I. INTRODUCTION

Measurements on collective flow in heavy ion collisions at the BNL Relativistic Heavy Ion Collider (RHIC) [1] showed that the matter produced, the quark gluon plasma (QGP), is a nearly perfect fluid [2, 3]. Because the strength of the collective flow increases with decreasing viscosity, indirect extractions of the shear viscosity have recently been performed by tuning the shear viscosity (or the QCD coupling) as a parameter in viscous hydrodynamic [4–8] and transport models [9–11] to match the elliptic flow v_2. A consistent result has been achieved: on a conservative basis the shear viscosity to the entropy density ratio η/s of the QCD matter at RHIC is less than 0.4 [12]. Uncertainties stem from assumptions in modelling the various stages that the matter undergoes during its evolution.

The results from the transport calculations using the Boltzmann Approach of Multiparton Scatterings (BAMPS) [11] showed that $v_2(p_T)$ as a function of the transverse momentum p_T is lower and the p_T spectra are harder than the experimental data, whereas the integral of both gives a p_T averaged v_2, which matches the experimental data. This inconsistency may stem from the nature of the rather complicated hadronization process than the simple parton-hadron duality picture used in [11]. Another reason may lie in the fact that only gluons are considered as interacting constituents in the calculations presented in [11]. Including quark dynamics will increase the number of parton degrees of freedom and, thus, may soften the p_T spectra and enhance $v_2(p_T)$. In this paper we employ BAMPS and include effective quark degrees of freedom to investigate how the increase and the equilibration of partonic multiplicities affect the elliptic flow and also the η/s ratio of the QGP.

This study shall demonstrate whether the buildup of elliptic flow in ultrarelativistic heavy ion collisions depends on the chemical equilibration of gluons and quarks. The latter determines the actual number of constituents in the partonic phase. In hydrodynamic calculations it is assumed that the matter stays in chemical equilibrium and thus the number of constituents is conserved. However, the situation in a real heavy ion collision might be considerably more complicated [13, 14]. Quarks are expected to achieve chemical equilibrium (if this occurs) later than gluons [13]. Even for gluons only, the chemical equilibration will proceed faster at the collision center than at the region near transverse edge of the parton system. The parton chemical equilibration can well be studied using the microscopic transport model with multiple scatterings such as BAMPS [15], because BAMPS imple-