Preface

Maps of the distribution of galaxies and of temperature fluctuations in the cosmic microwave background (CMB) are fundamental in determining the structure, geometry and evolution of the Universe. The non-uniform distribution of galaxies in the local Universe has been apparent since the early surveys by Shapley, de Vaucouleurs and collaborators. Recent redshift and imaging surveys of huge numbers of galaxies have vastly improved our knowledge of large-scale structure and the evolution of galaxies. The 2dF Galaxy Redshift Survey and the Sloan Digital Sky Survey are recent examples of massive redshift surveys that have precisely measured the properties of the large-scale galaxy distribution in the Universe today. The dramatic new maps of the fluctuations in the CMB at millimetre wavelengths reveal the large-scale structure in the matter distribution at a much earlier epoch, just 300,000 years after the Big Bang. The redshift surveys and CMB images thus provide the boundary conditions for the evolution of structure over most of the history of the Universe. In the last five years, these maps of the cosmos, together with supernova-based distances to galaxies at intermediate redshifts, have shifted the standard paradigm from a Universe dominated by dark matter to one dominated by dark energy.

Many uncertainties remain in our picture of the Universe and its evolution. These include the nature of the dark energy and the dark matter (which together make up 95% of the energy density of the universe), the distribution of baryons, the formation of galaxies and clusters, the history of star-formation, and the role of metallicity, infall and the ionizing background radiation field in regulating star-formation. New maps of the cosmos are being obtained in order to address these questions: maps of clusters of galaxies, maps of the distribution of Lyman-alpha absorbers, and maps of neutral hydrogen in the nearby and distant Universe. All provide new clues for understanding the distribution of the baryonic content of the Universe across the hot, warm and cool phases. High-redshift galaxy and QSO surveys are underway to probe the structure of the Universe at early epochs and trace the effects of the dark energy on the geometry of the Universe. Imaging surveys are utilizing gravitational lensing to map the dark matter distribution. Deep observations of the CMB at arcmin resolution are probing the Universe at earlier times and investigating the seeds from which all structures form. These observational efforts are matched by extensive theoretical and numerical investigations of the physics of the early universe and the evolution of structure in a complex, multi-phase medium.

This symposium, which was held alongside the 2003 IAU General Assembly in Sydney, provided a timely snapshot of this fast-moving field, allowing researchers from many different backgrounds to keep abreast of the enormous advances being made by their colleagues from around the world. Fascinating new results from the redshift and imaging surveys (e.g. 2dFGRS, 2QZ, SDSS,

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6dF, 2MASS), from X-ray studies of galaxy and cluster evolution using XMM and Chandra, and from the recent radio surveys (e.g. HIPASS, SUMSS, FIRST) were all presented at the symposium. Intriguing preliminary reports were also presented on deep redshift surveys employing the largest telescopes (such as the VLT and Keck), and prospects for the next generation of far-infrared surveys (SIRTF/Spitzer, ASTRO-F). Particular highlights were the new results based on the first year of operation of the Wilkinson Microwave Anisotropy Probe (WMAP).

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