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VLT OBSERVATIONS OF EARLY-TYPE DWARFS IN THE VIRGO CLUSTER: SOME FIRST SURPRISING RESULTS

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RESUMEN

En una muestra de 23 dS0s y enanas elípticas nucleadas observadas con el Very Large Telescope en las bandas B y R, hemos encontrado cuatro sistemas que exhiben estructuras no axi-simétricas, tales como una barra y/o brazos espirales, indicativas de un disco (IC0783, IC3349, NGC4431, IC3468). Los resultados sugieren que la fracción de enanas tempranas que alojan una componente de disco podría ser mayor que lo anteriormente supuesto. En un posible escenario, ellas son galaxias de disco tardías que durante su caída al cúmulo se han transformado en los objetos hoy observados.

ABSTRACT

Among a sample of 23 nucleated dwarf ellipticals and dS0s observed with the Very Large Telescope in B and R, we found four systems exhibiting non-axisymmetric structures, such as a bar and/or spiral arms, indicative of a disk (IC0783, IC3349, NGC4431, IC3468). The results suggest that the fraction of early-type dwarfs hosting a disk component could be higher than previously thought. In a possible scenario they are former late-type disk galaxies which have been transformed to the objects we observe today during their infall to the cluster.

Key Words: **GALAXIES: GENERAL — GALAXIES: PHOTOMETRY — GALAXIES: STRUCTURE**

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1. INTRODUCTION

It has always been suspected that a considerable number of early-type dwarfs might be disk galaxies. In fact, around 20 bright early-type dwarfs in the Virgo cluster are classified dS0 because of their S0-like morphology, exhibiting a lens, a bar, or high flattening (Sandage & Binggeli 1984; Binggeli & Cameron 1991). However, most of the few early-type dwarfs for which rotation curves have been observed so far seem not to be rotation supported (Ferguson & Binggeli 1994; de Rijcke et al. 2001; Geha et al. 2001). The discovery of disk components in these galaxies could further clarify the situation.

After the discovery of a spiral structure in IC3328 by Jerjen et al. (2000) we therefore started a careful search of the whole sample consisting of 23 early-type dwarfs. Using the same technique as in the case of IC3328 (a Fourier decomposition of the light distribution) we found seven promising candidates for disk structures. However, projection effects like twisting isophotes caused by changing ellipticities in triaxial systems and specific combinations of the ellipticity and position angle profiles can affect disk signatures in the results of the Fourier analysis. In order to solve this ambiguity, we applied a simple version of unsharp masking to our images.

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2. UNSHARP MASKING

Unsharp masking is a well established method for finding hidden structures in stellar systems. The fact that no assumptions like flattening or position angle of the major axis are needed is the big advantage of this method, even if it cannot provide any quantative properties of the objects.

In applying unsharp masking the images are basically smoothed with an appropriate strength. This can be done by convolving the image with a Gaussian or, even simpler, by transforming each pixel intensity to the mean intensity in a square around it. We used the latter version with a square size of $12\farcs2 \times 12\farcs2$. After dividing the images by this smoothed version three of our seven candidates showed no signs of a disk structure and the presence of a disk component in these objects cannot be confirmed. The results for the remaining four objects are shown in Fig. 1.

3. RESULTS

The results of unsharp masking confirm the findings of the Fourier analysis for the four galaxies IC0783, IC3349, NGC4431 and IC3468. Disk signatures are evident in all of the four objects.

IC0783: The two spiral arms of this "dS0" galaxy are already evident in the direct optical image. Obviously this is a disk galaxy, which now is also confirmed by the measurement of its rotation (Simien & Prugniel 2002). The central structure of this galaxy remains unresolved; we think there could be an inner ring.

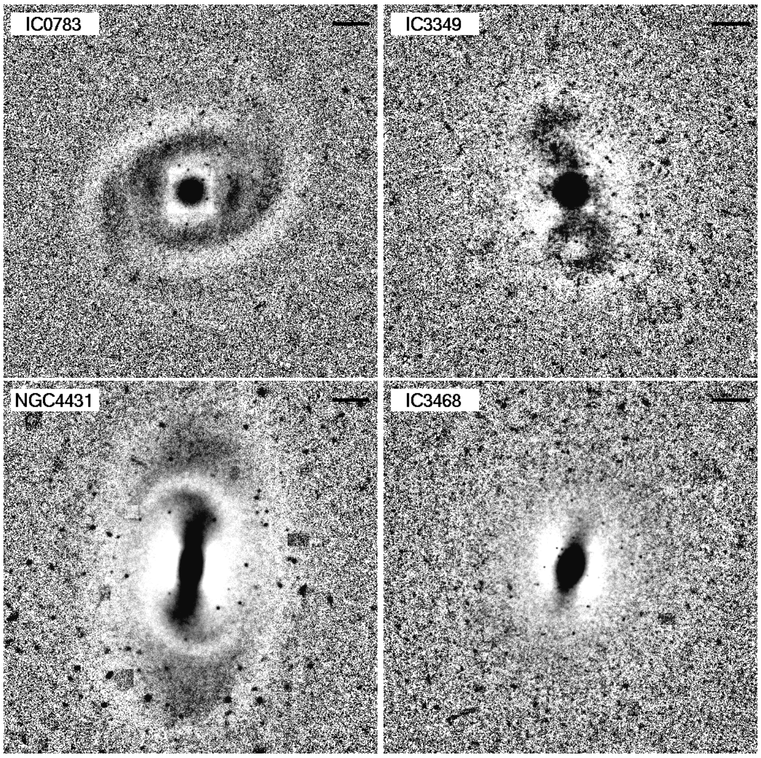

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Fig. 1. Result of unsharp masking for the four galaxies. The images are negatives. The bar in the upper right corner corresponds to 10″ ($\sim$ 1 kpc). Image size: 1′.7 × 1′.7. North is up and east to the left.

IC3349: The unsharp masking reveals a long and elongated (if only weak) structure in the central part, which we interpret as a bar in a nearly face-on disk. A revised type for this "dE" galaxy would be dSB0.

NGC4431: The quite strong bar present in this galaxy is the most striking discovery and clearly reveals the disk nature of this dwarf galaxy. Besides the bar trailing arms and two dense regions on the leading side of the bar are evident. A more fitting type for this "dS0" galaxy would be dSB0/a. Its rotation was measured as well by Simien & Prugniel (2002).

IC3468: In the very center of this dwarf elliptical we either observe a rather short bar in a nearly face-on disk, or a small disk seen edge-on in a spheroid.

Surprisingly, Simien & Prugniel (2002) found essentially zero rotation along the position angle of this structure, which renders a clear interpretation of what we see impossible at present.

The galaxies presented could be former late-type disk galaxies which have been transformed to early-type dwarfs during their infall to the cluster, somehow maintaining at least parts of their disk structure.

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