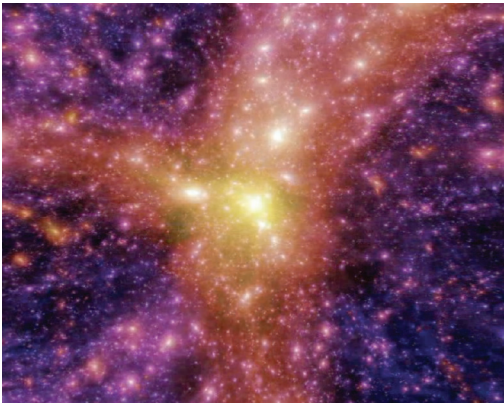


STRATAGRIDS for
A Matter Theater

MEASURING INFINITY A TEST ARRANGEMENT



A Conversation with and about
The Millenium Simulation

MEASURING INFINITY

A TEST ARRANGEMENT

STRATAGRIDS

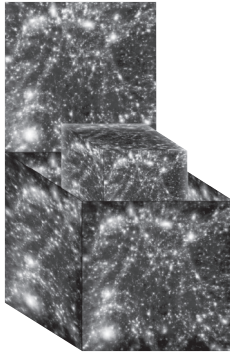
The Anthropocene Project. A Report.

A Matter Theater

HKW, 2014,

October, 16-18

A Measurement of Infinity: THE MILLENNIUM-SIMULATION



How to measure the immeasurable?

According to physicists, 95 percent of the universe consists of dark matter and dark energy, phenomena that cannot be observed, only indirectly traced and described. The Millennium-Simulation is an attempt to shed light on this supposedly powerful and yet imperceptible entity. Developed at the Max-Planck Institute for astrophysics in Garching (Germany), it exists as a parallel universe, a programmed copy of the existing one, including its beginning and entire lifespan to date.

In 2005, after about a month of calculation, the simulation was conceived with the help of a supercomputer the size of a supermarket. Since then, the simulation has served as a tool to address several hundreds of dark matter-related research questions.

Theoretical astrophysicists, who exclusively work with the simulation, use animated visualizations to communicate their research results to the science community as well as the general public. The generated images can be seen in full color HD.

The following conversation is set around a paradoxical situation of the imperceptible, yet simulate-able and animate-able. Akin to a continuous bonfire, the animation provides an appeasing and enlightening hub of concentration for the protagonists, and acts as a point of orientation in the infinite darkness of space.

CAST

DARK MATTER

MILLENNIUM-SIMULATION

simulates the formation of the universe
and the circulation of dark matter

CALCULATOR

generated the simulation

IMAGE MAKER

his assistant

OBSERVER

sees the universe through a telescope

WRITER

author of many short-stories and essays

PHILOSOPHER I

wants to meet the universe halfway

PHILOSOPHER II

nonchalantly enlightened

PHILOSOPHER III

believes in ghosts

CALCULATOR

Most of the ordinary matter in the universe—the stuff that makes up all the atoms, stars, and galaxies astronomers can see—is invisible.

It is either sprinkled throughout intergalactic space in tenuous forms that emit and absorb little light or else swaddled inside galaxies in murky clouds of dust and gas. When astronomers look out into the night sky with their most powerful telescopes, they can see no more than about 10 percent of the ordinary matter that's out there.

To make matters worse, cosmologists have discovered that if you add up all the mass and energy in the universe, only a small fraction is composed of ordinary matter.

A good 95 percent of the cosmos is made up of two very different kinds of invisible and as-yet-unidentified stuff that is “dark,” meaning that it emits and absorbs no light at all. One of these mysterious components is called dark matter. It seems immune to all fundamental forces except gravity and perhaps the weak interaction, which is responsible for some forms of radioactivity.

So how can we make sense of the universe, when 95 percent of it is not discernible to humans?

Lights off.
Millennium-Simulation on.
The conversation begins.

PHILOSOPHER I

Matter requires at least one other entity in order to be itself.

DARK MATTER

I am dark matter. I rule cosmic evolution on large scales, and I am the dominant source of gravity.

Thus, you can follow evolution in the dark part of the universe without worrying about other aspects of physics, like shocks, radiative cooling and heating or star formation, that affect ordinary matter.

The stuff I'm made of, you can't see in your laboratories.

That's because you won't find me interacting with conventional matter. I fly through earth, the solar system or even you people, without feeling even the slightest resistance.

I am exclusively subject to gravity. Ruling out this apparent and yet negligible fact, you might as well say that I am nothingness or for that matter: the void.

Rather than a form of matter, I am the absence of matter.

The blank page.

Utter silence.

No thing, no thought, no awareness.

IMAGE MAKER

To identify these strange and dark substances, we require more than just the evidence collected by telescopes. We need theoretical models of how the universe evolved – and we need a way to test those models. Fortunately, thanks to recent progresses in supercomputing, it's now possible to simulate the entire evolution of the universe numerically.

We rebuild the universe in order to understand it – in order to penetrate its in-transparencies.

CALCULATOR

The basic recipe goes as follows: take the original condition of the universe and reenact it on your computer. Add all laws of physics that are considered relevant for the cosmos. Then you calculate your way through time and examine what sort of universe will come of it.

A conventional computer won't do for this task, of course. The universe is humongous and somewhat elusive, as it constantly expands.

So even the supercomputers we use take about a month to compute the simulation. Once the calculation part is done, the obtained data can be applied to a wide variety of universe-specific questions. To communicate the answers we may find to those questions to laymen, we need to generate appropriate images.

MILLENNIUM-SIMULATION

Well, my appearance depends on the specific question you confront me with:

For instance, what can be considered a fair-sized sample for the problem, you wish to address?

I am only as vast as the smallest region of the universe you'd like to look at.

And keep in mind; the bigger my individual simulation particles are, the coarser my resolution, the more I'll have to compromise the structure of your object of interest.

The deeper you look into me, the larger the distances that you'll travel backward in time become. Actually, for reasons of exactitude, I am substantially larger than the minuscule region you survey.

WRITER

So, you are....a replica of the universe?
Like a 1:1 map?

MILLENNIUM-SIMULATION

{laughs shyly} In a way, yes. But I'm really more of a multidimensional map, showing space and time in relation to one another.

Mathematically, I am indeed capable of showing the whole, infinitely large universe. Given that my basic cube made up of simulated particles has an edge length of 2.1 billion light-years, I contain all possible variations of galaxies. Therefore, you can replicate this basic cube of mine in any space-direction.

OBSERVER

How come your appearance somewhat reminds me of images of a human's nervous system? Is this likeness intended? After all, the matter you depict is essentially supposed to be amorphous. If this so-called dark matter you apparently bring to light is so dark, why do you show its aggregation as light? {laughs}

IMAGE MAKER

We couldn't just show the program lines from our simulation codes in the way they flicker down our computer screens. No one would understand a thing. So, we use conventional imagery as an inspiration for our visualizations.

OBSERVER

{laughs} Now, that's pretty random. The image you generate has no relation whatsoever to the subject you are investigating. In fact, there is no image for what you are investigating.

WRITER

But mapping is often an act of abstraction with no direct visual reference. Your little quarrel reminds me of this short story I wrote a long time ago, it was about an empire, whose guild of map makers were quite precise about the directness of their mapping references. In fact, their cartography skills became so advanced that they developed a map, six yards to the mile. However, soon this map didn't satisfy them any more, so they tried making a map that was a 100 yards to the mile. Then came the grandest idea of all! They made a map of the country on the scale of a mile to the mile! It was never spread out. The farmers objected. They said it would cover the whole country, and shut out the sunlight! So they ended up using the country itself, as its own map, and I assure you it does nearly as well.

OBSERVER

That sounds a lot like what a kid called Girolamo once told me: a skilled cartographer got it into his head that the existing world should be left to its own devices and created a brand-new world of his own. He therefore decreed the construction of a globe exactly the same size as the old one, complete with perfect replicas of everything in it—every building and tree, every mountain, river and sea. The sphere used up vast quantities of building materials, of course, and these could be taken only from earth itself. So, earth got smaller and smaller, while the sphere got bigger and bigger. By the time the new world was finished, every last scrap of the old world had been carted away. What was more, the whole of mankind had naturally been obliged to move to the new world because the old one was all used up.

(SILENCE)

PHILOSOPHER I

*Faith, in fact, can help create those facts,
The way electrons exist only when they're measured,
or shy people stand alone at parties,
attract no one, then go home and feel more shy.*

*Holding a device towards the invisible,
magnitude and dimension appears as information,
heartbeats and earthquakes become curved lines,
scraped onto scale paper.*

WRITER

In magnitudes and dimensions there is really something artificial, something fictional. To measure, we must begin somewhere, but in space there is no "somewhere" marked out for us to begin. This measuring is something, after all, foreign to space, introduced by us for our convenience. We introduce something of our own, and are lost in the complexities, which this brings about.

PHILOSOPHER I

Calculus is revealed as the escape hatch, through which man can get rid of his own finitude. Man's reward will then be: a God's eye view of the universe, the universal viewpoint, the escape from perspective, with all the rights and privileges accorded therein. Vision that goes right to the heart of matter, unmediated sight, knowledge without end, without responsibility!

We decide, by our selection of the type of observation employed, which aspects of nature are to be determined and which are to be blurred.

All of this makes it so that every day it is more unlikely that man will encounter anything in the world around him that is not man-made. And hence, in the last analysis, it is nothing but he himself in a different disguise. The more ardently man wishes to eliminate all anthropocentric considerations from his encounter with the non-human world around him, the less likely he is ever to meet anything but himself.

PHILOSOPHER II

Leaving your house behind is the beginning of metaphysics, but as fear takes hold of the human Figure, the adventurer builds a boat. As long as the caravel moves beneath his feet, his self-confidence remains intact.

The voyage begins when one burns one's boats. Adventures begin with a shipwreck.

PHILOSOPHER III

Everything begins with the apparition of a specter.

DARK MATTER

What is a specter?

PHILOSOPHER III

What is a ghost? What is the presence of a specter, that is, what remains as virtual, insubstantial as a simulacrum? Is there there, between the thing itself and its simulacrum, an opposition that holds up?

There has never been a scholar who has really dealt with ghosts. A traditional scholar does not believe in ghosts – nor in all that, that could be called the virtual space of spectrality. There has never been a scholar who does not believe in the sharp distinction between the real and the unreal, the actual and the un-actual, the living and the non-living, being and non-being.

PHILOSOPHER II

Bumble bees and dune buggies, mountains and snow drifts, lions and tigers, boys and girls – apparent variety notwithstanding they are all one. Like everything else, they are clouds of particles without sound, odor, flavor or color. What really matters in science, are only things made up of smaller things made up of smaller things made up of smaller things. We started out with things made up of smaller things, made up of smaller things. We end up, it seems, with figments inside of figments.

DARK MATTER

Perhaps you should let me speak for myself. ■

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