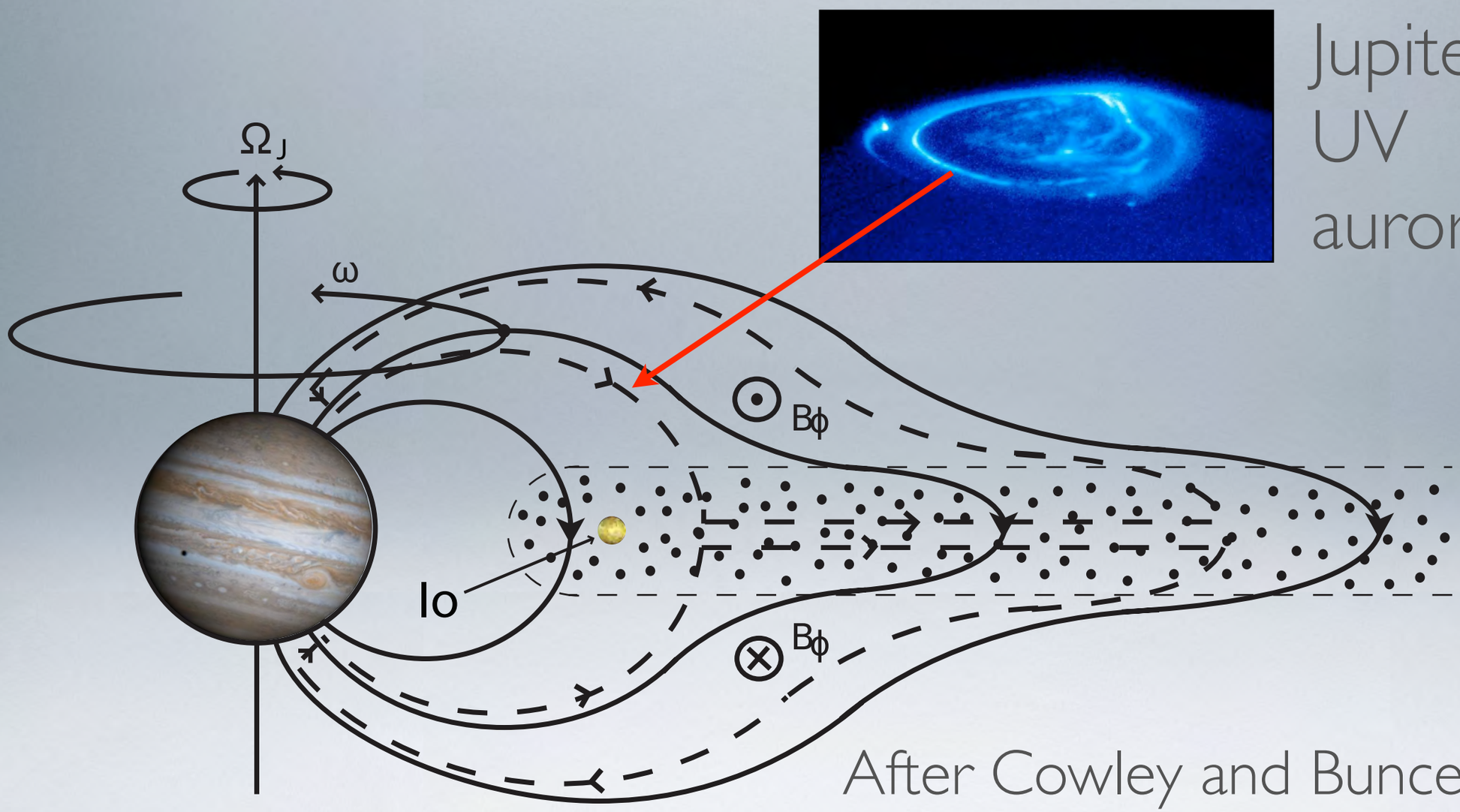
Some comments on M-I coupling



Jupiter's UV auroras

After Cowley and Bunce (2001)

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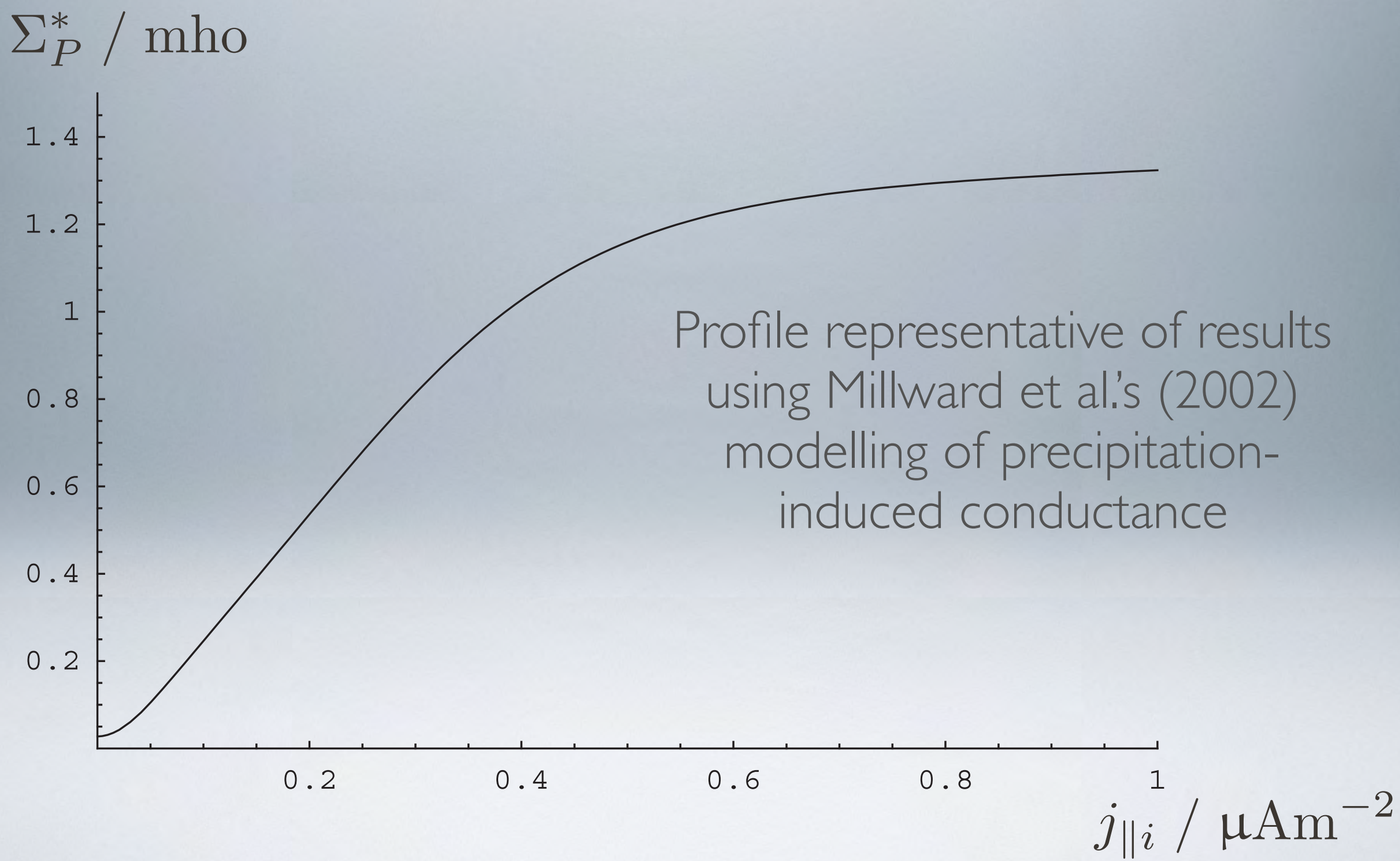
Pedersen conductance



Profile representative of results using Millward et al.'s (2002) modelling of precipitation-induced conductance

Nichols and Cowley (2004)

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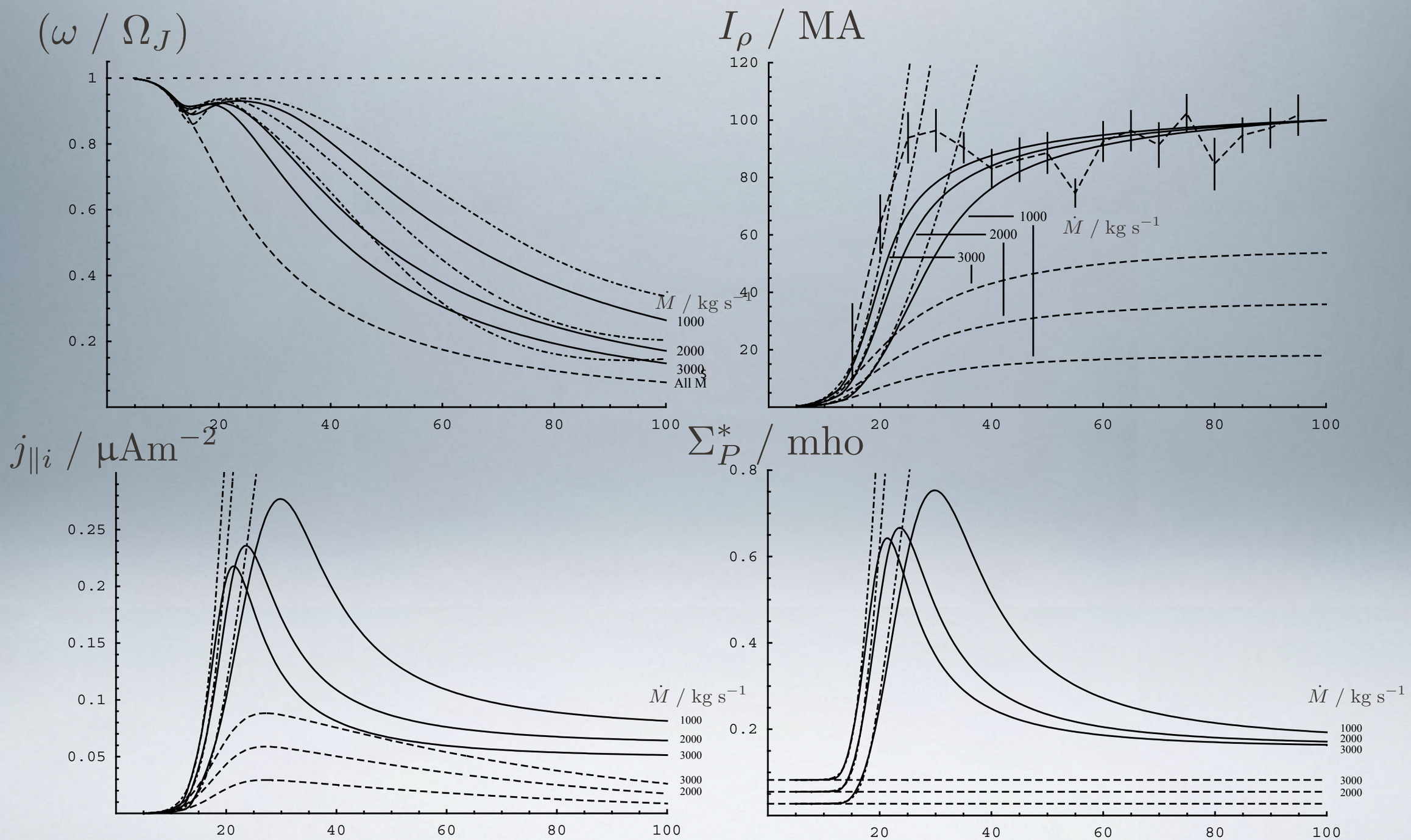
Pedersen conductance



Nichols and Cowley (2004)

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Magnetodisc/M-I coupling

$$\rho_m \frac{\mathrm{d}\mathbf{v}}{\mathrm{d}t} = \mathbf{j} \times \mathbf{B} - \mathrm{div}\mathsf{p}$$

Momentum equation

Azimuthal current:

$$\mathbf{j}_\perp = \frac{\hat{\mathbf{b}}}{B} \times \left[\rho_m \frac{\mathrm{d}\mathbf{v}}{\mathrm{d}t} + \nabla p_\perp + (p_\parallel - p_\perp)(\hat{\mathbf{b}}.\nabla)\hat{\mathbf{b}} \right]$$

Centrifugal force

Plasma pressure gradient

Pressure anisotropy

Nichols (2011), Nichols et al. (2016)

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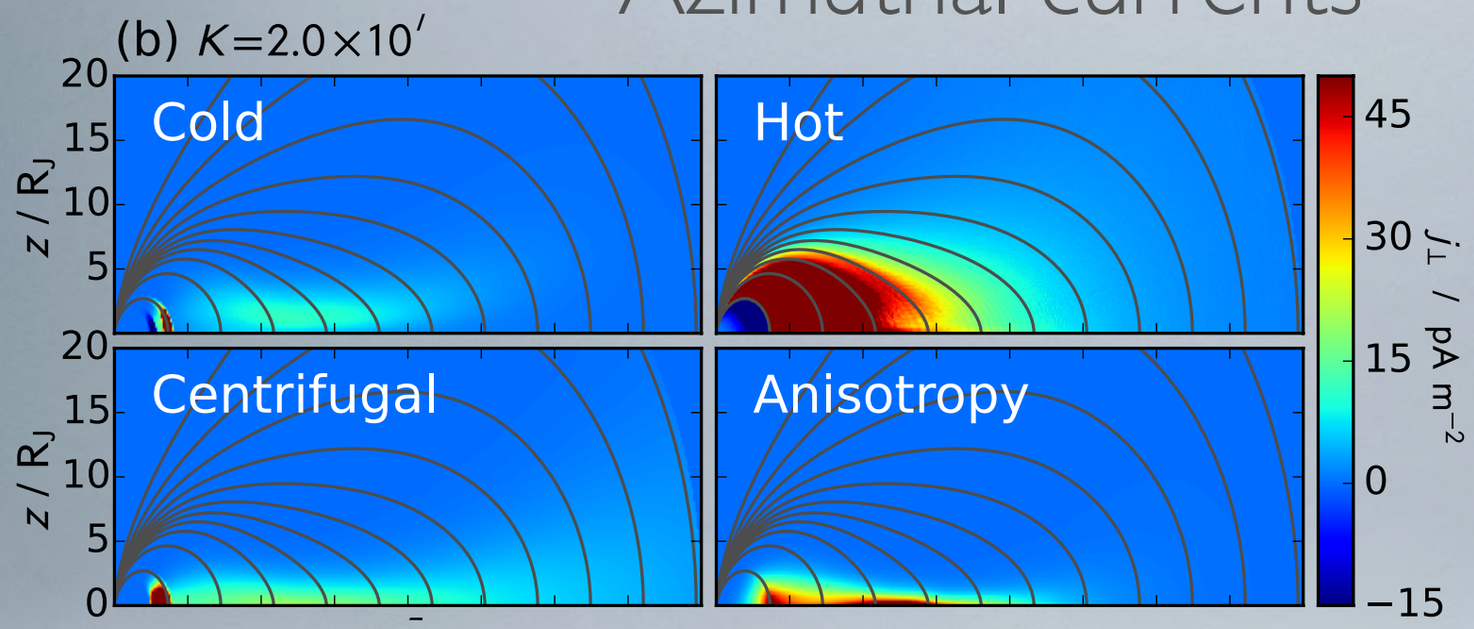
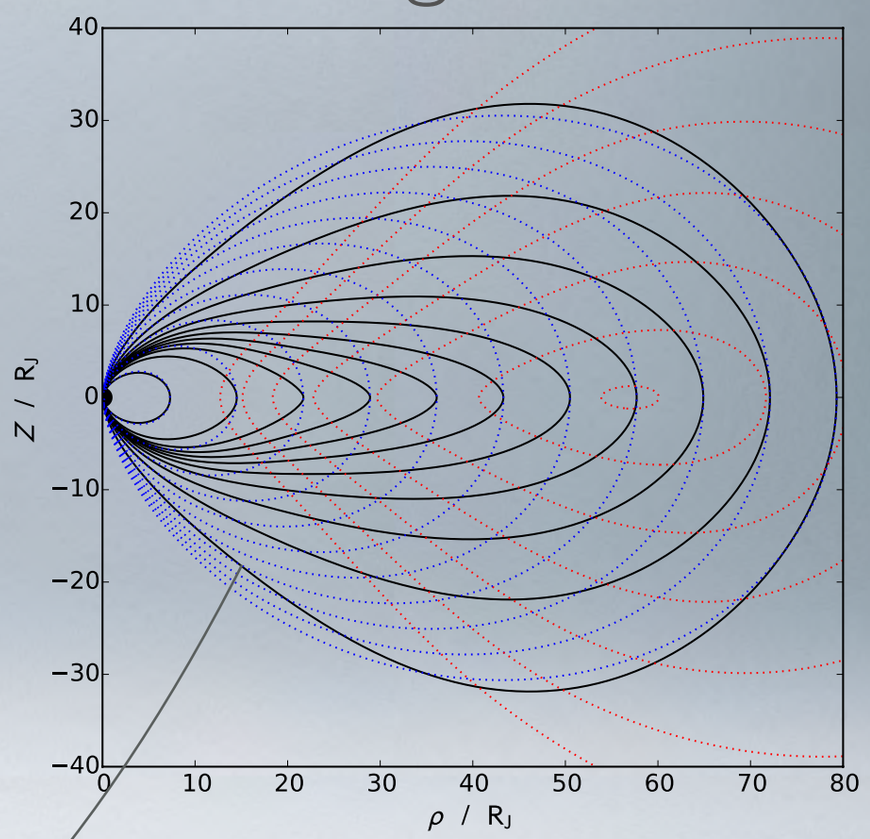
Magnetodisc/M-I coupling

Azimuthal currents



Magnetic field



$\Sigma_P^* = 0.1$ mho, $\dot{M} = 1000$ kg s^{-1}

B Field vector potential

$$\nabla^2 \mathbf{A} = -\mu_0 \mathbf{j} \quad \Rightarrow \quad \boxed{\mathbf{A}(\mathbf{r}) = \int_V \frac{\mu_0}{4\pi} \frac{\mathbf{j}(\mathbf{r}')\mathrm{d}\tau'}{|\mathbf{r}-\mathbf{r}'|}}$$

Nichols (2011), Nichols et al. (2016)

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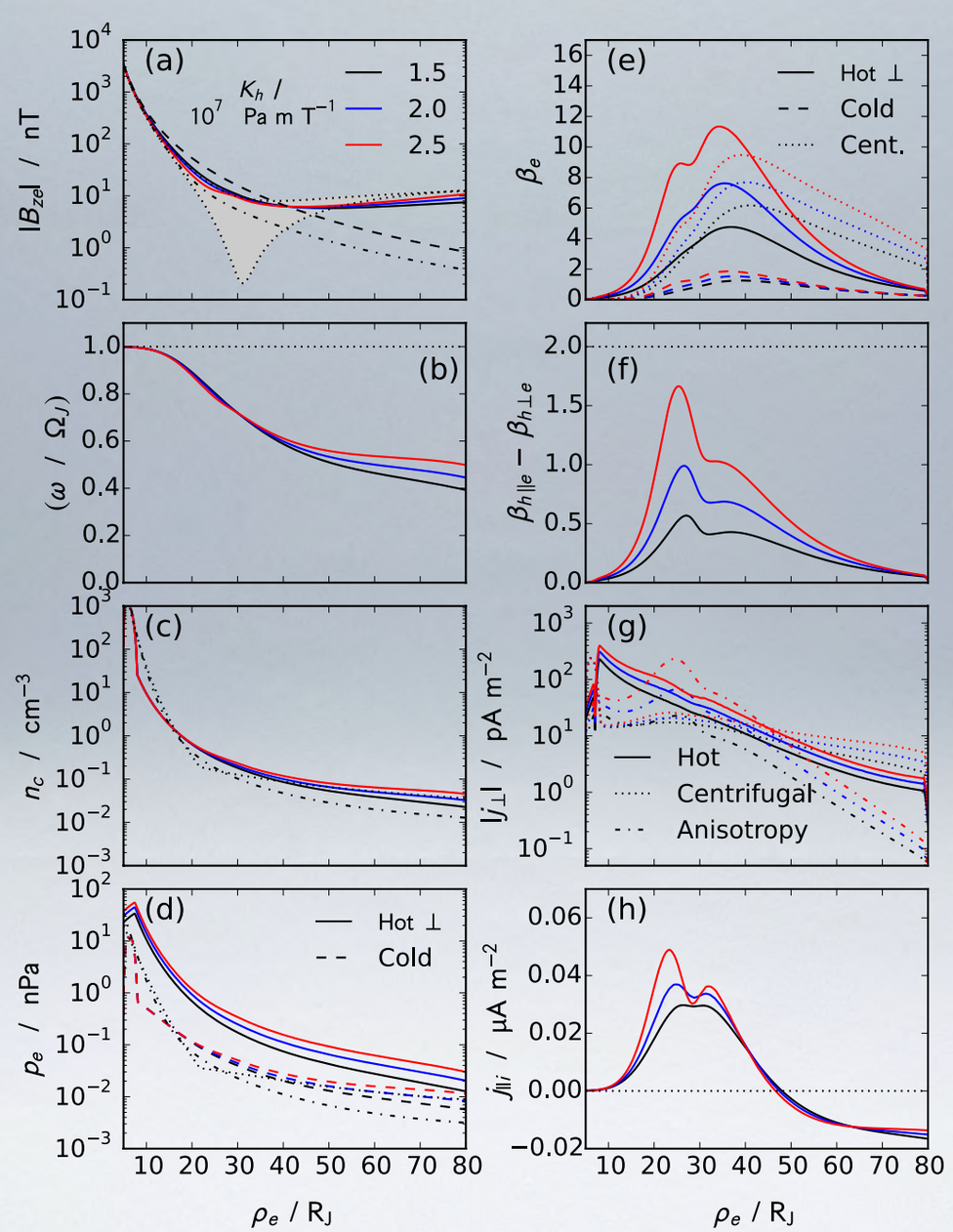
Magnetodisc/M-I coupling

Equatorial B field magnitude

Plasma angular velocity

Cold plasma number density

Plasma pressure



Plasma beta

Firehose parameter

Equatorial azimuthal current density

Field-aligned current density

Nichols (2011), Nichols et al. (2016)

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