2016.08.22 astro-ph Seminar (担当 大澤)

Diffuse Interstellar Bands and the Ultraviolet Extinction Curves: The Missing Link Revisited

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Abstract & Introduction

A large number of interstellar absorption features at ~ 4000 Å–1.8 μm, known as the "diffuse interstellar bands" (DIBs), remains unidentified. Most recent works relate them to large polycyclic aromatic hydrocarbon (PAH) molecules or ultrasmall carbonaceous grains which are also thought to be responsible for the 2175 Å extinction bump and/or the far ultraviolet (UV) extinction rise at $\lambda^{-1} > 5.9\,\mu\mathrm{m}^{-1}$. Therefore, one might expect some relation between the UV extinction and DIBs. Such a relationship, if established, could put important constraints on the carrier of DIBs. Over the past four decades, whether DIBs are related to the shape of the UV extinction curves has been extensively investigated. However, the results are often inconsistent, partly due to the inconsistencies in characterizing the UV extinction. Here we re-examine the connection between the UV extinction curve and DIBs. We compile the extinction curves and the equivalent widths of 40 DIBs along 97 slightlines. We decompose the extinction curve into three Drude-like functions composed of the visible/near-infrared component, the 2175 Å bump, and the far-UV extinction at $\lambda^{-1} > 5.9\,\mu\mathrm{m}^{-1}$. We argue that the wavelength-integrated far-UV extinction derived from this decomposition technique best measures the strength of the far-UV extinction. No correlation is found between the far-UV extinction and most ($\sim 90\%$) of the DIBs. We have also shown that the color excess $E(1300-1700)$, the extinction difference at 1300 Å and 1700 Å often used to measure the strength of the far-UV extinction, does not correlate with DIBs. Finally, we confirm the earlier findings of no correlation between the 2175 Å bump and DIBs or between the 2175 Å bump and the far-UV extinction.

今年で DIB が発見されてからおよそ 100 年 ("DIB" が定義されてから 80 年)
- 様々な線幅をもつ吸収線で紫外 (~4000 Å) から近赤外 (~1.8μm) に現れる

依然として DIB carrriers については interstellar 起源だということ以外判明していない
DIB carriers と Extinction Curve の関係については古くから調べられてきた
- 2175 Å の bump と FUV (λ-1 > 5.9μm-1) の rise/DIB carriers の起源と環境依存性を探るのに有効

1995 年の論文 "Diffuse Interstellar Bands and UV Extinction Curves – The Missing Link" を更新する
FUV と相関のありそうな DIB は 4 of 40 だけ (相関は弱い), 結局良くわからないまま

手法と新規性について
1. これまでは Extinction Curve の評価方法がまちまち → 適切な表現法(?)に基づいて評価
2. これまでで最大の DIB-Extinction Curve サンプル (40 DIBs, 97 sightlines) を構築 (主に可視光)
3. E(B-V) で規格化した DIB の強度と Extinction の間に相関がないか調べる

Figure 2: 減光曲線の表現方法

$$\frac{A_\lambda}{A_V} = \frac{a_3}{(\lambda/\lambda_{\rm VIS})^{a_1}+(\lambda_{\rm VIS}/\lambda)^{a_1}+a_2} + \frac{a_5}{(\lambda/0.2175)^2+(0.2175/\lambda)^2+a_4} + \frac{a_8}{(\lambda/\lambda_{\rm FUV})^{a_6}+(\lambda_{\rm FUV}/\lambda)^{a_6}+a_7},$$

$$\frac{A^{\rm int}_{\rm FUV}}{A_V} \equiv \int_{0.1\,\mu\mathrm{m}}^{\infty} \frac{a_8}{(\lambda/\lambda_{\rm FUV})^{a_6}+(\lambda_{\rm FUV}/\lambda)^{a_6}+a_7}\,d\lambda .$$

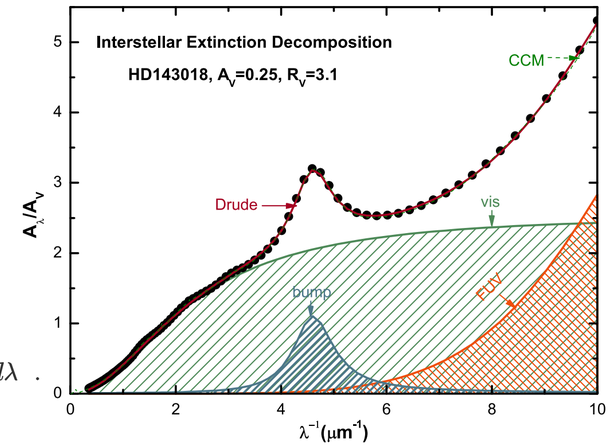

Figure 4: サンプルの特徴について

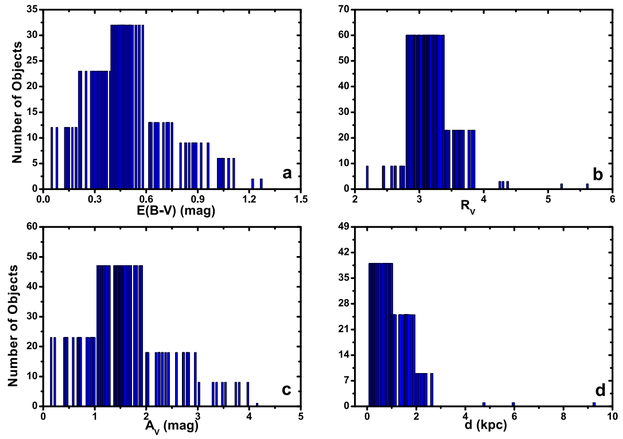

Figure 8: 主な結果 (相関なし)

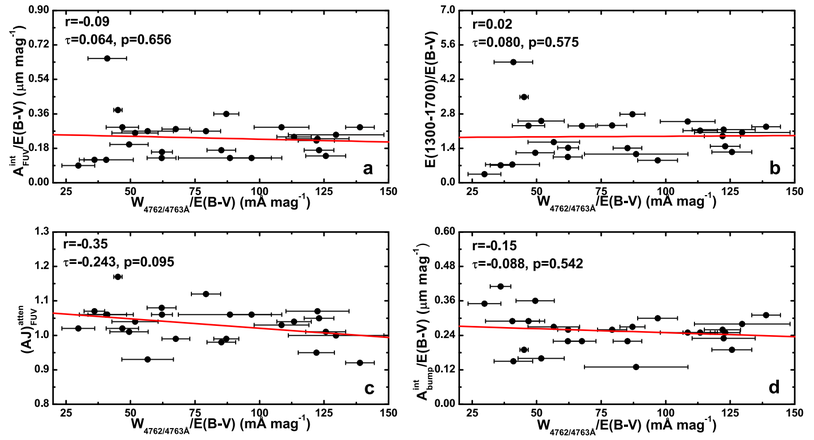

Figure 11-14: FUV と相関のありそうな 4 つの DIB

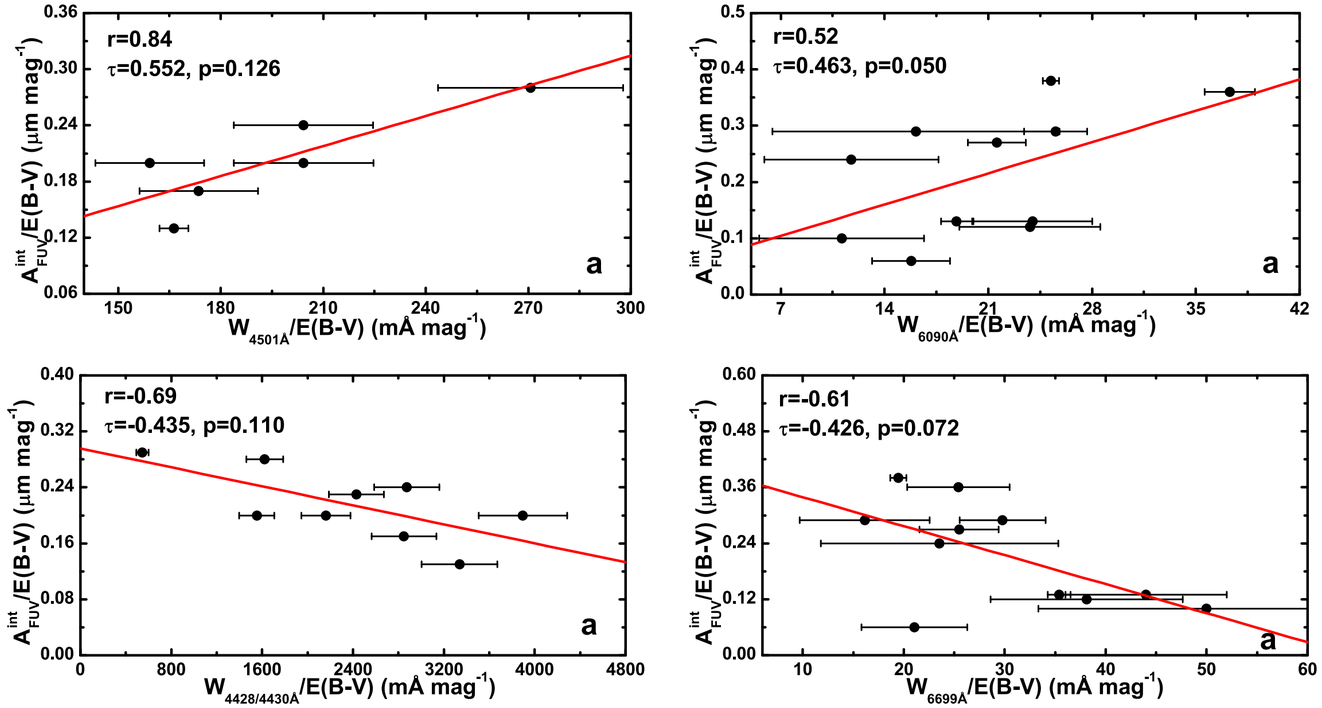

Figure 15: UV bump と FUV にはとくに相関なし