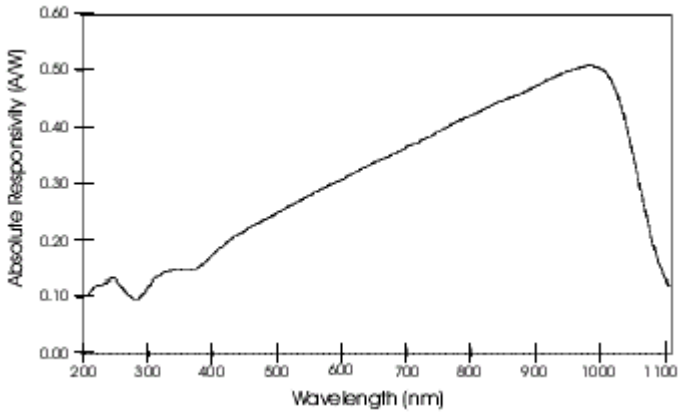
Measuring Luminance with the Minolta Camera—C.E. Mungan, Summer 2002

Here is a typical spectral responsivity for a silicon power meter. This was taken straight off a Laser Probe specification sheet.



As you can see, the responsivity is approximately linear at visible wavelengths owing to the fairly constant quantum efficiency (QE) of silicon. So how can one measure optical power at different wavelengths using such a detector?

The general answer is... you cannot! Good silicon power meters usually have a dial to enter the wavelength. Using such a power meter to measure a broadband light source will NOT give an accurate reading in watts, although the reading in amperes will be quite good. (One photoelectron is essentially generated for each incident photon. It would be wrong to interpret the above graph to mean that the detector works better at longer wavelengths!) I suppose one could design a coating to flatten the above responsivity, but who wants to buy a detector with a purposefully degraded QE at the red end?

So how does the Minolta LS-110 luminance meter (which incorporates a single-channel silicon detector) work? Answer: the correction filter must incorporate not just the CIE phototopic curve but also the above responsivity curve. That is, you could not take the filter out of the luminance meter and use it with say a thermal detector (which typically does have a very flat responsivity). The filter has been carefully designed to match the specific response function of the optics and detector inside a particular luminance camera.

To put it another way, the Minolta luminance camera works by simply throwing away large numbers of photons at the blue and red ends of the spectrum. Thus, a more accurate value of luminance for a weak blue or red emitter could be obtained by measuring the spectral power with a spectrometer and then multiplying that by the CIE curve directly, rather than using the luminance camera at all. Another option is to buy a luminance camera containing an array detector, but of course that gets expensive.