Class 13: inherited code, parameters & the blob pt 2

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Presentations

- Schedule up soon
- (Turn in HW 3 & survey)
- Starting Thursday next week

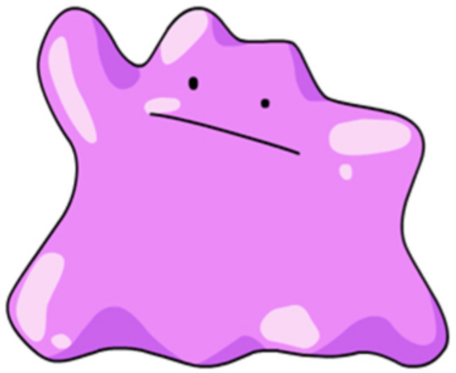
Next few days:

Th: Blind analyses, with David Hertzog

T: Plots as a language

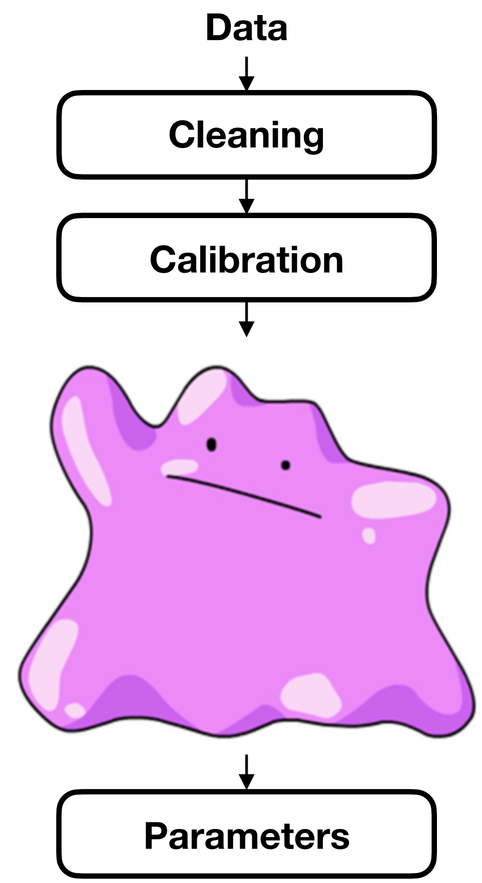
Th: First batch of presentations

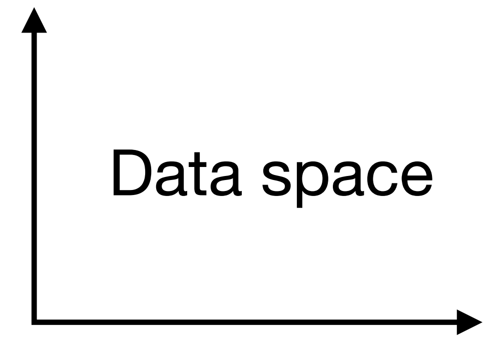
Inherited code & parameters (blob pt 2)

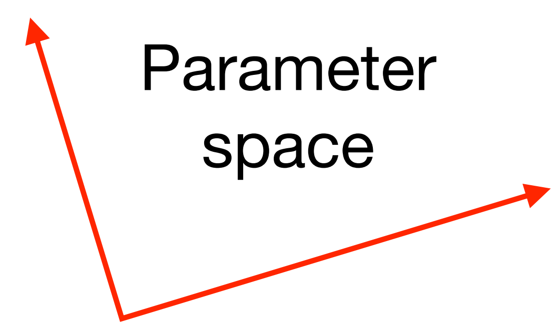


Parameters as measurement

- New measurement ‘space’
- Horrible, non-linear, but treat as a new measurement



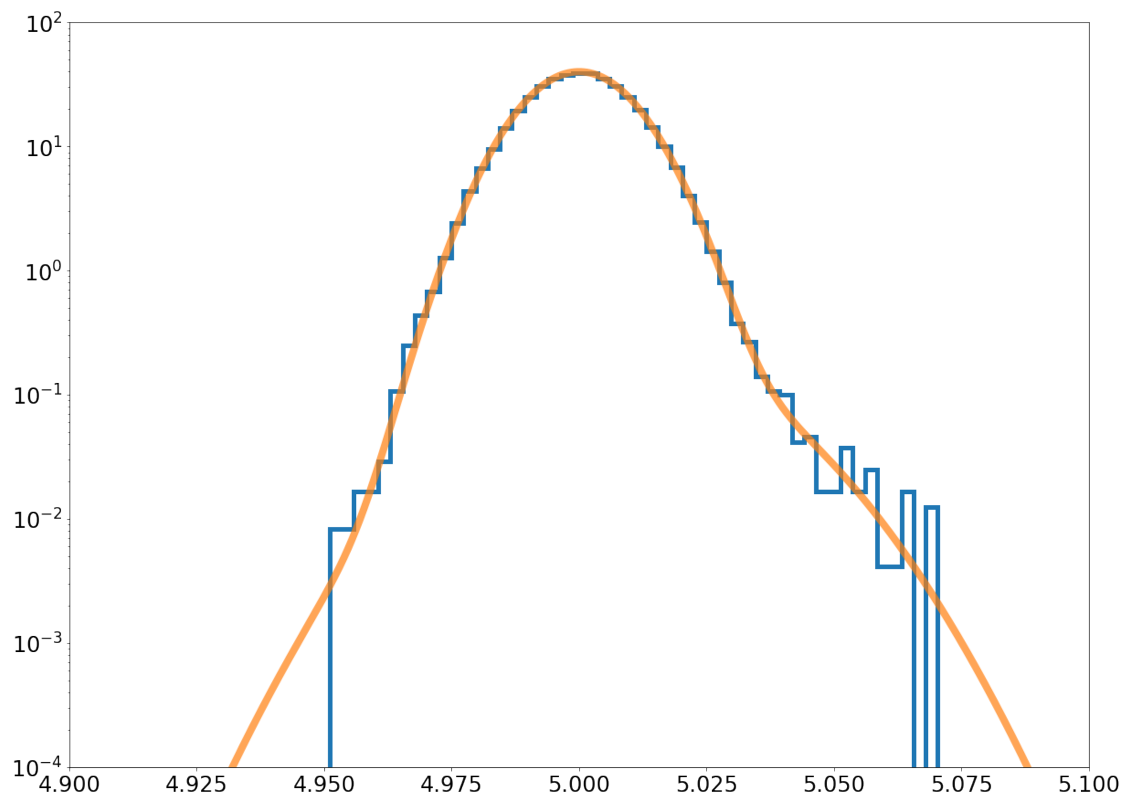




Background & parameters

- Often have 1 'signal' parameter & a few 'nuisance' parameters

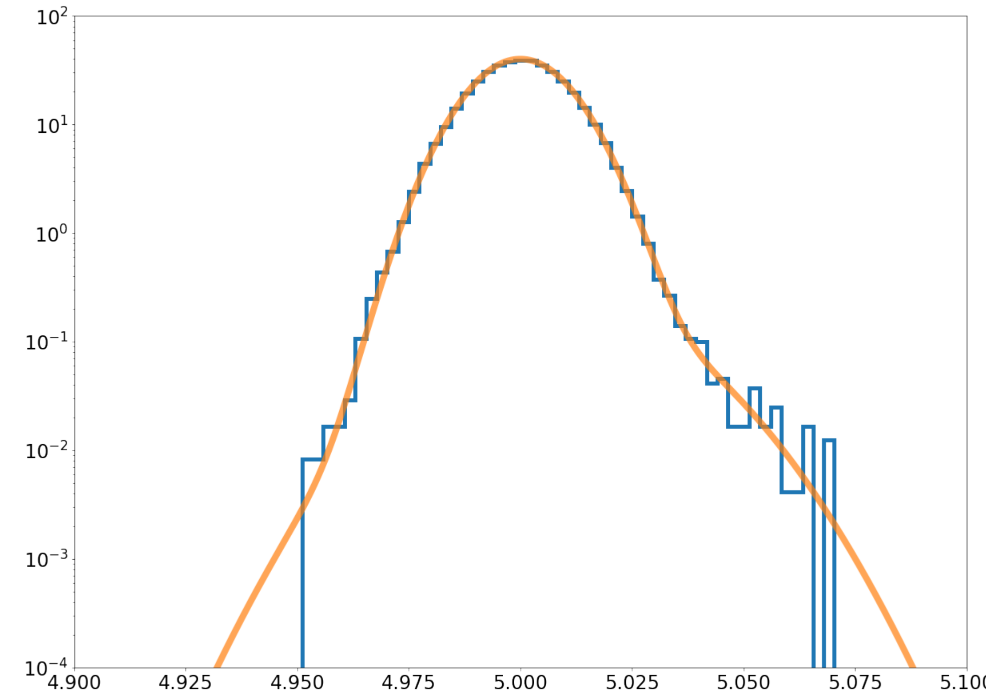
- Try giving analysis block many data examples with no signal, and histogram signal



Background & parameters

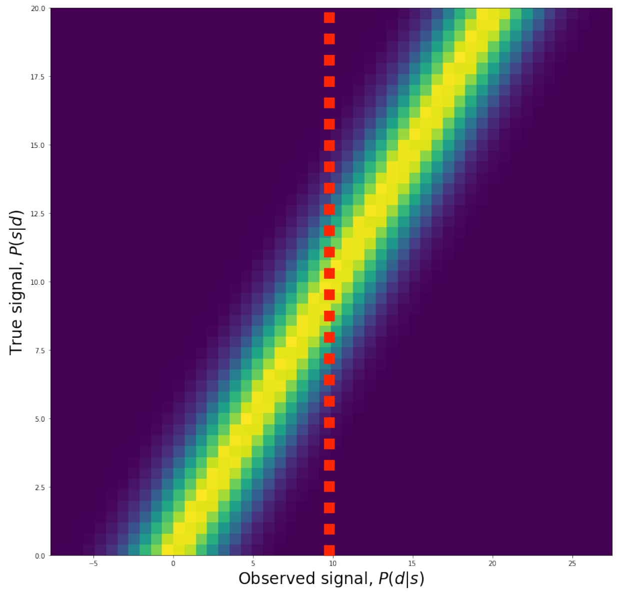
Zero signal examples can be

- Signal-free data
- MC simulation (signal turned off)



Statistics & Parameters

- Just treat like a measurement
- Background distribution for null hypothesis (σ significance)
- Confidence intervals
- All just like 'measurement' was the parameter*



*Common problems with parameters

Problems with parameters

- Implicit priors
- Local minima
- Degeneracy, catastrophic errors, chaos

Implicit priors

- Nuisance parameters (n_i)

$$P(s\,|\,d) = \frac{P(d\,|\,s)\,P(s)}{P(d)}$$

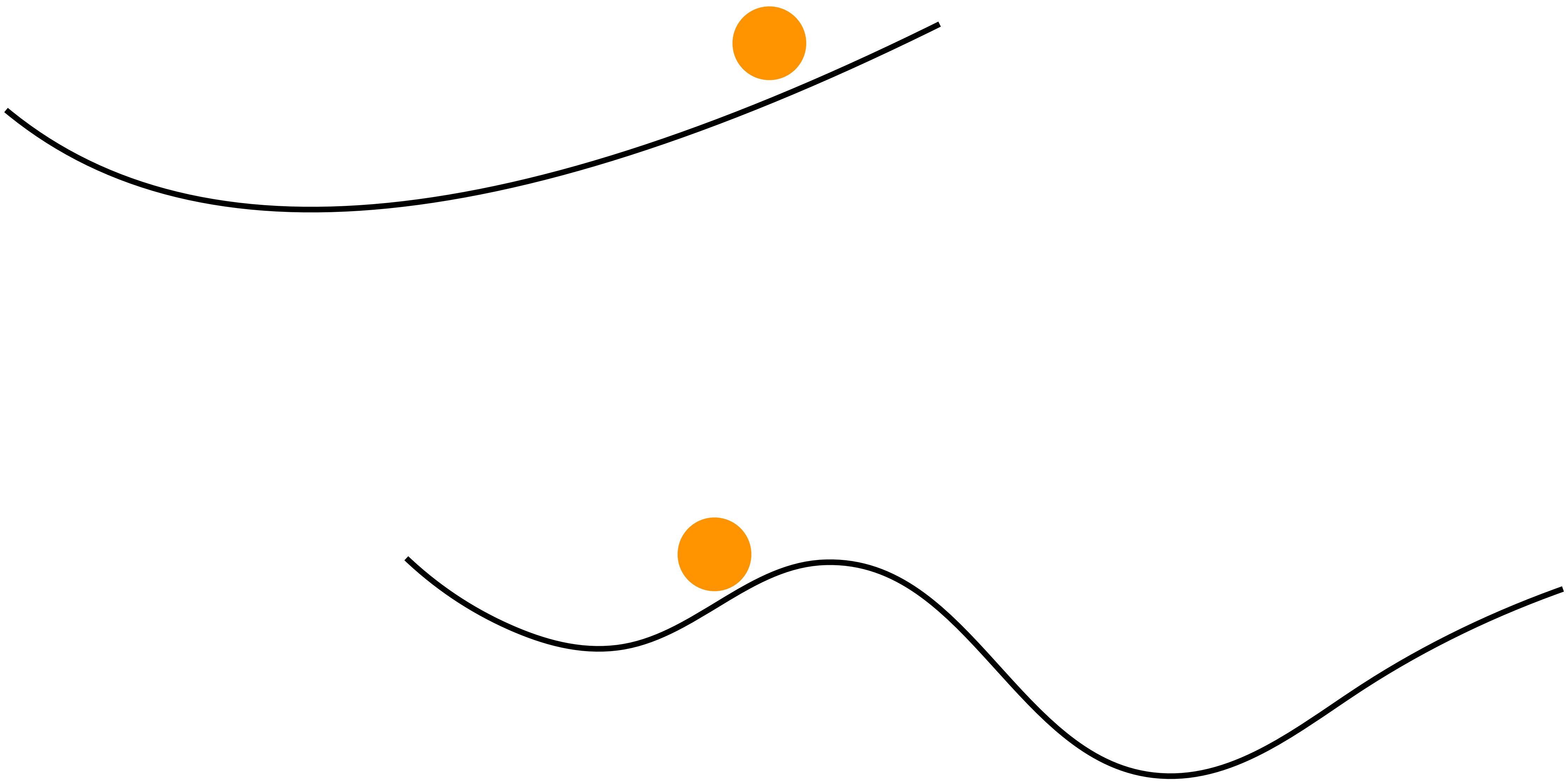
$$P(\{s, n_1, n_2, \ldots\}\,|\,d) = \frac{P(d\,|\,\{s, n_1, n_2, \ldots\})\ P(s)\ P(n_1)\ P(n_2)\ldots}{P(d)}$$

Implicit priors

- Does the real data have the same occurrence distribution $P(n_i)$ as your signal-free data or MC?
  - Data example(s)
  - MC example(s)

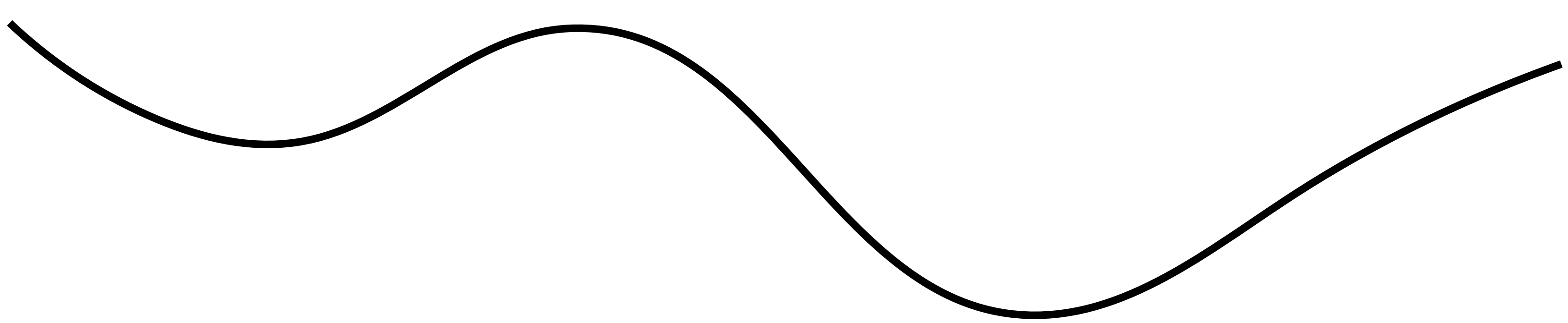
$$P(\{s, n_1, n_2, \ldots\} \,|\, d) = \frac{P(d \,|\, \{s, n_1, n_2, \ldots\})\ P(s)\ P(n_1)\ P(n_2)\ldots}{P(d)}$$

Local minima



Local minima

- Simulated annealing
- Genetic algorithms
- Markov Chain Monte Carlo sampling

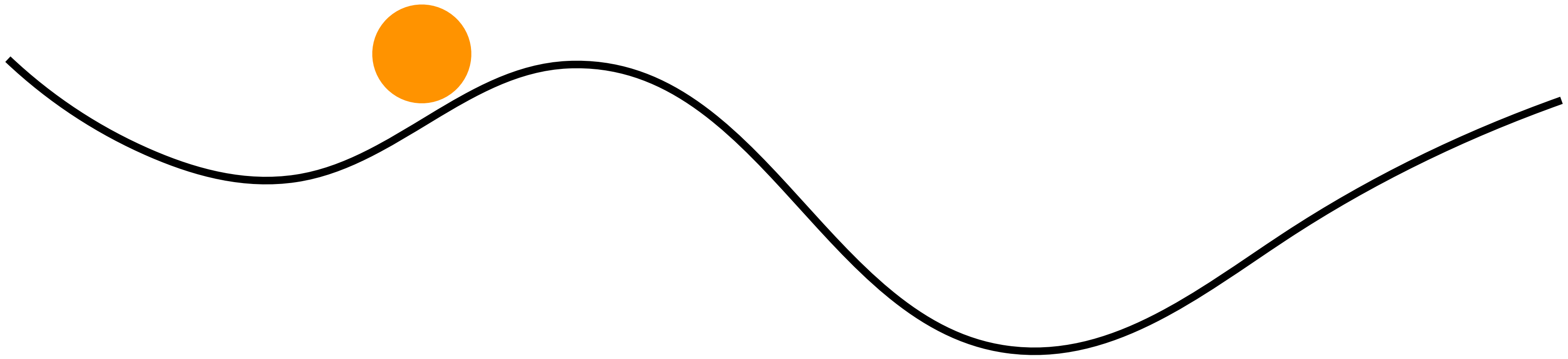


Local minima

Lots of options

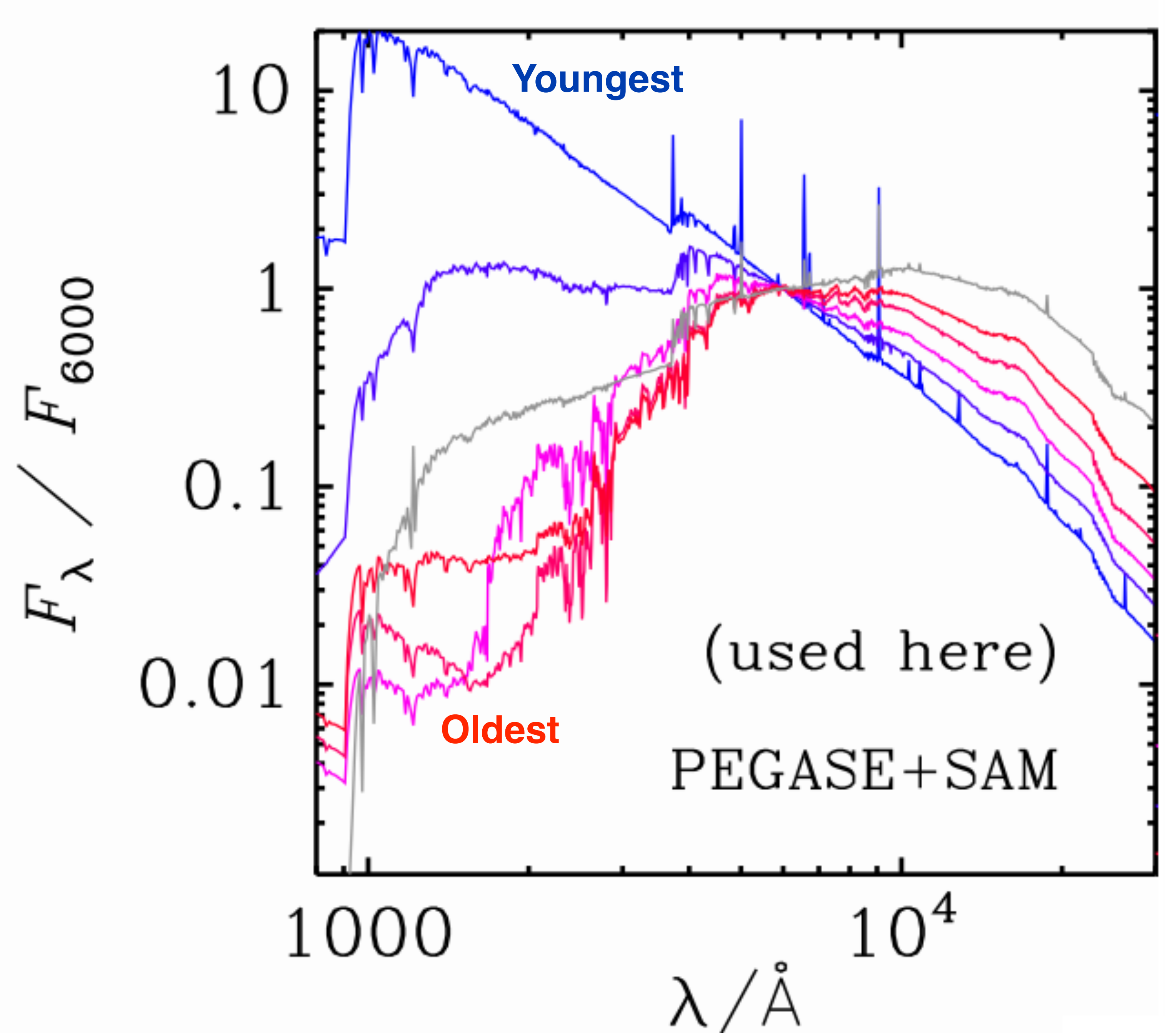
Make sure you actually need them…

- Related to degeneracies (telling you something)
- Adding more (or different) information can sometimes remove local minima

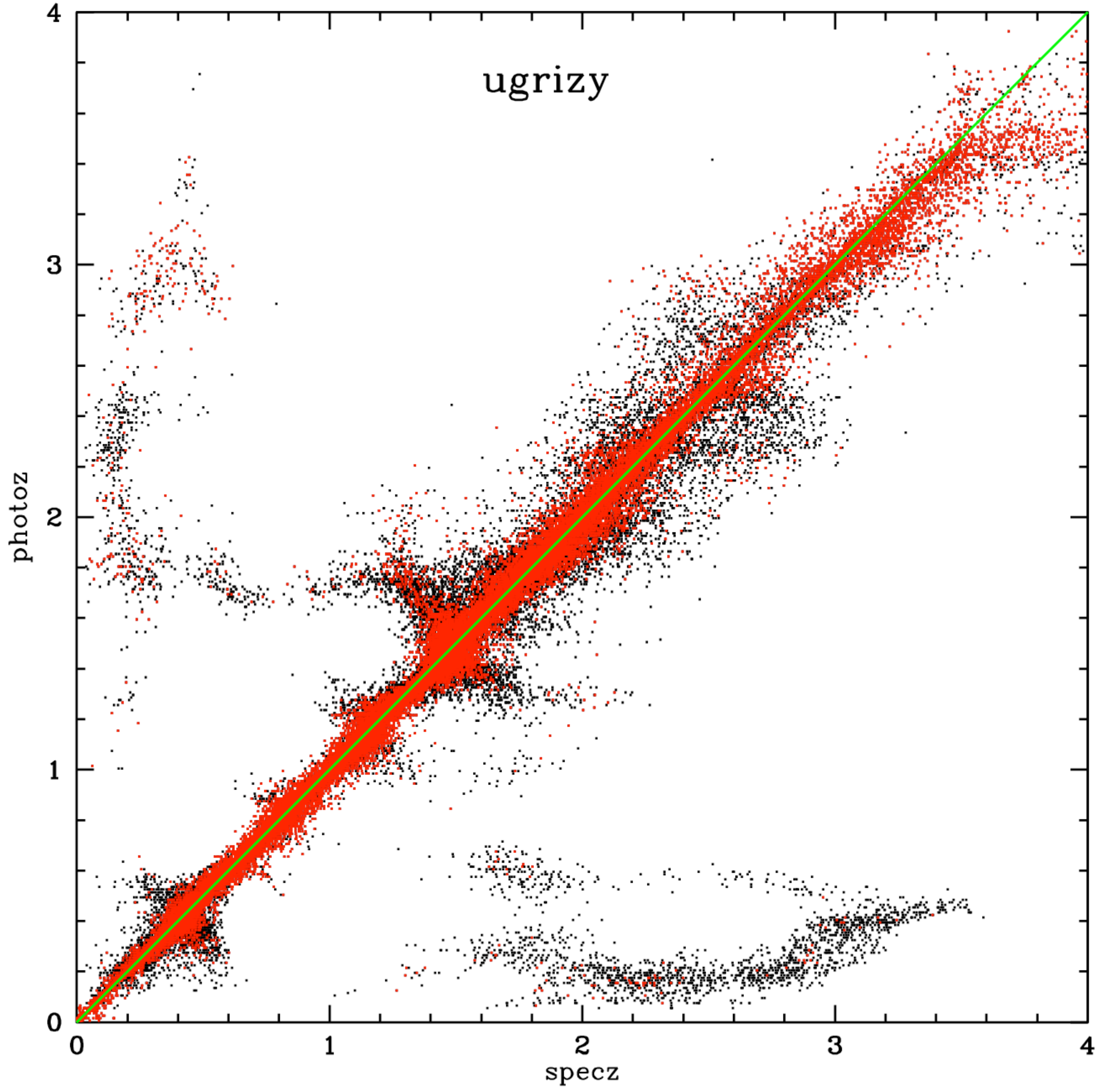


Degeneracy, catastrophic errors, chaos

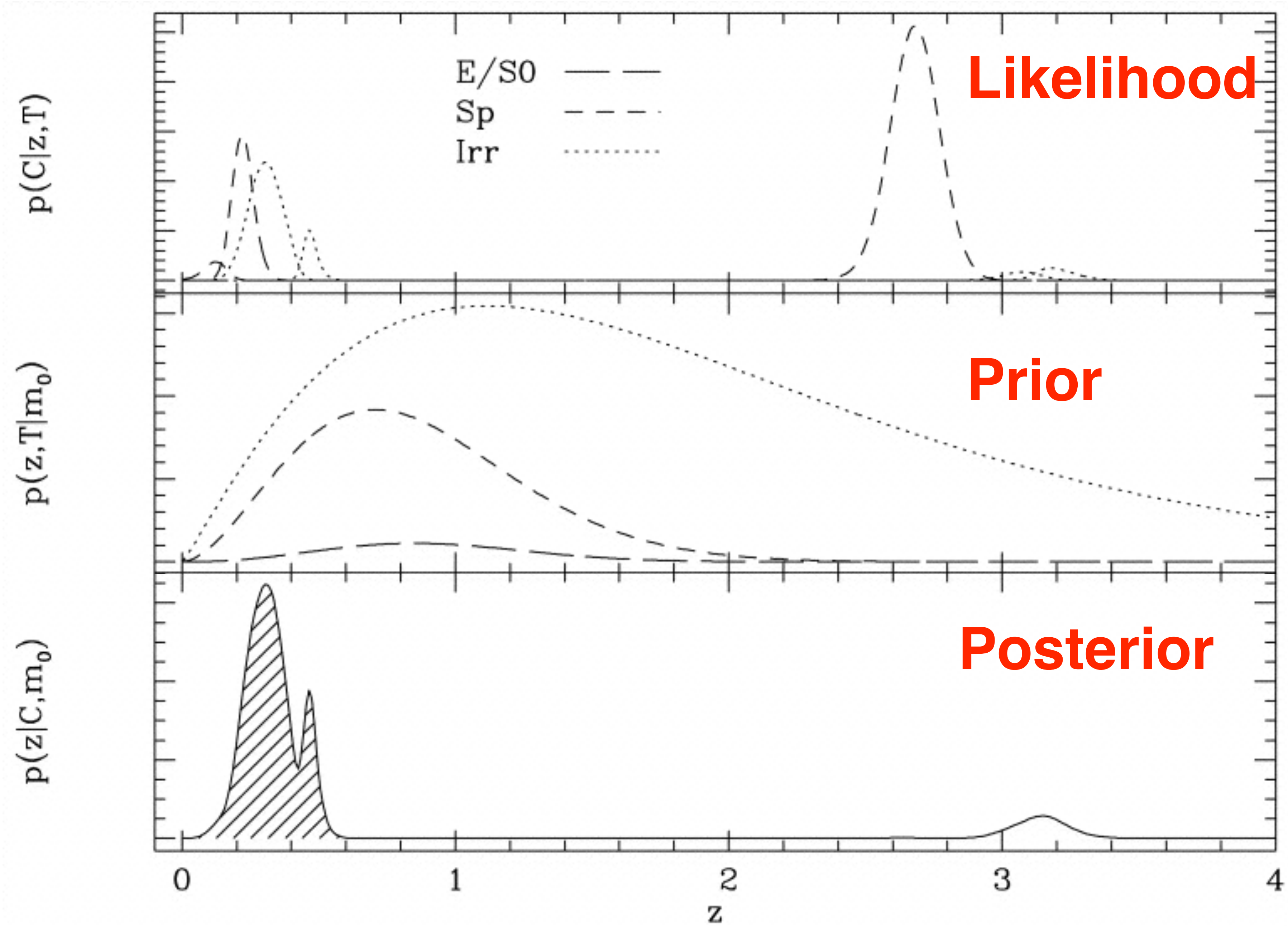
Catastrophic photo-z



Catastrophic photo-z



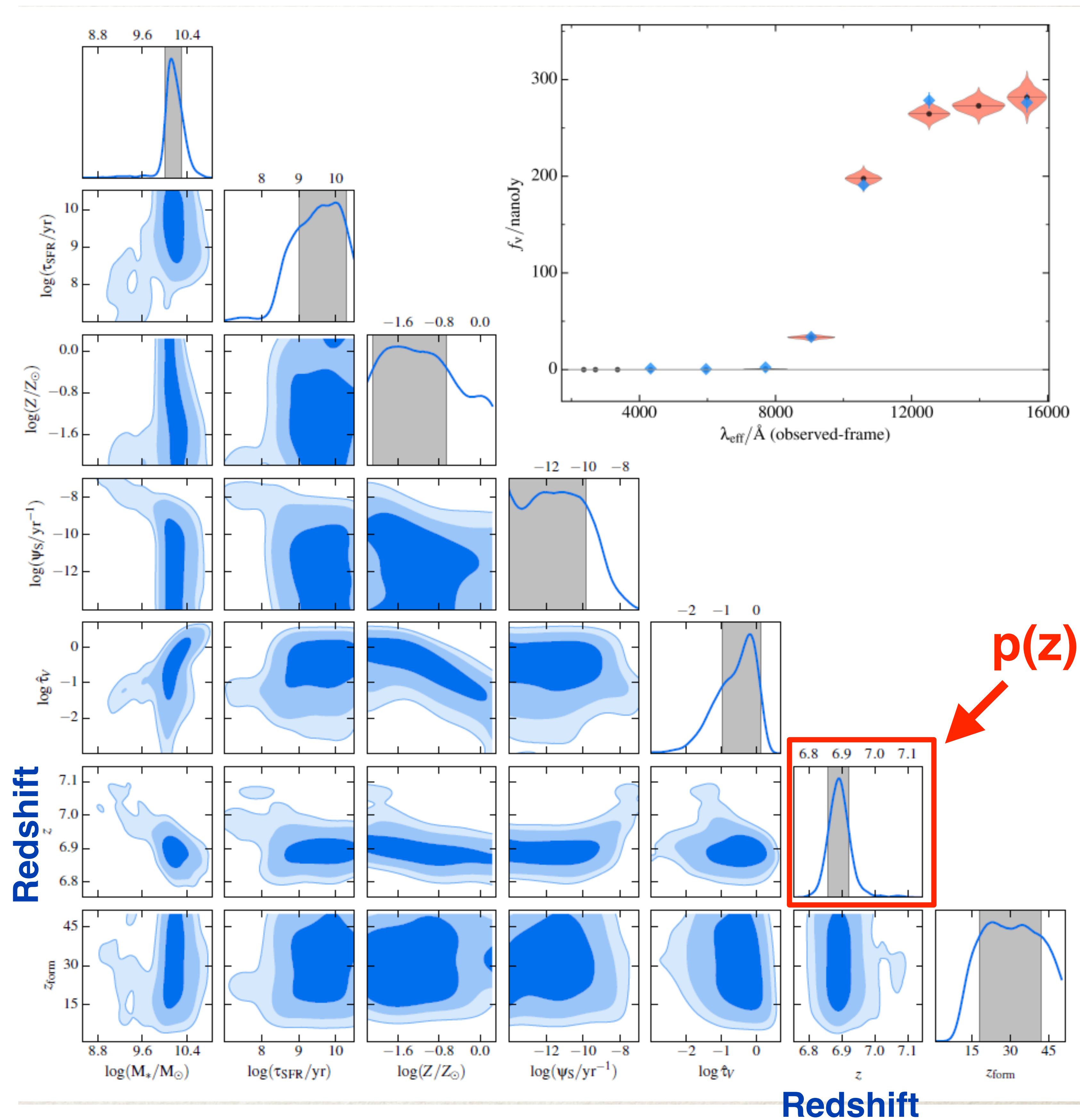
Catastrophic photo-z



$$P(\{s, n_1, n_2, \ldots\} \,|\, d) = \frac{P(d \,|\, \{s, n_1, n_2, \ldots\})\ P(s)\ P(n_1)\ P(n_2)\ldots}{P(d)}$$

Benitez 2000

Catastrophic photo-z



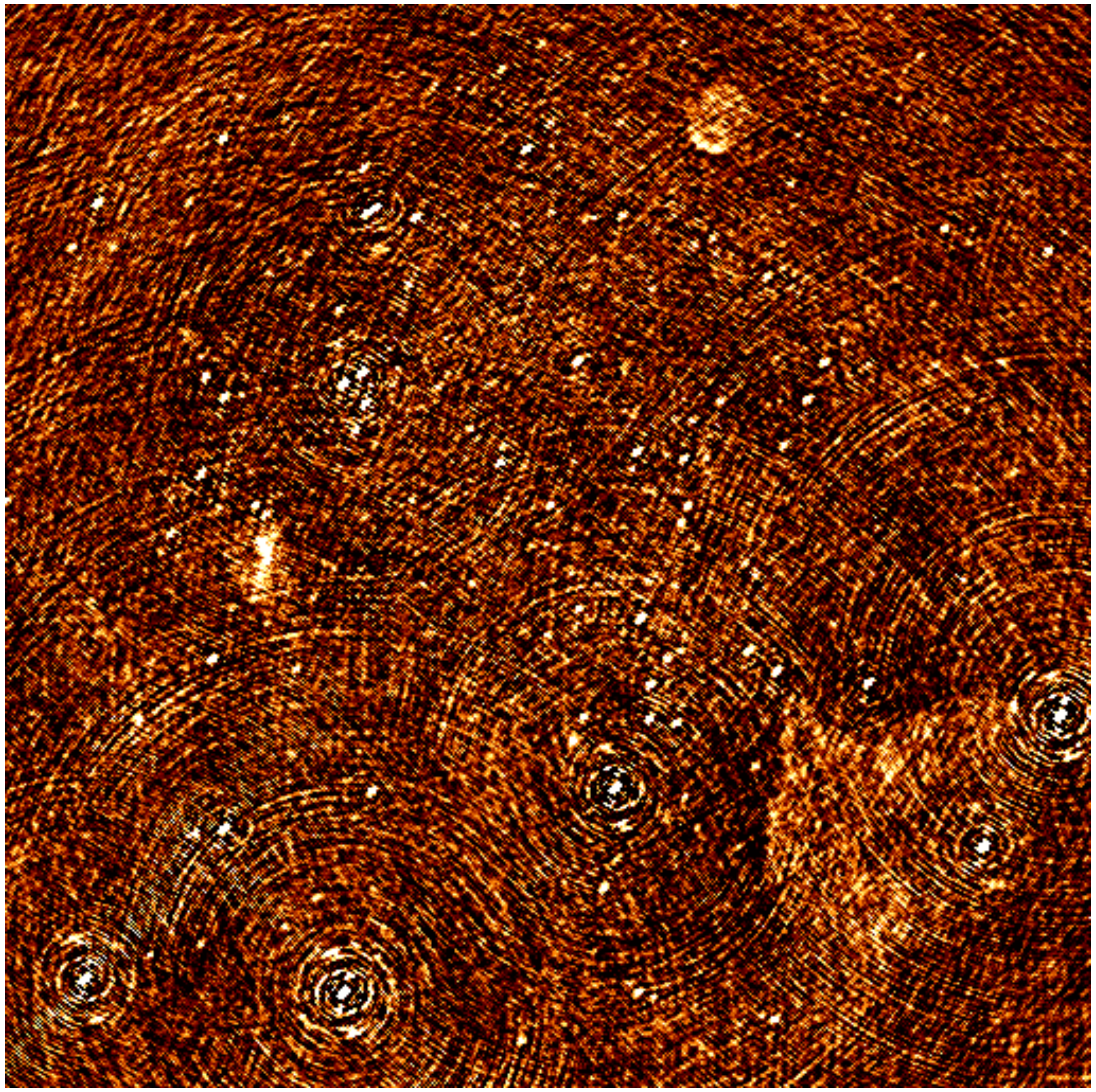
Chevallard & Charlot 2016

Degeneracy & catastrophic errors

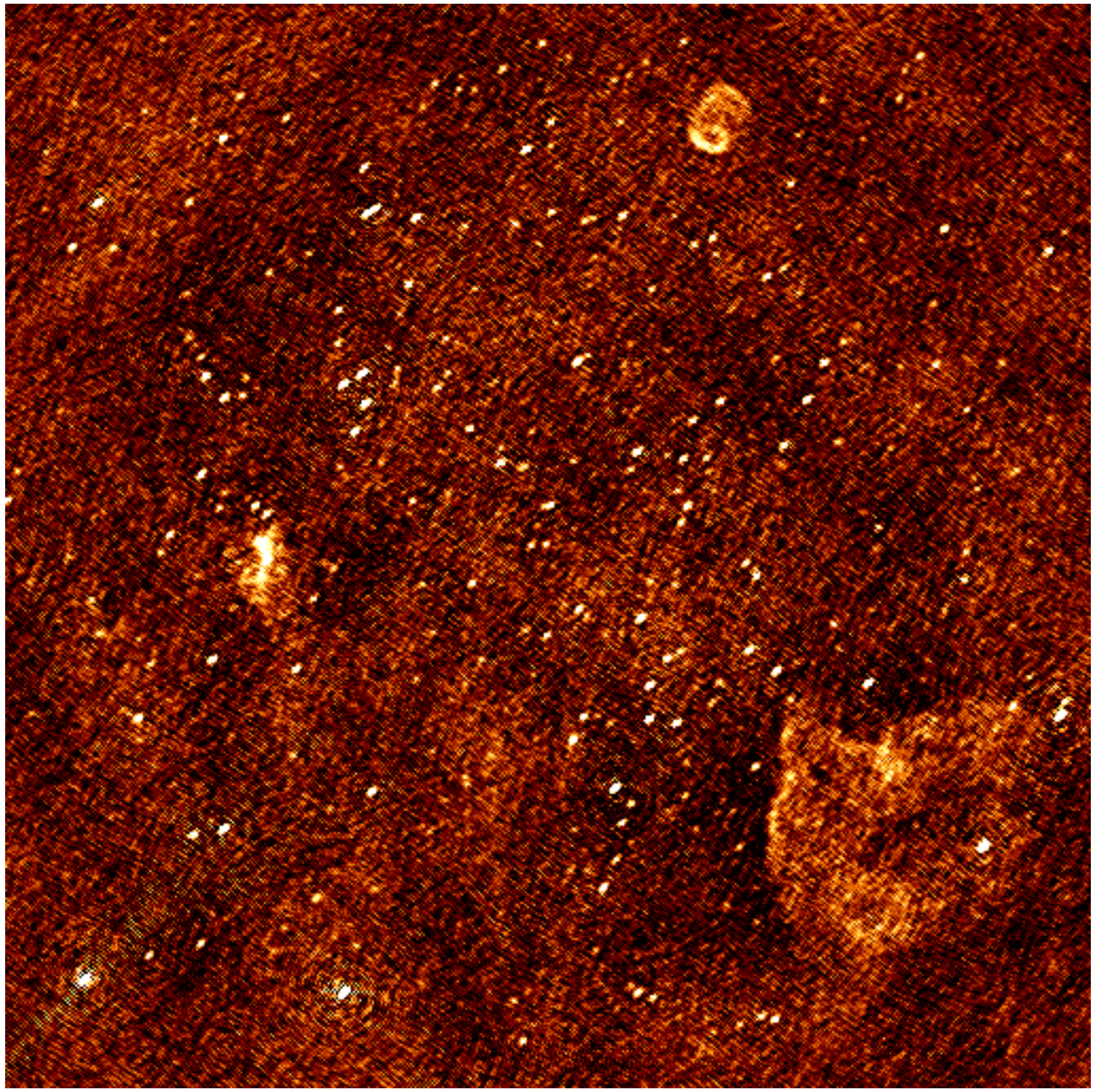
- Does it impact science?
- Can you get more information?
- Are priors your friend?

Chaotic algorithms (deconvolution)

clean-dirty.fits



clean-image.fits



Formally chaotic algorithms

- ‘Decision points’ in algorithm
- Gain or step control to help convergence
- Tend to have algorithm settings, which depend on implicit priors

Degeneracy, catastrophic errors, chaos

So what do you do?

- Be careful
- Test (implicit) assumptions
- Beware of walking out of applicability