

Table II  
Atomic and nuclear properties (ZE/dx, collision mean free path, radiation length, etc.) of materials used as absorbers and detectors

Material	Z	A	Cross section $\sigma$ [b]	$\frac{dE}{dx}$ [MeV/cm]	Collision length, $L_{col}$ [cm]	Radiation length, $L_{rad}$ [cm]	Density $\rho$ [g/cm <sup>3</sup> ]
H <sub>2</sub>	1	1.01	0.063	4.14	26.5	374	0.0708
Li	3	6.94	0.23	1.72	30.4	94.3	0.534
C	6	12.00	0.33	1.06	60.4	39.0	1.55 (variable)
Al	13	26.97	0.37	1.06	79.2	23.3	2.70
Cu	29	63.57	1.00	1.49	109.4	11.8	8.9
Sn	50	118.70	1.95	1.27	129.7	17.8	7.30
Pb	82	207.21	2.50	1.12	166.2	13.8	11.34
U	92	238.07	4.82	1.09	163.8	8.75	18.7
Hydrogen Bubble chamber (27.6°K)			0.243 MeV/cm	25.5	452	38	0.0586
Propane (C <sub>3</sub> H <sub>8</sub> ) bubble chamber			0.339 MeV/cm	48.9	119.3	44.7	0.41
Polystyrene (StH scintillator)			2.14 MeV/cm	54.9	52.3	43.4	1.05
Ilford emulsion			5.49 MeV/cm	103	27.0	11.2	3.815

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Table III  
Multiple scattering (Coulomb only) calculated from Molière theory.

$\theta_{mp}$  is the mean projected angle in radians between tangents to the particle trajectories:

$$\langle \theta \rangle_{average} = \theta_{mp} = \frac{13.6 \text{ MeV}}{p \beta} \sqrt{\frac{L}{L_{rad}}} (1 + \epsilon)$$

L is the thickness, and  $L_{rad}$  the radiation length (from Table II) for the absorber (atomic number Z). For particles of charge ze and velocity  $\beta c$ , the following table for  $\epsilon$  applies:

Z	$10^{-3}$	$10^{-2}$	$10^{-1}$	1	10
1	-0.20	-0.14	-0.08	-0.03	+0.02
6	-0.16	-0.07	-0.30	+0.06	+0.12
29	-0.18	-0.19	-0.21	+0.06	+0.13
82	-0.27	-0.37	-0.67	+0.02	+0.18
1	-0.26	-0.29	-0.14	-0.08	-0.03
6	-0.20	-0.32	-0.05	+0.01	+0.07
29	-0.20	-0.12	-0.07	+0.05	+0.12
82	-0.28	-0.17	-0.07	+0.06	+0.09
1	-0.31	-0.24	-0.18	-0.12	-0.07
6	-0.26	-0.18	-0.10	+0.03	+0.09
29	-0.25	-0.19	-0.26	+0.02	+0.08
82	-0.29	-0.17	-0.28	-0.01	+0.08
1	-0.34	-0.26	-0.20	-0.14	-0.08
6	-0.29	-0.20	-0.12	-0.05	+0.01
29	-0.34	-0.23	-0.13	-0.05	-0.03
82	-0.31	-0.19	-0.09	-0.05	-0.08

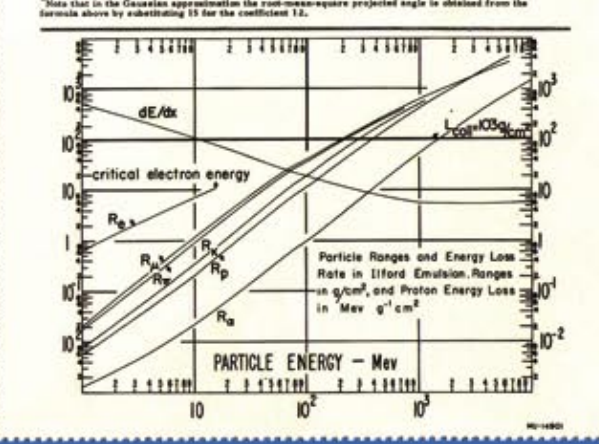
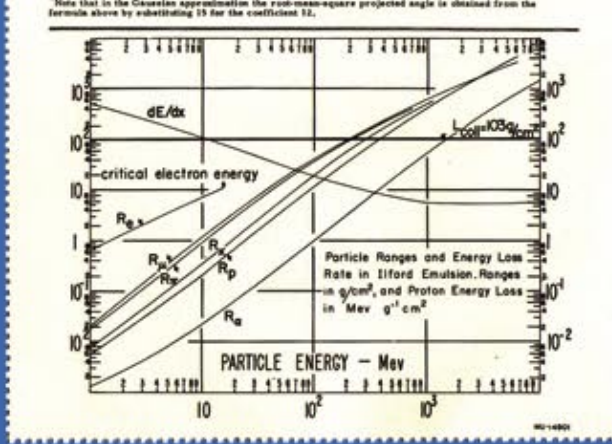
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29	-0.25	-0.19	-0.26	+0.02	+0.08
82	-0.29	-0.17	-0.28	-0.01	+0.08
1	-0.34	-0.26	-0.20	-0.14	-0.08
6	-0.29	-0.20	-0.12	-0.05	+0.01
29	-0.34	-0.23	-0.13	-0.05	-0.03
82	-0.31	-0.19	-0.09	-0.05	-0.08



In 1957 Murray Gell-Mann and Art Rosenfeld published the Particle Properties Tables in the 1957 *Annual Review of Nuclear Science*. Their intent was to amass experimental and theoretical information on decays of particles called hyperons and heavy mesons.

Rosenfeld and Walter Barkas decided to update that paper's "table of masses and mean lives" even before the 1957 *Review* was in print. The update appeared as an unpublished Radiation Laboratory Report, UCRL-8030. They revised the report in 1958 and, with it, issued a wallet card (above) summarizing the information.

"This was the *Particle Data Book*," says Michael Barnett, who now heads the Particle Data Group. Each summary sheet had twin copies of the card, with perforated holes to tear them apart. A publishing oversight reversed the image of the imperial ruler.

"The damn thing just grew," says Rosenfeld. "Pretty soon they became wallet sheets. The Russian word for bedsheets is different from a regular paper sheet, but they called it the Rosenfeld Bedsheet."

This year, the Particle Data Group celebrates its 50th anniversary with a release of a 1230-page edition of the *Review of Particle Physics*. With the wallet card long gone, the current abridged version, the *Particle Physics Booklet*, now fills 320 pages. "And we struggled to keep it short," says Barnett. **Krista Zala**