

ISO 3-12 Micron Spectra of Normal and Seyfert Galaxies:
An IPAC ISO Template Program

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ABSTRACT

We will describe a large sample of ISOPHOT 3-12 micron infrared spectra of galaxies extracted from the ISO archive and reduced interactively in a uniform way. The sample contains about 100 normal galaxies ranging from ellipticals to dwarfs and about 100 known active galactic nuclei of various seyfert types. As part of the IPAC ISO template service program, these spectra will be released to the public via World Wide Web in the near future. We will also present results from our statistical and correlation studies

OUTLINE OF THE POSTER

1. Introduction

We will describe the IPAC ISO template service program that intends to provide expert reduced data from the PUBLIC data archive of the Infrared Space Observatory.

2. Sample, Data and Data Reduction

We will describe how we selected the sample, the procedure of data reduction, and the format of the final data product.

3. Spectra

We will show and characterize the spectra of

- * Normal Galaxies
 - * Ellitical galaxies
 - * Giant spiral galaxies
 - * Dwarf irregular galaxies

- * Seyfert Galaxies
 - * Type 1
 - * Type 1.5
 - * Type 2

4. Summary

ISOPHOT 3-12 Micron Spectra of Galaxies:
An IPAC ISO Template Program & Classification of Mid-IR Galaxy Spectra

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1. Introduction

The ISO archive contains about 1400 spectroscopic observations with the PHT-S spectroscopic mode of ISOPHOT which has a $24'' \times 24''$ aperture, two 64-element linear detector arrays covering the ranges from 2.5 to $4.9\mu\text{m}$ ($0.04\mu\text{m}$ per pixel) and from 5.9 to $11.7\mu\text{m}$ (0.1 per pixel), respectively. These observations offers a rich database to study the mid-IR spectra of a variety of celestial objects that are difficult to obtain from the ground.

As a service program at IPAC, we have uniformly reduced all the PHT-S observations at a position that matches the position of an optical galaxy within a radius of $0'.3$. Our final sample contains 85 normal galaxies and 88 galaxies known to be Seyferts. Table 1 breaks down the sample according to optical morphology or Seyfert types. For each galaxy in the sample, the following product will be soon available from IPAC via WWW: (i) a fully reduced PHT-S spectrum and (ii) any necessary data reduction notes.

In the remainder of this poster, we use this large database to characterize into 3 broad classes the mid-IR spectra of galaxies.

2. Characterization of Mid-Infrared Spectra of Galaxies

As summarized in **Table 2**, the mid-IR spectra of galaxies can be characterized into 3 broad classes.

Class I – Spectra dominated by those mid-IR broad emission features (EFs) centered respectively at 6.2, 7.7, 8.6 and $11.3\mu\text{m}$. The vast majority of normal disk galaxies (S0 to dwarf irregulars) and most ($\sim 70\%$) of Sy 1.8-2.0 galaxies belong to this class. **Fig. 1** compares average PHT-S spectra among Class I sample galaxies: spirals, irregular dwarfs and Sy2 galaxies. Class-I spectra are similar to those Type-A spectra defined for Galactic sources.

Class II – Spectra dominated by the continuum emission in mid-IR with the forenamed EFs being either weak or absent. All the elliptical galaxies in the sample and the majority ($\sim 90\%$) of Sy 1.0-1.5 galaxies show Class-II spectra. The average Class-II spectra are shown in **Figs. 2** and **3** for ellipticals and Sy 1.0-1.5 galaxies, respectively.

Class III – Spectra dominated by a broad “hump” around $8\mu\text{m}$. As shown in **Table 2** a few early-type normal galaxies and a number of Seyfert galaxies fall into this spectral category. **Fig. 3** shows just a few examples.

Table 1. Galaxy Sample

| Morphology/Seyfert Type | Number of Galaxies |
|-------------------------|--------------------|
| Normal Galaxies | |
| E | 6 |
| E? | 2 |
| S0-S0/a | 17 |
| Sa-Sab | 12 |
| Sb-Sbc | 16 |
| Sc-Sd | 20 |
| Sdm-Im | 12 |
| Seyfert Galaxies | |
| 1.0 & 1.2 | 20 |
| 1.5 | 16 |
| 1.8 & 1.9 | 11 |
| 2.0 | 36 |
| 2.5 | 1 |
| Unknown Type | 4 |

Table 2. Distribution of Spectral Classes

| Optical type | Total Number ^a | Class I | Class II | Class III |
|------------------|---------------------------|-----------|-----------|-----------|
| Normal Galaxies | | | | |
| E | 6 | 0 (0%) | 6 (100%) | 0 (0%) |
| S0 | 15 | 11 (74%) | 2 (13%) | 2 (13%) |
| Sa–Sab | 10 | 9 (90%) | 0 (0%) | 1 (10%) |
| Sb–Sbc | 16 | 16 (100%) | 0 (0%) | 0 (0%) |
| Sc–Sd | 20 | 20 (100%) | 0 (0%) | 0 (0%) |
| Sdm–Im | 11 | 11 (100%) | 0 (0%) | 0 (0%) |
| Seyfert Galaxies | | | | |
| 1.0–1.2 | 20 | 2 (10%) | 17 (85%) | 1 (5%) |
| 1.5 | 16 | 1 (6%) | 16 (94%) | 0 (0%) |
| 1.8–1.9 | 9 | 5 (56%) | 3 (33%) | 1 (11%) |
| 2.0 | 34 | 25 (73%) | 6 (18%) | 3 (9%) |

(a) – Only spectra of an adequate S/N ratio are used here.

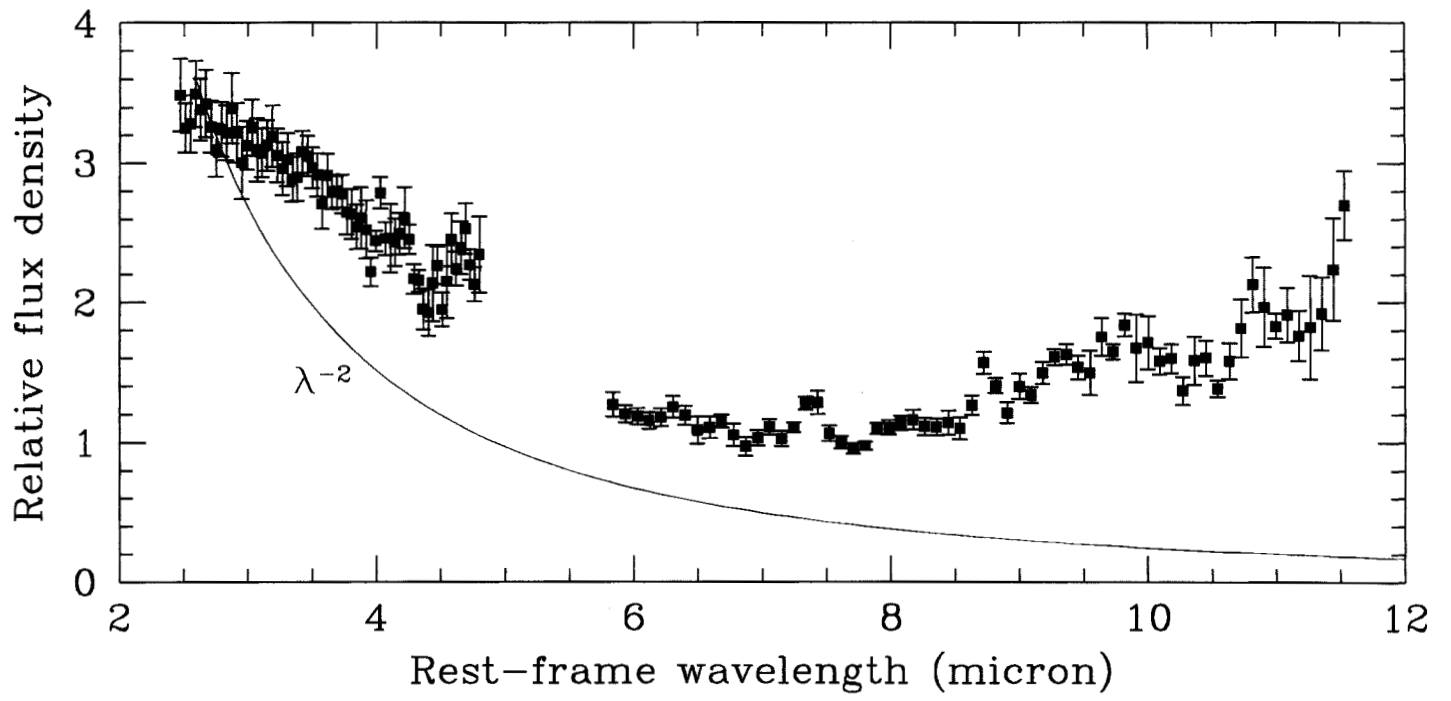


Fig. 2

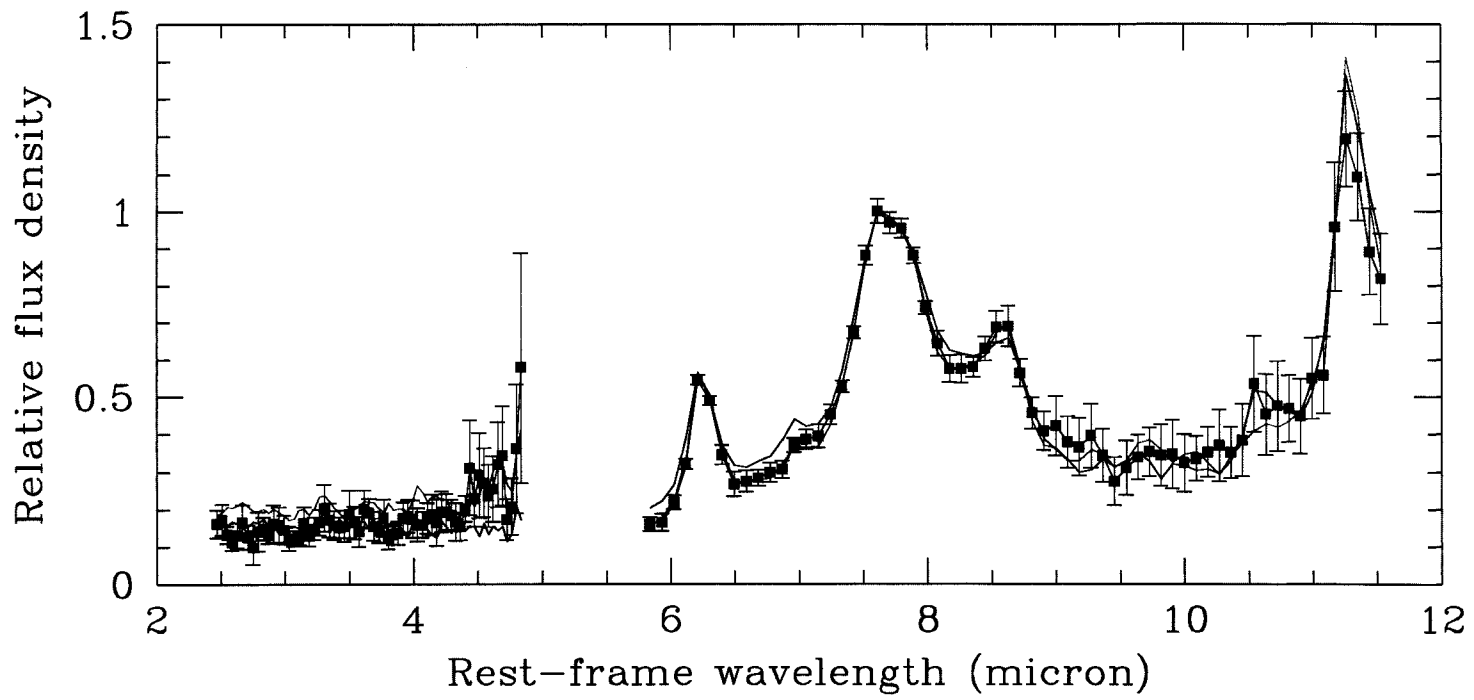


Fig. 1

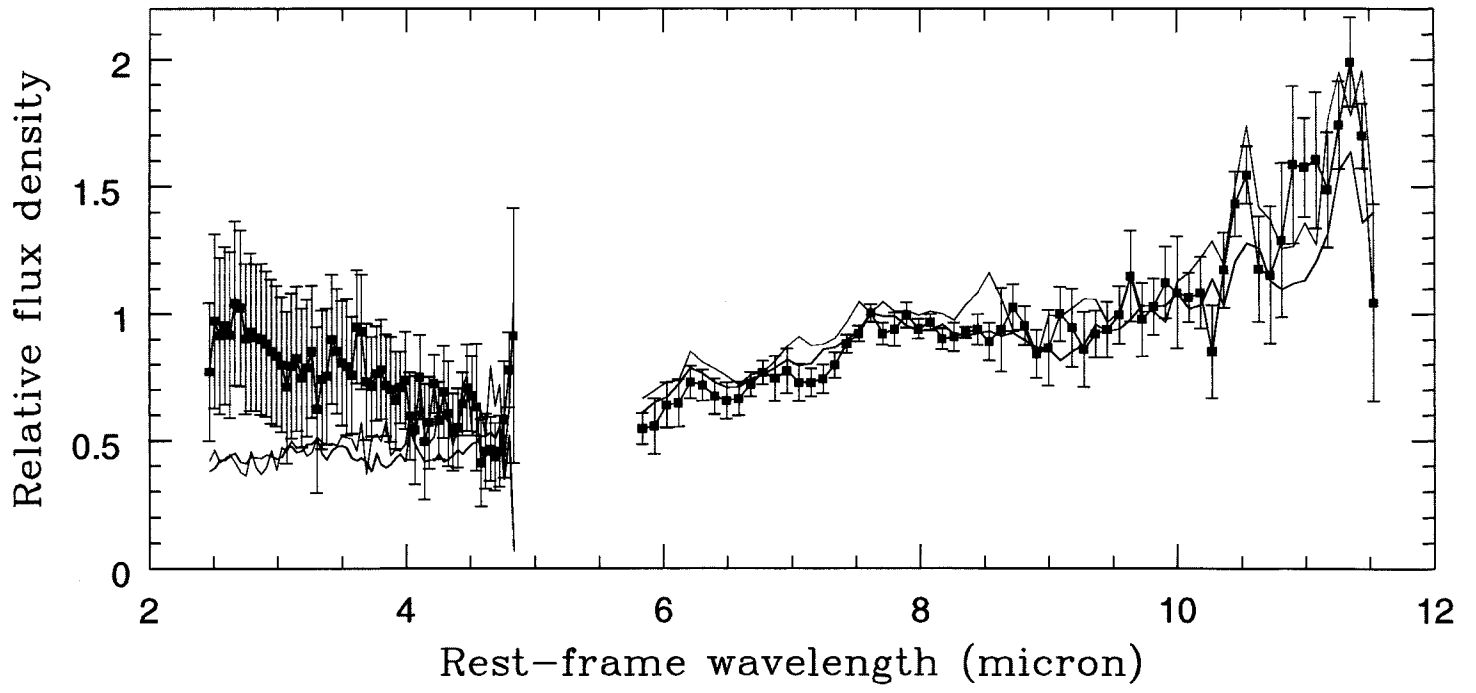


Fig. 3

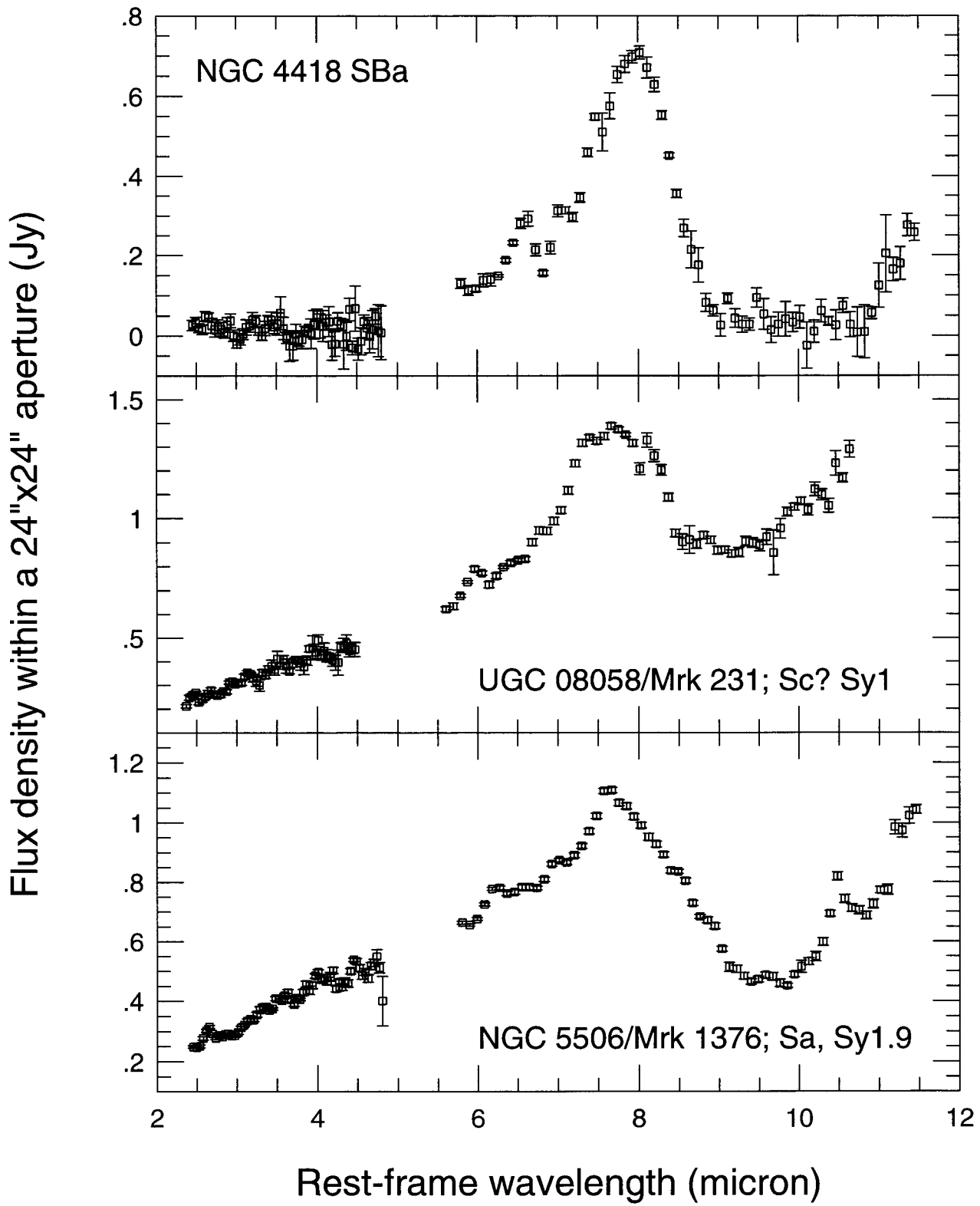


Fig. 4