

Research Note

Three new low velocity irregular galaxies undetected in HI

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Abstract. We have detected in H α three very nearby ($D < 3$ Mpc) irregular dwarf galaxies, which have been observed but undetected in HI. Their heliocentric radial velocities are: -64 km/s (Cam C), $+445$ km/s (Arp 211), and -141 km/s (NGC 6789) with the standard error ± 8 km/s.

Key words: galaxies: individual: Cam C=G 0318+6236; Arp 211; NGC 6789 – galaxies: irregular – local group – galaxies: distances and redshifts

1. Introduction

Creation of the complete sample of nearby galaxies situated within the Local Group as well in its neighbourhood is one of the key tasks of extragalactic astronomy. Different observing teams are continuously and successfully "hunting" new nearby objects, using various means: HI and IR surveys of the Milky Way regions shaded by interstellar dust clouds (Kraan-Korteweg et al., 1994, Huchtmeier et al., 1995, McCall & Buta, 1995), search for low surface brightness dwarf galaxies (Binggeli et al., 1990, Schombert et al., 1992, Impey et al., 1996), careful optical and HI inspection of the nearest galaxy groups (Börngen & Karachentseva, 1985, Côté et al., 1997) etc. As a result of these joint efforts the initial sample of 179 nearby galaxies in the Local Volume (=LV) having radial velocities $V_0 < 500$ km/s (Kraan-Korteweg & Tammann, 1979) has been recently increased by more than a hundred new objects (see a compilation by Karachentsev & Makarov, 1998).

An attempt to find new LV galaxies was undertaken by Karachentseva & Karachentsev (1998), who presented a list of 260 nearby galaxy candidates selected during inspection of films of the POSS-II and ESO/SERC surveys. In a HI pilot survey of part of the sample, Huchtmeier et al. (1997) noted that about 70% of the galaxies are detected in the 21 cm line with a median radial velocity of 1300 km/s, a quarter of them having corrected radial velocities within 500 km/s.

Among the rest of the galaxies of the sample one can also find very nearby galaxies, undetected in HI due to their low gas content (dwarf spheroidal systems), or to confusion by the Galactic hydrogen emission. To check this we took from the list three objects undetected in HI (Huchtmeier, 1998), whose morphology suggests the existence of HII regions. The results of our spectral observations confirm that these galaxies are expected to be the LV members.

2. Observations

The observations were carried out at the 6-meter telescope with the prime focus CCD spectrograph UAGS. A 520×580 pixels CCD with a pixel size of 18×24 microns together with a 1300 grooves/mm grating provide a dispersion of $1.6 \text{ \AA}/\text{pixel}$ and a spectral resolution of about 3 \AA . The slit length and width were $150''$ and $2''$, respectively. We observed the following objects: Cam C, Arp 211, and NGC 6789 on 30.08.1997, 3.03.1997, and 26.04.1996 respectively with a typical exposure time of 900 sec in the H α region. In each case the slit was located approximately along the galaxy major axis. The image processing was carried out with the LONG procedure in the MIDAS reduction package.

3. Results

Fig. 1 shows images of the three observed galaxies reproduced from the Digital Palomar Sky Survey. In the spectra of all three galaxies one sees a bright H α line and also faint lines of [NII] and [SII]. The run of the radial velocities measured from H α along each galaxy major axis is presented in Fig. 2. In each case the systematic internal motions do not exceed a one-sigma value of 30 km/s that indicates a low mass. Some basic parameters of the observed objects are given in Table 1. Its lines contain:

- (1,2) — equatorial coordinates at the 1950.0 epoch;
- (3) — major and minor angular diameters of the galaxy in arcmin, corresponding to the 25 mag/sq.arcsec isophote;
- (4) — integral apparent blue magnitude;
- (5) — galactic extinction according to Burstein & Heiles (1984);

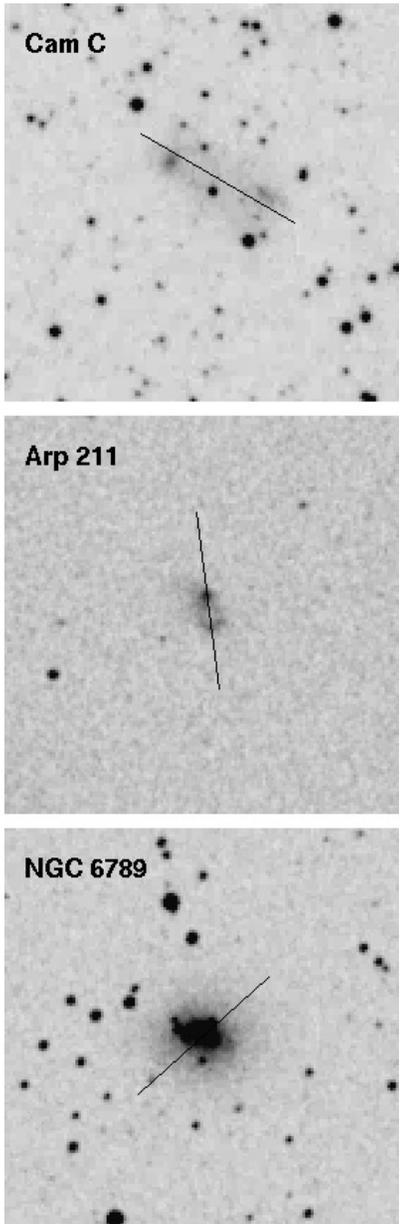


Fig. 1. Reproduction from the digital POSS-1 of the objects: Cam C, Arp 211, NGC 6789. Each chart is 4×4 arcmin, North at top, East at left. The slit positions are indicated by straight lines.

(6) — mean measured radial velocity and its $1\text{-}\sigma$ error;

(7) — galaxy radial velocity with respect to the Local Group center calculated using the apex parameters: $\{l_a = 93^\circ, b_a = -4^\circ, V_a = 316 \text{ km/s}\}$ (Karachentsev & Makarov, 1996);

(8) — distance to the galaxy via its radial velocity with a Hubble parameter $H = 70 \text{ km/s/Mpc}$ (H) or via photometry of the brightest stars (P);

(9,10) — galaxy absolute magnitude and linear diameter, corrected for galactic extinction;

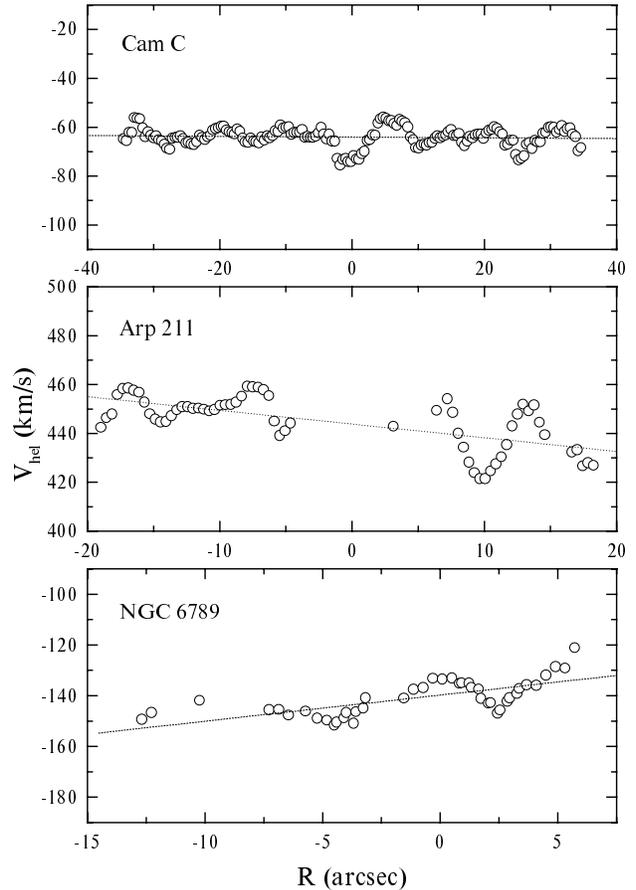


Fig. 2. Distribution of measured radial velocities across each galaxy body.

(11) — 1σ upper limit of the mass-to-luminosity ratio in solar units assuming $V_{\text{rot}} < 15 \text{ km/s}$ and a correction for the galaxy inclination;

(12) - membership of the galaxy to nearby groups.

Below we present brief comments to each object.

a. Cam C = G0318+6236. This low-surface brightness galaxy lies at a low galactic latitude in the Camelopardalis constellation. Its rectangular shape and the presence of several eccentric knots suggest an irregular type. We estimated its apparent magnitude by eye with an accuracy of 0.5 mag. Judging by its linear size and luminosity the galaxy is a typical dwarf irregular system. With respect to the nearby giant spiral IC 342, Cam C has a radial velocity difference of -86 km/s and a linear projected separation about 300 Kpc. Like UGCA 86 it may be considered as a distant and faint companion of IC 342.

b. Arp 211. This blue compact galaxy is well resolved into stars (Arp, 1966). Stellar photometry was carried out by Makarova et al. (1997) and Makarova et al. (1998). Judging by its photometric distance, 2.8 Mpc, it is situated on the near side of the scattered Canes Venatici cloud. Given its size, luminosity, colour and bright $H\alpha$ emission, this pygmy galaxy can be called an intergalactic HII region.

Table 1. Basic parameters of the dwarf galaxies

Object:	Cam C	Arp 211	NGC 6789
RA (1950)	03 ^h 18 ^m 53 ^s .2	12 ^h 34 ^m 56 ^s .4	19 ^h 16 ^m 17 ^s .0
DEC (1950)	+62°36'27"	+39°01'12"	+63°52'54"
Dimensions(')	1.8 × 0.9	0.7 × 0.4	1.4 × 1.2
B _T (mag)	16.8:	15.74	13.83
A _B (mag)	4.0:	0.02	0.31
V _{hel} (km/s)	-64 ± 6	+445 ± 9	-141 ± 9
V ₀ (km/s)	+151	+471	+144
D ₇₀ (Mpc)	2.2 (H)	2.8 (P)	2.1 (H)
M _B (mag)	-14.2	-11.5	-13.0
A ₂₅ (Kpc)	2.7	0.5	0.8
M ₂₅ /L _B	1.9	3.4	3.5
Membership	IC 342 gr	CVn cloud	Isolated

c. *NGC 6789*. This globular compact object is the nearest representative of a rare type of dwarf galaxies having a regular shape of its periphery but an irregular core resolved into blue stars. Two isolated galaxies: NGC 1705 and NGC 2915 (Meurer et al., 1992) belong to this type, as well as UGC 1104 in the NGC 628 group (Sharina et al., 1996). On CCD frames obtained with the 6 m telescope and the 2.5 m Nordic telescope the galaxy is well resolved into stars, which confirms the low distance estimate suggested by its radial velocity. Note that NGC 6789 is a very isolated galaxy situated inside the Local Void described by Tully (1988).

From the data of Table 1 one can see that all three dwarf irregular systems have a small mass-to-luminosity ratio, which indicates the absence of large amount of dark matter within their optical extent. The discovery of such nearby ($D < 3$ Mpc) irregular dwarf galaxies, which are undetected in the 21 cm line, should be taken into account when one estimates the completeness degree of HI surveys of the Nearby Universe, which are presently being done with large radiotelescopes (Ekers et al., 1998).

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