By using the Q3D magnetic spectrograph of the Maier-Leibnitz-Laboratorium at München, particle-hole states in $^{208}$Pb are investigated. At a resolution of about 3 keV, in the reactions $^{208}$Pb($p, p'$) and $^{207}$Pb($d, p$) more than 150 states in $^{208}$Pb below $E_x = 7.0$ MeV are identified [1, 2, 3]. Excitation energies are derived with absolute uncertainties of 0.1 keV for strongly excited states by calibration with known data from Nuclear Data Sheets [4]. The method of $^{208}$Pb($p, p'$) via isobaric analog resonances (IAR) in $^{209}$Bi [1] is used to derive the structure of almost all particle-hole states in $^{208}$Pb below $E_x = 6.4$ MeV. The selective excitation in an IAR yields the parity. By the excitation in different IAR, a dozen doublets of states in $^{208}$Pb at less than 2 keV or even vanishing distances are resolved. The spin and the dominant neutron particle-hole configurations are determined from the angular distribution of $^{208}$Pb($p, p'$). Among about 120 states predicted by the shell model in $^{208}$Pb below $E_x = 6.4$ MeV, more than 80 states with negative parity and 30 states with positive parity are identified and their structure is determined.


Figure 1: Typical spectra of $^{208}$Pb($p, p'$) taken on the $g_{9/2}$ and $d_{5/2}$ resonance in $^{209}$Bi.