B2
Symmetry and Relativity
Lecture 20

Magnetic monopoles?

$$\nabla \cdot \mathbf{E} = \frac{\rho_e}{\varepsilon_0}$$

$$\nabla \cdot \mathbf{B} = \mu_0 \rho_m$$

$$\nabla \wedge \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t} - \mu_0 \mathbf{j}_m$$

$$\nabla \wedge \mathbf{B} = \mu_0 \varepsilon_0 \frac{\partial \mathbf{E}}{\partial t} + \mu_0 \mathbf{j}_e$$

Magnetic monopoles?

$$\begin{pmatrix} \rho'_e \\ \rho'_m \end{pmatrix} = \begin{pmatrix} \cos\xi & -\sin\xi \\ \sin\xi & \cos\xi \end{pmatrix} \begin{pmatrix} \rho_e \\ \rho_m \end{pmatrix}$$

$$\begin{pmatrix} \mathbf{J}'_e \\ \mathbf{J}'_m \end{pmatrix} = \begin{pmatrix} \cos\xi & -\sin\xi \\ \sin\xi & \cos\xi \end{pmatrix} \begin{pmatrix} \mathbf{J}_e \\ \mathbf{J}_m \end{pmatrix}$$

$$\begin{pmatrix} \mathbf{E}' \\ \mathbf{B}' \end{pmatrix} = \begin{pmatrix} \cos\xi & -\sin\xi \\ \sin\xi & \cos\xi \end{pmatrix} \begin{pmatrix} \mathbf{E} \\ \mathbf{B} \end{pmatrix}$$

- Duality transform:
  not observable if all particles have same magnetic/electric charge ratio

Charge quantization

- Dirac:
  end of infinite, unobservable dipole string

$$\frac{ge}{\hbar c} = \frac{n}{2}, \;\; n = 0, \pm 1, \pm 2, ...$$

$$\frac{g^2}{\hbar c} \approx \frac{137}{4} n^2$$

Magnetic monopoles?

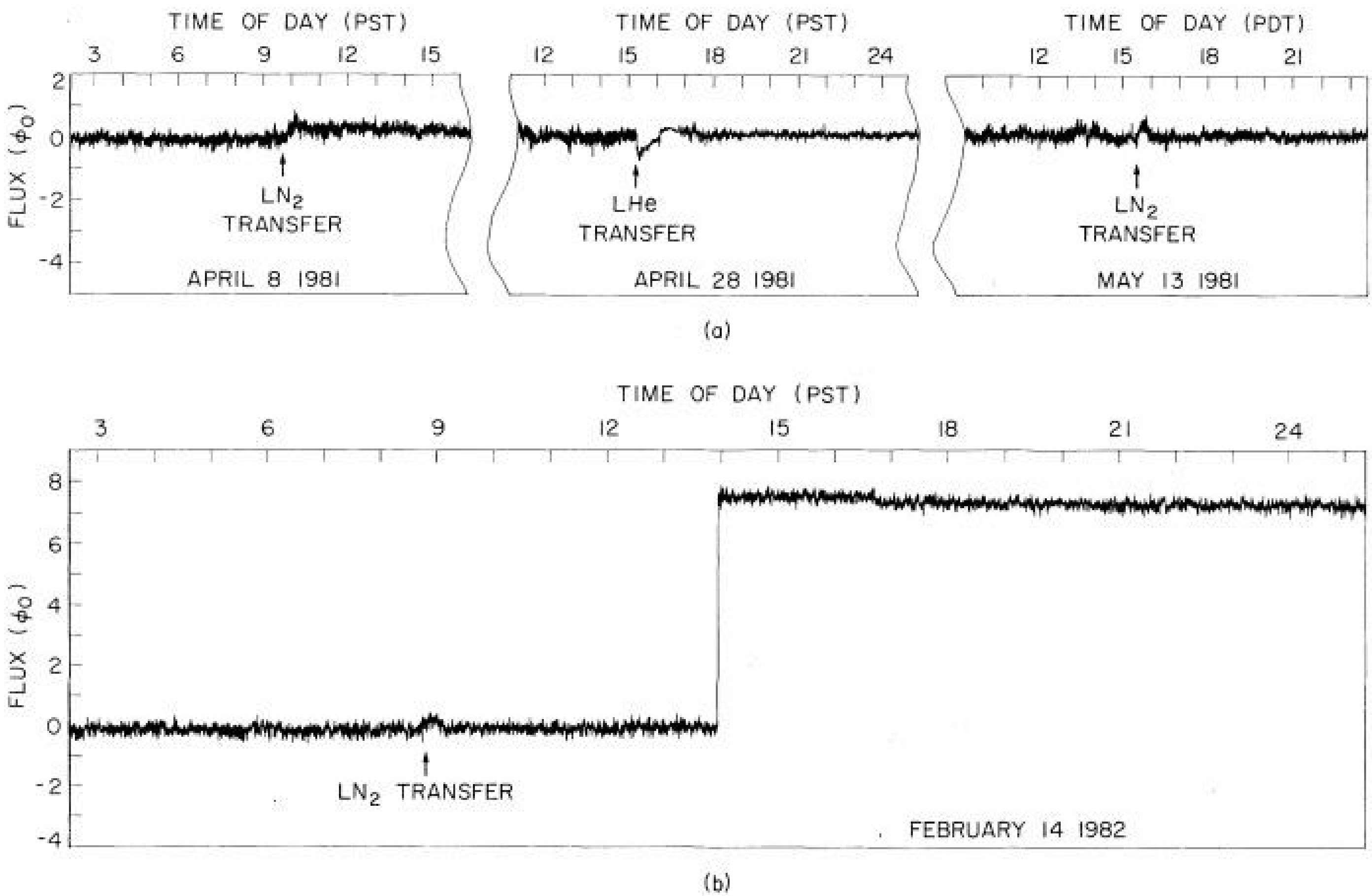

FIG. 2. Data records showing (a) typical stability and (b) the candidate monopole event.

B Cabrera, Phys Rev Lett 48, 1378 (1982)