

# **The Data2Dome Initiative at the Iziko Planetarium & the IDIA Visualisation Lab**

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## **Abstract**

With the advent of LSST, SKA and other petabyte-scale data facilities, data storage and visualisation will pose new challenges for the astronomical community. The Iziko Planetarium 8K Digital Dome and the Inter-University Institute for Data Intensive Astronomy (IDIA) Visualisation Lab are two cutting-edge research facilities in Cape Town (South Africa) which are jointly exploring new approaches to handle the exploration of big astronomical (and multi-disciplinary) data sets, including 3D projections, Data2Dome initiatives and Virtual Reality Environments.

**Keywords:** miscellaneous, **methods:** data analysis, astronomical data bases: miscellaneous

## **1. Introduction**

With the advent of LSST, SKA and other petabyte-scale facilities, data storage and visualisation represent renewed challenges facing the astronomical community. In this context, having access to cutting-edge facilities capable of handling and visualising large amounts of data through innovative projection systems is of crucial importance for the advancement of *Big Data Science*. Inspired by these goals, a consortium of South African Universities, led by the University of Cape Town (UCT) and including the University of the Western Cape (UWC) and the Cape Peninsula University of Technology (CPUT), together with the Iziko Museum and the South African Department of Science and Technology have invested resources in upgrading the existing analogue Iziko Planetarium to transform it into the most advanced digital Planetarium of the entire African Continent (<https://www.iziko.org.za/museums/planetarium>). At the same time, the Inter-University Institute for Data Intensive Astronomy (IDIA) with some of the above partners has created an advanced Visualisation Lab (<http://www.acgc.uct.ac.za/~jarrett/VisLab/>) hosted at the University of Cape Town, where scientists, together with a team of software developers, can experiment on data visualisation techniques.

Figure 1: Examples of data visualisations on the Dome. **Upper left panel:** 3D immersive visualisation of the 2MASS Galaxy Redshift Catalogue; **Upper right panel:** galaxy groups visualisation identified using the Two Micron Redshift Survey (2MRS); The physical groupings are indicated with the spherical mesh; This project is part of the MSc/PhD of UCT student Trystan Lambert (supervisor: T. Jarrett); **Bottom panels:** 3D dome projection of a mouse embryonic fibroblast stained for mitochondrial DNA (red), autophagosomes (green) and actin cytoskeleton (magenta), led by Dr. B. Loos (Stellenbosch Univ., <http://www.neuroresearchgroup.com>)



## 2. Technical overview of the Iziko Planetarium and of the IDIA Visualisation Lab

As scientific data sets become larger and more complex, it is necessary to migrate to new technologies to facilitate scientific analysis and exploration. The new Iziko Planetarium Digital Dome was designed to have two computer clusters, one for public shows and production, and the other for scientific data visualisation research. The digital full dome theatre has the following key features: six Sony 4K Laser projectors (creating a total of ~8K pixel projection), two computer clusters, 5.1 Surround Sound, optimal reflecting dome, raised floor and a new control center. The projectors can be driven by either cluster. Each cluster has 12 client computers and one master computer, as well as a sound computer. Each computer has a NVIDIA P6000 GPU, which provides more than enough power to render large data sets on the fly as well as run numerical simulations. The primary software that is used to ingest data and drive the projectors is Sky-Skan's DigitalSky Dark Matter (DS-DM), which is capable of traditional planetarium functionality as well as modern data exploration. Researchers use their own cluster, allowing them to optimize setups and save work areas without disrupting the production/show computers. The IDIA Visualisation Lab hosts another set of cutting edge visualisation tools: the IDIA Wide Area Large Interactive Explorer (or WALIE), an 8K resolution visualisation wall for data exploration and scientific discovery, which allows to carry out scientific analysis on features of interest by exploring multiple analytics (graphs, statistics, ancillary data etc.) at the same time.

For a more immersive individual experience, the IDIA Visualisation Lab hosts the *Cobra*, a 4K curved visual display system. The Cobra Panorama is very well suited to investigate and explore hyperspectral images and catalogues, using existing software tools, as well as custom developed software that will be used across the IDIA platforms. Finally the Lab hosts equipment and floor space to develop VR immersive data set visualisations in which the researcher can explore the data from a very unique perspective. Research groups working on Big Data visualisation at any partner can use the Iziko Planetarium and/or the IDIA Visualisation Lab to develop their studies.

### **3. The *Data2Dome* initiative (in a nutshell)**

The Iziko Planetarium and Digital Dome has officially opened in May 2017 and since then a number of activities have been developed. New digital-format shows have been uploaded to the systems and regular schools and general public visits have begun. Along with the more traditional planetarium shows (enriched by novel African contents), research activities have also begun within the much broader international effort known as the *Data2Dome* initiative. The *Data2Dome* project (<http://www.data2dome.org>), led by Dr. Mark Subbarao (Adler Planetarium) and the International Planetarium Society, aims to streamline the process of ingesting astronomical data into the Dome environment, increasing the potential for scientific communication and storytelling in the planetarium as well as to prepare planetaria for the big data streams that will come from next generation telescopes and numerical simulations. In this context, at the Iziko Planetarium several multi-disciplinary scientific data sets have been ingested into the DS-DM, creating new opportunity for 3D data exploration in an immersive 360-degree context. A few illustrative examples of *Data2Dome* experiments conducted so far are reported in Fig.1.