The Scale of Things – Nanometers and More

**Things Natural**

- **Ant** ~ 5 mm
- **Dust mite** 200 μm
- **Human hair** ~ 50-120 μm wide
- **Red blood cells** (~7-8 μm)
- **ATP synthase** ~10 nm diameter
- **DNA** ~2-1/2 nm diameter
- **Atoms of silicon spacing** 0.078 nm

**Microworld**

- 10^-2 m
- 1 cm
- 10 mm

1,000,000 nanometers = 1 millimeter (mm)

- 10^-3 m
- 0.1 mm
- 100 μm

- 10^-4 m
- 0.01 mm
- 10 μm

**Infrared**

- 10^-5 m
- 0.1 μm
- 100 nm

- 10^-6 m
- 0.01 μm
- 10 nm

**Ultraviolet**

- 10^-7 m
- 0.1 nm
- 100 pm

- 10^-8 m
- 1 nm
- 1 pm

- 10^-9 m
- 0.1 nm
- 1 pm

- 10^-10 m
- 0.1 nm
- 1 pm

**Nanoworld**

1 nanometer (nm)

**Things Manmade**

- **Head of a pin** 1-2 mm
- **MicroElectroMechanical (MEMS) devices** 10 -100 μm wide

- **Pollen grain**
- **Red blood cells**

- **Zone plate x-ray “lens”** Outer ring spacing ~35 nm

- **Self-assembled, Nature-inspired structure** Many 10s of nm

- **Nanotube electrode**

- **Carbon buckyball** ~1 nm diameter

**Quantum corral of 48 iron atoms on copper surface positioned one at a time with an STM tip**

Corral diameter 14 nm

**The Challenge**

Fabricate and combine nanoscale building blocks to make useful devices, e.g., a photosynthetic reaction center with integral semiconductor storage.