

From Nightsky Observations to Zodiacal Light Brightness

S. S. Hong¹, S. M. Kwon², C. Park¹, and J. L. Weinberg³

¹ Department of Astronomy, Seoul National University, Seoul, Korea

² Department of Science Education, Kangwon National University, Chuncheon, Korea

³ Space Astronomy Laboratory, 3440 Quinn Ridge Drive, Snellville, GA 30039, USA

In the reduction of zodiacal light, the atmosphere originated diffusely scattered light (ADL) is the most difficult component to remove from the observed night sky brightness. In order to understand how the ADL varies over zenith distance, we have formulated the problem of radiative transfer in an anisotropically scattering Earth atmosphere. For the incoming radiation of the astronomical background sources the Earth is assumed to be in an isotropic radiation field. For the airglow continuum an emitting layer of finite thickness is placed at a given height from the Earth surface. We then numerically solved the resulting quasi-diffusion differential equation by using a ray-tracing technique.

Another difficulty arises from difference in the extinction optical depth between point and extended sources. Because of the photons that are scattered more than once in the Earth atmosphere, off-axis light from extended sources comes into the telescope beam. Therefore, the conventional method of correcting the atmospheric extinction in stellar photometry would not work for the photometry of such extended sources as integrated starlight and zodiacal light. A usual practice is to use for extended sources an effective extinction optical depth, which is smaller than the point source extinction depth. We have thoroughly examined how much the effective extinction should differ from the point extinction. It is shown that the difference depends on the asymmetry factor and albedo of the scatterers, the height of the airglow emitting layer, and the total extinction depth of the atmosphere itself.

With these theoretical understandings we present a self-consistent methodology for reducing the zodiacal light brightness from night sky observations. We will also discuss its implications for modern projects of large scale sky survey.