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Two-fluid flowing equilibria of spherical torus sustained by coaxial helicity injection TAKASHI KANKI, Japan Coast Guard Academy, LOREN STEINHAUER, University of Washington, MASAYOSHI NAGATA, University of Hyogo — Two-dimensional equilibria in helicity-driven systems using two-fluid model were previously computed, showing the existence of an ultra-low-q spherical torus (ST) configuration with diamagnetism and higher beta. However, this computation assumed purely toroidal ion flow and uniform density. The purpose of the present study is to apply the two-fluid model to the two-dimensional equilibria of helicity-driven ST with non-uniform density and both toroidal and poloidal flows for each species by means of the nearby-fluids procedure, and to explore their properties. We focus our attention on the equilibria relevant to the HIST device, which are characterized by either driven or decaying λ profiles. The equilibrium for the driven λ profile has a diamagnetic toroidal field, high-β (β_t= 32%), and centrally broad density. By contrast, the decaying equilibrium has a paramagnetic toroidal field, low-β (β_t= 10%), and centrally peaked density with a steep gradient in the outer edge region. In the driven case, the toroidal ion and electron flows are in the same direction, and two-fluid effects are less important since the $E \times B$ drift is dominant. In the decaying case, the toroidal ion and electron flows are opposite in the outer edge region, and two-fluid effects are significant locally in the edge due to the ion diamagnetic drift.

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