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# Rejoinder

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We would like to thank Professor Loh and Professor Gelman for their thoughtful comments. Some of the detailed points that the discussants bring up remind us to emphasize that in many regards our article offers only an overview of the scientific questions we aim to address and of the methods, models, and algorithms that we employ. Some technical details are omitted in the interest of readability and space constraints. We hope that readers interested in the problems we discuss will consider reading the several related articles cited here and in the main article.

We have attempted to group Loh's and Gelman's comments into two broad categories: model checking, which we address primarily in the context of our method for DEM reconstruction, and issues specific to our image reconstruction. We discuss these two categories in turn.

## 1 Model Checking

Model diagnostics are an important part of any model-based statistical analysis, and especially so in the context of complex models of the sort described in our article. Ideally such diagnostics should investigate both internal consistency and objective outside evaluation of the results. Outside evaluations might compare predictions under the model with data not used to fit the model. Examples include cross-validation and the use of comparable data that is available from other sources. Our comparison of the X-ray image reconstruction of NGC 6240 with the optical image produced by the *Hubble Space Telescope* in Figure 9 illustrates this strategy and offers confirmation of our model, algorithms, and methodology. In a Bayesian data analysis, internal consistency is often investigated by comparing the observed data with the posterior predictive distribution. Gelman et al. (1996) describe how one can quantify and assess discrepancies between the two. Such posterior predictive checks are a standard component of our methodology for the parameterized spectral analysis described in Section 3.3. Although we did not describe model checking in the context of spectral analysis in the current article, interested readers are referred to van Dyk and Kang (2004) and van Dyk and Park (2004). These articles show how the posterior predictive distribution can be used to assess the magnitude of the inherently heteroskedastic residuals under Poisson models.

The models for image reconstruction and DEM reconstruction described in Sections 3.4 and 3.5 rely more heavily on blurring matrices (the point spread function and the emissivity matrix, respectively) than does the parametric spectral model. Thus, we expect our results to be more sensitive to misspecification of these matrices. To explore this, we generated several replicate data sets from the posterior predictive distribution

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