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Spectroscopic study of stars with dusty disks

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Abstract. We have selected several stars with far-IR (IRAS) fluxes indicating the presence of circumstellar dust shells and disks. In this paper we present an analysis of the spectra of these stars. In several of these stars we find evidence for gaseous envelopes in addition to dusty disks. In some of these stars we find complex and variable Hα profiles indicating the variations in the circumstellar envelopes and disks.

1. Introduction

After the IRAS mission, many stars which are in the main-sequence and pre-main-sequence stages of evolution was found to have circumstellar dust. These dusty disks could be proto planetary disk or the remant disk after the formation of planets (Aumann et al 1984, Zuckerman and Dyck, 1986, Backman et al 1993) In connection to the planetary system formation and the timescales, it is very interesting to study these stars with circumstellar dust. Some of the selected samples also show evidence of rotating disk, from the CO observations (Jura and Turner, 1998).

2. Observations

The observations were made with‘ the 2.3m telescope at VBO (Vainu Bappu Observatory), Kavalur, India. The spectra were obtained with OMR (Opto Mechanical Research) Spectrograph, which has a resolution of 2Å at 6000Å.

3. Individual Objects

IRAS 02143+5852 The optical spectrum shows strong absorption in the balmer lines. There are no helium lines seen in the spectra. The Hα line is also in absorption. The IR (IRAS) fluxes peak at 25μm indicating a detached cold dusty disk or a shell.
IRAS 04101+3103 The high resolution optical spectra shows double peak emission in the Hα line indicating the presence of gaseous disk. The presence of broad neutral helium lines at 5876Å and 6678Å lines show that it is a B type mainsequence star.

IRAS 04555+2946 It is a premainsequence star of Ae spectral type. It is thought to be a young counterpart of βpic. We found that it has Balmer lines in emission. The HeI, CaI IR triplet lines, NaI D1, D2 and the OI 7777Å lines are also in emission. The data at different epochs show that the lines are varying. We found the HeI and NaI D1, D2 emission vary periodically. The period is around 6 days. For this period and assuming a keplerian disk we get a size which is typical for a proto-planetary disk.
IRAS 05273+2517 It is quite similar to IRAS 04555+2946 shows emission in the same lines and also shows variations. But it is slightly of later spectral type.
IRAS 05328+2443 It shows a double peak emission in Hα indicating a gaseous disk. The profiles show variations.
IRAS 05355-0117 It shows Hα line in P-Cygni emission. The other balmer lines also show filled-in emission.
IRAS 11202-5305 It shows a strong P-Cygni profile in Hα. The OI 7777Å lines are in emission.
IRAS 11307-5402 It shows a Hα emission inside the photospheric absorption. This could be due to gaseous envelope or a shell around the star.
IRAS 13110-5425 The otpical spectra show strong absorption lines, so the star could be of late F or early G spectral type. There is no emission in the Balmer lines. The IRAS colours indicate detached dust shell or a disk. The star could be mainsequence or a post-mainsequence star which is in the post-AGB stage.
IRAS 15126-3658 It shows a strong emission in Hα . The Hβ line shows a double peak emission inside the photospheric absorption.
IRAS 15373-4220 It shows a strong emission in the Hα inside the photospheric absorption. The Hα emission shows variations, which is typical of most of the pre-mainsequence stars. IRAS 15373-4220 is a pre-mainsequence star with a gaseous and dusty disk.
IRAS 16102-2221 It is a very interesting object. It shows Hα which changes from emission to absorption.
IRAS 19089+1542 This could be a young premainsequence star with a gaseous and dusty disk. The broad lines from the central star indicates, it is not a post-mainsequence star.
IRAS 21153+6842 It shows shell like sharp absorption in the Hα line. There many sharp lines seen in the optical spectra which indicated that it could be due to a shell or an extended envelope.

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Table 1. **List of cadidate stars with dusty disks**

IRAS	l	b	m_v	Sp. type	12 μm	25 μm	60 μm	100 μm
02143+5852	133.85	-1.93			5.90	18.06	5.39	8.97
04101+3103	165.88	-14.39	10.14	AIab:e	2.98	6.80	5.27	3.44
04175+3827	161.64	-8.07	7.6	F2	.81	.32L	.40L	2.19
04555+2946	173.46	-7.91	7.73	A2	10.25	10.34	11.11	12.52
05273+2517	181.25	-4.78	8.29	A3	5.59	12.59	27.98	18.95
05328+2443	182.42	-4.04	10.7	F2IVe	6.21	20.66	21.88	13.65
05355-0117	205.49	-16.85	9.82	A5III	.68	3.89	10.38	9.00
07236-1404	229.45	+1.01	6.81	B9IV	4.95	2.87	.47	7.36L
07446-3210A	247.59	-3.70	8.60	A0	29.10	17.30	2.62	3.94
08128-5000	265.64	-8.53	10.30	B8	5.35	4.66	1.18	3.29
10046+1700	219.53	+50.75	3.511	A0Ib	1.93	.51:	.40L	1.00L
11202-5305	289.78	+7.22	6.770	B9Ve	40.16	27.24	6.19	7.96L
11307-5402	291.58	+6.81	7.79	A9V	7.23	33.59	39.36	23.86
12349-1659	298.22	+45.48	9.92	F5	7.14	1.83	.82L	1.00
12584-4837	304.60	+13.95	10.57	F	36.07	48.75	13.04	3.31
13110-5425	306.24	+8.03	8.39	F5Ia/Iab	.31L	2.11	7.60	5.33
15126-3658	332.39	+17.32	8.7	A0V	1.59	6.71	25.61	25.69
15373-4220	333.23	+10.20	8.2	A7V	4.11	18.14	19.30	13.94
16102-2221	352.42	+20.45	8.980	A8III/IV	5.68	5.89	5.01	3.14
17534+2603	51.43	+23.19	5.474	F2Ibe	97.52	54.49	13.42	6.04
17539-3409	356.77	-4.80		PN	.36L	1.37	2.63	5.43
18213-2948	3.39	-7.81	8.15	B9V	2.95	18.43	29.57	23.42
19089+1542	49.21	+2.89	7.2	B9	23.40	43.60	29.90	17.40
21153+6842	105.54	+13.68	8.88	A	3.68	10.76	4.26	3.58L

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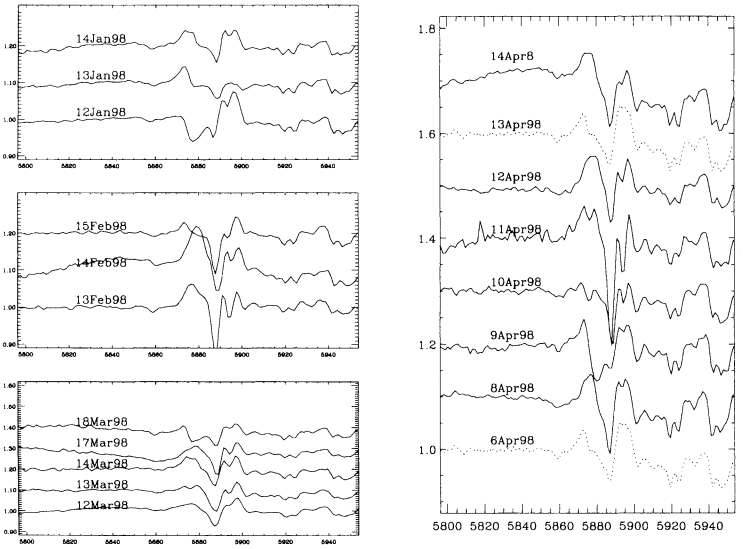

Figure 1. The HeI 5876 and the NaI D lines of IRAS 04555+2946 seem to show variations in timescale of days. The plot with the dotted lines is show that the line profiles looks alike on those days, indicating periodic variability which provides evidence of rotating disk.

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