**DEPARTMENT OF MATHEMATICS**

**Spring 2014 Term**

**Seminar Series: Statistical Mechanics and the Riemann Hypothesis**

**Wednesdays, 2:00–3:50 p.m.**  
**Room 1314 WWH**  
**Professor Charles Newman**  
*(January 29 to March 12, 2014)*

We present some old results concerning the location of zeros of partition functions (or moment generating functions) in certain statistical mechanics models and their possible connections to the Riemann Hypothesis (RH).

A standard reformulation of the RH is as follows. The (two-sided) Laplace transform of a certain specific function $\Psi$ on the real line is automatically an entire function on the complex plane and the RH is equivalent to this transform having only pure imaginary zeros. Also $\Psi$ is a positive integrable function, so (modulo a multiplicative constant $C$) is a probability density function.

A (finite) Ising model (with pair ferromagnetic interactions) is a specific type of probability measure $P$ on the points $S = (S_1, \ldots, S_N)$ with each $S_j = +1$ or $-1$. The Lee-Yang theorem implies that for non-negative $a_1, \ldots, a_N$, the Laplace transform of the induced probability distribution of $a_1 S_1 + \cdots + a_N S_N$ has only pure imaginary zeros.

The big question here is whether it’s possible to find a sequence of Ising models so that the limit as $N$ tends to $\infty$ of such induced distributions has density exactly $C \Psi$. We will focus on questions of this sort.

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Here are some background references: