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Covariant calculations of N* Dalitz decays

We present calculations of the electromagnetic transitions of the nucleon,
to nucleon resonances N^*, namely the $\Delta(1232)\frac{3}{2}^+$,
$N(1520)\frac{3}{2}^-$ and $N(1535)\frac{1}{2}^-$.
Our results for these $\gamma^* N \to N^*$ reactions are
based on a covariant quark model. In this contribution, we focus
on the timelike regime — where the square momentum transfer
is positive ($q^2 > 0$) — which is the kinematic region of interest for heavy
ion collisions experiments
at intermediate energies.

In addition to effects from the valence quark degrees of freedom,
we find parametrizations for meson cloud effects at low q^2 values, which are
determined by the dominant meson decay channels,
and are also constrained by the empirical data in the spacelike region ($q^2 < 0$).

The obtained theoretical transition form factors are
used to calculate the Dalitz decay rates $d\Gamma_{e^+e^-N}/dq$
for the resonances $\Delta(1232)\frac{3}{2}^+$,
$N(1520)\frac{3}{2}^-$ and $N(1535)\frac{1}{2}^-$,
as well as the corresponding Dalitz decay widths $\Gamma_{e^+e^-N}$.
The results from HADES suggest that the
$\Delta(1232)$ resonance dominate the Dalitz decay rates
for the kinetic energies near 1 GeV.
For larger kinetic energies, the impact of the
$N(1520)$ and $N(1535)$ resonances are expected to increase.

Our theoretical results are compared with recent di-electron production
data from the HADES Collaboration at GSI, on proton-proton (pp),
pA or πp scattering,
where creation and propagation of intermediate N^* states occur
($N^* \to \gamma^* N \to e^+e^- N$).
We present results
for the two isospin cases, i.e., for reactions with proton or neutron targets,
for which experimental data from HADES can also be provided.

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