

# “HR Diagram of M80” Laboratory Exercise

## Part 3: download, reduce and plot the data

Purpose: HR Diagrams are central to understanding stellar evolution. Here, we'll take real Hubble Space Telescope data, and make an HR diagram out of it.

Method: Download the data to your computer. Import it into Excel, and make a color-magnitude diagram, which is the same as an HR Diagram. You'll need to put your answers in a separate Word or PDF document and submit via Blackboard.

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Go to <http://hla.stsci.edu/> Click “Enter Site.” Search for M80. Then do an “Advanced Search”. Check off only the WFPC2 instrument. Search for Proposal ID 11233. Two “visits” come up, and eight results appear. Six of these results are not relevant to this lab. You only want to use “visit 6” for this lab. Locate the F450W and F814W data. Ignore the “F814W/F450W” and “detection” spectral elements. Now to download the Hubble Data to your computer. Put in the cart-basket the DAOphot data of WFPC2 for F450W, “visit 6”, and not the FITS or SEXphot data. Just get the DAOphot data. Next, put in the cart-basket the DAOphot data of WFPC2 for F814W, not the FITS or SEXphot data. Just get the DAOphot data. Go to the checkout and download that data to your computer.

It will come down in a “.cat” file format. Rename the files to “.txt” at the end.

Now to reduce your data. You'll just be doing a small part of it for now. First, open the F450W data in Excel or a similar spreadsheet tool. If you don't have Excel, then you can download OpenOffice for free from [www.openoffice.org](http://www.openoffice.org). It can do all those things and more. Now open the F814W data in Excel. On both data sets, we want to delete all the columns except “ID” and “TotMag”. (i.e. the identification number of the star and its magnitude.) These are columns 5 and 13. Be VERY careful how you separate them into columns. This is where it can EASILY go wrong. The columns are fixed-width delimited, and contain lots of spaces. Probably the best way to import it to Excel is to open it with Word or something like that. Then copy and paste the whole thing into the Excel page. It'll all be one column. Then you do “Text to Columns” and use “fixed width”, not delimited. Excel should detect the proper widths. You may just delete the header rows, and the extraneous columns.

Next, sort the data by the ID number and remove ALL stars whose ID numbers exceed 250. You will plot below at most 250 stars. The ID numbers run from 1 to well over 16000. Your task is to delete ALL but the “first 250.” Once you've found the ones with ID numbers between 1 and 250, you need to find all the stars that have magnitudes in BOTH filters.

To get the data you need, combine the two spreadsheets into one spreadsheet. Luckily, by this time, you have roughly 250 lines in both spreadsheets. Now, REMOVE any star that only has a magnitude in only one filter. KEEP only the stars with magnitude measurements in both filters. This will reduce it down further from 250 stars. You should now have lined them all up such that you have a star ID and its two magnitudes. And you will have thrown away any data which didn't have both magnitude measurements.

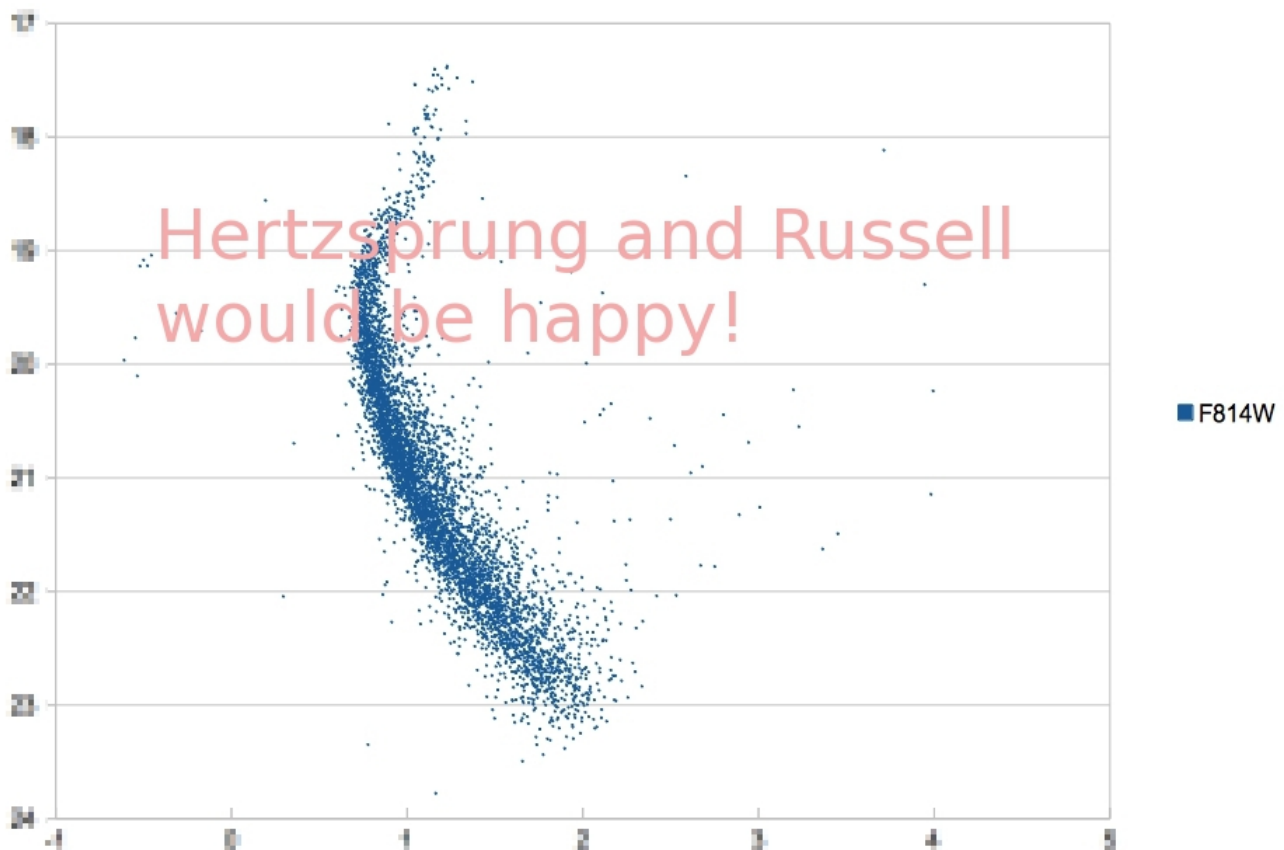
Our next step is to find the colors of these stars. To do this, create a new column in your spreadsheet containing a difference between the two magnitudes for each star. Let's difference all the values like this:

$$\text{Color} = F450W - F814W.$$

Do this for all the data in what's left over from the "First 250". Make SURE that you have matched up the ID's for the stars. The ID's MUST match for the two magnitude measurements.

Now plot the data using Excel's graph feature (or use any other plotter) with Color on the "X" axis, and the F814W Magnitude is on the "Y" axis. It helps a lot to simply copy the F814W data into a column to the right of the "color". This is your really tiny set (less than 250 stars) color-magnitude diagram (HR diagram) of M80. Make sure that you make the points of your plot very small, so you can see the shape of the diagram. Make sure that you arrange it so that "brightest" is up. You'll need to remember the definitions of Magnitude to make sure it's correct. Look at the example HR diagram at the bottom of this document.

This is what roughly what your HR Diagram should look like when you are done, but with a lot less points. Upload your Excel or OpenOffice sheet with final graph in it to Blackboard.



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