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Mehrnaz Rohbakhsh

Mapping Time: Harmonic Studies for Vera Rubin

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In this age of fragmented reality, Mehrnaz Rohbakhsh's *Mapping Time: Harmonic Studies for Vera Rubin*, is a fresh and welcome contemplation of universality and scientific truth. The work is a meditation inspired by galactic motion and grounded in the physical reality of gravity. The scale of the drawings, as well as the dark walls and lighting of the installation serve to evoke awe and even reverence, but rather than appealing to personal deities, Rohbakhsh points us to the skies, to the galaxies and to a simple but absolute truth that we all share: the effects of gravity.

Rohbakhsh's work is dedicated to Vera Rubin, the astrophysicist responsible for providing much of the evidence for the existence of dark matter, who was a pioneer both as a scientist and as a woman in a male dominated field. She was the first woman to use the telescopes at Mount Palomar Observatory (women were literally banned from using the telescopes until the mid 1960s). While Rohbakhsh pays personal tribute to Rubin in her title, the work itself strictly focuses on the scientific concepts to which Rubin contributed.

The first drawing describes Albert Einstein's gravitational field equations. While there is no direct mapping of the equations to the drawing, it very effectively conveys two central ideas about Einstein's theory of gravitation. The panel on the left conveys the non-linear relationship of the gravitational attraction between two objects and the distance between

them. This is a feature shared by the gravitational theories of both Einstein and Isaac Newton. While Newton's gravitational theory was very successful in predicting the large scale motions of planets and stars, eventually more precise measurements of Mercury's orbit revealed discrepancies from the theory, the resolution of which eventually required a new way to model gravity. The repeated curves overlaid on the grid background in Rohbakhsh's first drawing evoke the search for a new theory: the existing one had the right shape, but the measurements revealed irregularities. While the measured irregularities seemed small, it turned out that in order to resolve them, Einstein had to construct a theoretical framework that broke radically from Newton's theory. Rather than thinking of gravity as a force signal that travels through space and time, Einstein instead saw gravity as a deformation of the fabric of space-time.¹ The panel on the right conveys this central concept of Einstein's gravitational theory – that the space behind the action of the curve is active in all kinds of detailed and compelling ways.

The second drawing depicts graphs from astrophysicist Vera Rubin's original research, which accumulated evidence for the existence of dark matter. The drawing includes graphs from a 1976 publication in which Rubin was able to deduce the motion of our own galaxy through a deep analysis of observations of far-away galaxies,² and graphs from a work published in 1980 in which she presented detailed measurements of the rotational velocities of a range and variety of galaxies, which amounted to the first set of robust evidence for dark matter.³ This evidence comes from measurements of the rotational velocity of spiral galaxies along the radius of the galaxy. Rubin and her team observed that the edges of spiral galaxies move at the same rate as the center region. Given the galactic mass distribution observed through telescopes, it was expected that

¹ Another important feature of Einstein's theory is that it does not differentiate between space and time, therefore physicists refer to the substance of the universe as a single entity, named space-time.

² "Motion of the Galaxy and the local group determined from the velocity anisotropy of distant SC I galaxies. II - The analysis for the motion" V. Rubin et al, *Astronomical Journal*. vol. 81, Sept. 1976, p. 719-737.

³ "Rotational properties of 21 SC galaxies with a large range of luminosities and radii, from NGC 4605 /R = 4kpc/ to UGC 2885 /R = 122 kpc/" Rubin et al, *Astrophysical Journal*, Part 1, vol. 238, June 1, 1980, p. 471-487.

the peak velocity of rotation should be somewhere near the center of the galaxy and that the edges of the galaxy would be moving much more slowly. The conclusion that fell out of the measurement analysis was that there must be a lot more matter in the galaxies than we can see, and this invisible matter was dubbed 'dark matter.' Rohbakhsh's drawing conveys the laborious process of assembling the detailed observations and comparing them to modeled predictions, which then presents the assemblage of evidence that introduced dark matter to our human body of knowledge.

The third drawing serves as an illustration of the rotational properties of spiral galaxies from a spatial perspective, detailing the complexity and variety of textures within galaxies. While the second drawing maps the velocities of and within various galaxies, this third drawing illustrates a galaxy from a spatial perspective, their literal layout as they would look through a telescope. This is the only colour illustration in the installation, but it is monochrome, in blue, referencing the sky, and architectural blueprints used to map spatial layouts.

The installation is completed by a sonic piece that translates the drawings into an immersive soundscape.

Rohbakhsh's practice is outwardly reflexive rather than inward looking. Instead of identifying a personalized perspective from which to speak, she hopes to let the universal speak. In her practice, she positions herself as a neutral interpreter: learning how to better coax equations that reveal physical truths into expressing themselves through her artistic visualizations and through her sonic works. She doesn't position herself as a woman, as an immigrant, as a daughter of refugees, but instead as an interlocutor of ideas, big ideas, ideas that exist beyond individual human identities. Rohbakhsh aims to express universals, to create work that stands alone on its ideas, on its conceptual and formalist principles. Such expression is a privilege that has been traditionally only afforded to white men, but Rohbakhsh claims it confidently and unassumingly, not unlike the way Vera Rubin confidently and unassumingly claimed the privilege

traditionally only afforded to men of observing, recording, and explaining the motions of the universe.

- Ana Jofre