Spider Web Cosmology

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Abstract

In this paper i present a simple and clear approach to extract useful energy out of the cosmic expansion using mithril material wires, i.e. wires with very high Young's modulus and ultimate tensile strength. This energy is renewable, such that it represents a continuous and probably eternal power source.

Introduction and Motivation

The industrial revolution has allowed for a significant growth of humanity. While global population numbers were around 300 million around 1000 CE, it scaled to almost 8 billion by 2000 CE. That is an almost 30-fold increase. This was made possible largely by two inventions: the combustion-engine driven tractor and the natural-gas-based ammonia synthesis. Both consume massive amounts of energy, which mostly came from fossil fuels, which are not renewable. This naturally raises the question of whether humanity will ever run out of energy, which would induce a reversal of this massive growth, i.e. a significant population shrinkage. Related to this is the problem of climate change, i.e. whether there exists a long-lasting energy source that does not poison our own living conditions that we rely on.

Ever since solar energy started around 2020 to become economically competitive, many people have felt deep relief from the anxiety around climate change and the threat that humanity would eventually run out of fuel. However, the sun is predicted to burn out in approximately 10 billion years, and then humanity will have to find a new source of energy. While other stars do exist, those too will eventually run out of energy, with the slowest-burning stars (red dwarf stars) predicted to last for approximately 1000 billion years. Slower-burning stars do not practically exist as they would not be massive enough to ignite nuclear fusion in the first place.

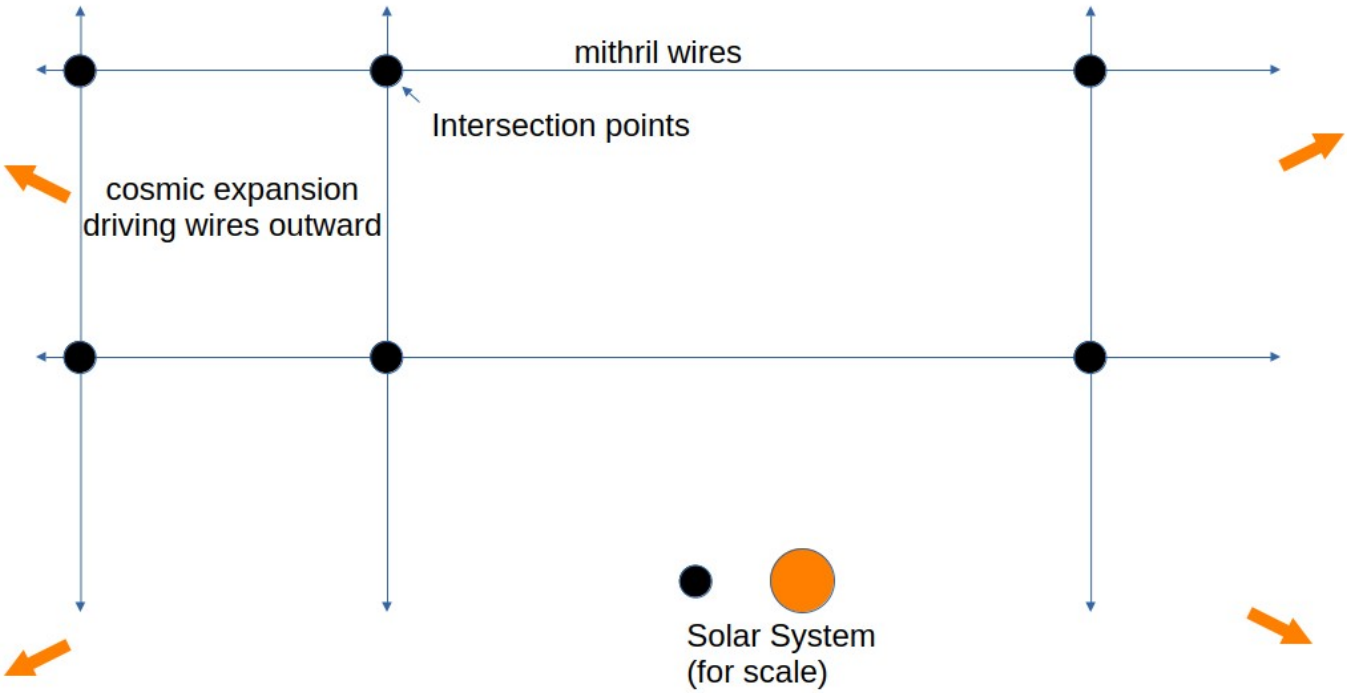
What other sources of energy are there in cosmology? Especially, do sources exist that do not run out after a while, i.e. that are truly renewable?

Scope and Context

This paper uses the insights from general relativity, especially cosmic expansion, and simple mechanics to present a mechanism for renewable power in cosmology. While quantum aspects, such as vacuum energy, are highly interesting and might slightly change the reality, they're left out of this analysis and regarded as an extra feature of nature that will have to be stacked on top of this one.

Mechanism

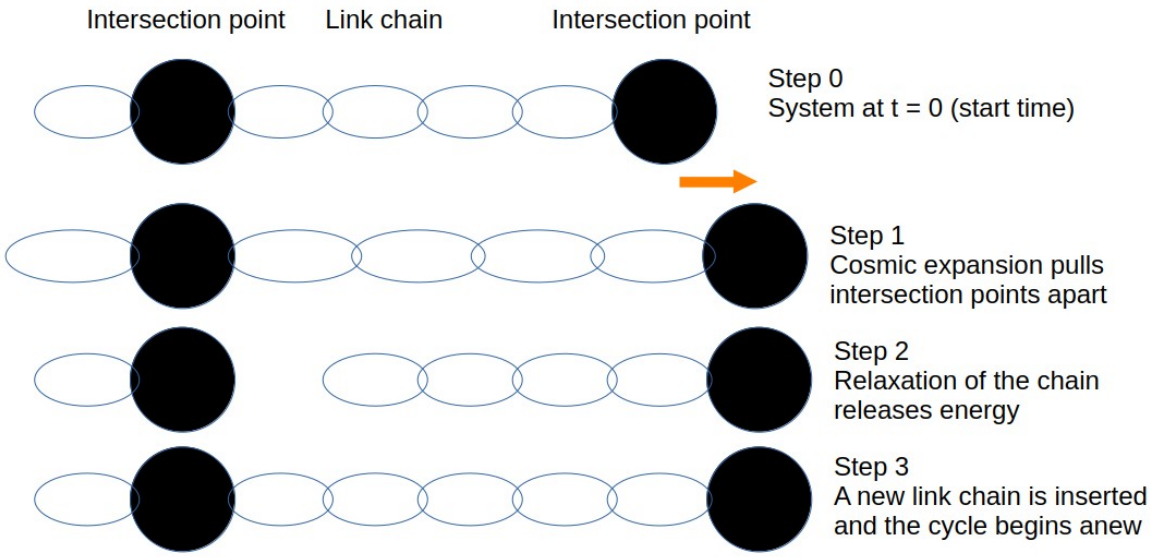
The term „spider web cosmology" is justified if one visualizes the core concepts of this proposal:



An array of wires made from a very thin (lightweight) material called „Mithril" are laid out throughout the universe, which have extremely high elasticity (Young's modulus), which means they exert force when stretched without significantly changing length.

Living organisms reside at the intersection points. As the intersection points are pulled away from each other over time, the wires between them will be stretched. The force that each wire exerts can then be calculated from Hooke's law: $F = \sigma \cdot A = E \cdot \epsilon \cdot A$, with F being force, σ being stress, E being Young's modulus, ε being axial strain, A being cross-section area.

The mithril wires are chains of small link elements. As the living organisms at the intersection point let the wires contract from time to time, while generating power from that contraction, new link elements are produced and attached to the wire.



The mithril wires have to be produced from new matter that gets produced from a matter-anti-matter pair, that gets produced from the energy harvested from the chain relaxation.
In other words, the chain has to release more energy when it relaxes than the rest mass of the mithril chain links.

This is why this mithril material has to be extremely lightweight while still having high Young's modulus and high ultimate tensile

strength. Practically speaking, I'm not entirely sure whether such a material could exist. Using simplifications and a linear model of elasticity, common steel does not have good enough properties for this application.

I will proof this in the following calculation. For this, we have to look at the rest mass of a steel chain link and the energy that can be released when the chain is relaxed by the length of one link element. Let x be the length of one link element.

The work W_1 released by the chain is $W_1 = F \cdot x = E \cdot \epsilon \cdot A \cdot x$, while the rest mass (rest energy W_2) of one chain link is $W_2 = \rho \cdot A \cdot x$ with density ϱ, therefore for W_1 to be larger than W_2 one gets the relation $E \cdot \epsilon > \rho$. Comparing this to the actual values for steel:

- E is around 200 GPa ($2 \cdot 10^{11}$ J/m³)
- ϱ is around 8 000 kg/m³,
  equivalent to a rest energy of around $8 \cdot 10^{20}$ J/m³

Therefore, ε would have to be larger than $4 \cdot 10^{9}$, i.e. the steel wire would have to stretch to 4 billion times its usual length. However, commercially available steel used in construction typically breaks apart for $\varepsilon > 3 \cdot 10^{-3}$ (Source: Wikipedia). These steel wires would have to have a factor 10^{12} higher ultimate tensile strength!!

The judgement is still out on whether a good enough mithril material could hypothetically exist.