Fig. 4-3: The emittance values and bin widths obtained from my analysis program. This data was obtained before corrections were made to the background suppression, so the most current values are around 200 and 290 for εx and εy respectively. Regardless, these values are thought to fall within the expected range for a system such as this, and were pointed out as actually being somewhat more reasonable than the values calculated by Dr Kamakura's program (both smaller by about a factor of 2). “emX_10” in this case means the emittance in the x direction where the included bins in the area calculation have emittance values >= 0.1*εmax (global maximum emittance value).

Week of 7-1-24

In general, this week was considerably less productive than usual – tours of J-PARC and Spring 8 laboratories (each encompassing an entire working day) this past Monday and Friday coupled with the midterm presentation Wednesday detracted strongly from my usual workflow. Nevertheless, some small advancements were made and there is a clear objective for future work this coming week.

The main accomplishment of this week was the production of a program that runs a Bayesian optimization that minimizes the total emittance of the beamline system. This is done by having the Bayesian optimization method (obtained via the GPyOpt BayesianOptimization python package) enter values for the ‘K1’s of each quadrupole magnet, running an OpalT simulation with these K1 values (requires generation of a new program file) and then reading the output of the simulation in order to determine the fitness of the optimization. Different methodologies for improving this optimization are being investigated, including performing an emittance calculation outside of OpalT (was brought to my attention Thursday – this may help to actually verify results) and altering the output quantity (for the moment, the quantity being minimized, or the ‘output’ fed back into the Bayesian algorithm was sqrt(em_x^2 + em_y^2), a physically meaningless quantity that was meant to contain emittance information for the x and y planes and therefore minimize both quantities at once). The results are somewhat appreciable for now, as the aforementioned quantity has been able to be reduced by ~35%, but using an independent analysis software to generate emittance values is being looked into since there appeared to be no appreciable effect on other aspects of the collected data just by using the default values calculated by OpalT.

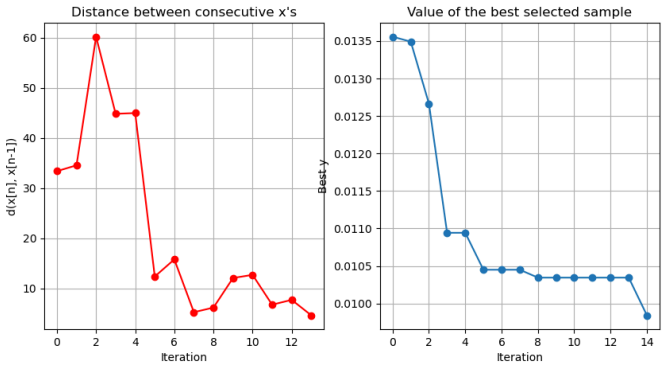

Fig. 5-1: Histograms generated by the Bayesian optimization algorithm. The left shows the distance between the consecutive iterations of each variable (probably some average or combination of the four variables being optimized) and the right shows the output value of each iteration (the fact that it's decreasing means that the optimization is functioning as intended).