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Ionic-Mode Contributions to the Refractive Index of Glasses[1]
CARRIE E. BLACK, E. SHILES, University of Vermont, D. Y. SMITH, University of Vermont and Argonne National Laboratory — The refractive index of materials transparent in the visible is commonly much smaller in the infrared than at shorter wavelengths because low-frequency ionic polarization lags the **E** field of higher-frequency light. This is often described by an IR Sellmeier term in empirical index fits. However, this separation of ionic and electronic contributions is not unique. A unique separation is given by Taylor expansion of the K-K relations in the region of transparency that yields a Laurent series in photon energy squared as the IR contribution. The coefficients are odd moments of the IR extinction coefficient. We studied this for vitreous silica and Corning ULE glass (92.5 % SiO_2 + 7.5% TiO_2). While the oscillator strength of the IR modes is four orders of magnitude less than that of the electronic transitions, the IR contribution to the index is comparable to the electronic contribution in the IR. In our examples, IR terms are sufficiently negative to bring the total index well below unity (but greater than zero) between 7 to 9 μm.

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