15 million US workers follow night or nonstandard shifts. A similar number of Americans travel overseas each year. This leads to misalignment of the daily (circadian) clock in individuals: a clock that controls sleep, performance, and nearly every physiological process in our body. Consequences include many of the reported major industrial accidents and automobile deaths. In the first half of this talk, I demonstrate how, when using a “simple” ode mathematical model of this clock, one can optimize schedules for transmeridian travelers and shiftworkers to maximize productivity and minimize jetlag. I then show how our smartphone app, ENTRAIN (www.entrain.org), which has been downloaded nearly 200,000 times in over 100 countries, simulates models and employs these optimized schedules. In the second half, I describe how large-scale mathematical models of brain regions controlling circadian timekeeping push the limits of scientific computing. Using a population density/particle method, contraction to low dimensional manifolds, and a new anzatz for simplifying coupled oscillator problems—I show how one can relate these simulations to predictions of jet lag and productivity. This work also presents a new paradigm for how one studies human behavior, where large-scale computing and mathematical analysis can translate basic neuroscience, to yield hypotheses that can be rapidly tested against social factors using mobile and wearable technology.

**Daniel Forger** received an undergraduate and master's degree from Harvard in Mathematics Applied to the Medical Sciences. His PhD work, in mathematics at the Courant Institute (NYU), developed mathematical models of circadian timekeeping, and was supported by an NSFGRF and an NIH training grant in Sleep Medicine (Harvard). Dr. Forger did an experimental post-doc on the molecular biology of circadian timekeeping (Blau lab, NYU) supported by a Sloan Foundation fellowship. He arrived at Michigan in 2005 and is now a Professor of mathematics and a Research Professor of computational medicine and bioinformatics. Past awards include the Kronauer Prize and the Air Force Young Investigator Award.