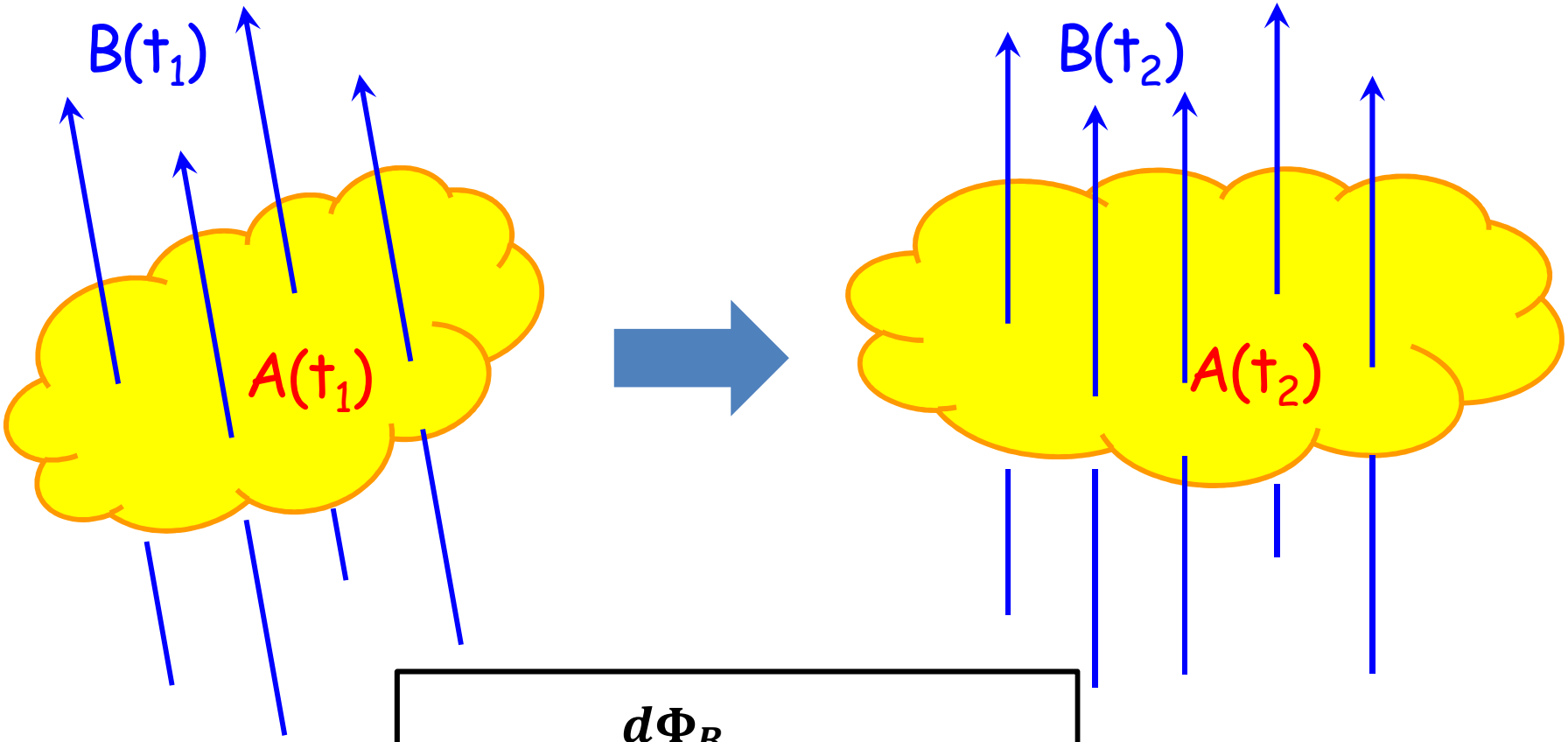
Frozen-in



$$\frac{d\Phi_B}{dt} = 0$$

$$\vec{B}(t_1) \cdot \vec{A}(t_1) = \vec{B}(t_2) \cdot \vec{A}(t_2)$$

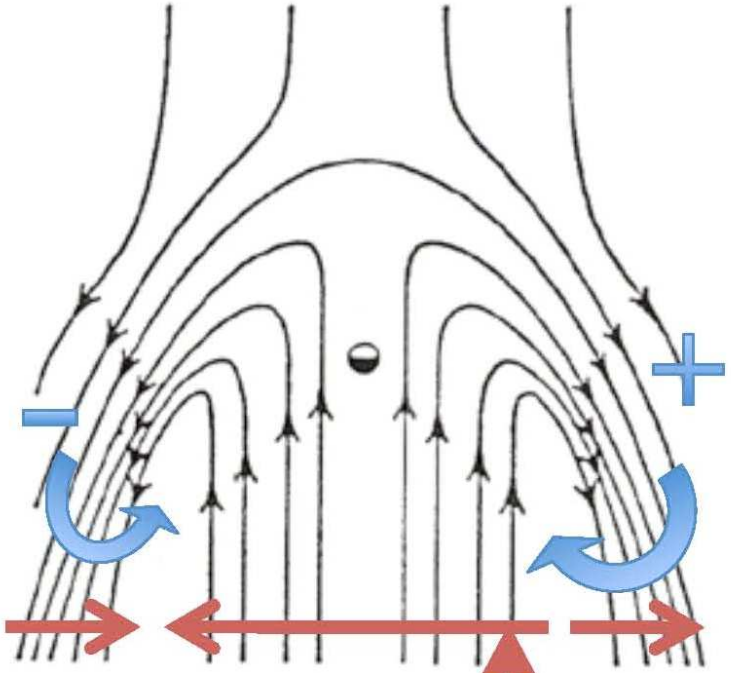
In MHD (magnetohydrodynamic), if the plasma has infinite electric conductivity, the magnetic flux through any closed contour moving with the plasma fluid is constant. → Magnetic flux is frozen-in the plasma.

地球磁層赤道剖面圖（圖中標有箭頭的線，是流線）

太陽風吹過地球磁層

如果地球不自轉····

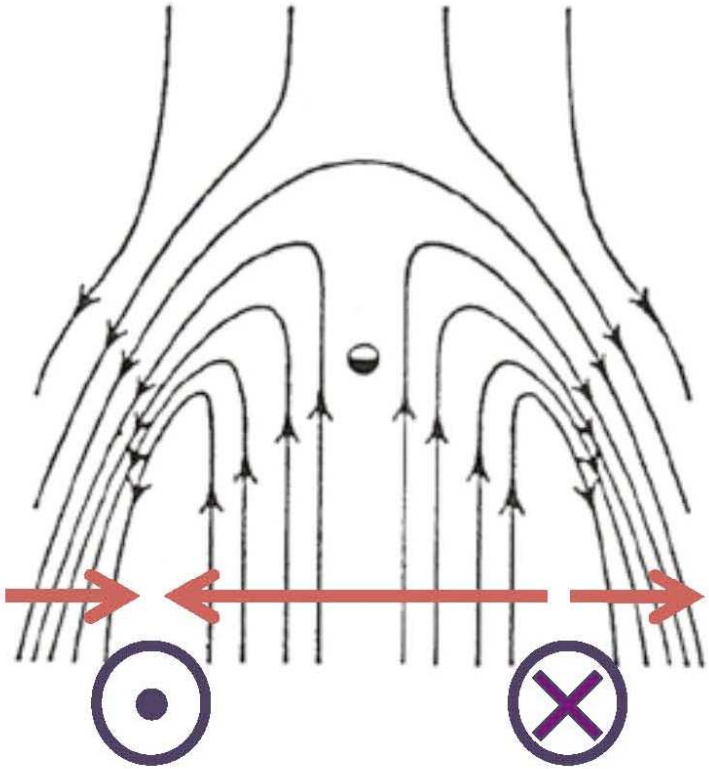
B



晨昏電場

形成磁尾
電漿片與
南北磁尾腔

$$\nabla \cdot \mathbf{E}_\perp = \nabla \cdot (-\mathbf{V} \times \mathbf{B})$$
$$= -\mathbf{B} \cdot (\nabla \times \mathbf{V}) + \mathbf{V} \cdot (\nabla \times \mathbf{B})$$
$$= -\mathbf{B} \cdot \Omega + \mathbf{V} \cdot \mathbf{J} / \mu_0$$
$$\approx -\mathbf{B} \cdot \Omega$$



Ω

$-\mathbf{B} \cdot \Omega < 0$

$\nabla \cdot \mathbf{E}_\perp < 0$

$\Omega = \nabla \times \mathbf{V}$

$-\mathbf{B} \cdot \Omega > 0$

$\nabla \cdot \mathbf{E}_\perp > 0$

http://www.ss.ncu.edu.tw/~lyu/lecture_files_en/index.html