THE PARTICLE DATA GROUP:
A SHORT HISTORY AND HOW IT WORKS
(and some current issues)
BEGINNINGS

W.H. Barkas & A.H. Rosenfeld, UCRL-8030, Data for Elementary Particle Physics, 1957 (not published).

The first Wallet Card, 1958.
WHO IS ROSENFELD?

Enrico Fermi’s last graduate student:

One of the pillars of the Alvarez Group. Spearheaded the effort beginning in the late 1950s to “computerize” data analysis of photos taken in the series of larger and larger Alvarez Group hydrogen bubble chambers running at the Berkeley Bevatron.

After the first gas crisis in 1973, left particle physics for energy conservation, especially in buildings and appliances. Winner of the Enrico Fermi Award (2006), and many other awards.
WHY BERKELEY? WHY THE ALVAREZ GROUP?

Because particles (but not $N^*$s) were being discovered by the Alvarez Group in bubble chambers at the Bevatron.

Discovered by the Alvarez Group (list not complete):

1960 $\Sigma(1385)$
1961 $K^*(892), \Lambda(1405), \omega(782)$
1962 $\Lambda(1520)$
1963 $\Sigma(1775)$
1966 $\Sigma(2030), \Lambda(2100)$

Discovered in the Alvarez 72-in chamber by other groups:

1961 $\eta(548)$ (Johns Hopkins U.)
1962 $\Xi(1530)$ (UCLA).

The 1968 Nobel Prize in Physics, awarded to Luis W. Alvarez:

“For his decisive contributions to elementary particle physics, in particular the discovery of a large number of resonant states, made possible through his development of the technique of using hydrogen bubble chambers and data analysis.”
1968: The first Particle Data Booklet, and the “Particle Data Group.”

In this era, the tables were commonly referred to as “the Rosenfeld tables.”
THE HEYDAY OF $N^*$ PHYSICS
(at least as far as the Particle Data Group was concerned)

*Handbook of Pion-Nucleon Scattering*, Physics Data 12-1 (1979)
G. Höhler, Kaiser, R. Koch, E. Pietarinen,
Karlsruhe & Helsinki

"Pion-nucleon partial-wave amplitudes," Phys. Rev. D20 (1979) 2839,
R.E. Cutkosky, C.P. Forsyth, R.E. Hendrick, R.L. Kelly,
Carnegie-Mellon & LBL.

Bob Kelly head of the Particle Data Group, $\approx$ 1975-1981.

Later history is probably better known to the audience than to me.
VII.12

Baryon Full Listings

$N$'s and $\Delta$'s

Fig. 1(a). The $E_{1/2}$, $S_{11}$, $F_1$, $F_0$, and $D_{15}$ partial-wave amplitudes for $eN$ elastic scattering. The upper plot for each amplitude is from ROHBLER 79 and the lower one is from CUTKOSKY 80. In the Argand plots, the ticks are at integral multiples of 50 MeV, and the established resonances are shown at their nominal positions. The real and imaginary parts of the amplitudes as functions of energy are shown projected in alignment with the Argand plots (in the projections of the CUTKOSKY 80 amplitudes, the "data points" are results of energy-independent fits, and the curves are from an energy-dependent fit to join them).
Fig. 1(b). The $L_0$, $L_2$, $F_1$, $F_3$, and $G_1$ partial-wave amplitudes for $\pi N$ elastic scattering. The upper plot for each amplitude is from BOHLEIER 79 and the lower one is from CUTKOSKY 80. In the Argand plots, the ticks are at integral multiples of 50 MeV, and the established resonances are shown at their nominal positions. The real and imaginary parts of the amplitudes as functions of energy are shown projected in alignment with the Argand plots (in the projections of the CUTKOSKY 80 amplitudes, the "data points" are results of energy-independent fits, and the curves are from an energy-dependent fit to join them).
Fig. 1(d). The $L_{\text{max}} = S_\text{max}$, $P_\text{max}$, and $D_\text{max}$ partial-wave amplitudes for $\pi N$ elastic scattering. The upper plot for each amplitude is from ROEBLER 79 and the lower one is from CUTKOSKY 80. In the Argand plots, the ticks are at integral multiples of 30 MeV, and the established resonances are shown at their nominal positions. The real and imaginary parts of the amplitudes as functions of energy are shown projected in alignment with the Argand plots (in the projections of the CUTKOSKY 80 amplitudes, the "data points" are results of energy-independent fits, and the curves are from an energy-dependent fit to join them).
MORE THAN 50 YEARS

Booklet for the 50th anniversary party
HOW WE WORK
(mostly how Ron Workman and I work)

Two people independently scan about 20 journals for articles that need to be looked at for the next update of the Review.

Relevant subsets of the total list are sent out to the overseers and encoders. For example, I oversee the ground-state $D$ mesons, and all the baryons except for those with a $b$ quark. So I work with several encoders. Ron Workman has been the encoder for $N^*$’s for many years. Before him, it was Mark Manley.

Ron reads the papers and sends me brief notes on them, and encodings of those with relevant data. I read Ron’s notes and look at the papers, especially those with data to be added to the Particle Listings. Sometimes we discuss a bit.

What papers get encoded?! Only those papers that influence our estimates of values of $N^*$ parameters!

There are lots of interesting and valuable papers that do not tell us we can narrow, say, the range of our estimate of the width of the $N(1700)$.

All new encodings are entered into the database by the chief editor, Piotr Zyla (a physicist). After entry and checking, requests go out to one person per paper for verification. I see to corrections, conflicts, etc.


ISSUES & PROBLEMS

DEPENDENT ANALYSES:
What values should we give for $N^*$ masses, widths, branching fractions, etc? For $D$ mesons, I get completely independent measurements of branching fractions from CLEO (Cornell), BABAR (Stanford), and Belle (KEK, Japan). These measurements come with both statistical and systematic errors, and are perfect for averages and fits. Nothing like this happens with $N^*$s. The global analyses use heavily overlapping data sets. The lesser analyses often start from the results from the global fits. In most cases, all we can do is eye-ball a reasonable range for a mass, a width, a branching fraction.

ISOLATION:
There is little attention from the wider high-energy physics community. The situation is like a decades-long war: The battlefront is now a thousand miles away; this $N^*$ back area is not nearly pacified, but nearly all attention is elsewhere. (Maybe this doesn’t matter: all large branches of science are splintered into many subcultures.)

NOT TO MENTION:
More and better data are needed.

NOTATION:
Eberhard Klempt favors a change of notation:

$$\Delta(1232) P_{33} \rightarrow \Delta_{3/2^+}(1232) .$$

Variations: $\Delta(1232) 3/2^+$; $\Delta(1232, 3/2^+)$. A change would be fine. But perhaps we ought to think twice before changing a long-used notation.
THREE WAYS TO GO

CONSERVATIVE:
Keep going more or less the way we are now. I probably favor this option, but perhaps the community does not. I should say that the Particle Data Group is never going to go beyond its “name, rank, and serial number” treatment of the resonances.

LIBERAL:
Form an outside “Partial Wave Averaging Group (PWAG),” to provide best $N^*$ numbers for the Review—such as those estimated best ranges of masses, widths, etc. There is an outside “Heavy Flavor Averaging Group (HFAG)” that does special topics, such as mixing and $CP$ violation, in charm and (especially) bottom physics. We use some of its numbers directly.
The PWAG would be independent of the Particle Data Group (i.e., its problems wouldn’t be our problems). Possible issues are reliability (e.g., being on time), partisanship.

RADICAL:
Break off the compilation of $N^*$ parameters from the Review. Make a separate publication, linked to the Review. In the process, enlarge and specialize the coverage of subjects of particular interest and value to the $N^*$ community.