## Abstract Submitted for the MAR05 Meeting of The American Physical Society

Formation of Suncups on Snowfields Exposed to Solar Radiation T. TIEDJE, BAYO LAU, A. BALLESTAD, ERIC NODWELL, Physics and Astronomy, University of British Columbia, Vancouver, BC — A mathematical model is proposed to explain the ablation hollows (suncups) that are observed on snowfields exposed to intense solar radiation. The model is derived by first expressing the distribution of scattered sunlight in the snow in terms of the local slope and curvature of the surface. From this expression, we use a perturbation method valid in the limit of weak surface topography to obtain a differential equation for the snow surface morphology. The resulting non-linear equation is the Kuramoto Sivashinsky equation except with the addition of a conservative non-linear term. In simplified form the equation is:  $\partial_t h = cF\left(\langle \ell \rangle \nabla^2 h - \langle \ell^3 \rangle \nabla^4 h + (\nabla h)^2 + \langle \ell^2 \rangle \nabla^2 (\nabla h)^2\right)$  where  $\langle \ell^n \rangle$  is the spectral average of the  $n^{th}$  power of the photon diffusion length. Multiple scattering from one concave part of the surface to another is treated self consistently. Numerical solutions of this equation with published values for the optical properties of snow yield spontaneous ordered patterns with a characteristic length of 25-50 cm and characteristic formation time under full solar illumination of 5-15 days, depending on the microstructure of the snow. The spontaneous pattern consists of a hexagonal array of parabolic valleys separated by sharp ridges that closely resemble suncups in size, shape and growth time.

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