Magnetic plasma are considered here for conditions where the electron temperature \( T_e \) varies in the direction perpendicular to an externally imposed homogeneous magnetic field \([6, 3]\). Such conditions are common in magnetic systems of plasma confinement. Here we have a cyclotron frequency smaller than the plasma frequency, i.e., \( \Omega_i < \Omega_c \). The relevant frequencies are assumed to be low so that the electron collisions can be taken to be in local Boltzmann equilibrium at all times. We assume quasi-neutrality, \( n_e = n_i \). For a linearized fluid model of the problem we readily derive a basic equation of the form

\[
\frac{\partial \psi}{\partial t} + u \frac{\partial \psi}{\partial z} = \frac{1}{\sqrt{\pi} \tau} \left[ \frac{\partial}{\partial z} \left( \frac{\partial \psi}{\partial z} \right) \right]
\]

where \( \psi \) is the potential, \( u \) the particle velocity, and \( \tau \) the collision time.

We can approximate the collision time \( \tau \) as being 

\[
\tau \approx \frac{\Omega_i}{\gamma_s} \approx \frac{\Omega_i}{\gamma_s} = \frac{\Omega_i}{\gamma_s}
\]

where \( \gamma_s \) is the ion Larmor radius.

In the limit we have \( \tau \rightarrow 0 \), and the dispersion relation reduces to \( \Delta \omega = 0 \) or \( \omega = \Omega_c \). This corresponds to the ion plasma wave with a frequency \( \Omega_c \).

The expressions \( \psi \) and \( \psi^* \) can be used to obtain normalized quantities by \( \psi \) and \( \psi^* \). Normalling frequencies and \( \tau \) we obtain

\[
\frac{\partial \psi}{\partial t} + u \frac{\partial \psi}{\partial z} = \frac{1}{\sqrt{\pi} \sqrt{\gamma_s} \tau} \left[ \frac{\partial}{\partial z} \left( \frac{\partial \psi}{\partial z} \right) \right]
\]

We now consider the limit where \( \Omega_i \rightarrow 0 \), and for \( \Omega_i < \Omega_c \), the latter containing also the ion cyclotron wave. The wave properties may be summarized as follows: The wave for low frequency \( \Omega_i < \Omega_c \) is approximately a group velocity and the wave vector. For very low frequency \( \Omega_i \approx \Omega_c \) for the \( \Omega_i < \Omega_c \), these two vectors are almost perpendicular, while they are close to parallel when \( \Omega_i > \Omega_c \). In the limit \( \gamma_s \rightarrow 0 \), the dispersion relation reduces to \( \Delta \omega = 0 \) or \( \omega = \Omega_c \). This corresponds to the ion plasma wave with a frequency \( \Omega_c \).

Our results are obtained for the case where \( \Omega_i < \Omega_c \). As mentioned above, we can approximate the collision time \( \tau \) as being 

\[
\tau \approx \frac{\Omega_i}{\gamma_s} \approx \frac{\Omega_i}{\gamma_s} = \frac{\Omega_i}{\gamma_s}
\]

where \( \gamma_s \) is the ion Larmor radius.

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\[
\frac{\partial \psi}{\partial t} + u \frac{\partial \psi}{\partial z} = \frac{1}{\sqrt{\pi} \sqrt{\gamma_s} \tau} \left[ \frac{\partial}{\partial z} \left( \frac{\partial \psi}{\partial z} \right) \right]
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We now consider the limit where \( \Omega_i \rightarrow 0 \), and for \( \Omega_i < \Omega_c \), the latter containing also the ion cyclotron wave. The wave properties may be summarized as follows: The wave for low frequency \( \Omega_i < \Omega_c \) is approximately a group velocity and the wave vector. For very low frequency \( \Omega_i \approx \Omega_c \) for the \( \Omega_i < \Omega_c \), these two vectors are almost perpendicular, while they are close to parallel when \( \Omega_i > \Omega_c \). In the limit \( \gamma_s \rightarrow 0 \), the dispersion relation reduces to \( \Delta \omega = 0 \) or \( \omega = \Omega_c \). This corresponds to the ion plasma wave with a frequency \( \Omega_c \).

In this limit all modes are confined to the striation, and \( \Omega_i < \Omega_c \). For high order \( \Omega_i < \Omega_c \) and \( \Omega_i > \Omega_c \) modes become radiating, and are no longer confined to the waveguide. We propose a phenomenological model equation Eq. (3) assuming 

\[
\dot{\psi} + u \dot{\psi} = \frac{1}{\sqrt{\pi} \sqrt{\gamma_s} \tau} \left[ \frac{\partial}{\partial z} \left( \frac{\partial \psi}{\partial z} \right) \right]
\]

where \( \dot{\psi} \) denotes convolution and \( \dot{\psi} \) is Heaviside's step function. The time scale \( \tau_c / \tau \approx 1 \) characterizes the time it takes for the wave to appear in the waveguide with a duration \( \Omega_c \). Physically we argue that, within the present model, the waveform will steepen until the shock width becomes close to its final value. At this point the harmonic frequencies will exceed \( \Omega_c \), begin to radiate, and their energy will be lost.