

CONTENTS

<i>Preface</i>	xi	
1	The technology	1
1.1	Introduction	1
1.2	Radio astronomy	3
1.2.1	The very large array: VLA	4
1.2.2	Very long baseline interferometry and very long baseline arrays: VLBI and VLBA	5
1.3	X-ray telescopes	6
1.3.1	HEAO 1	7
1.3.2	HEAO 2: Einstein Observatory	8
1.3.3	Advanced X-ray astrophysics facility: AXAF	9
1.4	Ultraviolet astronomy	9
1.4.1	International ultraviolet explorer: IUE	10
1.4.2	Hubble space telescope: HST	10
1.5	Optical telescopes	11
1.5.1	Schmidt telescopes	11
1.5.2	4 m-class telescopes	13
1.5.3	Next generation telescopes: NGTs	14
1.5.4	Hubble space telescope	15
1.6	Infrared telescopes	16
1.6.1	Ground based infrared telescopes	16
1.6.2	Infrared astronomical satellite: IRAS	17
1.6.3	Space infrared telescope facility: SIRTF	17
1.7	Conclusions	18
2	Quasar surveys	19
2.1	Optical surveys for quasars	19
2.1.1	Color based surveys	19
2.1.2	Spectroscopic surveys	21
2.1.3	Summary of quasar numbers	22
2.2	Surveys at other wavebands	24

2.2.1	Radio surveys	24
2.2.2	X-ray surveys	27
2.3	Distribution of quasars on the sky	28
2.3.1	Searches for evidence of anomalous redshifts	28
2.3.2	Tests for spatial correlations	30
2.4	Promise of future surveys	38
2.4.1	Faint X-ray, optical and infrared surveys	39
3	Cosmology	45
3.1	Introduction	45
3.2	Fundamentals of a cosmology	47
3.3	A newtonian cosmology	50
3.3.1	Open and closed universes in a newtonian cosmology	52
3.3.2	Observational constraints on open vs. closed	54
3.4	Deceleration parameter q and density parameter Ω	55
3.5	Relativistic cosmologies	58
3.5.1	Fluxes and redshifts	59
3.5.2	K-corrections	62
3.5.3	Angular diameter and surface brightness	65
3.6	Look-back times	67
3.7	Volumes of space	68
3.8	Speculations	69
4	Quasars as cosmological probes	70
4.1	Galactic envelopes of quasars	70
4.1.1	Isophotal angular diameters	71
4.2	Absorption lines	80
4.3	Gravitational lenses	84
5	Luminosity functions	93
5.1	Fundamentals of a luminosity function	93
5.2	Example of a luminosity function calculation	95
5.3	Completeness limits of samples	102
5.4	The local luminosity function for quasars	106
5.5	Luminosity function at high redshift	112
6	Quasar evolution	115
6.1	Basic test for evolution	115
6.2	Parameterizing evolution	117
6.3	Luminosity and density evolution	121
6.4	Comparing local and high redshift luminosity functions	123
6.5	Evolution constraints from X-ray properties	127
6.6	Utility of radio samples	131
6.7	Redshift limit for quasars	131
6.8	Physical consequences of quasar evolution	133
6.9	Searching for quiescent accretors	136

7	Continuous spectra	140
7.1	Introduction	140
7.2	Thermal processes	141
7.3	Non-thermal continua	142
7.4	Relativistic beaming	145
7.5	Observed generalities of quasar continua	147
7.6	Infrared continuum	148
7.7	Optical and ultraviolet continua	150
7.8	X-ray continuum	153
7.9	Bolometric luminosities	155
7.10	Radio continuum	156
7.11	Thermal vs. compact radio sources	158
7.12	Starburst nuclei	160
8	Emission line spectroscopy	164
8.1	Introduction	164
8.2	Equilibrium for hydrogen emission lines	167
8.3	Relative hydrogen line intensities	170
8.4	Balmer line luminosities	173
8.5	Ionization parameter	177
8.6	The forbidden lines	178
8.7	Emission line profiles	182
8.8	Other emission lines	186
9	Quasar structure	188
9.1	Introduction	188
9.2	Fundamentals of accretion models	189
9.3	Limits on the properties of a massive black hole	190
9.4	The accretion volume	193
9.5	The broad-line region	198
9.6	The narrow-line region	202
	<i>References</i>	206
	<i>Index</i>	215