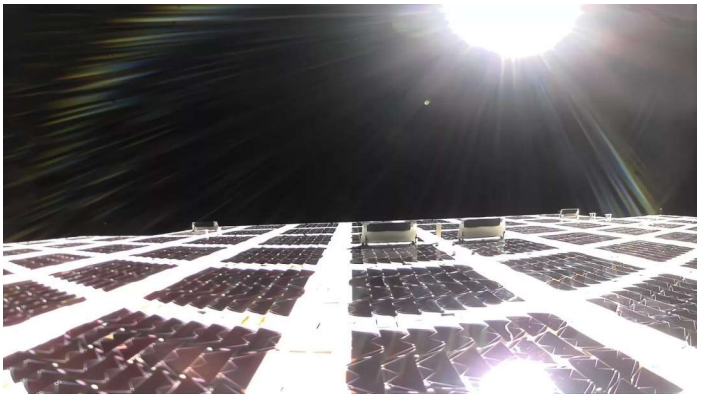
Analyzing the Deployment of Blue Walker 3

-Brad Young, Astronomy Club of Tulsa

I have the pleasure of being a member of the International Astronomical Union Center for the Protection of Dark and Quiet Skies (CPS). The main purpose of this workgroup is to monitor and advise on the megaconstellations of satellites that are being launched by several entities. The concern in the astronomical community began with the launch of the Starlink satellites. With these and other launches, the number of satellites in low earth orbit have increased dramatically over the past few years, with no sign of slowing.

The possible deleterious effect on optical and radio astronomy is alarming, in that we might be losing our ability to observe using multi-million-dollar telescopes and watch for incoming near-earth objects (NEOs). Early results show little effect. However, those results were based on the relatively faint Starlinks, which were adapted by SpaceX for the express purpose of dimming their appearance. SpaceX has been responsive to the concerns of the astronomy community, but it is unclear if other operators will be as concerned.

Lately, the focus has been the prototype Blue Walker 3 launched in September 2022 by AST Space Mobile and recently fully deployed on orbit. The deployment unfolded an antenna array that is 693 square feet, the size of a small apartment and the largest commercial communications array in low earth orbit.



(Image credit: AST SpaceMobile)

Because of the size of the array, the CPS is concerned that if the entire constellation of Blue Birds (the larger production model) is launched, which totals 168 satellites, the effect on optical and radio astronomy would be perilous.

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TABLE ONE BRIGHTNESS CHANGE OBSERVATIONS

UTC Date	UTC Time	Magnitude	Range (km)	Phase	Standard Magnitude
10/3/2022	2:59:45	5.7	1867	128	3.31
10/4/2022	1:08:36	7.4	1110	122	6.35
10/5/2022	2:26:20	4.6	1107	120	3.63
10/7/2022	1:51:15	7.5	1006	123	6.63
10/8/2022	1:33:16	5.9	1048	125	4.87
10/9/2022	1:14:56	5.8	1125	136	4.17
10/10/2022	1:57:04	5.2	1159	138	3.40
10/23/2022	10:48:00	7.0	872	126	6.33
				AVERAGE STANDARD MAGNITUDE	**5.06**
11/12/2022	11:22:00	1.4	644	75	2.61
11/20/2022	0:37:00	1.4	869	79	1.89
11/21/2022	0:21:00	1.8	843	21	2.89
11/22/2022	0:02:22	2.0	771	32	3.23
11/22/2022	23:42:00	2.7	990	99	2.54
11/23/2022	1:21:00	3.6	1199	122	2.39
11/26/2022	0:28:00	3.7	1336	83	3.20

All observations above by author; these calculations use a simplistic model that may be too conservative in predicting the optical behavior of the large array when reflecting light

AVERAGE STANDARD MAGNITUDE **2.68**

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To quantify the effect, the group has been observing Blue Walker 3 and recording its brightness before and after the deployment of the array. Several observatories and individuals across the globe have monitored the satellite before and after deployment of the array and the news is not good. The pre-deployment satellite appeared as a dim object, usually requiring binoculars to see, on a level with the post-darkening Starlinks.

After deployment of the array, the standard magnitude jumped by a factor of 9. Standard magnitude is a measure of brightness used by astronomers as a basis to compare different satellites. On a well-placed pass, this means Blue Walker 3 will typically appear as bright as a first magnitude star, with only 18 stars in the sky that are brighter. There are only a few other satellites this bright, notably ISS and CSS (the new Chinese Space Station). A press release from the IAU explains the situation further.

But the true scale of the problem is that the production objects (Blue Birds) will be even larger, therefore almost certainly brighter. And there will be 168 of them in orbit. The cell phone system will require at least two of the satellites to be always in your sky to maintain call quality. During the summer, temperate zone areas (where most professional telescopes are installed) will see these crossing the sky nearly all night, requiring constant monitoring of them to avoid ruining images. Since they are 100 times brighter than Starlinks, there is real danger of damaging sensitive CCD and other imaging devices.

Because of these critical issues, the IAU CPS has accelerated its goal to contact AST Space Mobile and find a solution. We are also involved in several other efforts to protect the night sky from what is becoming a real danger. Besides seeking a viable engineering solution to the problem, we are also engaging governments to modernize space policy and licensure to consider the effect of megaconstellations and bright objects. The effect on radio astronomy is also a major unknown, and the CPS is also working to address this issue.

Steps in the right direction include the formation of an office within the FCC (Federal Communications Commission – licensing agent for all satellites in the US) dedicated to space licensure. Previously, there had been no specific group charged with considering the effect on the night sky, only the communications concerns such as frequencies used etc.

The CPS will continue to monitor Starlinks and the Blue Walker / Blue Bird flock. We must also prepare for other systems that have been announced such as Secure Connectivity System by the EU, and Guowang by China. Lessons learned now and systems put in place to determine brightness and work within international law may help mitigate the damage.

If you would like to contribute your observations to the scientific study, consider becoming an affiliated member of the CPS by applying here. Visual reports can be made via SatHub and images collected at Trailblazer. Satflare.com has a report generator and database of observations.

Read my article on how to observe satellites and drive their brightness to a fair accuracy. Or, if you would just like to see Blue Walker 3 for yourself, you can find its passes on Heavens Above and several other sources. If you have any questions about observing the spacecraft or what the CPS is trying to do, be sure to contact me via my website.

A video of Trailblazer passing Deneb by Kevin Fetter

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