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Monitoring nuclear reactors with anti-neutrino detectors: the ANGRA project

Pietro Chimenti[*][†]**for the ANGRA collaboration.**
Universidade Federal do ABC-Brazil
E-mail: pietro.chimenti@ufabc.edu.br

We describe the status of the ANGRA Project, aimed at developing an anti-neutrino detector for monitoring nuclear reactors. Indeed the detection of anti-neutrinos provides a unique handle for non-invasive measurements of the nuclear fluel. This kind of measurements are of deep interest for developing new safeguards tools which may help in nuclear non-proliferation programs. The ANGRA experiment, placed at about 30 m from the core of the 4 GW Brazilian nuclear power reactor ANGRA II, is based on a water Cherenkov detector with about one ton target mass. A few thousand anti-neutrino interactions per day are expected. The latest results from simulations and the status of the construction are presented.

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[*]Speaker.
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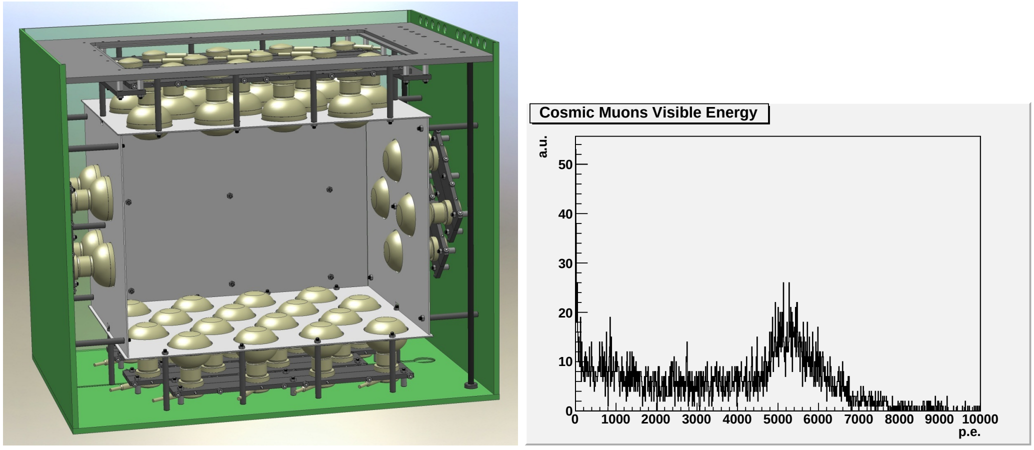

Figure 1: Left: Design of the Angra Water Cherenkov Detector (the external shield and veto is not included in the drawing). Right: expected distribution of photoelectrons produced by cosmic muons in the detector (simulation based on Geant4 [4]).

1. The ANGRA project

The possibility of applying antineutrino physics to monitor nuclear reactors for nonproliferation purpouses is of interest both of researchers and policymakers (see ref.[1] for an extended review). The ANGRA project [2] is currently developing a Gd-loaded Water-Cerenkov detector to monitor the the 4 GW Brazilian nuclear power reactor ANGRA II.

The detector (Fig.1), with about 1 tonn fiducial volume, will be placed at about 27 m from the reactor core. In this condition a few thousand interaction per day of antineutrino are expected, to be compared with the rate of cosmic rays of about few hundred Hz (the detector will be placed at surface).

In order to reject this huge background a high efficiency veto will be placed outside the central detector. Moreover the signal in the detector due to cosmic rays is typically much higher in amplitude than the one due to antineutrinos (see Fig. 1 and Ref. [3] for a comparison with the antineutrino signal) allowing for a further discrimination.

Both the central Water-Cerenkov and the external veto are under construction and should be installed in 2011.

References

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