

Energy calibration. PSI-2019.

Igor Zhitnikov 13.04.2021

Equation

- $E = \text{offset} + \text{gain} * \text{ADC_channel} + \text{non_linear} * (\text{ADC_channel})^2$

name	module	channel	offset	gain	non_linear
MB12A	0	1	0.044026	0.801366	6.715080e-09
MB12B	0	2	-0.005355	0.659917	1.947908e-08
MB12C	0	3	0.381754	0.643563	-5.272076e-19
MB13A	0	4	-0.056211	0.653690	3.163980e-17
MB13B	0	5	0.063532	0.671446	2.775900e-08
MB13C	0	6	0.023780	0.666553	2.642837e-08
MB14A	0	7	-0.068139	0.663383	1.235669e-27
MB14B	0	8	-0.157376	0.684938	-4.547050e-24
MB14C	0	9	-0.149966	0.702768	2.542796e-08
MB16A	1	1	-0.037361	0.598907	3.465520e-08
MB16B	1	2	0.060156	0.652946	-8.974690e-11
MB17A	1	4	0.371448	0.676299	5.969773e-08
MB17B	1	5	-0.049126	0.636961	2.509096e-08
MB17C	1	6	-0.064030	0.519545	3.653637e-08
MB18A	1	7	-0.777120	0.702545	-3.284616e-08
MB18B	1	8	-0.186624	0.662877	-3.991633e-09
MB18C	1	9	-0.154490	0.670685	1.613269e-08
MB22A	1	10	0.058078	0.570731	3.362849e-09
MB22C	1	12	0.025922	0.610283	3.532307e-08
MB23A	1	13	-0.069256	0.621752	4.713945e-11
MB23B	1	14	-0.004061	0.596440	2.305714e-25
MB23C	1	15	0.091281	0.633263	1.189222e-08
MB18A2	0	10	-32.600323	0.442353	-3.524899e-06
Ge10	0	11	0.047187	0.530917	-2.419519e-17
Ge11	0	12	-0.052902	0.172052	4.867796e-09

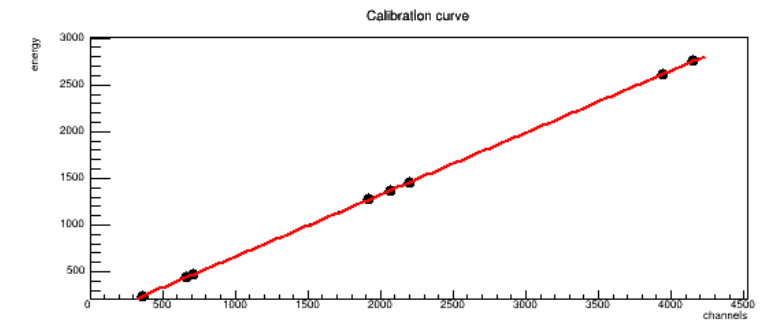
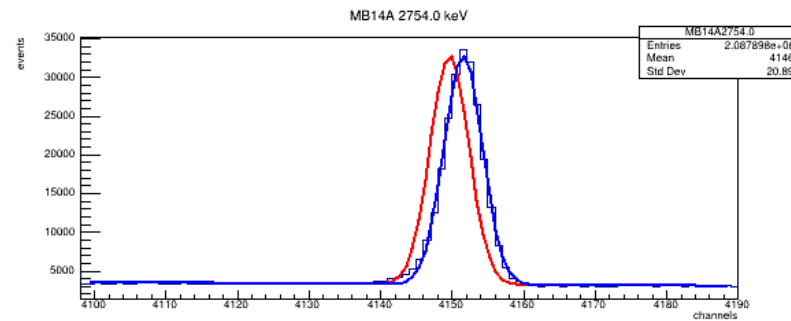
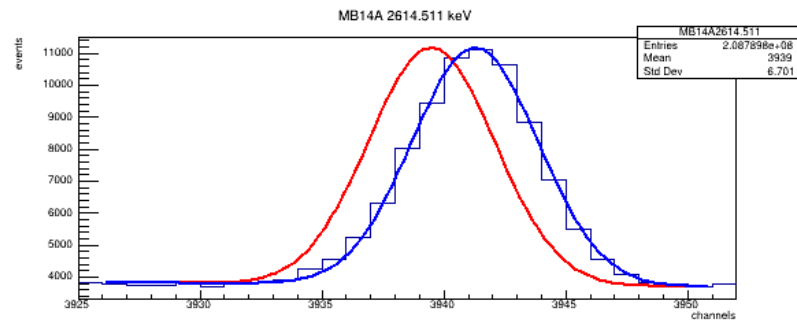
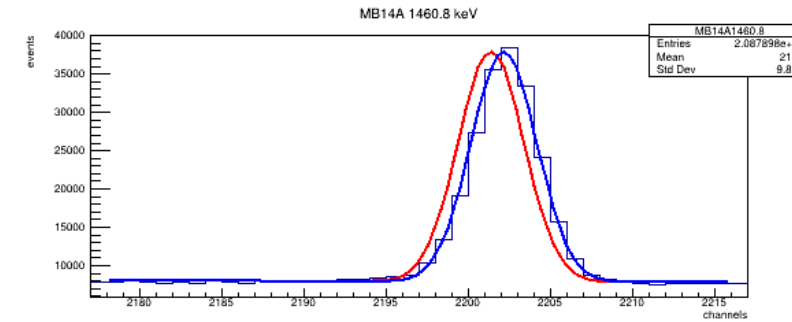
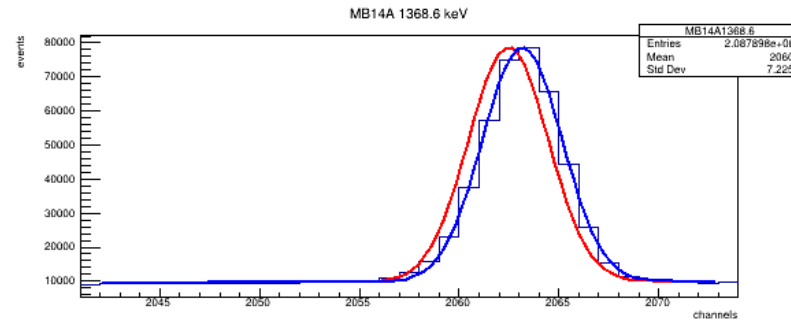
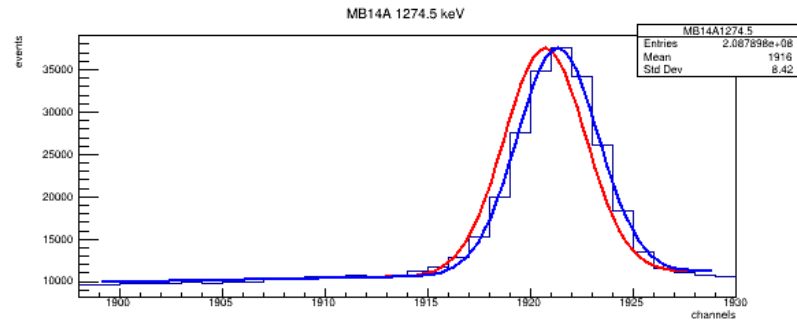
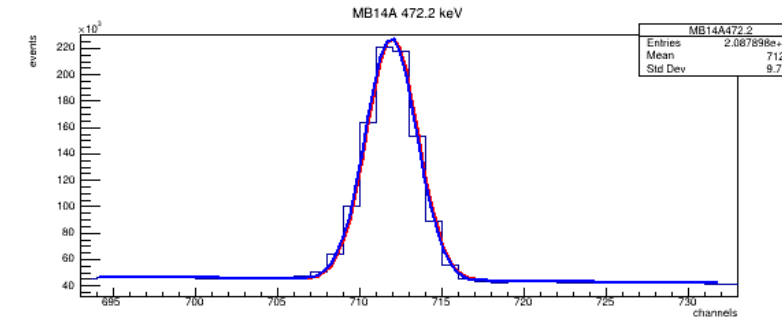
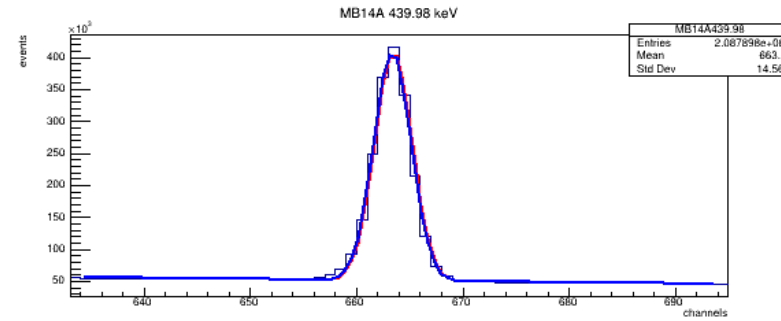
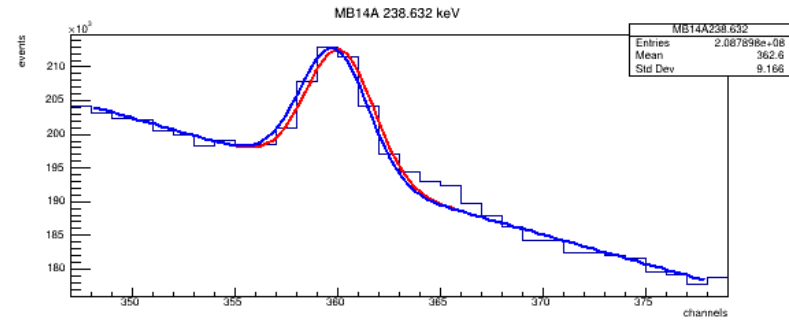
Configuration

- We have midas data files: run"%05d".mid.gz
- *.mid.gz -> analyzer (+ *.odb midas configuration) -> *.root
- *.root:

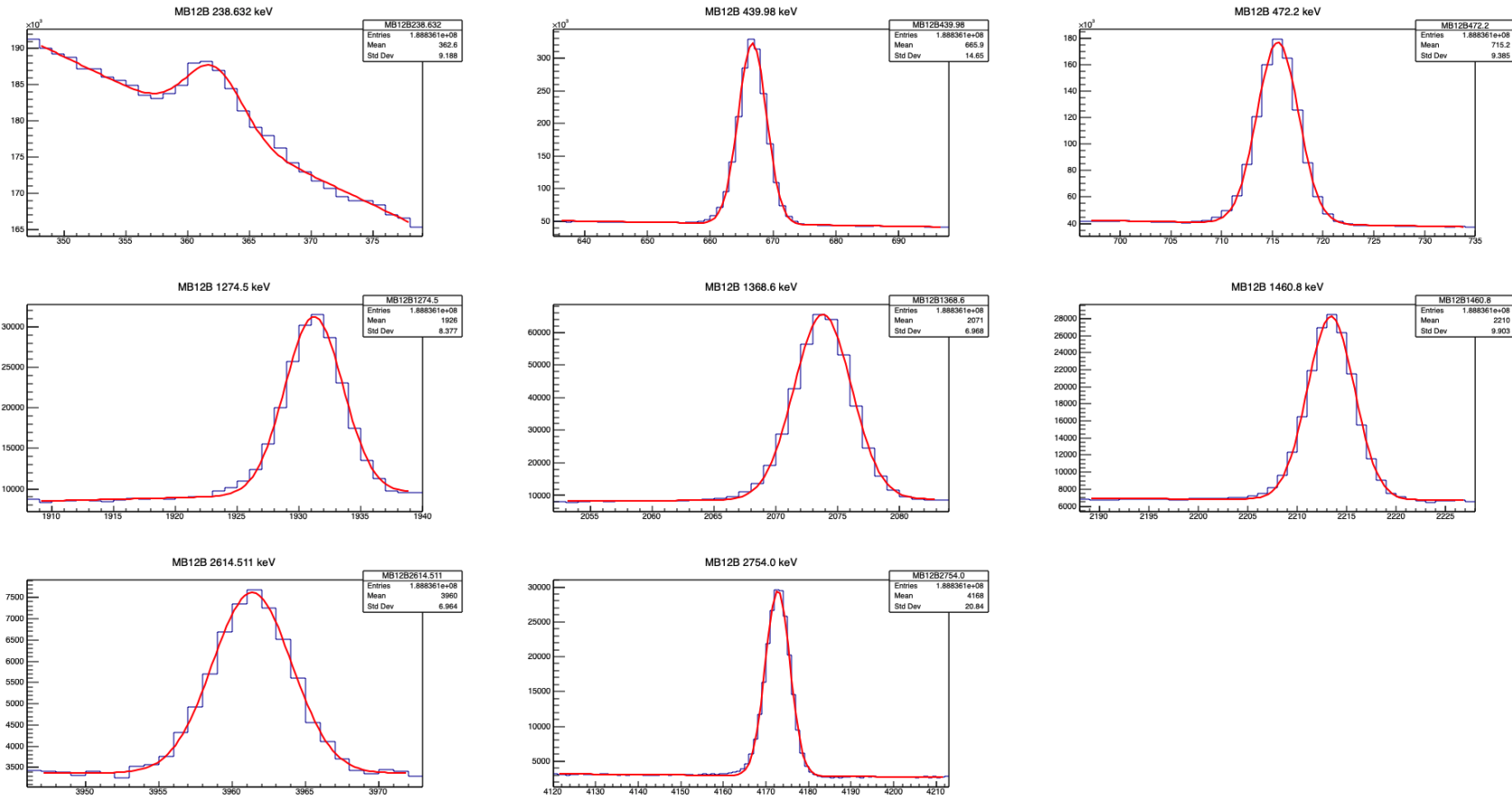
```
struct base_event
{
    Double_t energy;
    Double_t energyADC; // for Ge events only
    Double_t time;
    uint16_t module;
    uint16_t channel;
    uint8_t status_flag;
};
```

```
TTree * mu_tree = (TTree*)f->Get("MuonTree");
TTree * ge_tree = (TTree*)f->Get("GeTree");
TTree * n_tree = (TTree*)f->Get("NeutronTree");
TTree * el_tree = (TTree*)f->Get("ElTree"); // Electron Veto Events
```

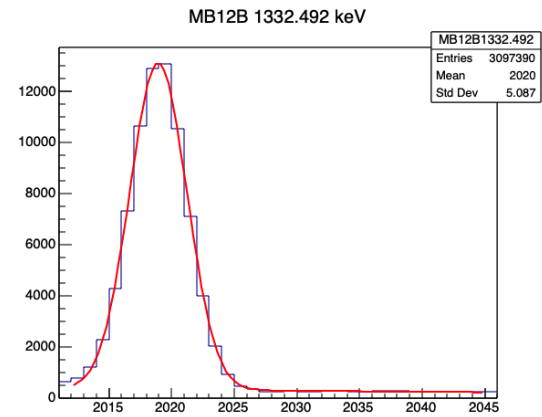
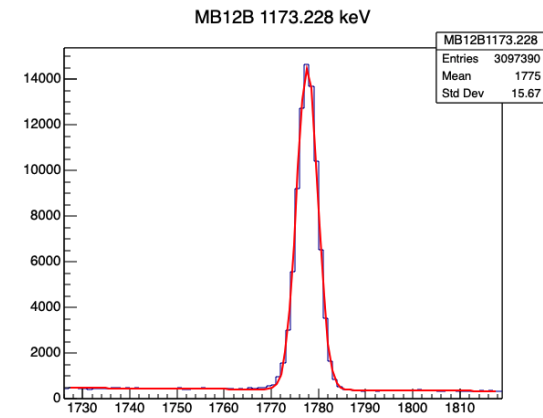
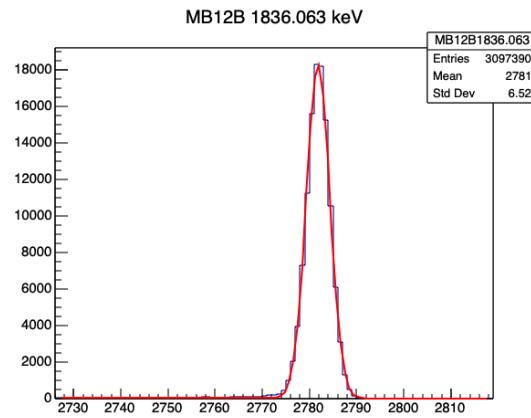
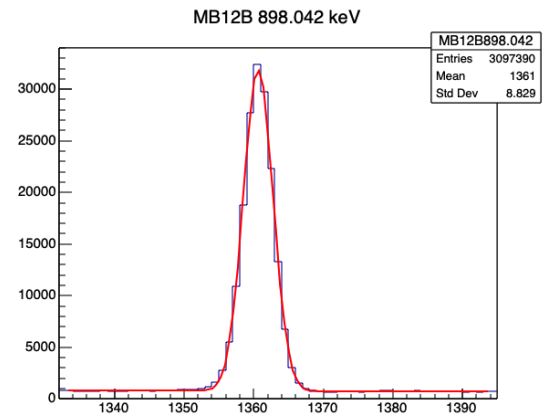
MB14A (red – old calibration, blue – new)



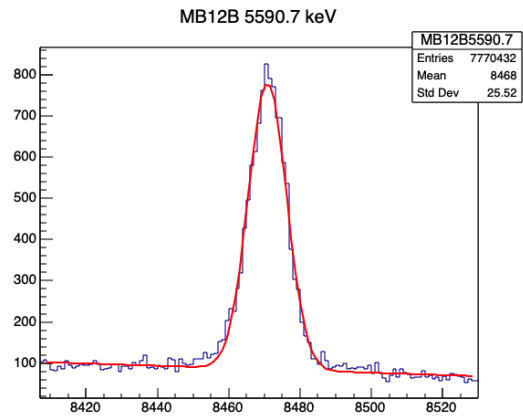
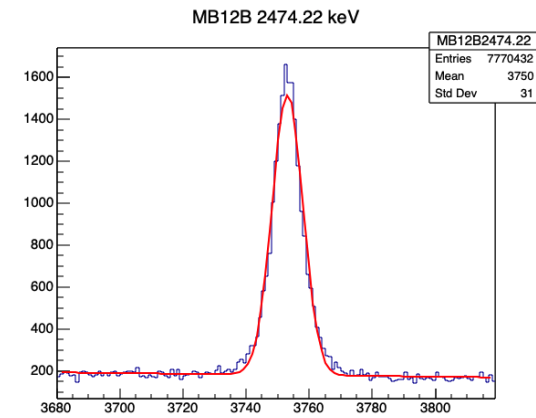
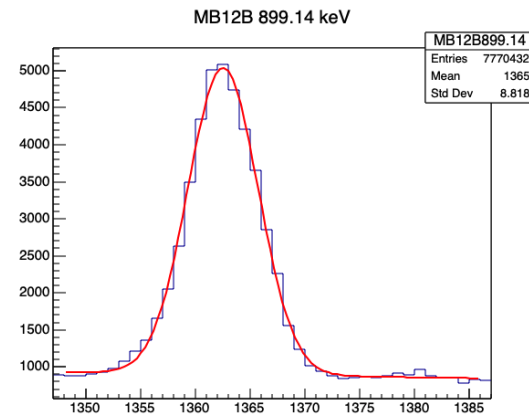
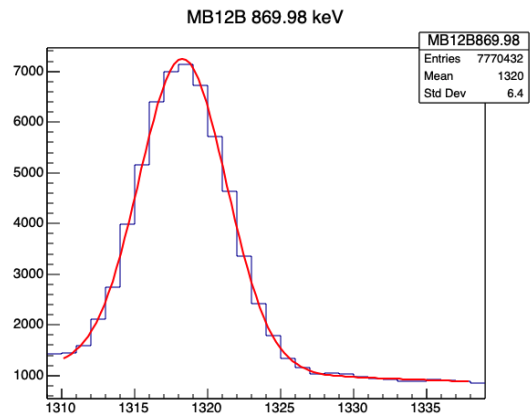
Mg-24 run (MB12B)



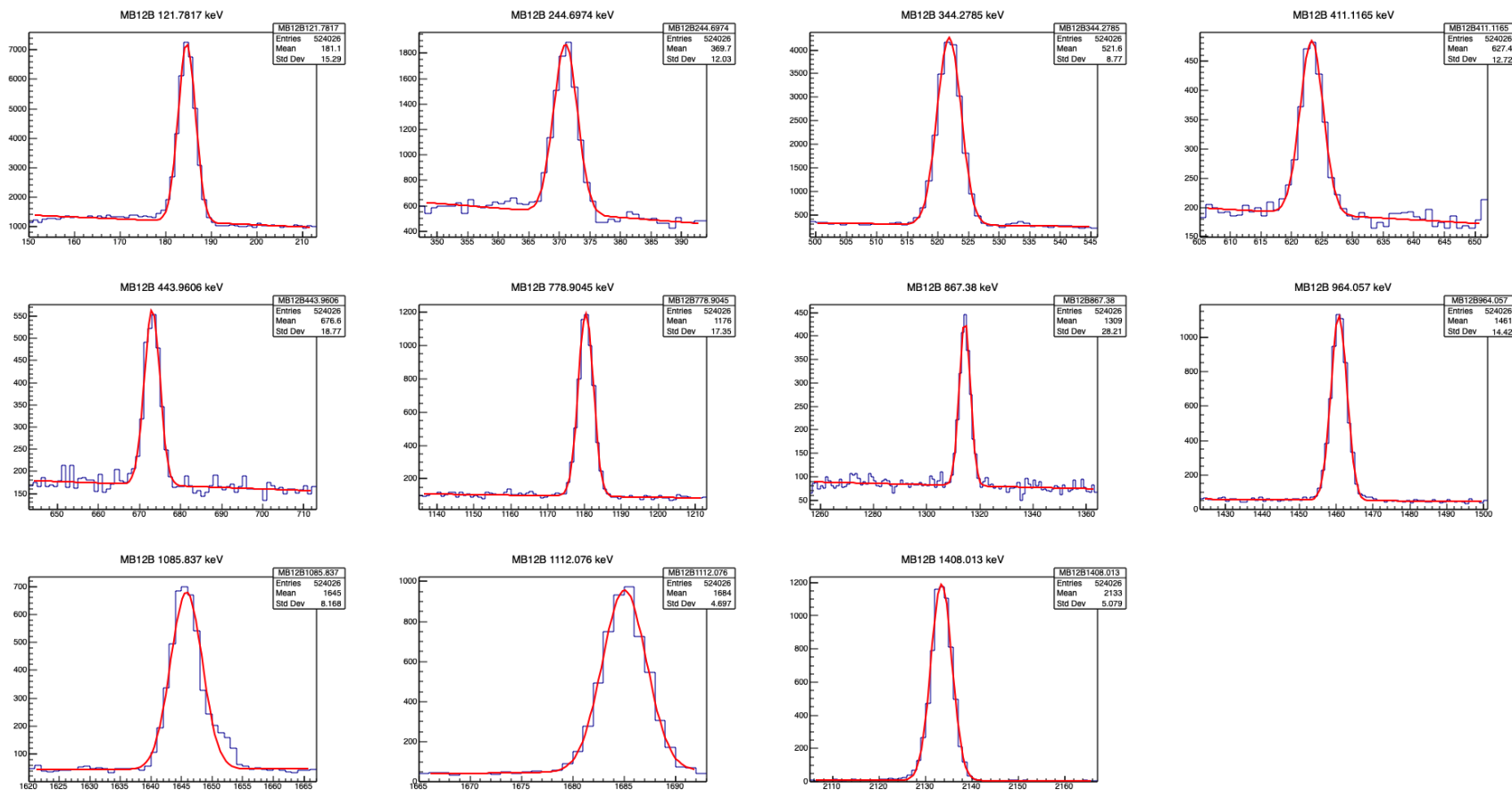
Am-241, Co-60, Y-88 run (MB12B)



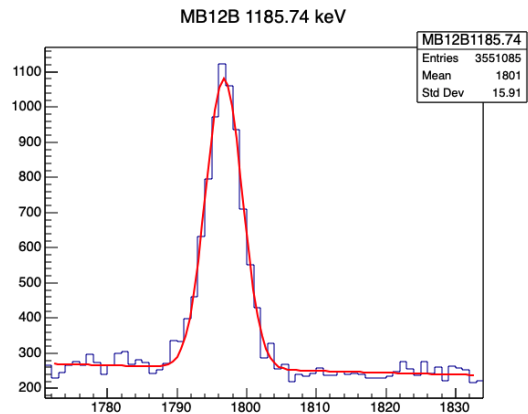
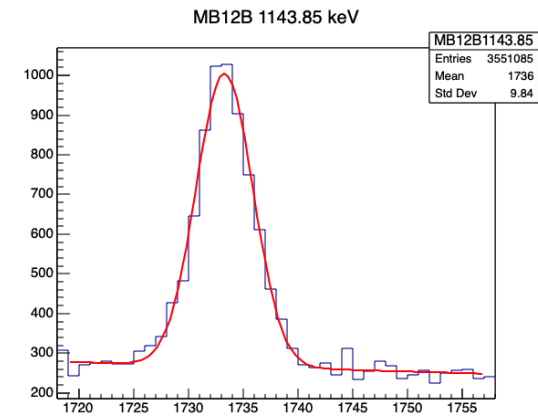
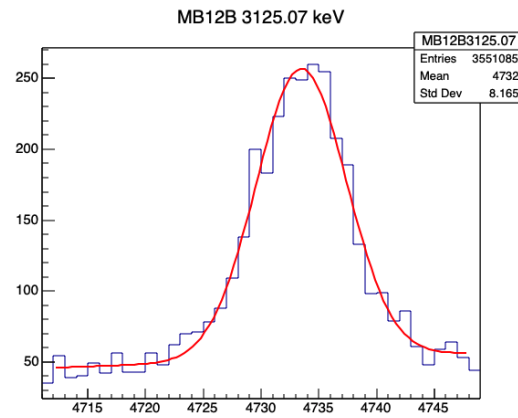
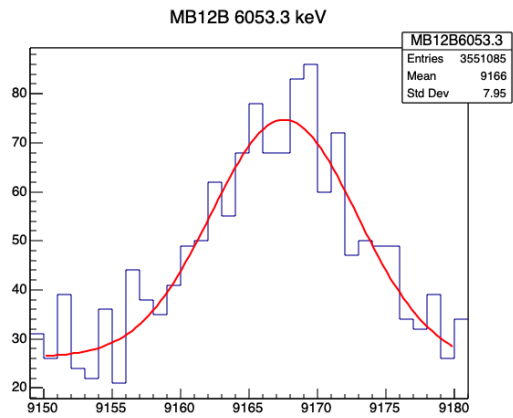
Au run (MB12B)



Eu-152 run (MB12B)

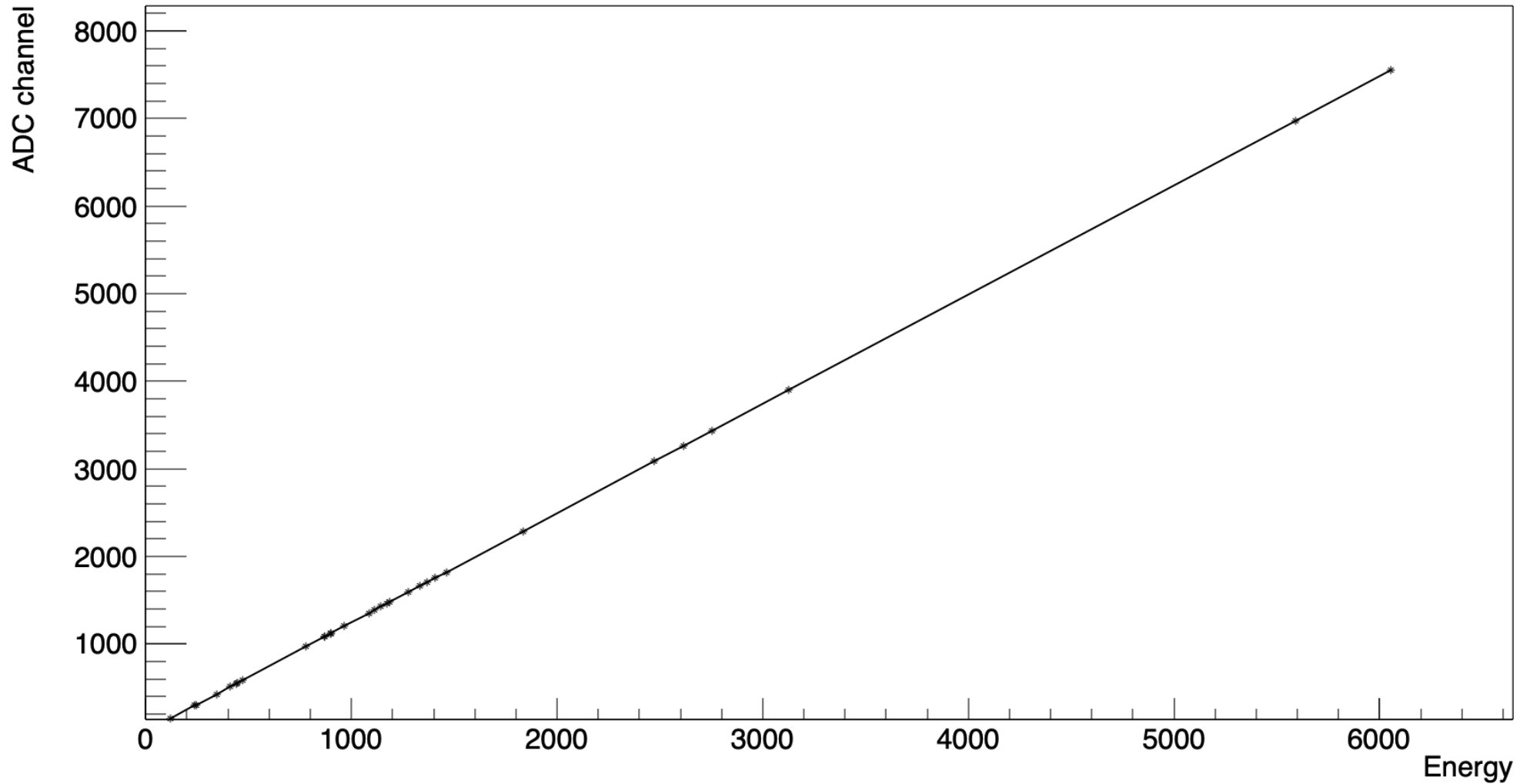


Th-232 run (MB12B)



Calibration curve (MB12B)

Calibration points



Residuals (keV)

energy_keV	121.7817	238.632	244.6974	344.2785	411.1165	439.98	443.9606	472.2	778.9045	867.38	869.98	898.042	899.14	964.057	1085.837
source	Eu-152	Pb-212	Eu-152	Eu-152	Eu-152	Ne23	Eu-152	Na24m	Eu-152	Eu-152	Au-197	Y-88	Au-197	Eu-152	Eu-152
Ge10	-0.147	-0.364	-0.067	-0.005	-0.009	-0.080	0.063	-0.095	0.155	0.194	-0.089	0.154	-0.065	0.189	-0.188
Ge11	-0.030	0.006	-0.005	-0.008	0.021	0.051	-0.016	0.051	-0.075	0.124	-0.055	-0.007	-0.011	-0.010	0.028
MB12A	-0.331	-0.409	-0.193	-0.136	-0.046	-0.140	-0.047	-0.126	0.077	0.094	0.033	0.224	0.005	0.206	0.145
MB12B	-0.134	-0.376	-0.154	-0.079	-0.205	0.023	-0.184	0.022	0.041	0.125	0.084	0.201	0.054	0.141	-0.172
MB12C	-0.098	-0.301	-0.002	0.029	-0.072	0.269	-0.168	0.272	0.046	-0.028	0.119	0.053	0.161	0.111	-0.222
MB13A	0.020	-0.414	-0.024	-0.082	-0.078	0.057	0.043	0.046	0.015	0.033	-0.001	0.191	0.041	0.072	-0.180
MB13B	-0.192	-0.332	-0.144	-0.172	-0.043	0.060	0.084	0.075	0.013	0.052	0.064	0.088	0.131	0.011	-0.308
MB13C	-0.219	-0.274	-0.175	-0.140	-0.217	-0.061	-0.172	-0.058	0.124	0.143	0.072	0.188	0.079	0.171	0.041
MB14A	-0.378	-0.600	-0.116	-0.045	0.101	-0.378	0.191	-0.368	0.098	0.220	-0.179	0.302	-0.185	0.301	0.351
MB14B	-0.183	-0.518	-0.187	-0.135	-0.118	-0.235	0.038	-0.250	0.172	0.233	0.171	0.298	0.146	0.246	0.018
MB14C	-0.248	-0.309	-0.231	-0.172	-0.097	-0.171	-0.053	-0.159	0.172	0.251	0.077	0.218	0.054	0.202	0.098
MB16A	-0.093	-0.511	-0.021	-0.005	0.034	-0.094	0.030	-0.051	0.109	0.148	-0.124	0.185	-0.128	0.216	-0.029
MB16B	-0.250	-0.286	-0.231	-0.112	-0.111	0.112	-0.139	0.111	-0.019	-0.007	0.087	0.189	0.073	-0.011	-0.216
MB17A	-0.095	-0.586	-0.018	0.074	0.206	0.028	0.037	0.046	-0.040	0.088	-0.173	-0.022	-0.174	0.168	0.035
MB17B	-0.090	-0.681	0.007	0.100	0.187	-0.151	0.177	-0.106	0.075	0.242	-0.182	0.135	-0.156	0.262	-0.018
MB17C	-0.117	-0.653	0.019	0.090	0.023	-0.160	-0.014	-0.120	0.179	0.298	-0.093	0.203	-0.064	0.250	-0.125
MB18A	0.042	-0.488	0.068	0.213	-0.145	-0.135	0.142	-0.077	0.113	-0.890	0.093	-0.013	0.056	0.168	0.034
MB18B	-0.106	-0.629	-0.016	0.034	0.119	-0.159	0.149	-0.140	0.167	0.150	-0.215	0.115	-0.221	0.208	0.101
MB18C	-0.086	-0.648	-0.027	0.145	0.199	-0.141	0.046	-0.115	0.131	0.269	-0.413	0.126	-0.383	0.327	0.215
MB22A	-0.189	-0.568	-0.178	-0.034	-0.012	-0.023	-0.042	0.005	0.050	0.068	0.097	0.253	0.116	0.125	-0.207
MB22C	-0.176	-0.302	-0.121	-0.103	-0.106	0.051	-0.144	0.033	0.062	0.143	0.039	0.262	0.049	0.036	-0.295
MB23A	-0.206	-0.388	-0.148	-0.088	-0.043	-0.042	-0.043	-0.016	0.021	0.026	0.117	0.184	0.048	0.114	-0.029
MB23B	-0.090	-0.309	-0.055	-0.181	-0.304	0.188	-0.135	0.159	0.036	0.184	0.205	0.189	0.195	0.030	-0.394

Residuals (keV)

energy_keV	1112.076	1143.85	1173.228	1185.74	1274.5	1332.492	1368.6	1408.013	1460.8	1836.063	2474.22	2614.511	2754.0	3125.07	5590.7	6053.3
source	Eu-152	Th-232	Co-60	Th-232	Na-22	Co-60	Na-24	Eu-152	K-40	Y-88	Au-197	Tl-208	Na-24	Th-232	Au-197	Th-232
Ge10	0.110	-0.137	0.112	-0.137	0.140	0.245	0.220	0.297	0.284	0.349	-2.767	0.420	0.379	1.123	-1.332	1.049
Ge11	0.076	-0.124	-0.052	-0.140	0.046	-0.027	0.026	0.015	0.105	0.029	-0.021					
MB12A	0.326	0.099	0.432	0.063	-0.009	0.475	0.016	0.338	0.096	0.624	-2.523	-0.070	-0.182	1.062	-0.965	0.861
MB12B	0.178	0.102	0.235	0.118	0.152	0.248	0.152	0.209	0.218	0.338	-2.589	0.232	0.178	1.077	-1.301	1.067
MB12C	0.092	0.037	-0.036	0.110	0.271	-0.144	0.073	0.022	-0.016	0.065	-2.530	0.235	0.330	1.366	0.235	-0.279
MB13A	0.199	-0.034	0.220	0.063	0.079	0.165	0.085	0.153	0.097	0.306	-2.594	0.164	0.227	1.120	0.190	-0.179
MB13B	0.191	0.145	0.086	0.131	0.265	0.028	0.254	0.148	0.263	0.181	-2.658	0.314	0.336	1.205	-1.289	1.013
MB13C	0.262	0.128	0.187	0.145	0.121	0.212	0.082	0.322	0.120	0.332	-2.525	0.206	0.144	0.955	-1.225	1.031
MB14A	0.565	-0.058	0.650	-0.036	-0.149	0.691	-0.092	0.488	-0.203	0.932	-2.507	-0.364	-0.195	0.993	-0.759	0.729
MB14B	0.291	0.030	0.358	-0.016	-0.093	0.490	-0.011	0.446	-0.062	0.563	-2.368	-0.291	-0.108	1.218	-1.042	0.901
MB14C	0.256	0.047	0.259	0.075	0.005	0.352	0.050	0.369	0.067	0.474	-2.569	0.007	0.039	1.126	-1.212	1.026
MB16A	0.271	-0.189	0.229	-0.211	0.222	0.185	0.171	0.274	0.133	0.375	-2.750	0.463	0.513	0.863	-1.073	0.860
MB16B	0.082	0.031	0.261	0.102	0.293	0.284	0.332	0.115	0.314	0.345	-2.701	0.308	0.408	0.902	-1.497	1.232
MB17A	0.371	-0.068	0.193	0.003	0.274	-0.043	0.198	0.126	0.042	0.343	-2.694	0.354	0.497	0.950	-0.503	0.380
MB17B	0.357	-0.233	0.259	-0.243	0.198	0.120	0.171	0.173	0.070	0.385	-2.735	0.474	0.481	0.868	-0.702	0.554
MB17C	0.220	-0.065	0.167	-0.123	0.004	0.285	0.062	0.399	0.148	0.376	-2.645	0.390	0.388	0.893	-1.150	0.935
MB18A	0.604	-0.274	0.220	-0.105	0.020	0.390	0.126	0.586	0.132	0.417	-2.688	0.196	0.042	1.230	-0.300	0.224
MB18B	0.437	-0.335	0.339	-0.323	0.176	0.273	0.231	0.310	0.186	0.492	-2.736	0.267	0.461	0.786	-0.753	0.631
MB18C	0.487	-0.406	0.301	-0.291	0.206	0.091	0.272	0.269	0.215	0.413	-2.859	0.441	0.541	0.878	-1.029	0.827
MB22A	0.114	0.127	0.280	0.122	0.216	0.293	0.145	0.145	0.088	0.346	-2.675	0.125	0.216	1.286	-1.492	1.205
MB22C	0.135	-0.028	0.207	-0.020	0.247	0.278	0.271	0.141	0.263	0.169	-2.904	0.584	0.415	1.181	-1.771	1.400
MB23A	0.155	0.047	0.238	0.109	0.215	0.157	0.197	0.164	0.131	0.310	-2.606	0.296	0.290	1.076	-1.500	1.215
MB23B	-0.073	0.188	0.042	0.088	0.190	0.136	0.231	0.157	0.172	0.075	-2.480	0.127	0.346	1.371	-1.218	0.929
MB23C	0.296	-0.030	0.374	-0.006	0.152	0.291	0.175	0.204	0.138	0.459	-2.653	0.208	0.270	0.985	-1.449	1.202

Sigma vs energy (MB12B) ?

Calibration points

