Effect of reflected star light on secondary transit of GJ 3470 b

If I am correct about the reflected light by the planet from the star, the calculation becomes a bit more complicated because the planet is to close to apply the simple inverse square law from a point source to arrive at the intensity of the light striking the surface of the planet. I came up with the expression in the attached word document for the contribution of reflected star light compared to the normalized transit depth using the simplification of representing the star and planet as flat disks located parallel to each other at their respective centers and neglecting the small tilt of the planet’s disk to our line of sight (COS(φ) = 0.999) and applying the calculation for intensity from a star in Henden and Kaitchuck appendix J .

The integral sums the flux from rings centered on the center of the stellar disk with projected area in the direction of the star 2πrdrCOS(θ) and .

Where

A = the Geometric albedo
IS = intensity of the star radiation per unit area
ap = the semi major axis of planetary orbit and in this case the orbit is essentially circular.
and the other variables have their usual meanings applied to star-planet systems. Also from exo.mast.stsci
ap/RS = 13.879

If I integrated correctly (well, at least correctly looked it up in my table of Integrals) and did’t make any math errors this complicated expression boils down to an increase in secondary transit depth compared to the loss of thermally radiated flux of

Addition to radiated flux = 0.23A\*TD. I don’t know what the albedo should be but 0.2 would not be a crazy number and if I assume that value then the additional flux from reflected star light is

0.046\*TD.

That isn’t a huge flux increase but would reduce the surface temperature of the planet to about 2550 K.