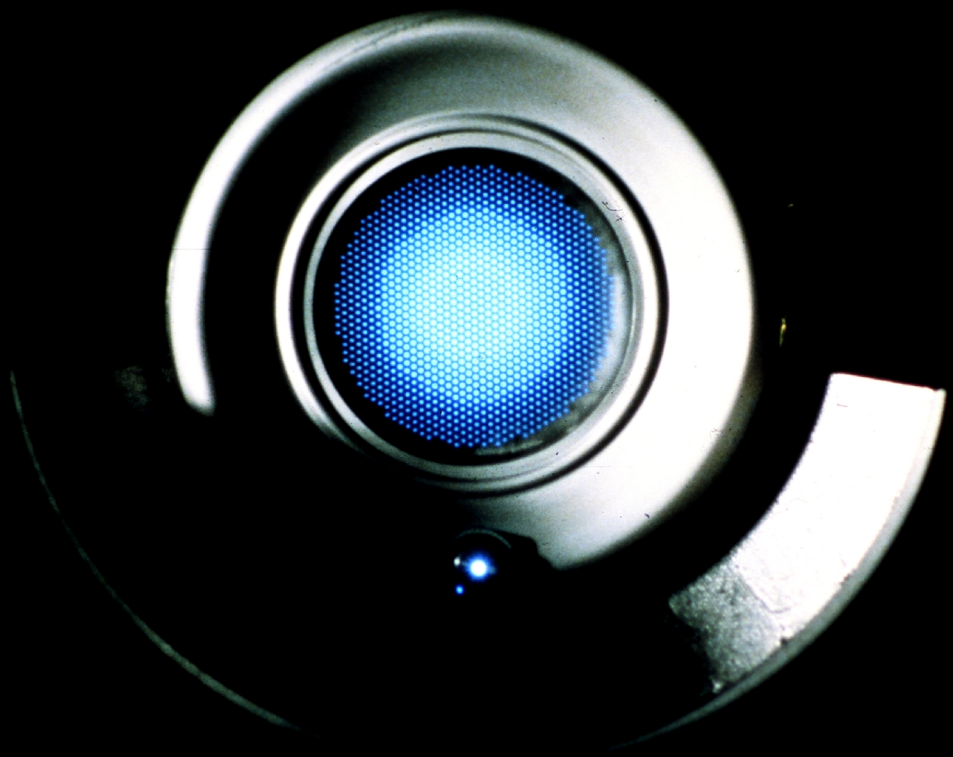
MUSEUM OF
SCIENCE FICTION

Washington DC
USA: Earth / Sol: Milky Way



Ambient Intelligence at the Museum of Science Fiction

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EARTH: SOL: MILKY WAY

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Cover art: Staring into the glowing blue exhaust of a mercury-ion thruster, February 1980; James L. Long and Associates (photo).

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Contents

What if . . .

HAL 9000
2001: A Space Odyssey

Science fiction has introduced us to advanced robots and computers that possess a high degree of intelligence. Remember GORT from *The Day the Earth Stood Still* (1951) and the HAL 9000 from *2001: A Space Odyssey* (1968)? These films have shown us what could be possible, given sufficient computing power and technical resources. The world of literary science fiction is even richer with alternatives that influence researchers in artificial intelligence today, concepts like Isaac Asimov's "Three Laws of Robotics" and other proposals for how to keep our new creations . . . on our side.

This white paper explores how science fiction can retain its fundamental essence – of being fun – while using the latest technology tools to inspire, entertain, and even teach. Science fiction has always been very good at asking "what if" questions, in which technology advancements later catch up with. For a science fiction museum, the opportunity is to create exciting and transparent environments that will interact with visitors in immersive new ways,

In a built environment, this is called "smart architecture." Over the past two decades, these intelligent systems have slowly entered the mainstream, offering home environment controls that learn and automatically adjust to meet personal needs. Among these smart products are wi-fi enabled security systems that allow people to remotely monitor and control their homes, thermostats that learn personal preferences, and responsive entertainment systems. Through seamless integration, these technologies aim to provide a personalized experience and make our daily lives easier, in a promised "Internet of Things."

These intelligent building technologies can extend beyond mere security and environmental controls. They can provide immersive and personalized, context-aware experiences that serve to encourage learning and immersive participation. They can enhance visitor experiences. Integrated with social media and mobile devices, these technologies can also facilitate increased personal interaction. Advancements in speech recognition, robotics, and artificial intelligence have opened new doors to how we experience our surroundings and interact with others. We are only now beginning to realize the true potential. Which prompts a question, what if the Museum of Science Fiction offered a showcase for this transition, taking smart architecture a little further to create an interactive, transformative, immersive, and educational experience for visitors?

This white paper discusses that possibility and the requirements involved for a museum to create an interactive environment that can simultaneously entertain and educate – presenting visitors with easier ways to understand more challenging scientific conceptual areas.

"Any sufficiently advanced technology is indistinguishable from magic."

Arthur C. Clarke

The embedded, contextual, and personalized future

At an increasing pace, technologies once thought to be solely in the realm of science fiction are steadily becoming reality. Cloaking devices, nanotechnology, 3D printing with advanced materials, and thought-controlled instruments are all being alpha prototyped and tested. As appetites and expectations for higher performance technologies increase, the mean time to reality (MTTR) will continue to drop. The next 20 years promise to be exciting as innovations build on innovations, and new technologies become ordinary more quickly. This environment presents new opportunities for institutions, such as museums, to begin exploring how best to integrate these concepts. One such not-so-new concept is ambient intelligence.

Ambient intelligence arose from several research areas involving pervasive networks, ubiquitous computing, context awareness, and human-centric computer interaction design. In *The Invisible Future: The Seamless Integration Of Technology Into Everyday Life* (2001), researchers Aarts, Harwig, and Schuurmans described the concept as having the following characteristics:

1. Embedded: many networked devices are integrated into the environment
2. Context aware: these devices can recognize a person and their situational context
3. Personalized: they can be tailored to individual needs
4. Adaptive: they can change in response to a person's needs
5. Anticipatory: they can anticipate a person's desires without conscious mediation

The technology needed to execute these concepts in a museum setting already exists. At the Museum of Science Fiction, for example, we see the potential to embed ambient intelligence into the gallery spaces so *amb-i* can be aware of and recognize visitors. Using common mobile devices, Museum visitors will be able to access enhanced exhibit content by connecting to the Museum's local area network. In this case, ambient intelligence may be built into the environment to allow Museum visitors greater interactivity and learning opportunities from exhibits and display objects – creating a personalized experience that balances entertainment with education.

Concerns over protecting user data and user privacy can be addressed by configuring the software to erase personal data after each session – if the user does not want the system to retain their data for their next visit. User-supplied data in an ambient intelligent system would likely be limited to user preference data and not sensitive personal identifiable information – much like the way a recommendation system works on Netflix.

You should meet *amb-i*

MOSF Mobile App

Designing ambient intelligence is a lot easier than creating artificial intelligence, although the final result might seem similar.

The main objective for putting ambient intelligence into the Museum of Science Fiction is two-fold: enhanced visitor engagement, and to experiment with a new type of STEAM (Science, Technology, Engineering, Arts, Math) educational tool. The Museum's initial requirements began with basic features and functionality and will gradually evolve to include more sophisticated adaptive and anticipatory behaviors.

This system is called *amb-i. amb-i* is enabled by installing and configuring software on a mobile device. The mobile software is then configured by the user, who sets their individual preferences in a series of screen sequences and sub-menus. When the set-up is complete and the app is initialized, the software will stay resident in the background and wait for *amb-i* awareness and recognition.

Using a network of sensors and beacons, *amb-i* will detect and recognize individual visitors via their mobile device as they move about the exhibit spaces. *amb-i* will then interact with the visitor, either by voice or by presenting information on display screens. A holographic projector may also present a 3D image of the visitor's favorite science fiction character, for example, with a spoken welcome greeting in the visitor's native language. The hologram may suggest a museum itinerary based on the visitor's preferences. Individualized tours could be dynamically arranged based on *amb-i* accessing the visitor's configuration settings and preferences.

For example, let us add some visitors to an exhibit space and have *amb-i* recognize that a few of them happen to like the film, *Interstellar* (2014). From here, several things can happen:

1. *amb-i* can notify Museum staff for an opportunity to provide an impromptu mini lecture about an *Interstellar*-related topic, maybe something about time travel and relativity, or perhaps suspended animation.
2. *amb-i* can present information on actual technologies in development such as NASA's TORPOR project related to suspended animation.
3. *amb-i* can direct visitors to Interstellar-related content around the Museum so they can meet other visitors.
4. New learning opportunities can be presented about related topics, ie. relativity and black holes, faster than light travel, and cryogenics.
5. Visitors can communicate with each other via *amb-i* and form relationships creating new social and learning communities.

Dynamically creating like-minded visitor communities involves another concept called architectural sociability. Steven Ochs defines architectural sociability as, "the advance of interactive architecture attempting to integrate social

communication and technology with built environments as an effective design solution using social networks, localized data streams, ubiquitous computing, pervasive networks, and smart environments."

The potential for *amb-i* to create new communities, both virtually and physically, is good, given science fiction's large worldwide popularity. It also can serve as a device to bring together virtual visitors and visitors at the physical site. These increased social connections will raise awareness, build interest, and allow easier access to a physical place that might be too geographically remote for some people to actually visit on a regular basis.

Another interesting aspect of blending virtual experiences with the actual physical location is that the virtual museum would always be open to an unlimited number of people at any given time.

Given the world's 24 time zones, overlaying the virtual museum on top of the physical museum allows global visitors and their friends to enter the museum whenever they like. The challenge is to create a realistic virtual world that equals the physical world's excitement and wonder – almost like navigating a remote VR drone around some distant location – similar to the way that NASA maneuvers its Mars rovers from the Jet Propulsion Laboratory in Pasadena, California.

A departure from museums as usual . . .

The primary goal for the Museum is to provide a rapid point of departure from museums-as-usual and give visitors new ways to interact with STEAM educational content that provides enhanced learning and entertainment experiences.

Science fiction has always enjoyed remarkable popularity with a large global community. For this reason, it is important for the Museum to bring exhibits to people that cannot physically experience everything in single location. The Museum will geographically expand the exhibitions using augmented and virtual reality. Virtual visitors will have continuous access to the galleries and enhanced programming in their native language.

The over-the-horizon social aspects and STEAM learning possibilities with the virtual-physical capability are intriguing. Besides interacting with other visitors and facilitating new social connections, *amb-i* will also give users wireless control of display objects. Once in the gallery space, visitors will be able to operate display objects and explore STEAM-related content – from their phones or their VR headsets and controllers.

Imagine a work of art that teaches . . . or a teaching tool that inspires and dramatically expands our horizons. Outward, to far galaxies . . . or inward, to sub-atomic particles in quantum computers . . .

The Museum's technology exhibits present unique opportunities to facilitate building visitor communities with similar interests, using *amb-i* to provide a sense of community/interaction without physical proximity to other people. For example, the "stillsuit," from Frank Herbert's novel *Dune*, was used as a survival suit that reclaimed water on the fictional desert planet, Arrakis Prime. This exhibit could compare the fictional suit to real-world advances in water reclamation and purification technology. The visitor could use their mobile device and augmented reality to learn how the stillsuit operates. Animated cutaway views of the display object could glow to illuminate the stillsuit's different water processing systems.

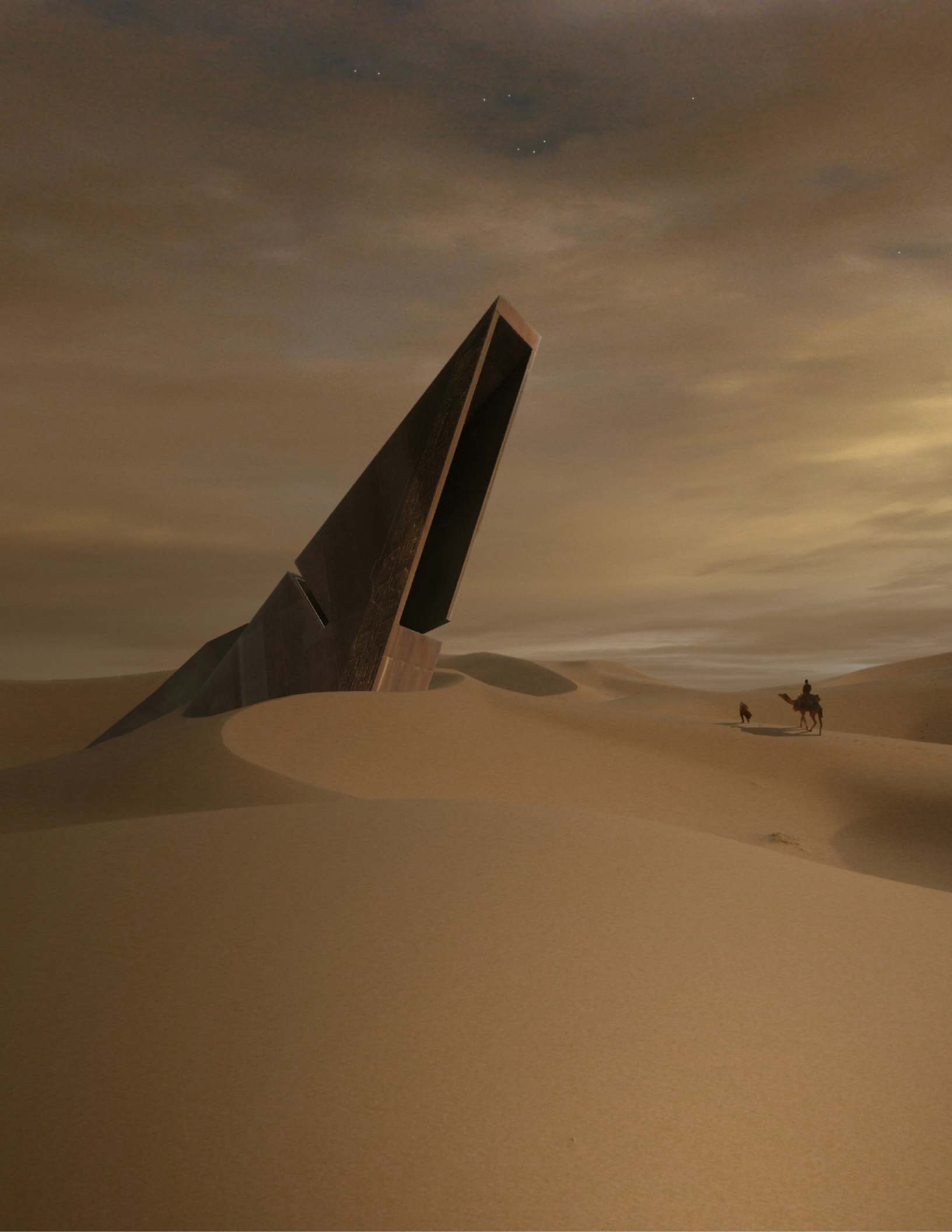
Sandworm, *Dune*

We have the capability to go beyond just creating an exact virtual model of the physical museum. VR Technology like Oculus can allow incredible freedom to augment what might be too big, too expensive, or too fantastic for the physical world.

This technology may be applied to provide students with a more engaging approach to learning about anatomy or physiology. For example, imagine being a student and walking into a (virtual reality) exhibit space to browse a vast science fiction catalog containing data about other worlds, vehicles, exobiology, technology, computers, and robots. You virtually sit down at a console and view (using Meta Quest) the exobiology sub-catalog. Scrolling through various categories: Literature, Television, Film, Not Classified . . . you tap "Literature" and browse another sub-catalog of lifeforms you've never seen before, created by the Museum's artist community. One catches your eye. It's labeled, "Sandworm." You double tap the image on the screen. A full-size, three-dimensional life form begins to form in front of you. It looks like a gigantic earthworm. You walk around the Sandworm to see the creature from different angles. A button on your virtual forearm controller is labeled, "cutaway." You press it and the species disassembles showing you internal biological systems and functions.

Organs glow and shimmer, arteries glisten.
You press "Cutaway" again and the body parts reassemble.

There is another button on your forearm controller labeled, "animate." You press it and the species comes to life showing you normal movement and associated sounds. If interested in further study, the visitor may press the "print" button on their forearm controller and a small 3D model of the species prints on a non-virtual 3D printer.



The learning objectives that go along with this example could provide students with a more interesting approach to understanding high school anatomy or physiology – not just exobiology.

Scenarios like the one just described are not science fiction anymore, given the present state of the technology and what will be available within the next few years. The Museum of Science Fiction presents a unique test-bed to experiment with multidimensional learning tools using integrated technology overlays – not just to entertain, but to educate as well.

WALL-E
WALL-E, 2008

Looking ahead

Ultimately, technologies like ambient intelligence, augmented reality, and virtual reality have the capability to transform visitor experiences – both within a physical museum and a virtual environment. As we look ahead to developing tangible learning objectives via software and programming that provides meaningful content with measurable results, we hope to create a new physical and virtual space that can entertain and educate. Museums in the 21st Century have a unique opportunity to usher in new levels of excitement based on their existing resources.

Art museums and history museums can also benefit from new technological overlays – adding more engaging, immersive depth to existing collections and exhibitions – already very rich in informational content. These technological overlays may also offer potential new monetization opportunities with access to special content and experiences – much in the same ways that video game publishers offer new add-on features to popular titles for large existing gaming communities eager for new toys.

Einstein said it best, “Imagination is everything. It’s the preview of life’s coming attractions.” At the Museum of Science Fiction, we could not agree more.

Authors

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