

IAUS 353 – Scientific Highlights

IAU Symposium 353, “Galactic Dynamics in the Era of Large Surveys” was the first major IAU Symposium dedicated to topic of galaxy dynamics in the past decade. One of the objectives of the meeting was to bridge the growing divide in the dynamical methods employed to understand the Milky Way (where 3D kinematics of resolved stellar populations observed from our helio-centric perspective are becoming available), and the dynamical methods employed in the study of external galaxies (where wide field line-of-sight kinematics are available for large samples of galaxies). The primary aim of IAUS 353 was to bring together these diverging communities to ensure that our growing understanding of the Milky Way and other Local Group galaxies informs our understanding of distant galaxies, while also using information gleaned from large surveys of external galaxies to understand the formation and evolution of the Local Group and its galaxies in a cosmological context.

Over 200 scientists from 23 countries gathered in Shanghai for 4.5 days to discuss the major challenges that we are facing in galactic astrophysics. The Symposium brought together observers, simulators, dynamical modelers and theorists to discuss how their diverse expertise and state-of-the-art research techniques can be combined to address important open questions in galaxy formation and evolution.

The past decade has witnessed an explosion in high quality resolved data on the Milky Way and other Local Group galaxies, resulting in a substantial revision in our understanding of both the structures of the individual galaxies and the dynamical interactions between them. Astrometric data from the Hubble Space Telescope and the Gaia Satellite and spectroscopic data from numerous ground-based surveys have provided three dimensional kinematical data that have enabled us to model both the detailed dynamical structure of the Milky Way and several Local Group galaxies, and have provide us with a precise knowledge of their past dynamical interactions and the influence of these interactions on the stellar populations of these galaxies.

While there have been significant advances in the theoretical understanding of the internal structure and evolution of external spiral and elliptical galaxies, it is not yet clear what the relative roles of internal secular evolution and environmental effects (especially minor mergers) are in the cosmological context. It has become clear that bars and spirals drive substantial secular evolution in disk galaxies, though there are still unsolved questions regarding the mechanisms. It is also clear that the simple divisions between “disk and elliptical” systems are no longer valid and that disks contain spheroidal components (halos and bulges) that share properties of disks, while some ‘fast rotator’ ellipticals share some of the properties of disks. An important theme that emerged from the conference was the idea that models that consider both stellar populations and their kinematics (“chemo-dynamical models”) are crucial for understanding the evolution of galaxies. Such models are becoming increasing possible with the advent of large surveys and several advanced modeling tools that were discussed.

The Symposium provided an important and timely platform to discuss and share ideas on the applications of galactic dynamics to the Milky Way and external galaxies. The key topics included:

- The structure, dynamics, and assembly history of the Milky Way Galaxy
- Dynamical evolution of the Local Group and its members (including M31, the Magellanic clouds, dwarf spheroidal galaxies)
- Dynamical influence of internal secular evolution - the influence of spiral structure, radial migration and bars
- Key dynamical results from large spectroscopic surveys of external galaxies
- Dynamics of bulges, pseudo-bulges, nuclear star clusters and galactic nuclei
- Dynamical modelling of galaxies to measure the mass profiles of baryons and dark matter halos and central supermassive black holes using large integral field surveys
- Dynamics of stellar halos as seen by large surveys
- Dynamics of galaxies at high redshifts