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The hard X-ray source GRS 1734−292: a Seyfert 1 galaxy behind the Galactic Center

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Abstract. The radio, infrared and optical counterparts of the hard X-ray source GRS 1734−292 (l^{II}=358.°9, b^{II}=+1.°4) are reported. The optical spectrum exhibits broad ($>$ 1000 km s^{-1}) Hα emission at a redshift of 0.0214$\pm$0.0005. The radio counterpart is a double-sided synchrotron jet of 5 arcsec, which at a distance of 87 Mpc corresponds to a size of 2 kpc. The multiwavelength observations of GRS 1734−292 indicate that this X-ray source is a Seyfert 1 galaxy behind 6 $\pm$ 1 magnitudes of visual absorption.

Key words: X-rays: galaxies – radio continuum: galaxies – galaxies: Seyfert – galaxies: individual: GRS 1734−292=NVSS J173728−290802– Galaxy: center

1. Introduction

The observations reported here are part of our ongoing project for the identification of radio, optical and infrared counterparts of hard X-ray sources detected by the GRANAT satellite in the Galactic Center region (Goldwurm et al. 1994). The original motivation of this search is based on the fact that previous identifications of GRANAT sources have yielded to the discovery of the so called galactic microquasars, i.e., systems whose physics is regarded as a scaled-down version of the same processes (outbursts, jets, disks, etc.) occurring in extragalactic quasars and active galaxies (Falcke & Biermann 1996). Their best representative examples known so far include 1E 1740.7−2942 (Mirabel et al. 1992), GRS 1758−258 (Rodríguez et al. 1992) and GRS 1915+105 (Mirabel & Rodríguez 1994). A complete account of our recent radio observations will be reported in a future paper (Martí et al. 1998), while here we intend to discuss the particular case of GRS 1734−292.

The original target source GRS 1734−292 was first detected by Sunyaev (1990) as a previously unknown hard X-ray emitter in the Galactic Center direction. The coded mask imaging spectrometer ART-P on board of GRANAT was used in this discovery. The spectrum between 4-20 keV was well described by a hard power-law, with a photon index of about −2 and a total hydrogen column density of $\sim 6 \times 10^{22}$ cm^{-2} (Pavlinsky et al. 1994). From the same authors, the corresponding luminosity for a 8.5 kpc distance was estimated to be 8×10^{36} erg s^{-1}, and the best ART-P position was known with a 90% confidence radius of 95″. Two years later, on 1992, GRS 1734−292 experienced a hard X-ray outburst from $<$ 20 mCrab to 36 mCrab in the 40-400 keV band. This was detected by the SIGMA telescope, also on board of GRANAT, and both the rise and the later decline took place in a matter of a few days (Churazov et al. 1992). No additional outbursts have been reported since then.

From observations in 1995 by Barret & Grindlay (1996), a ROSAT-HRI source was proposed as the soft X-ray counterpart of GRS 1734−292 with a positional accuracy of a few arcsec. Unexpectedly, we found that a much better position for the GRS 1734−292 candidate could be obtained from the public databases of the NRAO VLA sky survey (NVSS), at the wavelength of 20 cm (Condon et al. 1993). Indeed, the inspection of the NVSS field of GRS 1734−292, soon after its release, clearly revealed to our surprise the presence of a strong compact radio source well within both the ART-P and the ROSAT error boxes. The corresponding radio source designation is NVSS J173728−290802, with its flux density being at the 48 mJy level. The a priori probability of finding such a strong radio source within the ROSAT error box is as small as $\sim 2 \times 10^{-5}$. This clearly implies that the X-ray and the radio source are almost certainly related or identical, and the same is also very likely to be true for the GRANAT source. The position of the NVSS object was available with sub-arcsec accuracy and an exhaustive multi-wavelength campaign (optical, infrared and radio) was soon started based on the accurate radio position. The present paper will deal with the observational evidence, collected during this campaign, that suggests a Seyfert 1 interpretation for both the NVSS, ROSAT and GRANAT sources.

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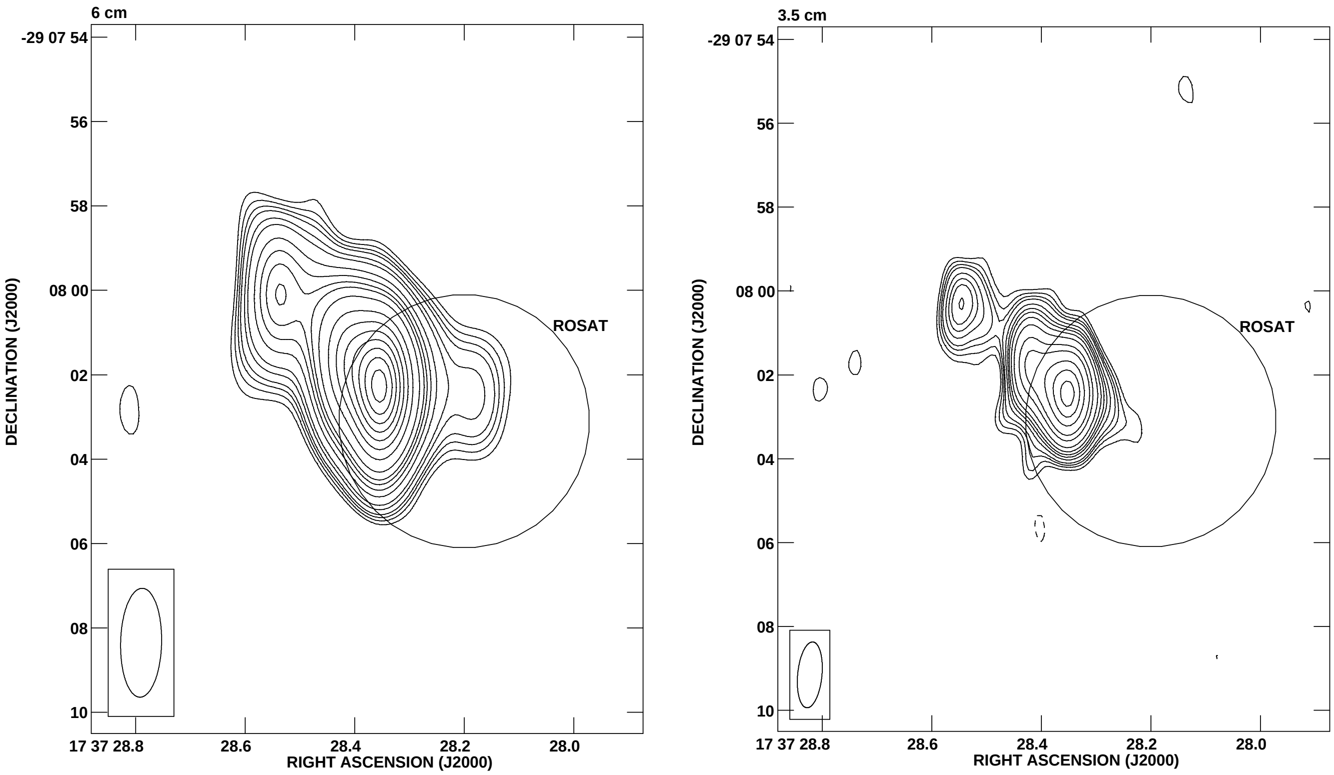

Fig. 1. Uniform weight maps of NVSS J173728−290802 at both 6 cm (left) and 3.5 cm (right) showing the jet-like structure of this radio source. The ROSAT 90% confidence error circle is also indicated in both images. Contours at 6 cm are −3, 3, 4, 5, 6, 8, 10, 15, 20, 25, 30, 40, 60, 80, 100, 120, 140, 160 and 180 times 0.063 mJy beam^{-1}, the rms noise. Contours at 3.5 cm are −3, 3, 4, 5, 6, 8, 10, 12, 15, 20, 30, 40, 60, 80 and 100 times 0.053 mJy beam^{-1}, the rms noise. The corresponding synthesized beams are $2\farcs58\times0\farcs98$ with position angle $-1\fdg4$ at 6 cm, and $1\farcs57\times0\farcs58$ with position angle $-5\fdg5$ at 3.5 cm, respectively.

2. Radio continuum observations and results

In a first step, the promising candidate NVSS J173728−290802 was extensively observed with the Very Large Array (VLA) interferometer of NRAO[1] in a search for short term radio variability that could confirm its microquasar nature. The array was most of the time in B configuration. The data were processed following standard procedures within the AIPS software package of NRAO, with 3C 286 and 1751−253 being the amplitude and phase calibrator, respectively. The results of our radio monitoring of NVSS J173728−290802 are summarized in Table 1, where the flux density at several wavelengths is listed for the different dates of observation. Some older radio measurements of NVSS J173728−290802 also quoted in Table 1 could be retrieved from the literature and the VLA archive database.

In all VLA observations (specially at 6, 3.5 and 2.0 cm) the source appeared resolved with a clear bipolar jet-like structure. From the 3.5 cm map, the J2000 position of the central core is found to be $\alpha = 17^h37^m28\fs35$ and $\delta = -29°08'02\farcs5$ (l^{II} =358.°9, b^{II} =+1.°4), with an uncertainty of about $0\farcs1$ in each coordinate. Contrary to our first expectations, no significant proper motion in the jet condensations, nor day to day variability in the source flux density, became detectable in a reliable way. In view of that, we decided to concatenate the (u, v) data of the highest quality sessions in order to obtain good maps of the NVSS J173728−290802 radio jets. The resulting images are presented in Fig. 1. The strongest jet-like feature emanates in the NE direction and is $\sim 3''$ extended, while a weaker $\sim 2''$ counterjet is also evident.

Since our VLA monitoring lasted for about five weeks and there was no positional change in the jet condensations larger than $\sim0\farcs2$, the corresponding proper motion upper limit is about 5 mas d^{-1}. We soon considered all these facts as a first indication that the object we were studying did not behave as expected from a microquasar source.

On 1997 April 10, the frequency coverage of the observations was wide enough to measure the spectral properties of the source radio emission. A typical non-thermal radio spectrum was observed and we present it in Fig. 2. A power law fit indicates that the spectrum is well described by S_ν = (76 ± 4 mJy)$(\nu/\mathrm{GHz})^{-0.75\pm0.03}$.

3. Infrared and optical observations and results

The radio position of NVSS J173728−290802 was observed at both infrared and optical wavelengths using different ESO

[1] The NRAO is operated by Associated Universities, Inc., under cooperative agreement with the USA National Science Foundation.

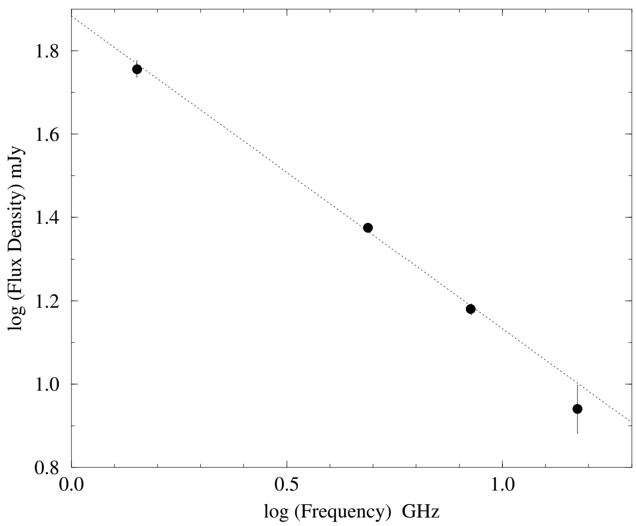

Fig. 2. The non-thermal radio spectrum of NVSS J173728−290802 from decimetric to centimetric wavelengths as observed with the VLA on 1997 April 10. The dotted line corresponds to a power law fit with the parameters described in the text.

Table 1. Radio observations of NVSS J173728−290802

Date	Julian Day (JD−2400000)	λ (cm)	Flux Density (mJy)
05 May 1980(1)	44364.8	6	18.8 ± 0.3
1989(2)	−	20	56
23 Oct 1993(3)	49184	20	48 ± 2
28 Mar 1997	50536.0	20	63 ± 1
		6	22.8 ± 0.2
10 Apr 1997	50549.0	21	57 ± 1
		6	23.7 ± 0.2
		3.5	15.1 ± 0.2
		2.0	8.7 ± 0.6
19 Apr 1997	50557.9	6	23.9 ± 0.2
		3.5	15.7 ± 0.2
04 May 1997	50572.9	6	24.0 ± 0.3
		3.5	14.7 ± 0.4

(1) VLA Archive Database; observer: Sramek R.
(2) Helfand et al. 1992, ApJSS, 80, 211
(3) NVSS maps; Condon et al. 1996 (in preparation)

telescopes[2]. All frames were reduced using standard procedures based on the IRAF image processing system.

3.1. Imaging

Imaging infrared observations in the J and K bands were carried out with the IRAC2b camera mounted at the F/35 photometer adapter of the 2.2 m telescope. We observed on four nights from 1997 March 23 to April 3. The infrared counterpart of NVSS J173728−290802 was preliminarily identified by measuring offsets from a nearby bright star. Wide field CCD

[2] Based on observations collected at the European Southern Observatory, La Silla, Chile.

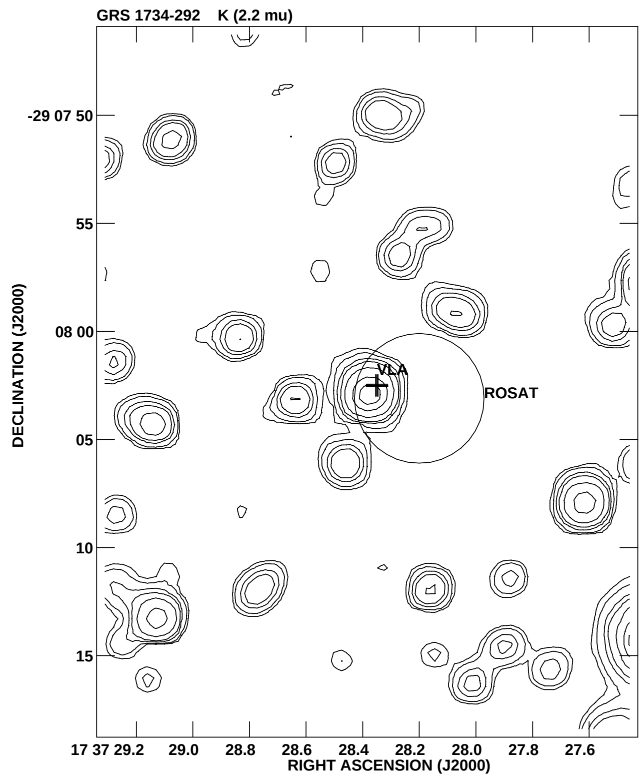

Fig. 3. Finding chart of the NVSS J173728−290802 infrared counterpart in the K band. The little cross represents the accurate VLA radio position and the circle is the ROSAT error box at the 90% confidence level. The proposed counterpart is the only object consistent with both the radio and X-ray positions.

images in the V, R and I bands were later obtained with the Danish 1.54 m telescope on 1997 April 10, using the DFOSC camera whose scale is $0\farcs40$ pixel^{-1}. An accurate astrometrical analysis of these optical images was carried out using nine reference stars from the Guide Star Catalogue (Taff et al. 1990), thus confirming our previous infrared identification. The total offset between the radio and optical position was found to be about $0\farcs6$. This is well within the astrometrical errors of the fit (rms$\sim0\farcs4$) and also well inside the ROSAT error circle. We therefore conclude that our identification is correct and that the optical/infrared counterpart found is the same object as GRS 1734−292, NVSS J173728−290802 and the ROSAT source. Finding charts at K and R bands to assist in future observations are shown in Figs. 3 and 4. The two infrared sources IRAS 17342−2908 and 358.83+1.39 proposed by Cherepashchuk et al. (1994) as counterpart candidates are not consistent with our identification.

On the other hand, our identified source did not display clear evidences of photometric variability during both the infrared and optical imaging observations. Although we only had one night at the 1.54 m telescope, the lack of variability in the optical can be established from the similar R band magnitude derived during the spectroscopic session described below. The photometry of the source is summarized in Table 2.

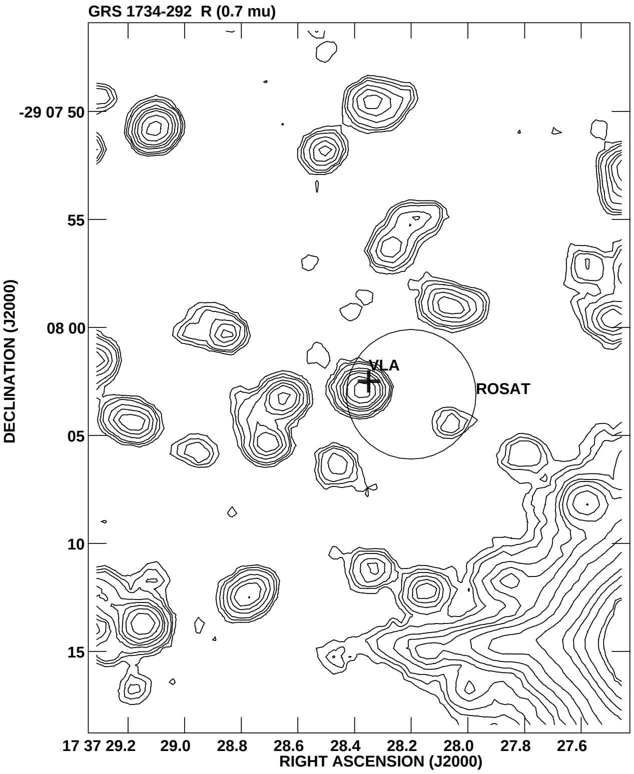

Fig. 4. Finding chart of the NVSS J173728−290802 optical counterpart in the R band with the ROSAT and VLA positions also indicated. The field is exactly the same as in Fig. 3

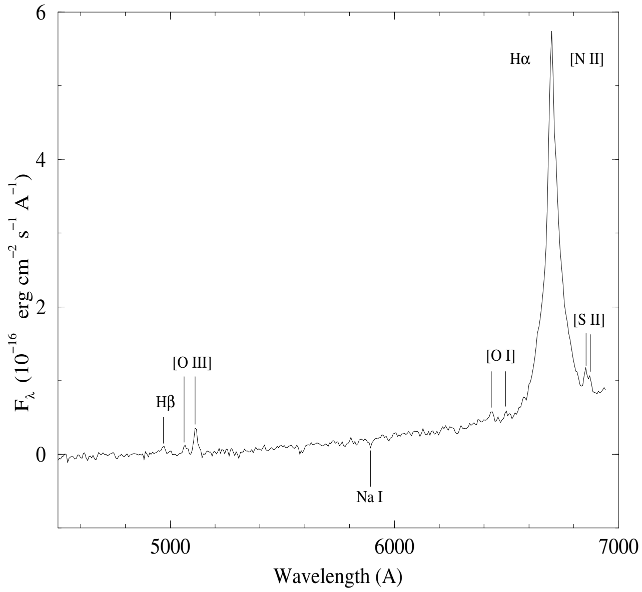

Fig. 5. Optical broad band spectrum of GRS 1734−292 obtained on 1997 March 12 with the EFOSC1 instrument at the 3.6 m ESO telescope.

Table 2. Magnitudes of the GRS 1734−292 counterpart

Filter	Observation Date	Telescope	Magnitude
V	1997 April 10	1.54 m + DFOSC	21.0 ± 0.3
R	1997 April 10	1.54 m + DFOSC	18.3 ± 0.1
I	1997 April 10	1.54 m + DFOSC	16.8 ± 0.1
J	Average all dates	2.2 m + IRAC2b	13.7 ± 0.1
K	Average all dates	2.2 m + IRAC2b	11.1 ± 0.1

3.2. Spectroscopy

Broad band spectroscopic observations of the GRS 1734−292 optical counterpart were also carried out with EFOSC1 on the 3.6 m ESO telescope, using the B300 grism whose dispersion is 2.0 Å pixel^{-1}. As shown in Fig. 5, they revealed that the optical spectrum is completely dominated by strong and very broad emission from the blended Hα and [NII] lines. Other emission lines from [OI], [OIII] and [SII] are also identifiable. A consistent redshift measurement is obtained from all of them, with our best estimate being $z = 0.0214 \pm 0.0005$.

The full width zero intensity of the blended Hα and [NII] is extremely broad, nearly 450 Å or $\sim$ 20000 km s^{-1}. Their total flux in emission is 3.8×10^{-14} erg s^{-1} cm^{-2}. We have attempted to deblend these three lines using Gaussian components at the expected wavelengths for $z = 0.0214$. The results obtained are given in Table 3. This table also includes information on the other spectral lines most evident in the GRS 1734−292 spectrum. We wish to point out that the deblending procedure may not be completely reliable here because the Hα and [N II] lines are very difficult to separate. In particular, the full width half maximum (FWHM) derived for the forbidden [N II] components (often narrower than $\sim$1000 km s^{-1} in Seyferts) seems to be unusually high, and perhaps we are underestimating the Hα emission. It is also possible that Hα has an even broader component that our deblending fit is not accounting for.

4. The column density towards GRS 1734−292

In this section, we undertake a comparison study of the total absorption column density N(H) towards GRS 1734−292 derived by three independent methods. A mean value is finally adopted in order to deredden the photometric magnitudes of the previous section. This will help us later to estimate the unabsorbed optical luminosity of GRS 1734−292 when discussing its physical nature.

4.1. An upper limit to $N(H)$ from the sodium interstellar absorption line

The spectrum in Fig. 5 displays an absorption feature at 5893.5 Å (see Table 3). This can be interpreted as an unresolved detection of the two Na D interstellar absorption lines. The Na D lines are expected to be at 5890 and 5896 Å, respectively. The absorption feature mentioned is well located at the middle point between these two wavelengths. The identification is thus convincing, although our resolution is not good enough to distinguish the two components separately.

The intensity of the Na D absorption feature can be used to estimate both the extinction and the distance for objects within

Table 3. Main lines in the GRS 1734−292 optical spectrum

Line	Observed wavelength (Å)	Observed flux (erg s^{-1} cm^{-2})	FWHM (Å)	FWHM (km s^{-1})	EW (Å)	Notes
[S II]	6853.3	4.8×10^{-16}	15	660	−6	
	6871.7	2.5×10^{-16}	12	530	−3	
Hα	6701.5	8.3×10^{-15}	30	1340	−120	Peak wavelength
[N II]	6688.1	1.5×10^{-14}	123	5510	−216	Assumed wavelength for deblending
	6723.9	1.5×10^{-14}	104	4640	−200	Assumed wavelength for deblending
[O I]	6432.4	4.2×10^{-16}	32	1490	−10	
	6503.5	4.2×10^{-16}	35	1610	−9	
Na I D	5893.5	-1.8×10^{-16}	17	870	9	Interstellar line
[O III]	5113.5	6.8×10^{-16}	17	1000	−400	Continuum very weak
	5066.5	2.1×10^{-16}	18	1070	−172	Continuum very weak
Hβ	4966.0	2.8×10^{-16}	31	1870	−555	Continuum very weak

the Galaxy. The corresponding relationship is given by:

$$A_V = 3.8EW,$$

where EW is the mean equivalent width in Å of the two Na D-lines, and a 1.9 mag kpc^{-1} absorption of optical light near the Galactic Plane has been assumed (Allen 1973). For extragalactic sources, the Na lines only provide an indication of the length of the line of sight within our own Galaxy. This is, of course, making the reasonable assumption that all the Na absorption is produced inside the Milky Way.

In our case, we are not able to resolve the Na lines and only an upper limit to the mean equivalent width is available from observation ($EW \leq 9$ Å). This implies from the previous equation that the extinction towards GRS 1734−292 should be $A_V \leq 34.2$ mag, and consequently the line of sight towards GRS 1734−292 intercepts less than 18 kpc of gas and dust within our Galaxy. From the relationship by Predehl & Schmitt (1995):

$$A_V = 0.56 \left[\frac{N(H)}{10^{21}\ cm^{-2}}\right] + 0.23,$$

this corresponds to a total hydrogen column density of about $N(\text{H}) \leq 6.1 \times 10^{22}$ cm^{-2}.

This upper limit is consistent in order of magnitude with the rough estimate $\sim 6 \times 10^{22}$ cm^{-2}, or $A_V \sim 34$ mag, derived by Pavlinsky et al. (1994) from X-ray model fitting with their ART-P data. However, the fact that an optical counterpart has been found for GRS 1734−292 is difficult to reconcile with an optical extinction of more than thirty magnitudes. Therefore, the ART-P column density is likely to be strongly overestimated and we will show below that this is certainly the case.

4.2. *$N(H)$ estimated from neutral hydrogen absorption*

A H I absorption experiment at 21 cm was carried out with the VLA on 1997 April 10 and it was also reduced using standard AIPS procedures. The resulting spectrum (not shown here) was not of high signal to noise ratio. The only absorption feature detected was localized at 3.6 ± 0.1 km s^{-1} LSR velocity, with an estimated peak opacity value of $\tau_0 = 1.10 \pm 0.02$. This implies that most of the absorption is produced in the Saggittarius arm. The FWHM was 21.1 ± 0.3 km s^{-1}. The corresponding column density of H I along the line of sight to NVSS J173728−290802 can be expressed as $N(\text{H I}) = (4.2 \pm 0.2) \times 10^{21} (T_s/100\ \text{K})$ cm^{-2}, where T_s is the hydrogen spin temperature. Using the canonical value $T_s = 125$ K, we estimate that $N(\text{H I}) = (5.3 \pm 0.3) \times 10^{21}$ cm^{-2}.

Since GRS 1734−292 is close to the Galactic Center direction, $N(\text{H})$ should include another important contribution from the metals associated to the abundant molecular hydrogen component $N(\text{H}_2)$ in addition to the atomic species. In order to derive $N(\text{H}_2)$, we have used the Columbia ^{12}CO (J=1-0) survey by Dame et al. (1987) together with the empirical relation of $N(\text{H}_2)$ with the integrated CO line intensity. This relation can be expressed as $N(\text{H}_2) = 3.6 \times 10^{20} \int T(\text{CO})dv$ (Scoville et al. 1987). By interpolating the Columbia survey at the GRS 1734−292 position, we find one single emission component at a LSR velocity of -5 ± 1 km s^{-1}. A Gaussian fit to this line yields a peak temperature of 0.29 ± 0.02 K with a FWHM of 22 ± 3 km s^{-1}. The corresponding value of $N(\text{H}_2)$ is thus $(2.4 \pm 0.4) \times 10^{21}$ cm^{-2}.

By combining the H I and CO information, the total absorbing column density in the GRS 1734−292 direction can now be found from $N(\text{H}) = N(\text{H I}) + 2N(\text{H}_2)$. The final result is $N(\text{H}) = (1.0 \pm 0.1) \times 10^{22}$ cm^{-2}, equivalent to a visual extinction of $A_V = 5.8 \pm 0.5$ magnitudes using again the Predehl & Schmitt (1995) relation. It is important to mention here that recent studies by Dahmen et al. (1996) suggest that the conversion factor between the CO emission and the H_2 column density may be overestimated by an order of magnitude. If this is the case, the A_V value derived above should be consequently revised. Nevertheless, a reliable lower limit of $A_V > 3.2$ magnitudes can be established from the H I contribution alone.

4.3. *$N(H)$ estimated from the Balmer decrement*

The extinction and the hydrogen column density towards GRS 1734−292 can also be independently estimated from the measured line ratio Hα/Hβ in the optical spectrum and using Table 3 values. Following Miller & Mathews (1972), the Hα/Hβ re-

Table 4. The main physical parameters of GRS 1734−292

Parameter	Value	Notes
Redshift	z = 0.0214 ± 0.0005	
Distance	D = 87 Mpc	H_0 = 75 km s^{-1}
Jet size	$l_{jet} \simeq$ 2.1 kpc	
Visual absorption	A_V = 6 ± 1	
H column density	N(H) = (1.0 ± 0.2) × 10^{22} cm^{-2}	
Radio luminosity	$L_{rad} \simeq 7 \times 10^{39}$ erg s^{-1}	0.1-100 GHz band
Optical luminosity	$L_{opt} \simeq 2 \times 10^{43}$ erg s^{-1}	4900-9000 Å band
X-ray luminosity	$L_X \simeq 1 \times 10^{44}$ erg s^{-1}	0.5-4.5 keV band
Line luminosity	$L_{H\alpha} \simeq 5 \times 10^{41}$ erg s^{-1}	Deblended value
	$L_{H\beta} \simeq 1 \times 10^{41}$ erg s^{-1}	
	$L_{[S\ II]} \simeq 4 \times 10^{40}$ erg s^{-1}	
	$L_{[O\ I]} \simeq 6 \times 10^{40}$ erg s^{-1}	
	$L_{[O\ III]} \simeq 4 \times 10^{41}$ erg s^{-1}	

lationship with galactic extinction can be expressed as:

$$A_B = 8.5 \log ((H\alpha/H\beta)/3.0),$$

while absorption at other bands can be easily computed using the following parameterized reddening curve:

$$A_\lambda = 0.74\lambda^{-1} - 0.34,$$

where λ is the central band wavelength expressed in microns.

The Hα flux in GRS 1734−292 is, of course, less than the total blended emission of the Hα and [N II] lines (H$\alpha < 3.8 \times 10^{-14}$ erg s^{-1} cm^{-2}). This implies that Hα/H$\beta < 136$, and we confidently estimate that $A_V < 10.5$ mag. Furthermore, if the deblending procedure in Table 3 was appropriate, we would find more precisely that Hα/H$\beta \simeq 30$. Such a line ratio then yields A_V = 6.3 mag, with a formal likely uncertainty of ±0.5 mag. This final absorption estimate translates into N(H) = (1.1 ± 0.1) × 10^{22} cm^{-2}.

Summarizing this section, all three independent used methods seem to provide consistent results. This agreement may be further tested in the future by carrying out additional spectroscopic optical and radio observations with higher resolution and sensitivity. In the following, we will adopt A_V = 6 ± 1 mag, or equivalently N(H) = (1.0 ± 0.2) × 10^{22} cm^{-2}, as a compromise mean value for discussion purposes. Such an amount of visual extinction is indeed a reasonable result at 1°.4 of galactic latitude. The mean values of A_V as a function of b^{II}, and close to the Galactic Center direction, have been studied for instance by Catchpole et al. (1990). The statistical analysis of these authors using colour-magnitude diagrams does provide $A_V \sim 5$ mag for galactic latitudes in the 1°.0-1°.5 range, i.e., where GRS 1734−292 is located.

5. Discussion

The observed redshift of GRS 1734−292 corresponds to a recession velocity of 6500 km s^{-1}. Such a high value rules out any interpretation based on the systemic velocity of a binary star in the Galaxy. For this galactic interpretation, one should expect a redshift (or blueshift) of at most $\lesssim$ 1000 km s^{-1}, i.e., the typical kick velocity acquired by the binary system after the supernova explosion forms the compact companion. On the contrary, the simplest way to account for the observed redshift is to assume that GRS 1734−292 lies at a cosmological distance and is, therefore, an extragalactic source. Using Hubble's law, the corresponding distance can be estimated as $D = 65h^{-1}$ Mpc (where the Hubble constant is expressed here as $H_0 = 100h$ km s^{-1} Mpc^{-1} and a Universe with Ω = 1 is assumed).

The spectrum in Fig. 5 is highly reminiscent of a Seyfert 1 Galaxy given the large width of permitted lines. For a Seyfert galaxy at a z = 0.0214 redshift, it should normally be possible to see some arcsec extended nebulosity if located at high galactic latitude. The deep R band CCD image in Fig. 4 shows that this is not the case. The discovered optical counterpart appears as an unresolved source and only the galactic nucleus is evident. This is possibly due to the optical extinction in the galactic plane (b^{II} =1°.4). Although not extremely great ($A_V \simeq 6$ mag), it is apparently sufficient to prevent any faint nebulosity from being seen in the optical. In the K band no nebulosity is seen either, and this compactness could mean that GRS 1734−292 is a nearby quasar instead of a Seyfert 1. However, we believe that the optical spectrum observed is a very strong evidence to prefer by now a Seyfert 1 interpretation.

The catalogue of GRANAT sources does not include many examples of extragalactic objects and our discovery adds a new member to this scarce group. Only three extragalactic sources have been extensively detected by the SIGMA telescope on board of GRANAT. They are the quasar 3C 273, the Seyfert 1.5 galaxy NGC 4151, and the radio galaxy Cen A (Bassani et al. 1993; Jourdain et al. 1993). All of them are characterized by displaying clear hard X-ray variability and spectral evolution in time scales of both years and, in some cases, few days. In particular, Cen A was observed to decrease its 40-120 keV flux by a factor of 1.5 within only four days. This behavior compares well with that of GRS 1734−292. Our target source is currently accepted as a confirmed variable (Barret & Grindlay 1996), and it exhibited a few day time scale variability during its 1992 hard X-ray outburst (Churazov et al. 1992). On the other hand, the GRS 1734−292 spectrum became extremely hard during this flaring event, and this is remarkably similar to the spectrum hardening observed by SIGMA in the NGC 4151 Seyfert during epochs of high photon flux (Bassani et al. 1993).

There are in addition other observational clues in agreement with a Seyfert 1 galaxy scenario. For instance, the total radio power derived from the spectrum in Fig. 2 is $L_{rad} \simeq 4 \times 10^{39} h^{-2}$ erg s^{-1} and, in particular, $P_{21cm} \simeq 3 \times 10^{29} h^{-2}$ erg s^{-1} Hz^{-1}. This correlates well when plotted in monochromatic 21 cm radio power versus 0.5-4.5 keV X-ray luminosity diagrams for Seyfert 1 galaxies by Wilson (1991). The unabsorbed value of the X-ray output is taken to be here $L_X \simeq 6 \times 10^{43} h^{-2}$ erg s^{-1} by extrapolating the power law fit from Pavlinsky et al. (1994).

The observed radio jet morphology and spectral index are quite common among Seyfert galaxies. The case of GRS 1734−292 should be classified as belonging to the L or *linear* class in the Wilson (1991) scheme. The radio jet size ($l_{jet} \simeq 1.6h^{-1}$ kpc) also correlates acceptably well with the radio power from a Seyfert 1 object (Ulvestad & Wilson 1984). The optical luminosity estimated from our broad band spectrum and VRI photometry using A_V = 6 mag is $L_{opt} \sim 1 \times 10^{43} h^{-2}$ erg s^{-1} in the 4900-9000 Å band. This is again in good order of magnitude agreement with expectations based on the radio/optical power correlation studied by Edelson (1987) for Seyfert galaxies in the CfA sample. Other correlations that test acceptably well are those involving the [O III] luminosity versus Hβ luminosity, radio power and FWHM of [O III] (Lawrence 1987; Whittle 1985).

We close this discussion by giving in Table 4 the main physical parameters of GRS 1734−292, expressed for the particular case of H_0 = 75 km s^{-1}, and mentioning that this Seyfert also fits reasonably well the Falcke & Biermann (1996) scheme for AGNs when plotted in their diagram of monochromatic radio power versus core disk luminosity.

6. Conclusions

We have presented observations that provide a very accurate positional identification of the radio, infrared and optical counterpart of the GRANAT source GRS 1734−292. The discovered counterpart displays clear evidence of being a Seyfert 1 galaxy. The most remarkable properties of the system are perhaps its clear linear jet-like structure and its broad Hα emission.

A redshift measurement yields the value $z = 0.0214 \pm 0.0005$, thus providing a distance to GRS 1734−292 of 87 Mpc (H_0 = 75 km s^{-1} Mpc^{-1}). The column density towards GRS 1734−292 is also estimated using three different techniques and an average value of $A_V = 6 \pm 1$ mag is proposed. This is equivalent to a hydrogen column density of N(H) = $(1.0 \pm 0.2) \times 10^{22}$ cm^{-2}. The Seyfert 1 nature of GRS 1734−292 is additionally confirmed by a satisfactory agreement with different well established correlations for Seyfert galaxies. We also point out that the hard X-ray behavior of GRS 1734−292 is consistent with extragalactic sources studied by GRANAT.

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