obtained by this calibration method. And the relative error between measurements and calculations is better than 2%. Considering the lack of experiment data at very low energy in this work, the calibration results in very low energy part just could be used as a reference, which is shown in the inset picture of Fig. 3.

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5 - 3 A New Method of Energy Calibration of Position Sensitive Silicon Detector

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In α-decay spectroscopy, there are two steps in the energy calibration of a position sensitive silicon detector (PSSD), the linear calibration and the correction of it. Here we present a new method to correct the linear calibration. The procedure of this new method is much simpler than that of the traditional one[1]. Moreover, by using this new method, the energy resolution is improved.

In our recent experiment, three PSSD detectors were used, each of which is divided into 16 position sensitive strips. Each strip has two outputs, E_1 and E_2, from top and bottom end, respectively. The total energy deposited in the strip is $E = E_1 + E_2$, while the relative position of an event is given by $\eta=(E_1 - E_2)/(E_1 + E_2)$. So a simple relation between energy and relative position, $E/E_1=2/(1+\eta)$, can be deduced. The general expressions of E_1, E_2 and η have been obtained by linear calibration[2]. As shown in Fig. 1(a), after the linear energy calibration, the distribution of events of each individual external α source looks like a curve rather than a straight line. The main goal of the correction of linear calibration is to make the curve become a straight line.

Now we take E, in $E/E_1=2/(1+\eta)$, to be the literature values of the external α sources. Then, a new relation of top energy and relative position, $E/E_1=f(g)$ where $g=2/(1+\eta)$ and f is a function to be found, is created. Three groups of events circled with color lines in Fig. 1(a) are presented in Fig. 1(b), respectively, in a coordinate system of $g - E/E_1$. It can be seen that the three groups of events almost overlap together completely.

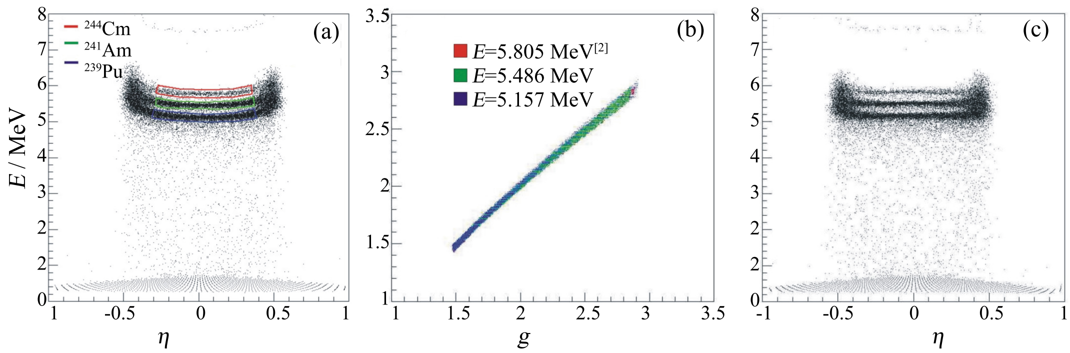

Fig. 1 (color online) (a) Distribution of the events of three external α sources(^{244}Cm, ^{241}Am, ^{239}Pu) after the linear calibration. Three groups of events circled with color lines are created by the three external α sources respectively and exclude the events contaminated by noise. (b) Three groups of events circled with color lines in (a) are drawn in a coordinate system of $g - E/E_1$. (c) The corrected results of (a) using the new method.

The function $f(g)$ can be found by a fitting of these three groups of events. $f(g)= ag^2+bg+cg^{1/2}+d$ was found to fit the events well. Finally, the corrected energy, $E = E_1 \times f(g)$, is obtained and shown in Fig. 1(c). For the problems of dead layer of the detector and pulse-height-defect of heavy nucleus in silicon[3], the α decay energy calibrated by the three external sources is different from the literature values. This difference can be reduced by a general linear correction of the calibrated energy with the help of identified internal α sources. The energy resolution obtained using this new method is improved compared with the traditional one[4].

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