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GALAXY CONTAMINATION IN GALACTIC REDDENING MAPS

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ABSTRACT

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1. INTRODUCTION

As luminosity is a fundamental property of astrophysical objects, properly correcting for the attenuation of light due to dust extinction is important. Accurate luminosities are needed for calculating energy budgets, sizes of objects, and the calibration and use of astrophysical objects as standard candles to measure distances in the universe.

Dust extinction can occur anywhere along the line of sight from an object to the observer where there could be dust, including circumstellar dust, dust in the host galaxy of an object, circumgalactic dust, intergalactic dust, and dust in our own Milky Way galaxy. These multiple components can make it complicated, but it is usually assumed that the component of dust extinction arising from the MW is the best understood. The all-sky dust reddening maps of **?**, hereafter referred to as SFD98, calibrated the luminosity at 100 μm from COBE/DIRBE and IRAS/ISSA to dust reddening using the colors of elliptical galaxies. These maps have made it convenient to look up the SFD98 reddening (or the rescaling by **?**) via the NASA Extragalactic Database (NED[1]; **?**) or other electronic queries without having to understand the data or read the paper or even the warnings from NED[2]. Combined with the mean value of R_V=3.1 from **?** and ignoring the variations in the Milky Way (**?**) one has the extinction as a function of wavelength or can also implicitly assume those as well as the elliptical galaxy spectrum used by SFD98 and have the extinction readily computed in a number of common passbands.

note: Given the warning of ? that "Even lines of sight with $R_V \simeq 3.1$ deviate asmuch from these standard extinction laws as from the CCM expression, and the deviations become increasingly large and systematic as R_V deviates from 3.1" makes one wonder why we feel we can correct for extinction at all.

? mentioned in a footnote that the SFD98 maps were contaminated by M82, brought to our knowledge through studies of the extinction toward the supernova (SN) 2014J (**?**). **?** cautioned about not just the contamination of M81 and M82 but also the highly variable region nearby. As dust reddening from anywhere has strong consequences in the ultraviolet, the authors were led to ask the question "What other galaxies might be contaminated in this same way?"

[1] https://ned.ipac.caltech.edu/

[2] https://ned.ipac.caltech.edu/classic/help/faq3.html#3a

In this short paper we describe how we searched for examples of contaminating galaxies and give a table of recommended extinction values for the ones we found.

2. ANALYSIS

Having one example to work from, the nearby, extreme starburst galaxy M82, we began our search by looking at the next eleven closest galaxies hosting supernovae observed by Swift (see e.g. **?**).

compare with near-infrared K-band brightness

To detect higher A_V sources in the dust maps, we decided to look up the value of A_V at the center of each galaxy and 20′away in each of the four cardinal directions. We could then individually examine sources which were significantly higher than the mean of the 20′radius. As a baseline for what a significant excess is, we first looked up those values for 102 random positions in the sky. We looked up the values for each of the extragalactic sources in **?**, the 70 brightest of which should already have been removed from the SFD98 maps. For our scientific purposes, we also examined the nearby host galaxies used to calibrate the Cepheid-Supernova Ia distance ladder (**?**), over 700 supernova host galaxies observed by Swift (**?**). The central and mean radial values are plotted in Figure 2.

Most of the data cluster around the 1:1 line. From the random positions, we set one and two sigma limits of 12 % and 22% which encompass 68% and 95% of the points, respectively. We manually examine all points for which the central position has an A_V of 12% greater than (or less than) the mean of the points at 20 ′.

Some sources appear to be partially removed, replacing the pixels with the median value of a nearby annulus.

Other values are not properly corrected for. In the case of M31

The recommended value for the region around M31, as given in Appendix C of **?**, is E(B-V)=0.062. This is the value obtained from the NASA Extragalactic Database[3] when searching the position of M31. Since M31 is not removed from the maps, however, one obtains a value of E(B-V)=0.69 from the NASA/IPAC Infrared Science Archive from the website[4] or python's astroquery.

3. SAVING THE WORLD, ONE EXTINCTION VALUE AT A TIME

Is it better to underestimate, rather than overestimate galactic reddening?

You still have the issue of misascribing how much is from the host. But if you have to little MW reddening

[3] https://ned.ipac.caltech.edu/

[4] https://irsa.ipac.caltech.edu/frontpage/