The atomic force microscope (AFM) operates by bringing an extremely sharp nanotip close to a surface to measure the atomic scale forces. Images are obtained by scanning with the tip. Unlike in the scanning tunneling microscope (STM), there is no current between the tip and sample, and so AFM can also be used on insulating materials. With atomically sharp tips, individual atoms and even electronic structure can be distinguished.

In non-contact mode, the AFM tip is at the end of an oscillating cantilever.

**Evolutional optimization**

Population → Crossover → Mutation → Survival

Fitness $F = \sum (f_{\text{ref}} - f_{\text{exp}})$

**In practice**

Vs. experiments - MgO (100)

Fitness based on representation of reference data - various fitness functions can be used

The atomic force microscope studies surfaces by feeling them with an atomically sharp tip.

Different tips give different signals - what do we see?

A "reflection" of the tip in the images - what is the tip?

**Good news**
- Good qualitative estimates
- Good sampling of configuration space
- Multiple solutions
- Tip structure constrained by boundary structure
- Metastable structures
- Classical potentials not enough, needs ab initio
- Ab initio still too expensive

**Bad news**