Science with the *Galaxy Evolution Explorer:* Starbursts and Stellar Populations

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Abstract. The *Galaxy Evolution Explorer* was launched in April 2003 and has returned wide field UV imagery in a far UV (1450A) and near UV (2800A) channel. We report on new results in the study of starbursts and stellar populations. Galex detects light from recently formed massive stars, and also from hot evolved older stars. Combining SDSS and Galex photometry gives a large multiwavelength dataset. Fitting the SEDs to population models in a statistical sense gives constraints on the starburst history of galaxies. Galex is remarkably sensitive to low levels of star formation, some of which is detected in the red sequence of ellipticals and bulges, even to $10^{-3} M_{\odot} yr^{-1}$. The UV rising flux is clearly seen in nearby bulges and elliptical, and is also detected to $z \sim 0.1$ in A2670. Constructing a sample of ellipticals selected from SDSS to lack emission lines to appear in all respects "old, red, and dead" we find no correlation between the UV rising flux and the Lick Mg_2 index, or with any other measurable parameter such as velocity dispersion; this finding contradicts some earlier studies.

1 Introduction

The *Galaxy Evolution Explorer* was launched in April 2003 and began its first science observations in July. This review addresses our modeling of the starburst history of the local Universe and our study of the ultraviolet rising flux in old stellar populations. GALEX is described in the accompanying article [1]. Images in the far-UV (FUV; λ_{eff} = 1516 Å, $\Delta\lambda$=268Å) and near UV (NUV; λ_{eff}=2267Å, $\Delta\lambda$=268Å) bandpasses are obtained simultaneously over a 1.2° diameter circular field. The detector is a photon counting MAMA detector and consequently there is no "red leak": only UV photons can trigger the photoelectrons. By selecting a grism instead of the default dichroic, low resolution spectroscopy in both bandpasses can be obtained for every object in the field.

Although UV light suffers from extinction, observations in the UV are powerful probes of star formation history because the far UV flux of a starburst declines relatively slowly compared to $H\alpha$ emission. Only the most massive O stars produce copious numbers of the $>$ 13.6eV photones needed to ionize hydrogen, while the UV continuum is produced by a wide range of stellar masses. While $H\alpha$ flux falls by an order of magnitude within few $\times 10^6$ yr, it takes 5×10^8 yr for the UV continuum to fall that much; GALEX may be most powerful in its study of these 'aged' starbursts. Given the importance of mergers and gas infall in driving the evolution of galaxies, the ultraviolet view of the Universe gives a powerful insight into galaxy evolution.

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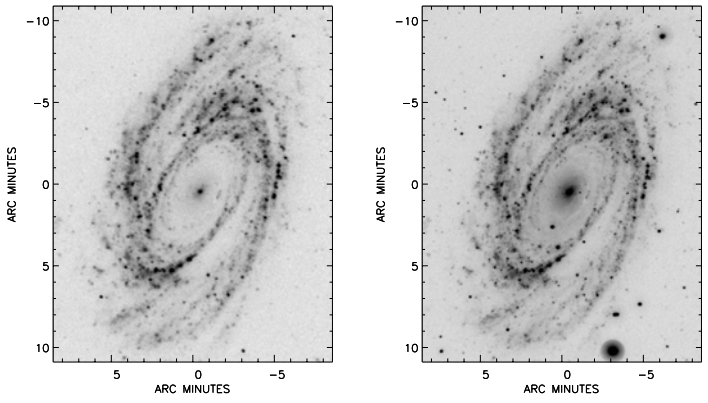

Fig. 1. M81 as imaged with *GALEX* showing the power of wide field UV imaging to delineate both the youngest and oldest stellar populations. The left panel illustrates the FUV (1200-1800A) image, and the right panel shows the NUV (1800-2800A) image– $12' \times 22'$, North up and East left. The star forming regions of the disk are detected clearly in both bands. The nuclear bulge is also detected, but the light of the bulge arises from evolved stars in > 10 Gyr old stars; the nuclear AGN may contribute a portion of the far UV light in the starlike nucleus. Halos around bright stars are artifacts of the detectors. The full 1.2° GALEX field of view is large enough to image both M81 and M82. Figure courtesy M. Seibert

Fig. 1 shows how GALEX views the Sb spiral galaxy M81. It is important to recall that while the light comprising the spiral arms is due to star formation, the nucleus and bulge shine by the light of > 10 Gyr old evolved stars (the UV rising flux). Note that the problem of the UV rising flux (UVX) in old stellar populations remains unsolved [2].

2 The Starburst History of the Local Universe

The Sloan Digital Sky Survey has proven crucial to using GALEX to interpret the properties of local starburst galaxies. SDSS gives optical counterparts and spectra. Our Medium Imaging Survey (MIS) data is an excellent complement with SDSS, reaching m(AB)$\sim$ 23.5 in one 1500 sec shadow "orbit". One of our major programs addresses the starburst history of the local Universe ($0 < z < 0.25$). We consider galaxies from the SDSS Main Galaxy Sample for which we also have GALEX MIS photometry and aim to constrain the star formation histories, stellar masses, and extinction in these galaxies. Following methods developed by Kauffmann et al. [4],[5] we generate a library of $> 10^4$ Monte Carlo realizations of different star formation histories based on the Bruzual-Charlot [6] models, including starbursts of varying strength and decay time spanning spanning $-1 < [Fe/H] < +0.3$. We fit the seven flux points (FUV, NUV, *ugriz*) and generate median likelihood estimates of burst mass fractions, the time since