THE STELLAR KINEMATICS AND POPULATIONS OF BOXY BULGES: POSSIBLE PURE DISK GALAXIES MNRAS (arXiv:1102.2438)

MICHAEL WILLIAMS[A] williams@mpe.mpg.de, MICHEL ZAMOWSKI[B], MARTIN BUREAU[C], HARALD KUNTSCHNER[D], MIKE MERRIFIELD[E], TIM DE ZEEUW[D,F], KONRAD KUIJKEN[F]

[A] MPE, [B] SPITZER SCIENCE CENTER, [C] OXFORD, [D] ESO, [E] NOTTINGHAM, [F] LEIDEN

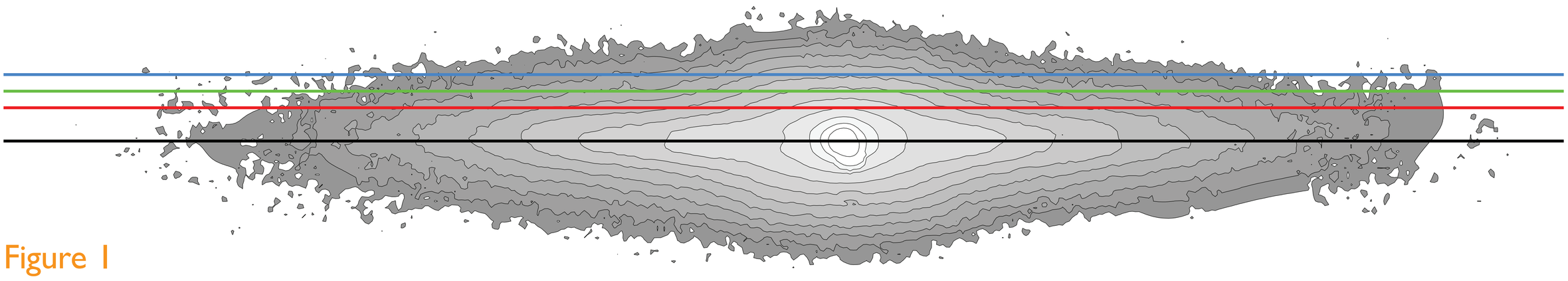
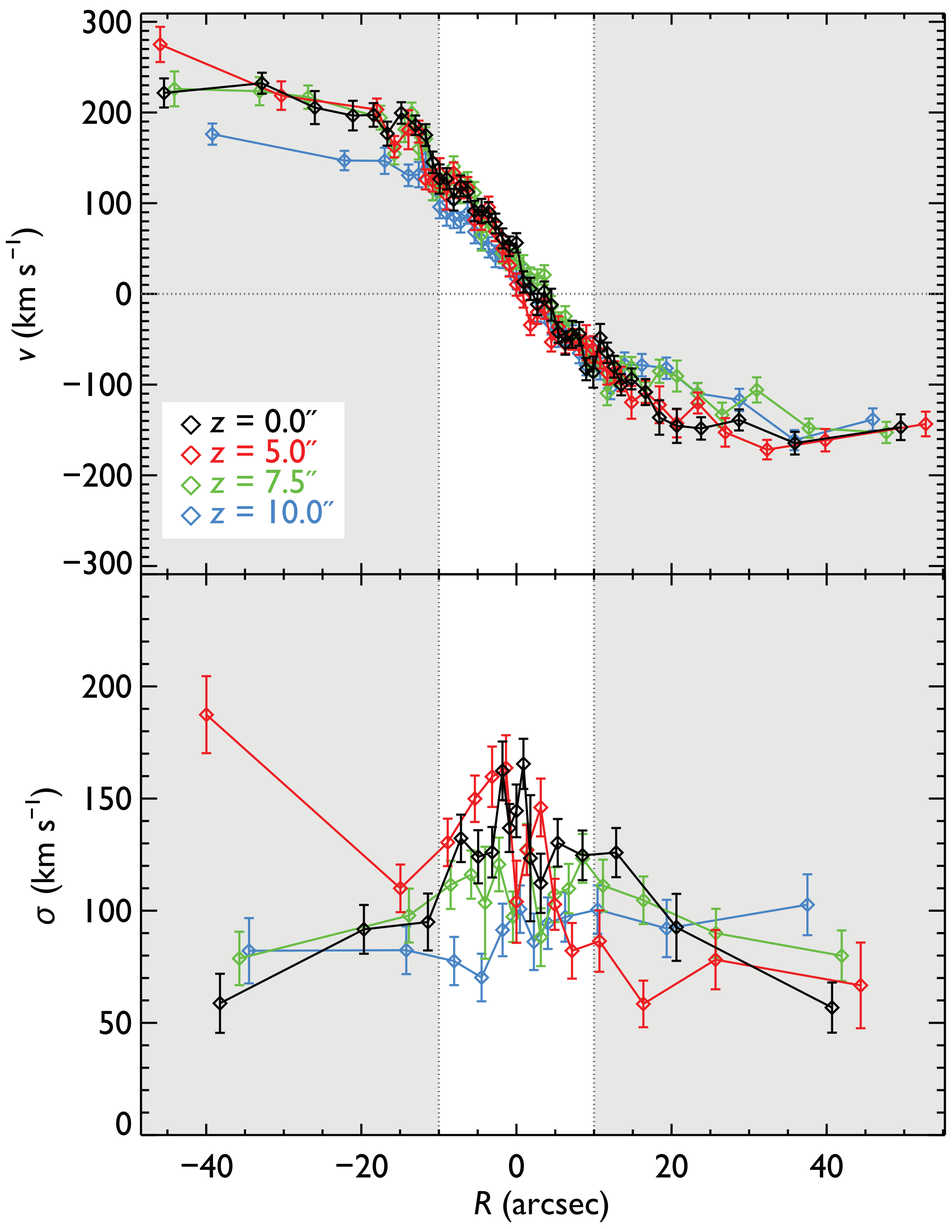


Figure 1

K-band image of the edge-on Sb galaxy NGC 3390, which hosts a boxy boxy bulge. Example long-slit positions are shown as coloured horizontal lines.



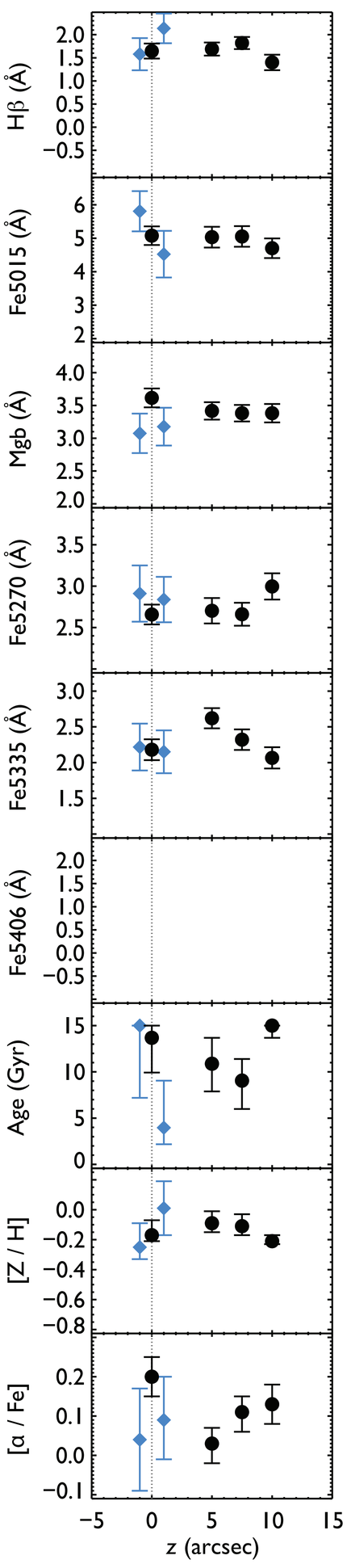


Figure 2

Stellar kinematics (above) and populations (right) of the boxy bulge of NGC 3390. Taken together, the kinematics and populations imply that this is a pure disk galaxy.

R is the distance along the major axis, *z* along the minor axis. On the stellar kinematics plots, the four colours represent the four slit positions at successive heights above the disk (see Figure 1). The unshaded region is the bulge (outside this region disk stars likely dominate). In this galaxy cylindrical rotation ($\partial v/\partial z = 0$) is strikingly well-defined within the bulge.

On the populations plots, the blue symbols are values for the disk ($z = 0$) at large $\pm R$. In this galaxy there is no evidence of any vertical stellar population gradients.

Boxy bulges

Boxy and peanut-shaped bulges are seen in about half of edge-on disk galaxies, including the Milky Way. If these bulges are nothing more and nothing less than bars viewed in projection, then this may imply that their hosts are pure disk galaxies with no classical bulge. But classical bulges are a ubiquitous feature of giant disk galaxies formed in a hierarchical universe with our current understanding of galaxy formation physics. Since there is nothing special about edge-on galaxies, this raises the possibility that a demographically significant population of disk galaxies are irreconcilable with our understanding of galaxy formation. It is therefore crucial to better understand these bulges.

Our work

A handful of them, including that in the Milky Way, have been observed to rotate cylindrically, i.e. with velocity independent of height above the disc. In order to assess whether such behaviour is ubiquitous in boxy bulges, and whether a pure disk interpretation is consistent with their stellar populations, we have analysed the stellar kinematics and populations of a targeted sample of five boxy bulges.

We used long-slit spectroscopy taken on the ESO NTT. We used four slit positions parallel to the major axis to build up two-dimensional coverage of the bulge.

We find one clear case of a pure disk galaxy (see Figure 2) and one clear case of a galaxy which hosts a classical bulge and a boxy bulge (NGC 1381). We therefore conclude that some, but not all, galaxies that host a boxy bulge are indeed pure disk galaxies in the cosmological sense.