

Name: \_\_\_\_\_

Date: \_\_\_\_\_

## Phys 194–FYRE Assignment #3 Astropy Quantities & Python Plotting

**Assignment Policy:** You can consult class notes, books, and online resources. You can work in small groups (2 or 3), but you must turn in your own work. Make sure you are clear about the process you use to solve the problems: partial credit will be awarded.

### Getting Started

Today we will experiment with some simple python coding exercises that involve loading Astropy and Matplotlib to practice using *quantities*, unit conversion and plotting. To do so, login to your NANOGrav notebook account and `cd` into your personal directory within `shared/UWM_Fyre/`. If you haven't made your own directory yet, do so now. Copy the `Assignment3.ipynb` file to your directory and open it through the notebook graphical user interface to begin.

Double click the first cell in the notebook and add your names, then run the cell with `[Shift] + [Return]`. This is a *markdown* cell, so everything entered is formatted as plain text. You can format a cell by clicking on it and selecting an appropriate type from the *Cell → Cell Type* menu. Many of the other cells you will be working with today are *code* cells, which allow you to run python commands as you normally would in an interpreter.

Experiment with all the commands noted in each tutorial (make new cells as needed) and read the corresponding text. Complete the final exercises, again making new cells as needed and answer questions on this worksheet.

# Astropy Quantities & Unit Conversion

1. What function associated with Astropy quantities allows you to simplify/cancel units?
2. What is the Earth's orbital speed in furlongs per fortnight? You may want to look at the full list of units available in Astropy by following the link provided at the top of the Jupyter notebook, or you can try defining your own quantities. *Note:* do not bother computing Earth's orbital speed by hand at the end of the first exercise.
3. Using the provided planet distances from the Sun, what are their orbital speeds in km/s? In furlongs/fortnight?

4. Look up the distances of four moons and calculate their orbital speeds (km/s) around Jupiter.

## Plotting with Matplotlib

1. Skim through the python plotting tutorial and experiment with some of the code in your notebook.
  
2. Look up or calculate orbital periods for the planets/moons from before and plot squared orbital periods versus cubed distances for all of them. Additional plot features to add:
  - Make points for planets/moons different colors.
  - Change x/y axes to log-scale.
  - Label your axes.
  - (Anything else you like!)

3. Draw the plot you created in the space provided. What do you notice about it? Describe how you might add lines to the plot that would go through each group of points.