1 The Concept

2 The Model

The model is a simple disk+bulge galaxy, with the following parameters:

- R_{disk}, disk half-light radius
- F_{disk}, disk flux
- g_1^{disk}, disk intrinsic alignment
- g_2^{disk}, disk intrinsic alignment
- R_{bulge}, bulge half-light radius
- F_{bulge}, bulge flux
- g_1^{bulge}, bulge intrinsic alignment
- g_2^{bulge}, bulge intrinsic alignment
- g_1^{shear}, lensing shear
- g_2^{shear}, lensing shear
- mu, lensing magnification (this parameter is optional)

g_1^{disk}, g_2^{disk}, g_1^{bulge}, and g_2^{shear} all model intrinsic alignment, but are parameterized like reduced shear in weak lensing formalism because it's easy to apply with galsim. The bulge is drawn with a De Vaucouleurs profile, and the disk is drawn with an $n = 1$ Sérsic profile. The image is convolved with a $\sigma = 0.25$ arcsecond Gaussian PSF.

2.1 The color "prior"

One important aspect of the model is that the disk and bulge can optionally be drawn with different $r - g$ colors such that $(g-r)_{disk} \approx (g-r)_{bulge} - 2$. (n.b. I have to check to ensure that these magnitudes are being calculated correctly.) We have been treating the color difference between the disk and bulge like a prior in that we are interested in how much switching it on affects our fits, but our current treatment presumes perfect knowledge of the color difference between disk and bulge.

3 Priors

Besides the "prior" on disk and bulge color, we are applying two empirically motivated priors.

3.1 The Kormendy Relation

The Kormendy relation essentially a projection of the fundamental plane. It states that for elliptical galaxies, $R_e \propto \langle I \rangle^{0.83}$. We take, as a prior on the bulge radius and flux, a distribution that is normally distributed around the line in $\log I$ - $\log R$ space defined by the Kormendy relation.

3.2 Orientation Prior

Assuming that the disk and bulge are oriented randomly in 3D space, they take on a non-uniform distribution of inclination angles. By assuming a uniform distribution of 3D orientations, we arrive at a prior proportional to $g = \sqrt{g_1^2 + g_2^2}$ for the disk and bulge.

4 Doing fits

At first, we tried using a simple custom quadratic MLM estimator (What's the technical terminology?). Due to difficulties in fitting parameters with complex constraints, we switched to MCMC fitting with emcee.