Contents

1 Introduction 1
- 1.1 Overview on the MedAustron project . . . 1
- 1.2 Physics beam options and main parameters . . . 2
  - 1.2.1 The options for the accelerator parameters . . . 2
  - 1.2.2 Proposed accelerator option for physics beam . . . 4
- 1.3 Comparison of nuclear physics facilities . . . 4

2 Education and training aspects 7

3 Particle detectors 11
- 3.1 Overview . . . 11
  - 3.1.1 Classification of detectors . . . 11
  - 3.1.2 Future applications . . . 13
- 3.2 Detector development . . . 13
  - 3.2.1 Beam parameters . . . 13
  - 3.2.2 Interaction in the detector material . . . 14
  - 3.2.3 Detector tests . . . 16
- 3.3 Preparation of test systems . . . 21
- 3.4 Requirements . . . 22

4 Proton scattering facility 23
- 4.1 General concept . . . 23
- 4.2 Nuclear radii . . . 24
  - 4.2.1 Introduction . . . 24
  - 4.2.2 Fraunhofer diffraction theory . . . 25
  - 4.2.3 Comparison of a diffraction pattern with experimental data 27
  - 4.2.4 Results of r_{BS} determination from elastic proton scattering data . . . 28
  - 4.2.5 Reaction cross section measurements in the black sphere regime . . . 30
  - 4.2.6 Tentative physics programme . . . 31
- 4.3 Optical potentials at intermediate energies . . . 32

4.3.1 Relativistic nucleon-nucleus optical potentials 33
4.3.2 Global relativistic optical potential 35
4.4 Reaction cross sections 36
4.4.1 Introduction 36
4.4.2 Experiments performed at other facilities 37
4.4.3 Possible experimental directions at MedAustron 41
4.5 Proton-proton scattering 43
4.5.1 Off-shell behaviour of nucleon-nucleon interaction 43
4.5.2 Capability of the MedAustron 44
4.6 Instrumental aspects 46
4.6.1 Accelerator 46
4.6.2 Count rate estimates 47
4.6.3 Detectors 49
4.7 Measurement of spin-observables 55
4.7.1 Polarised proton target 56

5 Other physics applications at MedAustron 63
5.1 Proton computed tomography (pCT) 63
5.1.1 General ideas 63
5.1.2 Basics of proton computed tomography 64
5.1.3 A high resolution HepCT set-up 66
5.1.4 Some opportunities for applications of the proposed HepCT 69
5.2 Radiation damage in HTS 70
5.3 Dosimetry 72
5.3.1 Solid-state nano-dosimetry 72
5.3.2 Simulation of cosmic-ray components 73
5.3.3 Experimental prospects at MedAustron 75
5.4 Single-hit ion micro-probe 76
5.4.1 Attractivity of a single-hit ion micro-probe 76
5.4.2 Requirements for single-hit ion micro-probe experiments 79
5.4.3 Summary of necessary components 81

A Reviews 101