CHAPTER 5 CONCLUSIONS AND SUGGESTIONS

5.1 Conclusions

Based on the analysis and simulation results of this research, the following conclusions are obtained:

1. The Pencil Beam Scanning (PBS) technique required 528 seconds of irradiation time, while the Passive Scattering (PS) technique required 1.040 seconds to deliver the same prescribed dose. This finding indicates that PBS allows for shorter treatment delivery durations, which may enhance patient comfort and reduce the potential movement during treatment.
2. In terms of dose distribution, PBS showed better conformity to the Planning Target Volume (PTV), achieving 100.1% dose coverage in line with ICRU recommendations. In contrast, PS delivered 94.7%, slightly below the minimum standard which is from 95% - 107%. Moreover, PBS resulted in lower radiation doses to surrounding OARs. These findings confirm that PBS not only improves dose precision to the target but also enhances protection for nearby healthy tissues.

5.2 Suggestions

Based on the findings encountered in this research, several recommendations are proposed for future research to improve simulation accuracy and treatment planning in proton therapy using PHITS:

1. consider the application of multiple irradiation beam angles directed toward the cancer target. This strategy may contribute to better dose conformity and reduced radiation exposure to surrounding healthy tissues, thereby enhancing both treatment precision and therapeutic safety.
2. The implementation of a voxel-based phantom is recommended to improve anatomical accuracy in dose calculation. Voxel phantoms offer a more

realistic representation of human organ structures compared to mathematical phantoms. However, this method requires patient-specific medical imaging data, which must be converted into voxel models using specialized software.