Procedure for analyzing T. Brown HST data from 2010 and 2012 with Dolphot

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Keywords:

"CMD" = Color-Magnitude Diagram
"DM" = Dolphot Manual
"DS9" = SAOImage DS9 Program
"HST" = Hubble Space Telescope
"IR" = Infrared (filters)
"LF" = Luminosity Function
"MAST" = Mikulski Archive for Space Telescopes
"PM" = Proper Motion
"WFC3" = Wide Field Camera 3
"WFC3M" = Wide Field Camera 3 Manual
"UVIS" = Ultraviolet and Visible (filters)

1   Preliminary

Programs needed:
Dolphot – Dolphin Photometry (author: Andrew Dolphin, Raytheon Company)
DS9 – Image Visualization Package (author: Smithsonian Astrophysical Observatory)
Python

2   Data

This section describes retrieving the relevant data and preparing it for analysis.

2.1   MAST

The HST data to be downloaded from the MAST archive is as follows:

- F555W/F814W/F160W/F110W filter data from WFC3 of the "Stanek" field (Proposal ID: 11664) This is 2010 data.

- F814W filter data from WFC3 of the "Stanek" field (Proposal ID: 12666) This is 2012 data.

2.2 Prep Data

Once files are downloaded, place them in separate (by filter) working directories (don't forget to create backups of all files as Dolphot will actively alter them during processing!) Now move only the "`*_flc.fits`" files into a separate (by filter again) working directory.

3 Running Dolphot

Dolphot will be run from the terminal within the current working directory. Most of the steps listed here will refer to the DM or the WFC3M. At this point, creating/selecting a reference image is not necessary for our analysis. The steps for analysis are as follows:

3.1 F110W and F160W IR Images

- Run 'wfc3mask' (ref. WFC3M)

- Run 'calcsky' (ref. WFC3M)

- Run 'dolphot' (ref. WFC3M)

3.2 F814W and F555W UVIS Images

- Run 'wfc3mask' (ref. WFC3M)

- Run 'splitgroups' (ref. WFC3M)

- Run 'calcsky' (ref. WFC3M)

- Run 'dolphot' (ref. WFC3M)

There are several outputs from the routine; most importantly is the main photometry list (no file extension) and the '.columns' file which describes each column printed out in the photometry list.

A small Python script can be written to condense this master photometry list down to an array with just the relevant quantities desired (x-position, y-position, object type, instrumental magnitude, magnitude uncertainty, etc). Cuts can also be made on the array to reject object types not listed as 'star' (ref. DM and WFC3M).

4   Color-Magnitude Diagrams

CMD's (F110W - F160W vs. F160W, and F555W - F814W vs. F814W) can be generated from the Dolphot master photometry lists by simply calculating the color (difference in instrumental magnitude between F110W/F160W and F555W/F814W respectively) and plotting it against the instrumental magnitude column in the various filters. Calculating an example CMD from F555W and F814W would be something like;

Column 16 (F555W magnitude) - Column 29 (F814W magnitude), print to new column (call it 'color'). Then just plot 'color' column versus column 16 or 29. Color is x-axis, magnitude is y-axis. Here is one CMD that has been created thus far:
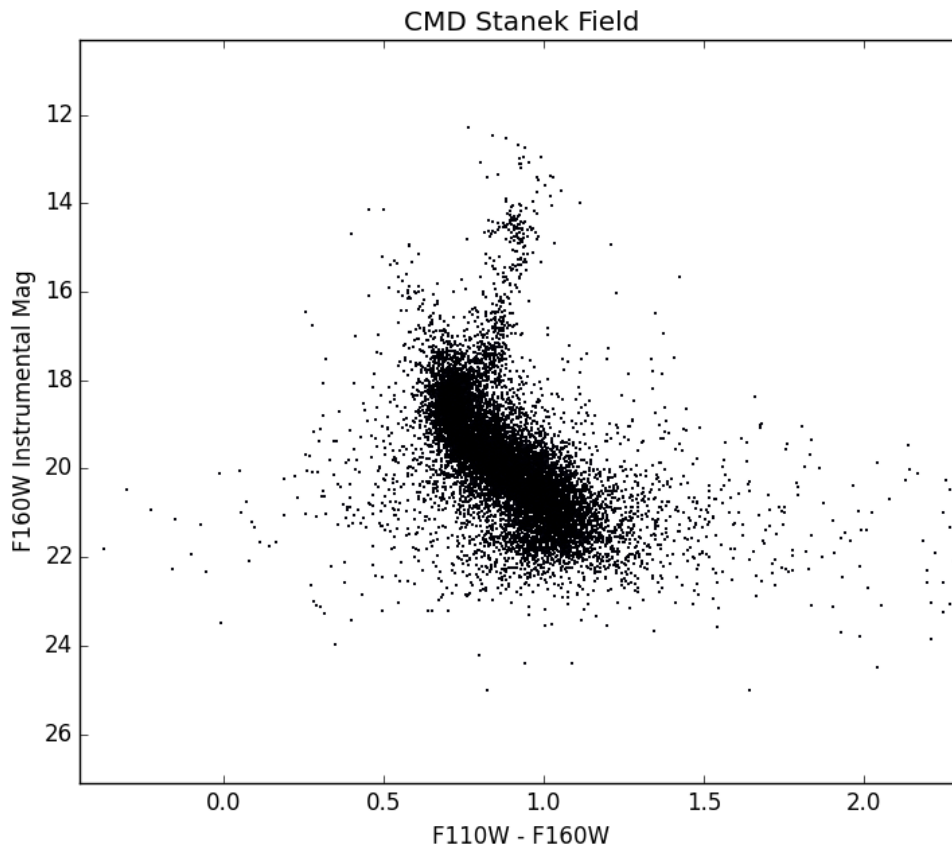
IMPORTANT: This CMD includes both bulge stars AND foreground disk stars. Our aim for this part of the project is to generate disk-decontaminated CMD's that are composed primarily of only bulge stars. The most efficient way to do this is by matching and rejecting stars by their proper motions, which we explain in section 5.