International Conference on

Heavy Quarkonium 2013

Beijing
April 22-26, 2013

Production Sessions: Monday, Tuesday April 22-23

Discussion of Production Monday at 15:20

higher order corrections,
matrix-element extractions,
factorization,
etc.

Discussion of Production Monday at 15:20

Please contribute to the discussion
by submitting questions to be discussed
by the participants which will include

Geoff Bodwin Berndt Kniehl
Adam Leibovich Jian-xiong Wang
Jianwei Qiu Kuang-Ta Chao

Submit your questions by

- sending them by email to braaten@mps.ohio-state.edu
- submitting them in person to one of the
  Production convenors: Geoff Bodwin
  Eric Braaten
  Jianwei Qiu
  Vaia Papadimitriou

谢 谢

Discussion of Production

A. Perturbative QCD expansion

Berndt Kniehl
Jian-xiong Wang
Kuang-Ta Chao

B. Factorization

Geoff Bodwin
Adam Leibovich
Jianwei Qiu

C. Additional issues

Discussion of Production

A. Perturbative QCD expansion

1. The NRQCD production matrix elements
   are treated as phenomenological parameters
   that must be extracted by fitting data.

   What ranges of the transverse momentum p_T
   should be used in those fits?

1. What ranges of p_T in the data do you think should be used in fits to extract the NRQCD LDMEs?

Discussion of Production

A. Perturbative QCD expansion

2. The NRQCD factorization predictions
seem to overshoot the data
at the largest p_T's measured at the LHC.

One possibility for improving the agreement
between theory and experiment
is to resum logarithms of p_T/m_Q.

What are the prospects for such resummations?

What observables would be most affected?

2. The predictions seem to overshoot the data for the largest values of p_T measured at the LHC. Kniehl and Butenschoen have suggested that the agreement between data and theory might be improved by resumming large logs of p_T^2/m^2. Are you working on such a correction? How do you expect it to change the relative sizes of the color-octet contributions, and how would this affect the polarization predictions?

Discussion of Production

A. Perturbative QCD expansion

3. NLO predictions for charmonium polarization have been calculated independently by 3 groups. What are the prospects for NLO predictions for bottomonium polarization?

3. What are the prospects for making NLO predictions for the Upsilon(nS) polarizations?

Discussion of Production

A. Perturbative QCD expansion

4. What are the most likely candidates for solving the polarization puzzles?

Which approach(es) are probably to be candidates to solve the polarization puzzling?

Discussion of Production

A. Perturbative QCD expansion

4. Are the NLO predictions stable
   with respect to relativistic corrections?

Discussion of Production

B. Factorization

1. The SCET approach requires matching
   between SCET
   and a boosted NRQCD factorization formula.
   Does the boost affect the power-counting
   for NRQCD factorization?

1) In SCET approach to heavy quarkonium production, it was argued that the SCET
can be naturally matched to the boosted NRQCD factorization formalism.
If this is true, the NRQCD factorization of fragmentation functions should work.
But, as you know, we are having difficulties to prove that.
I hope, we can learn some insides from the match between SCET and NRQCD at the scale near 2m_Q.
SCET is by design for observables with a large momentum scale,
while, NRQCD is naturally expanded in the rest frame of the heavy quark pair.
I am having difficulties to matching these two, and not even sure how to frame my questions.
A simple question could be: will the boost affect the power counting of NRQCD factorization?

Discussion of Production

B. Factorization

2. NRQCD factorization should work for observables that are sufficiently insensitive to soft physics.
Could polarization be sufficiently sensitive to soft physics that NRQCD factorization fails?

2) By summing the soft physics into the local matrix elements, NRQCD factorization
should work well for observables not sensitive to the details of soft physics.
The question is how soft is the soft?
For inclusive cross section of producing stable ground states, it is more likely safe to factorize.
However, for the observables, like the polarization, or excited states, may have the very different
or much more enhanced sensitivities on the physics that we freeze into the local matrix elements.
Does the velocity counting be universal or sensitive to observables (corrections?)?

Discussion of Production

B. Factorization

3. Wilson lines must be included in the definitions of the color-octet NRQCD matrix elements.

Are the NRQCD matrix elements now sufficiently well-defined that the question of whether NRQCD factorization holds at large p_T is a well-posed problem?

Can you discuss how well defined are the NRQCD matrix elements?
what is their actual definition, and how it was proved that it has to be so?

Discussion of Production

B. Factorization

3. The color-singlet model correctly describes some observables in the low-p_T region.
   Is there any plausible mechanism that could justify the color-singlet model at low p_T ?

2) Given that low-P_T Upsilon NLO CSM predictions (up to 5 GeV) perfectly agree with the data (plot attached from the LHCb paper).
- isn't there a potential caveat to disregard the low-P_T data in NRQCD fits for Upsilon ?
- eventually, would not the NRQCD P_T spectrum systematically overshoot low P_T data ?
- if one argues that NRQCD factorization breaks down at low P_T,
  is there a foreseen mechanism which could explain such a disappearance of CO contributions at low P_T ?