Measuring high-energy γ rays with Ge detectors

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Gamma rays with energies up to 20.7 MeV produced by the ^{208}Pb(p,γ) capture reaction were measured with the AFRODITE germanium detector array at iThemba LABS. The measured full energy peak efficiency of the array is 1.5% at 1.3 MeV and $9(2)\cdot10^{-4}$ at 15 MeV. The FWHM of capture γ ray peaks were 50 keV up to the highest measured energies. The efficiency curve has been calculated using a Monte Carlo simulation code GEANT. The simulation and measurements agree very well.

The proton beam energies ranged from 11.3 MeV up to 16.9 MeV. The aim of the experiment was to measure excitation functions for capture into different single proton states in ^{209}Bi. The measured excitation functions are well explained with the consistent direct-semi-direct model [1]. In addition, previously unknown states in ^{209}Bi were observed in the excitation energy range between 6.2 and 7.5 MeV at the highest proton energies. These states are selectively populated in the ^{208}Pb(p,γ) reaction, they are equidistant in energy and they all decay to the $J^{\pi}=1/2^{+}$ state in ^{209}Bi at E_x=2443 keV, which is identified as a proton particle-hole excitation.

[1] M. Lipoglavšek et al., Phys. Lett. **B593**, (2004) 61.