

LIGHT POLLUTION: THE PROBLEM AND THE POTENTIAL SOLUTIONS

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Abstract. Essentially all astronomical observing sites have been adversely affected by light pollution, the increasing sky glow above all cities worldwide. Those sites not now affected will be in time. There is no getting away from it. This sky glow is decreasing the value of our observing facilities, and several observatories have been compromised to the extent that “dark sky” astronomy is no longer possible. Furthermore, this sky glow is also affecting almost all amateur astronomy and the general public, removing much of the universe from the view of us all. The change in only one generation is remarkable. Something must be done. Fortunately, there are solutions. They have been implemented to some extent in a number of locations, and we know they work. The problem is in building awareness of the issues and of the solutions and then in overcoming the apathy of most people, including astronomers, to do something to help implement the solutions. We are fortunate in that all of these solutions help to improve greatly the quality of our outdoor nighttime lighting, improving visibility, removing glare, saving energy and increasing the ambience of the nighttime environment. We can all win, and we must.

Key words: atmospheric effects – site testing – telescopes

1. INTRODUCTION

Have you heard of light pollution? Have you been bothered by it? Professionally or personally? Is it getting worse over time? Have you ever been bothered by glare, or by your neighbors outdoor lighting?

Doing anything about it? Any idea of what to do? Anybody else doing anything to help?

There is a problem, and it is getting worse. If you are not bothered by it yet, you will be. Even the best prime observing sites will be in time if we do not do something now to help preserve the good skies. Professionals and amateurs alike are suffering. So is the general public, due to the steady increase of poor lighting in most of our communities. It can and does compromise our limiting magnitudes and increase greatly the signal to noise ratio of our observations. A lot of the universe is disappearing from view.

How can anything as good as lighting be a bother? It can, and for many reasons.

Glare never helps visibility, and yet most of our lighting has a great deal of glare. There is no excuse for it. It does not have to be there. We should not tolerate such lighting.

Light trespass is a bother to most everyone. By that, we mean some outdoor lighting that bothers us, shining into our property, our yards, through our windows, into our telescope buildings. It can be as bad or worse than noise pollution, or offensive smells. Again, there is no excuse for any of it.

Much of our outdoor lighting is very wasteful, with light going in all directions, only a few of which need any light, and often of much more intensity than needed and at times when it is not needed. All this means energy (and money) waste. There is no excuse for it. We do not need to have all this waste nor all this glare.

Such wasted light contributes greatly to the urban sky glow above all of our cities worldwide. Such sky glow is in fact evidence of the poor lighting and the waste. We do not need all that light up there. It is just a sign of all the money burning up to produce it. We astronomers know about it, for it is rapidly diminishing our ability to see the universe at most locales. The view of the universe is also important for the public, most of us think. Where would we be without it? Our ancestors were much more in tune with the night sky, for they could see actually see it. Stars and the Milky Way were a real thing to them.

All of the above problems mean that the ambience of the night environment is badly compromised. It is another way in which we are treating our environment harshly. If we continue, our descendants will only ever be able to see the universe in a planetarium. We can and must do better.

2. THE PROBLEM

Anyone involved with the night sky, either professionally or just as a casual viewer, knows that the stars have been disappearing from view over the last decades, getting lost in the increasing sky glow from our cities. Population growth has been rapid in many locations, and the growth of outdoor lighting has been even more rapid than population. Unfortunately, a great deal of this lighting is of rather poor quality. By that I mean lighting that has a lot of glare, a lot of light trespass, and a lot of direct up light. The same poor lighting fixtures or installations cause all of the above. While the latter affects both astronomy and the public view of the night sky, the former two affect everyone.

Glare never helps visibility, yet it is very common in much of our outdoor lighting. Almost all of us have been bothered by our neighbor's lighting, whether they are private citizens or automobile dealers or shopping complexes. Good lighting has little or none of these problems, and usually it costs no more to install. It almost always costs less to operate, for lighting is used not wasted, hence energy is saved. It is easy to show that in the United States alone we waste well over one billion dollars a year just to light up the sky. There is no excuse for any of this poor lighting.

Let me summarize the adverse effects of bad lighting:

1. Glare. We should strive for a "glare free environment."
2. Light trespass. Many present lighting installations bother us as much or more than they help us. Such wasted light shines in our yards, our windows, even our telescope buildings. As with noise pollution, we do not need any of this bad stuff.
3. A trashy looking, confusing nighttime environment. We should have a nice looking community, at night as well as in the day. Poor looking environments are part of the stress of today's life. Remember, night is part of the environment too.
4. Energy waste. We waste an astronomical amount of energy by all this bad lighting, shining it where it is not needed, including up into the sky, and by using energy inefficient light sources. Better to use that money to improve our world, not mess it up.
5. And finally, the adverse sky glow. We do not live up there in the sky; we do not need all that light up there.

3. THE SOLUTIONS

The key to solutions is to educate everyone about the value of dark skies and of quality outdoor nighttime lighting. Both have great value. Few realize this, even astronomers. My goal is to educate as many as possible, in astronomy, in the lighting community, in governmental circles, and in the general public. The hope then is that some of these will then educate others. Thus we begin an exponential growth in awareness of the issues and of the solutions. It is not easy to change the mind set of the world, but we must. I think we can. If we don't, the universe will disappear from view, for astronomers and for everyone else. While I like planetaria very much, it would be a crime if that was the only place future astronomers, children, and most anyone could see the stars or the universe.

Let me sketch out the specific things that can be done to improve the quality of outdoor lighting, and hence to preserve the night skies.

1. Use only good lighting. Seems obvious, but it is not, as evidenced by all the poor lighting in most of our cities. Good lighting is really just a common sense thing. Let's not any of us tolerate bad lighting.

2. Shine the light down, where it is needed. Control the light output to locations where it is needed; do not shine it where it is not needed. Don't waste the light. This means using good lighting fixtures, ones that control the light output. "Full cut-off" lighting fixtures have no direct up light and very little light at the higher angles that cause most of the glare.

3. Use time controls when possible, and dimmers or other controls, to insure that light is there when needed and not there when not needed.

4. Design the lighting installations so that glare is minimized or completely avoided. Most all glare comes from poor lighting fixtures or poor installations. There is no need for either. Glare never helps visibility!

5. Use the right amount of light for the task, not overkill. More lighting is not always better. When not blinded by glare, the eye is a remarkable instrument and can see very well at what seems to be quite low lighting levels. In addition, going from over lit to darker areas means that we don't see too well (called "transient adaptation"), and the opposite holds to some extent also. Dark shadows near overlit areas are dangerous.

6. Use energy efficient lighting sources. Light sources vary greatly in their efficiency. Consider especially the use of low pressure sodium (LPS) lamps; they are the most energy efficient of all. They are also the ones most preferred by astronomers, for they have a monochromatic light output which can be filtered out very well at the telescope. LPS is excellent for street lighting, parking lots, security lighting, and other applications where color rendering is not critical. Creative design can use LPS along with some white light sources for most any application, even where color is critical.

7. Consider the implementation of outdoor lighting control ordinances (laws). Such ordinances then define the community standard for good lighting. Such cities or other entities then end up with better lighting, they are safer, they have a much better nighttime ambience, they save a lot of energy, and they go a long way to preserving dark skies.

All of the above really are just common sense. There is little objection to any of it from anybody once they become aware. The two major problems by far are lack of awareness and apathy. Both must be overcome if we are to have solutions.

4. CAN WE DO IT?

Yes we can. In almost every location where we have been able to devote the time to educating people in all the communities (astronomy, lighting, governmental, business and the public), we have been successful. There are many outdoor lighting ordinances now in place, and they work well. They have support from all the communities, and they help greatly in improving the nighttime environment, both for astronomy and for living. We know that the solutions work! For example, one can still see the Milky Way from Tucson, a city of over 700 000 inhabitants, and the major observatories only 50 km from Tucson still have prime dark skies. But it has taken a great effort and time over the years to accomplish these results.

Many consider the whole thing too big a problem to deal with. "How can one convert Los Angeles to better lighting? It's impossible." But it is not. In fact, the City of Los Angeles is now using all full-cut-off lighting fixtures for all their new installations and is retrofitting the older fixtures, the ones with lots of glare and waste, to full-cut-off fixtures as fast as budgets allow. The city engineer in charge of lighting for Los Angeles is now on the IDA Board of Directors even!

It can be done. But we must overcome the lack of awareness and the apathy in almost all individuals and organizations, even in the astronomy community.

5. RESOURCES

Many in the local, national and international lighting communities now understand the issues. Many are working as hard as we are to improve the quality of our outdoor nighttime lighting. Standards for lighting quality are improving, and the lighting literature is beginning to take these issues into account, and to urge solutions. These individuals and organizations need all the help we can give them.

There are, unfortunately, many others who still need to be educated, and many who must be pushed so as to overcome the apathy of getting solutions implemented. The educational efforts are critical to success. Even in the astronomy community, many know little or nothing about the issues or the solutions. We all should, and we all should be supporters of the cause.

There is a non-profit organization, the International Dark-Sky Association (IDA), whose goals are to educate everyone about the issues. It is now eight years old, and has about 1800 members, from all of the states in the U.S.A. and from 62 other countries. While that is a non-negligible number of members, it is less than one percent of the number of amateur astronomers in the world, and very few professional astronomers are members. There are actually more lighting engineers who are members than there are professional astronomers. Strange but true.

To help those interested in the issues and in becoming active, IDA has produced over a hundred information sheets about the issues, as well as eight slide sets (of 20 slides each) and other materials that can be used as resources by those who want to become informed and who want to become involved in helping to educate others. IDA produces a regular newsletter for members and others, and it now has a Web page on the Internet. The address is: <http://www.darksky.org>. Have a look.

IDA is making a difference. With your help, it can do much more. Basic individual memberships begin at \$ 20 a year, organizations at \$ 100. For information on the issues see, the IDA Web page, or write to IDA, 3545 N. Stewart, Tucson AZ 85716 U.S.A. About

25 percent of those who have joined or renewed are doing so at more than the standard annual membership rate.

There is a slowly growing awareness of the problems and of the solutions. But much more must be done, everywhere. We must all get involved. We all should be IDA members. As IDA grows in size, it will grow in impact and will become a very viable force in behalf of dark skies and of good lighting. Join the cause, now! We take cash, checks (in U.S.A. dollars, drawn against a U.S.A. bank), Visa and MasterCard.

6. SUMMARY

There is a problem, a severe one, and it is still getting worse in most locations. However, there are solutions, and we know that they work. They also improve the quality of the lighting in our communities, hence visibility and safety and security, as well as saving a great deal of energy and money. Lack of awareness and apathy are the main problems, not any resistance to good lighting and dark skies. With good nighttime lighting, we all win. Please do get involved; the stars and the universe need your help.

