Galaxy And Mass Assembly

# Why we need survey-style bulge-disk decomposition

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## 1. Introduction

Essentially all present-day giant galaxies can be described, to first order, by some combination of a disk and a spheroid (where ellipticals are considered single-component ‘bulge-only’ galaxies and are included in the term ‘spheroid’). These two components contain essentially all of the present-day stellar mass, and their kinematics, stellar populations, gas contents, etc., show them to be very different entities. Although the disk-spheroid dichotomy does not capture the morphological diversity of galaxies in its entirety, it nevertheless provides the most significant division known. This suggests that, fundamentally, it is these *components*, not the various *types,* of galaxies that are associated with distinct formation and evolutionary processes. Indeed, in virtually all theories of galaxy formation the fundamental differentiation is that between disks and spheroids. It is our aim to approach galaxy evolution by studying large samples of cleanly separated spheroids and disks.

Here, we provide a teaser by sketching some of the results of a large survey of nearby disks and spheroids (MGC), and briefly describing a new, much larger survey to be launched in 2008 (GAMA).

## 2. The luminosity functions of spheroids and disks

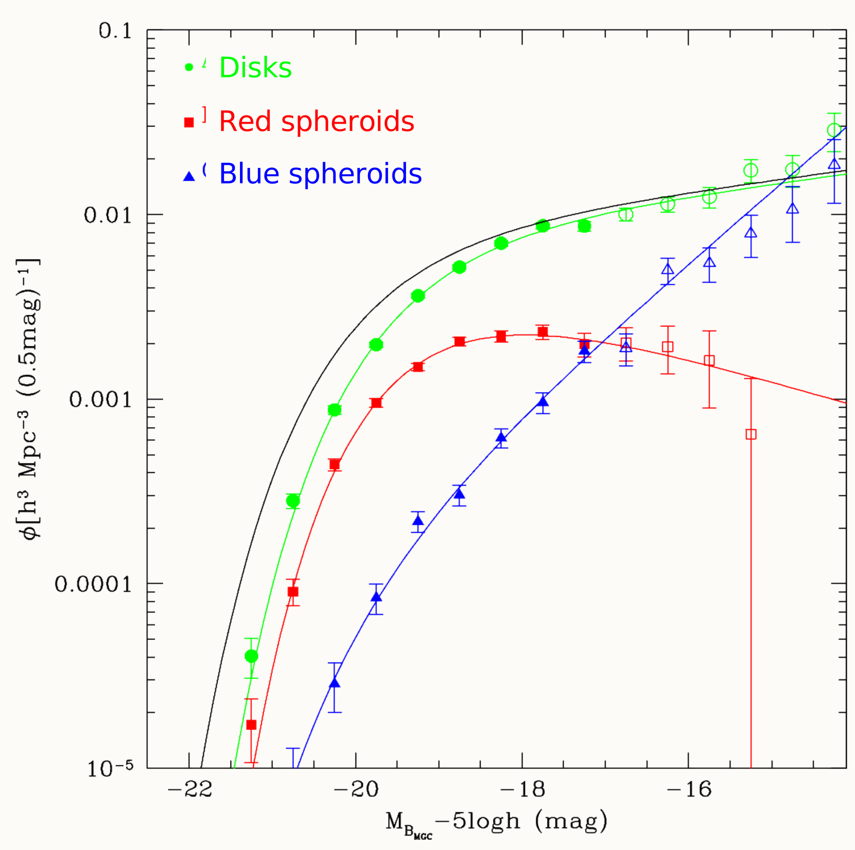
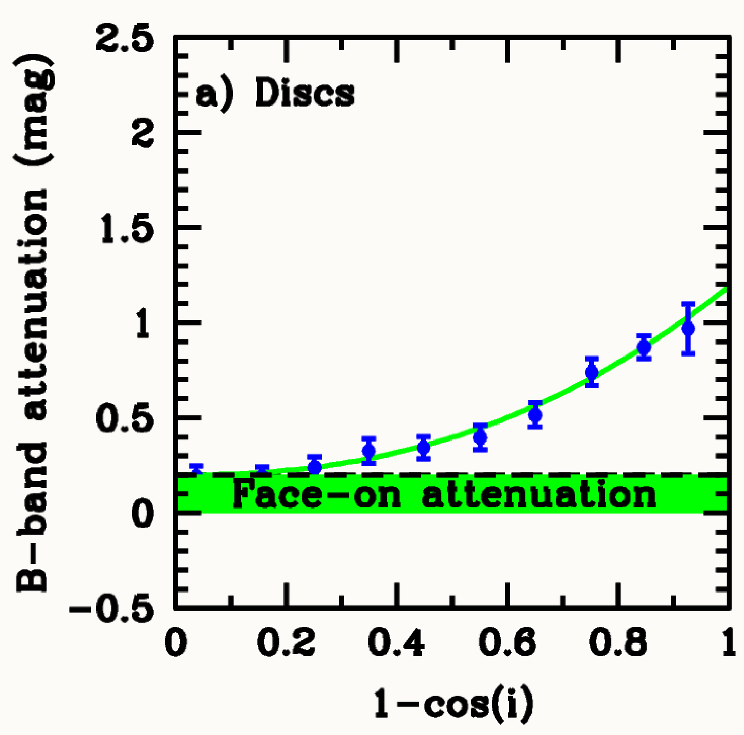
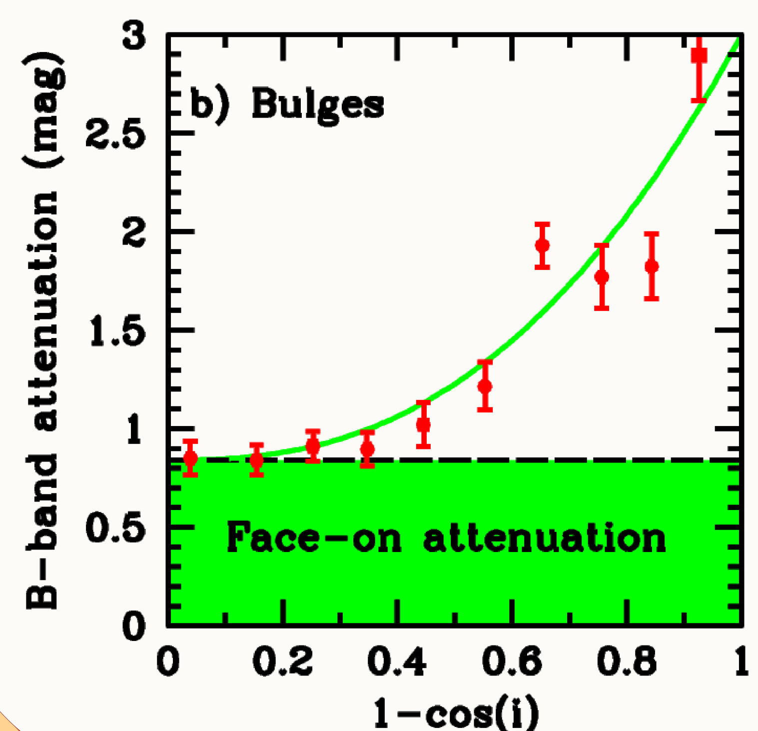



Fig. 1 shows the luminosity functions of disks and spheroids (=bulges + ellipticals) as derived from the bulge-disk decompositions of ~10k galaxies (Allen et al. 2006) with <z> = 0.12 drawn from the Millennium Galaxy Catalogue (MGC; Liske et al. 2003). We justify the lumping together of ellipticals and bulges by the similarity of the shapes of their individual luminosity functions. We find that disks contain (58±6)% of the total present-day stellar mass, while (red) spheroids represent (39 ± 6)% (Driver et al. 2007).

## 3. Dust in disks

It turned out, however, that the above luminosity functions cannot be taken at face value. Dust in the disk attenuates the starlight from both the disk itself as well as that from the bulge, depending on disk inclination. Measuring the luminosity functions' M* values as a function of disk inclination directly yields the attenuation-inclination relations for both disks and bulges as shown in these figures (Driver et al. 2007).

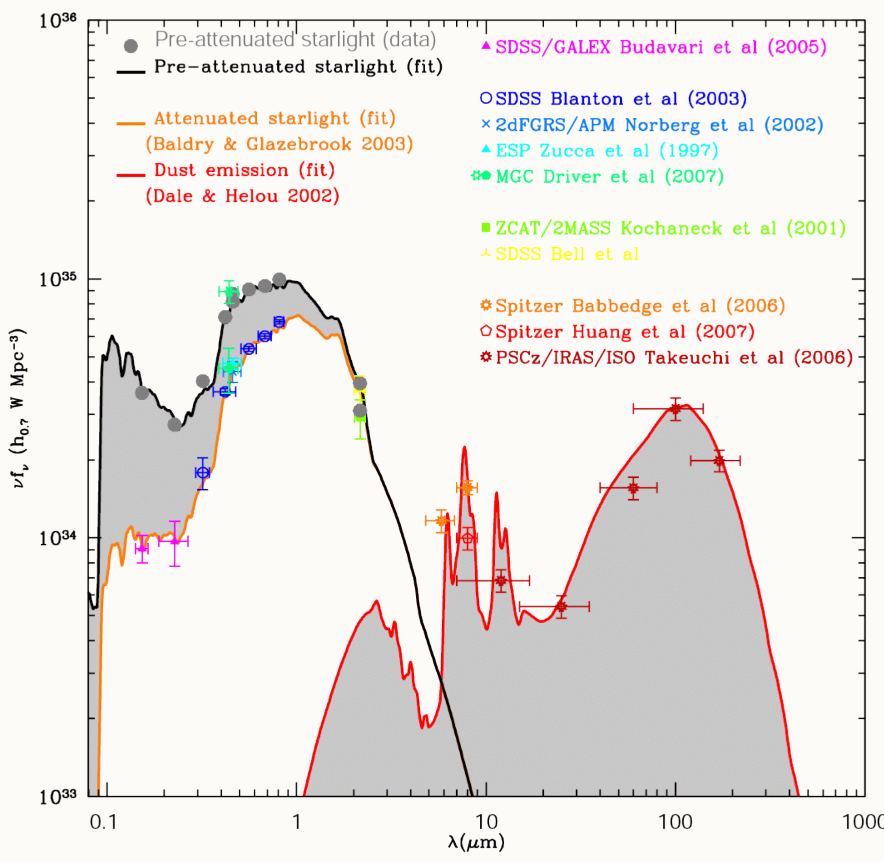



The multi-component dust model of Popescu et al. (2000) is capable of re-producing both of these relations after adjustment of only a single parameter (green lines). This model then also provides the residual attenuation experienced by face-on systems (marked green in Fig. 2). Applying the full dust correction increases the total stellar mass in disks by 16% while the stellar mass in bulges is increased by 38%.

## 4. The cosmic SED corrected for dust

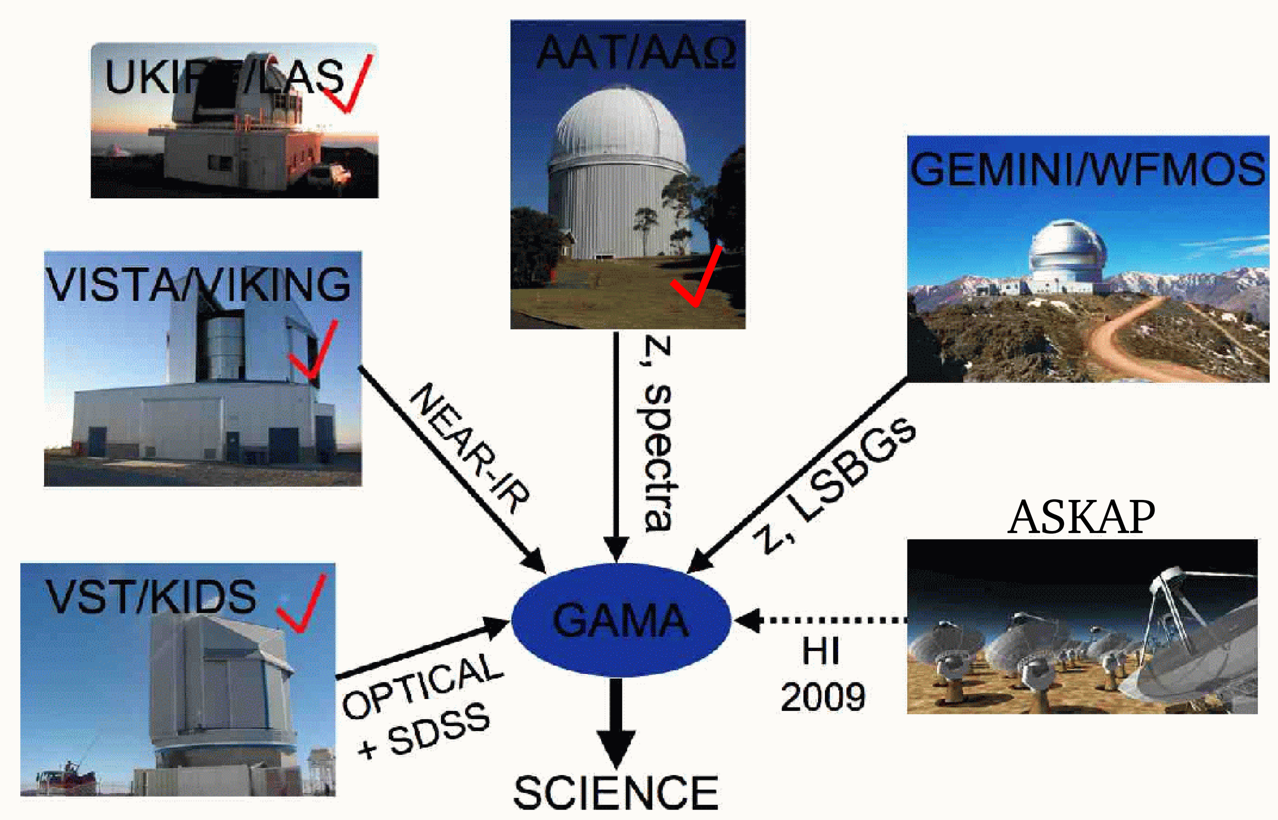
Using our dust corrections we can obtain the *B*-band luminosity density intrinsically produced by stars directly from the MGC. Using our calibrated dust model we can also compute the photon escape fractions of galaxies at any other wavelength, enabling us to correct other luminosity density measurements. In Fig. 3 we show the cosmic SED of the nearby Universe before (orange) and after (black) correction for the effects of dust. The energy absorbed by the dust in the UV-optical (left grey area) is re-radiated in the far-IR. If the dust model is correct then the absorbed energy should not exceed the total far-IR output from nearby galaxies (right grey area). In fact, we find that the two are equal to within the errors, leaving little room for additional sources of dust heating.



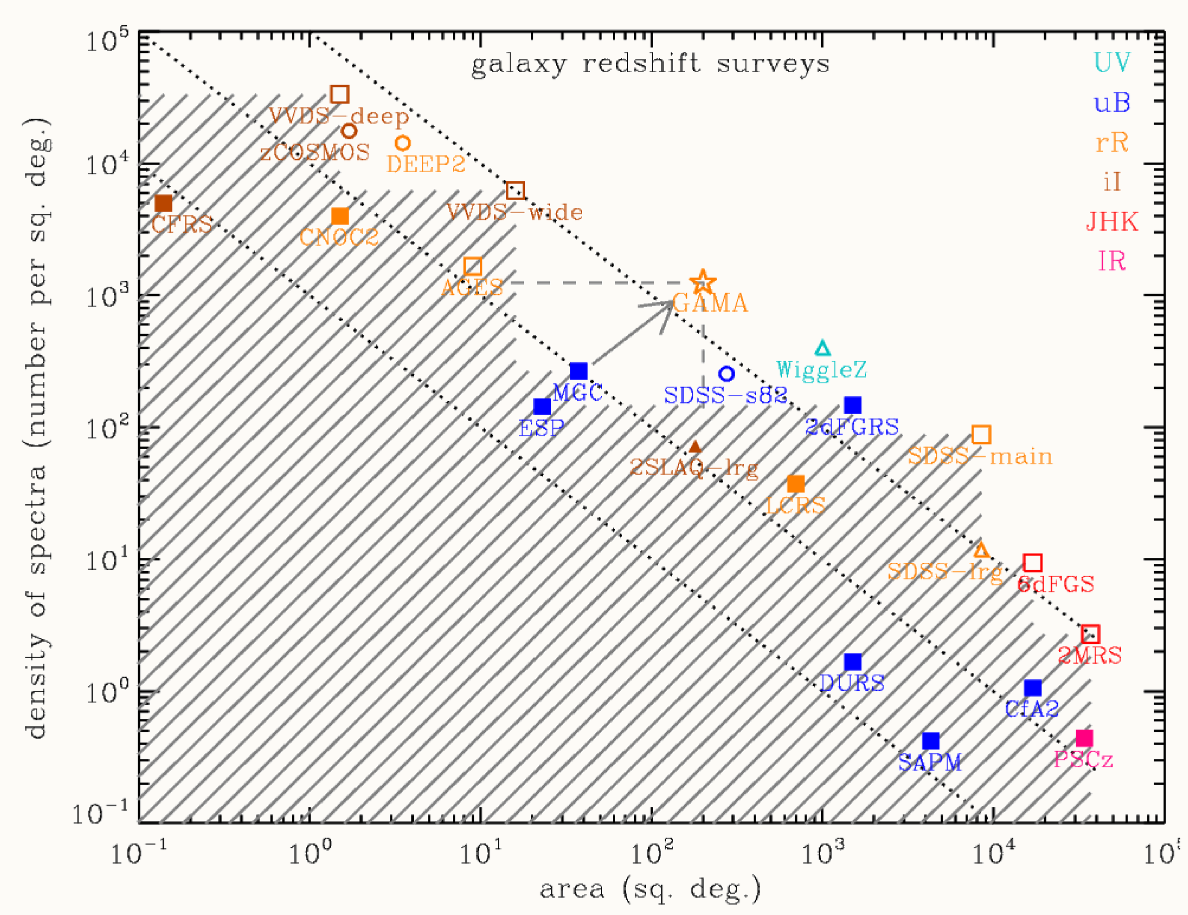

## 5. Galaxy and Mass Assembly

www.eso.org/~jliske/gama

GAMA is a project to exploit the latest generation of ground-based wide-field survey facilities to study galaxy formation and evolution. GAMA will bring together data from the AAT, the VST, VISTA and ASKAP in order to construct a state-of-the-art database of ~250,000 galaxies in the local Universe over a 200 deg$^2$ region of sky.




The main objective of GAMA is to study structure on kpc to Mpc scales, including a measurement of the group halo mass function and the environment-dependent merger rate. However, the deep, high resolution optical and near-IR imaging from VST and VISTA (through KIDS and VIKING, approved ESO Public Surveys) will also allow the bulge-disk decomposition of ~100k galaxies. Recently, GAMA has been awarded 66 nights on AAOmega to commence the spectroscopic survey in early 2008 (until 2010).




This figure compares existing (filled symbols) and planned (open) galaxy surveys. GAMA will fill the obvious gap between the shallow near-all-sky surveys and the deep pencil beam surveys.