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The Cold Universe

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Edited by D. Pfenniger and Y. Revaz

With 129 Figures

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Preface

Modern astronomy has stretched its domains of exploration tremendously. Not only objects at very large distances and very old states of the Universe can be examined, but also all kinds of radiations and phenomena are now accessible. Astronomers constantly move from considerations about very diluted to very dense systems.

Hot and energetic systems, being the easiest to observe, have attracted a lot of attention. However the cold and low energetic states have been somewhat neglected, either because being harder to observe they appear unexciting, or because being less well known they tend to be ignored. However the Universe background radiation has now been determined as the most perfect known case of a black-body spectrum, a substantial fraction of matter spends some time close to the temperature of this universal thermal bath, before being transformed into stars or planets. Some objects, such as rapidly expanding gas shells in planetary nebulae, may even succeed in reaching a temperature well below the background radiation temperature through the mere action of adiabatic expansion. In view of the highly dynamical and turbulent state of the interstellar medium, hot *and cold* temperature fluctuations must be expected, while the clear observational bias is to observe the hot rather than the cold fluctuations. Fortunately with the accessibility of far-infrared and sub-millimetric instruments such as SCUBA, WMAP, Planck or ALMA, we can expect in the coming years continuous advances in our understanding of these harder to observe cold stages of matter.

For these reasons the members of the Swiss Society for Astrophysics and Astronomy voted in favor of the organisation of a winter Saas-Fee course on the Cold Universe. The aim of this course was to cover as well as possible the current knowledge in observational and theoretical astrophysics dealing with the coldest objects in the Universe. The selected lecturers, Andrew Blain, Françoise Combes and Bruce Draine have succeeded in bringing to the 70 participants a very rich and interesting amount of information, that the reader can enjoy now in the following pages. We are very grateful to the lecturers for their invaluable live lectures as well for their presently available written versions.

We thank also the course Secretary, Ms Irène Scheffre, and our colleagues Paul Bartholdi, Veruska Muccione, Yves Revaz, and Nunos Santos, for all their help in the practical organisation of the course.

As a reminder the course took place in the picturesque village of Grimentz in the south Alps of Switzerland. As a practical introduction to the Cold Universe, the participants could taste ice-cream made on the spot with a mixture of raspberries, strawberries, liquid cream and liquid nitrogen! The picture shows from left to right Yves Revaz, Paul Bartholdi, Veruska Muccione and Françoise Combes enjoying the cooling process.

Geneva, July 2003

*Daniel Pfenniger
Arnold Benz
Thierry Courvoisier
(The Course Organisers)*

Contents

Galaxy Evolution in the Cold Universe	
Andrew W. Blain	1
1 Introduction	1
1.1 The Difficulties of Observing Faint and Distant Cold Objects	4
2 Radiation from the Cool ISM in Galaxies and Its Detection	7
2.1 Galaxy Structure	7
2.2 AGN Accretion and Star Formation	8
2.3 The Structure of Infrared Emission	9
2.4 Dust Emission at the Coarse Level Relevant to Cosmology ...	11
2.5 Dust Mass and Temperature	14
2.6 Long-Wavelength Observations of Low-Redshift Galaxies ...	17
2.7 Absorption Studies	18
3 Evolution of Low-Redshift Galaxies	21
3.1 Description of Galaxy Surface Densities	21
3.2 Detecting Evolution in the <i>IRAS</i> Survey	27
3.3 Galaxy Formation Scenarios	28
3.4 Gas Cooling and Star Formation	31
4 Cosmology	33
4.1 The Shape and Size of the Universe	33
4.2 Dynamics of the Universe	35
4.3 Horizons	37
4.4 Distance Measures	37
4.5 Growth of Perturbations	40
4.6 The Growth and Collapse of Individual Halos	43
4.7 Press–Schechter Formalism and Extensions	45
4.8 Angular Momentum of Galaxies	49
4.9 Correlations and Peculiar Velocities	50
4.10 Cosmology and Studies of Galaxy Evolution	51
4.11 K Corrections	51
5 The Cosmic Microwave Background (CMB)	54
5.1 Secondary Anisotropies	57
5.2 Foregrounds and Signatures of Galaxy Formation	61

6	The Evolution of High-Redshift Galaxies	61
6.1	Optically Selected Galaxies	62
6.2	Red Galaxies and Extremely Red Objects (EROs)	63
6.3	Active Galaxy Selection	64
6.4	Faint Radio Galaxies	65
6.5	Submillimetre Galaxies and the Optical and Radio Populations	65
6.6	Gravitational Lensing	67
6.7	The Process of Constraining Galaxy Evolution from Submillimetre Observations	70
6.8	The Evolution of the Submillimetre Galaxy Population	73
6.9	Simple Forms of Evolution	73
6.10	Caveats	76
6.11	Redshift Distributions	77
6.12	Semi-analytical Modelling	80
6.13	Background Radiation Constraints	82
6.14	Constraints from Bright Counts	82
7	Properties of High-Redshift Dusty Galaxies	83
7.1	Radio (and Optical) Pre-selection	85
7.2	Gamma-Ray Burst (GRB) Host Galaxies	88
8	Galaxy Evolution: A Global, Multiwavelength View	88
8.1	Observing First Light	89
9	Future Observations of the Distant Cold Universe	91
9.1	Sensitivity and Field of View	91
9.2	Resolution	93
9.3	Other Techniques	94
10	Summary	95
	References	96

Molecules in Galaxies at All Redshifts

	Françoise Combes	105
1	How to Observe the H ₂ Component?	105
1.1	The H ₂ Molecule	105
1.2	Infrared Lines of H ₂	107
1.3	UV Lines of H ₂	108
1.4	The CO Tracer	109
1.5	The Dust Tracer	112
1.6	Conclusion	114
2	Molecular Component in the Milky Way	114
2.1	CO Surveys of the Milky Way	114
2.2	CO Distribution and Spiral Structure of the Milky Way	115
2.3	The Inner Galaxy	118
2.4	Vertical Distribution	121
2.5	Gamma-Ray Surveys	124

2.6	Conclusion	124
3	The Fractal Structure of the Molecular Gas	125
3.1	Self-similarity of Clouds	125
3.2	Limits of the Fractal	126
3.3	Scaling Laws	126
3.4	Turbulence	129
3.5	Numerical Simulations of Turbulence	131
3.6	Self-gravity	132
3.7	Molecular Fractal and IMF	134
3.8	Conclusions	137
4	Stability and Formation of the Fractal	137
4.1	Stability of the Molecular Disk	137
4.2	Star Formation and Critical Surface Density	142
4.3	Small-Scale Stability	144
4.4	Gas in the Outer Parts	145
4.5	Formation of the Structures	146
4.6	Conclusions	148
5	H ₂ in External Galaxies	149
5.1	H ₂ Content and Morphological Types	149
5.2	Molecular Disks Structure	152
5.3	H ₂ in Barred Galaxies	154
5.4	Molecular Gas in Polar Ring Galaxies	155
5.5	Molecular Gas in Elliptical Galaxies	156
5.6	CO Emission in Tidal Dwarf Galaxies	157
5.7	Conclusions	158
6	Molecules in ULIRGs, and High Density Tracers	159
6.1	Ultra-luminous Galaxies	159
6.2	Molecular Gas in ULIRGs	162
6.3	High Density Tracers	165
6.4	Conclusions	169
7	Molecules Traced in Absorption	170
7.1	Advantages of the Absorption	170
7.2	Molecular Absorption in the Galaxy	172
7.3	Extragalactic Molecular Absorptions	175
7.4	Conclusion	182
8	Molecules at High Redshift, Perspectives	182
8.1	Current State of the Art	182
8.2	Modelling of a Starburst	185
8.3	Prediction of Source Counts	190
8.4	Conclusions	190
9	History of the Molecular Component	191
9.1	Formation of H ₂	191
9.2	Chemistry of the Early Universe	194
9.3	First Structures in the Dark Age	195

9.4	H ₂ Formation and Cooling	198
9.5	What Are the First Structures?.....	199
9.6	Conclusion	202
References		202

Astrophysics of Dust in Cold Clouds

Bruce T. Draine	213
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1	Introduction to Interstellar Dust	213
1.1	Interstellar Extinction	213
1.2	Scattering of Starlight by Dust Grains	215
1.3	Polarization of Starlight	215
1.4	Spectroscopy of Dust: The 2175Å Feature	217
1.5	Spectroscopy of Dust: The Silicate Features	217
1.6	Spectroscopy of Dust: Diffuse Interstellar Bands	218
1.7	Spectroscopy of Dust: The 3.4μm Feature	219
1.8	Spectroscopy of Dust: Ice Features	220
1.9	Spectroscopy of Dust: PAH Emission Features	220
1.10	IR and FIR Emission	222
1.11	Interstellar Depletions: Atoms Missing from the Gas	223
1.12	A Provisional Grain Model	224
1.13	Far-Infrared and Submm Opacities	225
2	Optics of Interstellar Dust Grains	225
2.1	Cross Sections, Scattering Matrices, and Efficiency Factors ...	226
2.2	Grain Geometry?	228
2.3	Dielectric Functions	228
2.4	Computational Techniques	230
2.5	Scattering by Homogeneous Isotropic Spheres	231
2.6	Discrete Dipole Approximation	232
2.7	Infrared and Far-Infrared	233
2.8	Kramers-Kronig Relations	235
2.9	Kramers-Kronig Relations for the ISM	236
2.10	Microwave	238
2.11	X-rays	240
3	IR and Far-IR Emission from Interstellar Dust	241
3.1	Heating of Interstellar Dust	241
3.2	IR and Far-IR Emission Spectrum	244
3.3	The Small Magellanic Cloud (SMC)	247
4	Charging of Interstellar Dust	248
4.1	Collisions with Electrons and Ions	249
4.2	Photoelectric Emission	252
4.3	Charge Distribution Functions	256
5	Dynamics of Interstellar Dust	257
5.1	Gas Drag	257
5.2	Lorentz Force	260

5.3	Radiation Pressure	261
5.4	Recoil from Photoelectric Emission and Photo-desorption	262
5.5	Drift Velocities for Interstellar Grains	266
6	Rotational Dynamics of Interstellar Dust	266
6.1	Brownian Rotation?	266
6.2	Suprathermal Rotation	268
7	Alignment of Interstellar Dust	273
7.1	The Motion of Spinning Grains	274
7.2	Grain Magnetic Moments and Precession Around B	275
7.3	Barnett Effect	276
7.4	Alignment by Paramagnetic Dissipation: Davis-Greenstein Mechanism	277
7.5	Effect of Suprathermal Rotation	278
7.6	Thermal Flipping vs. Suprathermal Rotation	279
7.7	Effect of Radiative Torques	280
7.8	Alignment and Disalignment in Different Regions	281
7.9	Summary of the Grain Alignment Story	281
8	Evolution of the Grain Population	283
8.1	Dust Formation in Stellar Outflows	283
8.2	Grain Growth in the ISM	284
8.3	Photolysis	286
8.4	Photo-desorption	286
8.5	Grain Destruction in Shock Waves	287
8.6	Thermal Sublimation	290
8.7	Gamma Ray Bursts	291
8.8	Time Scales	292
9	Effects of Dust on Interstellar Gas	293
9.1	Photoelectric Heating	293
9.2	H ₂ Formation and Other Chemistry	293
9.3	Grains as Sources of Complex Molecules	295
9.4	Ion Recombination on Dust Grains	295
9.5	Coupling Neutral Gas to Magnetic Fields	295
9.6	Dust Grains as Magnetometers?	296
10	Concluding Remarks	298
	References	298
	Index	305