Plan

03.11

1. Single cell model
   a. Morphology
      i. Mouse STN cell morphology in .swc files: https://ml-neuronbrowser.janelia.org/
      ii. Kitai had the earliest and still best description of STN neuron types. They don't have standardized files for us to use directly, but we can change the .swc files according their descriptions. They classified the cells in two groups: one with local axon projections; one only project to downstream targets.
      https://onlinelibrary.wiley.com/doi/abs/10.1002/cne.902150302;
      https://onlinelibrary.wiley.com/doi/abs/10.1002/cne.902210110;
      https://link.springer.com/chapter/10.1007/978-1-4684-5347-8_25;
      (a review)https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7189217/.
      iii. In PD, STN morphology changes. For example, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8019994/. This would be a good research question that how this morphological changes contribute to the symptoms in PD STN.
      iv. Side notes: bursting cells in general are different than regular spiking cells, here's an example from SC region. (https://www.janelia.org/lab/spruston-lab/resources/morphologies) Also, they are a good source for CA1 hippocampus morphology, in case we/you want to do hippocampal modeling later.
   b. Ion channels
      i. Hjorth et al., PNAS paper claimed they found the gene density of different ion channels here: www.informatics.jax.org, which I failed to find anything useful. I couldn't find their results either, so it could be that I didn't use it correctly. Good to have another try.
      ii. We could just adopt standard ion channel combinations.
   c. Single-cell level fitting
      i. Data: mouse data from Jeon et al., Cell Rep. They classified into two groups PV+ and PV-.
      ii. Explore ion channel specific roles. This is the main ref: https://pubs.aip.org/aip/cha/article/31/11/113121/342208/Mathematical-model-of-subthalamic-nucleus-neuron. These are useful as well: https://pubmed.ncbi.nlm.nih.gov/12848936/; https://www.sciencedirect.com/science/article/pii/S0149763421005455#fig0010.
2. Assemble a STN network
   a. Cell type distributions (E/I distribution): Jeon et al.; Sharott et al.
   b. Synaptic density: Kitai's papers may have this value?
   c. Connection strength between cell types is something we need to fit later. This and how it changes in PD are major parts of our research question.
3. Fitting network level dynamics

a. Healthy
    i. I have some healthy mice STN data from old lab.
b. PD
    i. Human data. We may not use human data directly due to uncertainties on ethics. But we can fit to general features in published papers.
    ii. E/I distribution, connection strengths are the main free parameters.