Why Astronomy Needs LPS Lighting

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Astronomers generally use filters when making images of astronomical objects or when simply measuring the amount of light coming from particular stars or objects. These filters limit the range of colors or wavelengths that are observed to less than what would be observed by unfiltered instruments. By isolating different portions of the spectrum in this way, much information can be gathered about the conditions under which the light has been produced. As a simple example, by comparing the amount of light in the red portion of the spectrum with the amount in the blue, astronomers can often measure the temperature of the objects observed, since hotter objects or stars produce more blue light than cooler stars.

Sometimes the filters used are quite peculiar and developed to allow a specific problem to be addressed, but more often "standard" filters are used to allow the data gathered to be compared with the large database collected by many astronomers using the same filters over many decades. The use of such "standard" filters allows the astronomer to take advantage of the context and understanding developed over many years by many astronomers.

There are three principal "standard" filter systems used. These are the Johnson broad-band system (there are a few "subsets" that are similar), the Strömgren intermediate-band system, and the Sloan (SDSS) broad-band system. Each of these "systems" consists of several filters to isolate separate regions of the spectrum. The transmission curves of these three systems are shown in Figure 1, along with the spectra of the three most common lamps used in outdoor lighting.

The almost monochromatic light emission from low-pressure sodium lamps is "filtered out" with two of the four filters in the Johnson system, four of the five filters in the SDSS system, and all filters in the Strömgren system. So complete observations using all filters in each of the first two systems will be only partially contaminated by LPS light, while those taken in the Strömgren system will avoid LPS entirely. It is (usually) not a case of simply avoiding the filters that allow LPS light to pass, since for most effective use of the "standard" systems data must often be obtained using all filters in the system, so in the Johnson and SDSS systems astronomers cannot entirely avoid LPS emission. But at least there is the possibility of working around LPS emission in some situations and for some kinds of research, so the contamination that is unavoidable is limited.

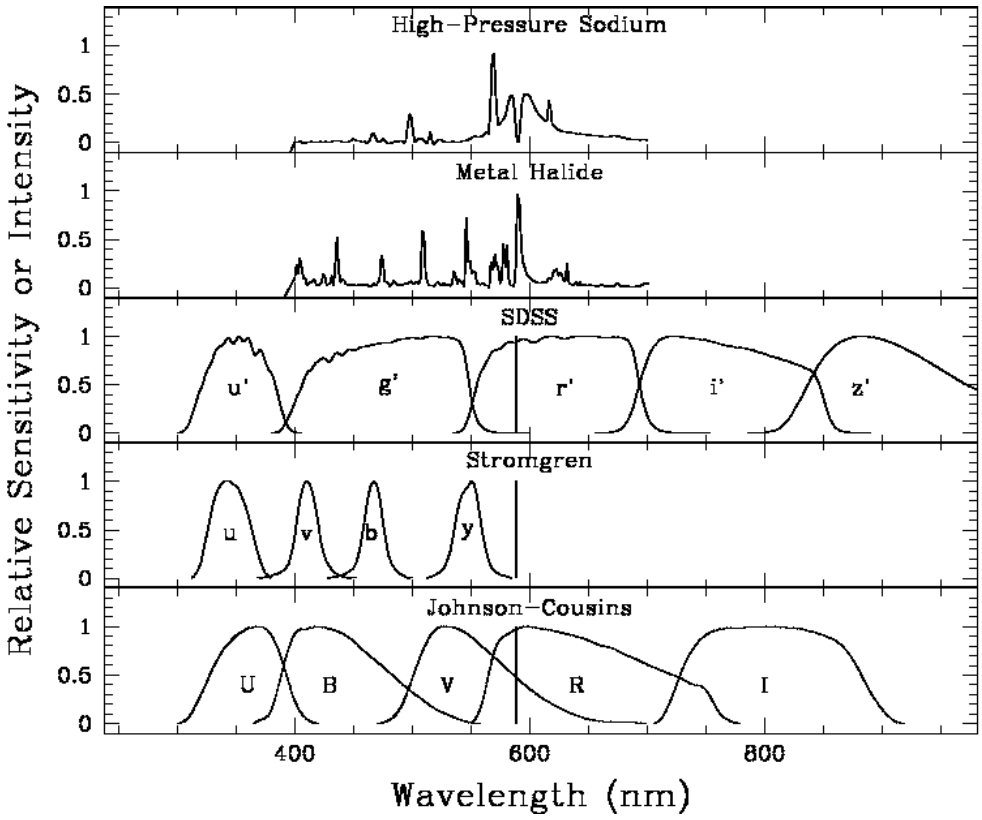

Figure 1. Relation of high-pressure sodium, metal halide and low-pressure sodium emission (vertical bar at 589 nm in the lower three panels) to the three photometric filter systems. Only a portion of the emission spectra of HPS and MH is shown. (from Luginbuhl, IAU Symposium 196, 2001)

In this sense only can it be said that astronomers can "filter out" LPS light. It is a limited sense. It is not correct to say that "LPS can be completely filtered out by astronomers and therefore causes no interference." Astronomers can only avoid light pollution caused by LPS light if they do not need data from that particular region of the spectrum. Of course, it much more often will happen that they can avoid this narrow part of the spectrum than that they could avoid the entire visible spectrum. Since all other lamp types such as high-pressure sodium, metal halide, fluorescent and incandescent emit light at all visible wavelengths, these lamps cause light pollution in all filters and there is no possibility of avoiding it.

You can see a discussion of these issues in more detail in IAU Symposium 196 "Preserving the Astronomical Sky," Astronomical Society of the Pacific Conference Series, Cohen and Sullivan, eds., page 81.