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Rejoinder

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We thank the discussants David Poole, Pritam Ranjan, Earl Lawrence, David Higdon, and David van Dyk for their commentaries on our paper, and for raising many interesting points for discussion, ranging from practical questions related to the implementation of our methodology to fundamental issues of the role and purpose of Bayesian analysis in science. We respond to each of the discussants as follows.

1 Response to David Poole

Poole agrees that often a fully Bayesian analysis for computer models can be difficult and that simplifications such as a the Bayes Linear approach described in our paper are often helpful. He then goes on to discuss another technique known as Bayesian Melding, whereby prior information regarding both the inputs and outputs of the computer model function are amalgamated into a single prior over x. He remarks that such an approach would most likely not be suitable for use on the Galform model due to computational reasons (as melding normally requires complete knowledge of the function $f(x)$). We would state that while it is possible that these computational issues could be resolved by the appropriate use of emulators within the melding calculation, there are unresolved issues about the validity of the melding calculations, consideration of which would have taken us beyond the remit of the study.

Poole then asks "what one loses by doing a Bayes Linear approach?" compared to a hypothetical fully Bayesian analysis. We respond that (as we discuss toward the end of section 3.3), if a fully Bayesian approach were feasible, in that we were prepared to spend the considerable amount of extra time and effort to construct and document realistic joint priors over the input space, the model discrepancy and all other quantities of interest, and if such priors contained extra physical information that was defensible to other cosmology experts in the field, then we would be able to perform a more detailed fully Bayesian inference which would reflect the additional physical information contained within the prior specification.

However, an elicitation for such complex objects would present substantial conceptual and practical difficulty, and hence we perform a Bayes Linear analysis which may be viewed as a pragmatic compromise to such an arduous analysis, as it only requires expert assessments over means and variances. Were we confident enough to obtain more detailed expert judgements, then we can incorporate these within the Bayes Linear framework also (by writing down covariances of more complex objects e.g. higher order quantities (Goldstein and Wooff (2007))). We choose the Bayes Linear method to

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