Authentic Astronomical Discovery in Planetariums

Bringing Data to Domes

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Planetariums offer a unique opportunity to disseminate astronomical discoveries using data visualization at all levels of complexity: the technical infrastructure to display data and a sizeable cohort of enthusiastic educators to interpret results. "Data to Dome" is an initiative the International Planetarium Society to develop our community's capacity to integrate data in fulldome planetarium systems—including via open source software platforms such as WorldWide Telescope and OpenSpace. We are cultivating a network of planetarium professionals who integrate data into their presentations and share their content with others. Furthermore, we propose to shorten the delay between discovery and dissemination in planetariums. Currently, the "latest science" is often presented days or weeks after discoveries are announced, and we can shorten this to hours or even minutes. The Data2Dome (D2D) initiative, led by the European Southern Observatory, proposes technical infrastructure and data standards that will streamline content flow from research institutions to planetariums, offering audiences a unique opportunity to access to the latest astronomical data in near real time.

IPS Science Data & Visualization Task Force

"Data to Dome" is an initiative of the International Planetarium Society (IPS) Science Data & Visualization Task Force to make it easier to visualize scientific data in a planetarium. By providing the planetarium community with software tools and professional development opportunities, we hope to expand the use of data visualization in modern planetariums.

ips-planetarium.org/page/data2dome
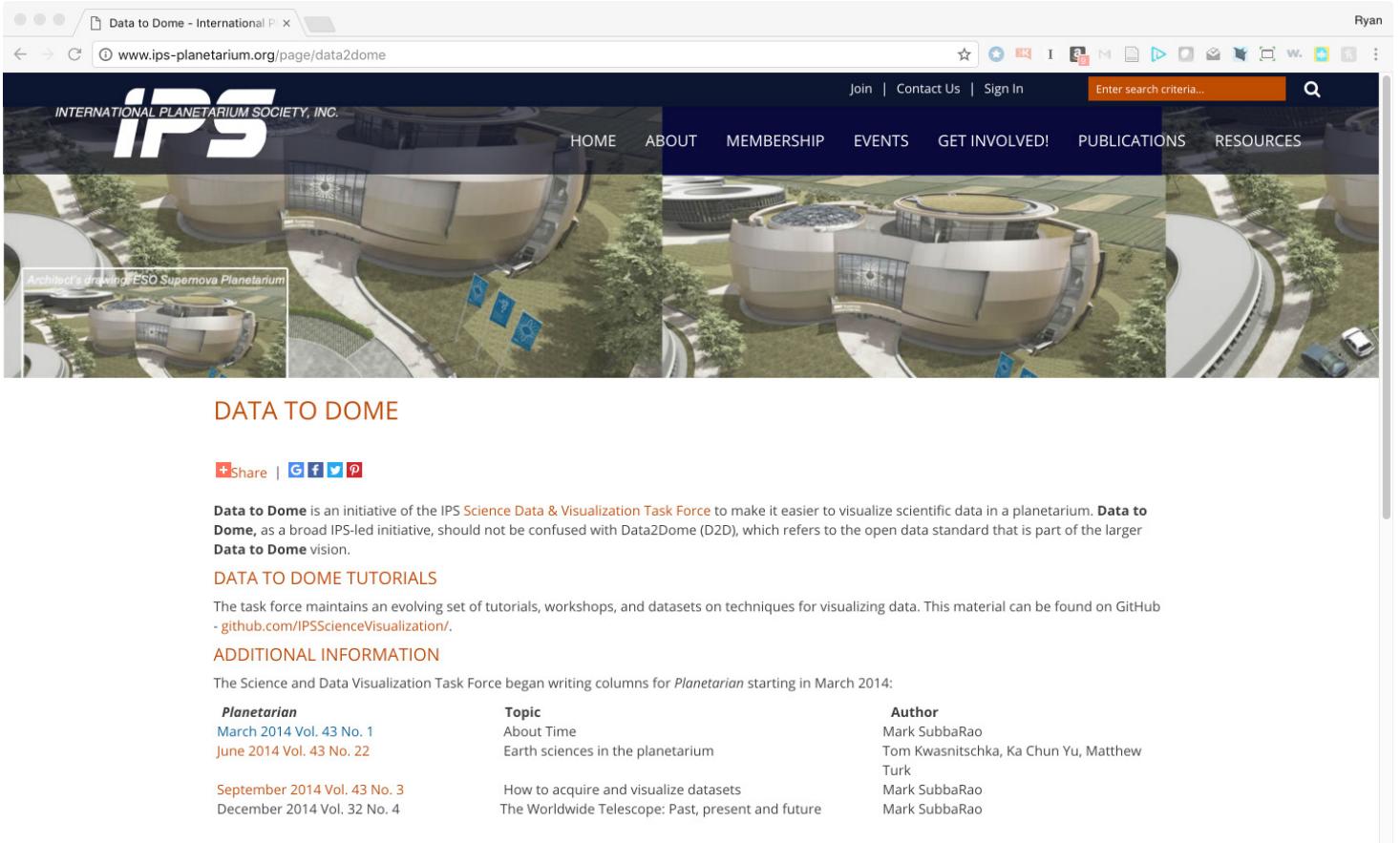
The task force maintains an evolving set of tutorials, workshops, and datasets on techniques for visualizing data, available on GitHub.
github.com/IPSScienceVisualization

Data2Dome

Data2Dome is an effort of the European Southern Observatory (ESO) and the International Planetarium Society. It uses a content distribution and publishing standard aimed at bringing astronomy data seamlessly into planetarium systems real-time It allows data providers to publish news and information "feeds" which may be accessed directly via planetarium software. The vision is that every day, planetarium presenters can access a menu to select fresh news, datasets, sky event data, historical event data and more. Content, and metadata describing it, are fed via a reasonably fast Internet connection (at least 10-20 Mbit/s) into the planetarium system automatically, significantly reducing the workload for the planetarium operator.

Every morning, planetarium presenters around the world will be able to access a menu that will allow them to select interesting news and fresh datasets — news, sky event data, historical event data and more (see the use cases below) — and mark up the full datasets and metadata for download, for possible inclusion in show segments during the day. Some of these items may be under embargo and will only be shown when they are public. In some sense the presenter can be seen as an "Astronomical Weatherman" being able to report on fresh events almost as they take place.

D2D launched early in 2017. Its first implementation is through a Evans & Sutherland Digistar 6 platform. Work is continuing with other planetarium vendors to incorporate it into their systems as well.

data2dome.org

Potential Reach

Space science and astronomy are attractive subjects to both students and the general public. Contact with these subjects has a positive effect on students' interest in science and scientific careers, and on public support for science and technology. In addition, the importance of science museums to scientific learning is well known. Museums are among the main sources that people rely upon for learning about science and technology (Falk, 2007). Planetariums are important venues where the public can get excited about science and as learning environments they have a proven advantage over classrooms and other venues. Yu et al. (2015) found that immersion in a dome theatre leads to greater learning in university students. The wide field of view reduces the cognitive load for spatial understanding, and the stimulation of the peripheral vision leads to greater attention.

Looking at estimated annual attendance figures for planetariums around the world (school shows, public shows, concerts, laser shows, counted together) reveals some striking numbers. It is estimated that in 2017, up to 152 million people visited the 4,105 planetariums around the world (Loch Ness Productions, 2018). And this number may be on the increase (for comparison, in 1995, an estimated 75 million people visited the then existing 2,613 planetariums around the world). Not only is attendance high, but planetariums are also among the science-related activities and attractions that people would most like to visit. A study conducted in the UK reported that one in five (20%) UK citizens had an interest in visiting a planetarium, which contrasted with 12% who expressed an interest in visiting a museum or a science center (Mori, 2005).

Planetariums provide an opportunity to communicate data-driven astronomical discoveries to these broad audiences. The key is supporting the planetarium community in being able to access, visualize, and display the data—and to describe astronomical results to their audiences.

Planetariums, from their inception, have been about data visualization. For most of their history (including the history of mechanical planetariums, stretching back to the Antikythera mechanism) it was all about visualizing one dataset: the optical night sky, including the position of the visible stars, sun, Moon, and planets. The introduction of digital dome technology in the last two decades has allowed the unprecedented ability to immerse audiences in almost any dataset, vastly expanding the power of the planetarium to visualize and inspire—think of it as a group VR experience.

Figure 1. Adler Planetarium in Chicago, IL, United States—the oldest planetarium in the Western Hemisphere, which has supported digital displays since 1999.

Figure 2. A promotional image for the Eugenides Planetarium in Athens, Greece.
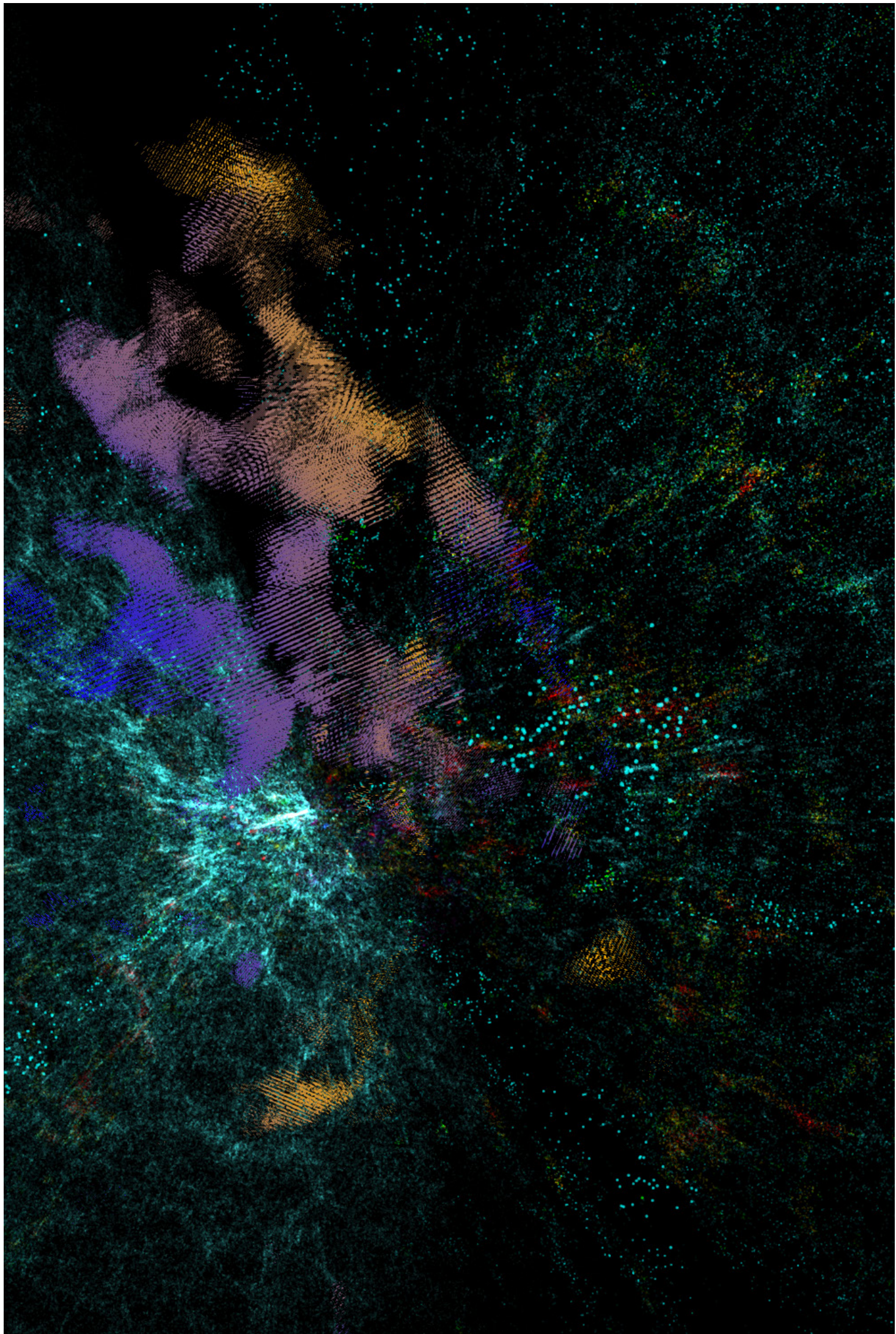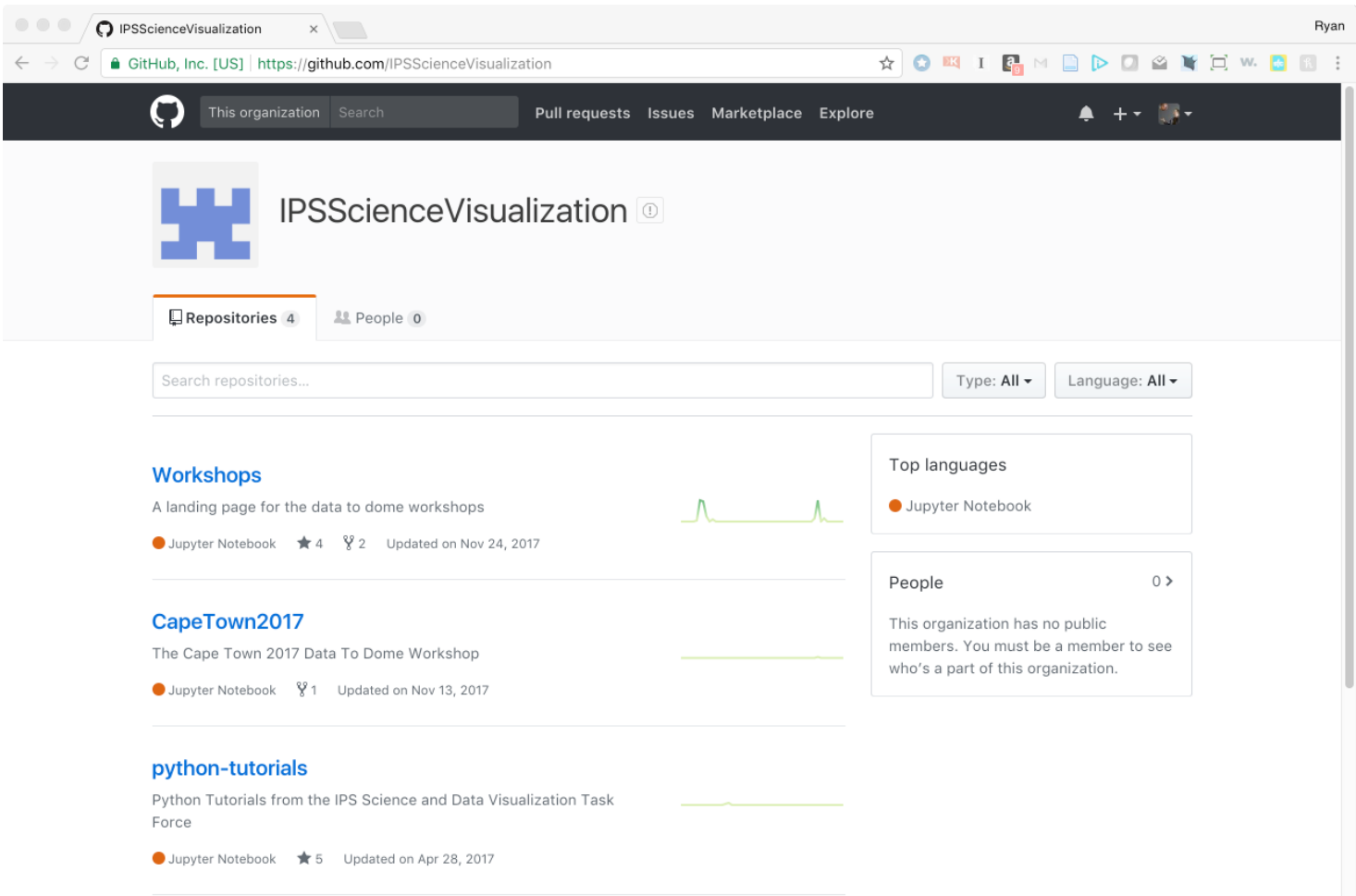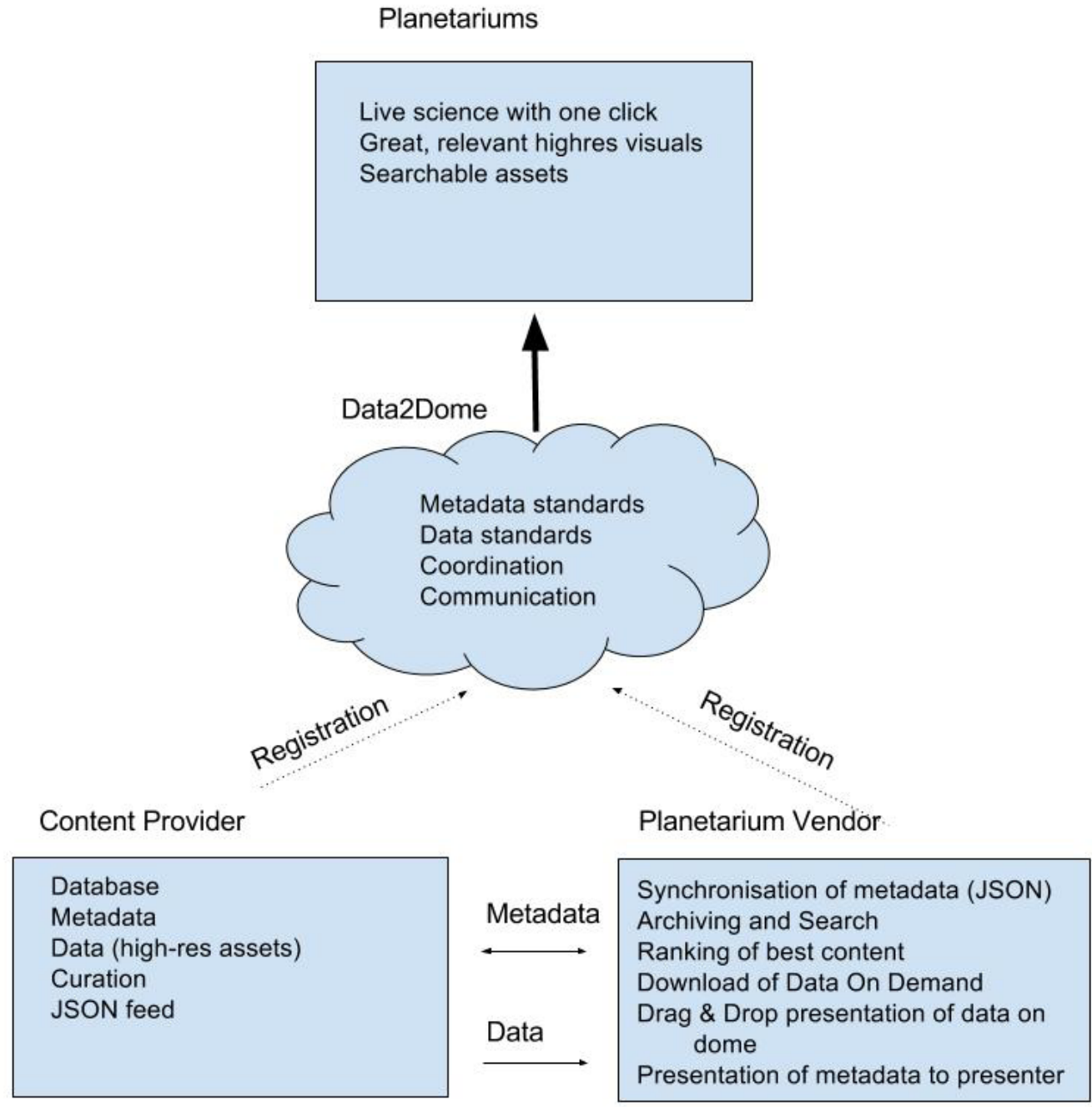

Figure 3. A collaborative visualization between Adler and Morrison Planetariums of dark matter distribution, color coded by velocity, adapted from Leclercq et al. (2017).

Data2Dome leverages the Astronomy Visualization Metadata standard, which leverages the work of the IAU Virtual Astronomy Multimedia Project (VAMP) Working Group under IAU Commission 55 Communicating Astronomy with the Public (Hurt et al, 2007).

virtualastronomy.org

References

European Commission, Eurobarometer 224/Wave 63.1: *Europeans, Science and Technology* (2005)

Falk (2007). Investigating public science interest and understanding: evidence for the importance of free-choice learning. *Public Understanding of Science*, vol. 16 (4), pp. 455–469

Hurt, R. , Christensen, L.L, Gauthier, A & Wyatt, R, Sharing Images Intelligently: The Astronomical Visualization Metadata Standard, *Proceedings from Communicating Astronomy with the Public 2007*, eds. L. L. Christensen, M. Zoulias & I. Robson, 2007, pp. 450–453

Leclercq, F., Jasche, J., Lavauxc, G., Wandelt, B., and Percival, W., The phase-space structure of nearby dark matter as constrained by the SDSS, Journal of Cosmology and Astroparticle Physics (June 2017)

Loch Ness Productions database, 2018: lochnessproductions.com/reference/attendance/attendance.html

Mori (2005). Science and Society. London: Office of Science and Technology. National Science Board (2014). Science and Engineering Indicators, Arlington: VA:NSF

Yu, K.C., Sahami, K., Sahami, V., & Sessions, L.C., 2015, Using a Digital Planetarium for Teaching Seasons to Undergraduates, *Journal of Astronomy & Earth Sciences Education*, 2(1), pp. 33–50

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