Abstract Submitted
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**Phonon Drag in InSb: Theory and "spin"-motive force** STEWART BARNES, Department of Physics, University of Miami, Coral Gables, FL 33124 , JOSEPH HEREMANS, Department of Mechanical and Aerospace Engineering, and Department of Physics, The Ohio State University, Columbus, OH 43210, — The phonon number operator $\hat{n} \rightarrow \sin^2 \frac{\theta}{2}$ defines the Euler angle $\theta$ and with the phase $\phi$ this maps to a precessing spin. Defined are a "spin" Berry phase and a "spin"-motive force (smf)[1]. Unlike an emf, an smf can act upon neutral phonons. Tradition[2] has sub-thermal phonons as central to the thermopower of semi-conductors. The momentum given to these phonons, by the temperature gradient, is transferred to the electrons by "drag" where it cancels a Seebeck effect electric field $\vec{E}$. Here, for InSb at low temperatures, thermal phonons actually relax momentum via boundary and umklapp scattering and energy conservation involves sub-thermal phonons, created by anharmonic effects, with a frequency $\hbar\omega_{\vec{q}} \sim k_B(dT/dx)\ell$ where $\ell$ is the phonon mean-free-path (mfp). The resulting smf acting upon the thermal phonons produces a "spin" voltage $\sim (k_B/e)\Delta T \sim 100\mu$V/K. Via the electron-phonon interaction, the smf, multiplied by the ratio $\ell_{ep}/\ell$, where $\ell_{ep}$ is the electron-phonon mfp, are detected, but not created by the few electrons in our InSb samples. [1] S. E. Barnes and S. Maekawa, Phys. Rev. Lett. **98**, 246601 (2007) [2] C. Herring, Phys. Rev. **95**, 954 (1954).

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