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 (α1950.0=17h 34m 29.2s, δ1950.0=−29° 29′ 0.8″) are reported. The optical spectrum exhibits broad (λ ≳ 400 Å) Hα emission at a redshift of 0.0214 ± 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 ± 1 magnitudes of visual absorption.

Key words: X-rays: galaxies – Radio continuum: galaxies – Seyfert: galaxies – Galaxies: individual: GRS 1734−292, NVSS J173728−290802

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 ∼ 6 × 1022 cm−2 (Pavlinsky et al. 1994). From the same authors, the corresponding luminosity for a 8.5 kpc distance was estimated to be 8 × 1038 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 ∼ 2 × 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.

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 in a search for short term radio variability that could confirm its microquasar nature. The array

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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 $\alpha = 17^h37^m28.35^s$ and $\delta = -29^\circ07'54''5$ ($l_{II}=358.9^\circ$, $b_{II}=+17.4^\circ$), with an uncertainty of about 0"1 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 $\sim 0''2$, 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 observation 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 $S_\nu = (76 \pm 4$ mJy $)(\nu/$GHz$)^{-0.75 \pm 0.03}$.

Table 1. Radio observations of NVSS J173728–290802

| Date          | Julian Day | $\lambda$ | Flux Density |
|---------------|------------|-----------|--------------|
| (JD−2400000) | (cm)       | (mJy)     |
| 05 May 1980$^{(1)}$ | 44364.8    | 6         | 18.8 $\pm$ 0.3 |
| 1989$^{(2)}$         |            | 20        | 56           |
| 23 Oct 1993$^{(3)}$  | 49184      | 20        | 48 $\pm$ 2   |
| 28 Mar 1997         | 50536.0    | 20        | 63 $\pm$ 1   |
| 10 Apr 1997         | 50549.0    | 21        | 57 $\pm$ 1   |
| 19 Apr 1997         | 50557.9    | 6         | 23.9 $\pm$ 0.2 |
| 04 May 1997         | 50572.9    | 23        | 15.7 $\pm$ 0.2 |
| 04 May 1997         | 50572.9    | 3.5       | 24.0 $\pm$ 0.3 |
| 04 May 1997         | 50572.9    | 3.5       | 14.7 $\pm$ 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)
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.

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 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 images in the V, R and I bands were later obtained with the Danish 1.54 m telescope on 1997 April 10, using the DFOCS camera whose scale is 0.′′40 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.′′6. This is well within the astrometrical errors of the fit (rms~0′′4) 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

\(^2\)Based on observations collected at the European Southern Observatory, La Silla, Chile.
derived during the spectroscopic session described below. The photometry of the source is summarized in Table 2.

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 [OII], [OIII] and [SII] are also identifiable. A consistent redshift measurement is obtained from all of them, with our best estimate being $z = 0.0214 ± 0.0005$.

![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.](image)

The full width zero intensity of the blended Hα and [NII] is extremely broad, nearly 450 Å or ~20000 km s$^{-1}$. Their total flux in emission is $3.8 \times 10^{-14}$ 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] component (often narrower than ~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 the Galaxy. The corresponding relationship is given by:

$$A_V = 3.8 EW,$$

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):

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

this corresponds to a total hydrogen column density of about $N(H) \leq 6.1 \times 10^{22}$ 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.
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]        | 6855.3                  | $4.8 \times 10^{-16}$                  | 15        | 660               | -6     |                 |
| [S II]        | 6871.7                  | $2.5 \times 10^{-16}$                  | 12        | 530               | -3     |                 |
| Hα            | 6701.5                  | $8.3 \times 10^{-15}$                  | 30        | 1340              | -120   | Peak wavelength |
| [N II]        | 6688.1                  | $1.5 \times 10^{-14}$                  | 123       | 5510              | -216   | Assumed wavelength for deblending |
| [O I]         | 6622.9                  | $5.6 \times 10^{-14}$                  | 104       | 4640              | -200   | Assumed wavelength for deblending |
| [O I]         | 6642.4                  | $4.2 \times 10^{-16}$                  | 32        | 1490              | -10    |                 |
| [O I]         | 6503.5                  | $4.2 \times 10^{-16}$                  | 35        | 1610              | -9     |                 |
| Na I D        | 5893.5                  | $-1.8 \times 10^{-16}$                 | 17        | 870               | 9      | Interstellar line |
| [O III]       | 5113.5                  | $6.8 \times 10^{-16}$                  | 17        | 1000              | -400   | Continuum very weak |
| [O III]       | 5066.5                  | $2.1 \times 10^{-16}$                  | 18        | 1070              | -172   | Continuum very weak |
| Hβ            | 4966.0                  | $2.8 \times 10^{-16}$                  | 31        | 1870              | -555   | Continuum very weak |

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 $N(H) = (4.2 \pm 0.2) \times 10^{21} (T_s/100)$ K cm$^{-2}$, where $T_s$ is the hydrogen spin temperature. Using the canonical value $T_s = 125$ K, we estimate that $N(H) = (5.3 \pm 0.3) \times 10^{21}$ cm$^{-2}$.

Since GRS 1734–292 is close to the Galactic Center direction, $N(H)$ should include another important contribution from the metals associated to the abundant molecular hydrogen component $N(H_2)$ in addition to the atomic species. In order to derive $N(H_2)$, we have used the Columbia $^{12}$CO (J=1-0) survey by Dame et al. (1987) together with the empirical relation of $N(H_2)$ with the integrated CO line intensity. This relation can be expressed as $N(H_2) = 3.6 \times 10^{20} \int T(CO) dv$ (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 $-5 \pm 1$ 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 $N(H_2)$ 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 $N(H) = N(H)$ + 2$N(H_2)$. The final result is $N(H) = 1.0 \pm 0.1 \times 10^{22}$ 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 now be found 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 relationship with galactic extinction can be expressed as:

$$A_\lambda = 8.5 \log (\langle H\alpha / H\beta \rangle / 3.0)$$

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

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

where $\lambda$ 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 (Hα < 3.8 × 10$^{-14}$ erg s$^{-1}$ cm$^{-2}$). This implies that Hα/Hβ < 136, and we confidently estimate $A_V < 10.5$ mag. Furthermore, if the deblending procedure in Table 3 was appropriate, we would find more precisely that Hα/Hβ ≃ 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 $N(H) = (1.1 \pm 0.1) \times 10^{22}$ 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 $A_V = 6 \pm 1$ mag, or equivalently $N(H) = (1.0 \pm 0.2) \times 10^{22}$ cm$^{-2}$, as a compromise mean value for discussion purposes. Such an amount of visual extinction is indeed a reasonable result at 1.34 of galactic latitude. The mean values of $A_V$ as a function of $b^J$, 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°-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 $\zeta \approx 1000$ 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 $D = 65 h^{-1}$ Mpc (where the Hubble constant is expressed here as $H_0 = 100h$ km s$^{-1}$ Mpc$^{-1}$ and a Universe with $\Omega = 1$ 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 ($b = 17^\circ$). Although not extremely great ($A_V \approx 6$ 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 galaxy. 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 low $N(H)$ column density ($\lesssim 10^{18}$ cm$^{-2}$), and, in particular, $P_{21cm} \approx 3 10^{38}$ erg s$^{-1}$ Hz$^{-1}$. This correlates well when plotted in monochromatic 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 H$\alpha$ emission.

A redshift measurement yields the value $z = 0.0214 \pm 0.0005$, thus providing a distance to GRS 1734—292 of 87 Mpc

| Parameter       | Value          | Notes                  |
|-----------------|----------------|------------------------|
| Redshift        | $z = 0.0214 \pm 0.0005$ |                       |
| Distance        | $D = 87$ Mpc   | $H_0 = 75$ km s$^{-1}$ |
| Jet size        | $l_{jet} \approx 2.1$ kpc |                   |
| Visual absorption | $A_V = 6 \pm 1$ |                   |
| H column density | $N(H) = (1.0 \pm 0.2) \times 10^{22}$ cm$^{-2}$ |   |
| Radio luminosity | $L_{rad} \approx 7 \times 10^{39}$ erg s$^{-1}$ | 0.1-100 GHz band |
| Optical luminosity | $L_{opt} \approx 2 \times 10^{43}$ erg s$^{-1}$ | 4000-9000 Å band |
| X-ray luminosity | $L_X \approx 1 \times 10^{44}$ erg s$^{-1}$ | 0.5-4.5 keV band |
| Line luminosity | $L_{H\alpha} \approx 5 \times 10^{41}$ erg s$^{-1}$ | Deblended value |
| $L_{[OIII]}$    | $L_{[OIII]} \approx 4 \times 10^{40}$ erg s$^{-1}$ |   |
| $L_{[OIII]}$    | $L_{[OIII]} \approx 6 \times 10^{40}$ erg s$^{-1}$ |   |
| $L_{[OIII]}$    | $L_{[OIII]} \approx 4 \times 10^{41}$ erg s$^{-1}$ |   |

References:

[Barret & Grindlay (1996)]
[Churazov et al. (1992)]
[Bassani et al. (1993)]
[Jourdain et al. (1993)]
[Lawrence (1987)]
[Whittle (1985)]
[Ulvestad & Wilson (1984)]
[Pavlinsky et al. (1994)]
[Wilson (1991)]
[Edelson (1987)]
[AGNs (1994)]
[Lawrence (1993)]
[Whittle (1985)]
[Ulvestad & Wilson (1984)]
[Pavlinsky et al. (1994)]
\( H_0 = 75 \text{ km s}^{-1} \text{ Mpc}^{-1} \). The column density towards GRS 1734--292 is also estimated using three different techniques and an average value of \( A_V = 6 \pm 1 \text{ mag} \) is proposed. This is equivalent to a hydrogen column density of \( N(H) = (1.0 \pm 0.2) \times 10^{22} \text{ cm}^{-2} \). 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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**References**

Allen C.W., 1973, *Astrophysical Quantities*, The Athlone Press, London

Barret D., Grindlay J.E., 1996, A&A, 311, 239

Bassani L., Jourdain E., Roques J.P., et al., 1993, A&ASS, 97, 89

Catchpole R.M., Whitelock P.A., Glass I.S., 1990, MNRAS, 247, 479

Condon J.J., Cotton W.D., Greisen E.W., Yin Q.F., Perley R.A., Broderick J.J., 1993, BAAS, 183, 6402C

Cherepashchuk A.M., Goranskij V.P., Karitskaya E.A., et al., 1994, A&A, 289, 419

Churazov E., Gilfanov M., Cordier B., Schmitz-Frayssse M.C., 1992, IAU Circ., 5623

Dahmen G., Huttemeister, S., Wilson, T.L., Mauersberger., R., Linhart A., et al., 1996, in *The Galactic Center*, ASP Conference Series, Roland Gredel, Ed., Vol. 102, 54

Dame T.M., Ungerechts H., Cohen R.S., et al., 1987, ApJ, 322, 706

Edelson R.A., 1987, ApJ, 313, 651

Falcke H., Biermann P.L., 1996, A&A, 308, 321

Goldwurm A., Cordier B., Paul J., Ballet J., Bouchet L., et al., 1994, Nat, 371, 589

Jourdain E., Bassani L., Roques J.P., et al. 1993, Adv. Space Res., Vol. 13., No. 12, pp.(12)705

Lawrence A., 1987, PASP, 99, 309

Martí J., Mirabel I.F., Rodríguez L.F., Chaty S., 1998 (in preparation)

Miller J.S., Mathews I.F., 1972, ApJ, 172, 593

Mirabel I.F., Rodriguez L.F., Cordier B., Paul J., Lebrun F., 1992, Nat, 358, 215

Mirabel I.F., Rodríguez L.F., 1994, Nat, 371, 46

Pavlinsky M.N., Grebenev S.A., Sunyaev R.A., 1994, ApJ, 425, 110

Predehl P., Schmitt J.H.M.M., 1995, A&A, 293, 889

Rodriguez L.F., Mirabel I.F., Martí J., 1992, ApJ, 401, L15

Scoville N.Z., Min Su Yun, Clemens D.P., Sanders D.B., Waller W.H., 1987, ApJSS, 63, 821

Sunyaev R. (on behalf of the GRANAT team), 1990, IAU Circ., 5123

Taff L.G., Lattanzi M.C., Buccarelli B., Gilmozzi R., McLean B.J., et al., 1990, ApJ, 353, L45

Ulvestad J.S., Wilson A.S., 1984, ApJ, 278, 544

Whittle M., 1985, MNRAS, 213, 33

Wilson A.S., 1991, ASP Conference Series, Vol. 18, 227

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