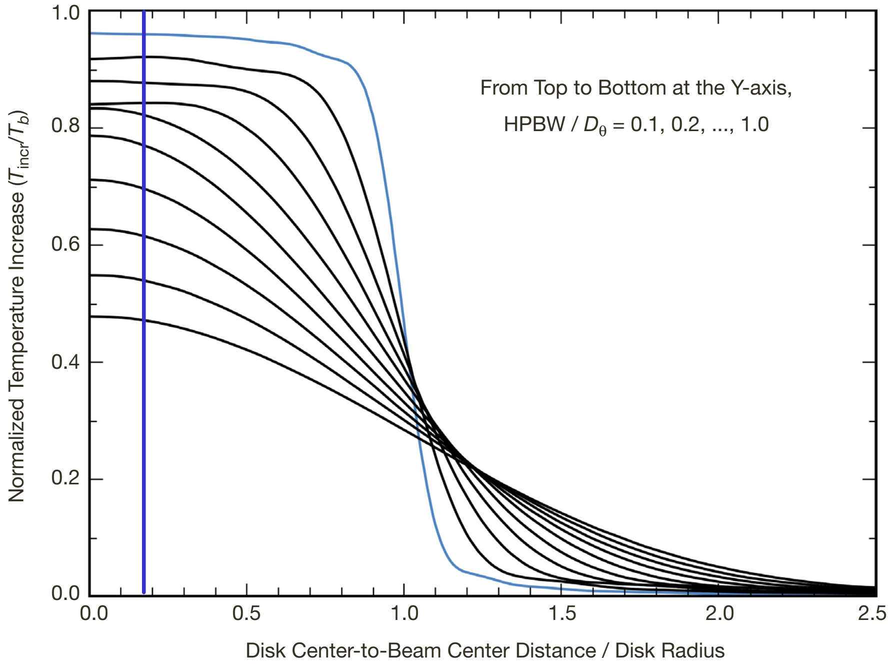

Figure 8. The normalized antenna noise temperature increase versus the normalized distance from the blackbody center when $HPBW \leq D_\theta$.

craft antenna has a 10-dB gain at 2.25 GHz. This is a low-gain, wide-beam antenna. When the spacecraft is receiving signals from Earth, its antenna is also pointing to the Sun at the same time. Based on the brightness temperature estimate at S-band, the antenna noise temperatures at various pointing offset angles can be calculated. The results of the system noise temperature and link margins are shown in Figure 9. From the figure, one can see that there are no significant differences in the link margins and temperature increases between 0 deg offset and 10 deg offset for this wide-beam antenna. For a 300,000 K solar noise temperature, the antenna noise temperature is about 24 K. The carrier margin is about 25 dB, while the data margin is about 9 dB. The antenna noise temperature increase is so low that pointing near the Sun will not cause a significant problem in this link design. However, this will not be the case for a high-gain antenna where the antenna beamwidth is comparable to or smaller than the solar disk, as shown in Figure 8.

III. Summary

In this study, a general range of solar brightness temperatures and the antenna noise temperatures at microwave frequencies have been defined using average solar cycle models. These estimates can be used by systems engineers for the design of telecommunication systems. Based on solar radio emissions measured at 2.8 and 8.8 GHz, the solar brightness temperatures have been derived, and a periodic model over the 11-year solar cycle has been presented. From the measured emission values at both frequencies, solar brightness temperatures have been developed for use at S-, X-, and Ka-bands. Solar cycle dependence of the