HAZMAT III. The UV Evolution of Mid-type M Dwarfs with GALEX. A. C. Schneider[1] and E. L. Shkolnik[1], [1]School of Earth and Space Exploration, Arizona State University, PO Box 871404 (aschneid10@gmail.com)

Introduction: Low-mass stars, or M dwarfs (0.1-0.6 M_{Sun}), make up the vast majority of stellar constituents of the Solar neighborhood. Recent results have shown that the majority of M dwarfs host planets, with ~25% hosting an Earth-size or super-Earth-size planet within their habitable zone[1]. Furthermore, planet occurrence rates have been shown to increase with decreasing stellar mass [2], and the planets found around low-mass stars are typically smaller than those around higher-mass stars [3]. Considering that the stellar mass function peaks around spectral type M4 [4] and the numerous observational advantages that low-mass stars provide, mid-type M dwarfs may supply the most opportunities and advantageous conditions for detailed characterizations of habitable zone planets. However, because M dwarfs have active chromospheres and coronae that produce high-energy radiation that may be harmful for life, determining the habitability of planets orbiting M dwarfs is not straightforward. The Habitable Zones and M dwarf Activity across Time (HAZMAT) program was initiated specifically to determine the time-dependent habitability around such perpetually UV-active stars. Using UV photometry from the Galaxy Evolution Explorer (GALEX), we are investigating hundreds of young M dwarfs in the Solar neighborhood to measure the change in stellar activity over planet formation and evolution timescales.

Methods: The HAZMAT I study [5] investigated the UV evolution of early M dwarfs (M0-M3) using targets from several nearby moving groups and clusters with well-determined ages. Recent efforts have significantly increased the number of confirmed low-mass members of these groups, allowing us to extend the original HAZMAT study to later spectral types (M3-M6.5). We are combining the results of these surveys for low-mass members with UV photometry from GALEX to map out the high-energy environment, and thus potential habitability of planets, revolving and evolving around mid-M dwarfs.

Results: In the HAZMAT I study of the evolution of early type (<M3) M dwarfs [5], it was shown that the median of GALEX near- and far-UV fluxes drops by a factor of 12 and 31, respectively, from 10 Myr to a few Gyr. We are extending this work to lower mass M dwarfs (M3-M6.5), which are especially valuable since they have closer-in habitable zones and remain active for even longer with greater flare variability. We find clear evidence that mid-M dwarfs to not follow the same evolutionary trend as early-Ms. Mid-Ms retain high levels of UV activity up to field ages, with only a factor of ~3 decrease in GALEX FUV and NUV flux between young and old stars. We also investigate the the evolution of the FUV/NUV ratio, which can affect the photochemistry of important biosignatures, and again find significant differences between early- and mid-Ms. While the FUV/NUV ratio is both spectral type and age-dependent for early-Ms, it remains constant for mid-Ms throughout their lifetimes.

E. S. and A. S. appreciate support from NASA/Habitable Worlds Grant NNX16AB62G.

References:

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