

# Empirical parametrizations of the resonance transition amplitudes based on the Siegert's theorem

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The Siegert's theorem states that in a  $gN \rightarrow N$  transition, where  $N$  and  $N^*$  are respectively the nucleon and a nucleon resonance, the electric amplitude,  $E$  (defined by the transverse amplitudes) and the scalar amplitude,  $S$ , are related in the pseudo-threshold limit by  $E \sim w/qS$ , where  $w$  and  $q$  are the photon energy and momentum. The pseudo-threshold limit is the limit where  $q \rightarrow 0$ , when the nucleon and the resonance are both at rest. The explicit form of the electric amplitude  $E$  and the coefficients depend on the resonance angular momentum-parity state. Some empirical parametrizations of the  $gN \rightarrow N$  transition amplitudes, violate the Siegert's theorem. We will discuss in particular the results for the  $gN \rightarrow N(1535)$ , and  $gN \rightarrow \Delta$  and  $g^*N \rightarrow N(1520)$  transition amplitudes. Empirical parametrizations of the data consistent with the Siegert's theorem will be presented, and compared with alternative parametrizations. The physics associated with the parametrizations at low  $Q^2$  will be discussed. Finally new parametrizations will be proposed for large  $Q^2$ , compatible with the existent data and with the behavior expected from perturbative QCD.

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