



## HAO Colloquium Series

(Refreshments served)

**Speaker:** Alan Kiplinger, University of Colorado

**Time:** 1:30–2:30 pm

**Date:** Wednesday, October 2, 2013

**Location:** CG1 – 1210 South Auditorium (also webcast at <http://www.fin.ucar.edu/it/mms/cg-live.htm>)

**Title:** Very High Energy Solar Particles and the Kiplinger Effect

### **Abstract:**

There are two basic types of solar flares. For years they have been called impulsive and gradual flares, which is somewhat misleading. The primary distinguishing characteristics between the two types of flares are their types of hard X-ray spectral evolution over the individual hard X-ray flux peaks and their physical configurations. Over 90 percent of flares (called impulsive) have flux peaks that show a ‘Soft - Hard - Soft’ (from a peak’s beginning, maximum and end) in the hard X-ray regime of ~ 30 – 200 keV. Perhaps 5 percent of flares show a ‘Soft – Hard – Harder’ (SHH) evolution over their hard X-ray peaks. These have been associated with high speed coronal mass ejections and high energy interplanetary particle events, an effect first coined by Dr. Hugh Hudson and later by Dr. Stephen Kahler. Kahler states in a March 2012 *Ap J*. abstract:

*The Kiplinger effect is an observed association of solar energetic ( $E > 10$  MeV) particle (SEP) events with a ‘soft – hard – harder’ (SHH) spectral evolution . . . Besides its’ possible use as a space weather predictor of SEP events the Kiplinger effect has been interpreted as evidence of SEP production in the flare site itself, contradicting the view that . . .*

... (simplifying in my own words) Coronal Mass Ejections (CMEs) essentially do everything with regard to SEPs. These points will be addressed as well as timescales of SHS (impulsive) events vs. SHH (the most geo-effective energetic) events. Most flares display only SHS and a few show only SHH, but some show both types of evolution. Four out of the six largest Ground Level Events (GLE) are SHH events, demonstrating that ~ 1 GeV particles are associated with the Kiplinger effect. Observed heights of events will be discussed as well as a hope that HAO’s new K-coronagraph could provide invaluable insight to these uncommon, but very important solar and geo-effective events.