The Oslo nuclear group has developed a method to extract primary $\gamma$-ray spectra [1] at various excitation energies. From the set of primary $\gamma$-ray spectra nuclear level densities and $\gamma$-ray strength functions can be extracted [2] simultaneously. So far the method has been successfully tested on rare earth and mid shell nuclei. The application of the method to closed shell $^{205-208}$Pb and near closed shell $^{45}$Ti will be presented.

The experiments are performed on $^{206,208}$Pb and $^{46}$Ti targets using $^3$He ions and $^1$H beam at Oslo Cyclotron Lab (OCL). The inelastic scattering and transfer reactions were used to observe the particle-$\gamma$ coincidences. The total $\gamma$-ray spectra are unfolded using the unfolding technique described in Ref. [3], and first generation $\gamma$-rays are extracted [1] from the unfolded $\gamma$-ray spectra. The next step of Oslo method is to factorize the primary $\gamma$-ray spectra into level density and $\gamma$-ray strength function according to the generalized Fermi’s golden rule:

$$P(E,E'_\gamma) \propto T(E_\gamma) \rho(E_f).$$

Where, $P(E,E'_\gamma)$ is the primary $\gamma$-ray matrix, $T(E_\gamma)$ is the transmission co-efficient and $\rho(E_f)$ is the level density of final states.

The experiments and analysis method will be discussed briefly. The preliminary results for $^{205-208}$Pb and $^{45}$Ti nuclei will also be shown.
Fig. 1): Left panel: The Experimental nuclear level densities of $^{205,206}$Pb using the Oslo method. The filled squares are the data points compared with the known discrete levels. Right panel: The normalized $\gamma$-ray strength function of $^{205,206}$Pb.

References: