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Astrophysical Boundary Layers: A New Picture

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Accretion is a ubiquitous process in astrophysics. In cases when the magnetic field is not too strong and a disk is formed, accretion can proceed through the mid plane all the way to the surface of the central compact object. Unless that compact object is a black hole, a boundary layer will be formed where the accretion disk touches its surfaces. The boundary layer is both dynamically and observationally significant as up to half of the accretion energy is dissipated there.

Using a combination of analytical theory and computer simulations we show that angular momentum transport and accretion in the boundary layer is mediated by waves. This breaks with the standard astrophysical paradigm of an anomalous turbulent viscosity that drives accretion. However, wave-mediated angular momentum transport is a natural consequence of "sonic instability." The sonic instability, which we describe analytically and observe in our simulations, is a close cousin of the Papaloizou-Pringle instability. However, it is very vigorous in the boundary layer due to the immense radial velocity shear present at the equator.

Our results are applicable to accreting neutron stars, white dwarfs, protostars, and protoplanets.

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