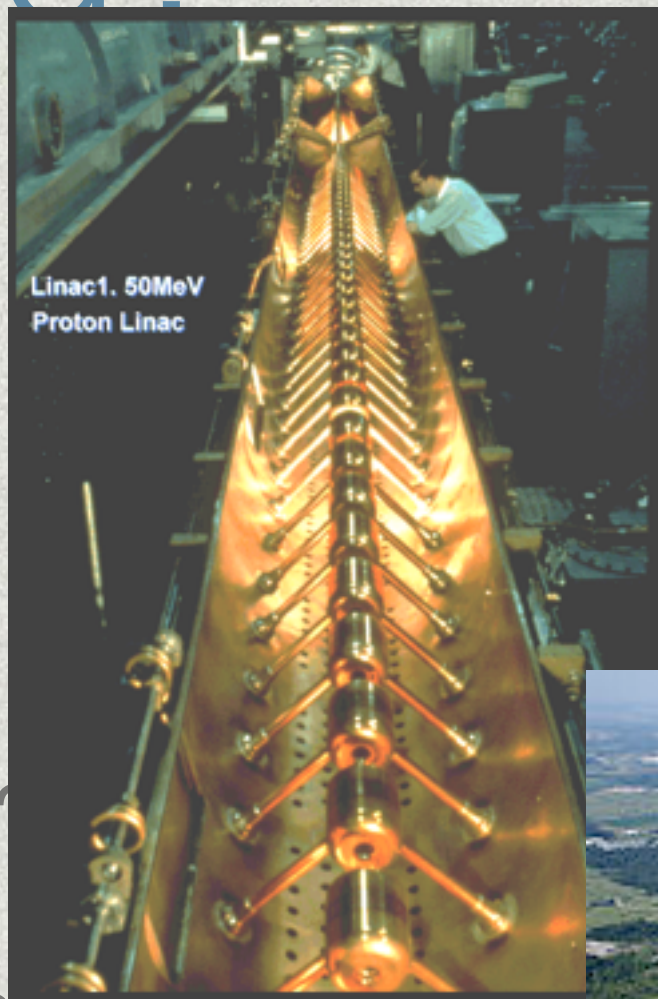


Let's Build A Particle Accelerator

A nerd's-eye view

What kind?



- * Linac
- * Electron - photon
- * Proton-Antiproton



How about a...

- * Alternating gradient synchrotron? - Sure!
- * (you can keep your cyclotrons)

Magnets - $\mathbf{F} = q(\mathbf{E} + \mathbf{v} \times \mathbf{B})$

- * Dipole - bend the beam
- * Quadrupole - focus the beam
- * Sextupole - correct the focus
- * Octupole - correct the chromaticity

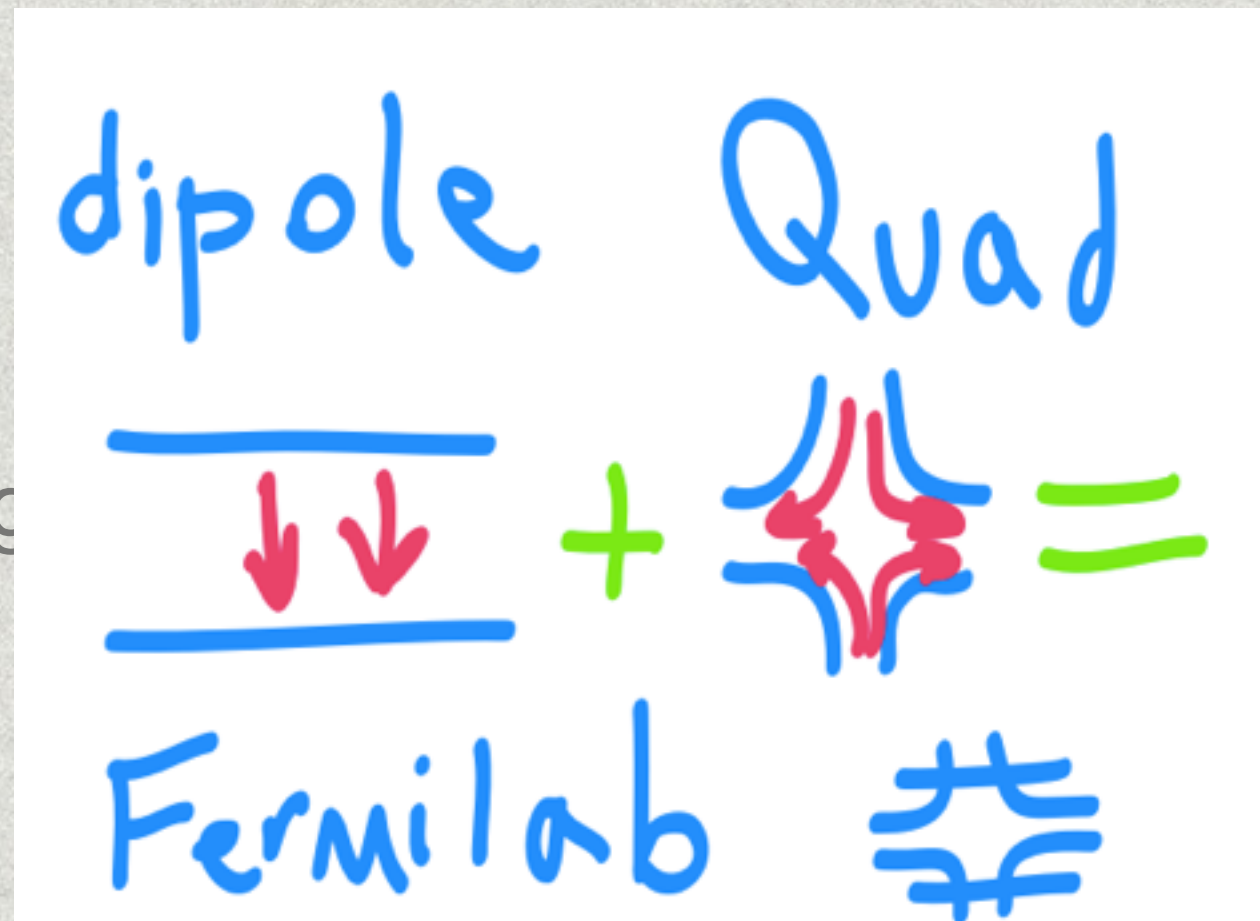


Beam

- * Phase space - stability
- * Dispersion
- * Tune, chromaticity
- * A real-world application for irrational numbers

Trivia

- * Check out this log

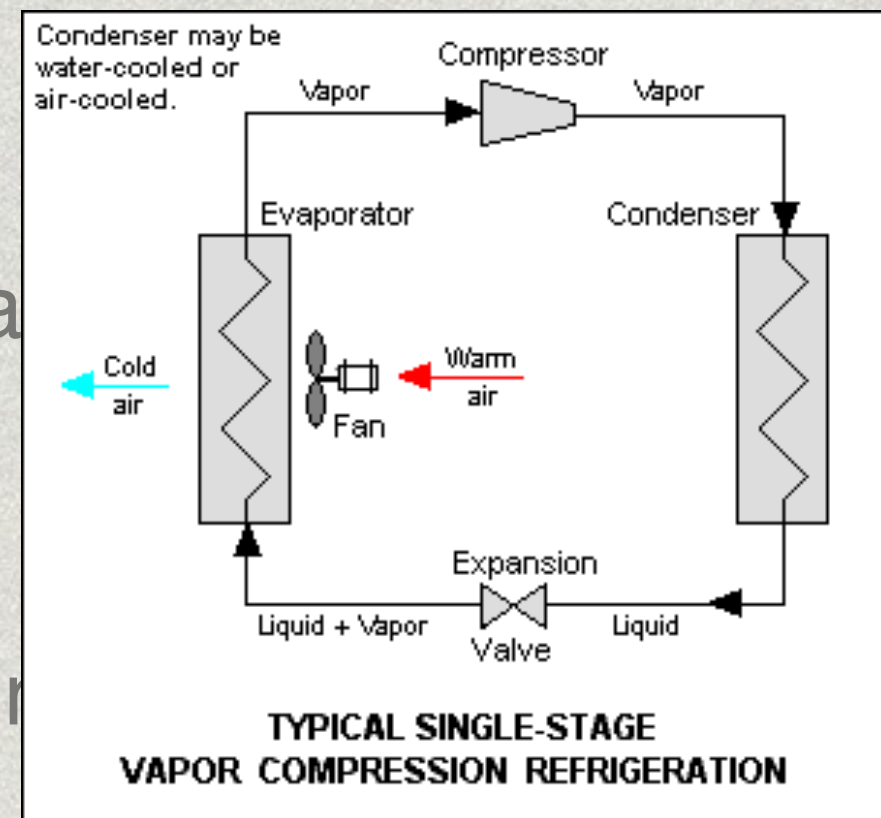


Vacuum

- * Better than the moon, much better
- * Vacuum pumps
 - * Roughing
 - * Turbo
 - * Ion
 - * Diffusion
- * Very low temps capture gasses

Cooling

- * LN2 - *cheapish*: nice beer
- * LHe - expensive: med/nice cha
- * meh, we'll make our own
- * a *big* refrigerator (hex, cooling
- * Nb-Ti likes about 4K (close to abs zero)



Acceleration

- * Everything is very close to c
- * Mainly adding energy
- * Space charge
- * Ramp - synchronize magnet strength w/ beam momentum/energy

Size/Superconducting

- * Opposition: machine size vs. max beam energy
- * Electricity: you need lots. CURRENT! ~4K amps
- * Conductor ~1cm square
- * Nb-Ti

Machine Safety

- * Quench (real bad)
 - * beam hits pipe & *adds energy*
 - * heats superconducting magnet
 - * magnet goes sub-superconducting
- * Safety system
 - * warm magnet uniformly
 - * vent coolants (expanding gas)
 - * dump current

People Safety

- * Interlocks
- * Keys - controlled entry
- * Radiation
- * Electricity