

Excursion

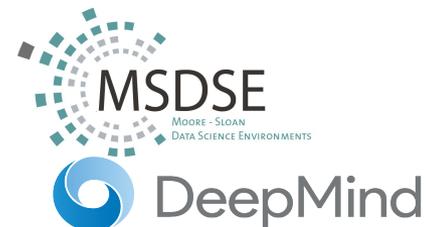
Efficient Reinterpretation Campaigns with Active Learning

Irina Espejo (NYU)

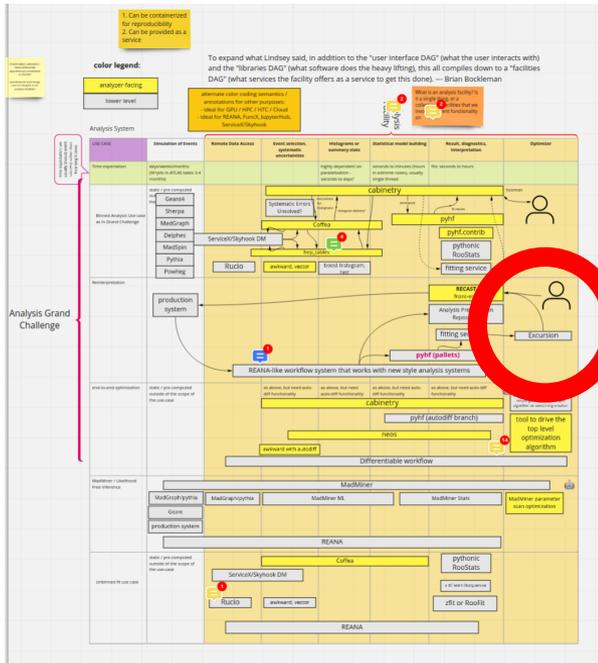
Lukas Heinrich (CERN)

Gilles Louppe (U. Liège)

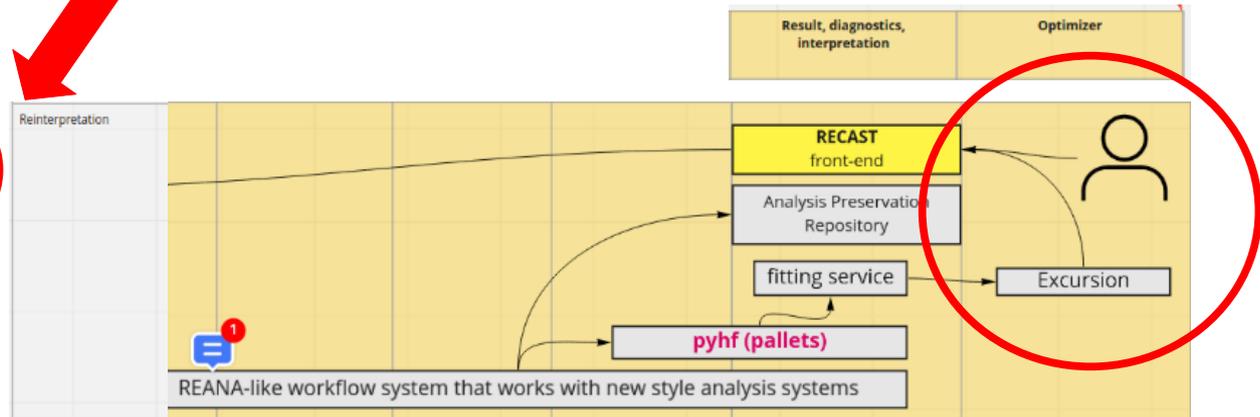
Kyle Cranmer (NYU)



Context



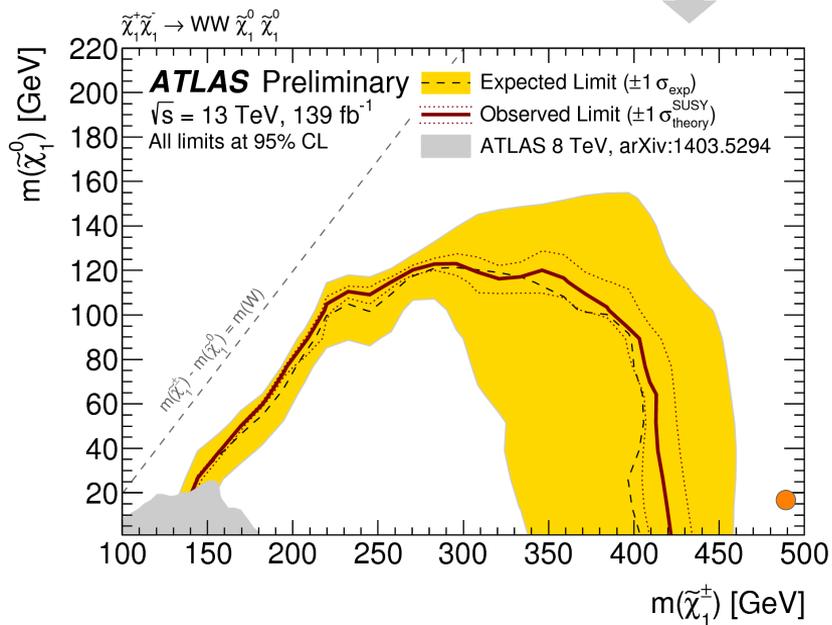
You are here



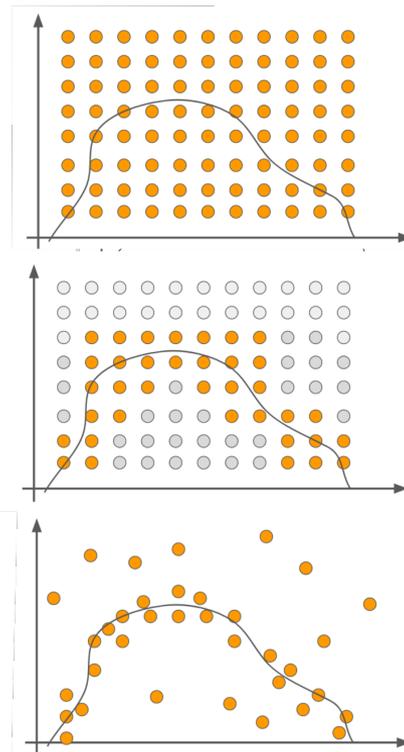
Excursion would orchestrate the sequential calls to RECAST and fitting-as-a-service

Context

The final stage of a BSM search is often presented as an exclusion contour



How to calculate the contour :

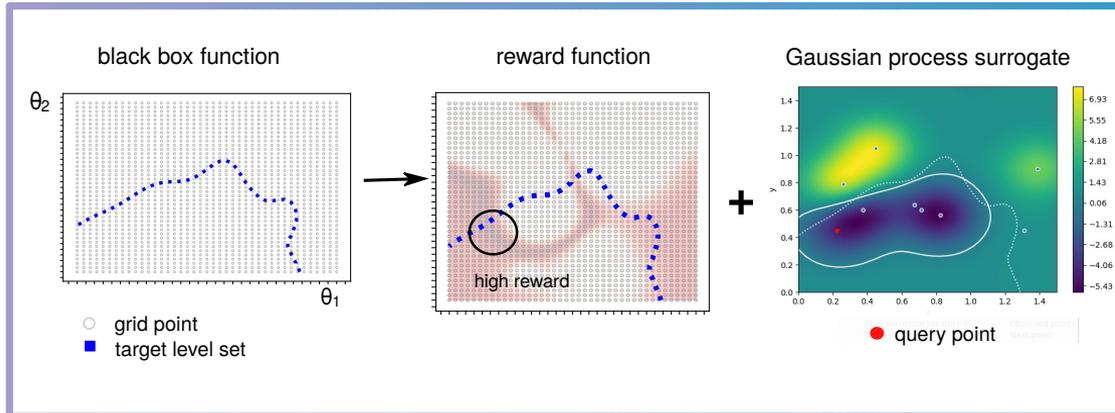
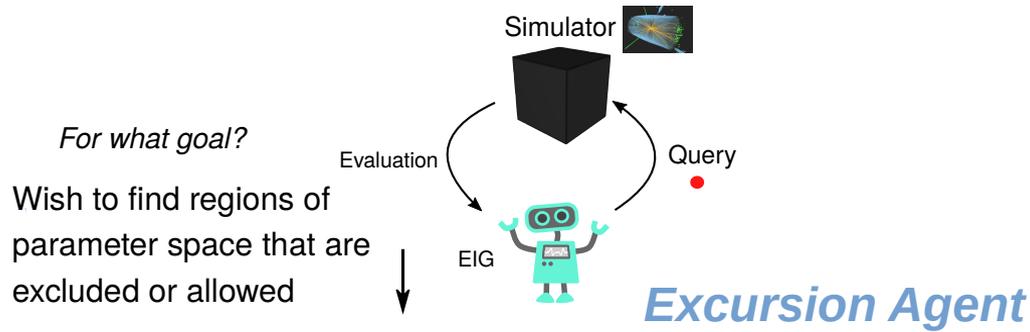


Regular grid
(expensive)

Ideal
(but we don't
know a priori)

Excursion
(balance
exploration vs
exploitation)

Basic idea



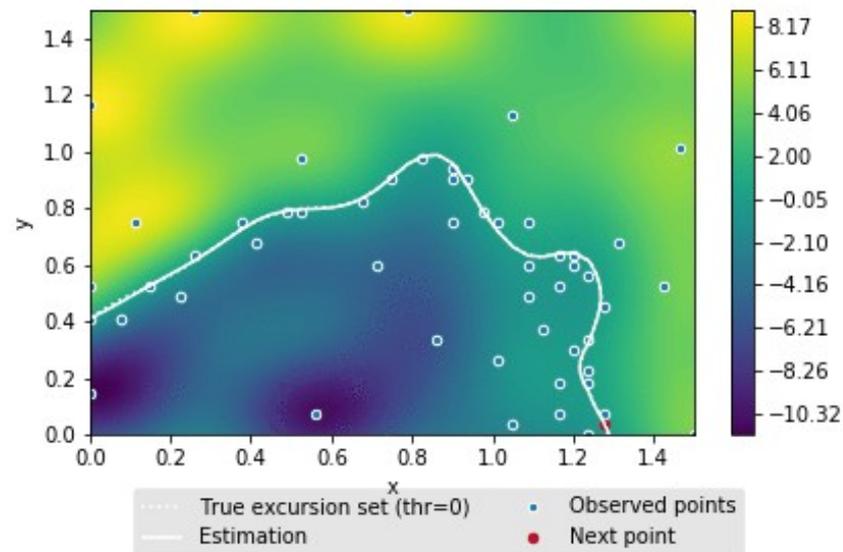
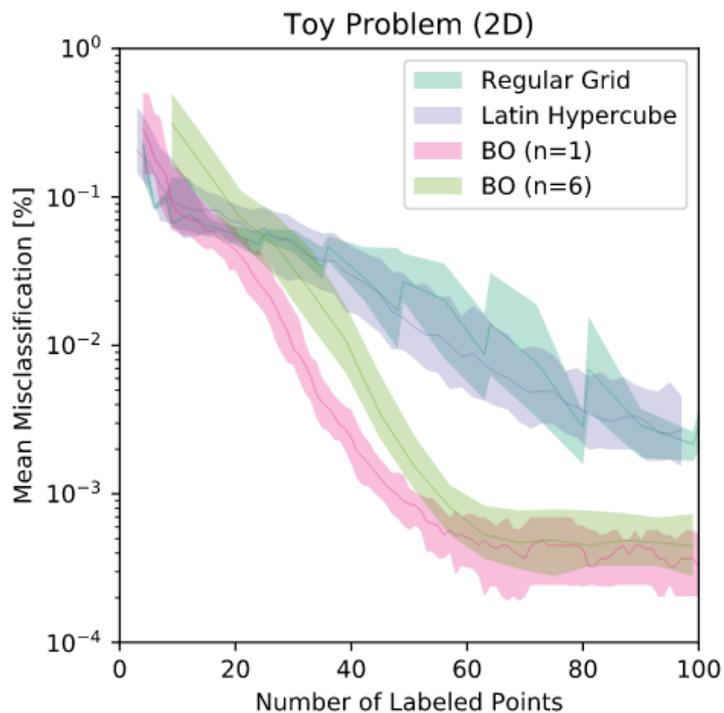
- Like Bayesian Optimization for black box functions but not trying to find a point that maximizes the function, *we are trying to find a contour, which is more difficult*

$$u_{MES}(x) = - \sum_{c_j} p_j(x) \log p_j(x) \quad \text{with } p_j(x) = \int_{t_j}^{t_{j+1}} \exp\left(-\frac{(y - \mu(x))^2}{2k(x, x')}\right) dy$$

Gaussian process: $Y(x) \sim \mathcal{N}(\mu(x), k(x, x'))$ thresholds: t_j

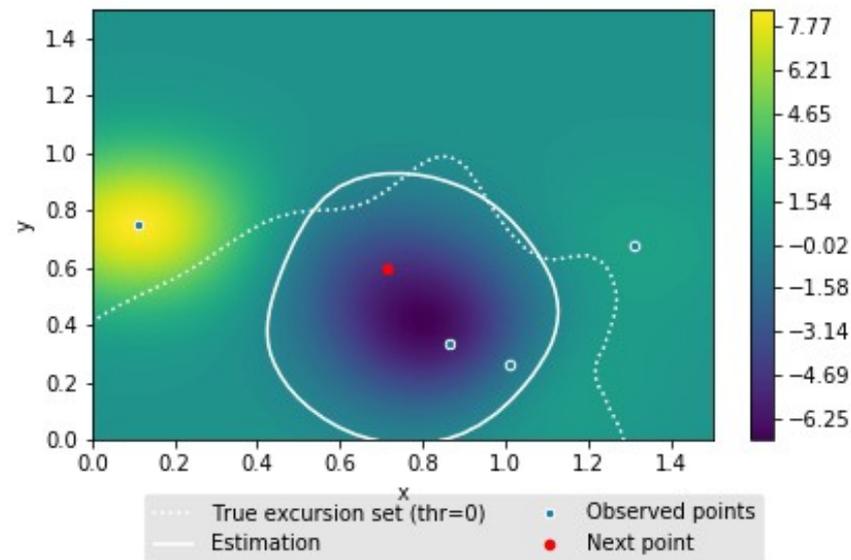
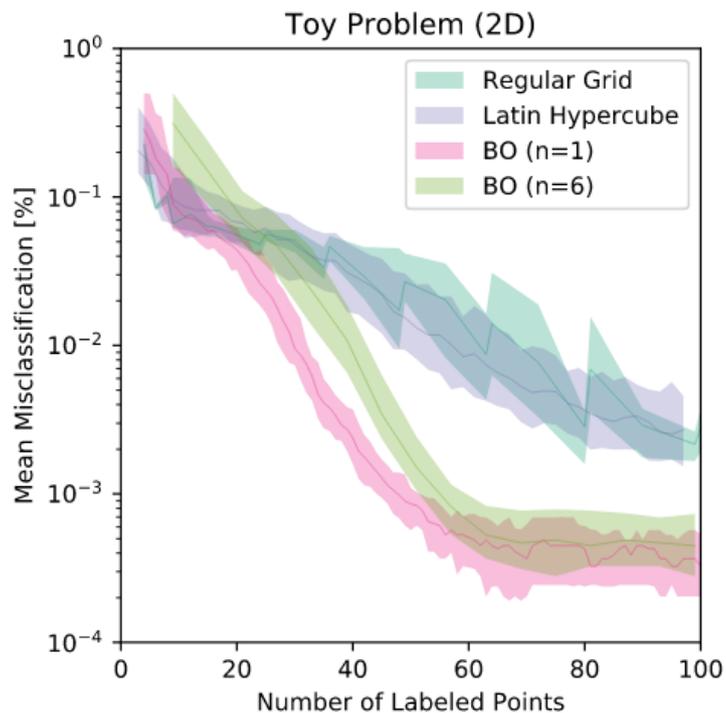
- Active Learning + Gaussian Processes
- Batches for parallelization

Excursion reduces computing demands for simulation



Samples concentrate around the true contour

Excursion reduces computing demands for simulation



...and GPyTorch too



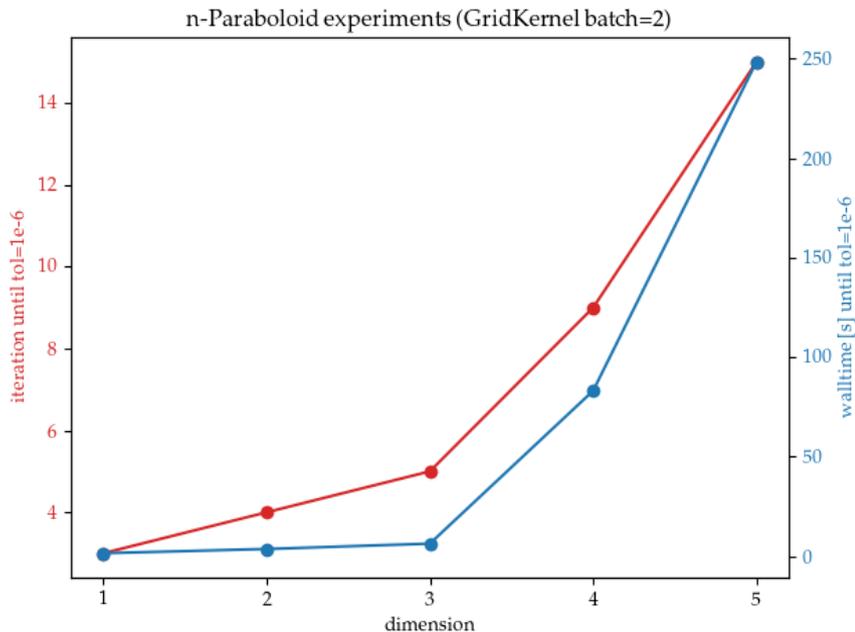
- Native GPU support
- State-of-the-art fast posterior fit techniques
- Specific kernel for data structured a grid
`GridRegressionKernel`
- Flexibility with priors, kernels, noise and exact vs approximate inference
- Hyperparameter tuning is easy thanks to autograd
- Multitasking feature
- Native Lazy Covariance tensor evaluation
- Good documentation
- Anyone interested in Pyro integration?



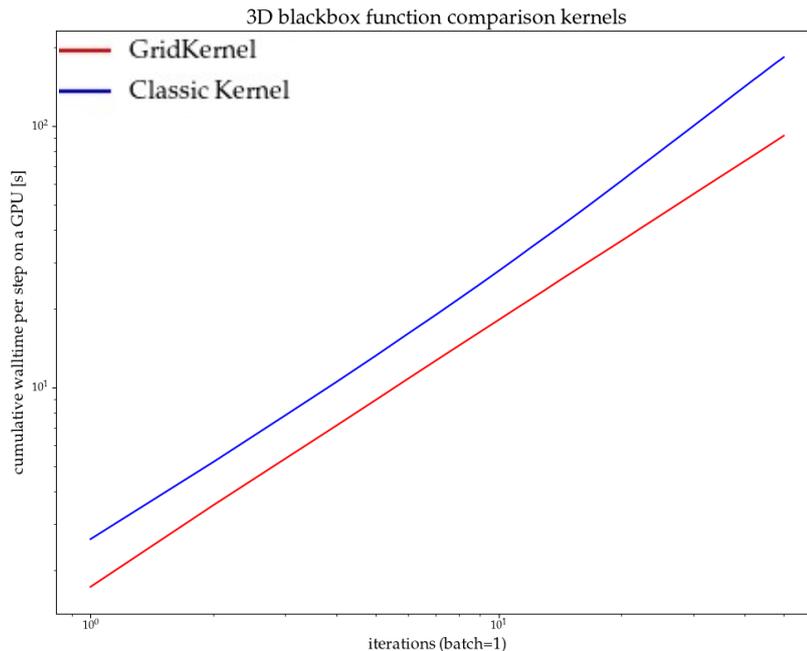
Exact GPs with Scalable (GPU) Inference

In GPyTorch, Exact GP inference is still our preferred approach to large regression datasets. By coupling GPU acceleration with **BlackBox Matrix-Matrix Inference** and **LancZos Variance Estimates (LOVE)**, GPyTorch can perform inference on datasets with over 1,000,000 data points while making very few approximations.

...and GPyTorch too



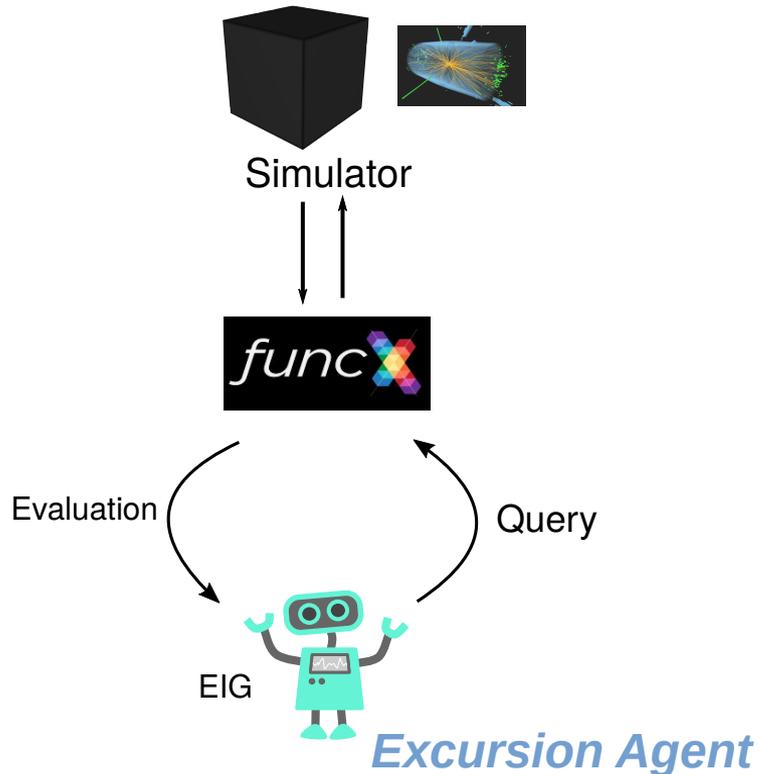
BSM theories have many parameters and GPyTorch GridKernel can scale to higher dimensions



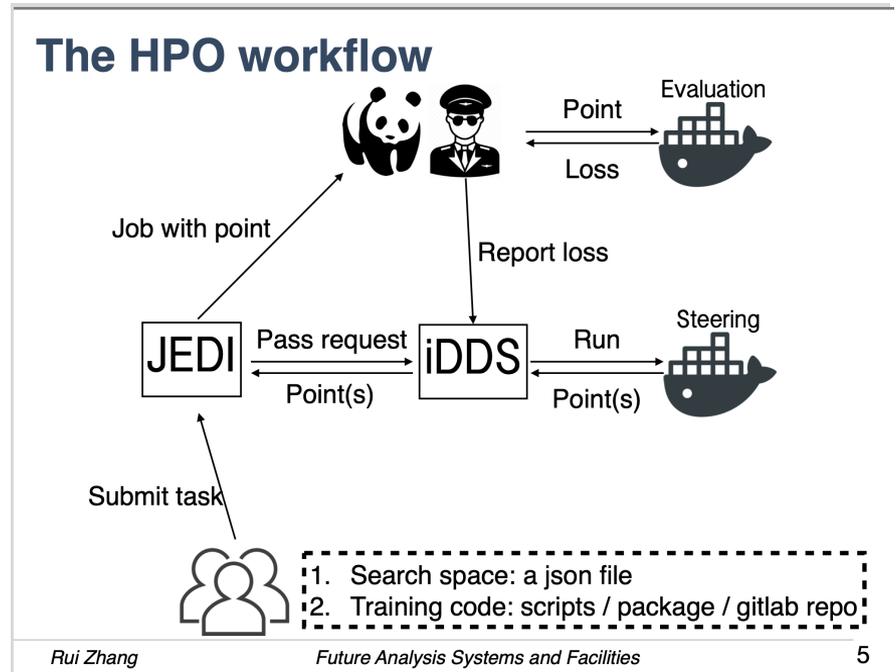
GPyTorch GridKernel is faster than a regular Kernel

Deploying excursion at Analysis Facilities

funcX could be used for a fast, approximate version of the full RECAST workflow

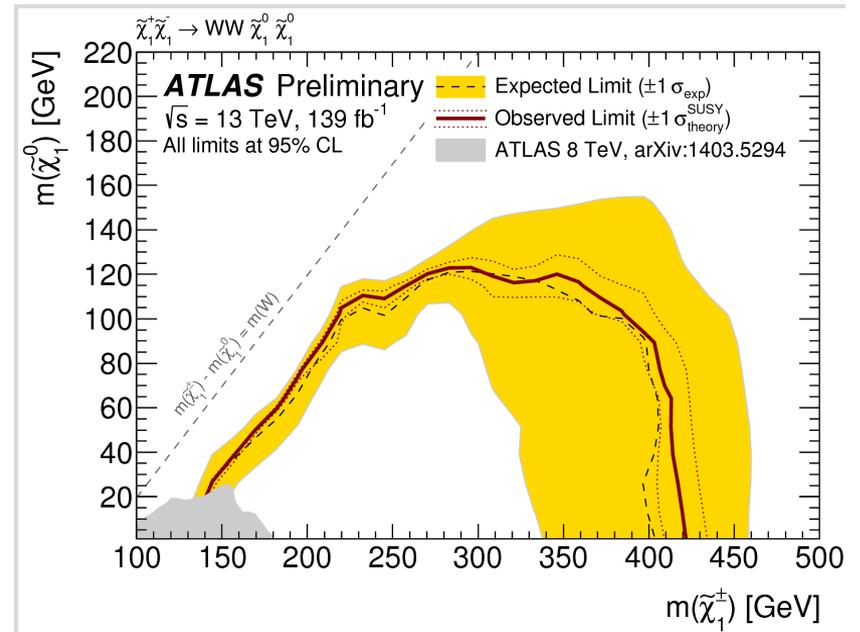


Could deploy similar to hyperparameter optimization



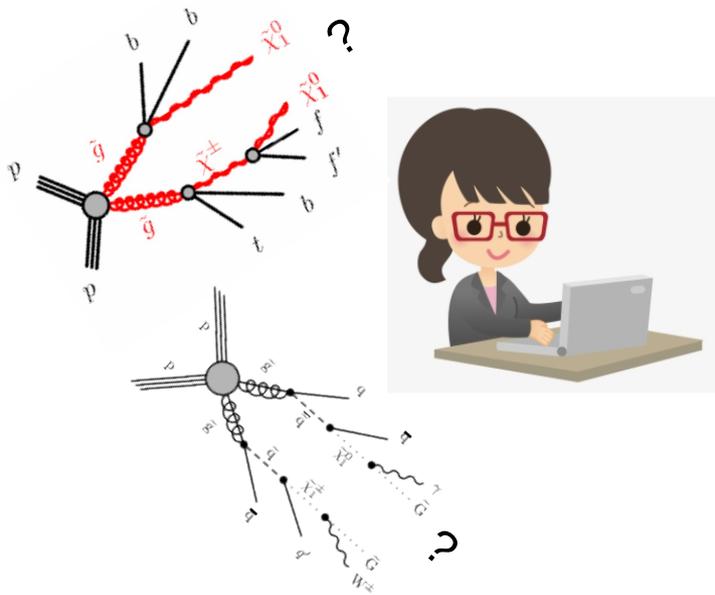
Going one level up in abstraction

The final stage of a BSM search is often presented as an exclusion contour

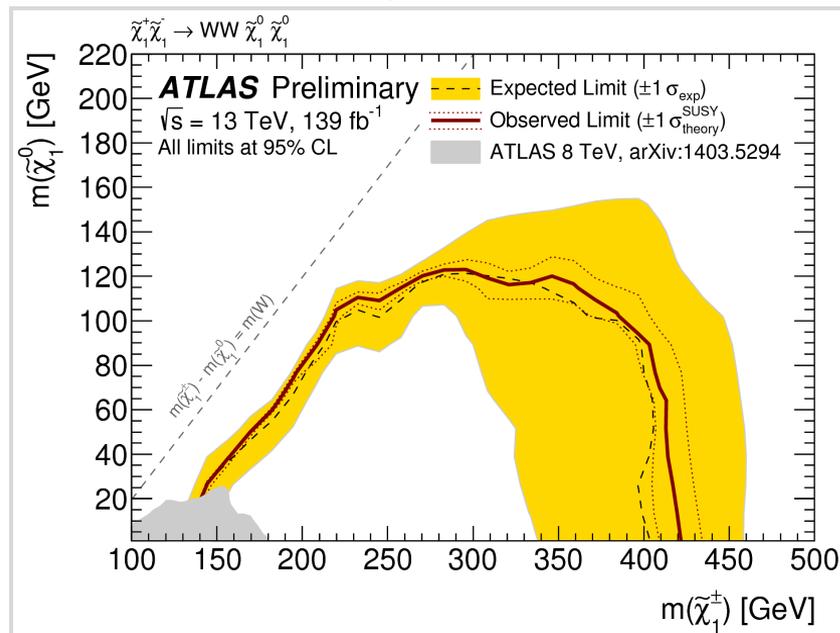


Going one level up in abstraction

The initial stage of a BSM search looks like this



The final stage of a BSM search is often presented as an exclusion contour



Active Learning



Thank you