Color Magnitude Diagrams for Quasars Using SDSS, GALEX, and WISE Data

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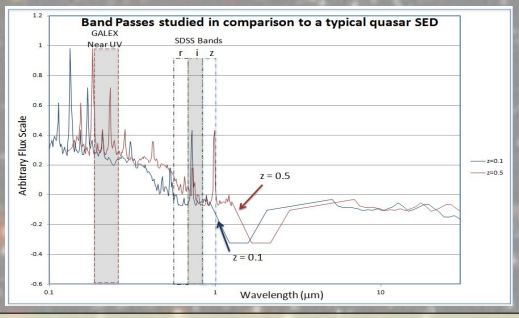
Abstract

Data from the Galaxy Evolution Explorer (GALEX), the Wide-Field Infrared Survey Explorer (WISE), and the Sloan Digital Sky Survey (SDSS) was used to construct color-magnitude diagrams for Type I quasars at redshift values of 0.1<z<0.5. This effort improved upon previous ones by increasing the sample size to more than 400 objects and by increasing the covered wavelength span from 0.25 microns to 22 microns. Color was plotted against absolute magnitude at a variety of wavelengths, from near ultraviolet to infrared. No tight correlations were found when comparing any of the UV or optical colors to the various infrared absolute magnitudes. However, a relationship was found using the NUV (GALEX) - i band (SDSS) color vs. NUV (GALEX) absolute magnitude.

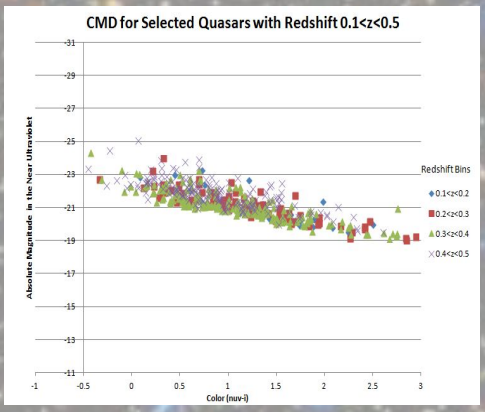


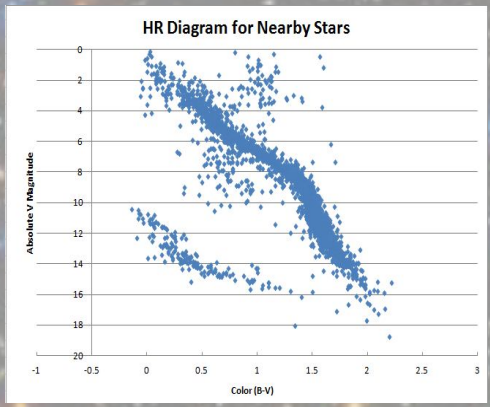
Spectral energy distribution of a typical quasar: This plot shows the typical SED of a quasar[3] redshifted from z = 0.1 to z = 0.5. Also shown are the band passes used in the study. Color was determined by the ratio of flux in the SDSS i, r, or z band to the flux in the GALEX Near UV filter.

Comparison of Quasar CMD to Stellar CMD

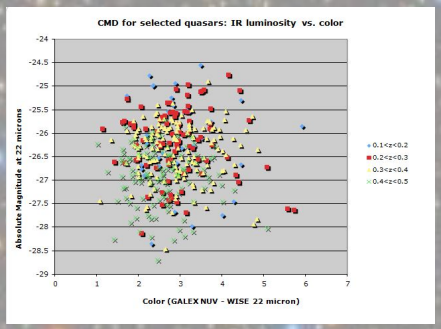
The correlation we found for quasars has a similar degree of scatter (about 2 magnitudes at any given color) The correlation found for quasars in this study covers a much more narrow range of magnitudes (about 7 magnitudes for quasars compared to 20 for stars)

Color Magnitude Diagram for Quasars: Color is the ratio of fluxes in the near ultraviolet (GALEX) to the z band (SDSS) and is plotted against absolute magnitude in the near UV (GALEX). Similar correlations to the UV magnitude were found when the r- and z-bands from SDSS were used to determine color. The plot shows that the correlation is similar for all values of redshift from z = 0.1 to z = 0.5





Color Magnitude Diagram for Stars: This plot shows the correlation between color (B-V) and absolute magnitude (V) of nearby stars. Data was taken from the HEARSARC catalog of nearby stars (3rd edition)[7]



CMD of Quasars Using Infrared Luminosity: Color is the ratio of fluxes in the near ultraviolet (GALEX) to the 22 micron filter (WISE) and is plotted against absolute magnitude in the IR (WISE 22 micron). No correlation was observed.

Conclusions

In studying type I quasars at redshift values 0.1<z<0.5, a correlation was found to exist between the color and the luminosity of the accretion disk. Color was measured by comparing flux from GALEX NUV (277.5 nm) to SDSS Z (913.4 nm), I (762.5 nm), or R (623.1 nm) bands, and was plotted against the absolute magnitude of GALEX NUV (277.5 nm). This correlation between color and luminosity of the accretion disk holds at individual redshift bins of 0.1z for values of z from 0.1 to 0.5 with little difference between bins. The range of magnitudes covered by the quasars studied, however, is quite narrow compared to the range of magnitudes in a typical HR diagram for stars. No correlation was found between the luminosity of the dusty torus, using the WISE 12 or 22 μm filter, to the color of the accretion disk, using the flux from GALEX NUV and WISE filters.

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