CONNIE: COHERENT NEUTRINO-NUCLEUS INTERACTION EXPERIMENT

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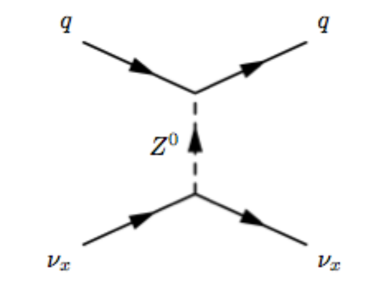
CONNIE

Goal:

Detection of coherent neutrino nucleus interactions by measurements of energy depositions of nuclear reactor antineutrinos scattering off silicon nuclei.

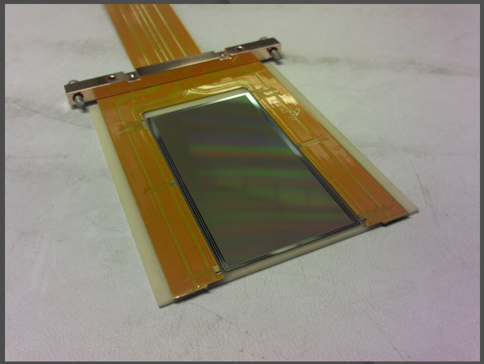


NC (right) neutrino interactions.

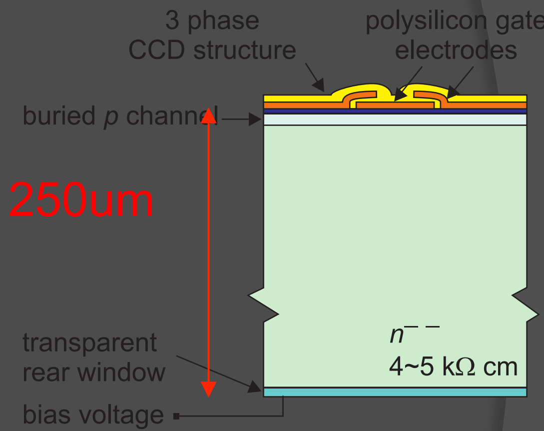
Where…?

The experiment will be placed at Angra Nuclear Power Plant in Angra dos Reis, Brazil.

How…? Using CCDs



High resistivity CCDs designed by Berkeley Lab. have two nice features: very low energy threshold and large mass.

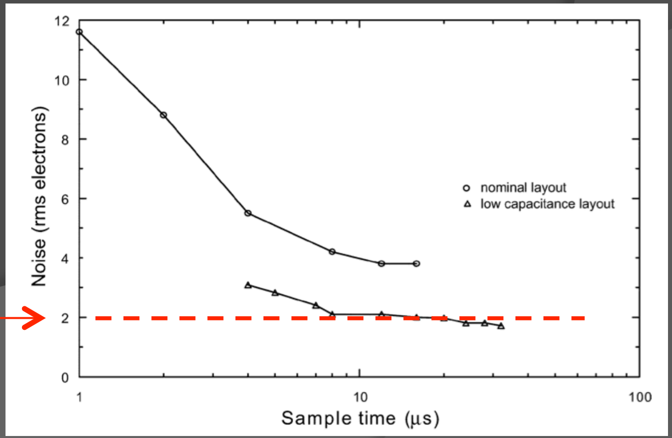


- ~20 times more mass than regular CCDs

1-1.5 g of detection mass per CCD

- The noise of the detector is reduced by increasing the pixel time up to a limit of 2e- = 7eV

7eV = 2e-

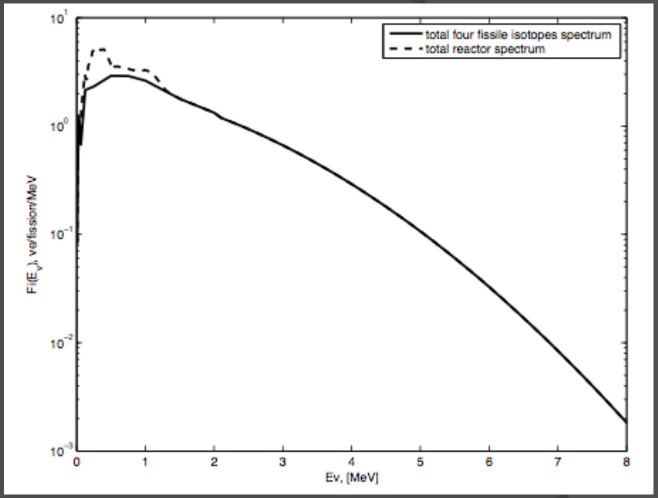


Antineutrinos and expected events

- Antineutrino Spectrum

4GW thermal power ______ $1.25\text{x}10^{20}$ v_e/sec

Maximum energy = 12MeV



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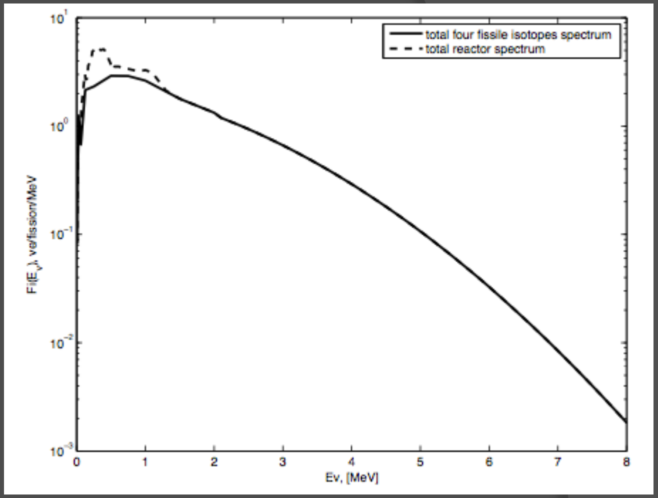
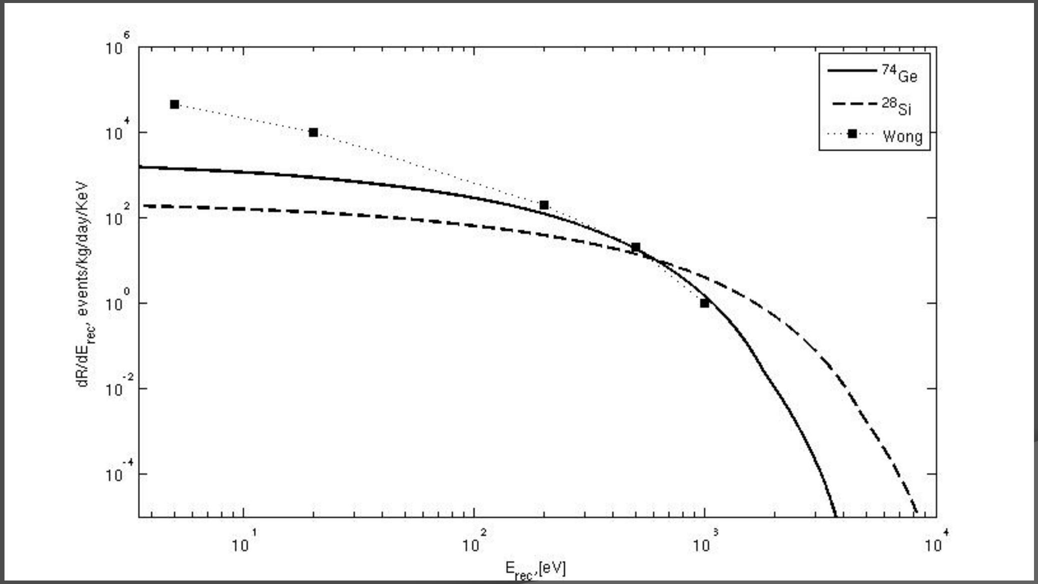
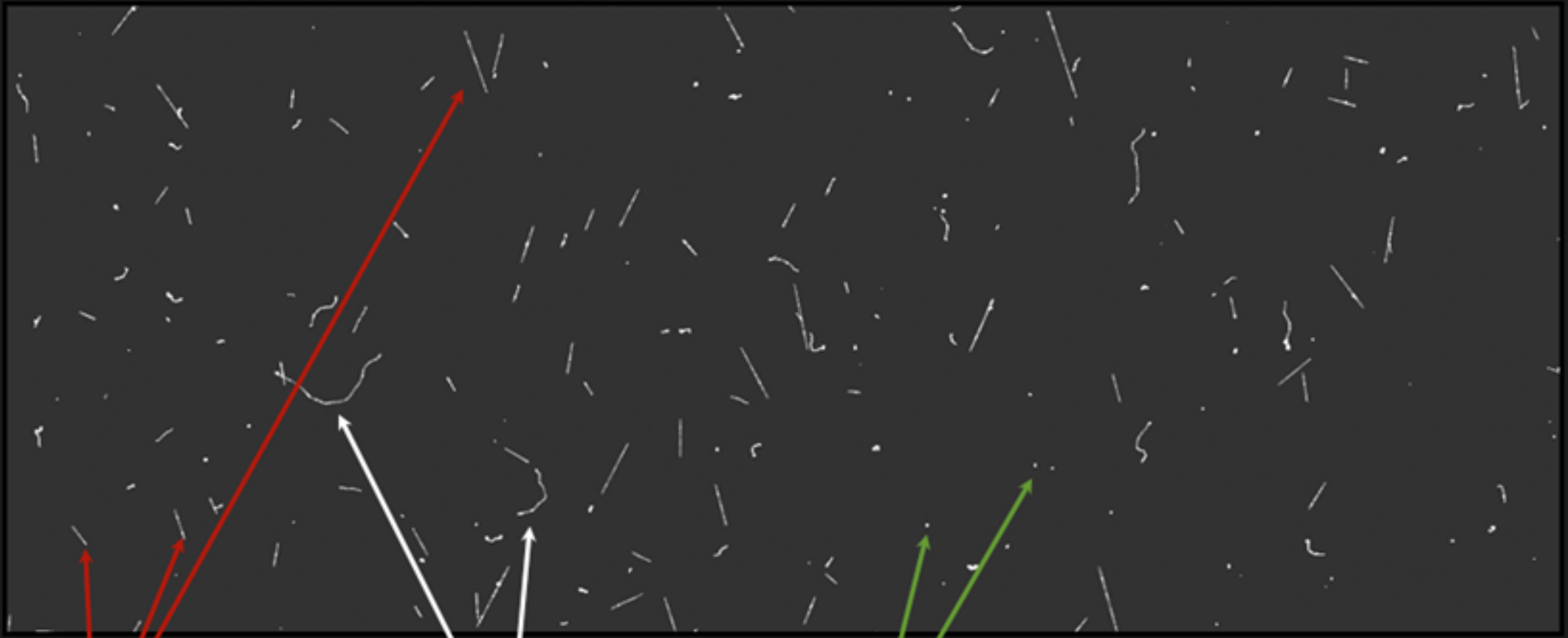


- All the events are in the keV range



10 g of silicon ~ 10 CCDs ⟶ ~0.33 events per day are expected

Detection of Particles with CCD

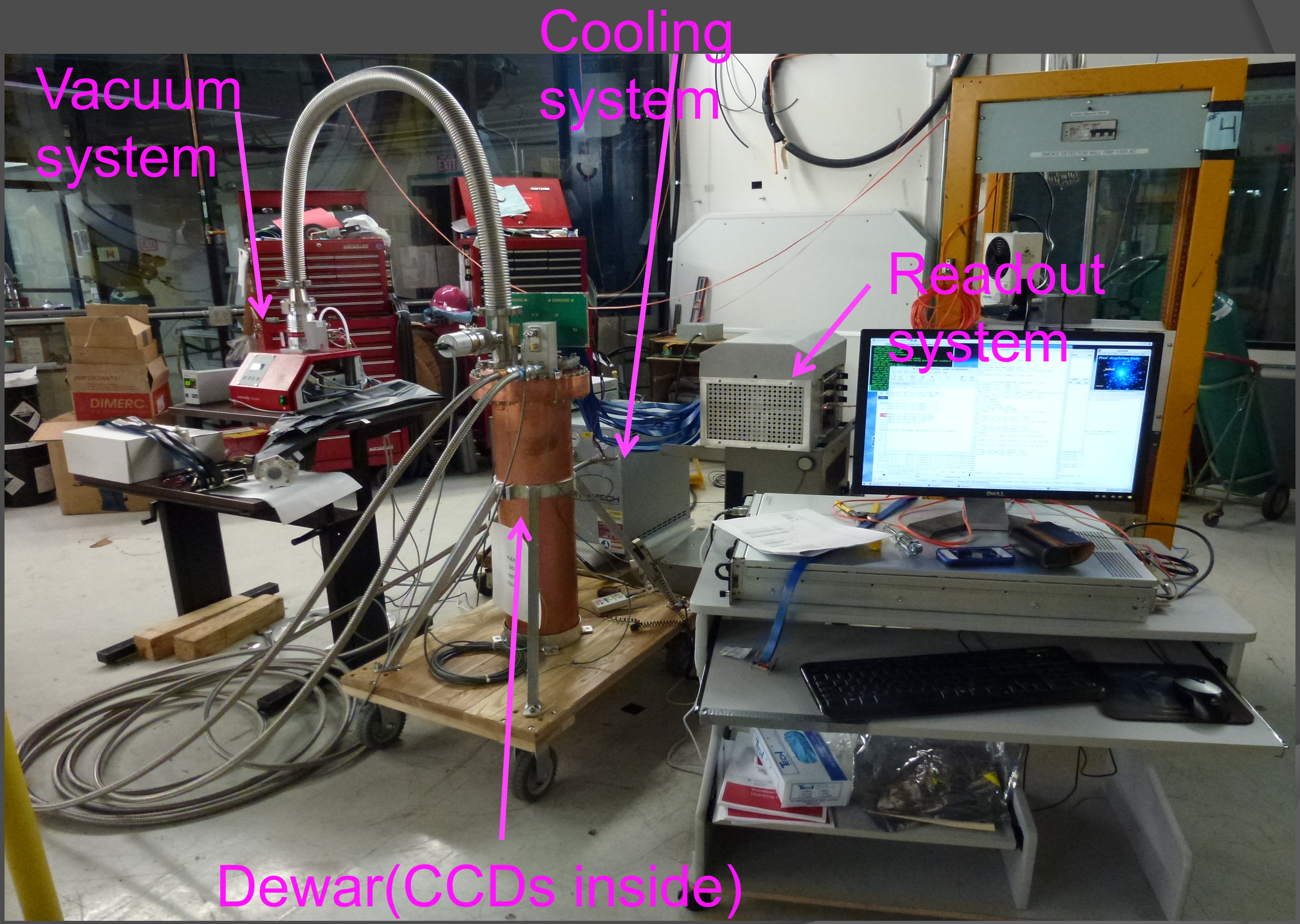


muons, electrons and diffusion limited hits.

nuclear recoils will produce diffusion limited hits

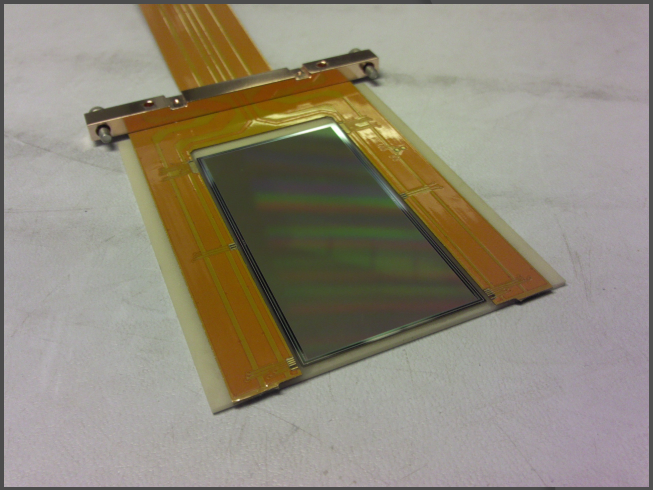
Detector

The detector is at Fermilab and is planned to be installed the first month of next year.

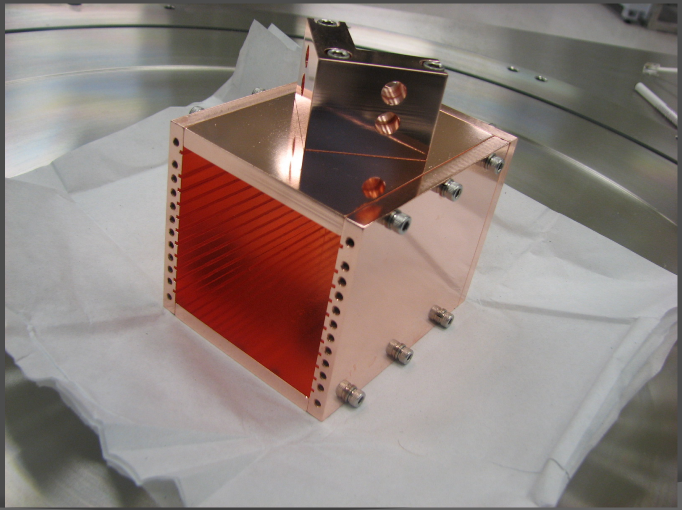


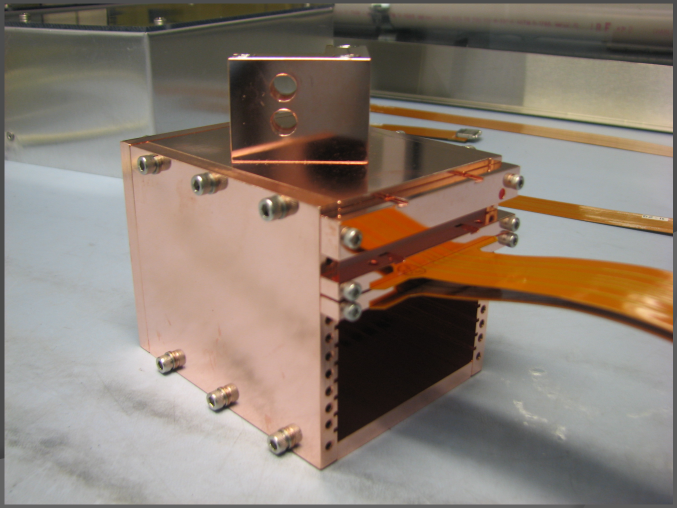
Detector

- The CCDs are installed in a low radiation package



- 10 CCDs are placed inside a copper box





Radiation background and Shielding

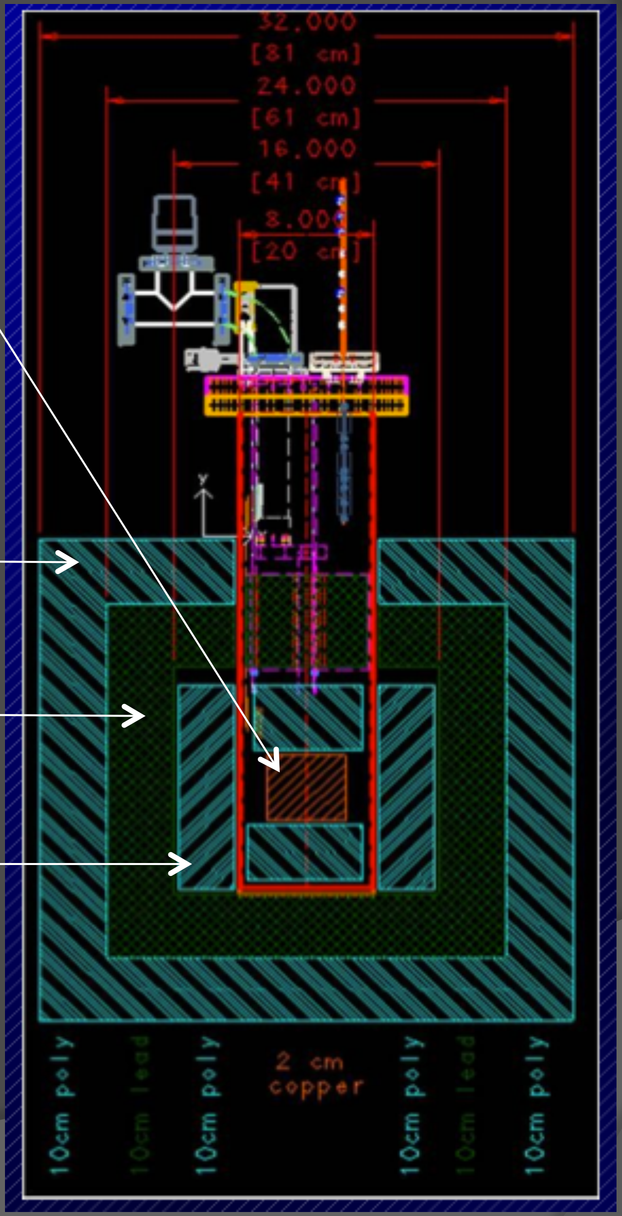
Three layers shielding

CCDs

1: polyethylene layer for stopping cosmic neutrons

2: lead layer for stopping photons

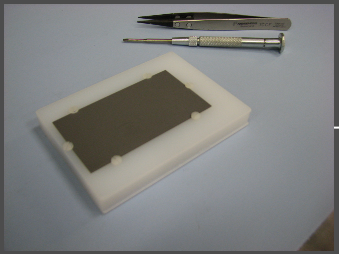
3: polyethylene layer for stopping neutrons produced in the lead by muons

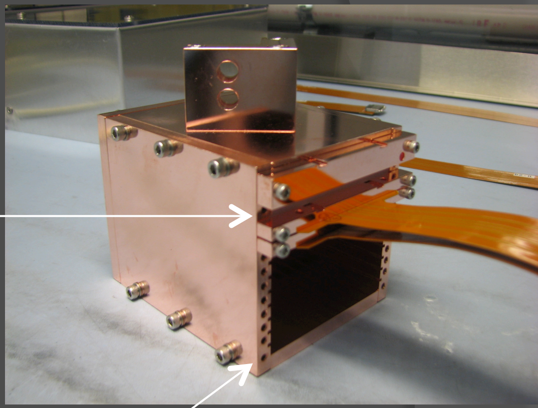


Radiation Background Measurements

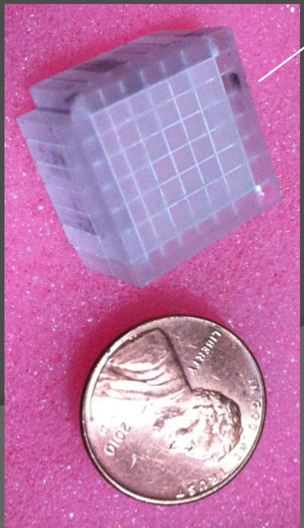
We are planning to use the same CCDs for measuring neutron and gamma background

Neutrons: Polyethylene + ^{10}B layer, facing the first detector





Gamma: Crystal facing the last detector



Conclusion

- Reactor Antineutrinos produce very low energy events.

- The CCDs seem to be a very good candidate for this low energy events. The lack of high mass is compensated by their low threshold.

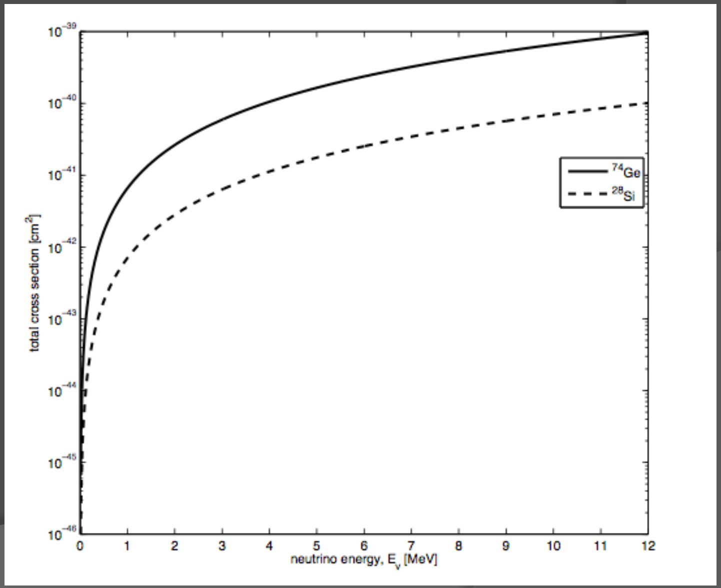
- Radiation background is a big issued and should be treated carefully. We are planning the installation of neutron and gamma detectors inside the same dewar.

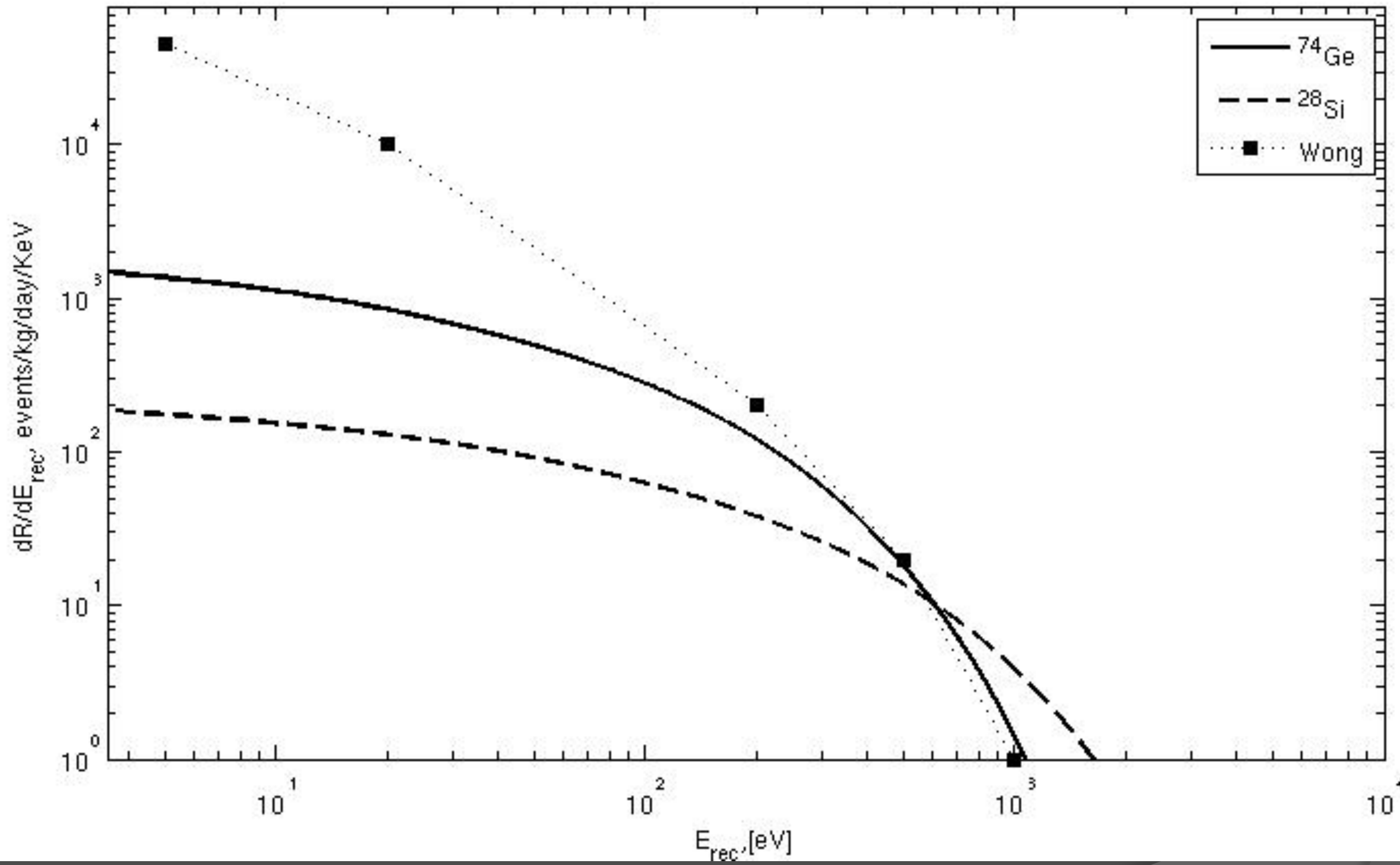
- The connie system will be ready to ship in the next month and we expect its installation at the Angra Nuclear Power Plant during the first semester of 2013.

Extra slide

$$\frac{d\sigma}{dE_{rec}} = \frac{{G_F}^2}{8\pi}[Z(4sin^2\theta_w - 1) + N]^2 M(2 - \frac{E_{rec}M}{{E_v}^2})|f(q)|^2$$

$$\sigma_{Tot} = \frac{{G_F}^2}{4\pi}[Z(4sin^2\theta_w - 1) + N]^2$$
$$\sim 4.22 \times 10^{-45} N^2 (\frac{E_v}{1MeV})^2 cm^2$$





^{74}Ge
^{28}Si
Wong
dR/dE$_{rec}$, events/kg/day/KeV
E$_{rec}$,[eV]
10^0
10^1
10^2
10^3
10^4