This is a compilation of the code that Maria used for various parts on the VLA proposal

Proposal can be found here: <https://www.overleaf.com/project/5f258de1b733a00001f6f715>

*Overall comments:* When going through all my notes for the VLA proposal I found two things. I adjusted them for the proposal itself. But these are now things that we will want to straighten out in the analysis we put into the paper.

[1] First, there was a small typo in our equation for Mdot in the SSA\_props function. The original equation has the term (epsilon\_b/0.1) and (f/0.5)^(-8/19). However, the code itself only said (epsilon\_b) and (f)^(-8/19) → it was missing the normalizations. This caused the quoted mass loss rates resulting from our radio analysis to be almost an order of magnitude smaller than they should have been. I have fixed this in some of my code, but in others where I was reading data files that were made with the old version there is just a correction factor (described below)

[2] Second I was going back to check an error bar on one of the upper limits for the second epoch of the data for PS1-11aop, and when I ran the data, I actually found that there was a detection in two of the frequencies. This doesn’t change our results; other than eliminating a few of the possibilities that survived when we only have two detections. But we should touch base on this. Here is a summary of the data I found for PS1-11aop:

* Epoch 1:
  + 0.0405 +/- 0.0078 mJy at 9.77 GHz
* Epoch 2:
  + < 0.405 mJy @ 3.00 GHz
  + 0.0318 +/- 0.0095 mJy @ 6.05 GHz
  + <0.258 mJy @ 9.02 GHz
  + 0.0258 +/- 0.0056 mJy @ 14.75 GHz

**Jupyter Notebooks:**

* **Names**: freesync\_PS11aop\_e1.ipynb, freesync\_PS11aop\_e2.ipynb, freesync\_PS11vo.ipynb
  + *What they do:* These are my equivalent of the code that we developed last year that runs a grid to check what SEDs are allowed by each of our data points.
    - These ones were run with the updated data that I referenced in point [2] above. This is now also coded up so that the Mdots and densities should be correct if you run them.
    - These also make a plot of the values that are allowed for each epoch.
  + *To Do:* Should run versions of these to get updated values.
* **Name**: 2020A\_SEDPlot.ipynb
  + *What it does:* This is the notebook that makes Figure 3 in the proposal with of all the different allowed SEDs at the epochs we have, and then shows what predicts for the next semester will be:
  + *What it needs:* For the epochs that we have already observed, it needs the output files of the form PS11aop\_grid\_e1\_allowed.csv created by the notebook above. For the panels that represent the future, it needs files of the form “Projection\_11aop\_SSA\_d2980.csv” which give allowed parameters projected forward to 2980 days after the explosion. These files were created by the notebook ‘SSAFFA\_SEDTest.ipynb, described below. I’ve uploaded files of this form to the google drive folder as well, so that you can run this code, however, I’ve uploaded files of this form to the google drive folder as well, so that you can run this code without going through those first.
  + *For the Paper:* First, we don’t need PS1-11vo for the first paper on PS1-11aop; second we also don’t need to project forward into the future for the paper. So really we only need the top left and top middle panels of this. But these are useful for some of the stylistic parts
* **Name**: 2020A\_DensityPlot.ipynb
  + *What it does:* it makes Figure 4 from the proposal, the summary density vs. radius plot for the combined results from the optical and radio emission.
  + *What inputs it requires:* 
    - For the results from the optical modelling, this needs the densities and the inner and outer radii to have been calculated elsewhere already. (Adaeze has code for that).
    - For the results from the radio modelling, this needs the relevant file of the form, “PS11aop\_grid\_e1\_allowed.csv”. Note that the version of those files that I was actually reading in was made before I caught the bug described in [1] above. So I had to correct the densities. For instance in line 108 of the main block there is the following line:  
      PS11vo\_den1 = data\_plot4['den']\*(1/0.1)\*(1/0.5)\*\*(-8/19)  
      The \*(1/0.1)\*(1/0.5)\*\*(-8/19) factor there is correcting the density for the typo earlier. **So if we output a new table that has the correct versions, then this factor would be removed in those lines.**
  + *What updates we should make for the paper:*
    - Should make a version with only PS1-11aop on it.
    - Probably want to adjust the labels, since the shaded regions were idealized for a proposal.
    - I definitely hacked the top axis. I feel like there should be a better way to do that.

OTHER THINGS THAT I AM DOING SOME TWEAKS ON STILL:

* **Name**: SSAFFA\_LightCurveTest.ipynb
  + *What it does:* This was the beginning of my attempt to make a code that would allow us to make our own version of radio light curves at a given frequency, for a shock velocity and mass loss rate. This involves two steps:
    - The first big block of code essentially runs a massive grid of the SSA+FFA SEDs. You input the distance to the supernova of interest and an array of sets of times post-explosion that you want it to calculate SEDS for. It will then cycle through code like what we have done before. It will output a bunch of large files: one each for every time post-explosion you requested where it tells you the synchrotron parameters (radius, vshock, mass loss rate, etc.) for every set of Fp and nu\_p that you requested in the grid.
    - The second block of code tries to turn this into a light curve. You tell it what shock velocity and what Mdot you want a light curve for. It will then search through the file for rows that were close to that, runs another tiny grid around those points to fine tune, and the writes out a file with what the Fp and nu\_p would be at each time post explosion (assuming the vshock and Mdot that you input)
  + *Known Issues:* 
    - This has some issues as it has been written now. Mainly if we actually wanted to use this to make light curves all the way from promptly after explosion (<~100 days) out to the epochs we are showing here, we need this to be a very large grid that we run (because the peak frequencies tend to evolve very quickly at early times). So it sometimes crashes. I’m working on a workaround for this.
    - This also as a few ‘correction factors’ in the current code to deal with the Mdot issue described at the top of this document. Will probably remove now, that I assume we will everything with updated version.
  + *Still to complete:*
    - In addition, the file piece of this will be writing a little script to turn the list of Fp and Nu\_p at each time post explosion into an actual light curve at a given frequency.
* **Name**: SSAFFA\_SEDTest.ipynb
  + *What it does:* This is the piece of code that made the final projections to semester 2021A for the proposal.
  + *What it needs:* 
    - You need a file of the form PS11aop\_grid\_e2\_allowed.csv telling us what was allowed at a previous epoch.
    - You need a file with the output of a large SSA+FFA grid (created by SSAFFA\_LightCurveTest.ipynb) at the date you want to project forward to.
  + *More details*:With those two inputs in hand it will search for the combinations of shock velocities and mass loss rates that were allowed at the earlier epoch in the big grid of data for the ‘future’ epoch in order to figure out what the Fp and nu\_p would be at that time in the future. The lower blocks then make figures of what this would look like.