may be expressed by transport coefficients which are typically derived in the vicinity of thermal equilibrium (Braginskii 1965). A presence of other kinetic effects may render questionable these collision-dominated theoretical predictions (in the collisionless limit the transport coefficients of Braginskii (1965) diverge). Some collisional transport coefficients can be calculated even far from thermal equilibrium, for example assuming drifting bi-Maxwellian velocity distribution functions for all particle species (Barakat & Schunk 1981; Hellinger & Trávníček 2009). For instance the proton-proton isotropization frequency $\nu_{\rm pp}$

$$\left[\frac{\mathrm{d}(T_{\mathrm{p}\perp}-T_{\mathrm{p}\|})}{\mathrm{d}t}\right]_{\mathrm{coll}} = -\nu_{\rm pp}\left(T_{\mathrm{p}\perp}-T_{\mathrm{p}\|}\right) \tag{1.1}$$

may be given as

$$\nu_{\rm pp} = \frac{e^4 n_{\rm p}\ln\Lambda}{10\pi^{3/2}\epsilon_0^2 m_{\rm p}^{1/2} k_B^{3/2} T_{\mathrm{p}\|}^{3/2}}\ {}_2F_1\left(\begin{array}{c}2, 3/2\\ 7/2\end{array}, 1-\frac{T_{\mathrm{p}\perp}}{T_{\mathrm{p}\|}}\right) \tag{1.2}$$

where ${}_2F_1$ is the standard (Gauss) hypergeometric function. In collisionless plasmas kinetic instabilities lead to effective transport coefficients. In the quasi-linear approximation it is possible to derive some of the transport coefficients (Yoon & Seough 2012; Hellinger *et al.* 2013) assuming the particle velocity distribution function is close to bi-Maxwellian.

The behavior of a driven system with Coulomb collisions and temperature anisotropy-driven instabilities is a complex nonlinear problem which is hard to investigate analytically so that a numerical approach is needed. In this paper we investigate expansion driven proton temperature anisotropies in high beta, weakly collisional plasmas. In high beta (collisionless) plasmas there are two dominant instabilities driven by the proton temperature anisotropy. For $T_{\mathrm{p}\perp} > T_{\mathrm{p}\|}$ it is the mirror instability (Hasegawa 1969). This instability is resonant (i.e., a substantial portion of the proton velocity distribution function resonates with the unstable waves (cf., Gary 1993)) through the Landau resonance. This kinetic feature is combined with fluid properties, the unstable waves are nonpropagating and have long wavelengths near threshold. The nonlinear properties of the mirror instability are not fully understood, as they seem to combine kinetic properties (the Landau resonance, particle scattering/trapping) and a fluid nonlinearity (Califano *et al.* 2008). For $T_{\mathrm{p}\perp} < T_{\mathrm{p}\|}$ the dominant growing mode is is the oblique fire hose instability (Hellinger & Matsumoto 2000). This instability is resonant through the cyclotron resonance and generates transient nonpropagating modes which eventually become propagating and damped (Hellinger & Trávníček 2008). Other instabilities (ion cyclotron, parallel fire hose, Weibel) may also play an important role in regulating the proton temperature anisotropy.

This paper is organized as follows: section describes the numerical code, section presents the simulation results for one simulation for the parallel proton temperature anisotropy $T_{\mathrm{p}\perp} < T_{\mathrm{p}\|}$ and one for the perpendicular anisotropy $T_{\mathrm{p}\perp} > T_{\mathrm{p}\|}$. The simulations results are summarized and discussed in section .

2. Expanding box model

Here we use the expanding box model (Grappin *et al.* 1993) implemented to the hybrid code developed by Matthews (1994) to study a response of a weakly collisional plasma to a slow expansion. In this Collisional Hybrid Expanding Box (CHEB) model the expansion is described as an external force. This model was developed in the context of the radial