

DIVISION VIII

GALAXIES AND THE UNIVERSE

LES GALAXIES ET L'UNIVERS

Division VIII provides a focus for astronomers studying a wide range of problems related to galaxies and cosmology. Objects of the study include individual galaxies, groups and clusters of galaxies, large scale structure, cosmic microwave background radiation and the universe itself. Approaches are diverse from observational one to theoretical one including computer simulations.

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TRIENNIAL REPORT 2006 - 2009

1. Introduction

As documented by the report of the president for the triennium 2003-2006, there have been dramatic developments in the fields of extragalactic research and cosmology recently. During the period 2006-2009 even more rapid progress has been made.

2. Observations

On the observational side, this progress has largely come about because of large and/or deep surveys of galaxies and galaxy systems, and because of new observing windows opened by such satellites as *Spitzer* <www.spitzer.caltech.edu/>, *AKARI* <www.ir.isas.jaxa.jp/ASTRO-F/>, and *GALEX* <www.galex.caltech.edu/>. *HST* <www.stsci.edu/hst/> continues to produce valuable data, and we look forward to its further operation after Servicing Mission 4, planned for October 2008.

Over the past three years, cosmological parameters have been more strongly constrained through a number of approaches. Chief among these have been studies of the CMB: their importance for cosmology was recognized by a Nobel Prize in 2006. The *WMAP* satellite has now accumulated five years of data, which provide an accurate determination of important cosmological parameters (Hinshaw, G., *et al.* 2008, in press;

Komatsu *et al.* 2008, in press). Further pressure on the cosmological model comes from supernova work and from studies of structure formation (e.g., Zhen *et al.* 2008, *AJ*, 135, 1766; Wright 2007, *ApJ*, 664, 633), and from projects investigating the locations of baryons and the epoch of re-ionization through studies of quasar/AGN absorption lines (e.g., Danforth & Shull 2008, *ApJ*, 679, 194), the population of early galaxies, and the problem of the causes and effects of feedback.

3. Theory

On the theoretical side, several groups have performed sophisticated cosmological simulations to study the evolution of galaxies and large scale structure in the Universe, including the effects that supermassive black holes can have on their host galaxies. Such simulations include

- the Millennium Simulation Project <www.mpa-garching.mpg.de/galform/virgo/millennium/>,
- the Cosmic Data ArXiv <t8web.lanl.gov/people/heitmann/test3.html>
- the Marenstrum Numerical Cosmology Project <astro.ft.uam.es/marenstrum/>
- the HORIZON project <www.projet-horizon.fr/rubrique3.html>

4. Surveys

Shown here is an (inevitably incomplete) list of major recent non-targeted surveys that are intimately related to the activities of our Division.

- SDSS: Sloan Digital Sky Survey <www.sdss.org/>
- COSMOS: Cosmic Evolution Survey <cosmos.astro.caltech.edu/index.html>
- DEEP2: Deep Extragalactic Evolutionary Probe 2 <deep.berkeley.edu/>
- UKIDSS: The UKIRT Infrared Deep Sky Survey <www.ukidss.org/>
- VIMOS-VLT Deep Survey <www.oamp.fr/virmos/index.html>
- Subaru Deep Surveys
 - SXDS: Subaru-XMM Newton Deep Survey (Furusawa *et al.* 2008, *ApJS*, 176, 1)
 - SDF: Subaru Deep Field (Kashikawa *et al.* 2006, *ApJ*, 648, 7)
 - MOIRCS Deep Survey (Ichikawa *et al.* 2008, *PASJ*, 59, 1081)
- Hubble Ultra Deep Field <www.stsci.edu/hst/udf>
- 2dFGRS: 2df Galaxy Redshift Survey <www2.aao.gov.au/2dFGRS/>
- 2SLAQ: 2dF-SDSS LRG and QSO survey <www.2slaq.info>
- 6dF Galaxy Survey <www.aao.gov.au/local/www/6df/>
- CFHT Legacy Survey <www.cfht.hawaii.edu/Science/CFHLS/>
- 2MASS: The Two Micron All Sky Survey <www.ipac.caltech.edu/2mass/>
- GOODS <www.stsci.edu/science/goods/>; <www.eso.org/science/goods/>
- GEMS <www.mpia.de/GEMS/gems.htm>
- GRAPES <www.stsci.edu/~san/Grapes/>
- COMBO-17 <www.mpia.de/COMBO/>
- EdisCS <www.mpa-garching.mpg.de/galform/ediscs/>
- SHADES <www.roe.ac.uk/ifa/shades/>
- The Phoenix Deep Survey <www.physics.usyd.edu.au/~ahopkins/phoenix/>
- MUSYC <www.astro.yale.edu/MUSYC/>
- The H α Galaxy Survey. VI (James, P. A., *et al.* 2008, *A&A* 486, 131)
- The Gemini Deep Deep Survey <lcirs.ociw.edu/gdds.html>
- SAURON Project. XI (Peletier, R.F., *et al.* 2007, *MNRAS*, 379, 445)

- Chandra Deep Field <www.astro.psu.edu/~niel/hdf/hdf-chandra.html>;
<www.mpe.mpg.de/~mainieri/cdfs~pub/>
- The Arecibo Galaxy Environment Survey <www.naic.edu/~ages/>
- NVSS: NRAO VLA Sky Survey <www.cv.nrao.edu/nvss/>
- VLA FIRST survey <sundog.stsci.edu/>
- SUMSS <www.astro.physics.usyd.edu.au/SUMSS/>
- HIPASS: HI Parkes All-Sky Survey <www.atnf.csiro.au/research/multibeam/>
- WiggleZ <wigglez.swin.edu.au/Welcome.html>
- GAMA: Galaxies And Mass Assembly <www.eso.org/~jliske/gama/>

The availability of large amounts of data, which cover wide areas of the sky and/or the majority of cosmic history from several hundred million years after the Big Bang to the present, and the many predictions that can be made from numerical simulations, have reduced the heights of the barriers between theoreticians and observers, and between galaxies and cosmology.

Division VIII, the largest division (with 1544 members), will continue to contribute to our understanding of the properties of galaxies, the formation and evolution of galaxies and large scale structure, and the content and fate of the Universe.

Sadanori Okamura
president of the Division