

The Iziko Planetarium 8K Digital Dome: Big Data visualisation & public engagement

Lucia Marchetti^{1,2} and Thomas H. Jarrett¹

¹ Department of Astronomy, University of Cape Town
Private Bag X3, Rondebosch, 7701, South Africa

² Department of Physics and Astronomy, University of the Western Cape
Robert Sobukwe Road, Bellville, 7535, South Africa
email: marchetti.lu@gmail.com, jarrett@ast.uct.ac.za

Abstract. In 2017 the planetarium hosted by the Iziko Natural History Museum in Cape Town underwent a major upgrade from 1980-era analogue star machines to cutting-edge 8K digital projection driven by GPU-based computer clusters. This upgraded facility is conceived as both a conventional planetarium – edutainment – and a research facility for BigData visualisation and computing. The Iziko Planetarium 8K Digital Dome is the most advanced digital planetarium on the African continent, and is actively participating in the **Data2Dome** initiative which aims to facilitate the visualisation of scientific data on the dome.

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1. Introduction

With the advent of SKA and other TB-scale data facilities, data storage and data visualisation represent new challenges facing the scientific community. At the same time, one must be able to communicate Astronomy (or Science in general) with the Public in ways that are still able to capture the attention of the audience in an era of fast technological transformation. In this context, having access to cutting-edge facilities capable of handling and visualising large amount of data through innovative projection systems, and, at the same time, capable to create immersive experiences for the general audience is of crucial importance for the advancement of both the field of **BigData Science** and of Science Communication. 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.

2. Technical overview of the Iziko Planetarium

The new Planetarium system 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 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 cosmological simulations. The primary software that is used to ingest data and drive the projectors is Sky-Skan Digital Sky: 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.

3. The Data2Dome initiatives and other activities 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 in the systems and regular schools and general public visits have begun. Along with the more traditional planetarium show programs (enriched by novel African contents), the research activities have also begun. These first research exercises of data ingestion into the planetarium software have been immediately linked to the much broader international effort that goes under the name of **Data2Dome** initiative. The **Data2Dome** project (www.data2dome.org), led by Dr. Mark Subbarao (Adler Planetarium) and the International Planetarium Society, aims to streamline the process of putting astronomical data in 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. These first data visualisation exercises are already enabling novel approaches to e.g. study the galaxy clustering properties and the Cosmic Web. Both these studies greatly benefit from the 3D data rendering in the Dome, but more work will be done in other research fields such as biology, neural and medical science.



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., www.neuroresearchgroup.com)