The t-channel Singularity and its Thermal Regularization

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If a given particle scattering process occurs through an exchange of a massive, stable t-channel particle, this particle (called „mediator") can, under certain conditions, become on-mass-shell which leads to a singular, infinite value of the cross section. An example of a process possibly affected by this singularity is a weak analogue of the Compton scattering process, Z $e^- \to e^-$ Z. Physically, the appearance of the singularity is related to an infinite lifetime of the mediator. Therefore, in order to regularize the singularity, the lifetime-limiting effects should be taken into account. In reality, the mediator propagates not through the vacuum (in which its lifetime would be infinite in fact) but through a gas of particles forming the environment of the process. Interactions of the mediator with those particles limit its lifetime and lead to the appearance of an effective width which allows to regularize the singularity. In my talk, I will provide strict conditions for a given $2 \to 2$ scattring process to be singular (regarding the standard and the thermally averaged cross section). I will describe the method of effective-width calculation that uses the statistical field theory. I will also present exemplary numerical results obtained for the vector-fermion dark matter model (VFDM).