design and analysis of novel thermionic converter concepts and experiments. He holds a Ph.D. in physics from The University of Chicago, where he was supported by the Hertz Fellowship, and focused on theoretical descriptions of high-temperature superconductors and ultracold atomic superfluids. He completed a postdoctoral fellowship at The University of Chicago Pritzker School of Molecular Engineering, where he performed electronic structure calculations to support the development of novel materials and quantum computing architectures.

Roelof Groenewald is a senior computational physicist at Modern Electron, with experience in thermionic converter theory, particle-in-cell simulations of thermionic converters, models of plasmas used in thermionic converters, and experiments on thermionic converters. He has also performed electromagnetic modeling of radiative heat transfer for thermionic converter design. He holds an M.S. in computer science and a Ph.D. in physics from the University of Southern California, where he worked on computational condensed matter physics, including ab-initio studies and method development for computing many-body interactions.