Luttinger-Tisza method applied to frustrated magnetic systems
ETHAN COLDREN, MARTIN GELFAND, KATE ROSS, Colorado State Univ —
A frustrated magnetic system is one in which a spin ‘wants’ to align with some of its
neighbors, but ‘wants’ to anti-align with others, and a long range ordered state that
completely satisfies all interactions is not possible. This can lead to many interesting
spin structures, including helical phases with incommensurate ordering wavevectors.
In order to determine the magnetic structure of a given frustrated Hamiltonian, we
developed a program that uses the Luttinger-Tisza method to predict the ground
state spin configuration. This is used to compare to neutron scattering data on
materials thought to embody the frustrated spin models. The program has been
tested for the $J_1 - J_2 - J_3$ Heisenberg model on a honeycomb lattice, for which the
exact results are known. The method was then applied to a $J_1 - J_2$ Heisenberg
model for the three dimensional lattice appropriate to the highly frustrated material
$\text{Fe}_3\text{PO}_7$. The result for the relevant parameter regime for $\text{Fe}_3\text{PO}_7 (\frac{J_2}{J_1} = 1.9)$ is a
quasi-degenerate ring of $\vec{k}$-vectors, in excellent agreement with observations from
neutron scattering. Our result for $\text{Fe}_3\text{PO}_7$ gives insight as to why this material does
not form a fully long range ordered state, but instead forms nanosized domains of
partial helical order.

Ethan Coldren
Colorado State Univ

Date submitted: 20 Sep 2017