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Weisberger W I. Renormalization of the weak axial-vector coupling constant. *Phys. Rev. Lett.* **14**:1047-51, 1965.
[Stanford Linear Accelerator Center, Stanford University, CA]

The SU(3) X SU(3) algebra of the integrated time components of the vector and axial-vector current octets were combined with the partially conserved axial-vector current hypothesis to obtain an expression in terms of π-proton total cross sections for $|G_A/G_V|$, the absolute ratio of renormalized axial-vector and vector coupling constants in neutron β-decay. Numerical evaluation using experimental values of the π-proton cross sections gave a value for $|G_A/G_V|$ in good agreement with the measured value. [The *SCI*® indicates that this paper has been cited in over 430 publications since 1965.]

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"In 1964, I began my first postdoctoral research position at the Stanford Linear Accelerator Center and was trying to strike out in a different direction from my thesis research. Sidney Drell, head of the theory group, suggested that one of the outstanding problems in particle physics was to explain the value of G_A, the axial-vector coupling constant in nuclear β-decay, which was 1.18 times G_V, the corresponding weak vector coupling constant. (The presently accepted value is 1.24.) G_V was expected to be unrenormalized because of the conserved vector current hypothesis.

"Soon after, I saw a new preprint by Fubini and Furlan,[1] who proposed using the equal time commutation relations of currents to get sum rules for the renormalization of their associated coupling constants. They illustrated their technique with the weak vector currents.

"I realized that this idea could be applied to the current algebra commutation relations (symbolically [A,A] = V,) which had been proposed by Gell-Mann,[2,3] to obtain a sum rule for G_A. Moreover, by use of the partially conserved axial-vector current explanation of the Goldberger-Treiman relation, the deviation of G_A/G_V from 1 could be expressed in terms of π-proton scattering matrix elements.

"However, the form of the sum rule which emerged initially did not appear useful. The result seemed to depend on the proton momentum and contained unphysical singularities. Adding the various terms with their energy denominators was like doing old-fashioned perturbation theory with disconnected graphs and Lorentz frame dependent contributions from individual intermediate states. Eventually, I succeeded in summing everything up to show that the deviation of $(G_A/G_V)^2$ from unity could be expressed as a convergent energy integral over the difference between the total π^+-proton and π^--proton cross sections. Even before substituting the experimental data, it was clear that the sum rule gave an effect of the correct sign because of the dominant contribution of the (3,3) resonance, Δ(1232).

"At this moment, I heard that Stephen Adler, then at Harvard University, was working on the same problem. I called Adler the next day after completing the numerical integration. Though he had submitted his paper to *Physical Review Letters* a few days before, he offered to write the editors requesting that both our papers appear in the same issue.[4] We had, in fact, used slightly different techniques.

"Our work convinced most particle theorists that the current algebra ideas were correct and established a widely applied technique for the calculation of low energy interactions of pions and kaons and symmetry breaking effects.[5,6] The quark model origins of the currents gained added importance when they were incorporated into the unified theory of electromagnetic and weak interactions."

1. **Fubini S & Furlan G.** *Renormalization effects for partially conserved currents.* *Physics* **1**:229-47, 1965. (Cited 230 times.)
2. **Gell-Mann M.** Symmetries of baryons and mesons. *Phys. Rev.* **125**:1067-84, 1962. (Cited 1,550 times.)
3. ----------------. The symmetry group of vector and axial vector currents. *Physics* **1**:63-75, 1964. (Cited 770 times.)
4. **Adler S L.** Calculation of the axial-vector coupling constant renormalization in β decay. *Phys. Rev. Lett.* **14**:1051-5, 1965. (Cited 420 times.)
5. **Renner B.** *Current algebras and their applications.* Oxford: Pergamon Press, 1968. 177 p. (Cited 90 times.)
6. **Adler S L & Dashen R F.** *Current algebras and applications to particle physics.* New York: W.A. Benjamin, 1968. 394 p. (Cited 535 times.)

