1 Møte

1.1 Conservation of entropy

Advective term:

$$(\partial_t s_1)_{adv} = -\left[v_y \partial_y s_1 + v_z \partial_z s_1 + v_z \partial_z s_0\right] \tag{1}$$

Viscous term:

$$(\partial_t s_1)_{vis} = \frac{\mu}{\rho_0 T_0}(\partial_z v_y + \partial_y v_z)^2 \tag{2}$$

Thermal term:

$$(\partial_t s_1)_{thermal} = \frac{1.866 \cdot 10^6}{\rho_0 T_0}\left[\partial_z(T_0)(\partial_y s_1 + \partial_z s_1) + T_0(\partial_y^2 s_1 + \partial_z^2 s_1)\right] \tag{3}$$

Magnetic field term:

$$(\partial_t s_1)_B = \frac{\eta}{\rho_0 T_0}\frac{1}{4\pi}\left[\partial_y B_z - \partial_z B_y\right]^2 \tag{4}$$

1.2 Conservation of momentum

Advective term:

$$\hat{\mathbf{j}} : (\partial_t v_y)_{adv} = -\left[v_y \partial_y v_y + v_z \partial_z v_y\right] \tag{5}$$

$$\hat{\mathbf{k}} : (\partial_t v_z)_{adv} = -\left[v_y \partial_y v_z + v_z \partial_z v_z\right] \tag{6}$$

Pressure term:

$$\hat{\mathbf{j}} : (\partial_t v_y)_p = -\frac{1}{\rho_0}\partial_y p_1 \tag{7}$$

$$\hat{\mathbf{k}} : (\partial_t v_z)_p = -\frac{1}{\rho_0}\partial_z p_1 \tag{8}$$

Gravitational term:

$$\hat{\mathbf{j}} : (\partial_t v_y)_g = 0 \tag{9}$$

$$\hat{\mathbf{k}} : (\partial_t v_z)_g = -\frac{\rho_1}{\rho_0}g \tag{10}$$

Viscous term:

$$\hat{\mathbf{j}} : (\partial_t v_y)_{vis} = \frac{\mu}{\rho_0}\left[\partial_z^2 v_y + \partial_y \partial_z v_z\right] \tag{11}$$

$$\hat{\mathbf{k}} : (\partial_t v_z)_{vis} = \frac{\mu}{\rho_0}\left[\partial_y^2 v_z + \partial_y \partial_z v_y\right] \tag{12}$$

Magnetic field term:

$$\hat{\mathbf{j}} : (\partial_t v_y)_B = \frac{1}{\rho_0}\frac{B_z}{4\pi}\left[\partial_z B_y - \partial_y B_z\right] \tag{13}$$

$$\hat{\mathbf{k}} : (\partial_t v_z)_B = \frac{1}{\rho_0}\frac{B_y}{4\pi}\left[\partial_y B_z - \partial_z B_y\right] \tag{14}$$

1.3 Elliptic equation

Advective term:

$$\begin{aligned}(\nabla^2 p_1)_{adv} = &- \rho_0[v_y\partial_y^2 v_y + v_z\partial_z^2 v_z + (\partial_y v_y)^2 + (\partial_z v_z)^2 \\ &+ 2\partial_y(v_z)\partial_z(v_y) + v_y\partial_y\partial_z v_z + v_z\partial_y\partial_z v_y] \\ &- \partial_z\left(\rho_0\right)\left[v_y\partial_y v_z + v_z\partial_z v_z\right]\end{aligned}$$

Viscous term:

$$(\nabla^2 p_1)_{vis} = 2\mu(\partial_y\partial_z^2 v_y + \partial_y^2\partial_z v_z) \tag{15}$$

Magnetic field term:

$$(\nabla^2 p_1)_B = -\frac{1}{4\pi}\left[(\partial_y B_z)^2 + (\partial_z B_y)^2 - 2\partial_y(B_z)\partial_z(B_y) + B_z(\partial_y^2 B_z - \partial_y\partial_z B_y) + B_y(\partial_z^2 B_y - \partial_y\partial_z B_z)\right] \tag{16}$$