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Self-consistent determination of attached eddies in rotating plane Couette flow BRUNO ECKHARDT, MARINA PAUSCH, MARTIN G LELLEP, STEFAN ZAMMERT, Philipps-Universitaet Marburg — The formation of ever thinner boundary layers near a surface requires the presence of ever smaller structures in the flow, ideally organized in a hierarchical manner. We here show how exact coherent structures that have figured prominently in studies on the transition to turbulence can self-organize to provide such a cascade of structures to smaller scales. The flow studied is rotating Couette flow restricted to two spatial degrees of freedom, which is essentially equivalent to 2d Rayleigh-Benard flow. Within the quasilinear approximation to the Navier-Stokes equation, all transverse modes obey separate equations that depend on the mean velocity profile. The mean profile, on the other hand, is composed of contributions from all transverse modes. The hierarchy of modes that represent attached eddies then follows from a self-consistent solution to the coupled equations. As the Reynolds number increases, so does the number of contributing modes. Scaling properties of the modes and of the profile can be derived. The study provides a mechanism by which the hypothesized attached eddies emerge self-consistently from interactions in the Navier-Stokes equation.

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