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# ULTRAVIOLET RADIATION IN THE SOLAR SYSTEM

*by*

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# Contents

<b>Preface</b>	XI
<b>1 Historical Introduction</b>	<b>1</b>
1.1 The extension of visible spectra towards the red . . . . .	1
1.2 Photographic plates and radiation beyond the violet . . . . .	3
1.3 The Ultraviolet Catastrophe . . . . .	6
1.4 Laboratory experiments . . . . .	10
1.5 Composition of the Earth's atmosphere . . . . .	11
1.6 Balloons . . . . .	15
1.6.1 The pioneers . . . . .	15
1.6.2 Observations of planets . . . . .	18
1.6.3 Current projects . . . . .	19
1.7 Aircrafts . . . . .	20
1.7.1 The pioneers . . . . .	20
1.7.2 Solar eclipses . . . . .	21
1.7.3 Atmospheric measurements . . . . .	21
1.8 The structure of the terrestrial atmosphere . . . . .	22
1.9 Rockets . . . . .	26
1.9.1 From the pioneers to the V-2 . . . . .	26
1.9.2 First solar UV observations . . . . .	28
1.9.3 The Artificial Satellites . . . . .	31
1.9.4 Sounding rockets . . . . .	33
<b>2 Solar Ultraviolet Radiation and Magnetism</b>	<b>35</b>
2.1 History of Solar Observations . . . . .	35
2.2 The Sun as a Star . . . . .	38
2.2.1 Basic facts about the Sun . . . . .	39
2.2.2 Evolution of the Sun	
2.2.3 UV Variation during solar evolution	
2.3 The Solar Irradiance	
2.3.1 First measurements	
2.3.2 The Solar UV Spectrum . . . . .	45
2.4 Solar Observational Features . . . . .	47
2.4.1 The Photosphere . . . . .	48
2.4.2 The Chromosphere . . . . .	51
2.4.3 The Transition Region . . . . .	56

2.4.4	The Corona . . . . .	57
2.5	Magnetic field and Radiative Losses . . . . .	62
2.6	The Heating of the Outer Layers . . . . .	64
2.6.1	Primary requirements . . . . .	64
2.6.2	Acoustic Heating . . . . .	64
2.6.3	Magnetic Heating . . . . .	64
2.6.4	The Magnetic Carpet . . . . .	67
<b>3</b>	<b>The Solar UV Variability</b>	<b>69</b>
3.1	Sources of Solar Variability . . . . .	69
3.2	Short-Time Variations . . . . .	71
3.2.1	Solar Flares . . . . .	71
3.2.2	Coronal Mass Ejections . . . . .	74
3.2.3	Activity Waves in the Corona . . . . .	75
3.3	Variability of visible radiation during a solar activity cycle . . . . .	76
3.3.1	Solar Activity Indices . . . . .	76
3.3.2	Total Irradiance Variations . . . . .	77
3.4	Solar UV Radiation and the Activity Cycle . . . . .	81
3.4.1	General Trends . . . . .	81
3.4.2	Instrumental stability and the Mg II Index . . . . .	81
3.4.3	EUV and FUV measurements . . . . .	83
3.4.4	Correlations . . . . .	85
3.5	Simulation of UV variability . . . . .	85
3.5.1	Empirical modelling . . . . .	85
3.5.2	Synthetic modeling . . . . .	87
3.6	Proxies of long-term Solar Activity . . . . .	87
3.6.1	Cosmic Rays . . . . .	88
3.6.2	Nitrates . . . . .	88
3.6.3	Cosmogenic isotopes . . . . .	88
3.6.4	Meteorites . . . . .	92
3.6.5	The Moon . . . . .	92
3.7	Long Term Variation of Solar Luminosity . . . . .	93
3.8	Long-Term Decay of Magnetic Activity and UV emission . . . . .	95
3.8.1	Observations of solar-like Stars . . . . .	95
3.8.2	The Dynamo Theory . . . . .	96
3.8.3	Activity-Rotation Relation . . . . .	98
3.8.4	The Evolution of UV Radiation in solar-like Stars . . . . .	100
<b>4</b>	<b>Atmospheric Effects of Ultraviolet Radiation</b>	<b>103</b>
4.1	The Extraterrestrial Solar Spectrum . . . . .	103
4.1.1	The Spectral Distribution of Solar Radiation . . . . .	103
4.1.2	Atmospheric extinction . . . . .	104
4.1.3	Thompson and Compton Scattering . . . . .	106
4.1.4	Rayleigh-Mie scattering . . . . .	107
4.1.5	Absorption and Emission of Radiation by Molecules . . . . .	109
4.2	Airglow . . . . .	111

4.2.1	Nightglow . . . . .	113
4.2.2	Dayglow . . . . .	114
4.2.3	Twilightglow . . . . .	115
4.3	Diffuse UV background . . . . .	116
4.4	The Ionosphere . . . . .	117
4.4.1	Historical development . . . . .	118
4.4.2	General Structure . . . . .	120
4.4.3	Effects on Communications . . . . .	124
4.4.4	Variations with Solar Activity . . . . .	125
4.5	Photochemical Processes . . . . .	126
4.6	The Stratosphere and Ozone . . . . .	127
4.6.1	Pioneering Measurements and Observing Techniques . . . . .	127
4.6.2	Natural Processes of Ozone Formation and Destruction . . . . .	130
4.6.3	Catalytic Loss of Ozone . . . . .	133
4.6.4	Other photodissociation processes . . . . .	134
4.7	Variability of Total Ozone Content . . . . .	134
4.7.1	The Influence of Solar Variability on Ozone . . . . .	134
4.7.2	Solar Eclipses . . . . .	135
4.7.3	The Influence of Volcanoes . . . . .	135
4.7.4	Photochemical Replacement Time . . . . .	136
4.8	Dynamics of the Terrestrial Atmosphere . . . . .	137
4.8.1	Troposphere . . . . .	137
4.8.2	Planetary waves . . . . .	138
4.8.3	The Stratosphere . . . . .	140
4.8.4	The Quasi-Biannual Oscillation (QBO) . . . . .	140
4.9	UV and Tropospheric Climate Change . . . . .	142
4.9.1	Timescales and Sources of Climate Variability . . . . .	142
4.9.2	The Solar Print in the Upper Atmospheric Layers . . . . .	143
4.9.3	Ozone Chemistry . . . . .	145
4.9.4	The Natural Patterns of Climate Variability . . . . .	146
4.9.5	The Effect of Planetary Waves . . . . .	149
4.10	Effects of Solar UV on the Stability of Satellite Orbits . . . . .	154
<b>5</b>	<b>UV Radiation, Ozone and Life</b>	<b>157</b>
5.1	The Biochemistry of Life . . . . .	157
5.2	Radiation and Life . . . . .	159
5.2.1	Radiation Units . . . . .	159
5.2.2	Wavelength-dependent Functions . . . . .	160
5.2.3	Mechanism of Cell Damage . . . . .	161
5.3	Long-term Evolution of Ozone and UV Radiation . . . . .	162
5.3.1	Oxygen and Ozone Variation . . . . .	162
5.3.2	Early UV Surface Fluxes and the Origin of Life . . . . .	164
5.4	Ozone and UV Fluxes in Planets around Other Stars . . . . .	169
5.5	The Ozone Hole . . . . .	170
5.5.1	The Chlorofluorocarbons . . . . .	171
5.5.2	The Warning and the Measurements . . . . .	173

- 5.5.3 The Mechanism of Ozone Depletion at the South Pole . . . 176
- 5.5.4 Bromine . . . . . 178
- 5.5.5 Other anthropogenic mechanisms . . . . . 181
- 5.5.6 Natural sources of ozone depletion . . . . . 181
- 5.6 The Montreal Treaty . . . . . 182
- 5.7 Time Variation of Stratospheric Ozone . . . . . 183
  - 5.7.1 Global Ozone . . . . . 183
  - 5.7.2 Polar Ozone Holes . . . . . 184
- 5.8 The Future Evolution of the Ozone Hole . . . . . 186
- 5.9 Health Consequences of UV Radiation . . . . . 188
  - 5.9.1 Heliotherapy . . . . . 188
  - 5.9.2 Damaging Effects of the UV Radiation . . . . . 190
  - 5.9.3 Resistance to UV Radiation . . . . . 191
  - 5.9.4 Coral Bleaching . . . . . 192
  - 5.9.5 UV Damaging Effects on Plants . . . . . 192
  - 5.9.6 Damaging Effects of UV Radiation on Humans . . . . . 193
  - 5.9.7 The Biological Consequences of the Ozone Hole . . . . . 196
  - 5.9.8 Technological Solutions to the Ozone Hole . . . . . 196
- 5.10 Tropospheric Ozone . . . . . 197
  - 5.10.1 Sources and Relevant Reactions . . . . . 197
  - 5.10.2 Measurements . . . . . 198
  - 5.10.3 Biological Effects . . . . . 199
- 5.11 Climatic Effects of Ozone Changes . . . . . 200
- 5.12 Current Surface UV Fluxes . . . . . 201
  - 5.12.1 UV Index . . . . . 201
  - 5.12.2 Diurnal Variation of UV Surface Radiation . . . . . 203
  - 5.12.3 Temporal Variations . . . . . 203
  - 5.12.4 Hemispheric Differences . . . . . 205
- 5.13 Protection against UV Radiation . . . . . 205
  - 5.13.1 Artificial UV Sources . . . . . 205
  - 5.13.2 Sunscreens . . . . . 206
  - 5.13.3 Shading . . . . . 206
- 6 UV Fluxes on Other Bodies of the Solar System . . . . . 209**
  - 6.1 Planetary Atmospheres: Basics . . . . . 209
    - 6.1.1 Photochemistry . . . . . 210
    - 6.1.2 Atmospheric Physics . . . . . 211
    - 6.1.3 The Origin of Planetary Atmospheres . . . . . 215
  - 6.2 Venus . . . . . 217
    - 6.2.1 Basic Facts . . . . . 217
    - 6.2.2 Liquid Water on Early Venus . . . . . 218
    - 6.2.3 Meteorology . . . . . 219
    - 6.2.4 Atmospheric Chemistry . . . . . 220
    - 6.2.5 Airglow . . . . . 220
    - 6.2.6 The Ionosphere of Venus . . . . . 221
  - 6.3 Mars . . . . . 223



6.3.1	Basic Facts . . . . .	223
6.3.2	The Atmosphere of Mars . . . . .	224
6.3.3	UV Radiation Environment . . . . .	225
6.3.4	The Martian Ionosphere . . . . .	227
6.3.5	Airglow . . . . .	228
6.3.6	Ancient Mars . . . . .	228
6.3.7	Detection of Life on Mars: Viking and ALH84001 . . . . .	230
6.4	Mercury . . . . .	234
6.5	The Giant Planets . . . . .	234
6.5.1	Basic Facts . . . . .	234
6.5.2	Jupiter . . . . .	235
6.5.3	Atmospheres . . . . .	236
6.5.4	UV Photochemistry . . . . .	238
6.5.5	Aurorae . . . . .	239
6.5.6	Airglow . . . . .	241
6.5.7	Ionospheres . . . . .	242
6.6	Comets . . . . .	243
6.6.1	Basic facts . . . . .	243
6.6.2	UV Photochemistry of Cometary Atmospheres . . . . .	244
6.7	Meteorites . . . . .	247
6.7.1	Basic facts . . . . .	247
6.7.2	Surface Change on Meteorites due to UV Radiation . . . . .	248
6.8	UV Radiation and Its Effect on Planetary Satellites . . . . .	249
6.8.1	Jovian Satellites . . . . .	249
6.8.2	Triton . . . . .	251
6.9	Titan . . . . .	252
6.9.1	History and Basic Facts . . . . .	252
6.9.2	Atmosphere of Titan . . . . .	253
6.9.3	Surface of Titan . . . . .	256
6.9.4	UV Radiation and Photochemical Reactions on Titan . . . . .	257
6.9.5	The Huygens Probe . . . . .	262
6.10	Pluto . . . . .	263
6.10.1	Basic facts . . . . .	263
6.10.2	The atmosphere of Pluto . . . . .	264
<b>7</b>	<b>Ultraviolet Transitory Events and Life</b> . . . . .	<b>267</b>
7.1	Historical Introduction . . . . .	267
7.2	Biological Extinctions during Earth History . . . . .	268
7.2.1	The K/T extinction . . . . .	269
7.3	Radiation Events in the Solar System . . . . .	271
7.3.1	Solar flares . . . . .	271
7.3.2	Supernova Explosions . . . . .	271
7.3.3	Atmospheric effects of strong ionizing events . . . . .	274
7.3.4	The Biological Effects of a Nearby Supernova . . . . .	277
7.4	The Probability of Supernova Explosions . . . . .	278
7.4.1	The Galactic Environment . . . . .	279

7.4.2	Effects of Galaxy Collisions: The Case of Andromeda–Milky Way . . . . .	280
7.4.3	Milky Way History . . . . .	281
7.4.4	Activity in the galactic centre . . . . .	284
7.4.5	The Local Interstellar Medium . . . . .	284
7.4.6	Geomagnetic Field Reversals . . . . .	287
7.5	Evidence of Nearby Supernovae . . . . .	289
7.5.1	Frequency of External UV Events during the History of the Solar System . . . . .	289
7.5.2	Historical Supernovae . . . . .	290
7.5.3	Terrestrial Fingerprints . . . . .	292
7.5.4	Future Supernova Candidates . . . . .	295
7.6	Beneficial Evolutionary Effects of UV Radiation . . . . .	296
7.6.1	The Role of the Mutations . . . . .	296
7.6.2	Large Solar and Stellar Flares . . . . .	298
7.7	UV Resistance of Living Beings and the Panspermia Theory . . . . .	299
	<b>Bibliography</b>	<b>303</b>
	<b>Index</b>	<b>375</b>

# Preface

In the history of science the opening up of a new observational or experimental window is always followed by an increase in knowledge of the subject concerned. This is also the case with the subject of this book, ultraviolet radiation (hereafter UV).

In principle, the ultraviolet range might be just one more of these windows, of no particular importance. However, the energy per UV photon provides the main peculiarity, its magnitude being great enough to produce important chemical reactions in the atmospheres of planets and satellites, thereby affecting the transmission of this radiation to the ground.

The Sun is the main natural source of UV radiation in the Solar System and our planet is the body where its influences can be best tested and the only one where its relation with life can be studied. However, the terrestrial atmosphere blocks most of the photons in this electromagnetic range and astronomers have had to develop various techniques (balloons, planes and rockets) to cross this barrier and access the information. These tools have been used in parallel to investigate the physical properties of the terrestrial atmosphere and the interaction of its constituents with light. This book will address most of these topics.

Terrestrial life is based on nucleic acids and it happens that solar UV radiation has the capacity to seriously damage the structure of these acids. The evolution of solar UV radiation at the terrestrial surface has played an important role in the origin and development of life on earth and can serve as a guideline to speculations on the conditions of habitability of other astronomical bodies. Microbes have developed DNA repair systems and have evolved successfully in intense and fluctuating UV environments. Complex beings, however, are more affected by this radiation, humans suffering particular damages such as skin cancer and other ailments. The last decades have identified exposure to UV radiation as one of the most important problems for human health as a result of our technological development. The ozone hole and its consequences will be described in chapter 5.

Hot ionized gases, called plasmas, are the most efficient sources of ultraviolet light. There are many places in the Universe where such plasmas are created. We shall limit the scope of this book to processes occurring at the Solar System. However, we do not live in an isolated system and shall therefore cover, in the last chapter, the effects of variable external UV sources on our environment, with special emphasis on those relating to life of our planet.

The study of the interactions between UV radiation and the components of

the different environments of our planetary system produces an interdisciplinary communication between different branches of science.

We are astronomers, and this book is clearly biased towards the physical and observational perspective of the problem, although we have tried also to include the basics of the important influences of UV on living beings. We have furthermore tried to give a historical description of the development of the scientific ideas in every subject because this contributes towards a better understanding of the present situation.

The book is mainly addressed to physicists with a basic background in astronomy and to scientists working in the growing field of astrobiology.

Many people have been involved, in different ways, in the preparation of this book. At the IAC, R. Castro elaborated and retouched a substantial number of the figures and the Library staff (M. Gomez, and L. Abellán) provided an excellent service in tracing old publications. J. Beckman, S. Bauer, N. Benítez, S. Chueca, O. Fernández-Capetillo, C. Muñoz Tuñón, T. Mahoney, J. Maíz Apellániz and B. Ruiz Cobo have critically read different drafts of the book and made valuable comments, advice and suggestions.

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T. Mahoney made this book readable in English. We alone, however, bears the responsibility for its content. We thank the Kluwer/Springer staff, especially Dr. Harry Blom, for his confidence in our work.

Finally, our families showed great patience and gave us their full support during the lengthy process of writing this book, which we dedicate to our wives and children.

La Laguna and Graz, December 2004