TENTATIVE DETECTION OF FAR INFRARED EXCESS IN ARP 220

KIN-WING CHAN

NASA/Ames Research Center
MS 245-6, Moffett Field, CA 94035, USA

S. H. MOSELEY AND E. DWEK

NASA/Goddard Space Flight Center
Code 685, Greenbelt, MD 20771, USA

T. L. ROELLIG

NASA/Ames Research Center
MS 245-6, Moffett Field, CA 94035, USA

S. CASEY

Hughes/STX/NASA/Goddard Space Flight Center
Code 685, Greenbelt, MD 20771, USA

AND

R. LOEWENSTEIN

Yerkes Observatory
William Bay, Wisconsin, WI 53191, USA

Abstract. We report 36 to 50 μm observations of Arp 220 by the Goddard Cryogenic Grating Spectrometer on the Kuiper Airborne Observatory in May 1994. In this measurement, we find the galaxy to be four times brighter than in the measurements of Joy et al. (1986). If both of the observations are correct, this large far infrared luminosity increasing in a short time scale between the two observations suggests that the infrared emission in Arp 220 consists mostly of nonthermal synchrotron radiation which originates from the active nucleus.

Y. Sofue (ed.), The Central Regions of the Galaxy and Galaxies, 301-302.

1. Observation and Discussion

The infrared observations were made from the Kuiper Airborne Observatory (KAO) on May 15 1994. The far infrared spectrometer used in this observations was the Goddard Cryogenic Grating Spectrometer No. 2. We observed 36.5 - 50.5 μm bands of the central region of Arp 220 with spectral resolution of about 0.4 μm and a 20″ beam. The observations are calibrated to Callisto (see Chan et al. 1997 (ApJ, 483, 798) for the flux model of Callisto).

Our 36 and 50 μm spectrophotometric data and the data adapted from Joy et al. 1986 (ApJ, 307, 110) are summarized in Table 1. From Table 1 we find that at 50 μm our measured flux is factor of four higher than the 50 μm flux reported by Joy et al. who made the measurement in April 1985. The luminosity excess at 50 μm between ours and Joy et al. measurements is $> 5 \times 10^{11}$ $L_\odot$ (assuming a distance of 76 Mpc). We find that this high far infrared luminosity excess in such a short time scale ($\sim$ 9 years) could not plausible be explained as dust emission by starburst or AGN. On the other hand, the nonthermal synchrotron radiation mechanism can explain the large increasing of far infrared luminosity we observed here. Based on this model and the past published FIR and SUBMM data, we find that the spectrum of Arp 220 is self-absorbed in the FIR - SUBMM range and a power law with spectral slope of 1.8 - 2.5 can fit it. Finally, we derive the size of the nonthermal emitting region and find that it is $\sim 6 \times 10^{-2}$ ly.

TABLE 1. Arp 220 Infrared Fluxes

Measurements	Flux (Jy)	Uncertainty (Jy)	Beam size	Date of Observations
Joy et al. (1986)[a]				
50 μm	35	10.5	FWHM 13″ × 38″	April 1985
100 μm	126	37.8	FWHM 24″ × 38″	April 1985
This work[b]				
36.5 μm	77.6	9.6	20″	May 1994
50.5 μm	146.1	23.7	20″	May 1994

[a]The uncertainties are the flux calibration error which is less than 30% and we assume 30% here.
[b]The fluxes and the uncertainties of the two end points of our observed spectrum. The uncertainties are the statistical error only. The flux calibration error is less than 10%.

https://doi.org/10.1017/S0074180900085016 Published online by Cambridge University Press