Applying your photometric solution to the master images

Part 1: Instrumental magnitudes

pyraf 's qphot task defines an instrumental magnitude in terms of counts/second:

$$m_{inst} = -2.5*\log(\text{COUNTS}/\text{EXPTIME}) + 25$$

Since we based on zeropoints on qphot measurements of stars, we need to define our instrumental magnitudes the same way.

And since we medianed the images (rather than summing them), our EXPTIME is the exposure time of an individual image:

- V images: 900 seconds (15 mins)
- B images: 1200 seconds (20 mins)

So turn counts into instrumental magnitudes using those values.

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Part 2: Turn instrumental magnitudes into real magnitudes

Our photometric solution:

$$m_{inst,B} - m_B = C_B*(B-V) + ZPMASTER_B$$

$$m_{inst,V} - m_V = C_V*(B-V) + ZPMASTER_V$$

	B	**V**
C	0.160	0.289
ZPMASTER	3.704	3.514

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Part 2: Turn instrumental magnitudes into real magnitudes

Our photometric solution:

$$m_B = m_{inst,B} - C_B*(B-V) - ZPMASTER_B$$

$$m_V = m_{inst,V} - C_V*(B-V) - ZPMASTER_V$$

	B	**V**
C	0.160	0.289
ZPMASTER	3.704	3.514

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Part 2: Turn instrumental magnitudes into real magnitudes

Our photometric solution:

$$m_B = m_{inst,B} - C_B*(B-V) - ZPMASTER_B$$

$$m_V = m_{inst,V} - C_V*(B-V) - ZPMASTER_V$$

	B	V
C	0.160	0.289
ZPMASTER	3.704	3.514

But wait…

Subtract one from the other:

$$m_B - m_V = [m_{inst,B} - m_{inst,V}] - [C_B - C_V] *(B-V) - [ZPMASTER_B - ZPMASTER_V]$$

$$(B-V) = [m_{inst,B} - m_{inst,V}] - [C_B - C_V] *(B-V) - [ZPMASTER_B - ZPMASTER_V]$$

$$(B-V)*(1 + [C_B - C_V]) = [m_{inst,B} - m_{inst,V}] - [ZPMASTER_B - ZPMASTER_V]$$

$$(B-V) = ([m_{inst,B} - m_{inst,V}] - [ZPMASTER_B - ZPMASTER_V]) / (1 + [C_B - C_V])$$

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Summary

First measure counts and calculate instrumental magnitudes in each filter:

$$m_{inst,B} = -2.5*\log(COUNTS_B/EXPTIME_B) + 25$$

$$m_{inst,V} = -2.5*\log(COUNTS_V/EXPTIME_V) + 25$$

Then calculate the color:

$$(B-V) = ([m_{inst,B} - m_{inst,V}] - [ZPMASTER_B - ZPMASTER_V]) / (1 + [C_B - C_V])$$

Then insert that color into the photometric solution to calculate magnitudes:

$$m_B = m_{inst,B} - C_B*(B-V) - ZPMASTER_B$$

$$m_V = m_{inst,V} - C_V*(B-V) - ZPMASTER_V$$

or even simpler: $m_V = m_B - (B-V)$

	B	V
EXPTIME	1200	900
C	0.160	0.289
ZPMASTER	3.704	3.514

Final step – correcting for galactic extinction

After all photometry is done and you have your "final" magnitudes and colors, you want to correct for galactic extinction. Dust in the Milky Way (which we are looking through) both dims and reddens the light from M101.

Look up the galactic extinction on NED, using the estimate from Schlafly and Finkbeiner (2011). Then correct for extinction in each band by doing:

$$m_{B,0} = m_{B,obs} - A_B \quad \text{and} \quad m_{V,0} = m_{V,obs} - A_V$$

And then correct the color by doing either

$$(B-V)_0 = (B-V)_{obs} - (A_B - A_V) \quad \text{or} \quad (B-V)_0 = m_{B,0} - m_{V,0}$$

But not both! That is, don't calculate your color from the corrected magnitude and then *also* apply the reddening correction.

Working with your master images

- cd ~/Desktop/M101proj
- mv Bdata/M101B.fits .
- mv Vdata/M101V.fits .
- ds9 M101B.fits M101V.fits &
- in ds9:
  - Frame → Single Frame
  - Frame → Lock → Frame → WCS
  - Scale → Scale Parameters → -10 to 3,000
  - Scale → Log
  - Frame → Lock → Scale
  - Frame → Lock → Colorbar

If you are typing these inside a pyraf window, remember to put the "!" in front of each line….

This sets up ds9 so you can zoom, pan, and change the display stretch on one image, then hit "tab" and see the other image similarly displayed.

- ds9 regions (Regions → Shape):
  - Circles: can draw with cursor, then double click inside circle to pull up info box. Set size and center (in different units), click Analysis → Statistics for rough stats.
  - Ruler: will measure distances on image in different units

Doing Quick Photometry:

- stars: use pyraf's imexam task (good method)
- extended objects: enclose in region, look at regions stats (rough method)

Cleaning up

Once you are happy with your master image, clean up!

- /bin/rm –r Bdata Vdata

(as well as any other directory that holds old ASTR 306/406 imaging data from past classes, we don't need them any more….)

Everyone can download master images into their own linux accounts by logging in and doing:

- cp /astroweb_data/ASTR306/M101B.fits .
- cp /astroweb_data/ASTR306/M101V.fits .

Or get them onto your computer via the web at

- http://burro.case.edu/ASTR306

(use the "Save As…" feature on your web browser, and you must be on the CWRU network to download.)