

Challenge: Fast Bayesian Parameter Estimation

A single EIS raster could contain
 $100 \times 400 \times 20 = 8 \times 10^5$
 line profiles to fit!

Model:

$$I_i(\mu, \sigma, I_T, \beta) = \frac{I_T \Delta}{\sigma \sqrt{2\pi}} \exp \left[-\frac{(\lambda_i - \mu)^2}{2\sigma^2} \right] + \beta$$

Likelihood:

$$p(n_i | I_i) = \frac{(I_i)^{n_i}}{n_i!} e^{-I_i}$$

Posterior:

$$P(\mathcal{M} | \mathcal{D}) = \frac{P(\mathcal{D} | \mathcal{M})}{P(\mathcal{D})} P(\mathcal{M}) \propto \prod_{i=1}^M p(n_i | I_i) p_\mu(\mu) p_\sigma(\sigma)$$

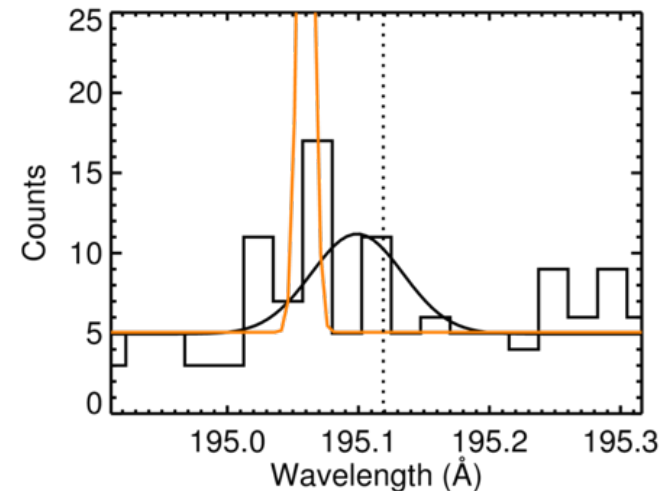
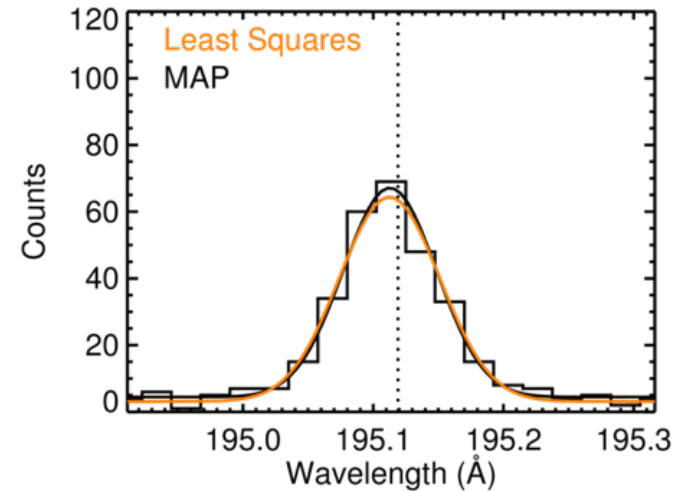
Log Posterior:

$$\mathcal{L} = \sum_{i=1}^M (n_i \ln I_i - I_i) + \ln p_\mu(\mu) + \ln p_\sigma(\sigma)$$

MH: Too Slow!

MAP: Much Faster!

$$\frac{\partial \mathcal{L}}{\partial p_k} = 0$$



But What are the Parameter Errors?

$$\sigma_p^2 = \text{diag}([\mathbf{J}^T \mathbf{W} \mathbf{J}]^{-1}) \quad ?$$

