Update: New Fast Approximate Method

- Use Laplace's method to approximate

$$p(y_k|A_m) = \int p(y_k|\theta_k, A_m)\, p(\theta_k)\, d\theta_k$$

  for the kth pixel and the mth atomic data curve

- From these, we can directly compute:
  - Separate analyses: $p(A_m|y_k) = p(y_k|A_m)/\sum_i p(y_k|A_i)$
  - Joint analysis: $p(A_m|y_1, \ldots, y_K) = \prod_k p(y_k|A_m)/\sum_i \prod_k p(y_k|A_i)$

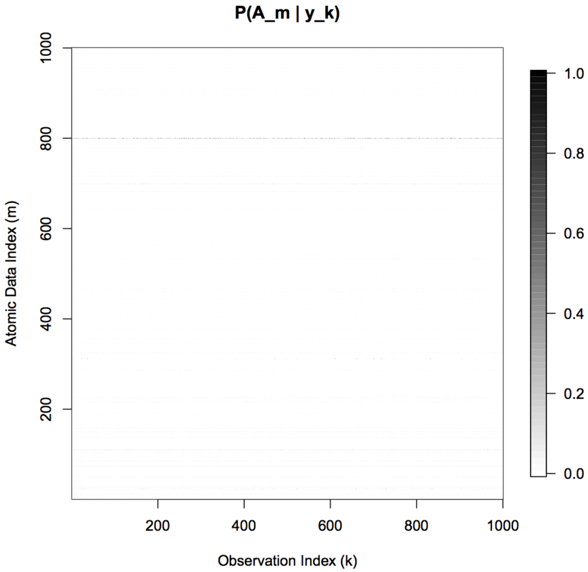
- Use Gaussian approximations for posterior distributions $p(\theta_k|y_k, A_m)$

- Computing time for 1000 pixels: 6.5 hours

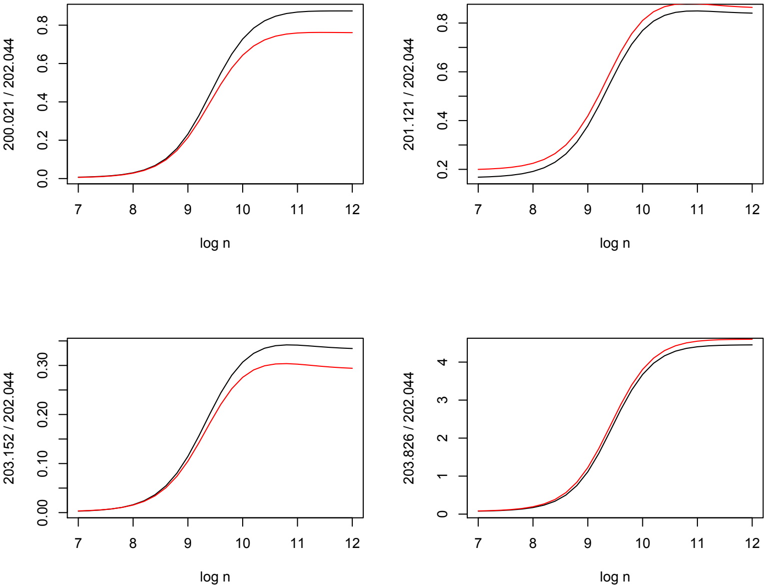
Single Pixel Results: $p(A_m|y_{661})$

m	HMC (Stan)	Laplace approx
312	0.825	0.831
23	0.135	0.140
699	0.030	0.021
others	< 0.0087	< 0.0083

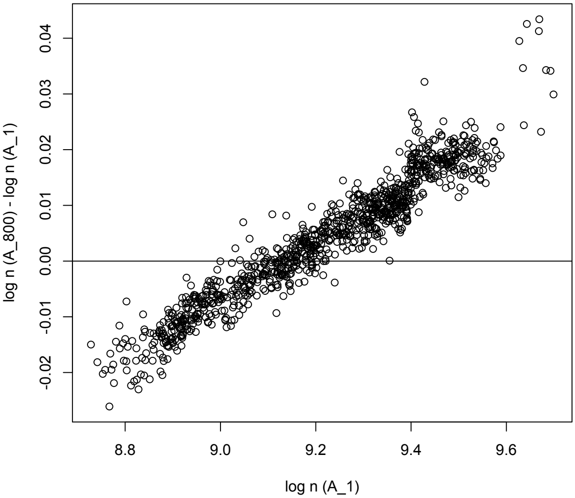
Results: Separate Analyses



A_1 vs A_{800}


200.021 / 202.044
0.0
0.2
0.4
0.6
0.8
7
8
9
10
11
12
log n
201.121 / 202.044
0.2
0.4
0.6
0.8
7
8
9
10
11
12
log n
203.152 / 202.044
0.00
0.10
0.20
0.30
7
8
9
10
11
12
log n
203.826 / 202.044
0
1
2
3
4
7
8
9
10
11
12
log n

Results: $\log n$ for A_{800} and A_1



Results: Entropy vs log n

- Let $p_{mk} = p(A_m|y_k)$
- $\text{entropy}_k = -\sum_m p_{mk} \log p_{mk}$
- Higher entropy $\rightarrow$ less info about A