On the Origin of the Inner Structure of Halos
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abstract
We calculate by means of the Press-Schechter formalism the density profile developed by dark-matter halos during accretion, i.e., the continuous aggregation of small clumps. We find that the shape of the predicted profile is similar to that shown by halos in high-resolution cosmological simulations. Furthermore, the mass-concentration relation is correctly reproduced at any redshift in all the hierarchical cosmologies analyzed, except for very large halo masses. The role of major mergers, which can cause the rearrangement of the halo structure through violent relaxation, is also investigated. We show that, as a result of the boundary conditions imposed by the matter continuously infalling into the halo during the violent relaxation process, the shape of the density profile emerging from major mergers is essentially identical to the shape the halo would have developed through pure accretion. This result explains why, according to high-resolution cosmological simulations, relaxed halos of a given mass have the same density profile regardless of whether they have had a recent merger or not, and why both spherical infall and hierarchical assembly lead to very similar density profiles. Finally, we demonstrate that the density profile of relaxed halos is not affected either by the capture of clumps of intermediate mass.