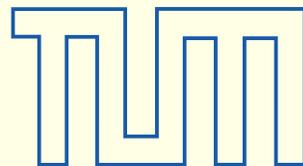


Heavy Flavour Suppression - round table -

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What do we know about the finite temperature potential?

The **potential** is the interaction describing the quarkonium time evolution in an EFT that follows from QCD by integrating out all modes of energy larger than the binding energy:

$$i \frac{\partial}{\partial t} \phi = \left[\frac{\mathbf{p}^2}{m} + V(\mathbf{r}, \mathbf{p}, T, \dots) + \text{low-energy interactions} \right] \phi$$

We distinguish two regimes:

- **Weak coupling**: all scales are perturbative, i.e. larger than Λ_{QCD} .
- **Strong coupling**: some scales are of order Λ_{QCD} .

Weak coupling

Temperature	Potential (LO)	Thermal Width	Dissociation Mechanism
$T \gtrsim mg$	screened	$\Gamma \sim \alpha_s T \times (m_D a_0)^2 > E_{\text{bin}}$	screening
$mg \gg T \gtrsim mg^{4/3}$	Coulomb	$\Gamma \sim \alpha_s T \times (m_D a_0)^2 > E_{\text{bin}}$	inelatic parton scattering
$mg^{4/3} \gg T \gtrsim mg^3$	Coulomb	$\Gamma \sim \alpha_s T \times (m_D a_0)^2 < E_{\text{bin}}$	inelastic parton scattering
$mg^3 \gg T$	Coulomb	$\Gamma \sim \alpha_s T \times (E_{\text{bin}} a_0)^2 < E_{\text{bin}}$	gluodissociation

$a_0 \sim 1/(mg^2) = \text{Bohr radius}$

$E_{\text{bin}} \sim mg^4 = \text{binding energy}$

$m_D \sim gT = \text{Debye mass}$

Strong coupling

- Analysis based on **lattice** calculations at different Euclidean times. See talk by A. Rothkopf.
- Such an analysis is important because we know from weak-coupling studies that the **real part** of the potential cannot be extracted from the Wilson loop free energy or from the correlator of Polykov loops. Moreover, it is crucial to obtain also the **imaginary part** of the potential.
- Ideally one would like to be able to express the real and imaginary part of the potential and its relativistic corrections in terms of **expectation values of non-perturbative operators**. A program that has been realized for quarkonium at zero temperature.

What is the experimental impact of the imaginary part of the potential?

- A specific weak-coupling case that could be tested at LHC could be the $\Upsilon(1S)$:

$$m_b \approx 5 \text{ GeV} > m_b \alpha_s \approx 1.5 \text{ GeV} > \pi T \approx 1 \text{ GeV} > m_b \alpha_s^2 \approx 0.5 \text{ GeV} \sim m_D \gtrsim \Lambda_{\text{QCD}}$$

- Can we have measures of the thermal width (\sim number) of the $\Upsilon(1S)$ at different temperature? In this case:

$$\Gamma \sim T \text{ (for gluodissociation) and } \Gamma \sim T^3/m^2 \text{ (for inelastic parton scattering dissociation).}$$