

# Sampling

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# Outline

Signal Reconstruction vs Processing  
Frequentist Sampling  
Bayesian Sampling

# Signal Reconstruction & Processing

Signal processing:

Signal  $\rightarrow$  Data  $\rightarrow$  Operation  $\rightarrow$  Result

$\leftarrow$  Verification

Signal reconstruction:

Process  $\rightarrow$  Signal  $\rightarrow$  Data

Prior  $\rightarrow$  Reconstruction  $\leftarrow$

# Frequentist Sampling

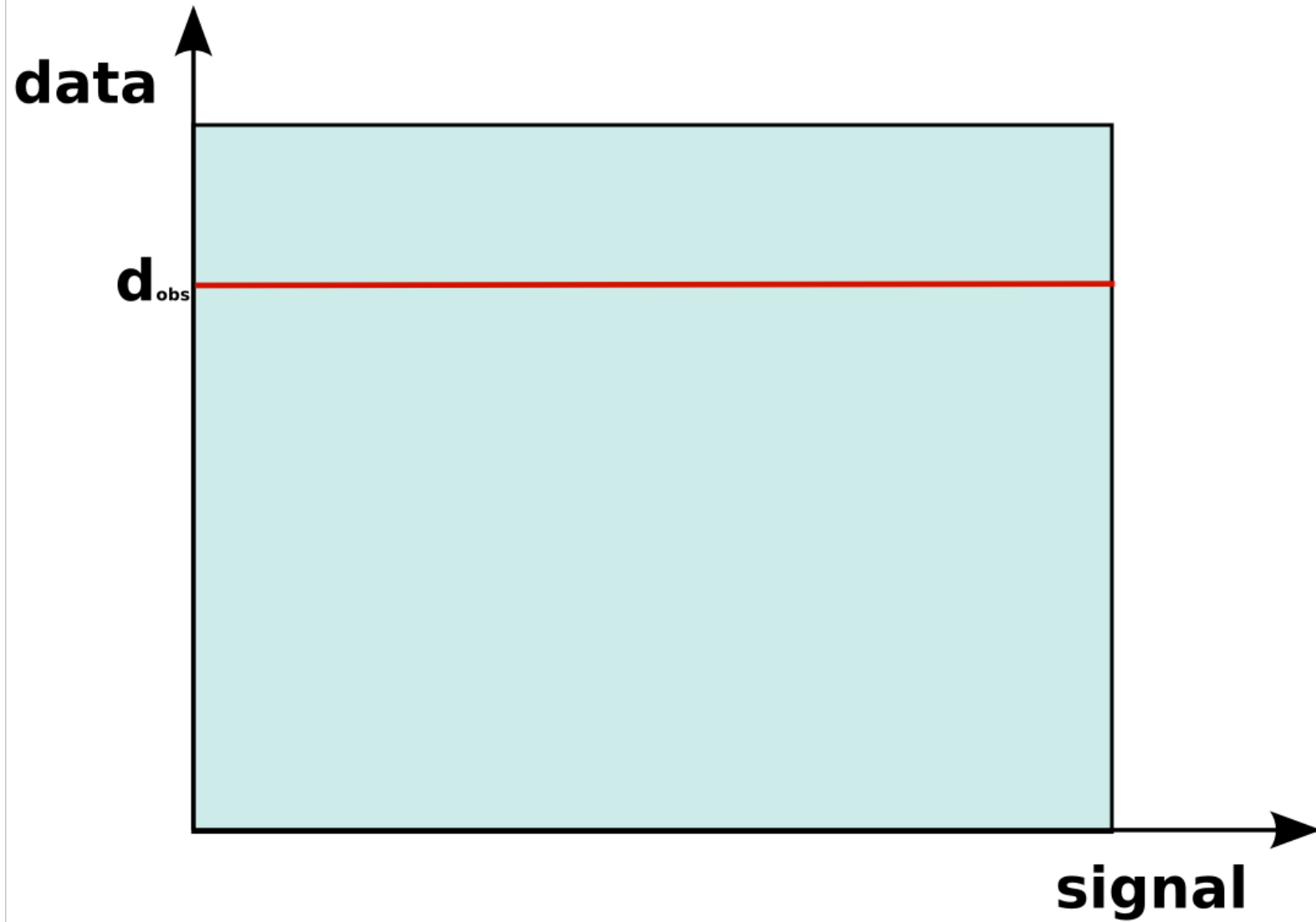
Frequentists regard data to be generated in repeatable random experiments.

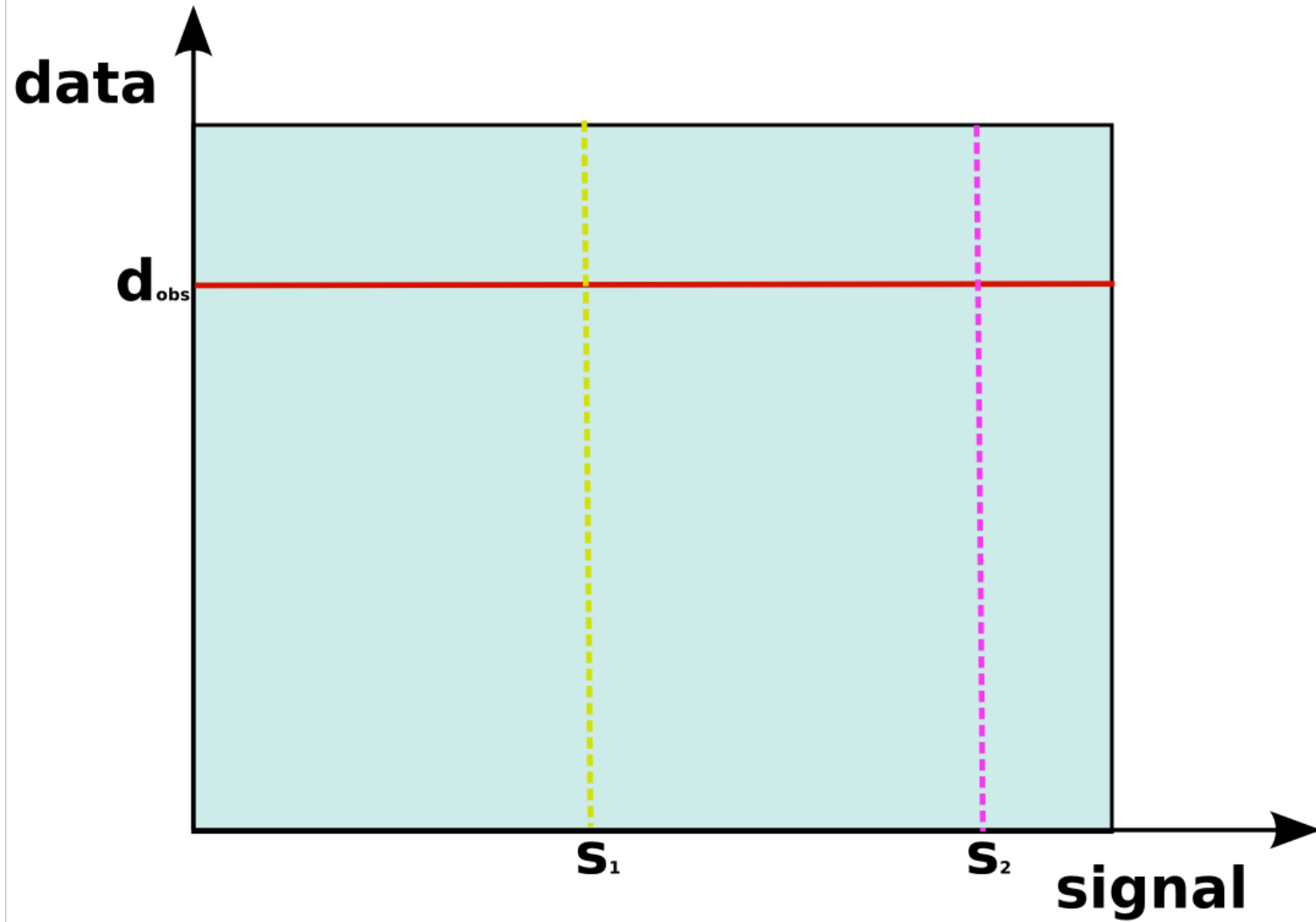
Statistics and sampling is performed only over repeated data generation processes.

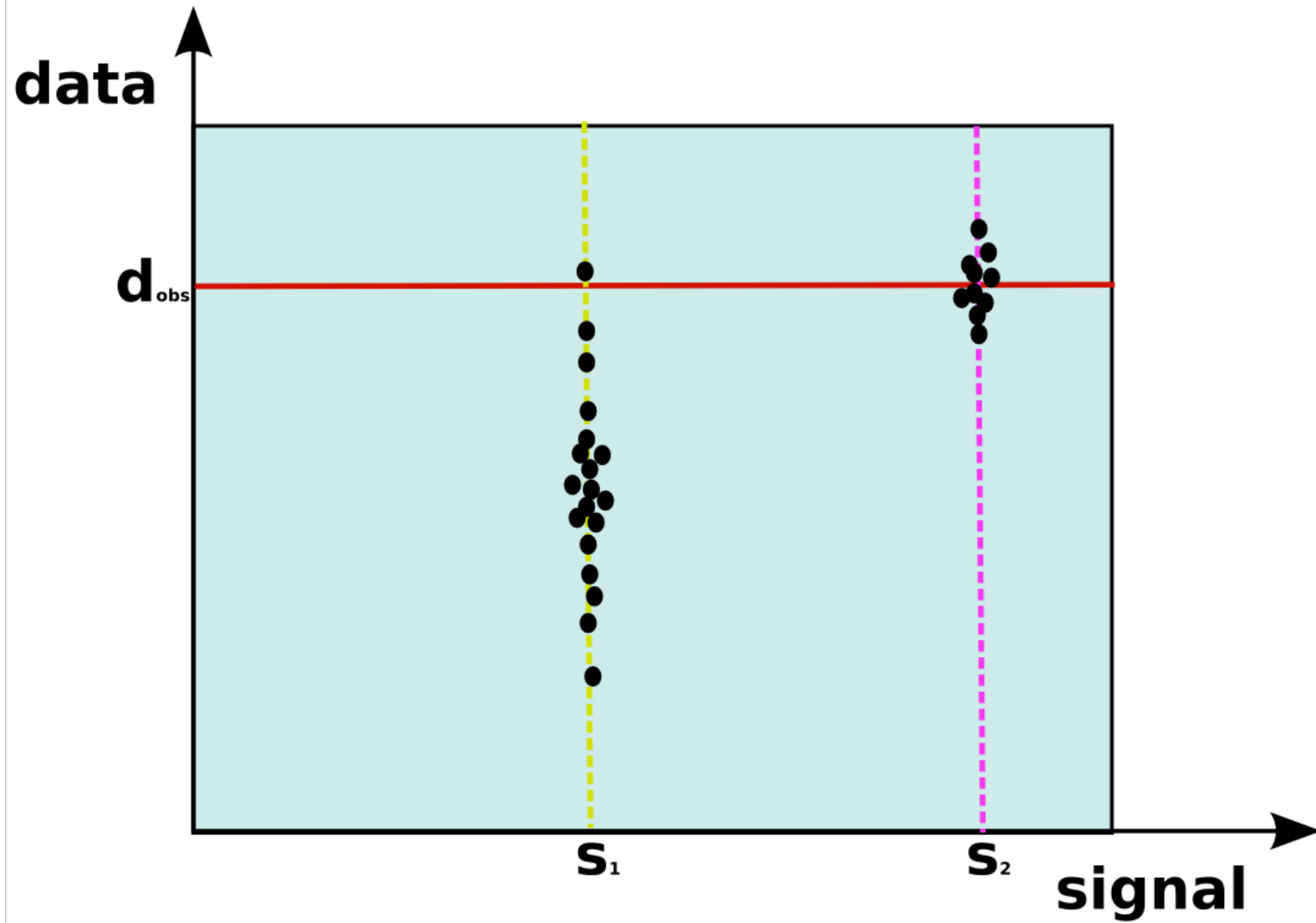
**data**



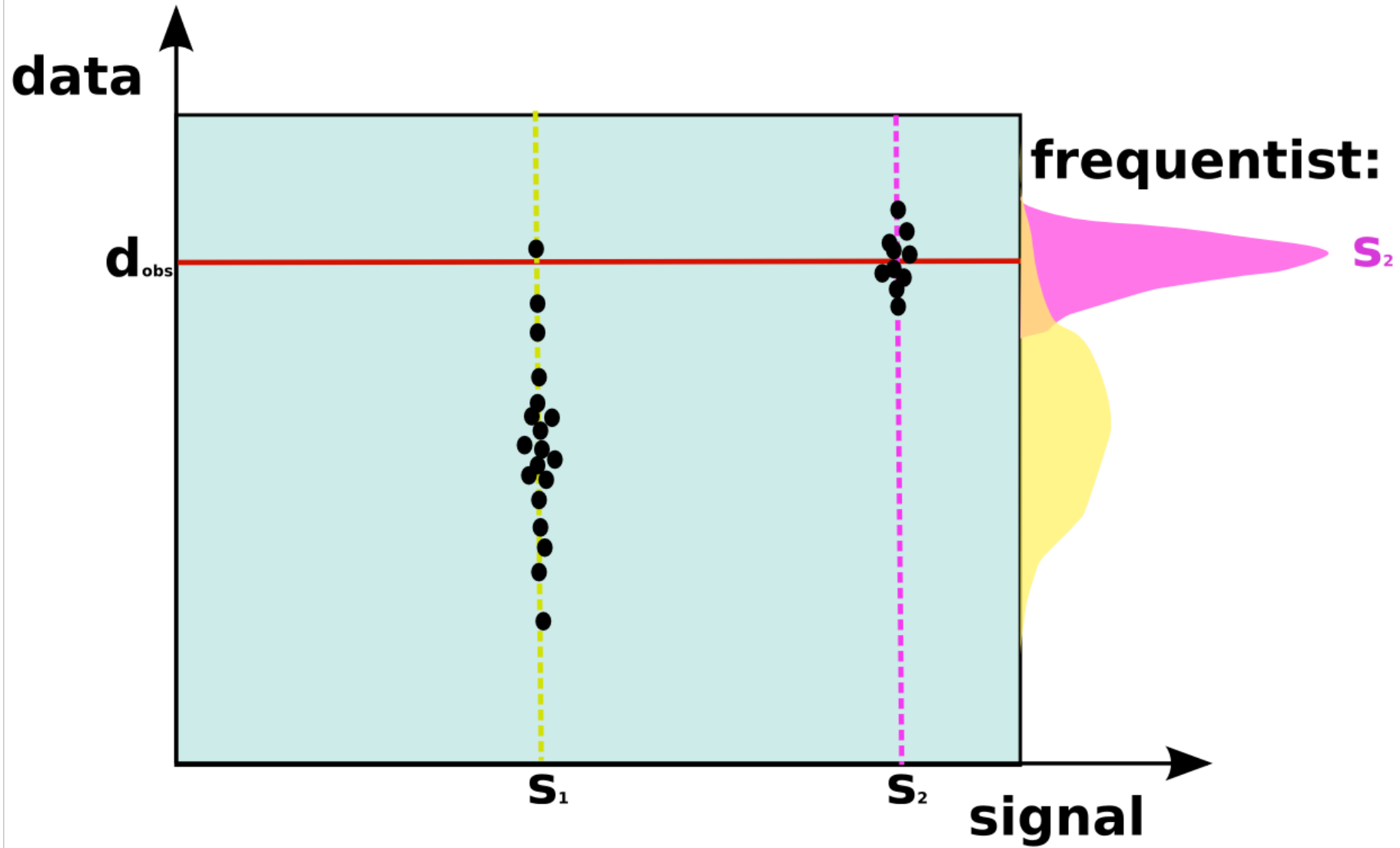
**signal**

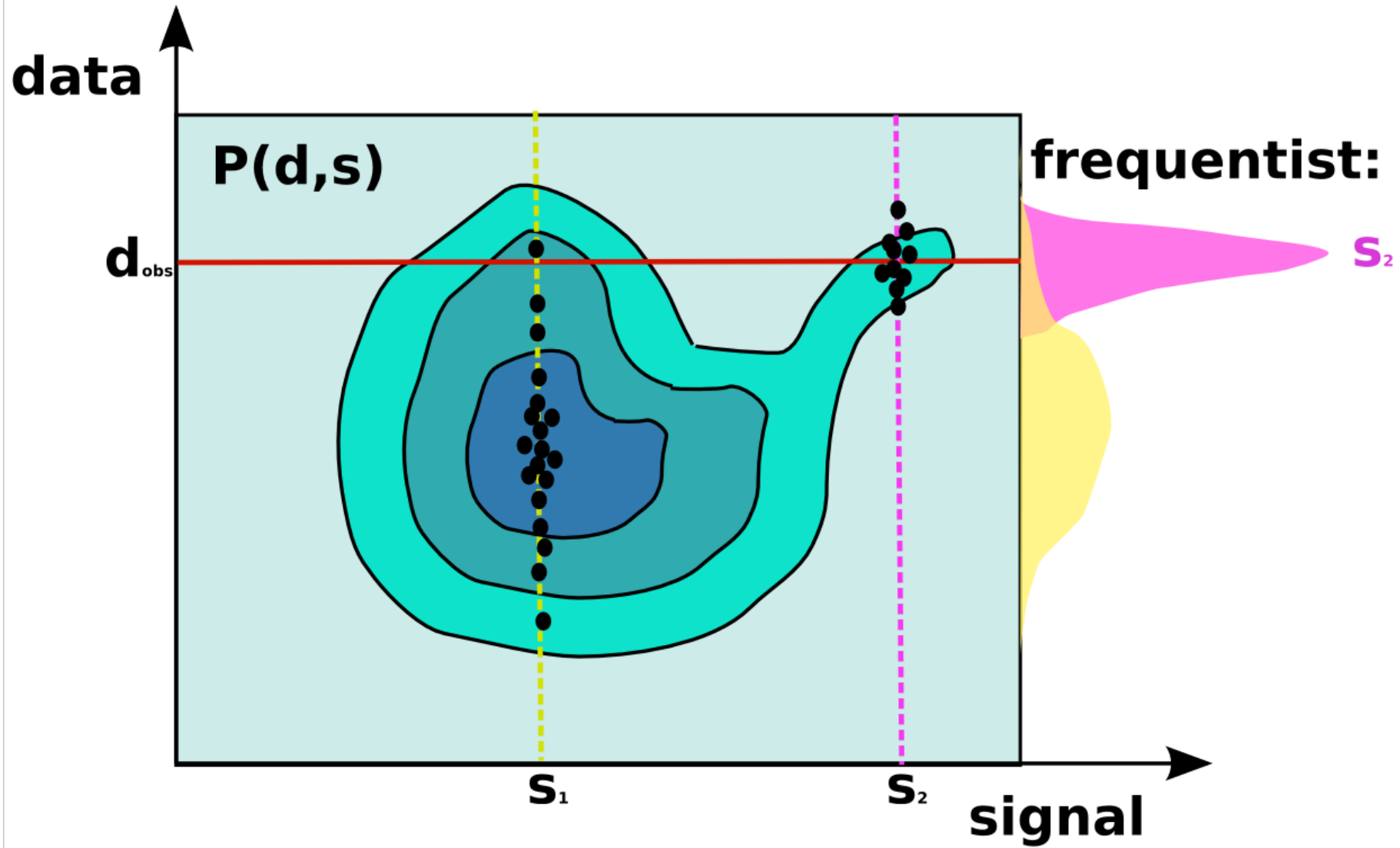




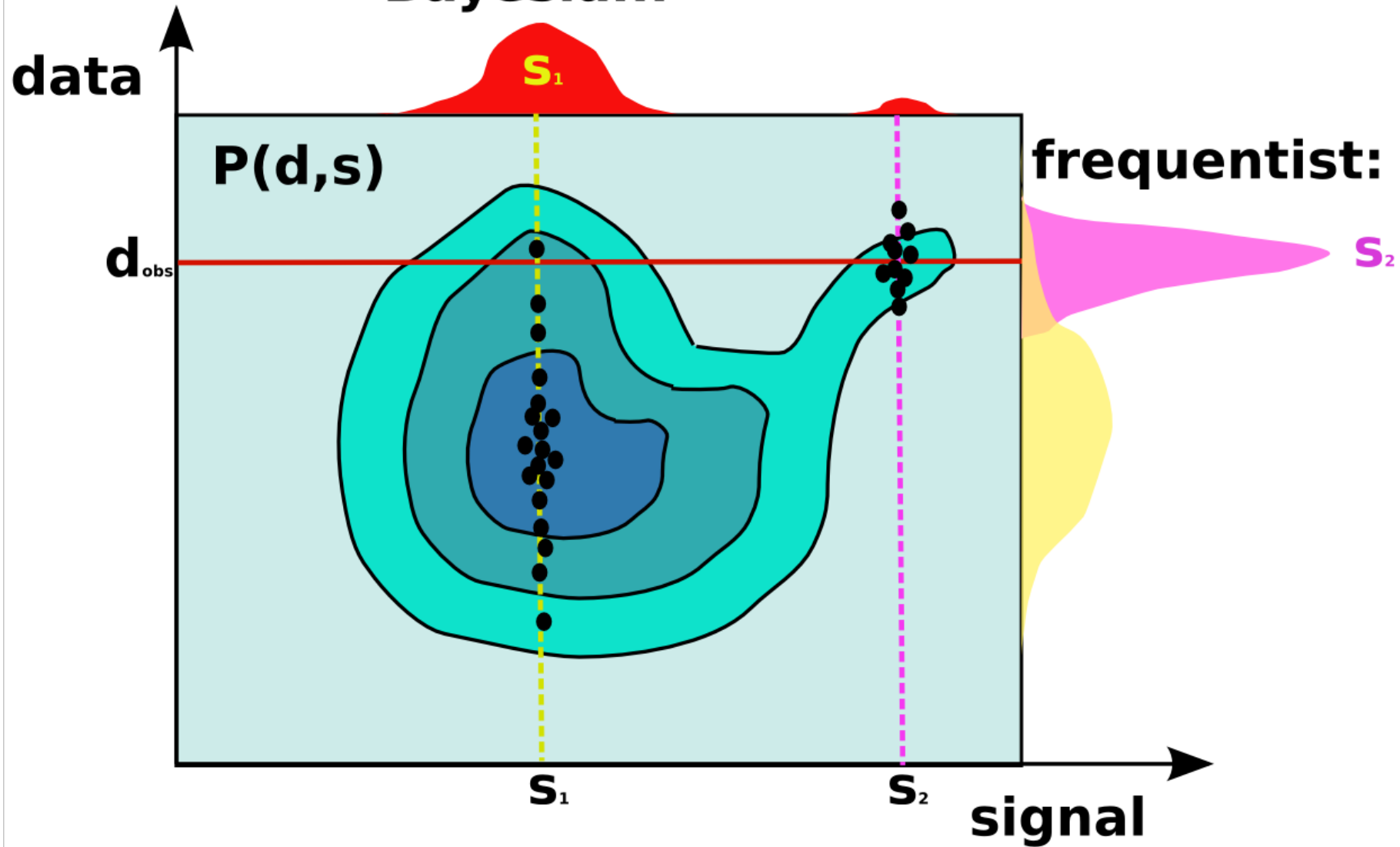




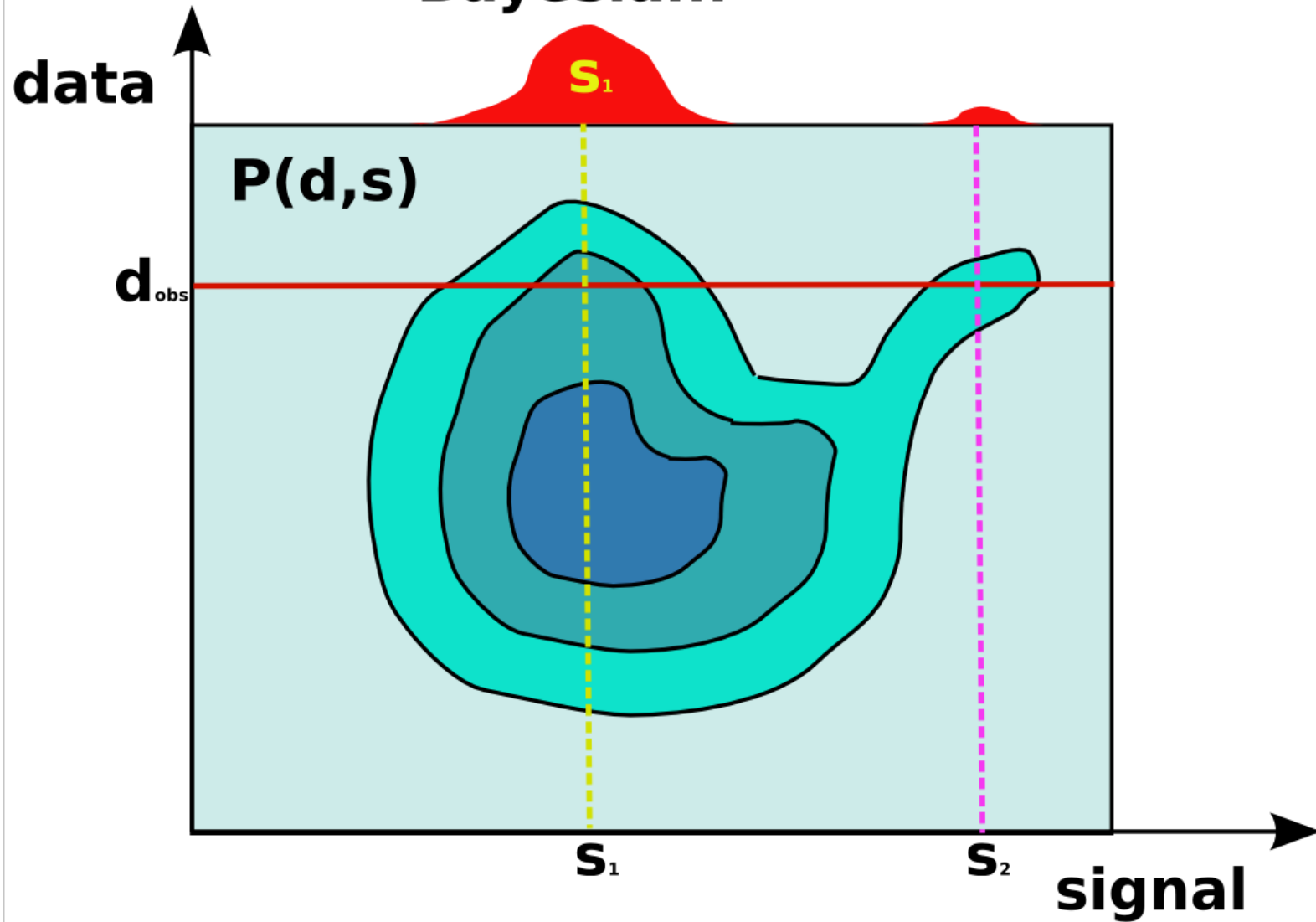




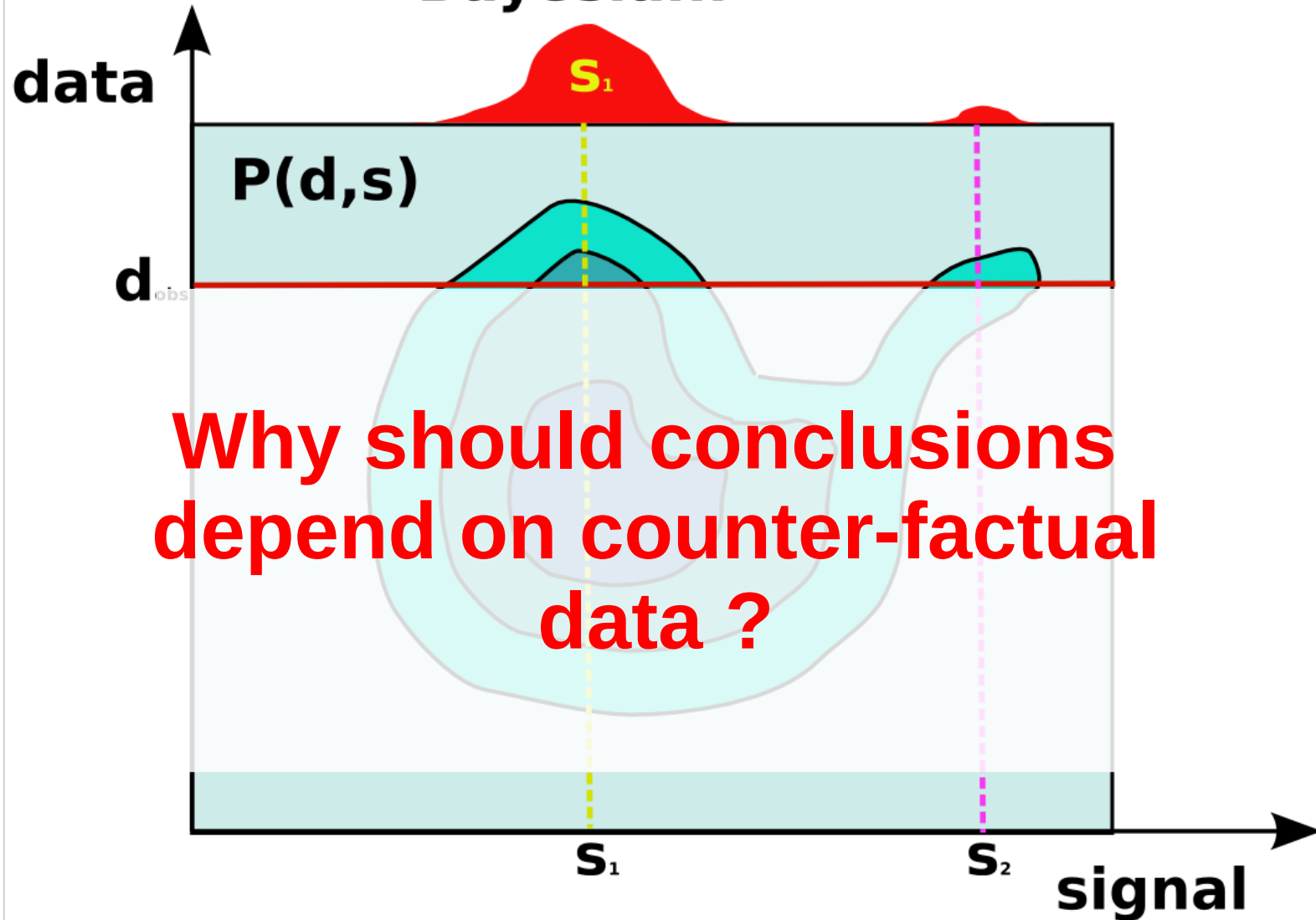
**Bayesian:**



# Bayesian:



# Bayesian:



**Why should conclusions depend on counter-factual data ?**

# Bayesian Sampling

Bayesian regard data as given and fixed.

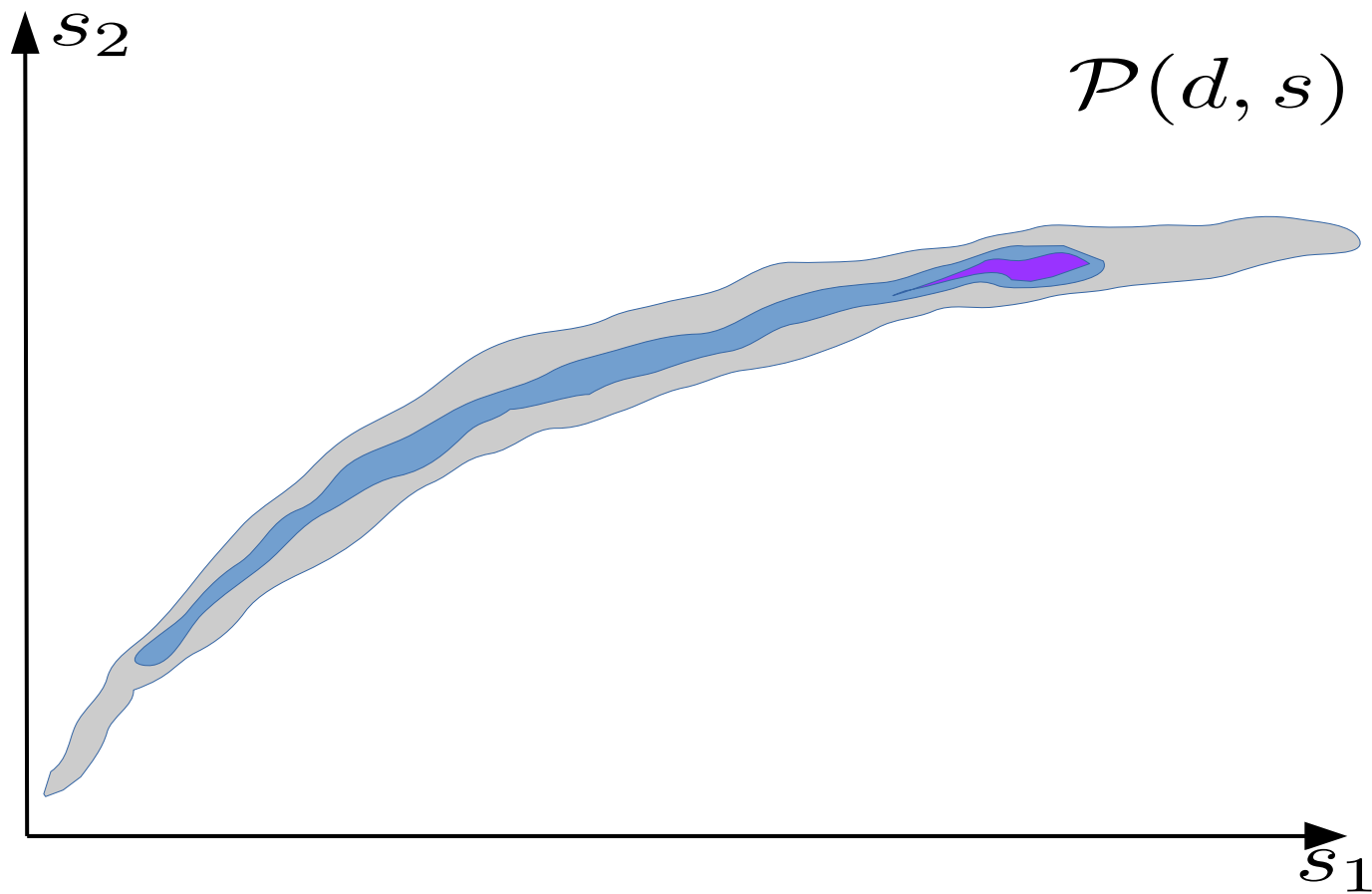
Looking at counter-factual data does not provide information on signal.

Sampling is done over the unknown signal according to its posterior probability  $\mathcal{P}(s|d) = \mathcal{P}(d, s)/\mathcal{P}(d)$ .

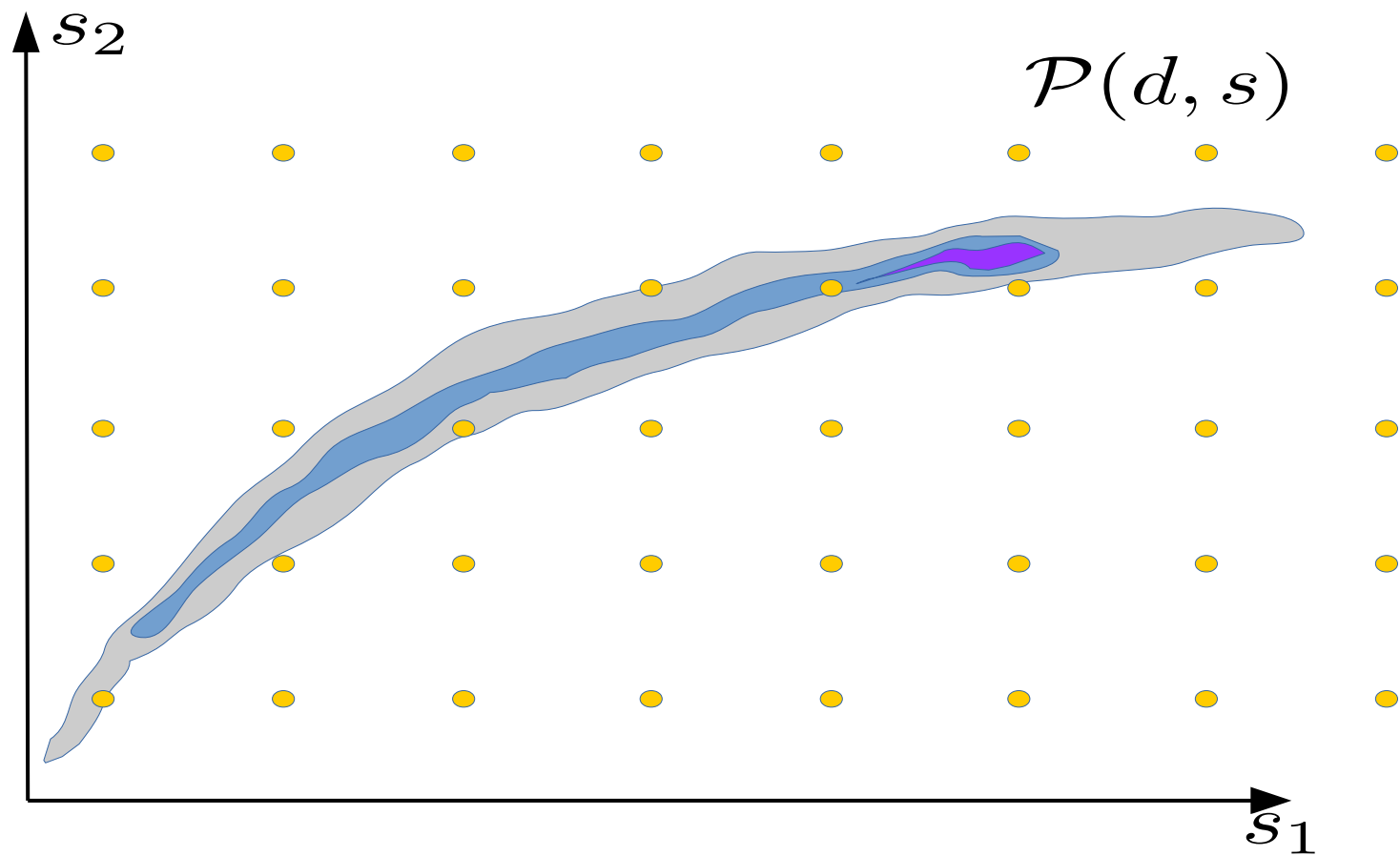
Goal is to calculate posterior expectation values:

$$\begin{aligned}\langle f(s) \rangle_{\mathcal{P}(s|d)} &= \int ds \mathcal{P}(s|d) f(s) \\ &= \frac{\int ds \mathcal{P}(d, s) f(s)}{\int ds \mathcal{P}(d, s)}\end{aligned}$$

# Sampling

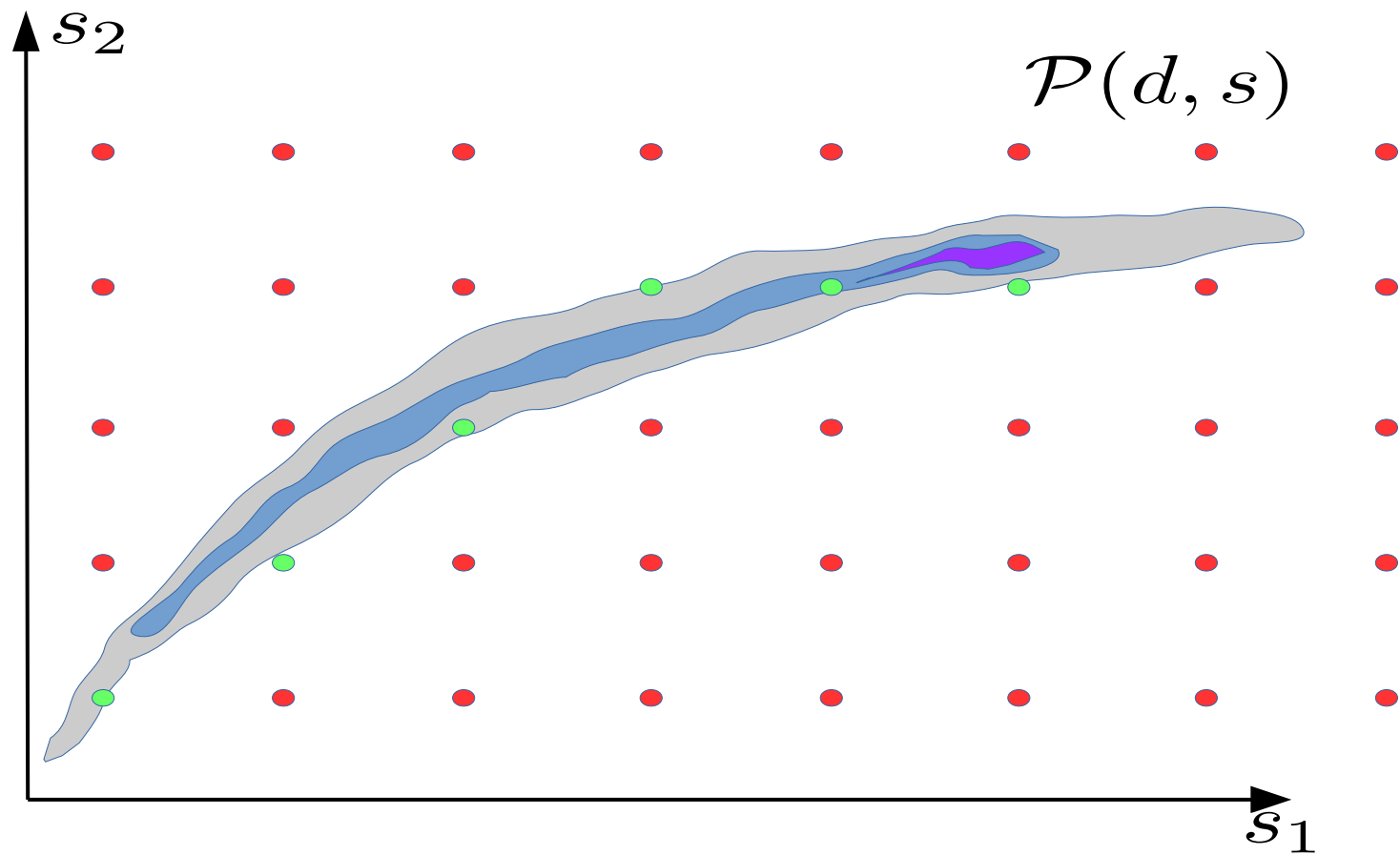


# Uniform Sampling

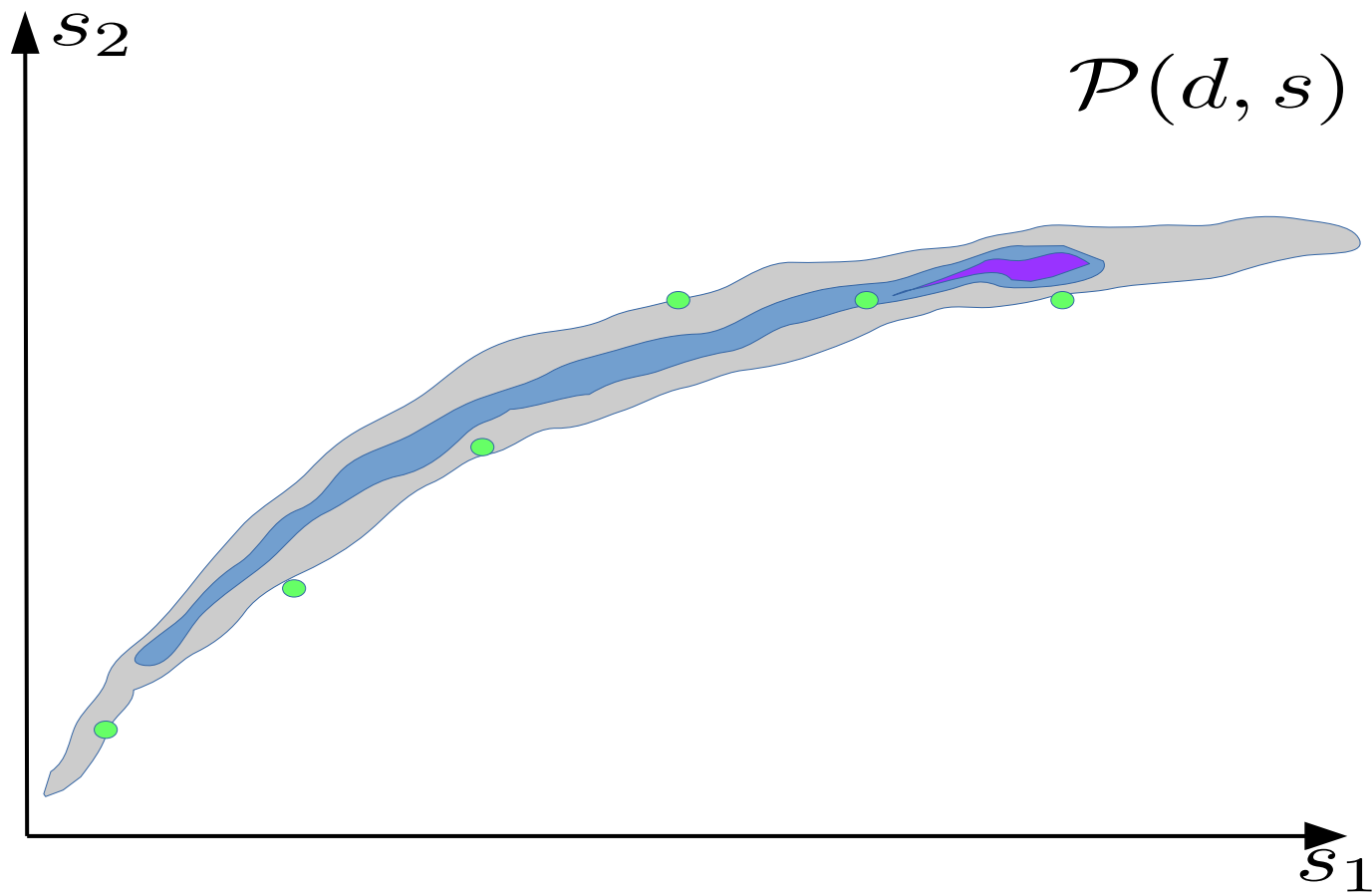




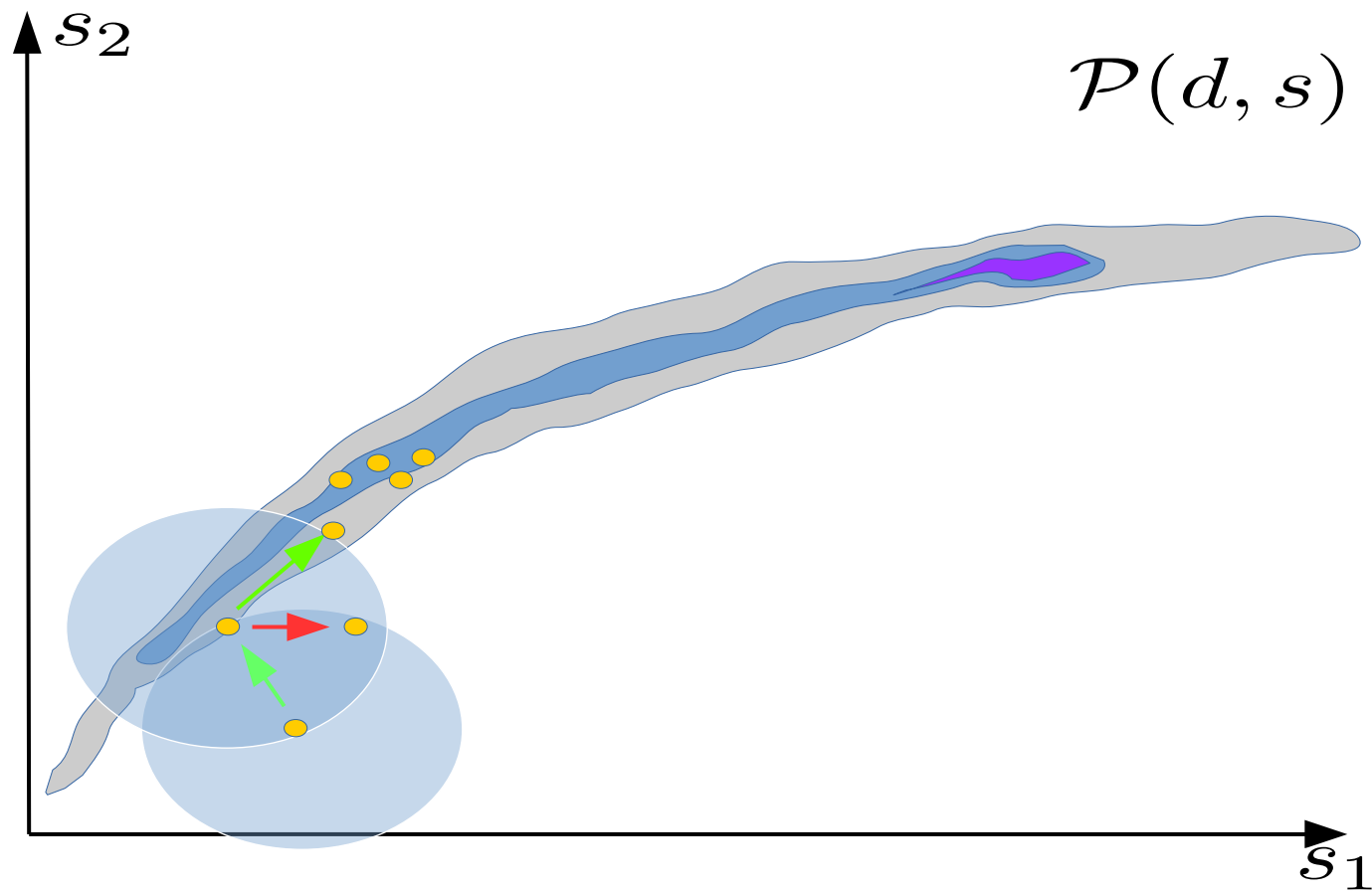
# Rejection Sampling



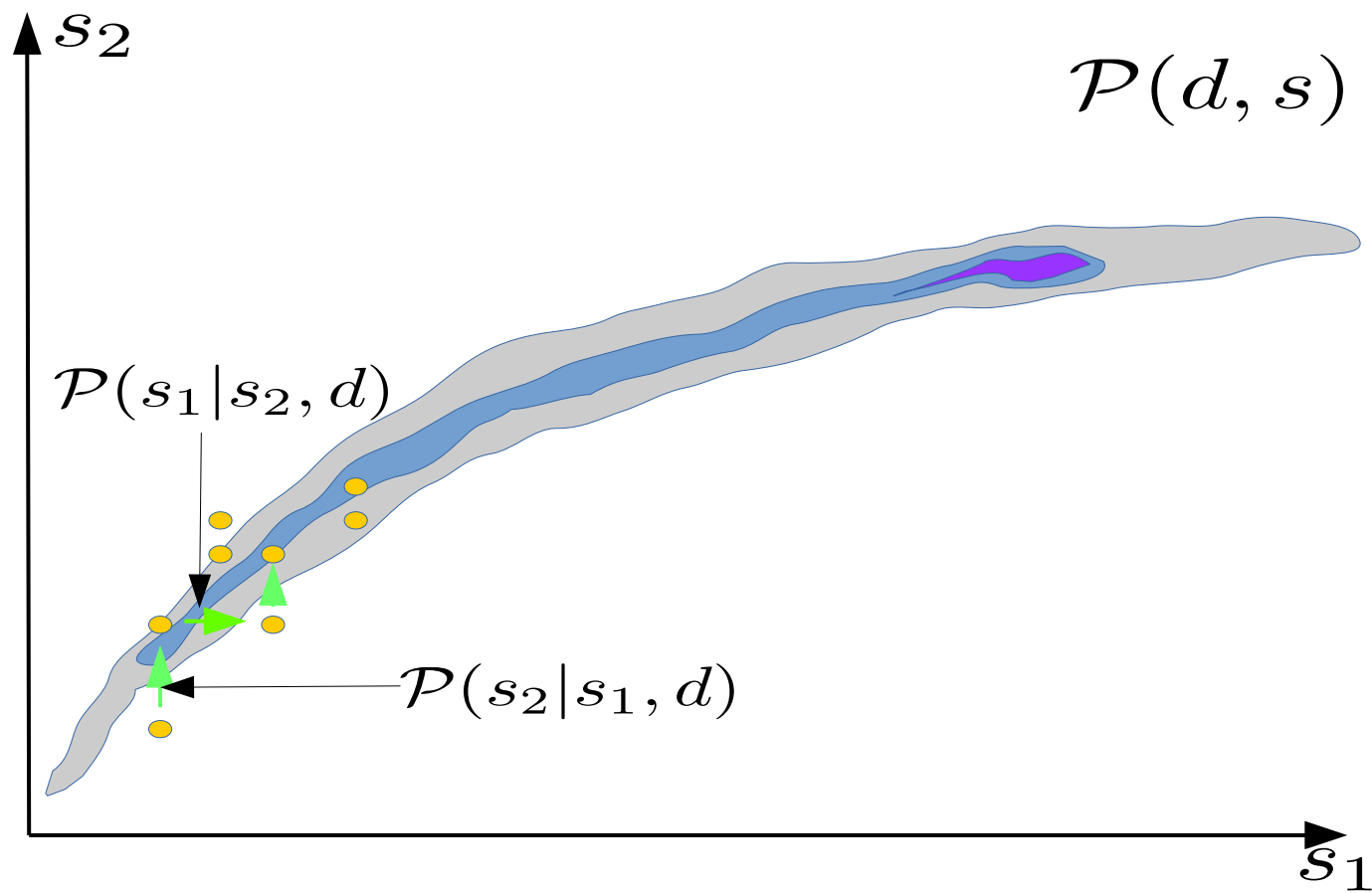
# Rejection Sampling



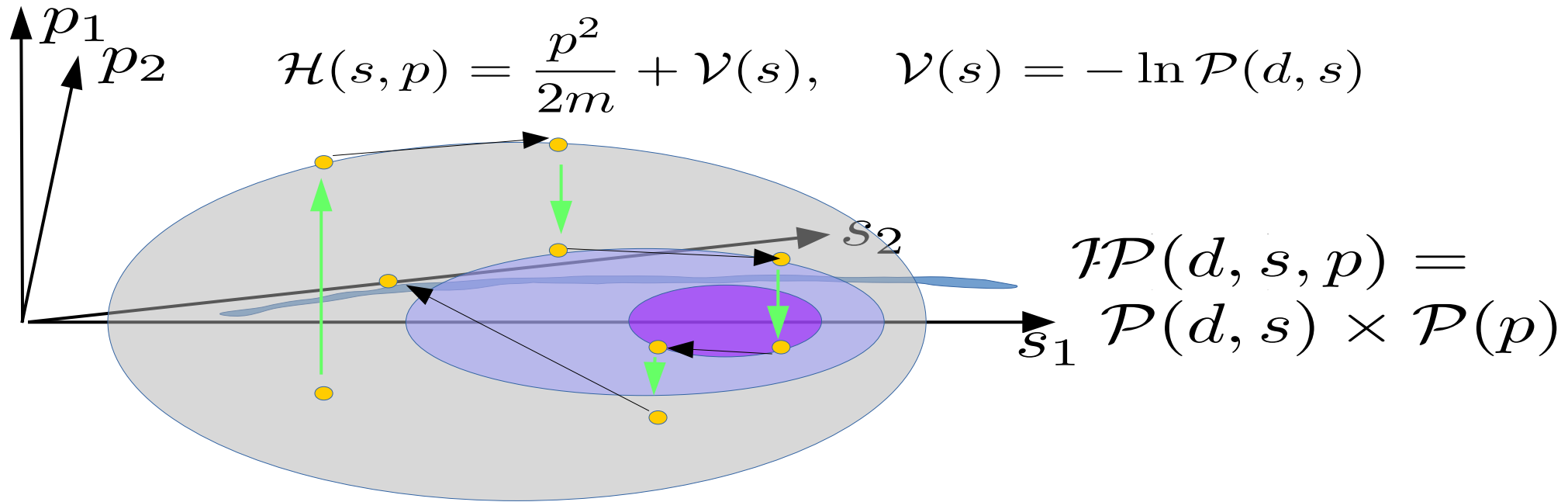
# Metropolis Hasting Sampling



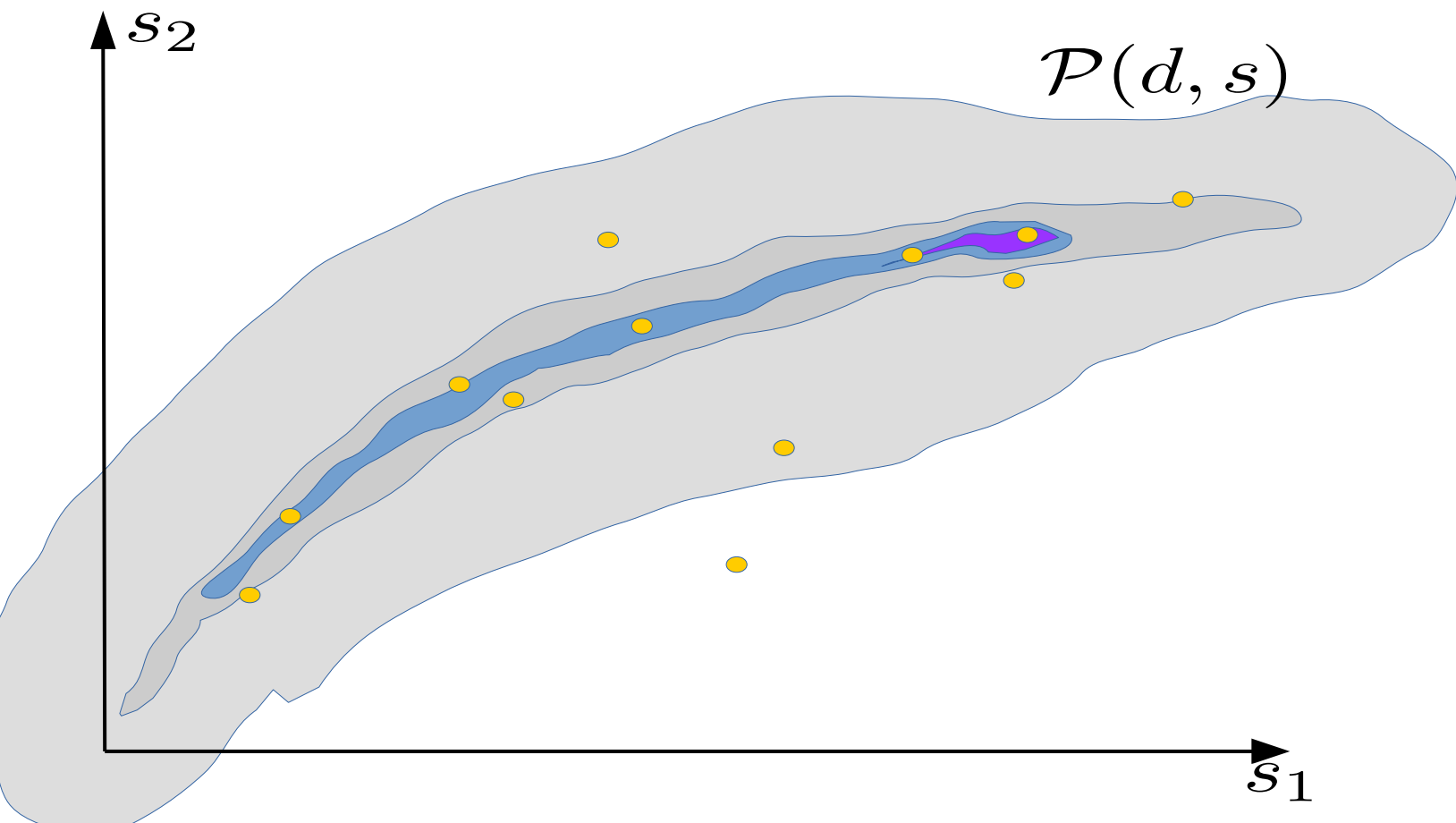
# Gibbs Sampling



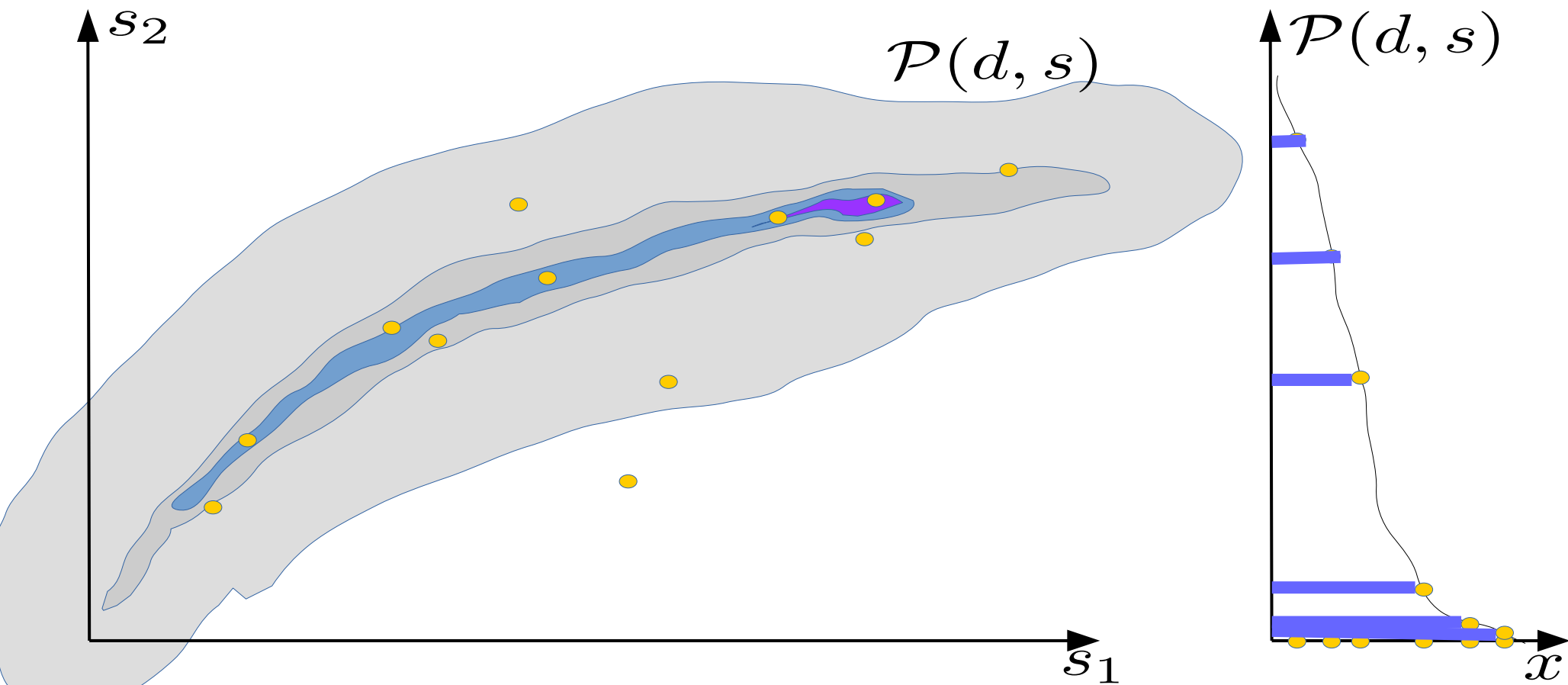
# Hamiltonian Sampling



# Nested Sampling



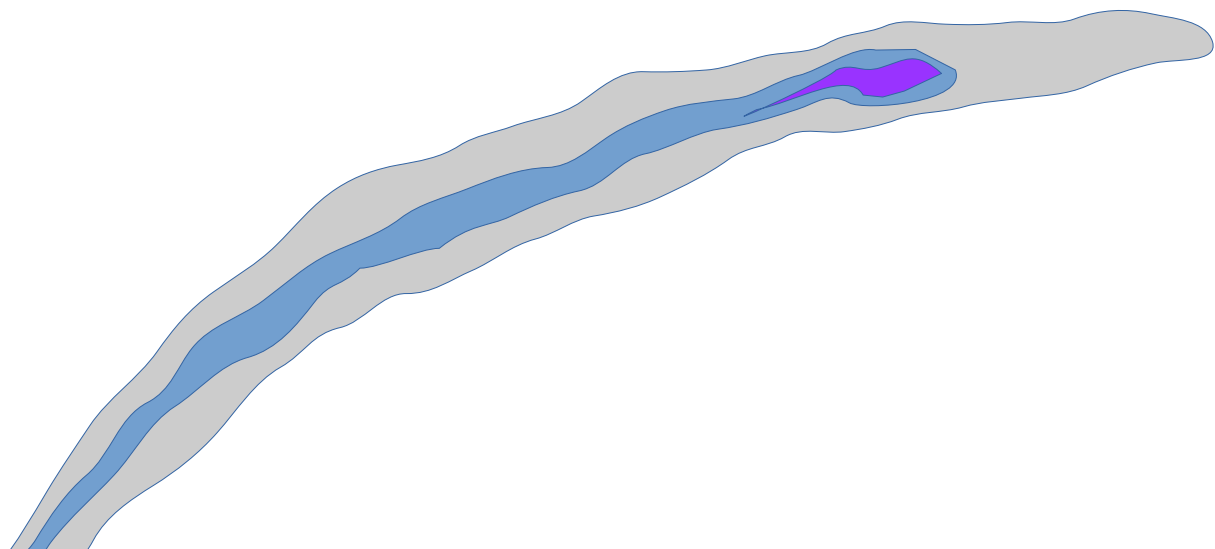
# Nested Sampling



# Sampling

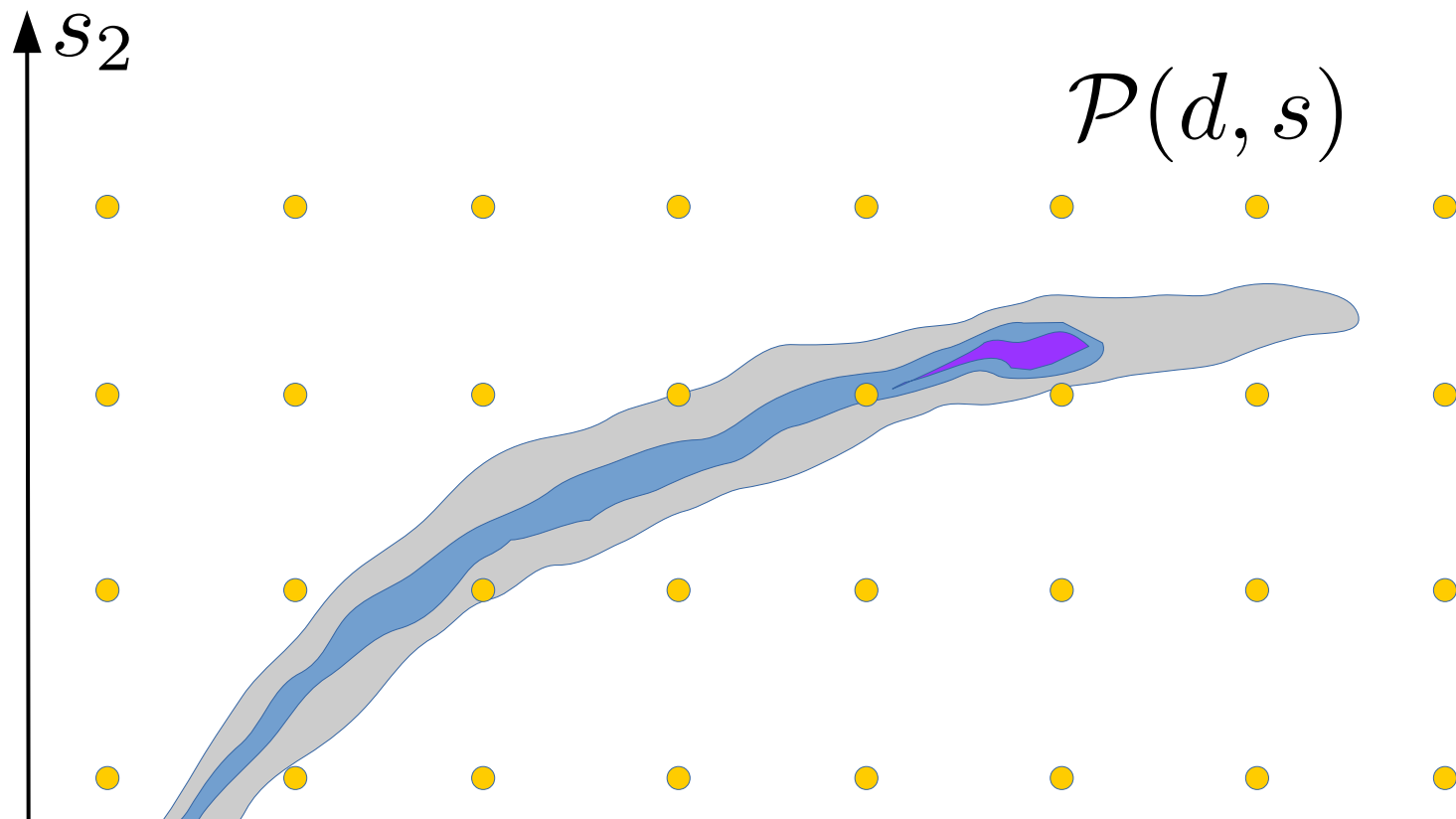
$s_2$

$\mathcal{P}(d, s)$

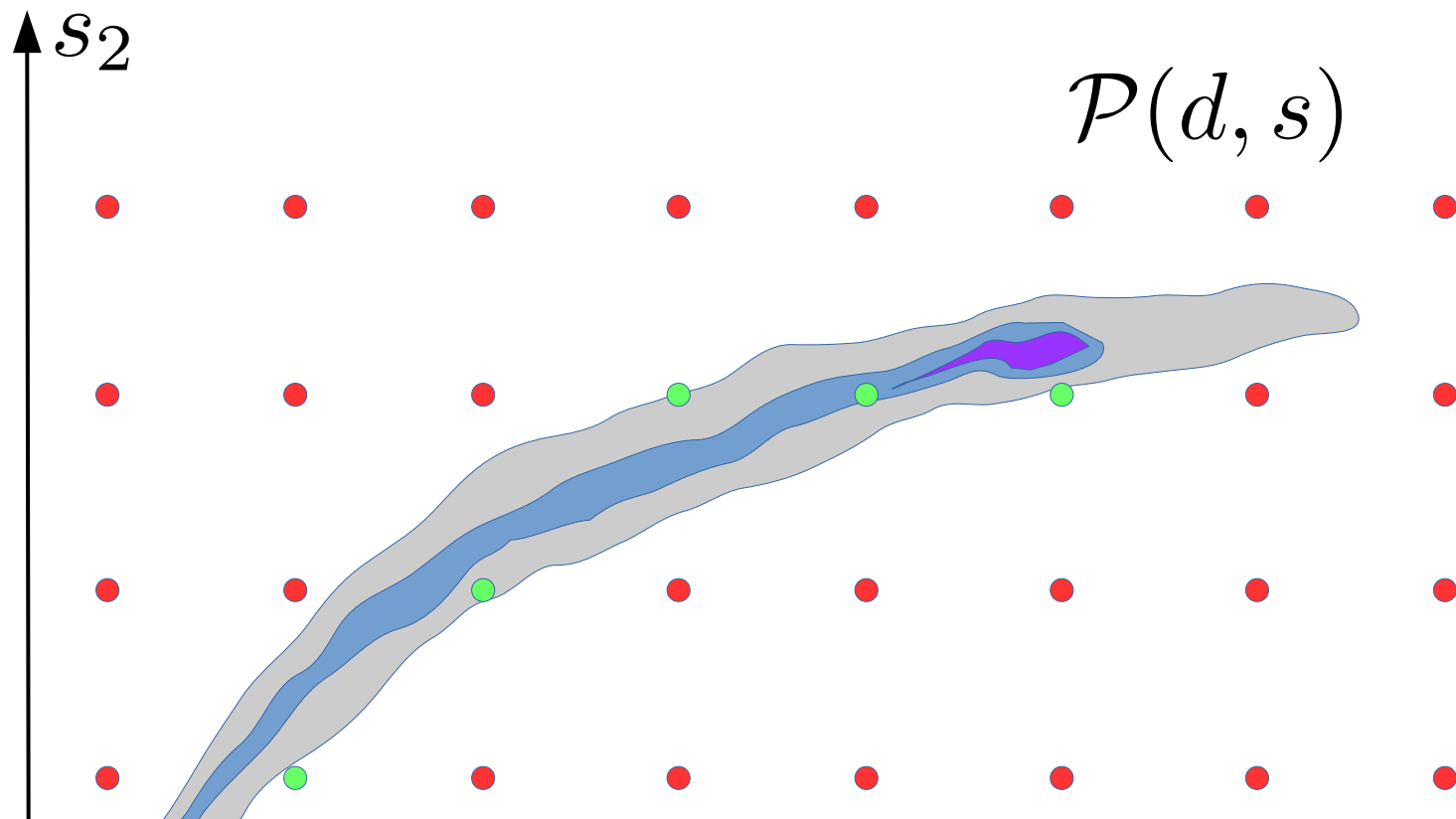




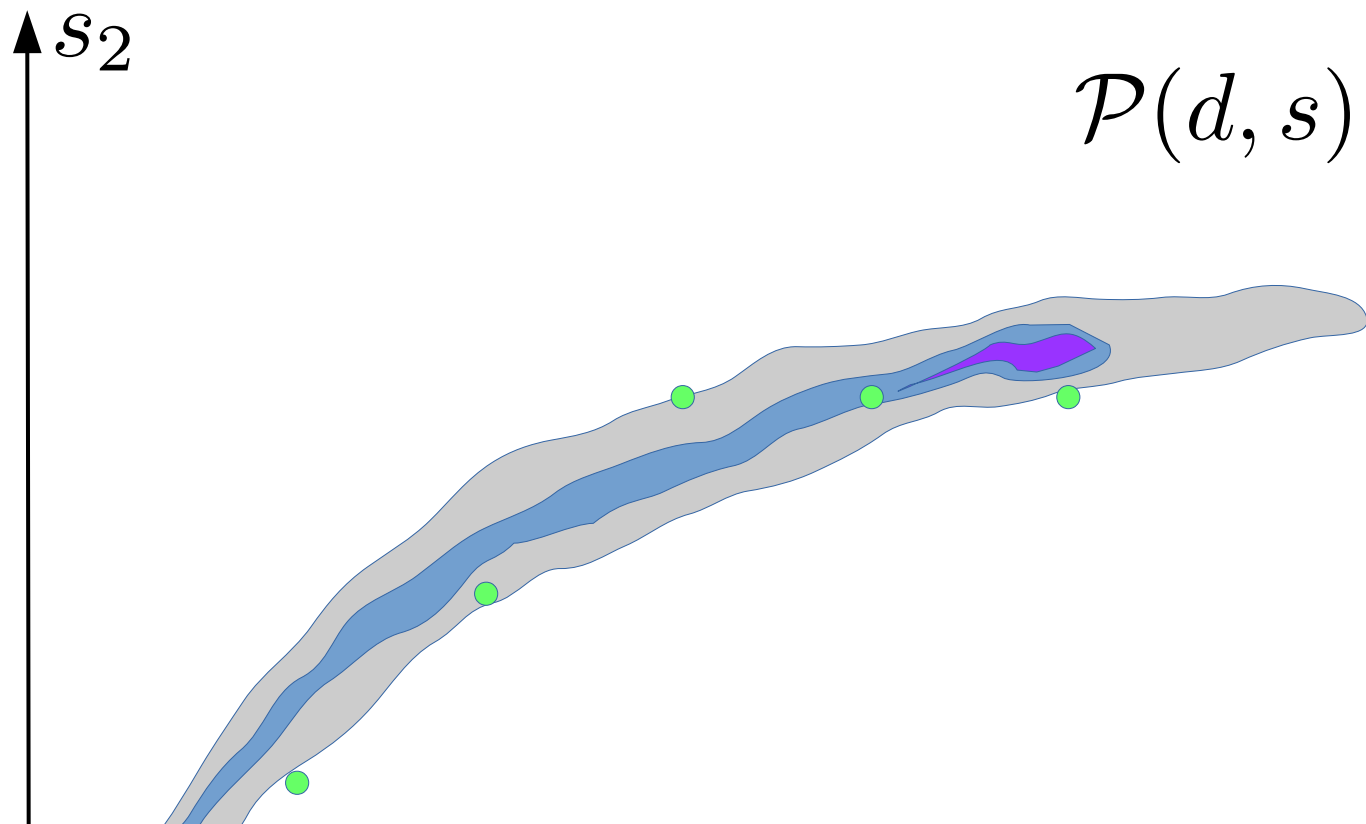
# Uniform Sampling



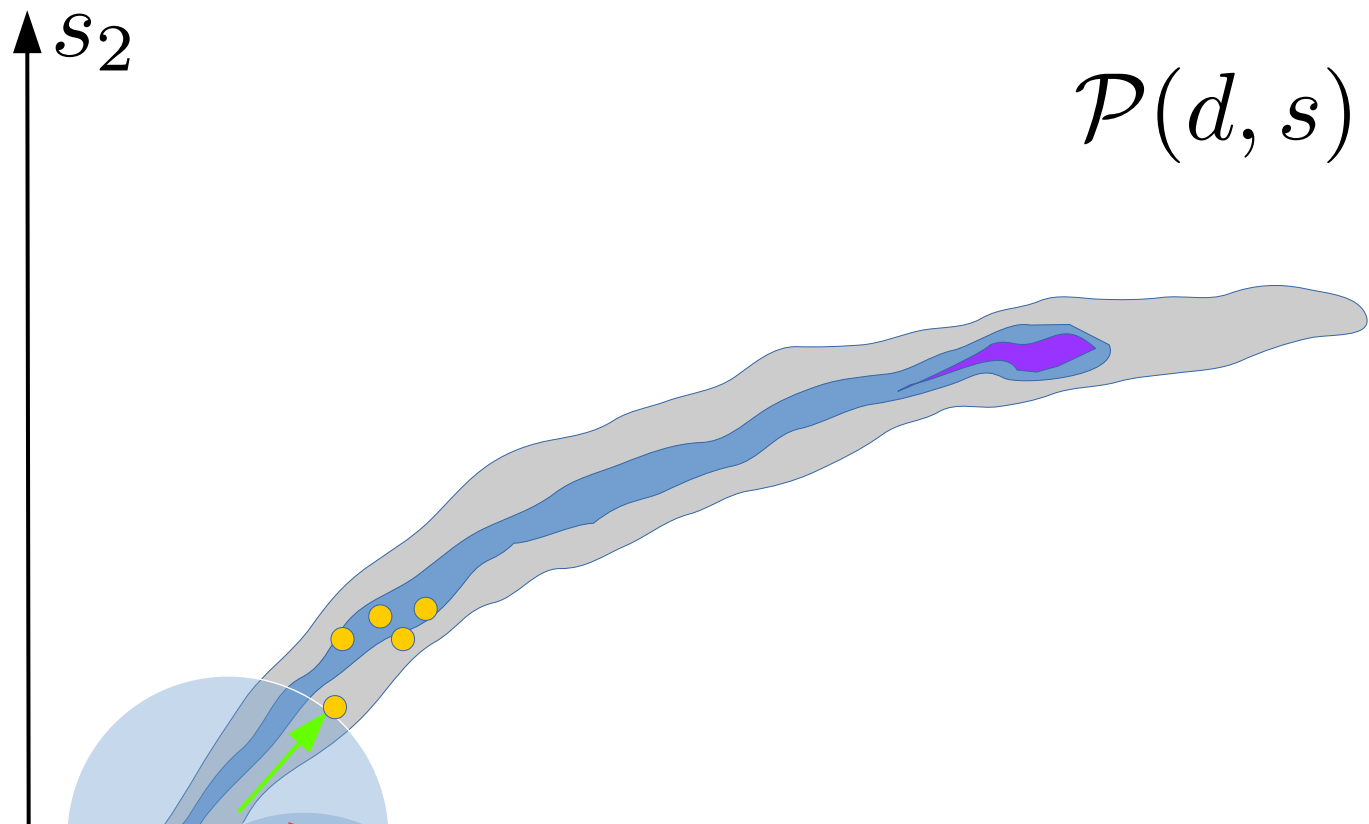
# Rejection Sampling



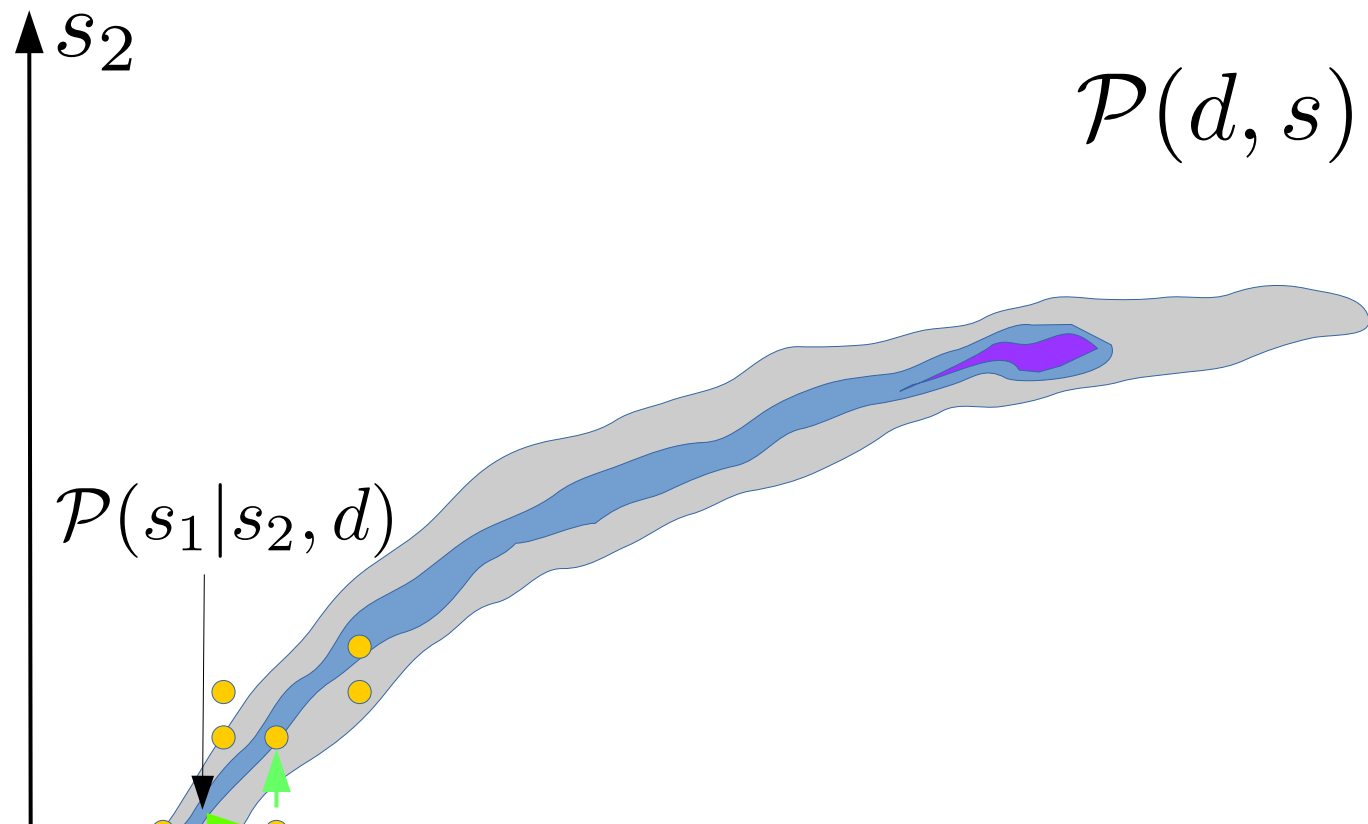
# Rejection Sampling



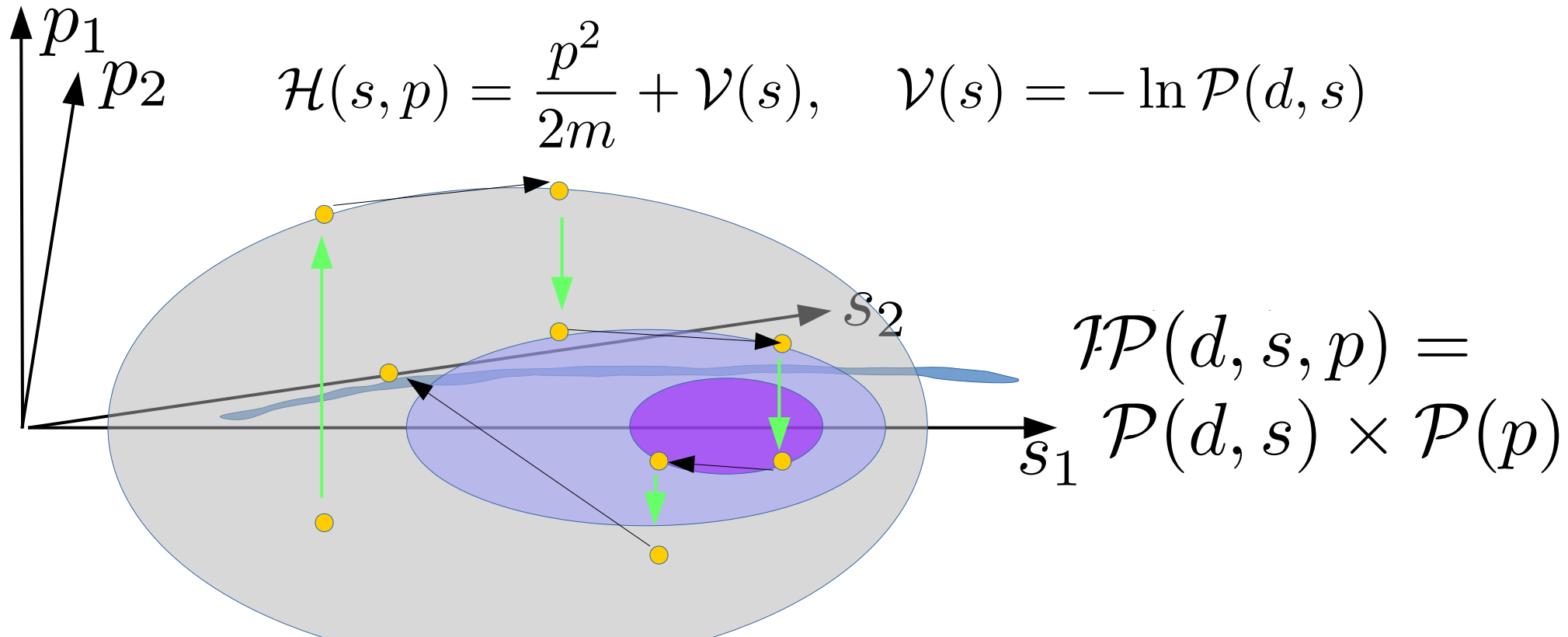
# Metropolis Hasting Sampling



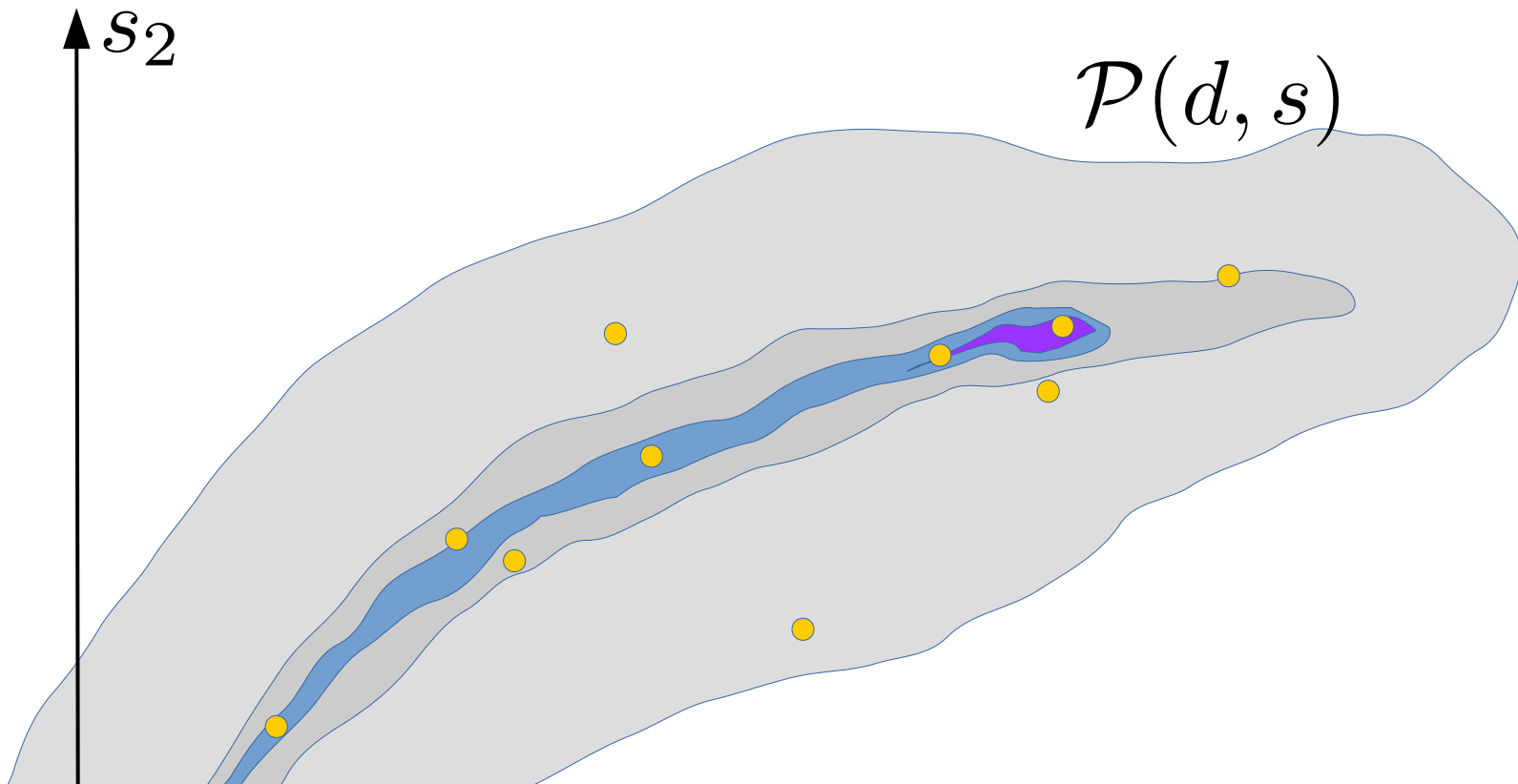
# Gibbs Sampling



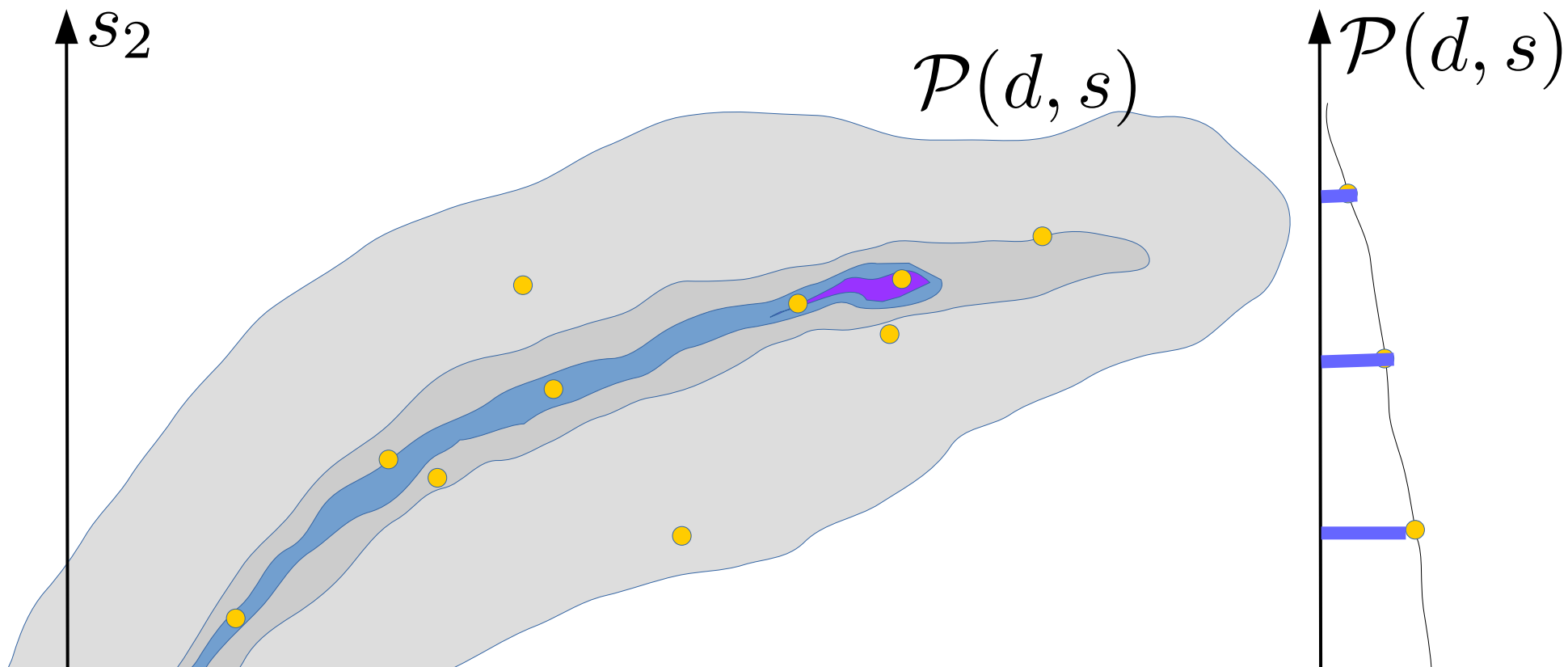
# Hamiltonian Sampling



# Nested Sampling

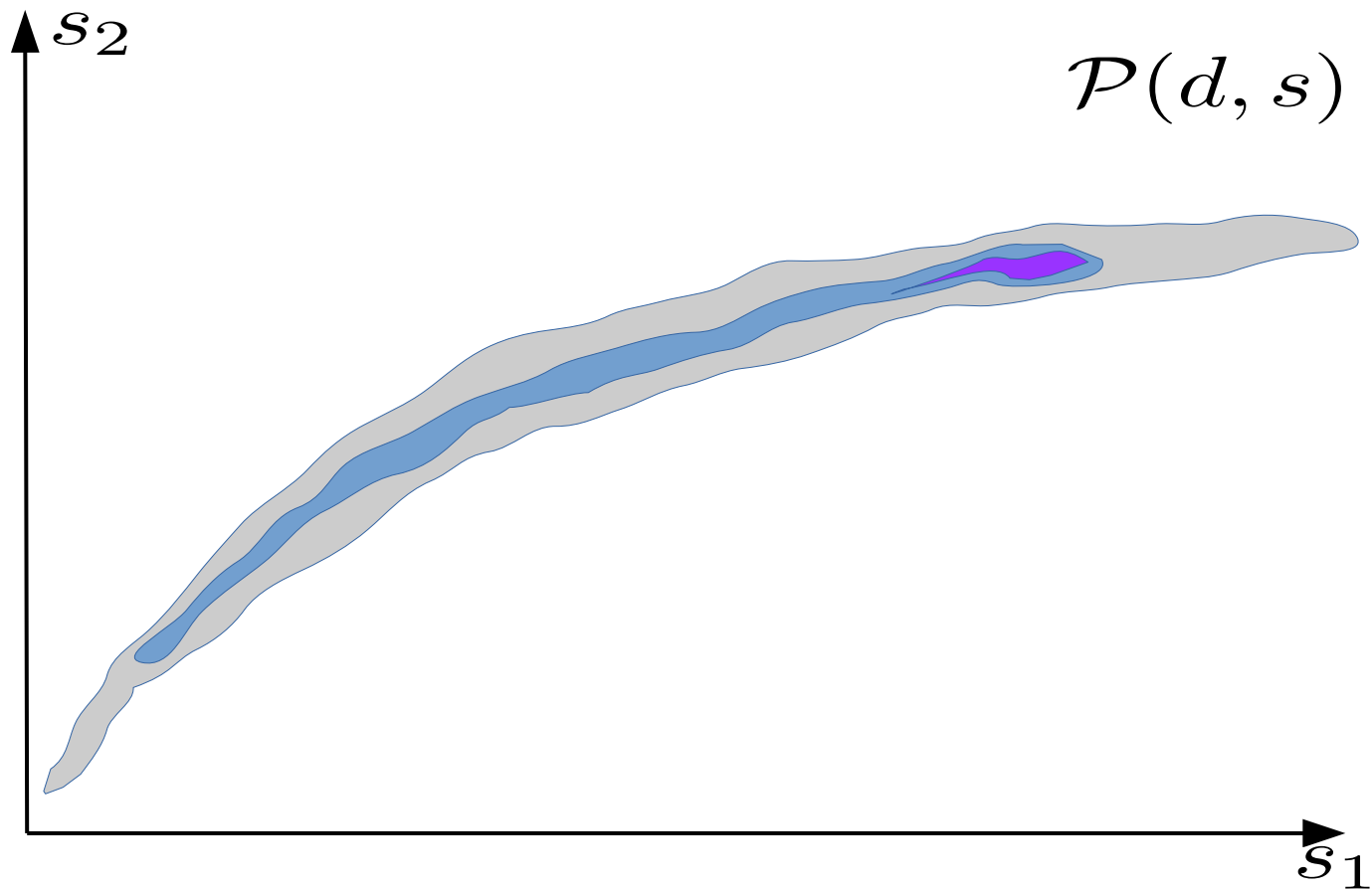


# Nested Sampling

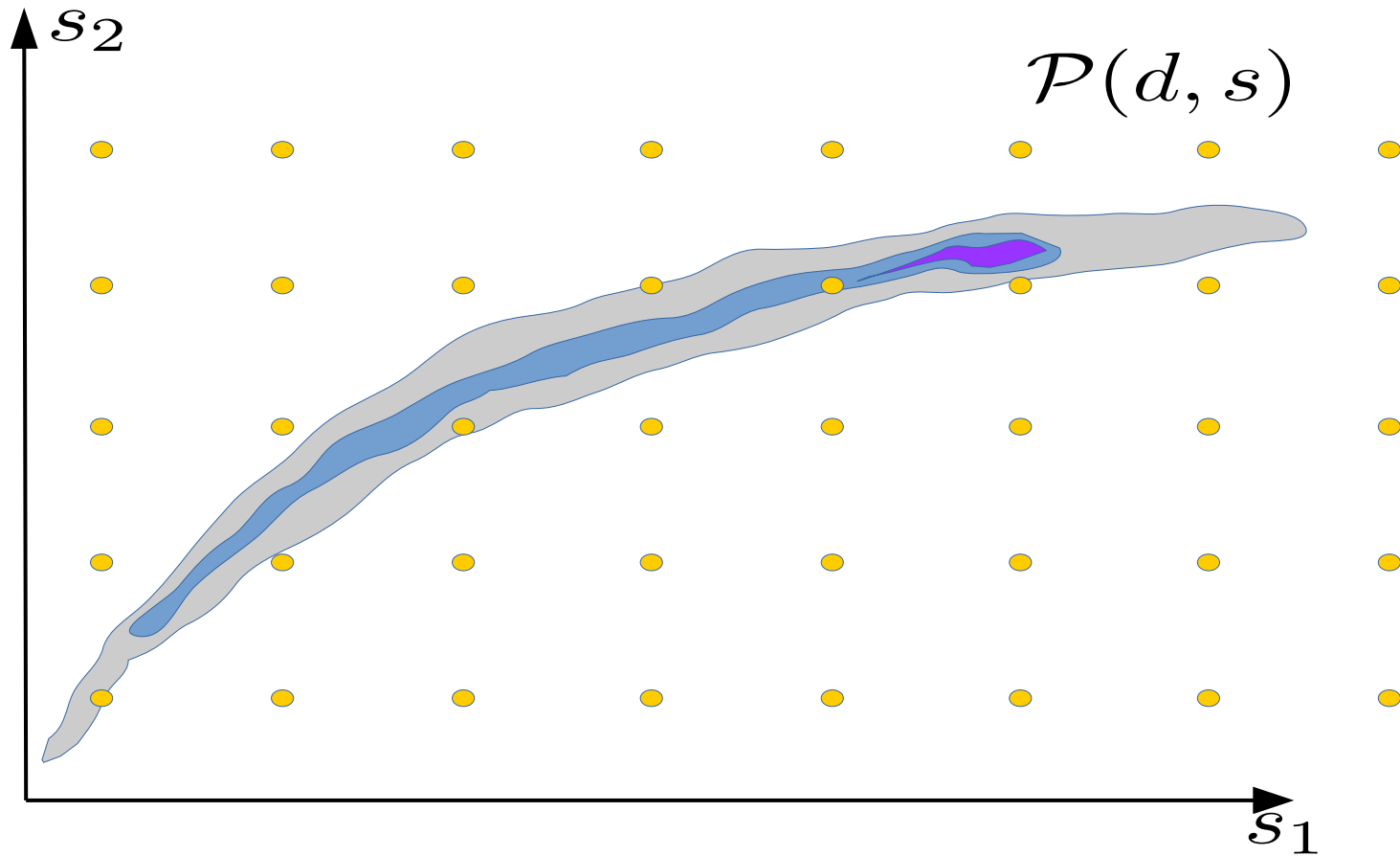




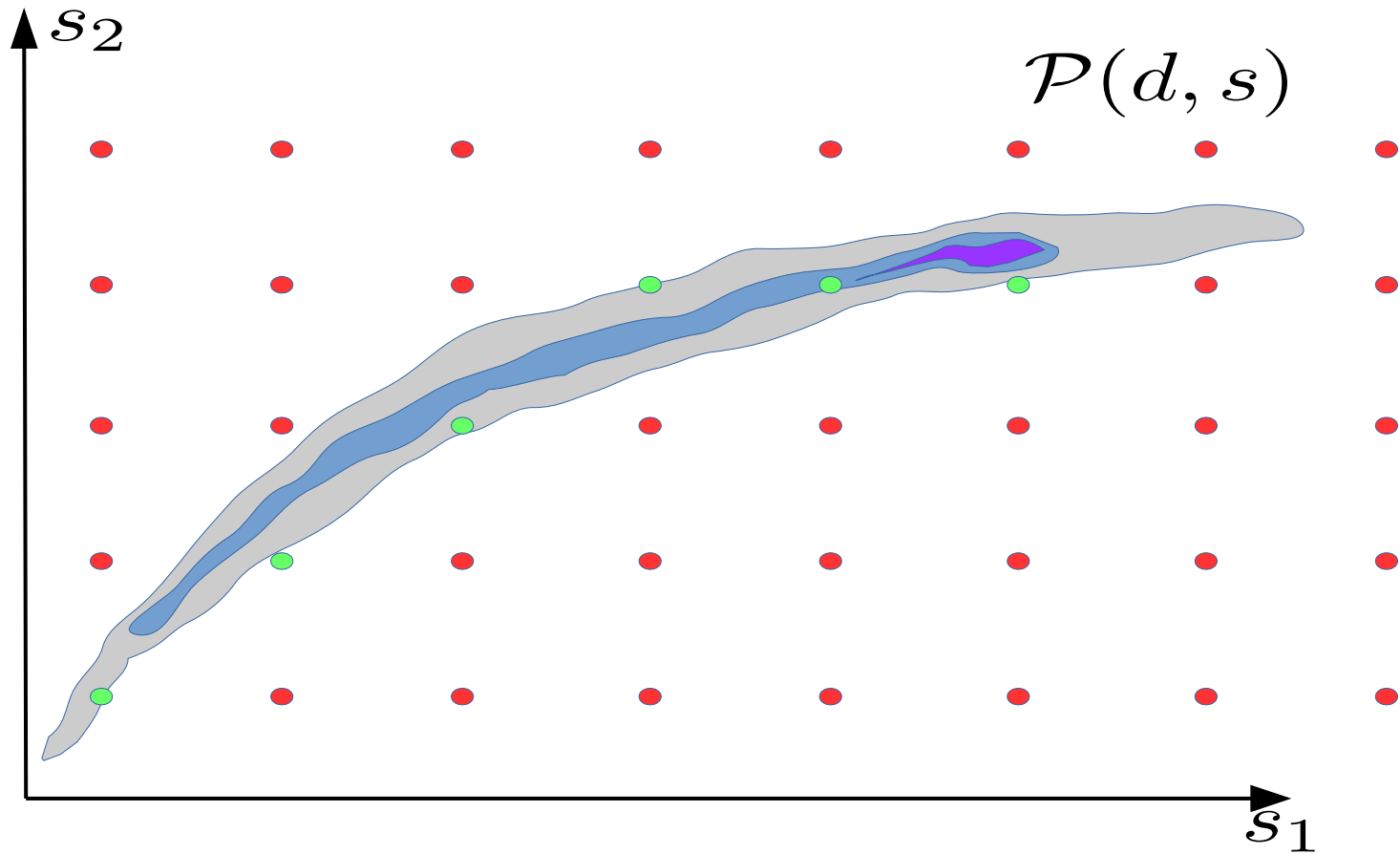
# Sampling



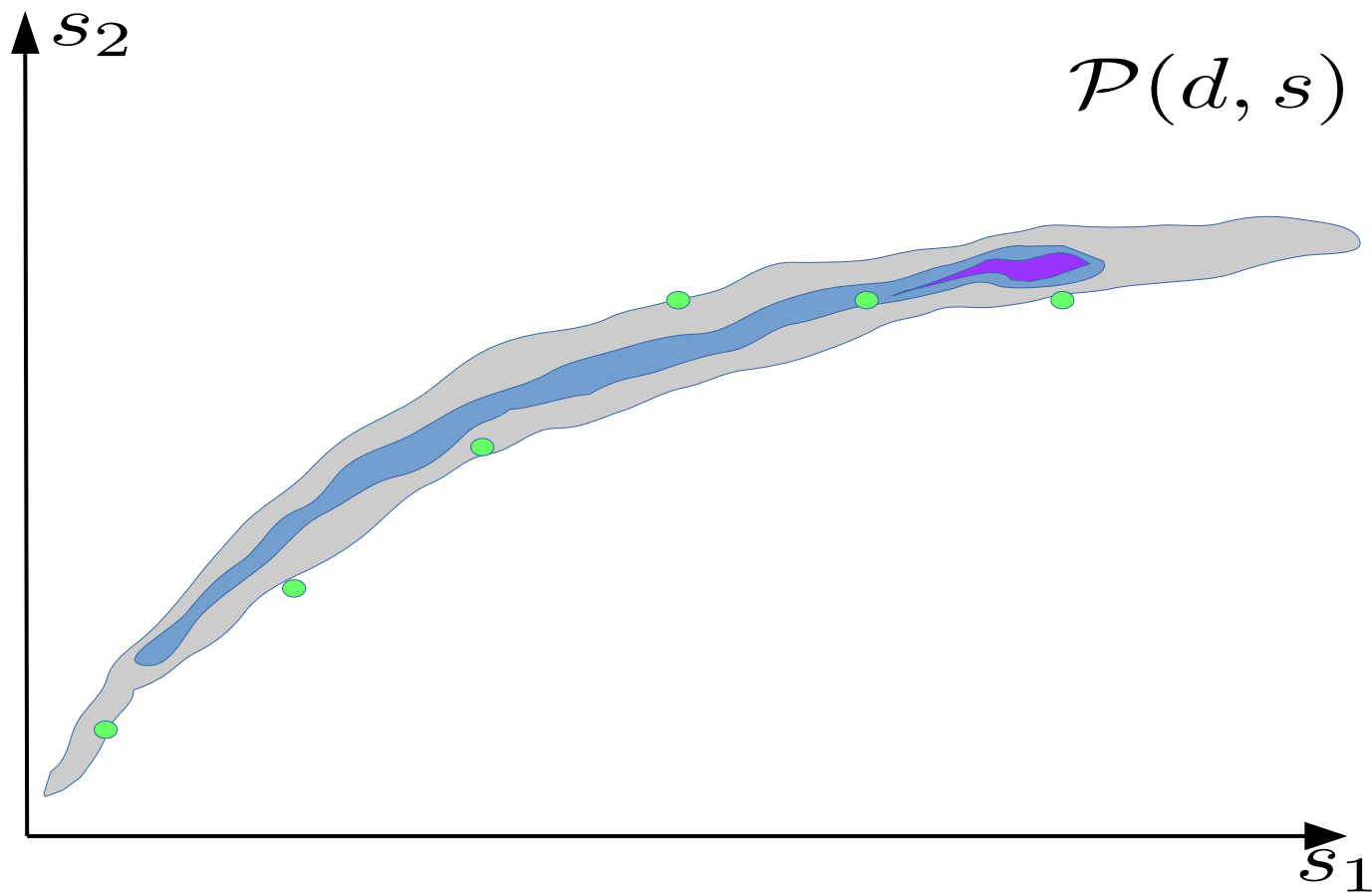
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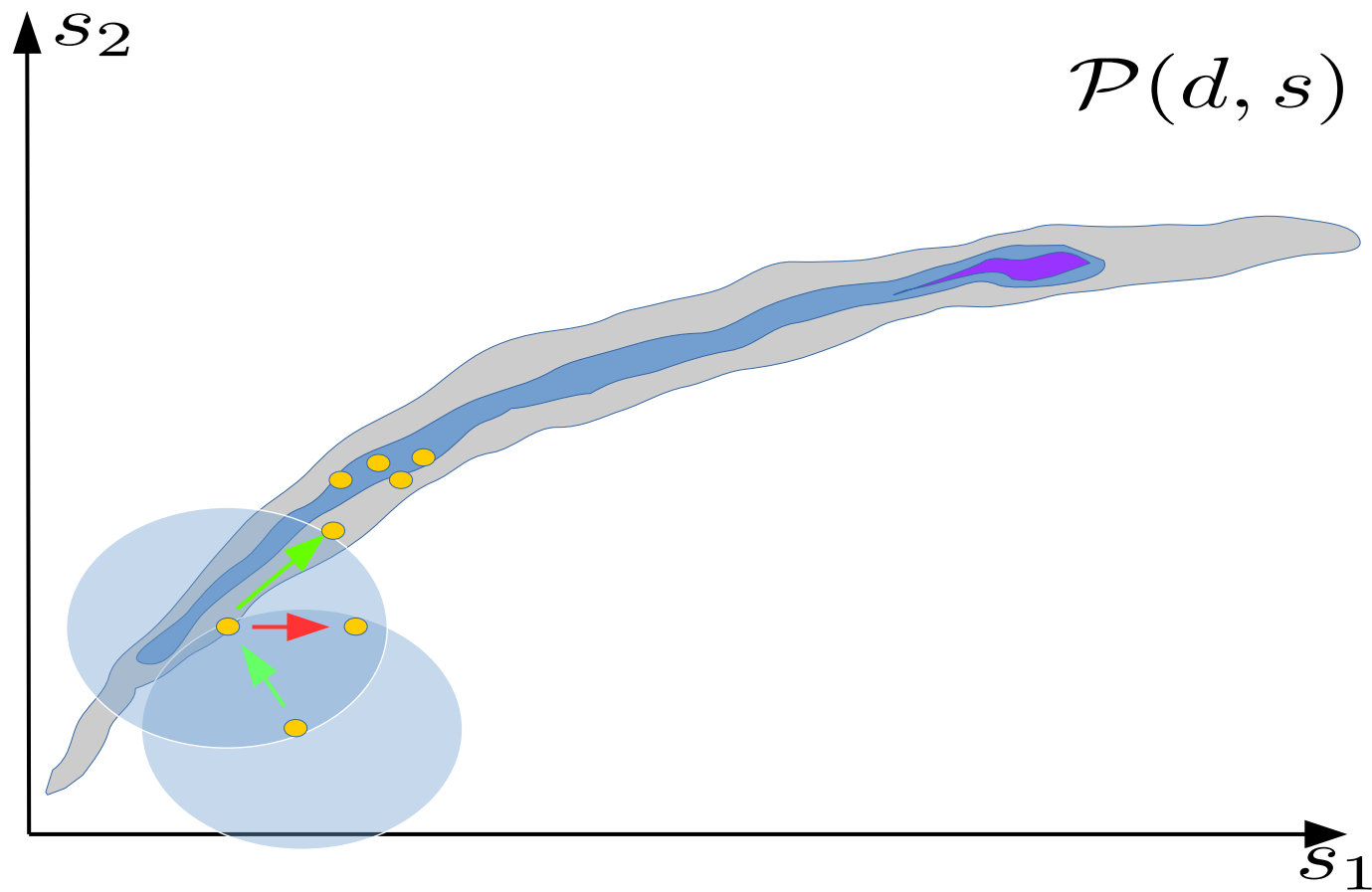
# Rejection Sampling



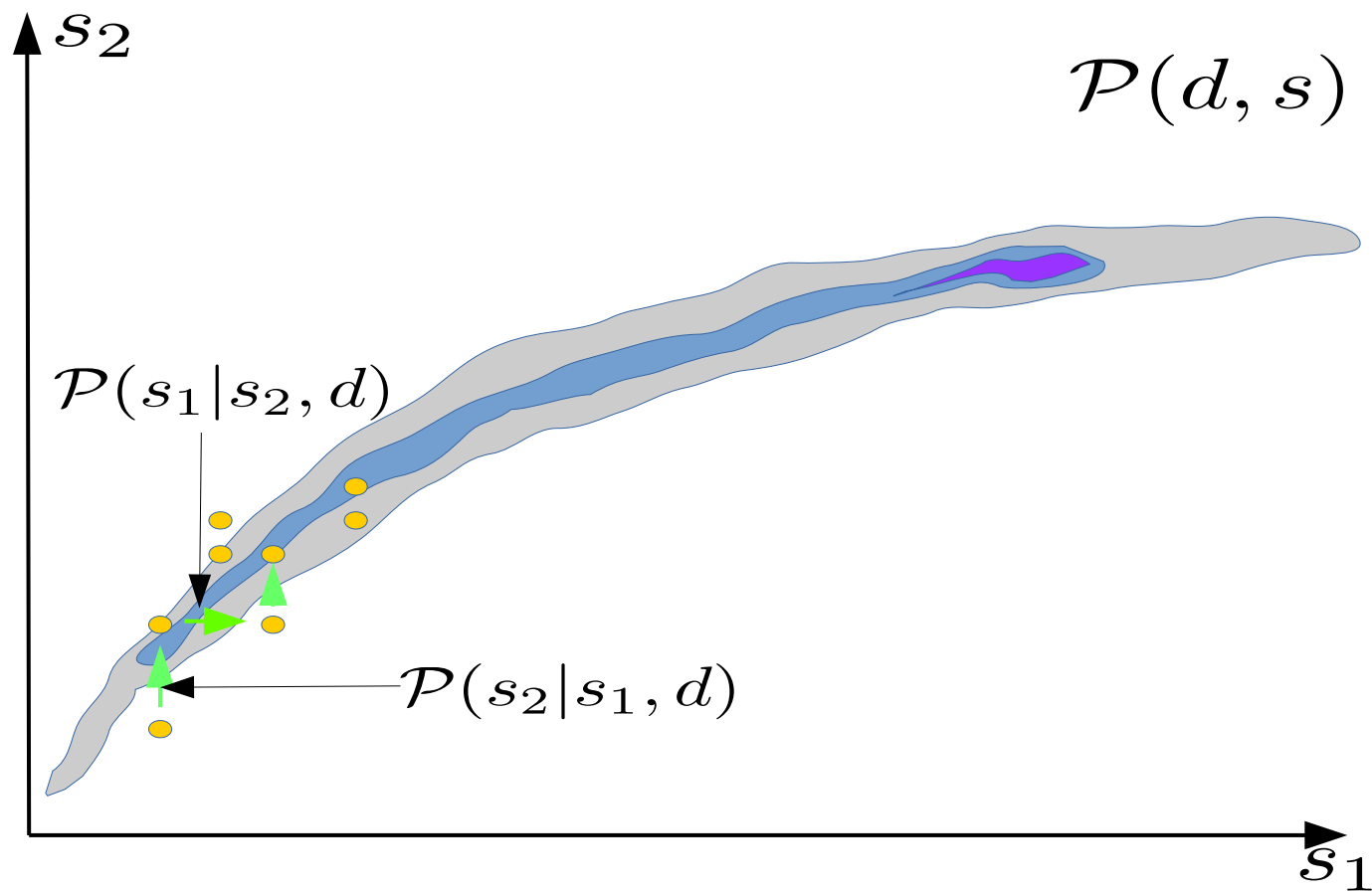
# Rejection Sampling



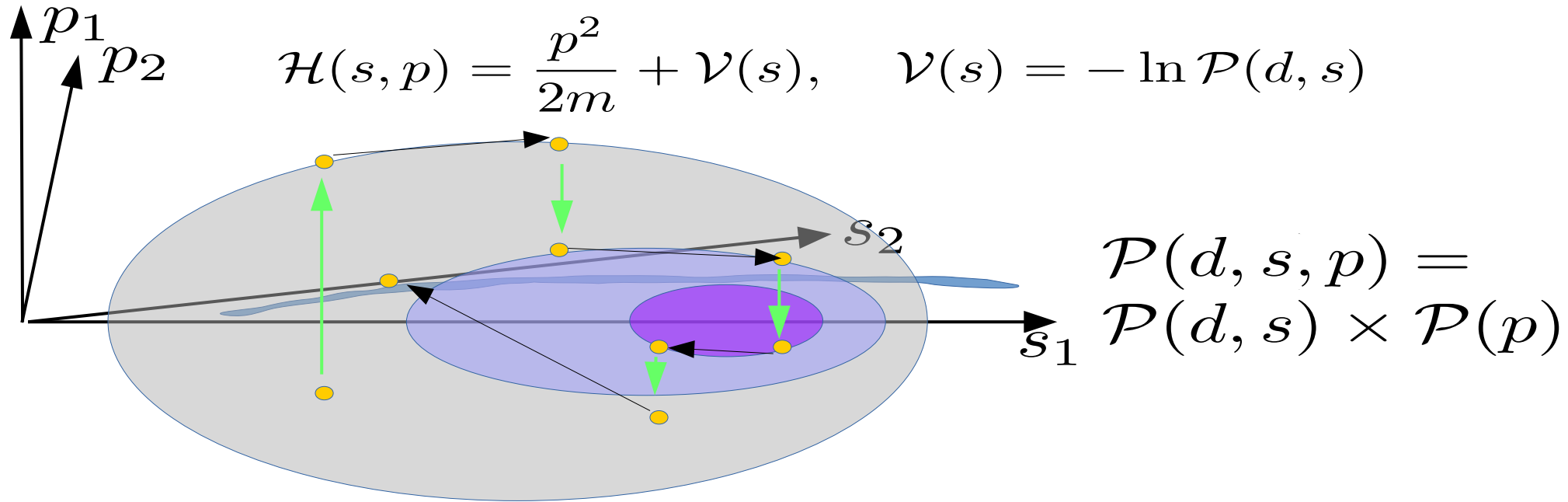
# Metropolis Hasting Sampling



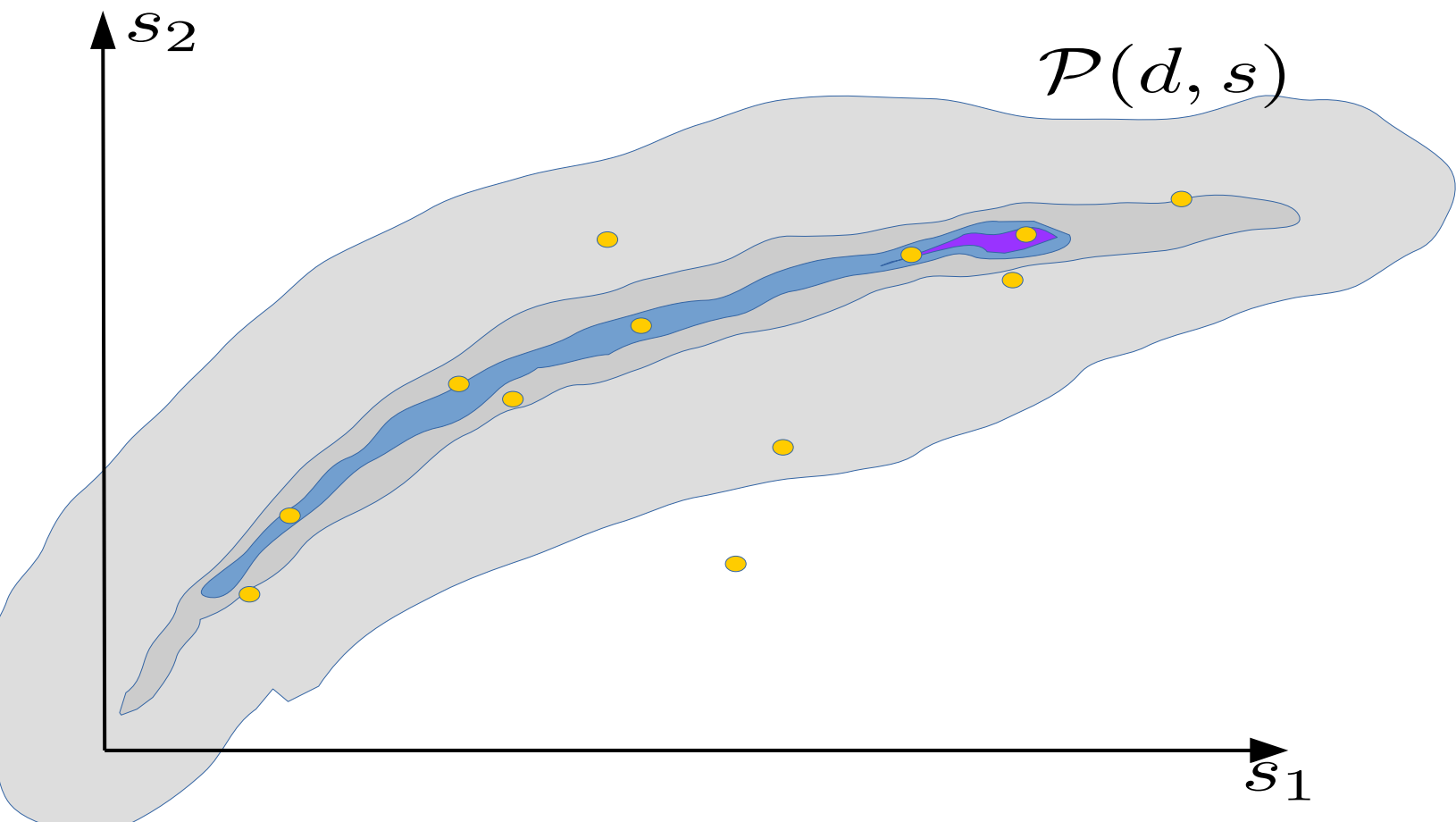
# Gibbs Sampling



# Hamiltonian Sampling



# Nested Sampling





# Nested Sampling

