Introduction

Opening by the Irish Minister for Education and Science, Mrs. Mary Hanafin, TD. Behind the table, from left to right: Pepi Fabbiano (SOC Co-Chair), Evert Meurs (SOC Chair) and Brian McBreen (LOC Chair).

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Populations of High Energy Sources in Galaxies
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Scope of this Symposium

E. J. A. Meurs

Dunsink Observatory, Dublin Institute for Advanced Studies, Dublin, Ireland
ejam@dunsink.dias.ie

The original idea for this IAU Symposium arose from realizing that present-day X-ray satellites, XMM-Newton and Chandra, are now allowing us to conduct studies of individual X-ray sources in other galaxies, much like this was until recently mostly confined to sources in our own Galaxy and in the Magellanic Clouds. In addition, γ-ray astronomy is catching up as it were, now being able to study well-defined sources in our own Galaxy with the INTEGRAL satellite, and also the highest-energy sources accessible, at TeV, with the newly constructed Cherenkov receiver array(s).

Observations employing high-energy radiation (X-ray, γ-ray) offer fascinating views of galaxies. As for a more everyday example, a human subject, different wavelengths of observation put the person in a different light, and highlight different aspects of the subject. Images of human faces in normal (visible) light are familiar enough, but when employing X-ray radiation we can focus on notably the underlying bone structure (the skull), and faces look different again at, for instance, UltraViolet or InfraRed wavelengths. The InfraRed mapping of a face, interestingly, can be used for deriving specific diagnostics of health conditions elsewhere in the body.

Similarly, when different wavelengths are used, galaxies show up in different ways. (For an example, compare optical and Xray images of the nearby galaxy M51, Figure 1 in contribution of Kilgard in these Proceedings.) The galaxian components highlighted at X-rays are stars in special, usually evolutionary advanced, stages of their development, e.g. X-ray binaries, SuperNova Remnants, colliding wind binaries, but also possibly a core source indicating some level of nuclear activity. Some galaxies feature noticeable diffuse emission components, such as the combined effects of stellar winds and supernova ejections. The individual sources (apart from a core source) represent comparatively short lasting stages in stellar evolution and the X-ray observations therefore highlight a particularly interesting, limited selection out of the 10^{11} or so members of the stellar population, thus being of specific diagnostic value.

Our ability nowadays to examine these X-ray sources in other galaxies in considerable detail, is a result of the improvements in the instrumentation of X-ray satellite observatories since X-ray astronomy began, 43 years ago with the discovery of the first X-ray source outside the solar system (Sco X-1).

As an example, it is instructive to follow how the X-ray observations became more informative for the nearest normal galaxy, M31 (the Andromeda Nebula). (For convenience of illustration we focus here on imaging data, but obviously spectral information has developed enormously as well.) In 1972 M31 appeared as an entry in the First Uhuru catalogue, a source with a 90% confidence area of 17 square degrees. The Uhuru satellite employed a collimator, that provided directional information but had no imaging capabilities. Around 1980 X-ray images were obtained, with the Einstein satellite of the central region of M31 in a HRI detector exposure (Van Speybroeck *et al.* 1979). ROSAT's HRI detector gave a still better image in the nineties (Figure 1). In 2004 Chandra obtained the sharpest picture to date; the correspondance with, and the improvement upon, the

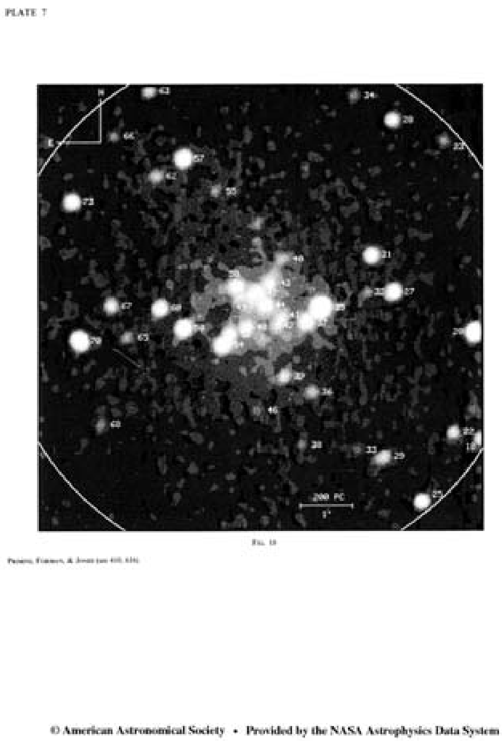

Figure 1. Central region of M31 with the ROSAT HRI (Primini *et al.* 1993).

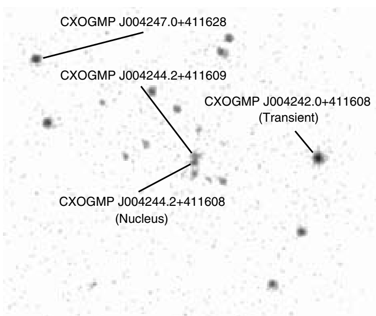

Figure 2. Central region of M31 with Chandra (Garcia *et al.* 2000).

comparatively much more diffuse individual source brightness distributions in the ROSAT HRI exposure is evident in Garcia *et al.* (2000; their Figure 1).

It is exciting that, at this moment, similarly important improvements in imaging capability are taking place at γ-rays (INTEGRAL) and at TeV energies (HESS array). These advances are also described in these Proceedings.

References

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