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Generalized dispersion relations for unphysical particles with complex masses

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Summary

A generalized dispersion relation is discussed for confined degrees of freedom
that are not present in the physical spectra but can give rise to observable bound states.
The propagator of the unphysical particles can have complex poles and cannot be reconstructed from the knowledge of the imaginary part. Under reasonable assumptions the missing piece of information is shown to be in the rational function that contains the poles and must be added to the integral representation.
For pure Yang-Mills theory, the rational part and the spectral term can be sorted out
by the explicit analytical expressions of the one-loop massive expansion, where a massive gluon propagator is inserted in the loops.
The spectral function turns out to be very small and from first principles, the simple rational part provides an approximate propagator that is equivalent to the tree-level result of simple phenomenological models like the refined Gribov-Zwanziger model.

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