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MEASURED THROUGHPUT AND BANDPASS OF THE RAMP FILTERS

R. C. Bohlin and Z. Tsvetanov
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ABSTRACT

ACS has 12 narrow band ramp filters with 2% bandpasses of δλ/λ and three ramps with medium bandpasses of 9%. Both the narrow and medium bandpass sets cover the range 3700-10700Å with a nominal 40x70 arcsec field of view. The transmission of the bandpasses have been measured as a function of wavelength and are fit with analytic functions. These characterizations are used to generate a uniform grid of 11 transmission curves over the wavelength range of each of the 15 ramp filters. This grid of transmission curves has been formatted and delivered to the STScI Synphot data base for use in the ACS Exposure Time Calculator and for instrumental absolute flux calibrations. Synphot computes the transmission curve at any wavelength in the range of a ramp filter by interpolation between the shapes of the two curves nearest in wavelength from the grid of 11.

1. Measurements and Analytic Fits

The final transmissions of the ramp filters T(λ) are empirical analytic fits to the data as a function of wavelength λ in Angstroms with the form:

$T(\lambda) = BP + Ped + Z,$

where BP is the primary component of the transmission, which sits on a broader pedestal level (Ped), all of which has a minimum out-of-band zero level transmission of Z=1e-6.

The BP and Ped are of the form:

$BP = T_{avg}\, F(\lambda)$

where

$F(\lambda)=1/\{[(\lambda-W_{cen})/(FWHM\ W_{cen}/2)]^8 + 1\}$.

Ped = $7\ 10^{-4}$ e-$\{[\lambda-W_{pc}]^4/(2[0.047W_{pc}]^4)\}$ for the narrow band filters and

Ped = $7\ 10^{-4}$ e-$\{[\lambda-W_{pc}]^6)/(2[0.197W_{pc}]^6)\}$ for the medium band filters.

The peak transmission is characterized for each filter by a quadratic fit:

$T_{avg}(\lambda) = b0+ b1\ W_{cen}+ b2\ W_{cen}\text{^}2$, where the wavelength λ is in Angstroms.

The fractional FWHM is fit by:

$FWHM(\lambda) = c0+ c1\ W_{cen}+ c2\ W_{cen}\text{^}2$.

W_{pc} is the pedestal central wavelength in Å that is used in the filter name, eg. for FR656N, W_{pc}=6560. W_{cen} is the central wavelength of a passband in the range of the minimum to the maximum wavelength in Table 1.

The 15 ACS ramp filters are listed in Table 1, along with the b and c coefficients and ancillary data.

Table 1. ACS Ramp Filters

Filter Name	Ramp Band	Minimum λ(Å)	Maximum λ(Å)	Segment Location	Filter Wheel Number	b0	b1	b2	ACS #	c0	c1	c2
FR388N	OII	3710	4049	middle	36	3.5965	-1.877E-3	2.794E-7	25M	-0.0400	2.486E-5	-2.243E-9
FR423N	OII	4049	4420	inner	36	1.2132	-3.647E-4	5.136E-8	25I	-0.0658	3.437E-5	-3.411E-9
FR462N	OII	4420	4824	outer	36	14.606	-6.143E-3	6.778E-7	25O	-0.1250	5.735E-5	-5.693E-9
FR505N	OIII	4824	5266	middle	50	1.1781	-1.756E-4	1.717E-8	26M	-0.2545	1.046E-4	-9.922E-9
FR551N	OIII	5266	5748	inner	50	5.4225	-1.735E-3	1.607E-7	26I	-0.0930	3.714E-5	-3.113E-9
FR601N	OIII	5748	6274	outer	50	6.3219	-1.900E-3	1.616E-7	26O	-0.0638	2.624E-5	-2.072E-9
FR656N	Hα	6274	6848	middle	38	-1.5151	6.860E-4	-5.121E-8	27M	0.1285	-3.385E-5	2.626E-9
FR716N	Hα	6848	7474	inner	38	-1.1078	4.744E-4	-2.880E-8	27I	-0.2437	7.193E-5	-4.931E-9
FR782N	Hα	7474	8158	outer	38	-2.8885	8.326E-4	-4.559E-8	27O	-0.4023	1.045E-4	-6.471E-9
FR853N	IR	8158	8905	inner	48	6.3224	-1.289E-3	7.569E-8	28I	-0.0324	1.165E-5	-6.80E-10
FR931N	IR	8905	9719	outer	48	-13.680	3.103E-3	-1.658E-7	28Ob	-0.4723	1.036E-4	-5.448E-9
FR1016N	IR	9719	10609	outer	49	-4.1362	1.005E-3	-5.081E-8	28Oc	0.1584	-2.741E-5	1.360E-9
FR459M	Broad	3810	5366	middle	49	-2.7452	1.458E-3	-1.500E-7	24Ma	-0.2946	1.423E-4	-1.351E-8
FR647M	Broad	5366	7574	inner	49	-0.0227	2.271E-4	-1.559E-8	24I	-0.0641	3.720E-5	-2.362E-9
FR914M	Broad	7574	10709	middle	48	1.056	-6.92E-5	4.213E-9	24Mc	0.001	1.000e-5	1.000e-9

2. Results

From 11 profiles spaced equally by 10% of the wavelength coverage of each ramp, Synphot finds the closest pair in wavelength from this set of 11

and accurately interpolates the transmission curve for any wavelength within the bandpass of each ramp. Figure 1 demonstrates that the interpolation of the shapes of the adjacent bandpasses produces errors that are usually less than 0.1%. The 11 profiles for each ramp filter are computed by the IDL routine RAMPROF.pro and formatted as FITS binary tables for delivery to Synphot by RAMPFITS.pro.

Figures 2-3 illustrate the smooth, continuous change of the bandpass width with wavelength for three ramp filter throughput profiles on each of the 15 ramp filters.

3. Acknowledgements

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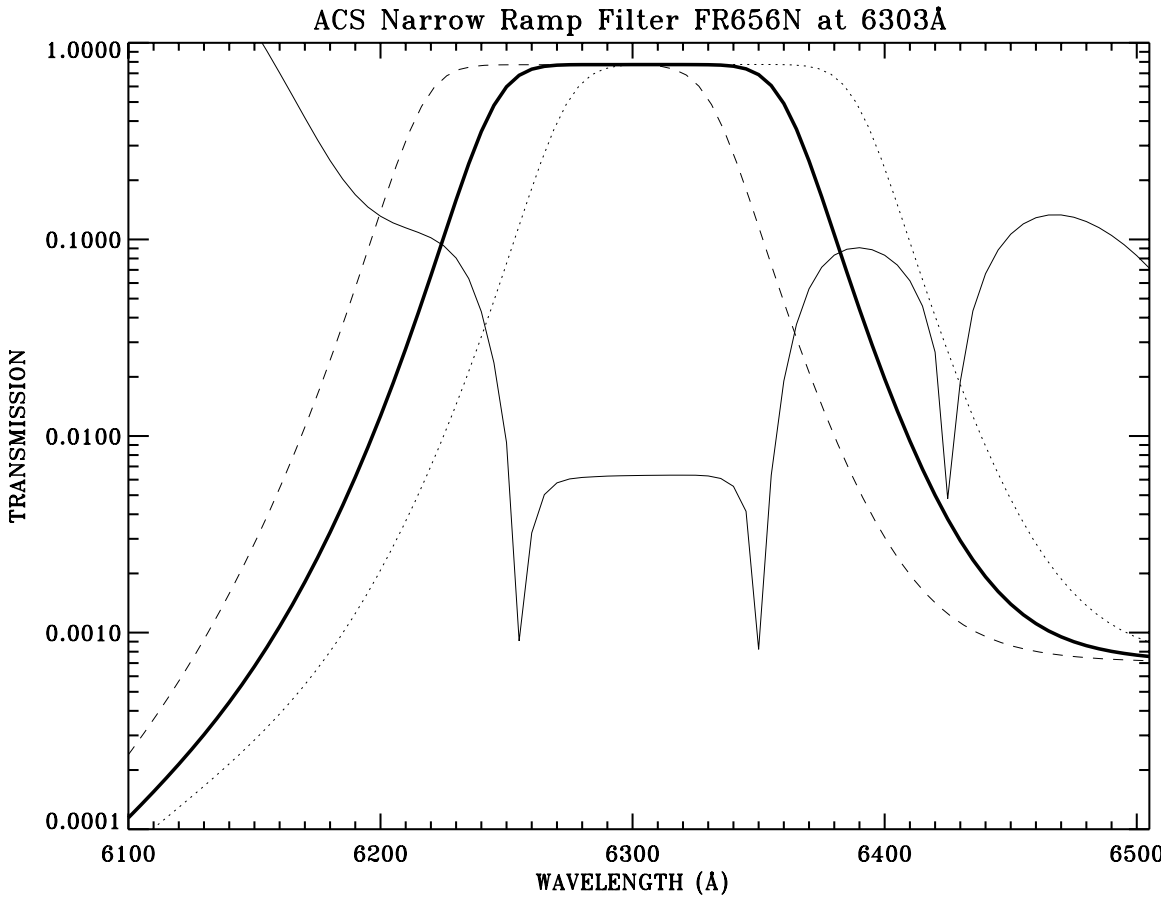

Figure 1: Heavy solid line is the bandpass of the FR656N filter at 6303Å, while the light dashed and dotted lines are the adjacent bandpasses at 6274 and 6331Å, respectively, that are used in the interpolation scheme. The light solid line is the error expressed as the percent difference between the interpolated shape at 6303Å and the computed shape at 6303Å. The error in the interpolation procedure is usually less than 0.1% but does exceed 1% in the short wavelength wing, where the transmission is <0.001. The analytic approximations to the transmission curves are non-physically asymmetric near the ends of their wavelength coverage; but the error in these computed transmissions is less than ~0.001.

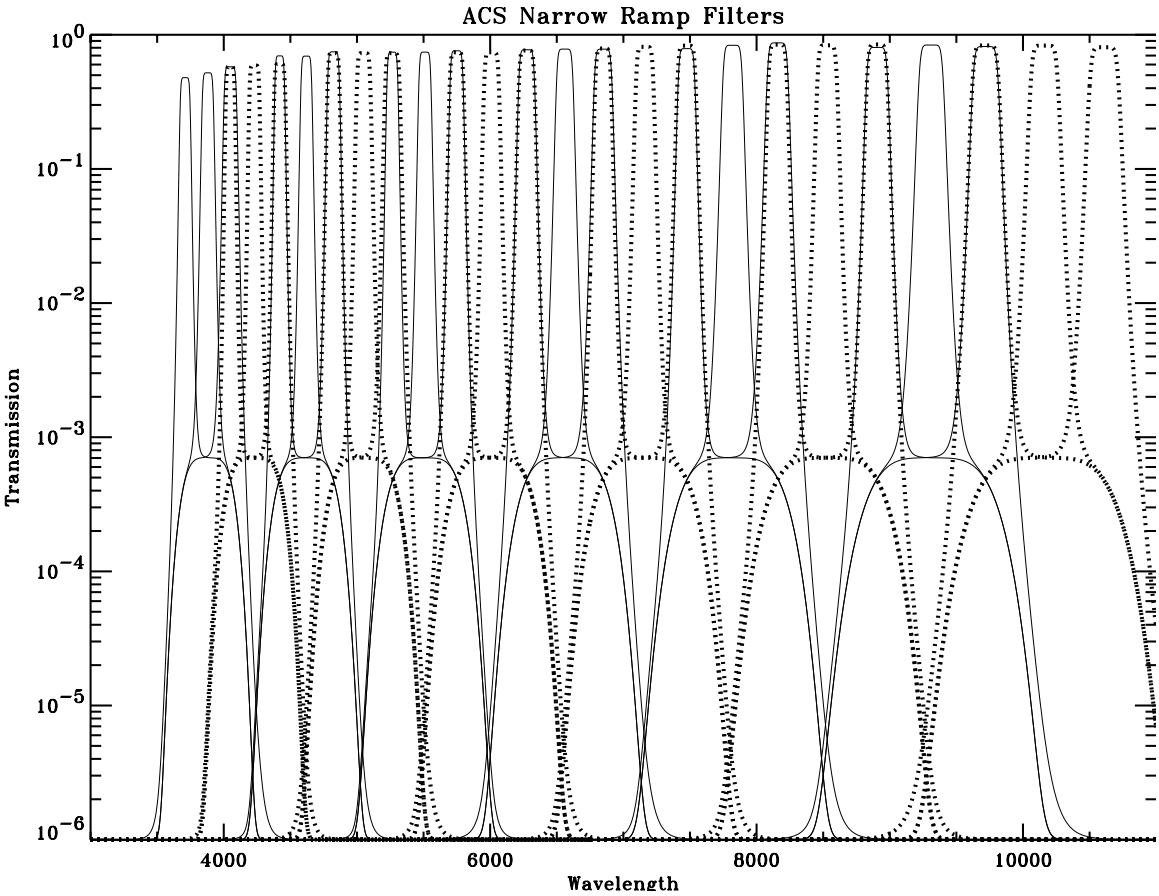

Figure 2: Sample transmission profiles for each of the 12 ACS narrow band ramp filters. The three samples are at the minimum, middle, and maximum of the wavelength coverage and are shown with the linestyle alternating between solid and dotted from one ramp to the next. The longest wavelength passband of a filter nearly coincides with the shortest passband of the next ramp. The peak transmission of the pedestal is just below 10^{-3}.

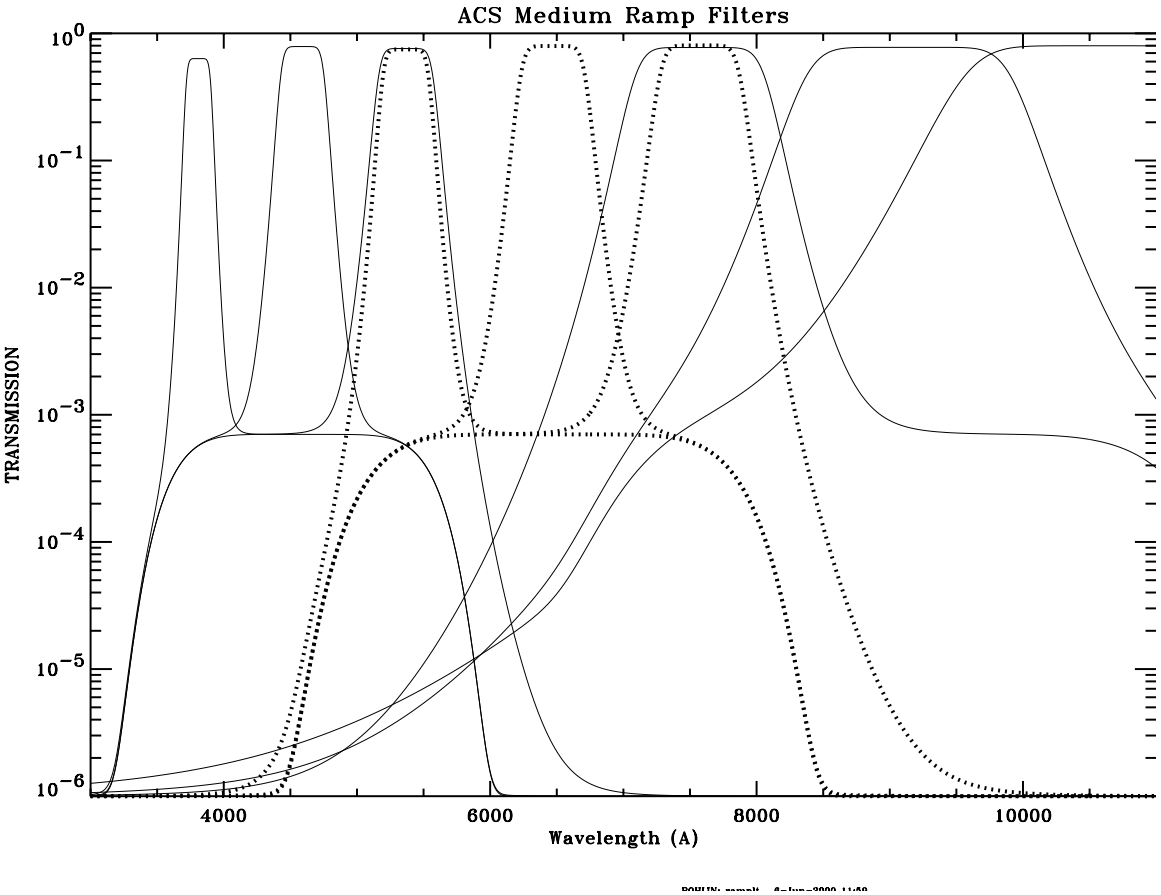

Figure 3: As in Figure 1, except for the medium band ramp filters.