Large Satellite Constellations and Optical Astronomy

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19 Starlinks crossing astronomical image
Effects on Astronomical Images – trails and saturated trails

- Loss of information in pixels.
- Cross-talk in electronics.
- Ghost images.
- Possible residual images.
Effects on Astronomical Images – ghost images
Any object in Earth orbit that reflects sunlight is of concern.

The top curve concerns astronomers and space safety.

Public catalog of objects > 10 cm.

Catalog incomplete.

New satellites brighter than 99% of existing objects!
May 2020 – 9 companies filed with FCC for new or expanded LEO constellations

More than 50,000 new satellites in addition to almost 60,000 previously known.

So more than 100,000 new satellites in Low Earth Orbit (LEO) altitude less than 2000 km

Possibly brighter than 99% of existing population of objects in Earth orbit.
Most concern to astronomers – higher altitude constellations visible all night long in summer – example OneWeb 47,844 satellites @ 1200 km.

From FCC filing:

Table B.1-1: Orbital Characteristics of the OneWeb Phase 2 non-GSO satellite system

<table>
<thead>
<tr>
<th>Max. Number of Planes</th>
<th>Max. Number of satellites per plane</th>
<th>Inclination</th>
<th>Maximum total for orbit shell</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td>49</td>
<td>87.9°</td>
<td>1764</td>
</tr>
<tr>
<td>32</td>
<td>720</td>
<td>40°</td>
<td>23,040</td>
</tr>
<tr>
<td>32</td>
<td>720</td>
<td>55°</td>
<td>23,040</td>
</tr>
</tbody>
</table>
Figure runs from sunset (left) to sunrise (right). Red lines are evening astronomical twilight (left) to morning (right) Darkest part of night is between those two lines.

Huge challenge for astronomy - satellites not visible to unaided eye but will saturate Vera Rubin detectors
Good news – SpaceX Starlinks’ orientation

SpaceX Starlinks – one VISORSAT launches tonight, 3 June