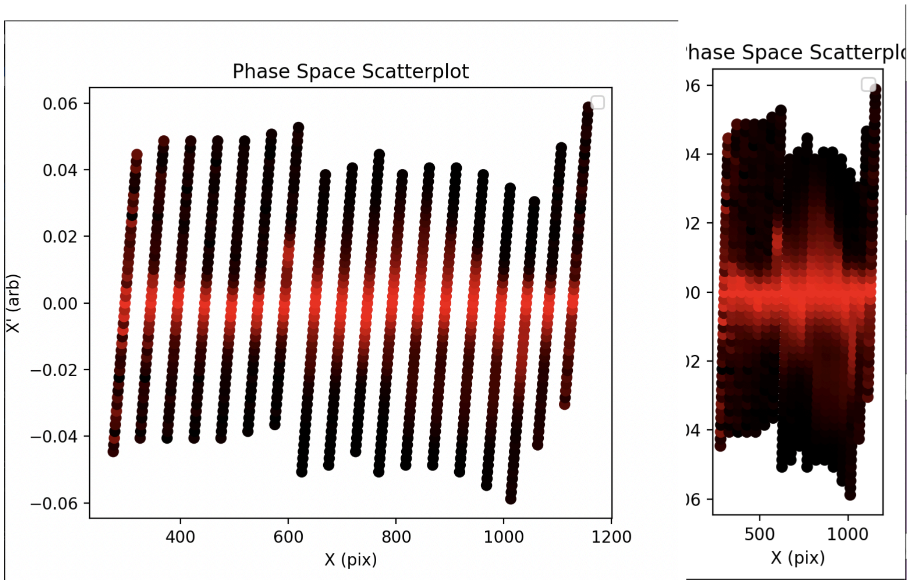
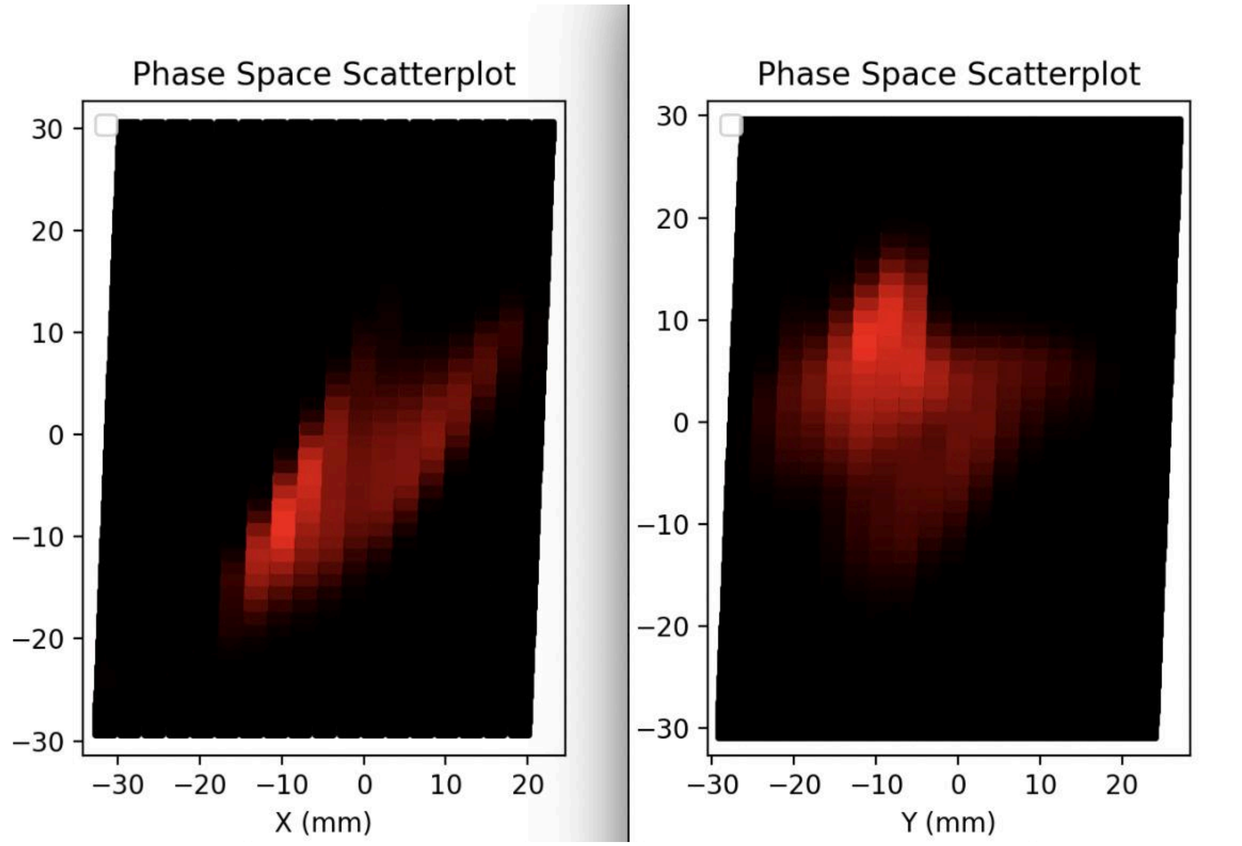


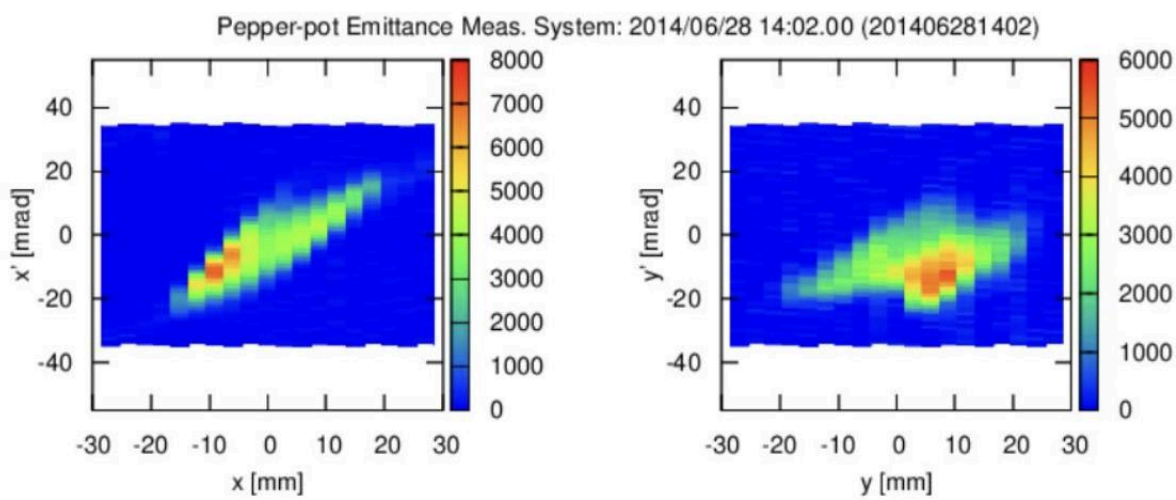
Figs. 3.3, 3.4: Phase space diagrams produced for testing purposes. These don't look great, but they're sufficient to observe the phase space distribution of the dataset. There's clearly some kind of alignment issue with this histogram at the moment (it seems the maxima aren't all fully in line with each other) but otherwise the distribution shows some promise.

As soon as the phase space diagrams are completed, finding the emittance values will be added (which shouldn't be a particularly difficult task – essentially just a portion of the area shown by the phase space diagrams) and the analysis program will be complete. After this point, a separate program will be written to use this data for some beam parameter optimizations using machine learning (exact methods / quantities TBD).

Week of 6-24-24

This week began with placing the finishing touches on the aforementioned analysis program (improving the visibility of the phase space, implementing methods to calculate emittance based on area, etc.) The program is, for the moment, finished, and this coming week I will turn my attention to making an optimal Opal simulation of a dataset that we would consider "ideal" (minimization of the area of the distribution in the phase space, and therefore the total emittance). The Opal simulation will have its parameters determined by a Bayesian optimization set to minimize the total emittance in the X, Y, and Z directions (in general a desirable trait for a beamline -- I believe this has to do with some correlation between emittance and accelerator inefficiency). I suspect that writing the Python script to interface with Opal and optimize the parameters will only take about a day (likely less, barring software issues) and once the simulation data is collected, I will begin looking into methods to design the machine learning algorithm that will likely encompass the rest of the project.





Figs. 4-1, 4-2: My analysis (red, top) and Dr Kamakura's analysis from 2014 as compared by using the same input file. The Y-Y' distribution for my analysis has its coordinates reflected across both axes in these images, but this has been corrected (I don't have access to the new images at the moment). In general, the distributions have very similar characteristics and are effectively "the same".

```
mrad: 1.239669421487548
mm: 2.975206611570247
emX_10: 170.23197948684606*pi mm*mrad
emY_10: 237.15075762996491*pi mm*mrad
```

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).