cients of this polynomial that are stored. If you click on the Gla button, the glass catalog menu will appear. The coefficients for any particular glass are represented by the numbers just to the right of the A0–A5 alpha-numerics. ZEMAX uses these coefficients to calculate the refractive index at any selected wavelength within the valid domain of the polynomial. Of course these coefficients are based on a polynomial fit to *measured* data over a certain spectral range.

The ZEMAX glass catalog provides explicit index data only for "*d*" light ($\lambda = 587$ nm). If you want to find out what the indices are for the wavelengths you have selected, you must click on Pre → Settings → Index Data → OK.

2.8 Odds and Ends

2.8.1 More on f-number

We saw that there are three distinct f-numbers shown in ZEMAX's General Lens Data list. The traditional f-number is given by the "image space f-number." What about the other two? Consider a ray parallel to the optical axis incident on a thin singlet at a height *y* as shown in Figure 2.7.

$$\text{image space f-number: } f/\# = \frac{\text{EFL}}{\text{EPD}} \tag{2.1}$$

$$f/\# = \frac{\text{EFL}}{2y} \tag{2.2}$$

$$f/\# = \frac{1}{2y/\text{EFL}} \tag{2.3}$$

$$\text{paraxial working } f/\# = \frac{1}{2\tan U'} \tag{2.4}$$

Here we see that f-number is related to the bend angle on the ray coming to a focus in image space. We'll call this the "paraxial working f-number." It will be the same as the "image space f-number" *only* when the object is at infinity. If the object is at some finite distance, then the bend angle U' will be different resulting in a different *effective* f-number.

The last f-number ZEMAX uses is called the "working f-number." It is defined as:

$$\text{working } f/\# = \frac{1}{2\sin U'} \ . \tag{2.5}$$

This f-number applies to real aberrated systems where U' departs from its ideal unaberrated path.

We will talk more about paraxial and real rays in Chapter 4.

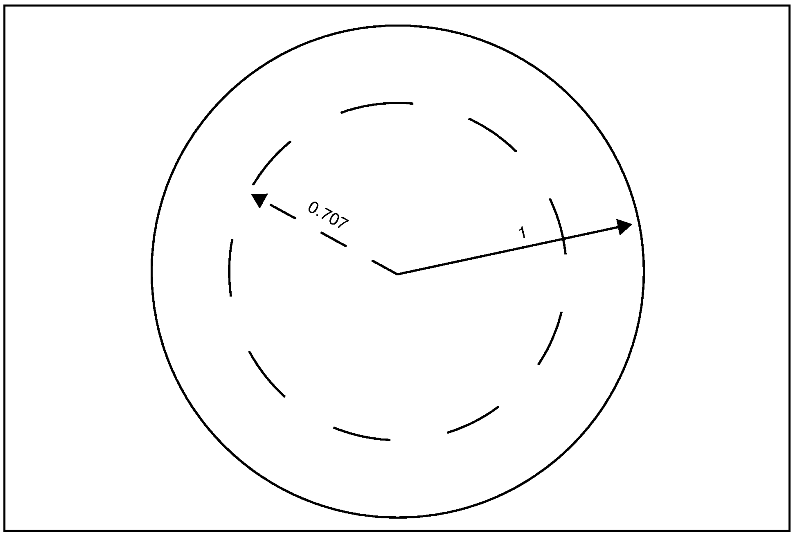

Fig. 2.8 *Zone selection for rays either in object field or in pupil.*

2.8.2 Ray Selection

Consider a unit circle as shown in Figure 2.8. Its area is 3.1416 units. What is the subradius that will enclose *half* this value?

$$\text{subradius} = \sqrt{\frac{3.1416}{2\pi}} = 0.7071 \qquad (2.6)$$

The subradius 0.7071 divides the unit circle into two regions (an inner circle and an outer annulus) having the *same* area. There are two traditional applications of this in lens design and in ZEMAX. The first is in selecting where in a circular object field rays emanate; the second, where in the circular entrance pupil rays are incident. When we use the *default* merit function in ZEMAX to set up the ray ensemble for tracing through the system for optimization, you'll see that use is made of this subradius. Back in Section 2.2.2 we selected fields of 0°, 7.07°, and 10°. The middle value was not an arbitrary selection; it was 0.707 times the maximum field angle.