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SHiP Spectrometer Optimization using Bayesian optimization with Gaussian processes

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SHiP is a new proposed fixed-target experiment at the CERN SPS accelerator. The goal of the experiment is to search for hidden particles predicted by models of Hidden Sectors. The purpose of the SHiP Spectrometer Tracker is to reconstruct tracks of charged particles from the decay of neutral New Physics objects with high efficiency. Efficiency of the track reconstruction depends on the spectrometer geometry. Parameters of the geometry can be optimized to archive the higher efficiency. One of the most popular methods of optimization is grid search. This method is reasonable when the number of the parameters is small. However, the grid size increases exponentially with number of parameters. This requires large computational resources to check all grid nodes. It is especially important when one node checking is expensive and requires to run the spectrometer simulation. Bayesian optimization is an optimization method of expensive objective function. At each iteration it estimates a new point to check where the objective function may has the optimum. This allows to find the optimum with lower number of checks than for the grid search. In this study the SHiP Spectrometer Tracker optimization using Bayesian optimization with Gaussian processes in considered. The study have been done on MC data. The results of the optimization is also considered.

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