

# Contents

<b>1 AN INTRODUCTION TO HII REGIONS</b>	<b>1</b>
1.1 Definition of an HII Region . . . . .	3
1.2 Strömgren radius . . . . .	4
1.3 Emission Measure . . . . .	7
1.4 Stratification of ionization . . . . .	8
1.5 Ionization processes in HII regions . . . . .	8
1.6 Evolution of HII region . . . . .	11
1.7 Emission line spectrum in a diffuse nebula . . . . .	14
1.7.1 Continuum emission . . . . .	15
1.7.2 Infra-red Emission . . . . .	17
1.8 Determination of temperature in the nebulae . . . . .	18
1.9 Shock waves in the Interstellar Medium . . . . .	19
1.9.1 Theory of shock waves . . . . .	21
1.10 Ionization front . . . . .	22
1.11 Jets and Herbig-Haro (HH) objects . . . . .	24
1.12 Turbulence . . . . .	26
1.12.1 Introduction . . . . .	27
1.12.2 Kolmogorov's prescription of turbulence . . . . .	28
1.12.3 Observational determination of Turbulence . . . . .	30
1.13 Models for expansion of HII regions . . . . .	32
1.13.1 Spherical model . . . . .	32
1.13.2 Blister Model . . . . .	32
1.13.3 Champagne Model . . . . .	33
1.13.4 Stellar wind bubble model . . . . .	36
1.14 Motivation for the present work . . . . .	38
1.15 Aim and scope of the present study . . . . .	39

<b>2 THE IMAGING FABRY-PÉROT SPECTROMETER (IFPS)</b>	<b>40</b>
2.1 Theory and Definition of FPS . . . . .	42
2.1.1 Merits . . . . .	46
2.1.2 De-merits . . . . .	47
2.2 Design and Fabrication of IFPS . . . . .	48
2.2.1 Choice of the étalon parameters . . . . .	48
2.2.2 Optical system . . . . .	50
2.2.3 Scanning the IFPS . . . . .	52
2.2.4 Interference filters . . . . .	54
2.3 Detectors . . . . .	55
2.3.1 Introduction to Imaging Photon Detector (IPD) . . . . .	58
2.4 Image data Acquisition System . . . . .	70
2.5 Instrument Performance . . . . .	72
<b>3 OBSERVATIONS AND DATA ANALYSIS</b>	<b>78</b>
3.1 Observations . . . . .	78
3.1.1 Orion Nebula . . . . .	79
3.1.2 Trifid Nebula . . . . .	81
3.2 Data analysis of the FP interferogram images . . . . .	84
3.2.1 Smoothing the data . . . . .	84
3.2.2 Calibration . . . . .	85
3.2.3 Determination of line of sight or radial velocities . . . . .	88
3.2.4 Errors in data reduction . . . . .	90
<b>4 VELOCITY FIELD STRUCTURE IN THE ORION NEBULA</b>	<b>93</b>
4.1 Introduction to the Orion nebula . . . . .	93
4.2 Earlier studies . . . . .	96
4.2.1 Kinematics . . . . .	96
4.2.2 Turbulence . . . . .	97
4.3 Present studies . . . . .	98
4.4 General velocity flow . . . . .	100
4.4.1 Two components . . . . .	100
4.4.2 Discussion . . . . .	108
4.4.3 Champagne flow . . . . .	112
4.4.4 Model Profile . . . . .	112

4.4.5	Axisymmetry . . . . .	117
4.4.6	Velocity flow around $\theta^2$ Ori . . . . .	118
4.4.7	The Orion dark bay . . . . .	120
4.5	High Velocity Flows . . . . .	121
4.5.1	Around identified stellar sources . . . . .	122
4.5.2	Around protostellar sources . . . . .	123
4.5.3	The molecular cloud region . . . . .	127
4.6	The bar ionization front . . . . .	128
4.6.1	Velocity field around the bar ionization front . . . . .	131
4.6.2	Width of the shock front . . . . .	134
4.6.3	Ionization mechanism at the shock front . . . . .	135
4.7	Turbulence . . . . .	137
4.7.1	Distribution of radial velocities . . . . .	139
4.7.2	Structure function . . . . .	142
<b>5</b>	<b>VELOCITY FIELD STRUCTURE IN THE TRIFID NEBULA</b>	<b>153</b>
5.1	Introduction . . . . .	153
5.2	Earlier studies . . . . .	154
5.3	Present studies . . . . .	156
5.4	General velocity field . . . . .	160
5.4.1	About two arc minutes around the central star HD 164492 . . . . .	160
5.4.2	Peculiar velocity flow . . . . .	161
5.5	Comparison of the velocity field structures of the Trifid and the Orion nebulae . . . . .	163
<b>6</b>	<b>SUMMARY AND CONCLUSIONS</b>	<b>164</b>
6.1	The Instrumentation . . . . .	164
6.2	Observations and results on the kinematics of HII regions . . . . .	165
6.2.1	Orion Nebula . . . . .	165
6.2.2	Trifid nebula . . . . .	170
6.3	Scope for future work . . . . .	171
<b>REFERENCES</b>		<b>173</b>