GP – Data-driven Approach for Interpolation of Sparse Datasets

- Accurate resonance studies need consistent datasets from multiple experiments.
- We use Gaussian Processes (GPs) to interpolate data and quantify uncertainties.
- Bayesian inference optimises GP hyperparameters.
- GPs allow prediction at any kinematic point—no arbitrary data weighting needed.
- Validated with pseudodata and applied to test cross-source data consistency.

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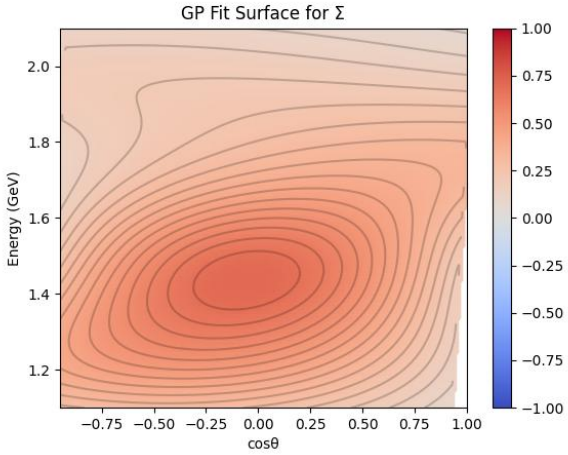
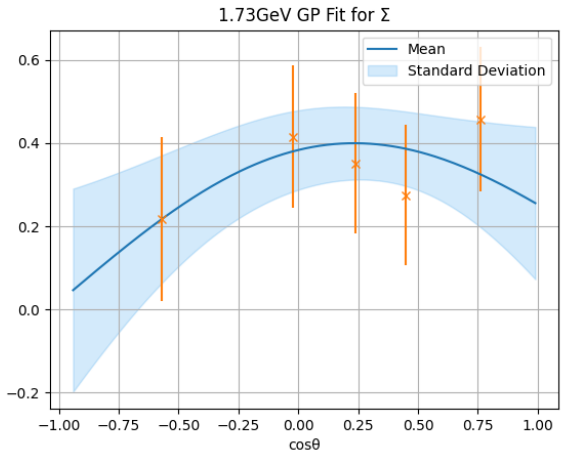
- Standard GP tuning via **log marginal likelihood** overfits on sparse data.
- We propose a **statistically motivated loss function** comparing predictive uncertainty to expected coverage (e.g., 68.3% within 1σ).
- Loss:

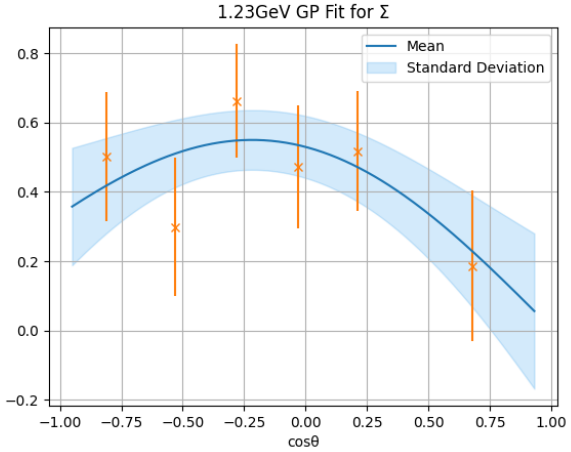
$$f(\vec{l}) = \int_0^3 \left| M(c\sigma, \vec{l}) - P(c\sigma) \right| dc$$

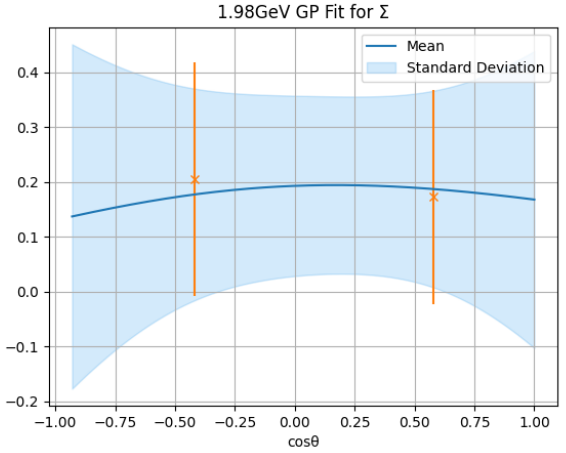
(M = measured, P = expected coverage)

- Approximated via discrete sum over 1000 cσ values.









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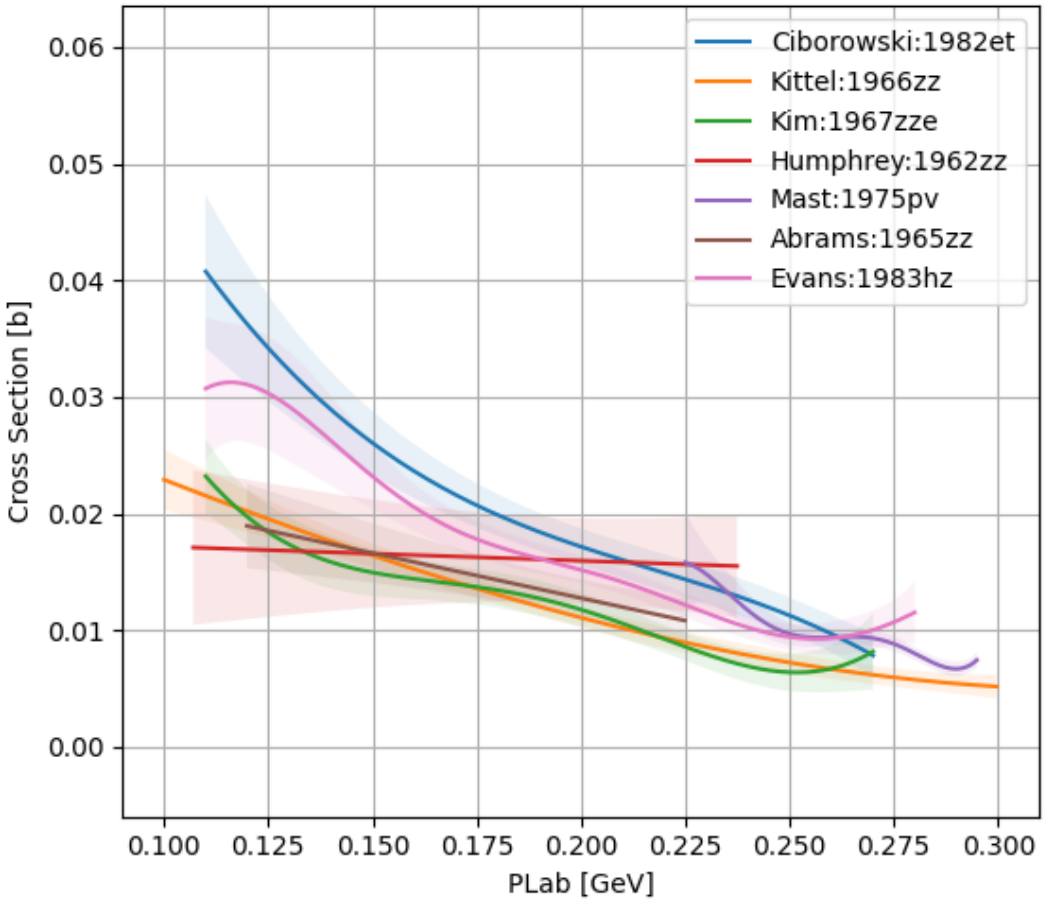

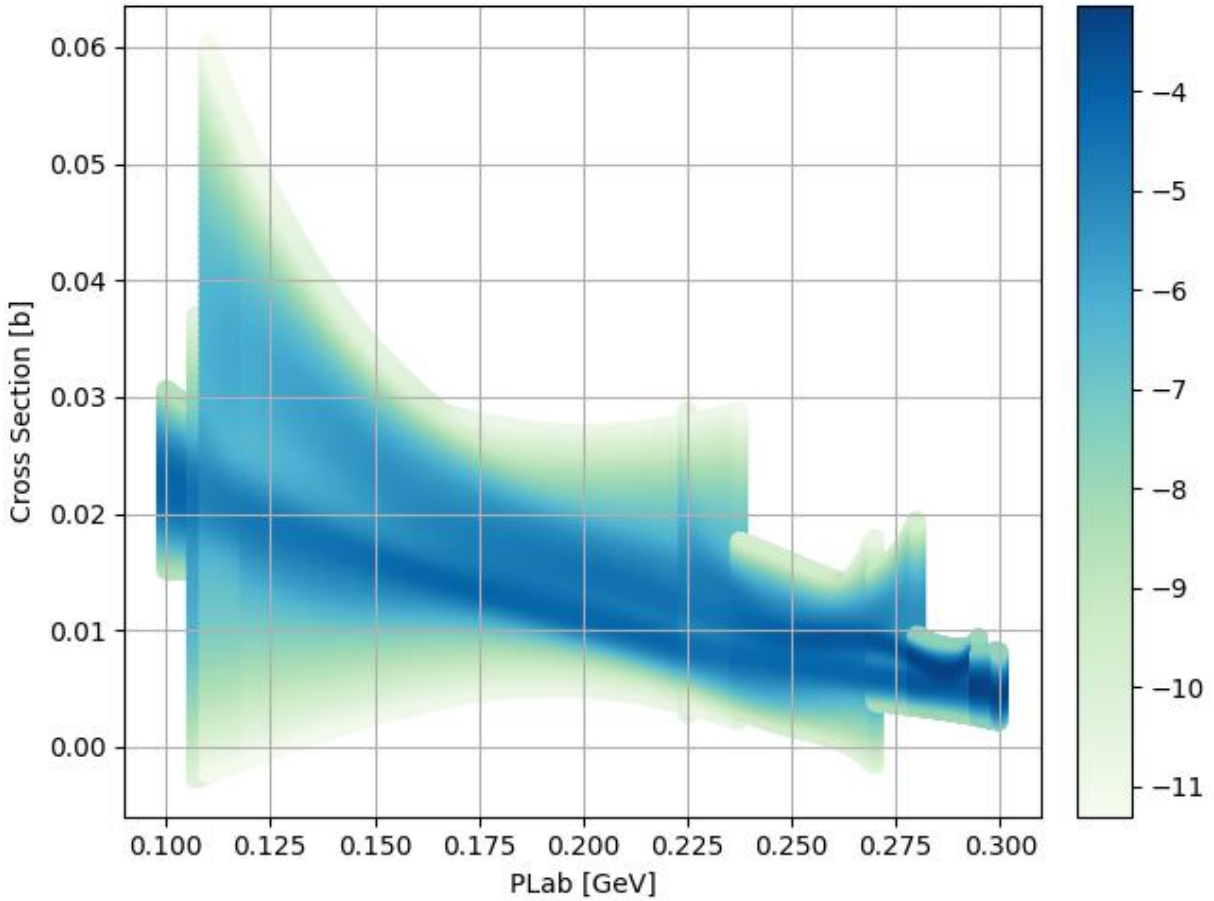

By performing GP fits on individual experiments, summing and normalising the curves for discrete energy values, the probability surface of cross sections (or other physics quantities) can be found

https://arxiv.org/abs/2505.01473

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