

A PECULIAR GALAXY NEAR M104

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Received April 24 2023; accepted July 3 2023

ABSTRACT

Messier 104, NGC 4594, also known as the Sombrero Galaxy, has been extensively studied, especially its structure and stellar halo. Its abundance of globular clusters has given rise to many theories and much speculation. However, other objects in the vicinity of such a spectacular galaxy are sometimes ignored. While studying HST images available on the HST Legacy website of the halo of M104 (HST proposal 9714, PI: Keith Noll), the author observed at 12:40:07.829 -11:36:47.38 (in j2000) an object about 4 arc seconds in diameter. A study with VO tools suggests that the object is a SBc galaxy with an AGN (Seyfert).

RESUMEN

Messier 104, NGC 4594, conocida como la Galaxia del Sombrero, ha sido extensamente estudiada, especialmente su estructura y halo estelar. La abundancia de cúmulos globulares que presenta ha dado lugar a muchas teorías y especulaciones. Sin embargo, otros objetos en las cercanías de una galaxia tan espectacular a veces son pasados por alto. Mientras estudiaba las imágenes del HST disponibles en el sitio web HST Legacy del halo de M104 (propuesta HST 9714, investigador principal: Keith Noll), el autor observó en las coordenadas 12:40:07.829 -11:36:47.38 (en j2000) un objeto de aproximadamente 4 segundos de arco de diámetro. Un estudio con herramientas de VO sugiere que el objeto es una galaxia SBc con un AGN (Seyfert).

Key Words: catalogues — galaxies: peculiar — galaxies: spiral — virtual observatory tools

METHODS AND DISCUSSION

The author, studying Hubble Space Telescope (HST) images of M104 available on the HST Legacy website (HST proposals 9714, PI: K. Noll, and 13364, PI: D. Calzetti), observed at coordinates 12:40:07.829 -11:36:47.38 an object located in the halo of the galaxy, about 4 arc seconds in diameter. It is catalogued by Simbad as a Globular Cluster Candidate. The Nasa/IPAC Extragalactic Database (NED)² shows its classification as an IrS (Infrared Source), not as a galaxy, with an available spectral energy distribution (SED) plot. A search of the Pan-STARRS1 data archive returns objName PSO J190.0326-11.6132, which in

VizieR shows a more complete SED plot³ with data from 5 catalogues: PAN-STARRS PS1, SDSSz, 2MASSJ, Spitzer:IRAC3.6 and VISTA:Z. After a new search in NED, the object in region #710, SSTS2 J124007.83-113647.1, seems to be the one.

The author has compared the object's SED plot with those of spiral galaxy models in Optical-NIR-MIR (Nicole 2012), and the object's NED plot points fit quite well.

HST Legacy has some images taken with the 435 and 555 filters, which are equivalent to *B*, *V* and *R* filters. So the bandwidth is from *B* to NIR. The results of an RGB of the images in Aladin Sky Atlas, (Figure 1b) show (limited by the resolution) a galactic centre and a central bar with reddish hues (555 filter, *R* of the Wide Field and Planetary Camera 2 [WFPC2]) and a blue ring around it (435 filter, *B+V* of the Advanced Camera for Surveys [ACS]).

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²https://ned.ipac.caltech.edu/byname?objname=SSTS2+J124007.83-113647.1&hconst=67.8&omegam=0.308&omegav=0.692&wmap=4&corr_z=1

³<http://vizier.cds.unistra.fr/vizier/SED/?-c=12+40+07.83277+-11+36+47.0442&c.rs=5.0>

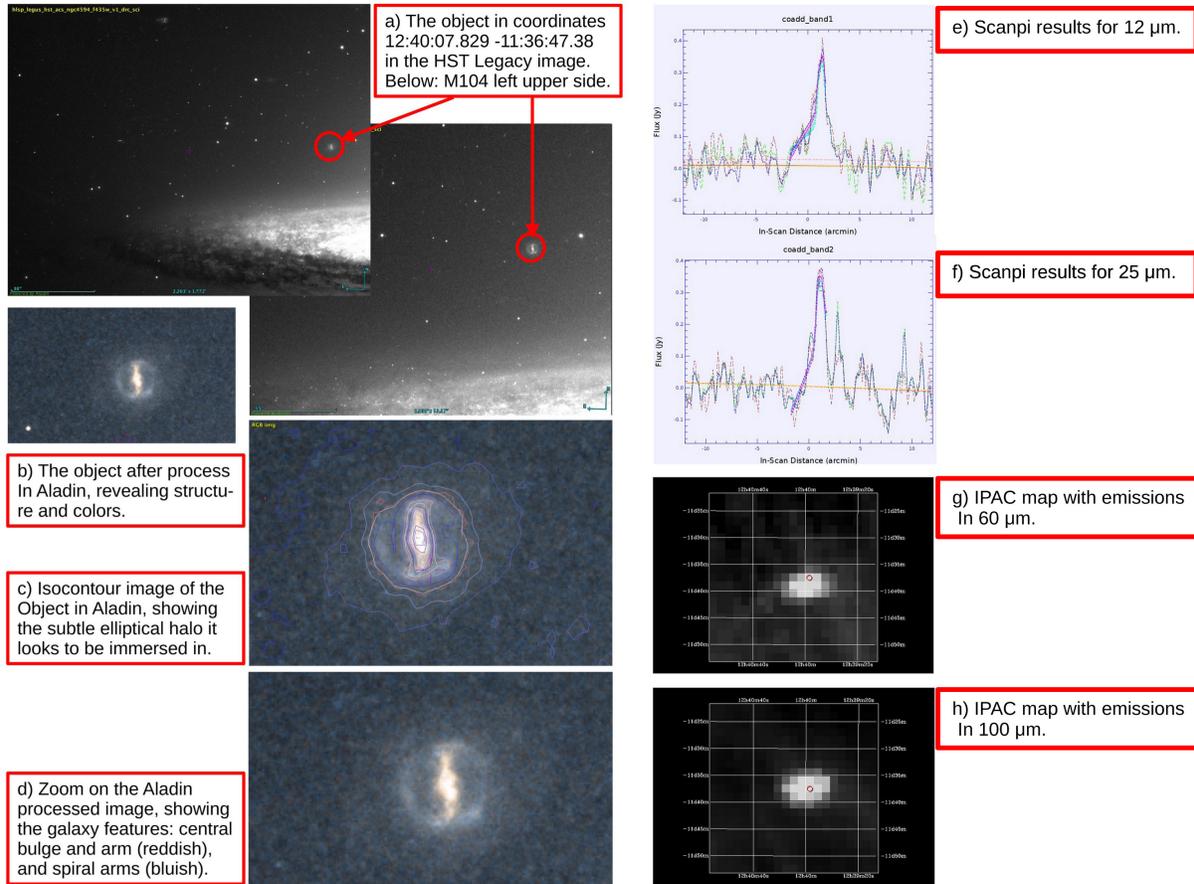


Fig. 1. The adjusted and zoomed RGB of the object in Simbad (a, b, c), the Scanpi results for 12 micrometers (d) and for 25 micrometers (e), and the IPAC map with emissions at 60 (f) and 100 micrometers (h) in the halo area shown in b.

This may suggest a central region of cool, old stars and two possible spiral arms with star-forming regions.

In addition, the approximately circular object (which appears to be face-on) has a subtle elliptical halo twice its size (Figure 1c), possibly a feature of the PSF due to the low signal-to-noise ratio in the area. The author obtained an IPAC map (with data from the Spitzer Space Telescope, Wide-field Infrared Survey Explorer WISE) showing emissions at 60 and 100 micrometers, within an approximate radius of 7 arc seconds around the coordinates of the object (Figures 1g and 1h), which is 4 arc seconds wide; it shows that the halo has an infrared emission, which is not a feature of the PSF. In Figure 1e, Scanpi results for the object show a flux gap at 12 micrometers (silicate absorption feature), which may be indicative of an AGN Seyfert galaxy (Köhler & Li 2010, Hao et al. 2007). Also shown in Figure 1f are the Scanpi results at 25 micrometers,

which show a peak. The 25 micrometers emission is a good measure of AGN luminosity (Severgnini et al. 2012). The WISE satellite offers a spatial resolution of approximately 6 arcsec⁴ while Spitzer provides about 2 arcsec⁵, so it is probable that the origin of the infrared emission is the galaxy, not the halo.

The silicate absorption feature may indicate that this galaxy once hosted massive stars (type O or B) capable of burning silicon in their final stages (Vollmer et al 2008). Supernova explosions may also have created a silicon-rich interstellar medium around the galaxy's core (Woosley, 2005).

In terms of redshift and angular size, Simbad⁶ gives us a radial velocity for the object of 1359 km/s and a $z = 0.004545 \pm 0.000027$. M104 has a

⁴<https://wise2.ipac.caltech.edu/docs/release/allsky/>

⁵<https://lweb.cfa.harvard.edu/~mmarengo/me/irac.html>

⁶<http://simbad.cds.unistra.fr/simbad/sim-id?Ident=%4012370942&Name=PSO%20J190.0301-11.6124&submit=submit>

$z = 0.003416$, so these data should be taken with the necessary caution. The measured redshift of a galaxy results from a combination of the cosmological redshift due to the expansion of the Universe and a Doppler shift due to the peculiar motions of the galaxy, and it is widely accepted that for galaxy collections, if the difference in redshift corresponds to a velocity difference below 500 km/s, or 1000 km/s for clusters, one cannot affirm with certainty that the objects are gravitationally unbound (Capelato et al. 1991). In this case the velocity difference is about 300 km/s. The author cannot confirm that the object is not gravitationally bound to M104, so it could be a satellite of the Sombrero galaxy with an angular size around 0.3 kpc.

As an alternative scenario, assuming the object is not associated with M104, it could be located at 20 Mpc ($H_0 = 67.04$, $\Omega_m = 0.3183$ and $\Omega_\Lambda = 0.6817$) with an angular size ≈ 22 Kpc, i.e. two thirds the size of the Milky Way. The object has a Fe/H metallicity of -0.309 dex (Alves-Brito et al. 2011), a relatively low value (metal-poor). Finally, there is an entry in HEASARC⁷ from the CXOGSGSRC table of the CHANDRA observatory database for the object at coordinates 12 40 06.24–11 36 47.7 with an X-ray flux emission of 2.410×10^{-15} erg/cm²/s, i.e. an X-ray luminosity of $L_X \approx 1.80 \times 10^{43}$ erg/s; assuming the alternative scenario with a distance of 20 Mpc; such a luminosity may indicate an active galactic nucleus (AGN), which is in the range observed for Seyfert galaxies (Panessa et al. 2006). Further studies would be needed to determine whether this is a Type 1 or Type 2 AGN.

CONCLUSIONS

The author has recognized an object (erroneously catalogued by Simbad as a Globular Cluster Candidate) as an SBc AGN Seyfert galaxy, $z = 0.004545 \pm 0.000027$, using VO tools. The Aladin Sky Atlas RGB suggests an SBc galaxy with a dominant central arm, a nucleus, and possibly two spiral arms with hot young stars and dust. VizieR and NED SED plots are consistent with a spiral galaxy. The object has a subtle elliptical halo twice the size of the central object, almost unnoticeable in the visible, with far-infrared emission in a radius of 7 arc seconds. Scanpi results at 12 micrometers show a silicate absorption feature and a peak at 25 micrometers suggests a possible AGN. The object has an X-ray emission luminosity of $L_X \approx 1.80 \times 10^{43}$ erg/s assuming a distance of 20 Mpc, suggesting a possible

Seyfert galaxy in the AGN Unification Model (Singh et al. 2011).

The author recommends adding the object to the “Galaxy” category, especially in public catalogues such as NED or Simbad, where it is still classified as an “Infrared Source” or “Globular Cluster Candidate”. The author proposes that it be named The Iris Galaxy.

Thanks to Adrian B. Lucy in the Space Telescope Science Institute for his kind help. Thanks to Alex Fraser for the English revision. Thanks to Agustin Trujillo (ULPGC) for the LaTeX translation help.

This research has made use of the Aladin Sky Atlas developed at CDS, Strasbourg Observatory, France, the NASA/IPAC Extragalactic Database (NED), the VizieR catalogue access tool, the Pan-STARRS1 Surveys (PS1), the Two Micron All Sky Survey (2MASS), the SDSS catalogue, the SIMBAD astronomical database, the European Space Agency (ESA) Gaia mission, and the Chandra X-Ray Center (CXC), operated for NASA by the Smithsonian Astrophysical Observatory. This research is based on observations made with the NASA/ESA Hubble Space Telescope obtained from the Space Telescope Science Institute.

This research has made use of the NASA/IPAC Infrared Science Archive, which is funded by the National Aeronautics and Space Administration and operated by the California Institute of Technology.

DATA AVAILABILITY STATEMENT

VO tables for the VizieR and NED SEDs plus data in Simbad and Heasarc are in the footnote links.

The short link for HEASARC stays for the url: <https://heasarc.gsfc.nasa.gov/db-perl/W3Browse/w3hdprods.pl?files=P&Target=heasarc%5Fxray%20%7C%7C%7C%5F%5Frow%3D1386796%7C%7C&Coordinates=Equatorial&Equinox=2000>.

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