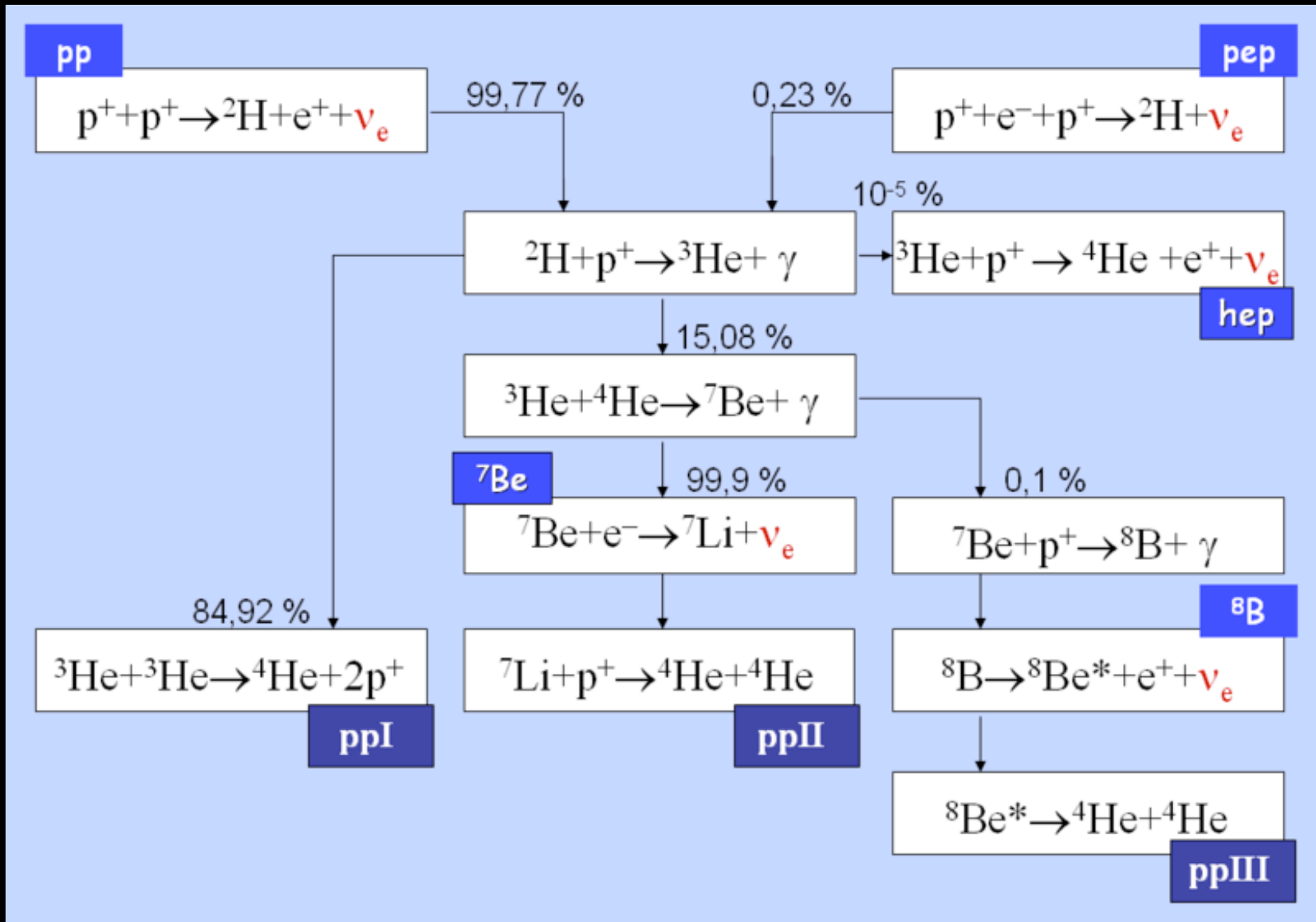


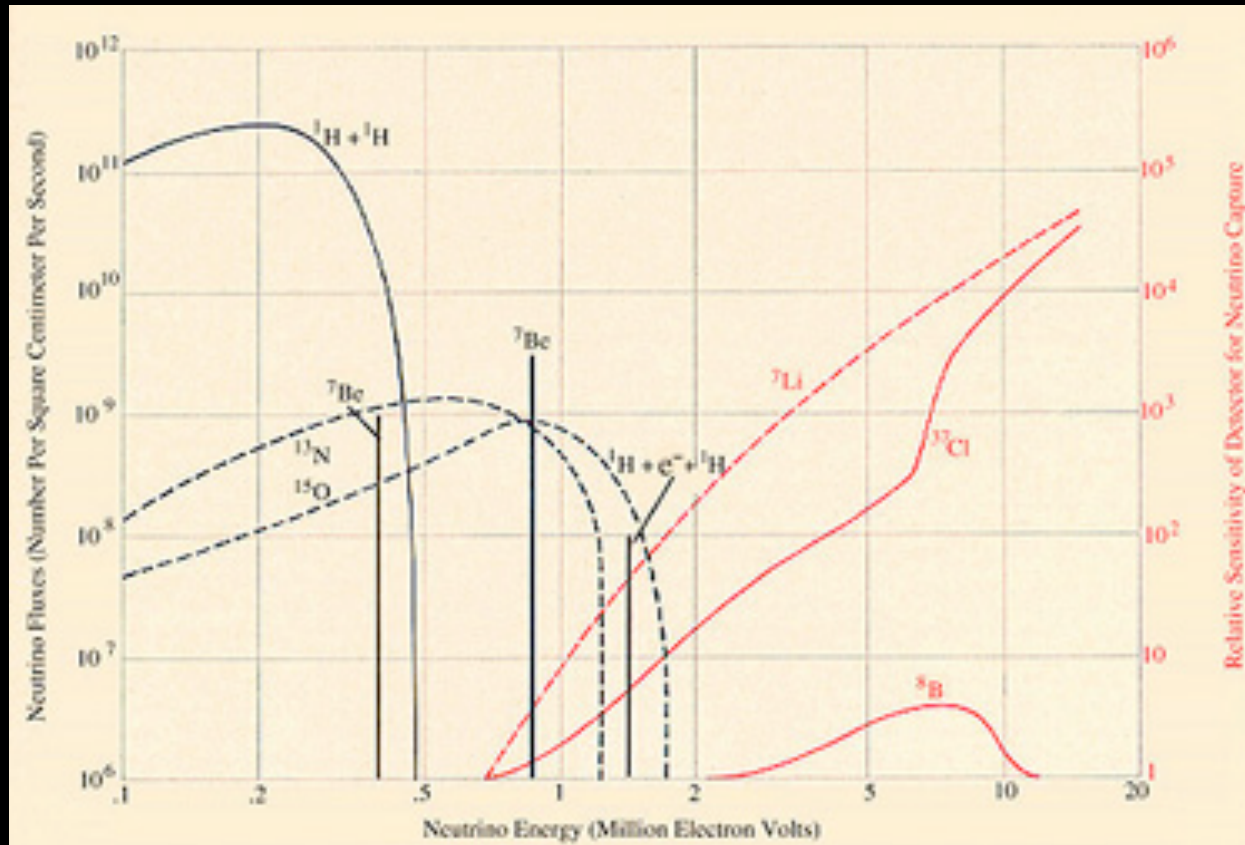
# The Solar Neutrino Problem

effective solar fusion reaction





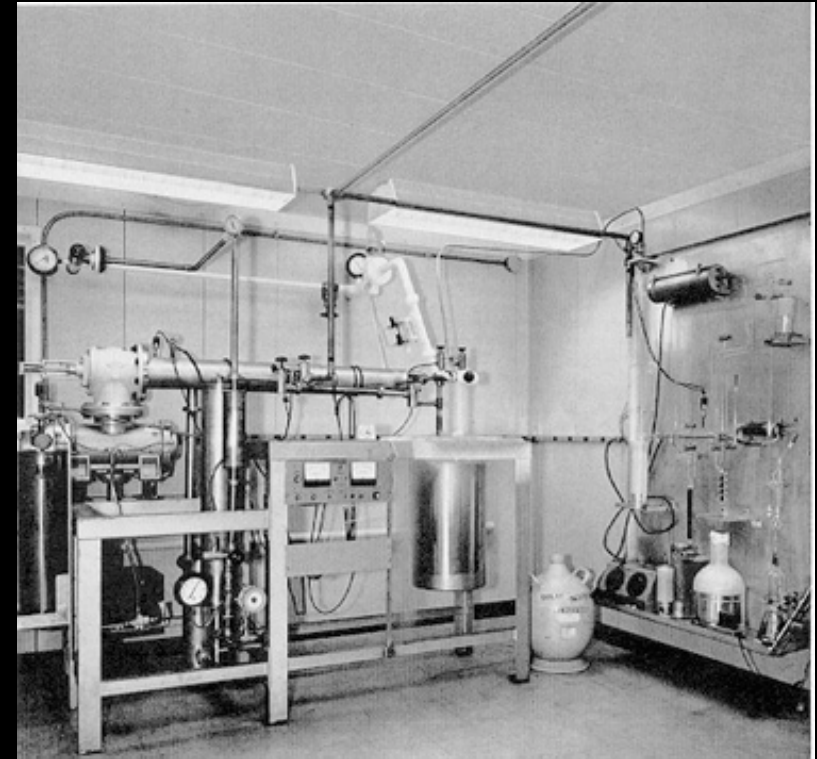
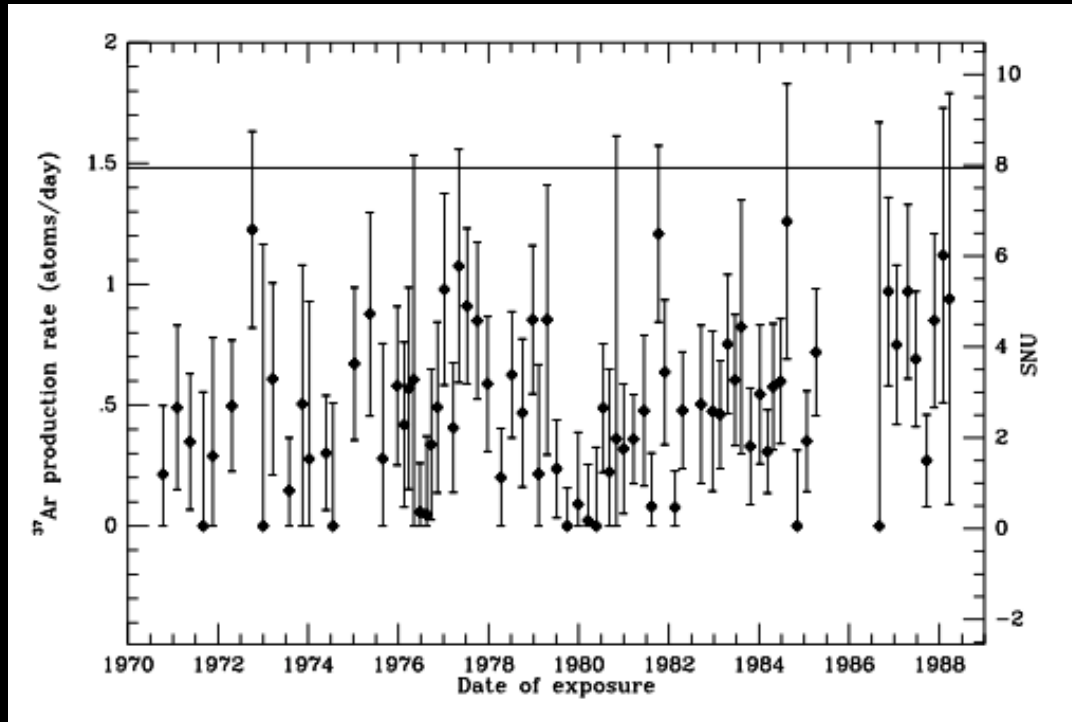
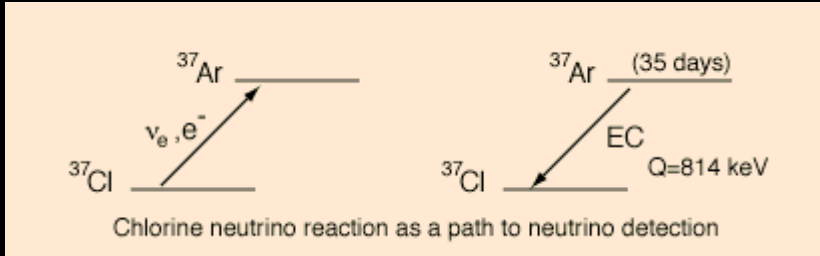
$$\text{SNU} = 10^{-36} \text{ events/atom/s}$$



**SPECTRUM OF SOLAR-NEUTRINO ENERGIES** is plotted with curves showing the sensitivity of the  $^{37}\text{Cl}$  detection system now in use (solid line in color) and the sensitivity of a proposed detection system employing lithium,  $^7\text{Li}$  (broken line in color). Neither system is sensitive in the region below about .8 MeV, where the energies of most of the solar neutrinos would be found. The lithium system, however, would be more sensitive than the  $^{37}\text{Cl}$  system to neutrinos produced by the pep reaction,  $^1\text{H} + e^- + ^1\text{H}$ . Most of the neutrinos expected to be captured by  $^{37}\text{Cl}$  are those released by the decay of  $^8\text{B}$ . Neutrinos from the proton-proton chain are indicated by solid black lines, neutrinos from the CNO cycle by broken lines. The neutrino fluxes are plotted as the number per square centimeter per second per MeV for continuum sources and as the number per square centimeter per second for line sources.

# 1964

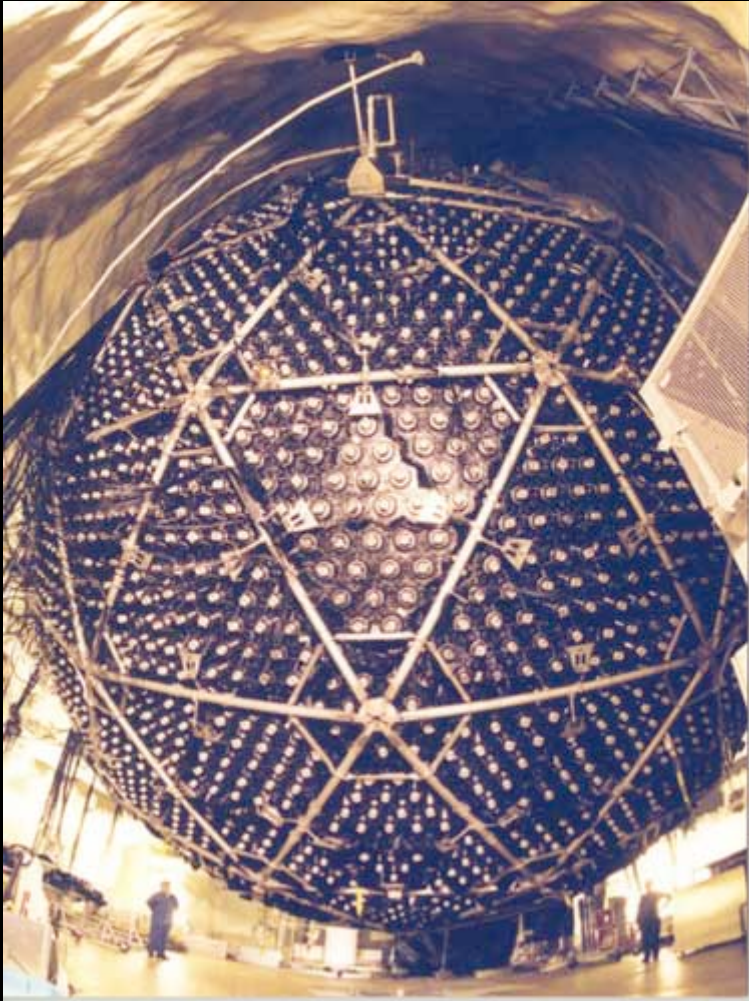
Raymond Davis of Brookhaven National Laboratory constructed a neutrino detector 1.6 km underground in the Homestake Gold Mine in Lead, South Dakota. The detector consists of a 378,000 liter tank of perchloroethylene, which is further isolated by being submerged in water. Theoretical expectations were about one neutrino-chlorine interaction per day, but the measured solar neutrino events were about a third of that, raising serious questions about the abundance of solar neutrinos





Friday Feature™, M. Gold

physics 492, Spring 2011



$$\nu_e \rightarrow W^+ + e^-$$

$$\nu_\mu \rightarrow W^+ + \mu^-$$

$$\nu_\tau \rightarrow W^+ + \tau^-$$

$$\nu \rightarrow Z + \nu$$

Sudbury Neutrino Observatory, a 12-meter sphere filled with heavy water surrounded by light detectors located two thousand meters below the ground in Sudbury, Ontario, Canada.

$$d + \nu \rightarrow p + n + \nu$$

Total Rates: Standard Model vs. Experiment  
Bahcall-Serenelli 2005 [BS05(OP)]

