The National Spherical Torus Experiment has been recently upgraded (NSTX-U) with substantial increases in magnetic field strength (0.5→1 T), plasma current (1→2 MA), neutral beam heating power (6→12 MW) and pulse duration (1→5 s) to expand operational flexibility for physics studies. Operations began Dec. 2015 and rapid progress has been made in the first few weeks of machine commissioning, including establishing plasma control and access to high-performance (H-mode) regimes (left figure).

One of the key research priorities in the upcoming NSTX-U run campaigns is to clarify what transport mechanisms limit the confinement in spherical tokamaks, which are uniquely characterized by low-aspect ratio (R/a~1.7), high plasma beta (~20%), strong toroidal flow (Mach numbers ≥0.5), and relatively large ratio of ion gyro-radius to machine size (r~1/100). Previous research has indicated that heat lost through the ions is often close to collisional (neoclassical) transport limits. However, there is a zoology of theoretical turbulent and energetic-particle-driven transport mechanisms (ITG, TEM, ETG, KBM, MTM, DTEM, KH, GAE, CAE-KAW, …) that have been proposed as possible explanations for the anomalous electron thermal transport. I will attempt to illustrate what a few of these mechanisms are and under what conditions they may be relevant in influencing confinement in NSTX-U plasmas. I will finish by challenging the audience to help clarify, and hopefully unify, our understanding of transport in spherical tokamaks through the use of theory, computation (right figure) and measurements.