# Double-parton effects in production of fully heavy tetraquarks in proton-proton collisions

We discuss the production mechanism of a new state,
a fully charm tetraquark, discovered recently by the LHCb at
M = 6.9 GeV in the $J/\psi J/\psi$ channel.
Both single parton scattering (SPS) and double parton scattering (DPS)
mechanisms are considered. We calculate the distribution in the invariant
mass of the four-quark system $M_{4c}$ for SPS and DPS production of
$cc\bar{c}\bar{c}$ in the $k_t$-factorization approach with modern
unintegrated gluon distribution functions (UGDFs).
The so-calculated contribution of DPS is almost two orders of
magnitude larger than the SPS one, but the tetraquark formation
mechanism is unknown at present.
We construct a simple coalescence model of the tetraquark out of
$c\bar{c}\bar{c}$ continuum.
Imposing a mass window around the resonance position we calculate the
corresponding distribution in $p_{t,4c}$ – the potential tetraquark
transverse momentum. The cross section for the $J/\psi J/\psi$ continuum
is calculated in addition, again including SPS (box diagrams) and
DPS contributions which are of similar size.
The formation probability is estimated trying to reproduce
the LHCb signal-to-background ratio. The calculation of the SPS
$gg \to T_{4c}(6900)$ fusion mechanism is performed in the
$k_T$-factorization approach assuming different spin scenarios
$(0^+, 0^-$ and $2^+)$. The $2^+$ and $0^+$ assignment is preferred over
the $0^-$ one by a comparison of the transverse momentum distribution
of signal and background with the LHCb preliminary data assuming
the SPS mechanism dominance.
There is no microscopic approach for the DPS formation mechanism
of tetraquarks at present as this is a complicated multi-body problem.

We do similar analysis for FCC energy $\sqrt{s}$ = 100 TeV.
We predict the production cross section order of magnitude larger
than its counterpart for the LHC.
We discuss also a possibility to observe the $T_{4c}$ state in the
$\gamma\gamma$ channel. The signal-to-background ratio is estimated.

We discuss also production of $c\bar{c}b\bar{b}$ tetraquarks and
discuss how the results depend on the mass of such an object.

**Primary authors:** SZCZUREK, Antoni; MACIULA, Rafal; SCHAFER, Wolfgang

**Presenter:** SZCZUREK, Antoni

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