

## Astronomy's problem with light pollution

**M**any urban areas suffer from severe pollution effects that worry residents and compromise the quality of life. Well known are water and air pollution. They affect us all, and solutions are difficult and expensive.

Less known is another type of pollution that affects the environment: light pollution. It is of great concern to astronomers, both professional and amateur, and, indeed, to any of the public interested in the clear night skies once prevalent as our window into the Universe.

Advances at the frontier of astronomy depend heavily upon observations of very faint objects that can be detected only with large telescopes located on prime observing sites well away from sources of both air pollution and urban nighttime sky glow. Observations of extremely faint extragalactic sources, and even of many objects of interest in our own galaxy, can be done only during the time when the moon is dark—the sky background being much too bright when moonlight is present. Man made lighting of the sky from cities has, unfortunately, the same adverse effect on nighttime sky brightness in limiting our observations. Astronomers and the lighting community call this increased sky glow “light pollution,” for it is wasted light that does nothing to increase nighttime safety, utility or security. It only serves to waste energy and money.

There are very few prime ground-based optical and infrared observing sites in the world, and these sites need protection from light pollution. Even in cases where the locations of large observatories had been carefully selected, based upon their sufficient distance from large cities, problems have arisen from both the remarkable increases in actual light output from urban areas and from the increased lighting that results from these cities' physical growth. At Palomar Observatory, location of the Hale 200-inch telescope, a doubling of the sky background level decreases the effective size of the telescope to that of a 140-inch aperture. The Lick Observatory's 120-inch telescope is affected even more.

Fortunately, there are solutions to light pollution that work and that do not have the high costs associated with controlling other forms of pollution. They involve:

- ▶ Turning to low-pressure sodium lamps wherever possible.
- ▶ Using just the right amount of light (avoiding overlighting).
- ▶ Minimizing wasted light, light trespass and glare with shielding and placement.
- ▶ Using timers and dimmers. (The second half of the night can be darker than the first half, for instance.)

Low pressure sodium lighting concentrates the pollution in the sodium D-lines, covering a few Angstroms that astronomers are prepared to sacrifice for freedom from pollution at other wavelengths. Some communities have opted for the lightly efficient LPS lamps solely to save money.

Near major observatories, particularly in Arizona, California and Hawaii, officials and public have begun to adopt some of these solutions (see page 63).

The current light pollution control programs are critical to the long-term success of frontier research. The argument that space astronomy will make this problem obsolete is not correct: the largest telescopes will continue to be based on the ground for a long time because of cost factors. It does not make sense to do in space, at higher cost, what can be done from the ground. There are many things that can only be done in space, and the demand for that type of research is severe. The experience of more than two decades of space astronomy is that space research has increased the demand for more ground-based facilities rather than making them obsolete. Planning for several new ground-based telescopes, much larger than anything now in existence, is well on its way.

Public awareness rather than resistance has generally been the difficulty in controlling light pollution. Educating the public, government officials and lighting professionals is the major thrust of most current control programs, including those of the American Astronomical Society and local astronomers. These education efforts have helped. The increase of light pollution near major sites is now moderating. More can and must be done. We in the astronomy community are urging the physics community as a whole to help us obtain this cooperation. We have been greatly pleased by the cooperation of officials, the public and the lighting community so far.

There is the added advantage that essentially everything done to minimize light pollution also saves energy and money by improving the efficiency and utility of nighttime lighting. Controlling light pollution is one of the very few programs in which everyone wins.

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