Pre-Quantum Theories

Mukund V, Rishi Kumar, Pugazharasu A D

July 24,2020

Newtonian Mechanics

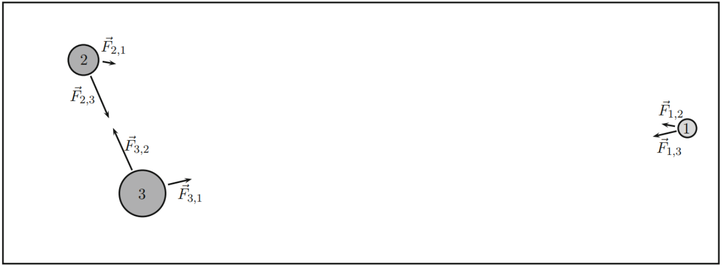
$$\vec{F}_{i,j} = \frac{Gm_i m_j}{r_{ij}^2}\hat{r}_{ij} \tag{1}$$

$$\vec{F}_i^{net} = \sum_{i \neq j} \vec{F}_{i,j} \tag{2}$$

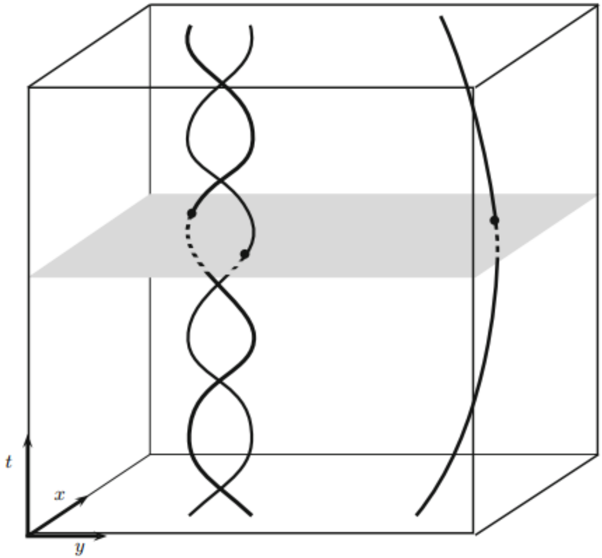
$$\vec{F}_i^{net} = m_i \vec{a}_i \tag{3}$$

$$\vec{F}_{i,j} = -\vec{F}_{j,i} \tag{4}$$

Newtonian Mechanics



Newtonian Mechanics



Maxwellian Dynamics

$$\vec{\nabla}.\vec{E} = \frac{\rho}{\epsilon_0} \tag{5}$$

$$\vec{\nabla}.\vec{B} = 0 \tag{6}$$

$$\vec{\nabla} \times \vec{B} = \mu_0 \vec{j} + \epsilon_0 \mu_0 \frac{\partial \vec{E}}{\partial t} \tag{7}$$

$$\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t} \tag{8}$$

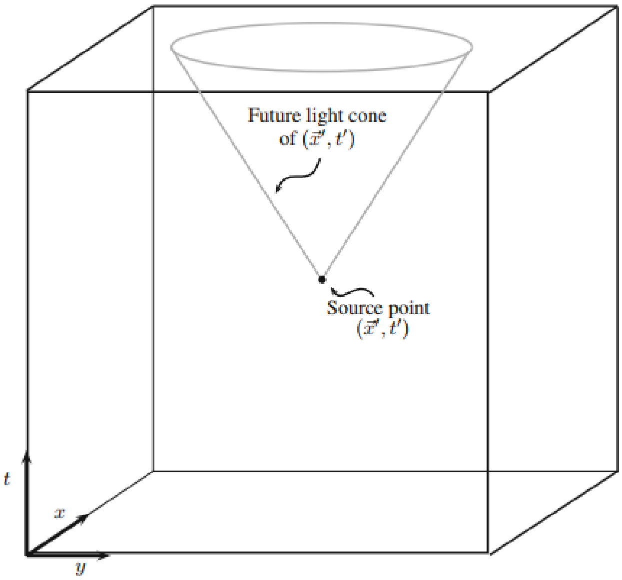
$$\vec{F} = q\vec{E} + q\vec{v} \times \vec{B} \tag{9}$$

Locality

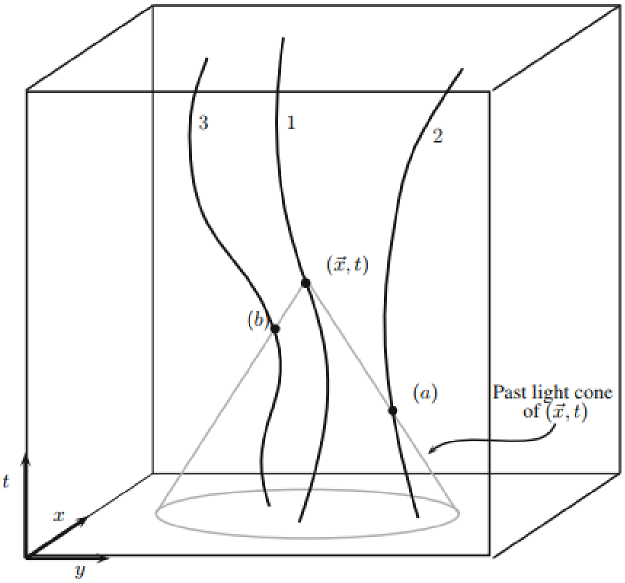
$$\nabla^2 \phi(\vec{x}, t) - \frac{1}{c^2} \frac{\partial^2 \phi(\vec{x}, t)}{\partial t^2} = f(\vec{x}, t) \tag{10}$$

$$c = \frac{1}{\sqrt{\epsilon_0 \mu_0}} \tag{11}$$

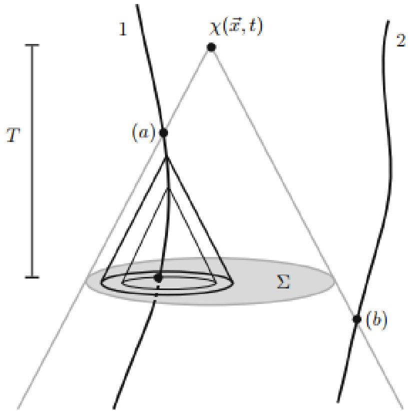
Locality



Locality

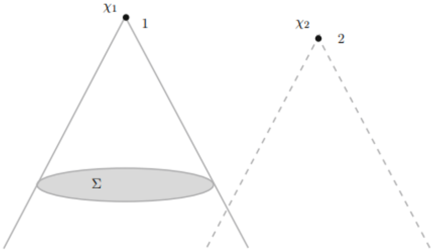


Bell's Reformulation of Locality



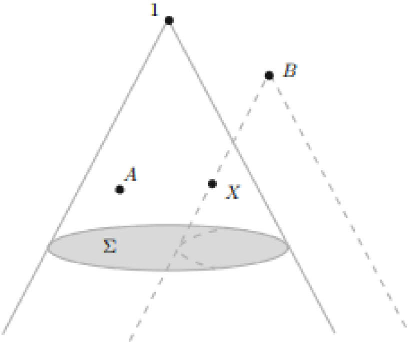
$$\chi(\vec{x}, t) = f(\mathcal{C}_\Sigma) \tag{12}$$

Bell's Reformulation of Locality



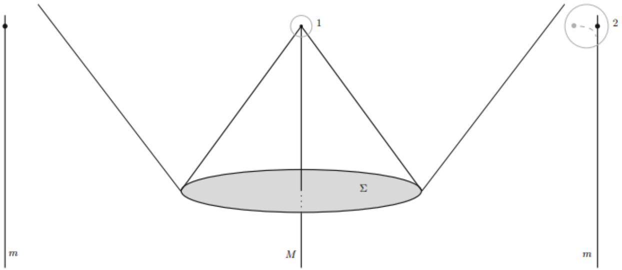
$$P[\chi_1|\mathcal{C}_\Sigma] = P[\chi_1|\mathcal{C}_\Sigma, \chi_2] \tag{13}$$

Bell's Reformulation of Locality



$$P[\chi_1|\mathcal{C}_\Sigma, \chi_2^{'}] = P[\chi_1|\mathcal{C}_\Sigma, \chi_2] \quad (14)$$

Bell's Reformulation of Locality



Ontology

$$\vec{B} = \vec{\nabla} \times \vec{A} \tag{15}$$

$$\vec{\nabla} \times (\vec{E} + \frac{\partial \vec{A}}{\partial t}) \tag{16}$$

$$\vec{E} + \frac{\partial \vec{A}}{\partial t} = -\vec{\nabla}\phi \tag{17}$$

$$\nabla^2\phi + \frac{\partial}{\partial t}(\vec{\nabla}.\vec{A}) = -\frac{\rho}{\epsilon_0} \tag{18}$$

$$\nabla^2\vec{A} - \frac{1}{c^2}\frac{\partial^2\vec{A}}{\partial t^2} = -\mu_0\vec{j} + \vec{\nabla}\left(\vec{\nabla}.\vec{A} + \frac{1}{c^2} + \frac{\partial\phi}{\partial t}\right) \tag{19}$$

$$\vec{A} \to \vec{A} + \vec{\nabla}\lambda \tag{20}$$

Ontology

$$\phi \to \phi - \frac{\partial \lambda}{\partial t} \tag{21}$$

$$\vec{\nabla}.\vec{A} + \frac{1}{c^2}\frac{\partial \phi}{\partial t} = 0 \tag{22}$$

$$\nabla^2 \phi - \frac{1}{c^2}\frac{\partial^2 \phi}{\partial t^2} = -\frac{\rho}{\epsilon_0} \tag{23}$$

$$\nabla^2 \vec{A} - \frac{1}{c^2}\frac{\partial^2 \vec{A}}{\partial t^2} = -\mu_0 \vec{j} \tag{24}$$

$$\vec{\nabla}.\vec{A} = 0 \tag{25}$$

Ontology

$$\nabla^2 \vec{A} - \frac{1}{c^2}\frac{\partial^2 \vec{A}}{\partial t^2} = -\mu_0 \vec{j} + \frac{1}{c^2}\vec{\nabla}\frac{\partial \phi}{\partial t} \tag{26}$$

$$\nabla^2 \phi = -\frac{\rho}{\epsilon_0} \tag{27}$$

$$\frac{1}{c^2}\frac{\partial^2 \vec{E}}{\partial t^2} - \nabla^2 \vec{E} = 0 \tag{28}$$

$$\frac{1}{c^2}\frac{\partial^2 \vec{B}}{\partial t^2} - \nabla^2 \vec{B} = 0 \tag{29}$$

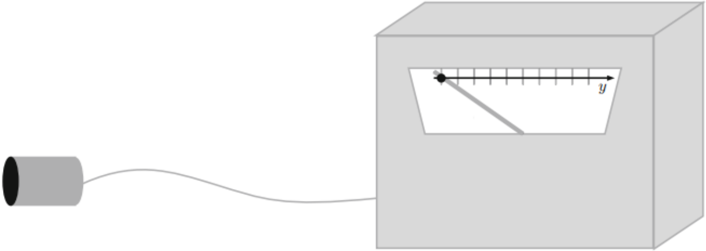
$$-\nabla^2 \phi = 0 \tag{30}$$

Measurement

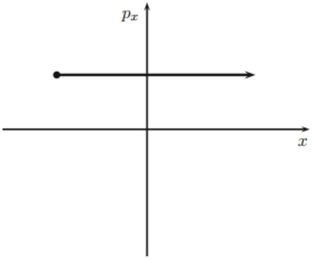
$$\vec{E} = \frac{m}{q}\vec{a} \tag{31}$$

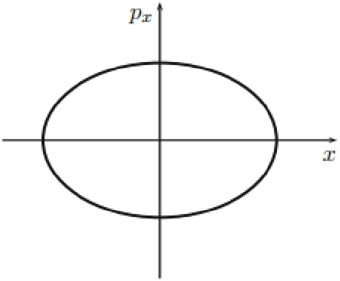
$$\vec{a} = \frac{2\Delta\vec{x}}{\Delta t^2} \tag{32}$$

Measurement

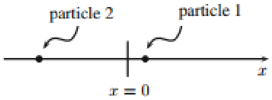


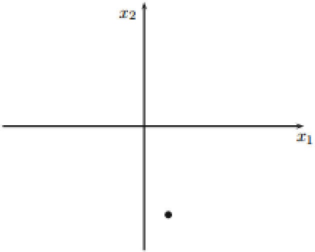
Abstract Spaces



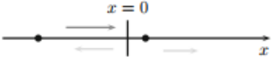


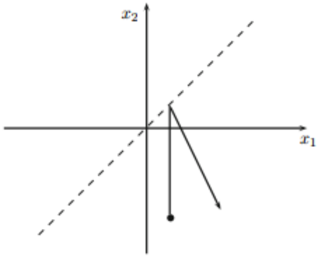
Abstract Spaces





Abstract Spaces





Reflection

Thank You

Bibliography and Image Credits

Foundations of Quantum Mechanics
Travis Norsen
springer