

# 计算物理作业 7

杨远青 22300190015



2024 年 11 月 8 日

在尝试抵御 *GPT* 的诱惑!

## 1 题目 1: 单摆运动积分

### 1.1 题目描述

Write a code to numerically solves the motion of a simple pendulum using **Euler's method**, **midpoint method**, **RK4 method** and **Euler-trapezoidal method** (implement these methods by yourself). Plot the angle and total energy as a function of time. Explain the results.

### 1.2 程序描述

### 1.3 伪代码

Powered by [L<sup>A</sup>T<sub>E</sub>X pseudocode generator](#)

### 1.4 结果示例

## 2 题目 2: 径向薛定谔方程求解

### 2.1 题目描述

Write a code to numerically solve the radial Schrödinger equation for

$$\left[ -\frac{1}{2} \nabla^2 + V(r) \right] \psi(r) = E \psi(r) \quad V(r) = V(r)$$

(1)  $V(r) = -\frac{1}{r}$  (hydrogen atom) (2)  $V_{\text{loc}}(r) = -\frac{Z_{\text{ion}}}{r} \text{erf}\left(\frac{r}{\sqrt{2}r_{\text{loc}}}\right) + \exp\left(-\frac{1}{2}\left(\frac{r}{r_{\text{loc}}}\right)^2\right)$

$$\times \left[ C_1 + C_2 \left( \frac{r}{r_{\text{loc}}} \right)^2 + C_3 \left( \frac{r}{r_{\text{loc}}} \right)^4 + C_4 \left( \frac{r}{r_{\text{loc}}} \right)^6 \right]$$

**Parameters:**

- Li:  $r_{\text{loc}} = 0.400000$
- $C_1 = -14.0093922$

- $C_2 = 9.5099073$
- $C_3 = -1.7532723$
- $C_4 = 0.0834586$
- $Z_{\text{ion}} = 3$

Compute and plot the first three eigenstates. Ref: [Phys. Rev. B 47, 4174 \(1993\)](#)

## 2.2 程序描述

## 2.3 伪代码

Powered by [L<sup>A</sup>T<sub>E</sub>X pseudocode generator](#)

## 2.4 结果示例