

Harvard-Smithsonian Center for Astrophysics
Precision Astronomy Group

To: Distribution
From: J.D. Phillips
Subject: FAME point spread function.

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The FAME point spread function (PSF) results from the rectangular aperture, with central obscuration (Fig.1)^a. Definitions are given in Table 1, and the PSF in Eq. 1. One obtains the number of counts in a given pixel by integrating Eq. 1 over wavelength and angle.

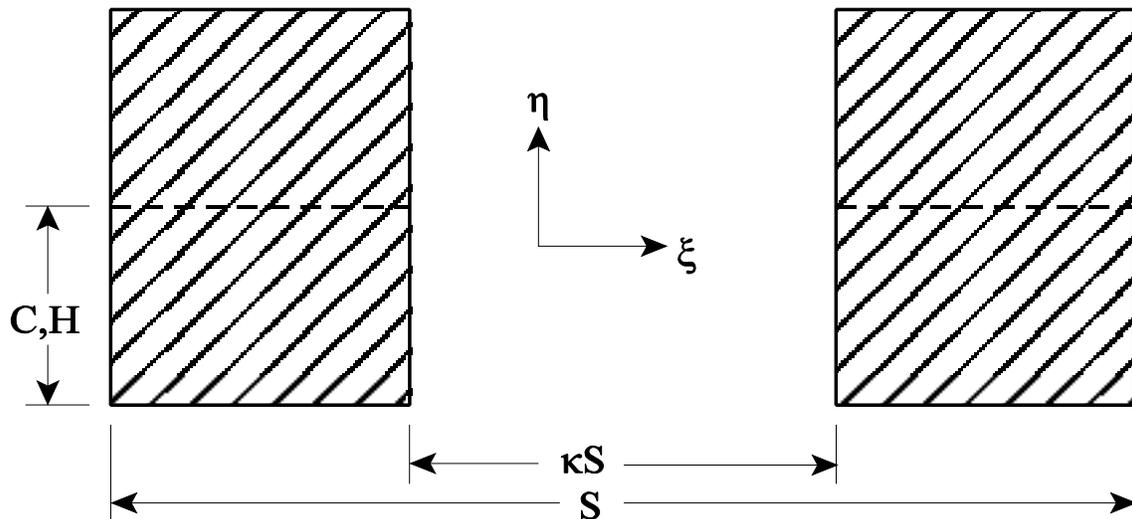


Figure 1. Aperture dimensions. The hatched portion passes light that reaches the detector. In TM96-04, the quantity C (cross-scan dimension) is referred to as H. (Note that in Fig. 1 of that memo, only half the aperture is shown, so H runs the full height of the drawing.)

^a Note that this is likely only an approximation to the obscuration of the final optical design.

The point spread function is

$$M(p, q, \lambda) = \left(\frac{15\eta\tau}{\pi^8} \frac{(hc)^3}{(kT)^4} F_o 10^{-0.4m_B} \right) \left(\frac{1}{\lambda^2} \frac{1}{e^{hc/kT\lambda} - 1} \right) \left(\frac{1}{q} \sin \frac{\pi q C}{\lambda} \right)^2 \otimes \left[\frac{1}{p} \left(\sin \frac{\pi p S}{\lambda} - \sin \frac{\pi p \kappa S}{\lambda} \right) \right]^2 \quad (1)$$

Table 1. Symbol definitions and nominal values.

Sym.	Description	Nominal Value
M	Number of photons detected per unit wavelength per unit solid angle in (p,q) space	
p, q	Angles in the scan and cross-scan directions, respectively	The PSF spreads over several pixels. One $(15 \mu\text{m})^2$ pixel subtends $(2 \mu\text{rad})^2$.
S, C	Aperture dimension, <u>s</u> can and <u>c</u> ross-scan, respectively	0.5, 0.25 m
κ	Fractional width of central obscuration	0.4
λ	Wavelength	
λ_m, λ_p	Wavelength limits	0.9 - 0.4 μm
η	Probability of detecting a photon entering the unobstructed portion of the aperture, i.e., the effect of mirror reflectivity and detector efficiency	0.31
τ	Integration time	1.56 sec
T	Blackbody temperature	5777 K, but wide range must be considered
F_o	Flux from a 0-magnitude star	$2.48 \times 10^{-5} \text{ erg sec}^{-1} \text{ cm}^{-2}$
m_B	Bolometric magnitude	

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FAME Web page *via* S. Horner