Hunting for invisible dust in the Milky Way

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Interstellar extinction is being used interchangeably with the term ``reddening" as a light beam, crossing an interstellar cloud, losses relatively much more violet than red photons and thus a star, seen through a cloud seems redder than it is in fact. The photometric equation defines the main parameters which determine the apparent magnitude of a star: its absolute magnitude, distance and extinction along the sightline.

$m - M = 5logD - 5 + A_V$

where the extinction term A_V is usually replaced by $R^*E(B-V)$ where R is called the total-to-selective extinction ratio. In the earliest efforts to establish the above equation Trumpler (1930, Lick Obs. Bull., 14, 154) allowed also an additional, neutral (grey) term in the interstellar extinction, i.e. $A_V = R^*E(B-V)+C$. He estimated the value of C=0.19 mag./kpc. The lack of reliable method of separation of both extinction terms affects strongly determination of distances to stars. The neutral term in the above equation is usually neglected.

Andriesse et al. (1978, MNRAS, 185, 771) considered condensation of dust around η Car and concluded that the condensate consists in part of large particles with a size of about 1 micron which can give an almost grey circumstellar extinction of 3 - 4 mag in the visual and UV range. I have considered the stars of the Orion Trapezium where distances were recently measured using the VLBI trigonometric parallaxes (Menten et al. 2007, Astr. Ap. 474, 515). Comparing two stars: HD37020 and HD37022 which should be at the same distance (~414pc) we found that the distances measured using our method, based on interstellar CaII lines (Megier et al. 2009, Astr. Ap., 507, 833), coincide with the trigonometric ones while the spectrophotometric distance of HD37020 is twice as big. Very good spectra from HARPS-N leave no doubt that the Sp/L's of both stars are correct and very similar. In this situation the only factor explaining the observed inconsistency is the grey extinction term.

An extensive survey of the O star's spectra demonstrates also that CaII distances usually agree with the trigonometric ones while spectrophotometric distances are often much larger (never smaller). Also this phenomenon may be interpreted only in terms of the additional, grey, extinction, observable in some of targets. The latter must be caused by relatively big size dust grains. The grey term does not seem to be related to any other interstellar features, currently observable. This fact proves that spectrophotometric measurements of distance, necessary to study the Galactic structure, are very unreliable because we never know the amount of possible grey extinction which acts in the photometric equation exactly in the same way as distance, attenuating all wavelengths.