IS IRAS F10214+4724 GRAVITATIONALLY LENSED?

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Abstract. We show that the $z = 2.3$ IRAS source F10214+4724 is gravitationally lensed by an intervening galaxy, as suggested by the observed near-IR structures. Its many anomalous properties can be explained if the source is an ordinary Seyfert 2 nucleus whose central regions are much more highly magnified than the surrounding host galaxy. Confirming expectations, we find a counterimage to the near-IR arc, and find spectral evidence for the lensing galaxy at $z \sim 1$. We present new optical images which show that the optical source is compact and highly magnified. F10214+4724 may represent a population of lensed AGNs whose central engines are obscured.

1. Introduction

The IRAS source FSC 10214+4724 (hereafter F10214) has attracted a great deal of attention in the past few years. It was discovered in a redshift survey of 1400 IRAS sources (Broadhurst et al. 1995), which were selected from the IRAS Faint Source Catalog. At $z = 2.3$, F10214 has by far the largest redshift in the survey (Rowan-Robinson et al. 1991), with an inferred far-IR luminosity of $L \sim 3 \times 10^{13} h^{-2} L_{\odot}$, an order of magnitude more luminous than any known source. CO line emission was also detected, also with a very high inferred luminosity (e.g. Brown & Vanden Bout 1991). The high inferred far-IR and CO luminosities led many investigators (e.g. Rowan-Robinson et al. 1991) to propose that F10214 was undergoing an intense starburst. However, the UV-optical spectral line ratios and the presence of highly polarized spectral emission suggested that the source is an extremely luminous Seyfert 2 nucleus (e.g. Lawrence et al. 1993).
Figure 1. Gravitational lens model for F10214, showing the source (left) and image (right) planes. The lens is centered on G and elongated N-S, with $\beta = 0.91''$, $\epsilon = 0.18$. The source consists of a small region ($r = 0.2''$) which produces the moderately magnified arc ($m \approx 5$), and a compact core ($r = 0.01''$) which is highly magnified ($m \approx 50$). The source is offset by $b = 0.024''$ from a cusp in the caustic.

Here, we propose that F10214 is an ordinary Seyfert 2 nucleus which has been gravitationally lensed by a foreground galaxy. High resolution near-IR images showed four objects near F10214 (Matthews et al. 1994), of which the brightest (Source 1) forms a $\sim 2''$ arc focused on the fainter Source 2, $1.2''$ away. The middle of Source 1 has a $\sim 0.5''$ core which is dominated by $H\alpha$ line emission. Matthews et al. (1994) suggested that the arc was gravitationally lensed by Source 2, but the marked difference between the continuum and $H\alpha$ structures led them to favor a merger scenario. We show that the structural differences at various wavelengths are the key to a complete understanding of F10214’s many unusual properties. A more complete discussion of this is presented in Broadhurst & Lehár (1995).

2. Lens Interpretation

We propose that the light from the distant IRAS source is magnified by the gravitational field of an intervening galaxy. We identify the IRAS source with the arc-shaped object (Source 1), and the lensing galaxy “G” with the central object (Source 2). Sources 3 and 4 cannot be additional lensed images of the IRAS source, and presumably these are just other galaxies close to the line of sight.

We designed a simple lens model which can produce the different struc-