Chapter 1 Methodology

1.1 Introduction

Today is 20211211, and I deciede to note down all of my knowledge about physics in this notebook. Actually we think for a while whether to seperatre the knowledge into different documents.

1.2 Preference

1.2.1 Volabulary

orthogonal matrix, 正交矩阵

1.3 History

1.4 观点

1.4.1 Videos

牛顿经典力学，场论定域论，最小作用量原理，都可以解释从 A 到 B 的路径，是等效的。So I made the hypothesis often that the laws are going to turn out to be, in the end, simple like the checkerboard, and that all the complexity is from size.

If you will not say that it is true in a region that you have not looked at, you do not know anything.

We always must make statements about the regions that we have not seen.

The mass of an object changes when it moves.

1.4.2 需要再确认的观点

行星和卫星公转轨道为什么是椭圆？

一个焦点位于原点的圆锥曲线 $\frac{1}{r} = C\left[1 + e\cos(\theta - \theta')\right]$ $f = -\frac{k}{r^2}$， $V = -\frac{k}{r}$ 只考虑 2 体，角动量守恒求出轨道方程，角动量 l 与 E 看做常数，

$$\frac{1}{r} = \frac{mk}{l^2}\left(1 + \sqrt{1 + \frac{2El^2}{mk^2}}\cos(\theta - \theta')\right)$$

离心率 e<1 椭圆，等于 1 是抛物线，大于 1 是双曲线。$e = \sqrt{1 + \frac{2El^2}{mk^2}}$

Chapter 2 Mechanics

2.1 Classical Mechanics

2.1.1 Center of Mass

Algebra defination $\boldsymbol{r}_c := \frac{\sum m_i \boldsymbol{r}_i}{\sum m_i}$, it relays to the choice of the coordinate system. If the map of the two coordinate systems is $T : S \to S'$, the matrix is orthogonal matrix, and m_i has no inflence to the space, $\boldsymbol{r}'_c = T\boldsymbol{r}_c$.

The operator $\boldsymbol{r}_c$ simplifies the calculation, $(\sum m_i)\boldsymbol{r}_c = \sum m_i \boldsymbol{r}_i$. We define the energy of the system like this, the whole energy $E_{all} := \sum \frac{1}{2} m_i \boldsymbol{v}_i^2$, the explicit energy $E_{ext} = \frac{1}{2}(\sum m_i)\boldsymbol{v}_c^2$, the intrenal energy $E_{int} := \sum \frac{1}{2} m_i (\boldsymbol{v}_i - \boldsymbol{v}_c)^2$, because $\sum m_i \boldsymbol{v}_c^2 - 2\sum m_i \boldsymbol{v}_i \boldsymbol{v}_c = -\boldsymbol{v}_c^2 \sum m_i$, we have $E_{int} = E_{all} - E_{ext}$.

2.1.2 Momentum

$\sum m_i \ddot{\boldsymbol{r}}_i = \sum(\boldsymbol{F}_i + \sum \delta_{ij} \boldsymbol{f}_{i\leftarrow j}) = \sum \boldsymbol{F}_i$. We define momentum $\sum \boldsymbol{P}_i = \sum m_i \dot{\boldsymbol{r}}_i$, therefore, $\frac{d}{dt}\sum \boldsymbol{P}_i = \sum \boldsymbol{F}_i$. [So the speed of light is always a const number, means that no other force can be applied to light?]

$\int \frac{d\boldsymbol{p}}{dt} = \boldsymbol{F}$, so $\int d\boldsymbol{p} = \int \boldsymbol{F} dt$.

2.1.3 Rigid Body

A rigid body changes from one position and orientation to another, the general movement can be represented as $\boldsymbol{v} = \boldsymbol{\omega} \times \boldsymbol{r}$.

Proposition 2.1 (One fixed rotation axis). *Proof that the transformation of a rigid body has one fixed rotation axis.*

As shown in the figure, supposed that point A and B are on a sphere, and are transformed to A' and B', and two perpendicular bisector lines meets at point N, the point N can be transformed to N', because that $\triangle ABN \cong \triangle A'B'N'$, and moving on the orientable surface the triangular *cannot transfered from $\triangle ABC$ into $\triangle ACB$, we say $N = N'$, the line ON is the axis that doesn't move during the transformation.*

The basis of the coordinate system $\boldsymbol{Z}^T := [e_1, e_2, e_3]$, represented as one line and three columns. The transformation of the basis $\boldsymbol{Z}' = \boldsymbol{Z}\boldsymbol{\Gamma}$, $\boldsymbol{Z}\boldsymbol{\Gamma}\boldsymbol{r}' = \boldsymbol{Z}\boldsymbol{r}$, so $\boldsymbol{r}' = \boldsymbol{\Gamma}^{-1}\boldsymbol{r}$, $\boldsymbol{\Gamma}\boldsymbol{\Gamma}^{-1} = \boldsymbol{I}$ is easy to say when we write left in detail and considering that the $\boldsymbol{\Gamma}$ is the unit orthogonal base. Then the $\boldsymbol{\Gamma} \in SO_3$.

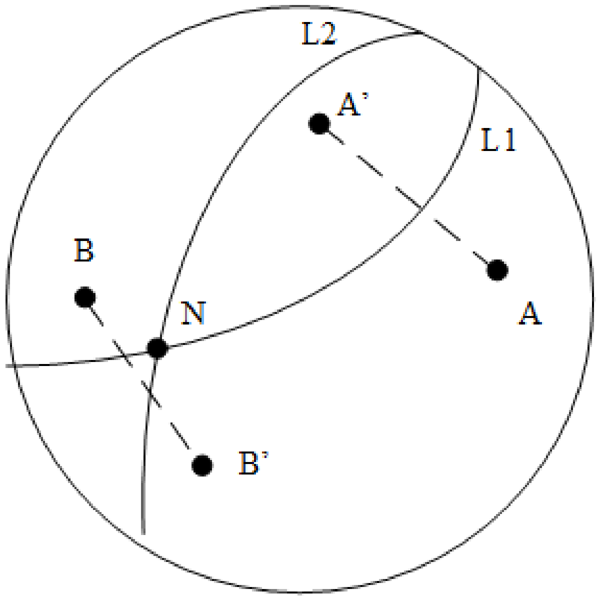

Figure 2.1: [T0004:ProvehasOneAxis]

The eigen value of $\boldsymbol{\Gamma}$, $|\boldsymbol{\Gamma} - \boldsymbol{\lambda I}| = \boldsymbol{0}$, so $-x^3 + \alpha x^2 + \beta x + 1 = 0$, since the image of the function is continuous through $(-\infty, +\infty)$, it must have one root. 1 is one of the root. If the three roots are all real, they are all 1, or 1,-1,-1. If the rest two roots are virtual, they are $e^{i\theta}, e^{-i\theta}$, so $T\phi = e^{i\theta}\phi$.

$$
\begin{aligned}
&\Gamma(\phi_1 + i\phi_2) = e^{i\theta}(\phi_1 + i\phi_2), \\
&\Gamma(\phi_1 - i\phi_2) = e^{-i\theta}(\phi_1 - i\phi_2) \\
&therefore: \\
&\Gamma(\phi_1) = \cos(\theta)\phi_1 - \sin(\theta)\phi_2, \\
&\Gamma(\phi_2) = \sin(\theta)\phi_1 + \cos(\theta)\phi_2
\end{aligned}
\tag{2.1}
$$

θ is the rotation angle.

2.1.4 Anglar Momentum

$\boldsymbol{L}_i := \boldsymbol{r}_i \times \boldsymbol{p}_i$, with the defination of $\boldsymbol{p}$, we have $\sum \boldsymbol{L}_i = \sum m_i \boldsymbol{r}_i \times \boldsymbol{v}_i$, and $\sum \boldsymbol{L}_i = \sum \boldsymbol{r}_i \times \boldsymbol{F}_i + \sum \boldsymbol{r}_i \times \sum_j \boldsymbol{f}_{i \leftarrow j}$. Since $\sum (\boldsymbol{r}_i - \boldsymbol{r}_j) \times \boldsymbol{f}_{i \leftarrow j} = 0$, we have $\sum \boldsymbol{L}_i = \sum \boldsymbol{r}_i \times \boldsymbol{F}_i$. We also call that Torque.

2.2 Reference

2.2.1 Todo

2.2.2 Tmeplate

Tmeplate

Theorem 2.1 (均值不等式)**.** *设 A, B 是两个实数, 则 $2AB \leq 2A^2 + B^2$.*

均值不等式. 设 A, B 是两个实数, 则 $2AB \leq 2A^2 + B^2$.

$\square$

The free fall ball ends at $[1 - |(\mu k)^{-1} \pmod 2) - 1|]kH$

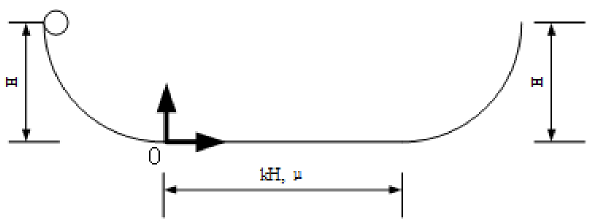

Figure 2.2: [T0001:]

Chapter 3 Electromagnetics

The energy is flowing through the space around the conductor.

Chapter 4 Quantum