

# Probing the 9.7 $\mu\text{m}$ interstellar silicate extinction profile through the Spitzer/IRS spectroscopy of OB stars

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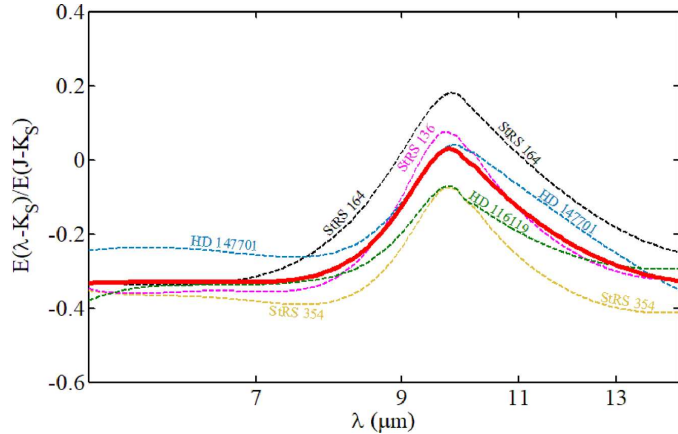
The 9.7  $\mu\text{m}$  interstellar spectral feature, arising from the Si-O stretch of amorphous silicate dust, is the strongest extinction feature in the infrared (IR). In principle, the spectral profile of this feature could allow one to diagnose the mineralogical composition of interstellar silicate material. However, observationally, the 9.7  $\mu\text{m}$  interstellar silicate extinction profile is not well determined. Here we utilize the Spitzer/Infrared Spectrograph spectra of five early-type (one O- and four B-type) stars and compare them with that of unreddened stars of the same spectral type to probe the interstellar extinction of silicate dust around 9.7  $\mu\text{m}$ . We find that, while the silicate extinction profiles all peak at  $\sim 9.7$   $\mu\text{m}$ , two stars exhibit a narrow feature of full width of half maximum (FWHM) at  $\sim 2.0$   $\mu\text{m}$  and three stars display a broad feature of FWHM at  $\sim 3.0$   $\mu\text{m}$ . We also find that the width of the 9.7  $\mu\text{m}$  extinction feature does not show any environmental dependence. With a FWHM of  $\sim 2.2$   $\mu\text{m}$ , the mean 9.7  $\mu\text{m}$  extinction profile, obtained by averaging over our five stars, closely resembles that of the prototypical diffuse interstellar medium along the lines of sight towards Cyg OB2 No. 12 and WR 98a. Finally, an analytical formula is presented to parametrize the interstellar extinction in the IR at  $0.9 \mu\text{m} \leq \lambda \leq 15 \mu\text{m}$ .

- Spitzer/IRS のスペクトルから **9.7  $\mu\text{m}$  silicate feature profile** の形状を正確に求める (=ダストの鉱物組成を知る)ことを目的とした研究
- profileの形状は測定した領域・ターゲットとした天体・測定した方法によって**中心波長( $\lambda$ )**と**バンド幅( $v$ )**が異なっている
- "astronomical silicate" (emission in the Trapesium region, Drain & Lee, 1983) では **( $\lambda, v$ )  $\approx$  (9.56  $\mu\text{m}$ , 3.45  $\mu\text{m}$ )**
- 銀河中心方向や分子雲の背景にある星のスペクトルからは ( $\lambda, v$ )  $\approx$  (9.8  $\mu\text{m}$ , 1.7–2.7  $\mu\text{m}$ ) のような profile が検出されている
- ここでは基本的に立ち返って "**pair method**" を用いて 9.7  $\mu\text{m}$  silicate feature の profile を導出した
- 5つの減光を受けたOB型星と減光を受けていない星のスペクトルを比較, 中心波長は9.7 $\mu\text{m}$ でバンド幅は2 $\mu\text{m}$ , 3 $\mu\text{m}$ の2グループにわかれた
- 今回の結果はCyg OB2 No.12などの結果と consistent, しかし先行研究で指摘された環境による profile の変化は確認できなかった
- 可視減光に対するバンド強度  $\langle A_V/\Delta\tau_{9.7} \rangle$  の値は太陽系近傍と近い  $\Rightarrow$  銀河中心方向やや AGN torus とは異なっている

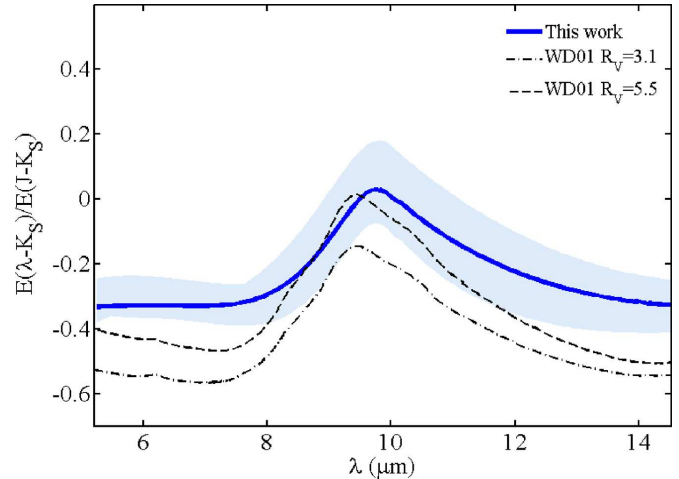
**Table 1&3.** Stellar parameters for the target and reference stars / 9.7  $\mu\text{m}$  silicate profile parameters.

Object	Type	$l$ (degrees)	$b$ (degrees)	S/N	$J - K_S$ (mag)	$Err(J - K_S)$ (mag)	$W_{CO}$ ( $\text{K km s}^{-1}$ )	$\lambda_{\text{peak}}$ ( $\mu\text{m}$ )	$\gamma_{\text{sil}}$ ( $\mu\text{m}$ )	$S_{9.7}$	$A_V$ (mag)	$\Delta\tau_{9.7}$	$A_V/\Delta\tau_{9.7}$
StRS 354	O7	076.97	-00.64	57	1.88	0.03	18.95	9.75	1.78	0.33	12.2	0.58	21.0
StRS 136	B8I	000.04	-00.57	74	1.78	0.03	425.26	9.69	2.11	0.42	11.9	0.71	16.8
StRS 164	B8I	014.21	-00.00	69	1.78	0.03	185.70	9.81	2.99	0.50	11.4	0.82	14.0
HD 116119	B8Ia	306.62	+00.63	59	0.42	0.02	40.85	9.75	1.90	0.25	2.38	0.11	21.6
HD 147701	B5III(?)	352.25	+16.85	43	0.48	0.03	13.50	9.87	3.07	0.35	3.01	0.17	17.7
HD 204172	B0I	83.39	-9.96	47	-0.06	0.03	0.03						
HD 128207	B8V	323.84	+18.35	76	-0.06	0.03	0.04						

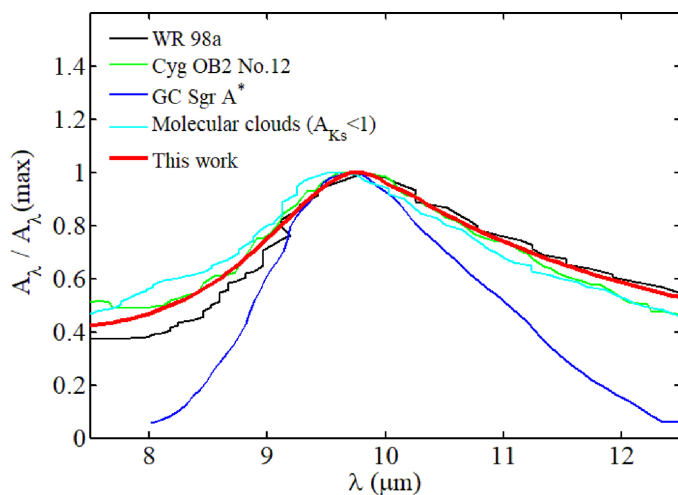
?: The classification as a giant may be wrong.



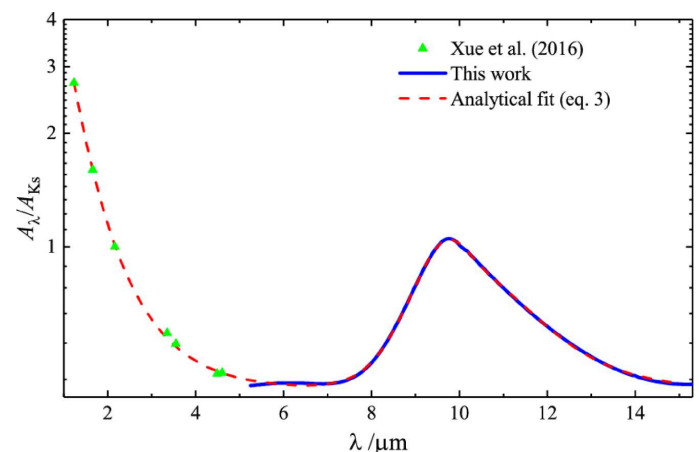
**Fig 8.** The 9.7  $\mu\text{m}$  silicate extinction profiles derived from the five targets.



**Fig 9.** Comparison of the mean 9.7  $\mu\text{m}$  profile with the WDO1 models.



**Fig 10.** Comparison of the mean 9.7  $\mu\text{m}$  silicate extinction profiles.



**Fig 13:** An analytical fit to the observed interstellar extinction curve in the IR.