

# Project for the final oral examination of PHY981

## Studies $\beta$ decay of ${}^6\text{He}$

The aim of this project is to perform shell-model calculations of the nuclei  ${}^6\text{He}$  and  ${}^6\text{Li}$ , studying the low-lying excited states and performing  $\beta$ -decay studies using Alex Brown's shell-model program NushellX.

The explicit task is thus to

1. Give a survey of  $\beta$ -decay experiments performed in this mass region. Motivate the importance of studies of  $\beta$ -decay in this mass region.
2. Perform shell-model studies of low-lying states of the above nuclei using both the  $0p$  and the  $1s0d$  shells. You may need to perform truncations of the basis by leaving out specific single-particle states (for example the  $0d_{3/2}$  state).
3. Go through the details in chapter 7.5 of Suhonen and convince yourself about the approximations and correctness of equations (7.118)-(7.123). Present also eventual other theoretical studies.
4. Calculate thereafter, based on your shell-model states, the relevant  $\beta$ -decays. Give a critical analysis of your results and compare with existing theoretical studies and experiments.