**Motivation:**
Representing distributions more compactly and often more quickly than a bag of samples from MCMC

Answer is obvious
Could optimize likelihood of dark matter position
Faster than MCMC!
Want some way to report error bars though.

Usually dark matter locations *not* obvious...
Summarizing beliefs?
— Average/mean sample?
— Most probable sample?
— Cluster?

I have several answers. But still a research question. For this course:
Some complicated distributions most easily represented by samples
Then predict under each possible world

Lower dimensional example

A posterior over some quantity $\alpha$ from http://iopscience.iop.org/0004-637X/711/2/1157/
Might summarize with the vertical credible intervals containing 95% and 99% of probability mass.
Mean, mode, median?

Weirder example

Red vertical bar is the mean (not a probable point, note log scale)
Median? Mode?

from http://link.springer.com/chapter/10.1007%2F11736790_3
Gaussian approximations

Finite parameter vector $\theta$

$P(\theta|\text{lots of data})$ often nearly Gaussian around the mode

Need to identify which Gaussian it is: mean, covariance