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Article

Preliminary Studies of Perovskite-Loaded Plastic Scintillator Prototypes for Radioactive Strontium Detection

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```
Beta detector with Al optical enclosure
c ************************** cell card*******************************
100  7    -1.19 (-1 -2 4) imp:e,p=1                          $ PVC
101  4    -1.22 (-5 -6 7) imp:e,p=1                          $ Scintillator
102  3    -1.5 (-5 -4 6) imp:e,p=1                           $ Reflector
103  1    -0.001293 (-8 -4 10)#102#101#400#401 imp:e,p=1
104  9    -2.7 (-9 -4 10)#103#102#101#400#401 imp:e,p=1
201  9    -2.7 (18 -19 ) imp:e,p=1                           $ Metal enclosure
301  9    -2.7 (-50 53 53 -57)#302#303#304#305 imp:e,p=1     $ Source_Al
302  1    -0.001293 (-52 53 -54) imp:e,p=1                   $ Source_support
303  10    -0.140625 (-51 54 -55) imp:e,p=1                  $ Source_Mylar Film
304  5    -7.93 (-51 55 -56) imp:e,p=1                       $ Source_Active
305  9    -2.7 (-51 56 -57) imp:e,p=1                        $ Source_Al Plug
400  12   -2.2 (-100 -7 101) imp:e,p=1                       $ PMT_silica glass
401  9    -2.7 (-8 -101 102) imp:e,p=1                       $ PMT_silica glass
500  1    -0.001293 -999#100#101#102#103#104#201
                    #301#302#303#304#305#400#401 imp:e,p=1
900  0  999 imp:e,p=0

c *******************************surface card*******************************
1      c/y 0 3.51 3.51                                       $ PVC
2   py   0.031                                               $ PVC
3   py        -0.015                                         $ PVC
4   py   0.011                                               $ Reflector
5   c/y 0 3.5 2    .5                                        $ scintillator
6   py   0                                                   $ scintillator
7   py        -0.2                                           $ scintillator
8   c/y 0 3.51 3.025                                         $ Aluminum Case_Inner
9   c/y 0 3.51 3.5                                           $ Aluminum Case_Outer
10   py       -18.3                                          $ Aluminum Case
11   c/y 0 3.51 0.12675                                      $ Beta Source_outer (S.S)
12   c/y 0 3.51 0.12625                                      $ Beta Source_inner
13   py   10                                                 $ Beta Source
```

```
14   py   10.2135                          $ Beta Source
15   py   10.2535                          $ Beta Source (S.S)
18   rpp     -27 27 -42 42 0 39            $ Metal enclosure_Inner
19   rpp     -30 30 -45 45 -3 42           $ Metal enclosure_Outer
50   c/y 0 3.51 1.27                       $ beta source_Outer
51   c/y 0 3.51 1.19                       $ beta source_Inner_support ring outer
52   c/y 0 3.51 1.02                       $ beta source_Support ring inner
53   py 10                                 $ beta source_support ring
54   py 10.09196                           $ beta source_Mylar Film
55   py 10.09260                           $ beta source_Active Element
56   py 10.118                             $ beta source_Al plug
57   py 10.318                             $ beta source_Bottom
100  c/y 0 3.51 2.55                       $ PMT_Silica glass
101  py   -0.4                             $ PMT_Silica glass
102  py   -0.6                             $ Aluminum plate for back scattering
999   so  999

c Data card
mode p e
sdef par=e erg=d1 rad=d2 ext=d3 pos= 0 0 0 axs= 0 1 0
si1 H 0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 &
          1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2       $ Beta energy
sp1  0 1.32 1.285 1.165 1 0.6 0.255 0.255 0.255 &
          0.255 0.255 0.255 0.245 0.235 0.22 0.205 0.185 &
          0.165 0.135 0.105 0.075 0.04 0.015                 $ Beta probabilities
si2 0 1.19
sp2 -21 1
si3 10.09260 10.118
sp3 -21 0
c ********************material**********************************************
m1   6000        -0.012                    $ Air (0.001293 g/cm3)
       7000        -0.745
       8000        -0.231
```

```
        18000       -0.012
m2   1000            10                               $ PMMA (-1.19 g/cm3)
       6000     6
       8000     5
m3   1000            8                                $ paper (-1.5 g/cm3)
       6000     5
       8000     2
m4  1000             -7.1                             $ Epoxy Resin (1.22 g/cm3)
      6000            -76
      8000            -16.9
m5  24000            19                               $ SUS304 (7.93 g/cm3)
      26000           71.8
      28000           92
m6  6000              6                               $ Acrylic (1.19 g/cm3)
      1000      1
      7000      7
m7  6000              2                               $ PVC (1.192 g/cm3)
      1000              3
     17000            1
m9   13000           -1                               $ Al (2.70 g/cm3)
m10    13000         -1                               $ Al_Mylar flim (0.140625g/cm3)
m12  14000           2                                $ Silica Glass (2.20 g/cm3)
        8000         1
c *******************************************************************
f8:e,p 101
e8 0.0 0.001 2048i 3
c ********************************************************************
nps 100000000
```

Figure S1. MCNP 6 simulation code for geometry optimization.

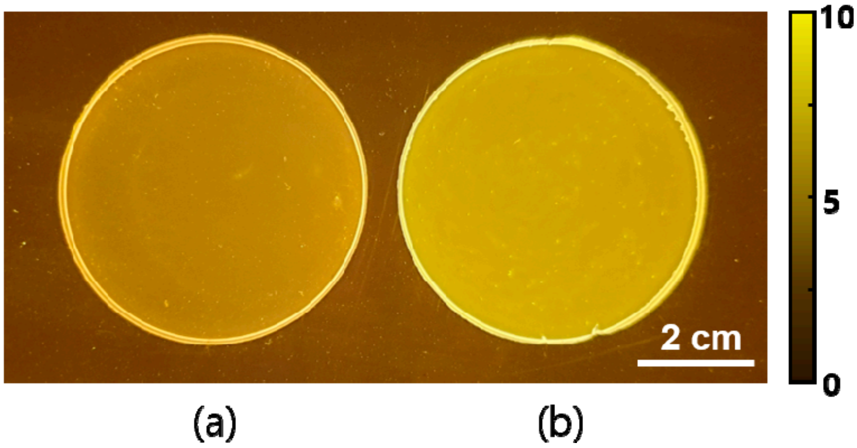

Figure S2. Photoluminescence of two plastic scintillators exposed by a LED Transilluminator (BLooK™, GeneDireX, Inc., TAIWAN) with a maximum emission at 470nm. (**a**) Epoxy-PPO/POPOP, and (**b**) Epoxy-PPO/perovskite.

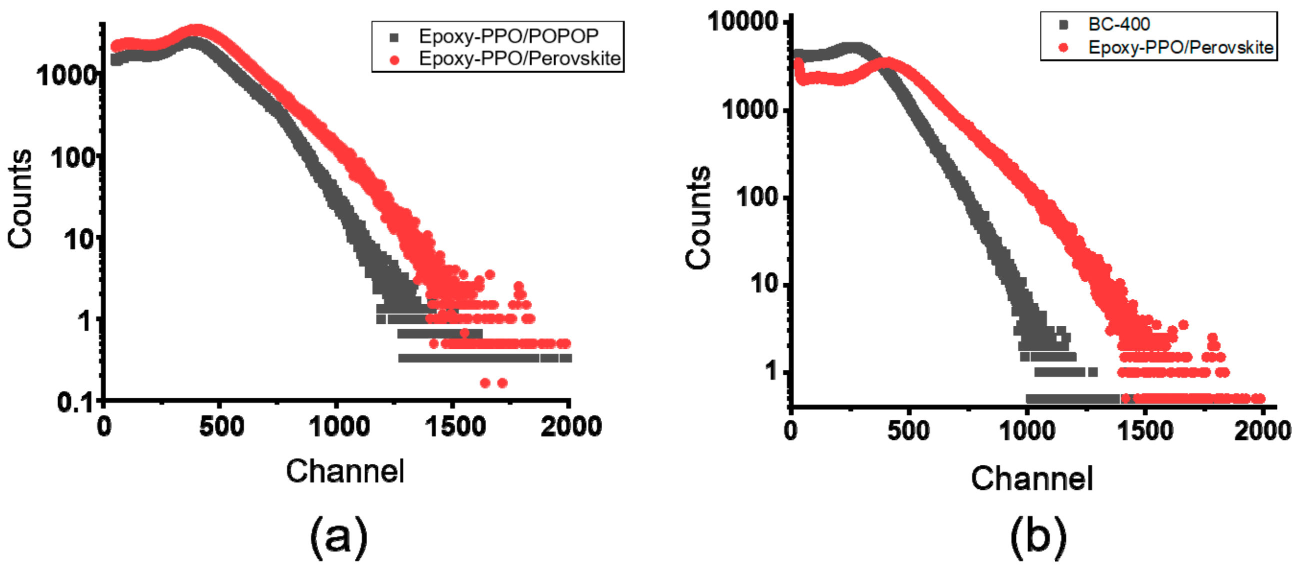

Figure S3. Compared radioactive strontium β-ray measurement spectrum using different plastic scintillators (**a**) Epoxy-PPO/POPOP versus Epoxy-PPO/Perovskite (**b**) BC-400 versus Epoxy-PPO/Perovskite.

Table S1. Standard error obtained by the radiation measurement for pulse-height spectra. The measurements were repeated three times for scintillators.

Standard Errors [σ]	BKG	^{90}Sr
BC-400	0.11	1.09
Epoxy/PPO/POPOP	0.28	1.96
Epoxy/PPO/Perovskite	0.01	0.96