Unveiling the Boxy Bulge and Bar of the Andromeda Spiral Galaxy

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For the past 50 years a number of studies have suggested that the center of M31 may be barred. These optical studies, however, have been hampered by the highly inclined ($i = 77.5°$) disk of M31 and the obscuring effects of its embedded dust, which strongly influence the observed isophotal structure of the M31 center. We analyze a new near-infrared survey of M31 by the Two Micron All Sky Survey (2MASS) 6X program. These data, covering the full extent of the optical disk, present a view of the central structure of M31 almost completely unfettered by dust. This new portrait vividly reveals a central bulge dominating the near infrared light profile from 3 to 1000 arcsecs along the semi-major axis, and with a number of interesting properties: (1) prominent boxy isophotes across the extent of the bulge, (2) a position angle inclined by about 10° from that of the M31 disk, (3) strong isophotal twisting in the innermost regions of the bulge, and (4) the presence of ansae symmetrically extending beyond the bulge along the position angle of the galaxy disk. In other highly inclined disks such properties have been associated with the presence of central bars obscured by projection effects. In the case of M31, these features have been well reproduced in a fully self consistent N-body simulation of a barred galaxy with a boxy bulge. The models further suggest the existence of an additional classical bulge component at the center of M31, and imply that the bar itself extends beyond the observationally established extent of the boxy bulge.