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Hadron Matrix Elements and the Feynman-Hellman Theorem

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Motivated by the Feynman-Hellman Theorem, we develop an improved method for computing matrix elements of external currents utilizing only two-point correlation functions.
The contamination from excited states is shown to be Euclidean-time dependent allowing for a significantly improved ability to reliably determine and control the systematics.
We demonstrate the utility of our method with a calculation of the nucleon axial-charge, performed at a single lattice spacing and a moderate unphysical pion mass.
The Feynman-Hellman Theorem can be derived from the long Euclidean-time limit of correlation functions determined with functional derivatives of the partition function.
This elucidates the generic applicability of our new method: one can determine matrix elements of any external current by computing only two-point correlation functions, including non-zero momentum transfer and flavor-changing matrix elements.

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