

# Heavy element surprise

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## Abstract

Astrophysics and cosmology produce continually surprises. The latest surprise that I know of relates to astrophysics. The standard view about generation of elements heavier than Fe is based r-process but no convincing model exists. Even the generation of elements heavier than H, He and Be produced in Big Bang is poorly understood and the hypothesis is that so called population III stars were the first step. Unfortunately, this population has no identified members, which of course might due their short age.

The surprising finding was that a population II star HE 1327-2326 contains unusually large amount of Zinc heavier than iron. This looks very strange since elements heavier than Fe should be produced much later. The proposal is that these stars collapse in neutron stars in asymmetric manner by generating jets so that the stars formed along jets would receive much more heavier elements.

TGD based vision about formation of galaxies, stars, and even planets relies of a cosmic network of magnetic flux tubes analogous to blood circulation. This network could make formation of galaxies a coherent process (due to dark matter as hierarchy of phases with effective Planck constant  $h_{eff} = nh_0$ ) involving transfer of matter along flux tubes in cosmological scales. Correlations in cosmic scales are predicted: mention only “Axis-of-Evil”. Dark nuclear physics with much smaller scale of nuclear binding energy can explain “cold fusion” and could be associated with the pre-stellar phases. Dark nuclear reactions would heat the matter to temperatures making possible ordinary nuclear fusion in stellar cores. Population III stars could correspond to these pre-stellar objects.

## 1 Introduction

Again a surprise in astrophysics (see the popular articles at <http://tinyurl.com/y2yexqq4> and <http://tinyurl.com/yybbc6e>). It is really amazing how little we actually know about the mechanism producing heavier elements.

1. Big bang produces H, He, and also Be but in trace amounts. Heavier elements are absent and are believed to be produced in stars. How the heavier elements are formed? This is the problem. One proposal is that during super-nova explosions so called r-process produces heavier elements outside supernova but SN1987A did not provide support for this (see <http://tinyurl.com/hs3x3se>). Second proposal is that the heavier elements are produced in the collisions of neutron stars. There is also a proposal is that they are produced in collapsing accreting disk when neutron star collapses to blackhole (see <http://tinyurl.com/y6cvldwm>).
2. Standard hypothesis is that so called population III stars produce elements heavier than Be. These stars would be very large and very short lived - age would have been around  $10^5 - 10^6$  years. Not a single population III star has been however observed but one could blame their short ages as a reason for this. So called population II stars would be their successors and have been observed. The amount of heavier elements in them is still much lower than in Sun.
3. Astrophysicists Frebel and Ezzeddine [E1] (see <http://tinyurl.com/y6bopwfo> and also the slides at <http://tinyurl.com/y6gupmzk>) have studied the spectral signatures of a population II star HE 1327-2326 and discovered it to contain unusually large amount of Zinc heavier

than iron. This looks very strange since elements heavier than Fe should be produced much later.

It has been proposed that the first stars did not explode in a spherically symmetric manner but generated jets in opposite directions, and Frebel and Ezzeddine suggests that this might explain the strange findings. Jets would have distributed heavier elements from population III stars stars to surroundings in a very undemocratic manner. Although the total amount of heavier elements would have been small, the density of heavier elements in the birthplaces of population II stars along the jets would have been much higher than spherically symmetric model predicts. This could explain the high amount of Zinc.

## 2 TGD explanation

While reading the article, I realized that the jetty picture is very natural in TGD framework.

1. Asymmetric jets are very natural in TGD vision about the formation of galaxies as tangles associated with long cosmic string known to form linear structures [L4]. This picture solves the galactic dark matter problem: dark matter and energy reside at cosmic strings thickened to flux tubes and create just the desired gravitational potential to explain flat velocity spectrum of distant stars. That there would be no dark matter halo conforms with the various findings strongly suggesting that this halo does not exist.

Flux tubes of long cosmic strings are what I call wormhole magnetic fields that is have same  $M^4$  projection except in the regions, where there are galaxies and stars. Wormhole magnetic field portions outside galaxies would be essentially dark energy since test particles do not experience the associated magnetic and electric fields. However, long range gravitational fields are created and make themselves visible as flat velocity spectrum around spiral galaxies [L5, L6].

The cosmic strings would have thickened and liberated energy in the process and given rise to ordinary visible matter: this would be analogous to the decay of inflaton field except that the magnetic energy and volume energy characterized by length scale dependent cosmological constant would replace energy of inflaton field.

The topology of tangles consisting of a looped monopole flux tube carrying monopole flux resembled the field line topology of dipole magnetic field. Stars and eventually even planets would have formed as sub-tangles around the flux tubes. Universe would be like highly neural network with quantum coherence even in cosmic scales instead of uncorrelated galaxies and stars.

2. The explosion of very earlier star like entity would have automatically created jets propagating along the flux tubes emanating from so that instead of being distributed in a spherically symmetric manner the elements in the earlier star would have propagated directly to the birth places of new stars along the flux tube having the exploded star as tangle. This would changes completely the view about star formation.

But what these very earlier stars might have been?

1. TGD based view about dark suggests a new mechanism for the production of heavier elements [L3, L2]. What I call dark nuclei (having non-standard value  $h_{eff} = n \times h_0$  of Planck constant) would be dark protons sequences along flux tubes and have nuclear binding energy much smaller than ordinary nuclei.

Pollack effect [L1] [L1] would give rise to these dark nuclei and they would be present in living matter and give a fundamental realization of genetic code: ordinary matter with ordinary value of Planck constant would mimic the dynamics of magnetic body having higher "IQ" (higher evolutionary level in number theoretical evolutionary hierarchy defined by extensions of rationals) definable as  $h_{eff}/h_0 = n$  and identifiable as dimension of extension of rationals.

The connection between biology and astrophysics looks of course strange but this is what the fractality of TGD Universe predicts. Same cosmic strings thickened to flux tubes are in all length scales and basic mechanisms are the same.

2. Dark nuclei would have been formed first and caused pre-heating during the pre-stellar phase. As the temperature became high enough, ordinary fusion reactions started and stars were born. The spontaneous transformation to ordinary nuclei liberating almost all nuclear binding energy would have also occurred and is proposed as a model for “cold fusion” reported to produce heavy elements.
3. One can ask why so much Zn in HE 1327-2326. Was “cold fusion” involved already at that time as TGD based model indeed proposes? Could the postulated but unseen population III stars be pre-stellar objects generating heavy elements by “cold fusion” and spraying them along flux tubes directly to the new stars rather than dispersing them to all possible directions? The Universe would have been a network analogous to neural system rather than soup and the formation of stars would have been a collective process with correlations in super-astrophysical length scales.

This is the also the picture about living matter provided by TGD, where flux tube network makes possible for reacting molecules to find each other and also provides a mechanism of catalysis based on the reduction of  $\hbar_{eff}$  liberating energy allowing to overcome the potential walls preventing the chemical reactions.

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