Bayesian hierarchial modelling outline

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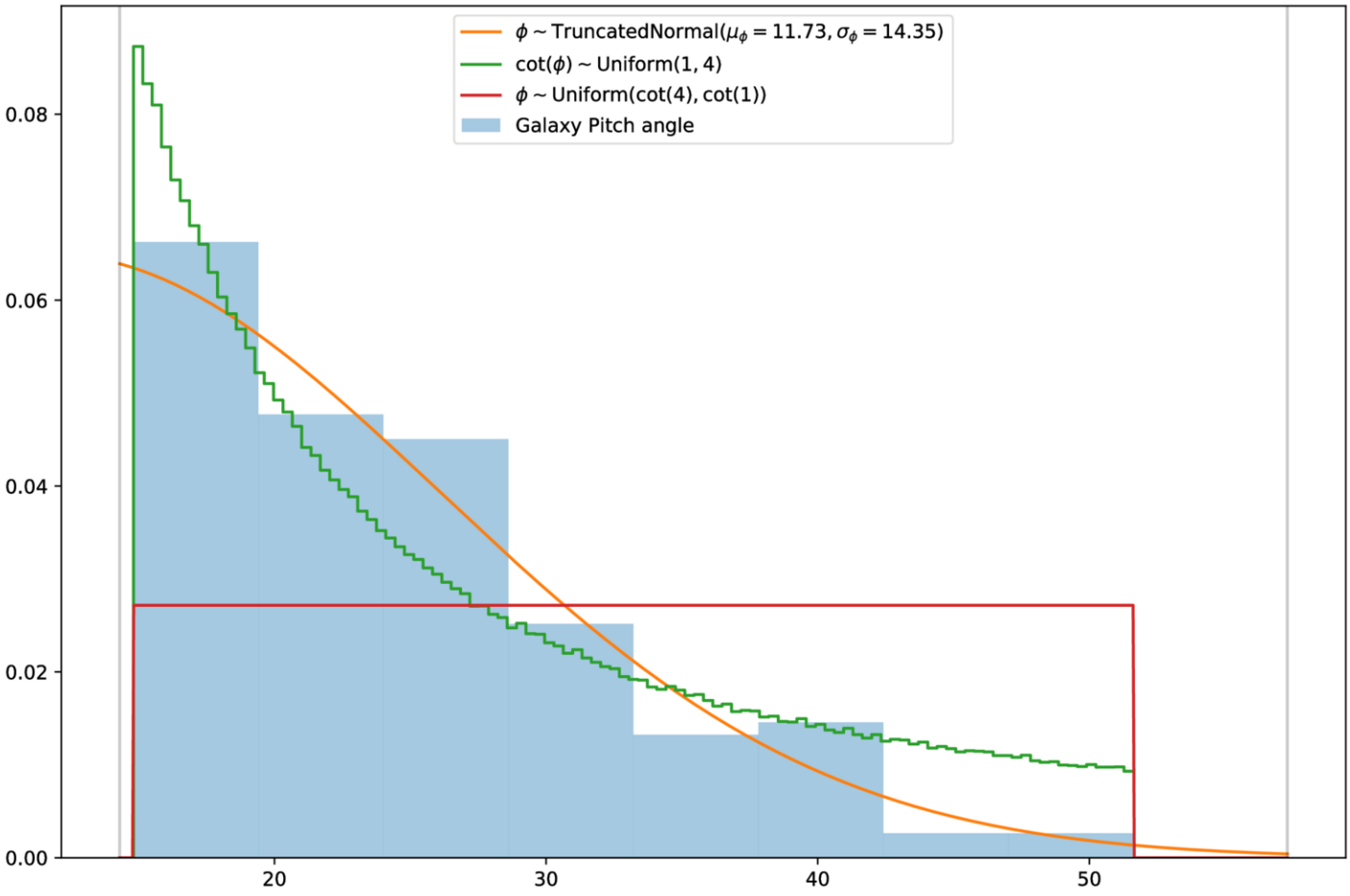
Uniformity in $\cot \phi$

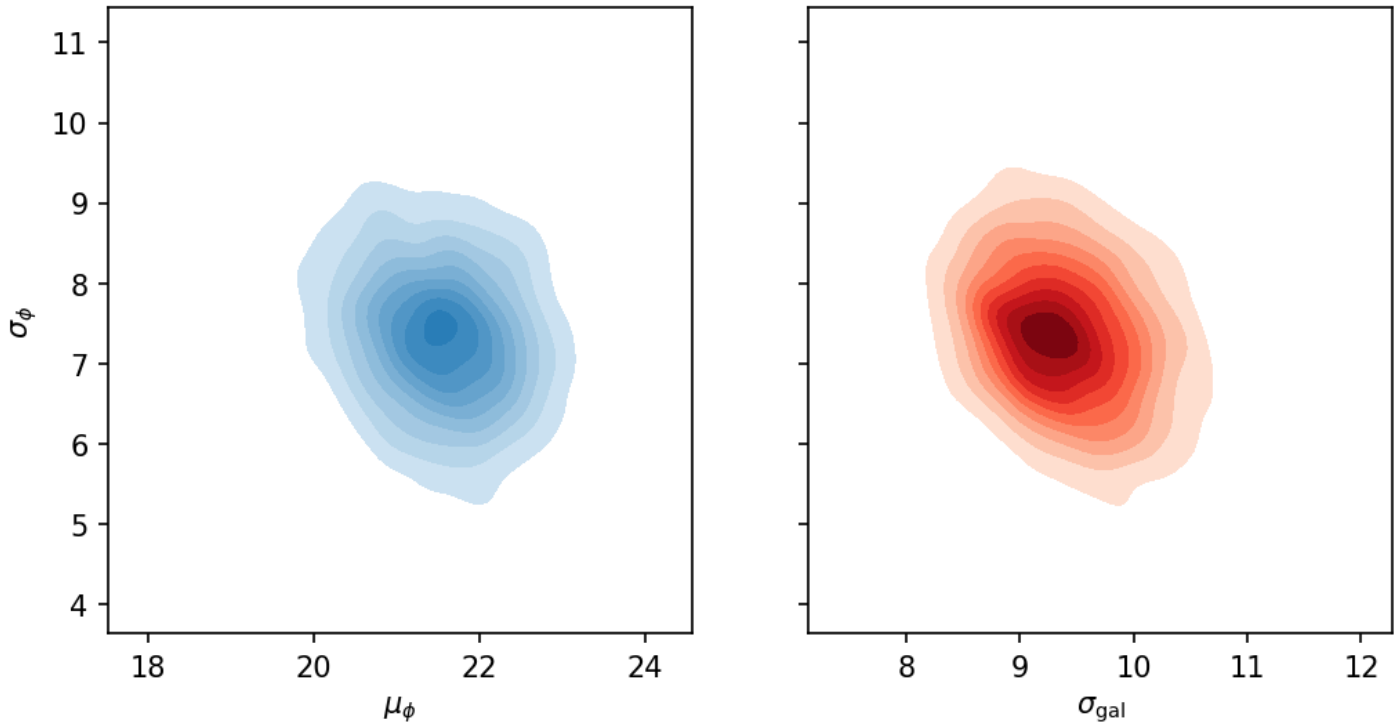
We do not see uniformity in $\cot \phi$, with a Kolmogrov-Smirnov test on a selection of galaxy length-weighted pitch angles between $\cot(4)$ and $\cot(1)$ returning a probability of 0.011. A truncated normal distribution on the same sample recieved a probability of 0.9626.



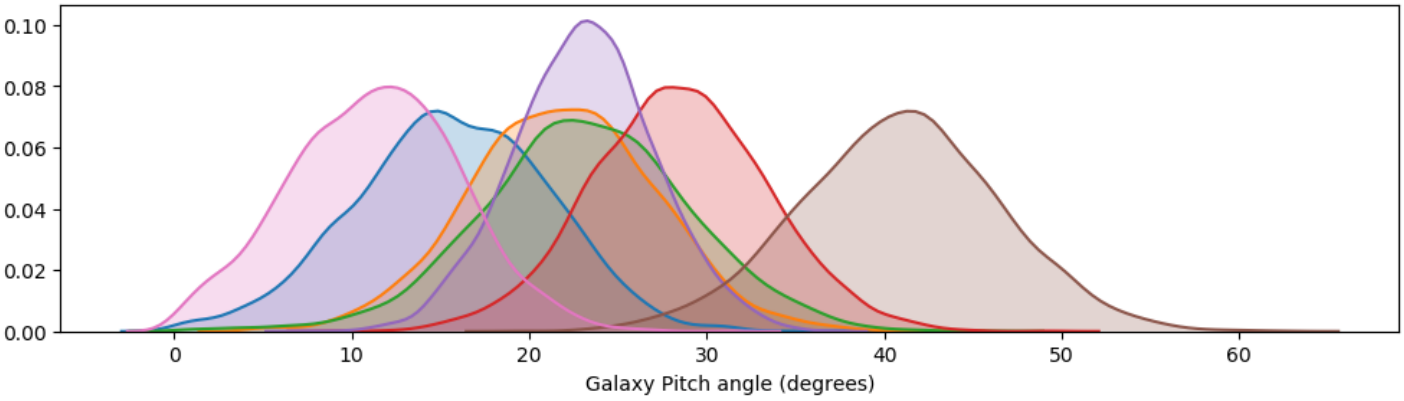
Results from Hierarchical model

Global Results

We find good constraints on the model's hyperparameters (the global mean and variance of galaxy pitch angles)



However, the pitch angle for an individual galaxy is not well constrained, as demonstrated by the large spread in posteriors:



Comparisons to Morphology

We see no correlation between galaxy pitch angle (obtained using the mean value of the posterior for each galaxy) and Galaxy Zoo 2's p_{bar} or p_{bulge}, with Pearson correlation coefficients of -0.004 and 0.012 respectively.

	bar fraction	bulge fraction	phi	sd	n
bar fraction	1	0.0714424	-0.00382568	-0.135374	0.166472
bulge fraction	0.0714424	1	0.0114804	-0.0287477	0.0424388
phi	-0.00382568	0.0114804	1	-0.181082	0.128063
sd	-0.135374	-0.0287477	-0.181082	1	-0.775143
n	0.166472	0.0424388	0.128063	-0.775143	1

Comparison to Stellar mass

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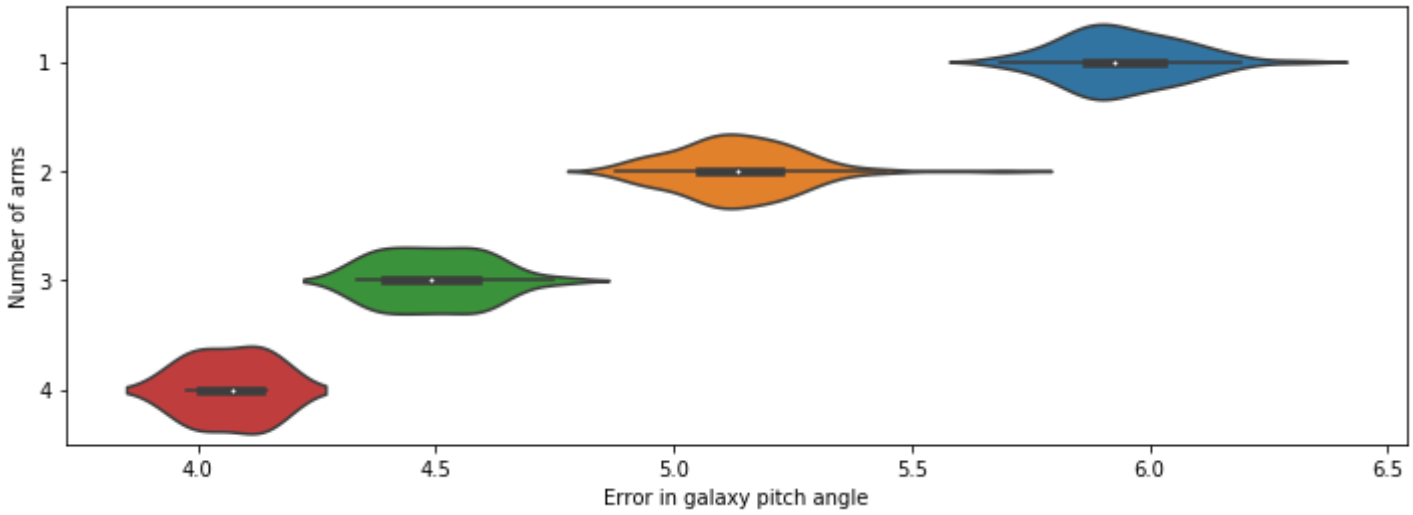
Discussion

It is commonly observed that spiral arms within a galaxy vary significantly in their pitch angle, hence the large variance in our galaxy pitch angle posteriors (as mentioned above). This is in a large part due to the limitation of only being able to measure a small number of arms for an individual galaxy - we see that variance in the galaxy pitch angle estimate drops as the number of arms increases:



This is potentially an indication that quoting a single “pitch angle” for a galaxy is highly subject to the number of spiral arms indentified by the method used, and highlights the difficulty in quantifying spiral tightness .