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The Influence of Trace Gases Absorption on Differential Ring Cross Sections

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The Ring effect refers to the filling in of Fraunhofer lines, which is known as solar absorption lines,caused almost entirely by rotational Raman scattering. The rotational Raman scattering by N2 and O2 in the atmosphere is the main factor that leads to Ring effect. The Ring effect is one significant limitation to the accuracy of the retrieval of trace gas constituents in atmosphere, while using satellite data with Differential Optical Absorption Spectroscopy technique.In this study,firstly the solar spectrum is convolved with rotational Raman cross sections of atmosphere, which is calculated with rotational Raman cross sections of N2 and O2, divided by the original solar spectrum, with a cubic polynomial subtracted off, to create differential Ring spectrum Ring1. Secondly, the Ring effect for pure Raman scattering of the Fraunhofer spectrum plus the contribution from interference by terrestrial absorption which always comes from a kind of trace gas (e.g.,O3) are derived. To allow for more generality, the optically thin term as well as the next term in the expansion for the Beer-Lambert law are calculated.Ring1, Ring2, and Ring3 are the Fraunhofer only, 1st terrestrial correction, and 2nd terrestrial correction for DOAS fitting.