ments perturbative QCD (pQCD) elastic collisions as well as the pQCD based inelastic bremsstrahlung incorporating full detailed balance.

The paper is organized as follows. In Sec. II we review the parton cascade BAMPS and introduce effective quarks into BAMPS as a simplification for real quark dynamics. In Sec. III the numerical results are shown to demonstrate the effect of the parton multiplicities on the elliptic flow of the parton matter. We summarize in Sec. IV.

II. BAMPS INCLUDING EFFECTIVE QUARK DEGREES OF FREEDOM

The detailed model description of the on-shell parton cascade BAMPS can be found in Refs. [15, 16]. In short, the feature of BAMPS is the successful implementation of particle number changing processes with full detailed balance. This is ensured by using the stochastic interpretation of the transition rates in the Boltzmann equations for partons. Other parton cascade approaches can be found in [10, 17–21].

The cross section of pQCD gluon elastic scatterings is given by [11, 15]

$$\frac{d\sigma^{gg\to gg}}{d\mathbf{q}_\perp^2} = \frac{9\pi\alpha_s^2}{(\mathbf{q}_\perp^2 + m_D^2)^2} \tag{1}$$

and the effective matrix element of pQCD inspired bremsstrahlung $gg \leftrightarrow ggg$ is taken in a Gunion-Bertsch form [13, 15, 22, 23],

$$|\mathcal{M}_{gg\to ggg}|^2 = \frac{9g^4}{2}\frac{s^2}{(\mathbf{q}_\perp^2 + m_D^2)^2}\,\frac{12g^2\mathbf{q}_\perp^2}{\mathbf{k}_\perp^2[(\mathbf{k}_\perp - \mathbf{q}_\perp)^2 + m_D^2]}\,\Theta(k_\perp\lambda_{\rm mfp} - \cosh y)\,, \tag{2}$$

$$|\mathcal{M}_{ggg\to gg}|^2 = |\mathcal{M}_{gg\to ggg}|^2/d_G\,, \tag{3}$$

where $g^2 = 4\pi\alpha_s$ and $d_G = 16$ is the gluon degeneracy factor for $N_c = 3$. $\mathbf{q}_\perp$ denotes the perpendicular component of the momentum transfer, $\mathbf{k}_\perp$ ($k_\perp = |\mathbf{k}_\perp|$) the perpendicular component of the radiated gluon momentum and y its rapidity in the center-of-mass frame of the collision, respectively. The suppression of the bremsstrahlung due to the Landau-Pomeranchuk-Migdal effect is effectively taken into account within the Bethe-Heitler regime using the step function in Eq. (2). Gluon radiations and absorptions are only allowed if the formation time of the process, typically $\tau = \cosh y/k_\perp$, is shorter than the mean free path $\lambda_{\rm mfp}$ of the radiated or absorbed gluon. $\lambda_{\rm mfp}$ is calculated self-consistently [15, 24], i.m., $\lambda_{\rm mfp}$ is the inverse of the total collision rate $R_{gg\to gg} + R_{gg\to ggg} + R_{ggg\to gg}$, where $R_{gg\to ggg}$ and $R_{ggg\to gg}$ also depend on $\lambda_{\rm mfp}$ as indicated in Eqs. (2) and (3) [see Eqs. (8), (9), (14), and (15)].