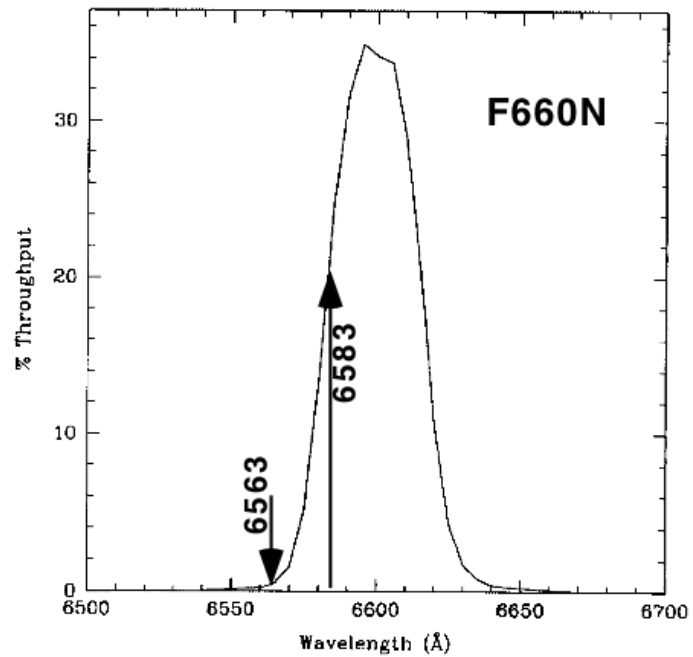
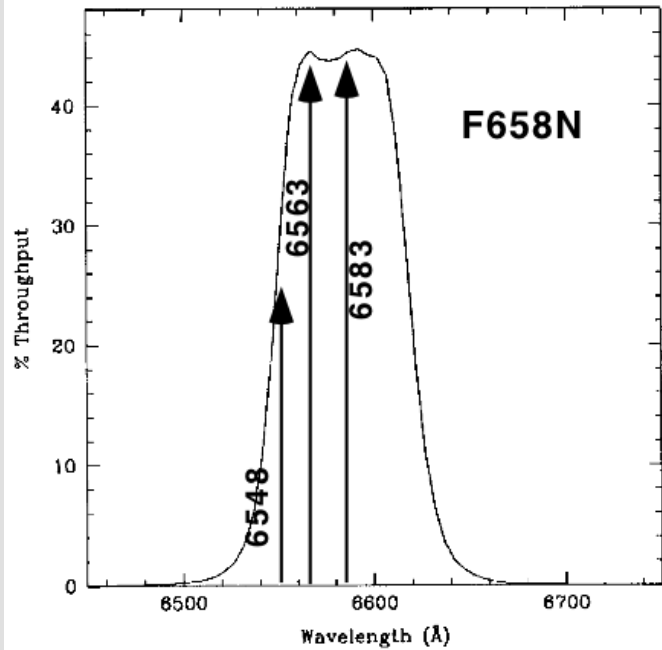
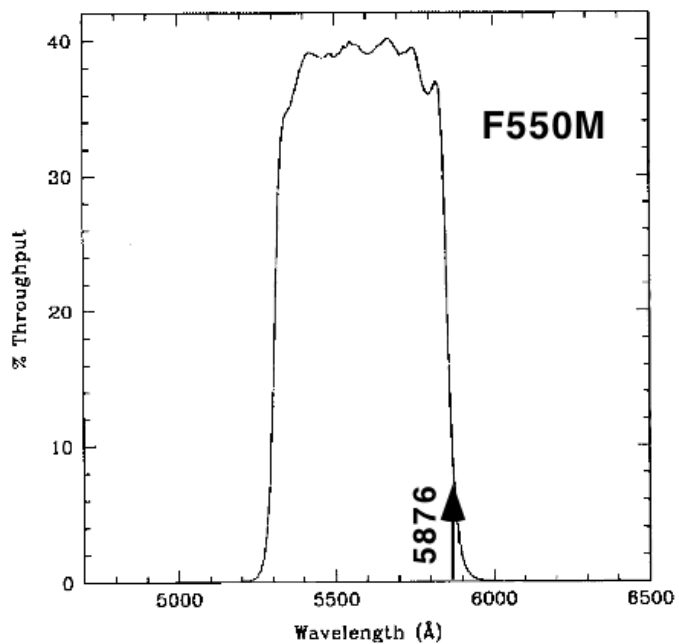
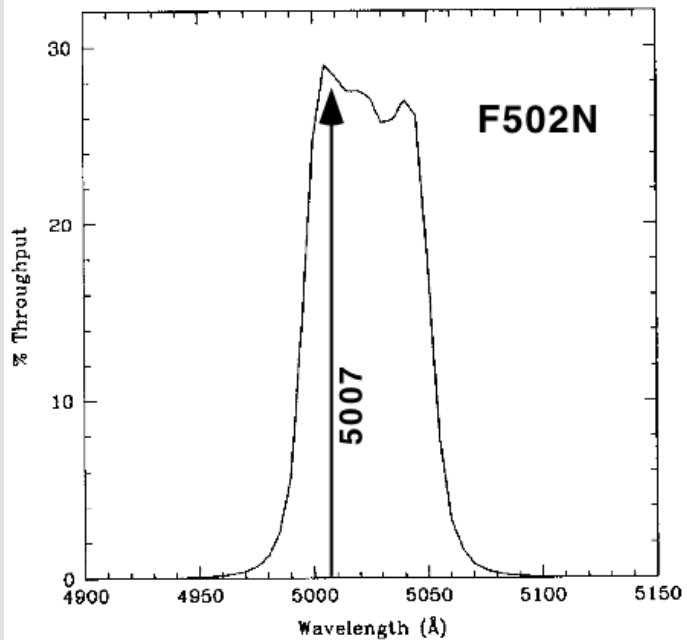


Calibration of the ACS Emission-Line Filters.

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The New ACS Camera has a limited and rather imperfect set of emission-line filters.

- The primary emission-lines for imaging nebulae are $H\alpha$ 6563 A, [OIII] 5007 A, and [NII] 6583 A.
- F502N gives a good isolation of 5007.
- F658N passes both 6563 and 6583 equally well.
- F660N passes only 6583.



The Conceptual Plan.

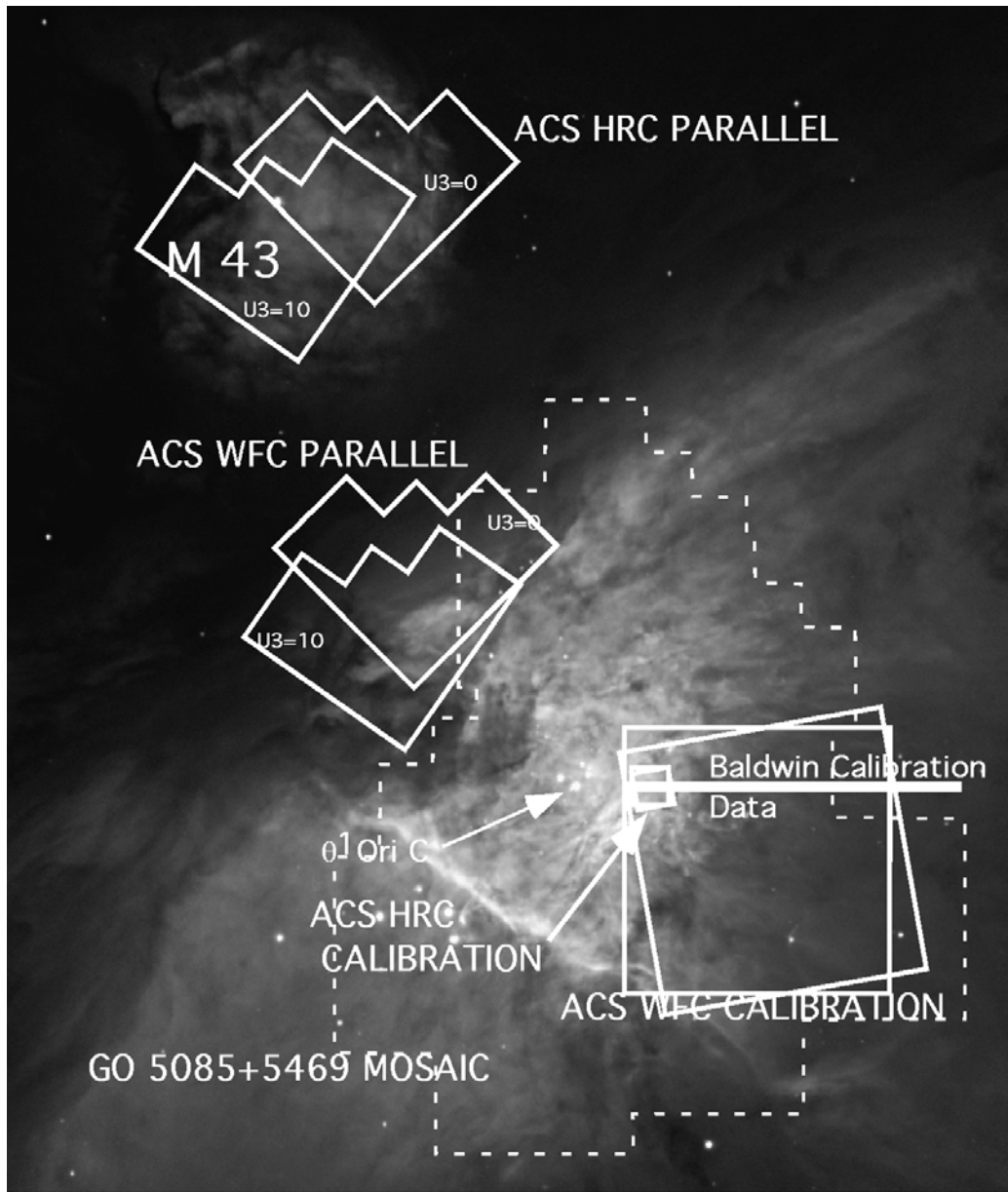
- Adopt a procedure insensitive to pre-launch calibrations.
- Identify an extended region already calibrated from the ground (NGC 1976).
- If possible, also use these ACS and parallel WFPC2 observations for science.

Calibration of the Surface Brightness of Orion.

- Published by Baldwin, et al. (1991, ApJ, 374, 580).
- Long 2" E-W slit east of Θ^1 Ori C divided into 15", 23", and 32" samples.
- Absolute surface brightness given for each sample along the slit.
- Relative line fluxes & Equivalent Widths of the continuum were determined within each sample.
- The actual positions were not quite what the paper said they were!

The Observing Plan.

- Observe the same regions as Baldwin et al. using the ACS camera in each of the emission-line filters.
- Use the signal from the F660N filter to correct the F658N filter's image for 6583.
- Use the F550M filter signal to correct for the continuum passed by the filter.
- Make parallel observations with the WFPC2.



The Starting Math.

$$R_{\text{filter}} = A\Omega(\sum s_{\text{line}} T_{\text{filter}}^{\text{<line}} S_{\text{line}} + s_{\text{cont}} E_{\text{filter}} S_{\text{filter}}^{\text{<cont}})$$

- R_{filter} = Count Rate
- A = Effective Aperture
- Ω = Solid Angle of a Pixel
- s = Q.E. of telescope-camera-detector
- $T_{\text{filter}}^{\text{<line}}$
- S = Surface Brightness
- E_{filter} = Effective Width of Filter

The Resulting Math.

$$A\Omega s[\text{OIII}]T^{\text{F502N}}_{<[\text{OIII}]} = (R_{\text{F502N}}/S_{[\text{OIII}]}) \cdot \{1 - (R_{\text{F550M}}/R_{\text{F502N}}) \cdot (s_{\text{F502N}}/s_{\text{F550M}}) \cdot (E_{\text{F502N}}/E_{\text{F550M}}) \cdot r_{[\text{OIII}]}\}$$

- This is the equation for the simplest case, the F502N filter, where only the 5007 line and the continuum are important.
- Only $K1 = A\Omega s[\text{OIII}]T^{\text{F502N}}_{<[\text{OIII}]}$ is important.
- $r_{[\text{OIII}]}$ reflects the color of the continuum.
- $K3 = s_{\text{F502N}}/s_{\text{F550M}} \cdot E_{\text{F502N}}/E_{\text{F550M}} \cdot r_{[\text{OIII}]}$ is a few percent and is largely from pre-launch calibration.

Similar Steps are done for F658N and F660N.

- Many more terms apply because of the serious contamination of the F658N ($H\alpha$) filter by both [NII] 6548 and 6583.
- The F660N ([NII]) filter is contaminated by $H\alpha$ 6563.
- This cross-talk causes the need for a K2 constant.

All this was done for both WFC and HRC.

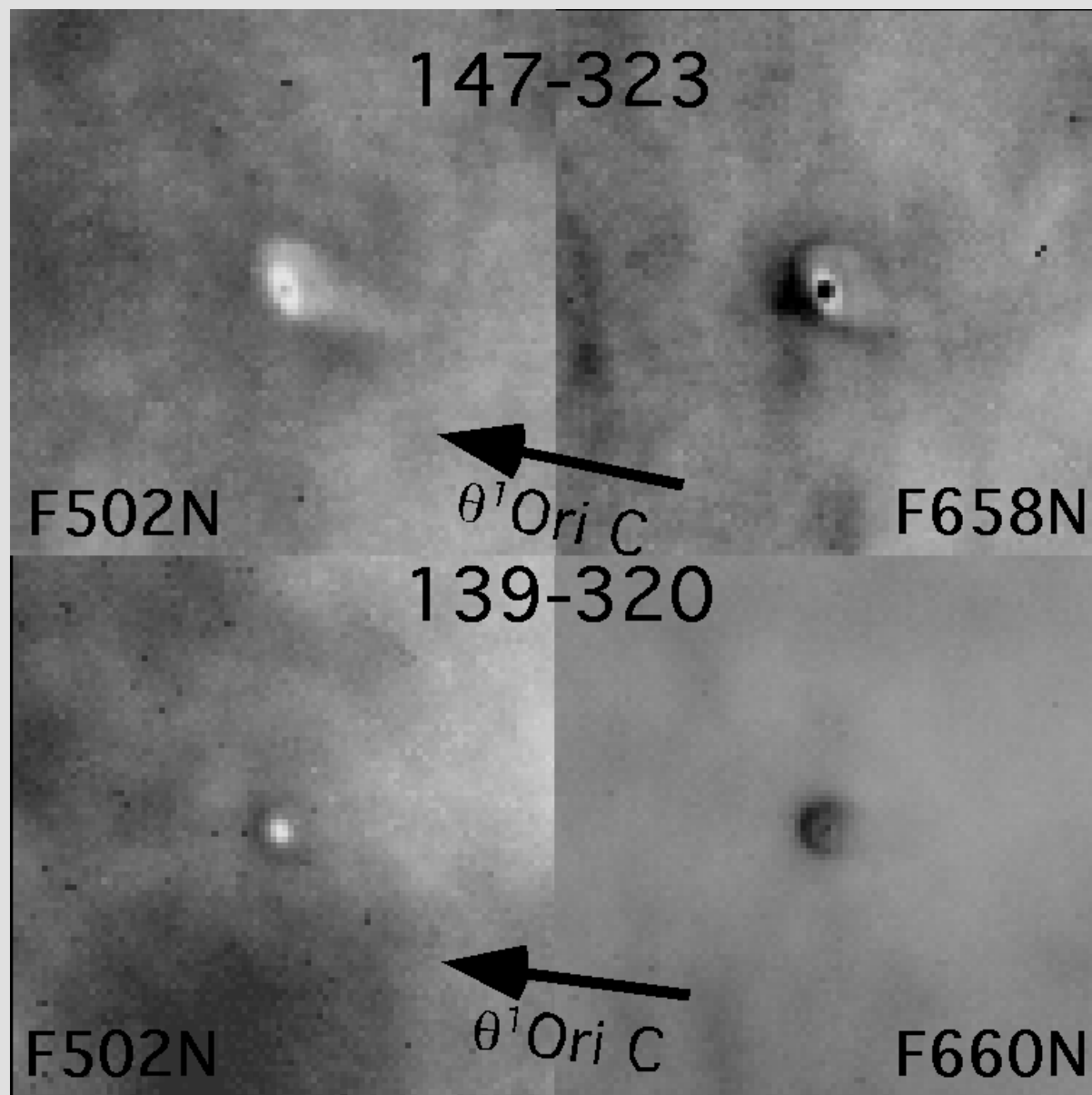
- $K1(\text{F502N-WFC})=7.4 \times 10^{-10} \pm 0.3$,
 $K3=0.069$.
- $K1(\text{F658N-WFC})=7.8 \times 10^{-10} \pm 1.5$,
 $K2=2.58$, $K3=0.022$.
- $K1(\text{F660N-WFC})=9.4 \times 10^{-10} \pm 1.3$,
 $K2=0.005$, $K3=0.056$.
- Etc.

Calculating Surface Brightnesses.

- Illustration is for the H α 6563 line, similar equations apply for the others.
- $$S_{H\alpha} = (R_{F658N} / K1_{F658N}) \cdot [1 - K2_{F658N} \cdot (R_{F660N} / R_{F658N}) - K3_{F658N} \cdot (R_{F550M} / R_{F658N})]$$

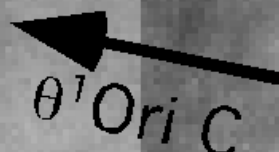
Comments on the Use of these Equations.

- In a weak-continuum (PN) object, the continuum contamination is very small and F550M observations are not needed.
- When the continuum term is strong, one needs to adjust for its color.
- Corrections for large radial velocities can be made.



147-323

F502N

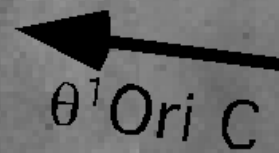


$\theta^1 Ori C$

F658N

139-320

F502N

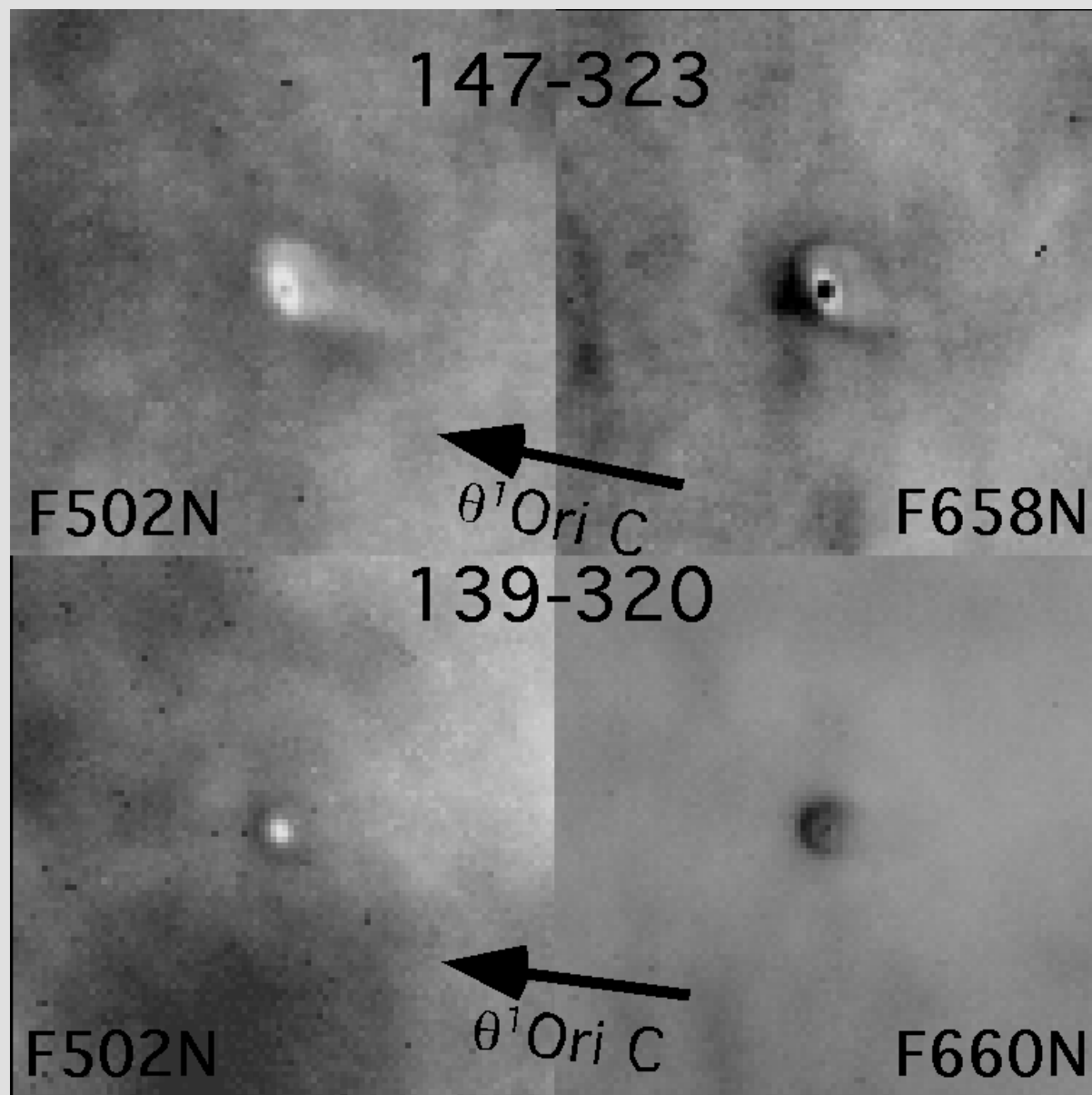


$\theta^1 Ori C$

F660N

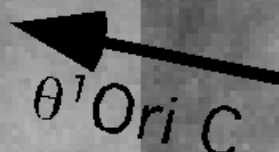
HRC Showed New Objects/Structure.

- Proplyd 147-323 had been seen with WFPC2, but ACS-HRC shows both the well defined inner disk and a low ionization jet.
- Proplyd 139-320 is new and shows an inner disk.
- Both Images are 2.5"x2.5".



147-323

F502N

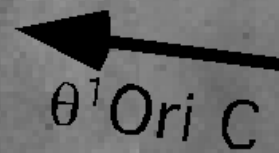


$\theta^1 Ori C$

F658N

139-320

F502N



$\theta^1 Ori C$

F660N

Summary

- A rigorous calibration of the ACS filters was achieved.
- A new inner-disk proplyd was found.
- Previously unseen structure in a second proplyd was revealed.

Publications.

- “Calibration of HST ACS Emission-Line Filters” C. R. O’Dell, 2004, PASP, 116, 729-733.
- Thanks to: GO 9898 and Ron Gilliland for help in making this program happen.
- Similar results for the WFPC2 are in O’Dell & Doi, 1999, PASP, 111, 1316-1320.