

# Spontaneous Symmetry

## Breaking

### Part 1

- Curie - Weiss model
- Mean - field approximation
- Landau Theory
- Hysteresis
- Relaxation to equilibrium.

Introduction to the course

Introduction

Part 1

- Case - West Nile
- Miasm - field of epidemiology
- London 1854
- Hysteria
- Reactions to social changes

## Mean-field approximation

Curie and Weiss introduced a phenomenological model of magnetism using a very clever idea. Consider a single spin  $1/2$  particle subject to a magnetic field. The Hamiltonian is

$$H = -h \sigma_z \quad (1)$$

In thermal equilibrium the partition function will be

$$Z = \text{tr} e^{-\beta H} = 2 \cosh(\beta h) \quad (2)$$

thus, the average magnetization will be

$$m = \langle \sigma_z \rangle = \frac{\text{tr}(\sigma_z e^{-\beta H})}{Z} \quad (3)$$

or 
$$m = \tanh(\beta h) \quad (4)$$

Now comes Curie and Weiss's idea: in a ferromagnetic material the system will feel, in addition to the external field  $h$ , an effective field due to the magnetization of all its neighbors.