SQuIDS: A Tool to Solve Time Evolution in finite dimensional (open) Quantum Systems

An Application to Neutrino Oscillations

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Introduction

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Clone the Repo!

Git Repository inlcuding all needed files:

Instructions

cd to the location where to place the repo

```
git clone git@github:path/to/repo.git
cd repo
```

Prerequisites

What do we need for this tutorial?

- A unix-like (sub-)system
  - Linux
  - Mac (+ Xcode developer tools!)
  - On Windows: WSL
- A C++ compiler
- Make, wget, Git

Use scripts `install_gsl.sh` and `install_SQuIDS.sh` from the repo!

Const class exercise

1. Declare a default constructed const class object
2. Answer the following questions:
   - 2.1 How many eV^{-1} correspond to $300\,\mathrm{km}$
   - 2.2 How many radians correspond to $25°$
   - 2.3 If you are 24 years old, how many eV^{-1} are you old?
3. Set the mixing parameters for three neutrino generations to:
   - $\theta_{12} = 33.48°$
   - $\theta_{13} = 8.55°$
   - $\theta_{23} = 42.3°$
4. Set the energy differences to:
   - $\Delta m^2_{21} = 7.5 \cdot 10^{-5}\,\mathrm{eV}^2$
   - $\Delta m^2_{31} = 2.45 \cdot 10^{-3}\,\mathrm{eV}^2$

SU vector exercise

1. Declare an empty SU vector corresponding to a 3D Hilbert space
2. Initialize an array of projectors for the three mass eigenstates (B_0)
3. Rotate them to the flavor basis (B_1)
4. Initialize a SU vector corresponding to the matrix (B_0)

$$\Delta\mathbb{M}^2 := \begin{pmatrix} 0 & 0 & 0 \\ 0 & \Delta m^2_{21} & 0 \\ 0 & 0 & m^2_{31} \end{pmatrix} \tag{1}$$

SQuIDS application: Neutrino oscillations in vacuum

Exercises

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