Theoretical and Applied Fracture Mechanics 79 (2015) 14–19

Contents lists available at ScienceDirect

Theoretical and Applied Fracture Mechanics

journal homepage: www.elsevier.com/locate/tafmec

Singleness of surface and volume: Space–time non-symmetry of energy density

G.C. Sih

International Center for Sustainability, Accountability and Eco-Affordability of the Large and Small (ICSAELS), Lehigh University, Bethlehem, PA 18015, USA

ARTICLE INFO

Article history:
Available online 11 August 2015

Keywords:
Energy density
Space–time
Surface–volume
Dark matter
Non-homogeneous
Non-symmetry

ABSTRACT

Space–time non-symmetry means that physical processes in the (+) direction are not the same as those in the (−) direction. Non-homogeneity and surface–volume interaction (SVI) are two aspects of the same effect that attributes to directional dependency. While the Einstein tensor and stress-energy tensor (SET) of space–time curvature are reminiscence of SVI, non-homogeneity were forsaken such that stress-energy became non-tensorial. The inconsistency definition of body-field energy and surface-traction force can be erased by considering SVI. No less emphasizes can be placed on the interchange of energy, mass and matter. Energy and mass trade-off can occur as a quotient via square of the "velocity" and product via square of the "momentum".

SVI was also recognized in the '80s as the missing link to explain crack growth in fatigue and non-equilibrium and non-homogeneous (NENH) problems in mechanics. Space–time non-symmetry (STNS) corresponds, respectively, to dissipated (past) and available (future) energy density. Paradigm-breaking called for higher order mathematical solutions to lock non-homogeneity and non-symmetricity into the experimental data that would otherwise be interpreted with oversimplified assumptions. The trade-offs of energy, mass, matter are made possible for a wide range of the *speed of space*, larger and smaller than the speed of light. The speed of light is no longer the pillar of particle physics. Corrections to ordinary data can thus be made without knowing the composition of the atomic structures, which may not explain nature in its entity.

In the language of fracture mechanics, any *available fatigue crack growth data can be corrected to include NENH and STNS for different scale ranges.* The "energy density" fits into the space–time non-symmetry (STNS) scheme of non-zero volume/area. Physicists and engineers are no longer next door neighbors, but they live under the same roof. In a nut shell, science has identified the *cause* of space non-symmetry (SNS) and time non-symmetry (TNS), while technology has recognized the *effect* of NENH.

1. Introduction

Modern physics has brought science to the door step of technology. Based on the earthly conceived model of the single universe, temperature and volume expansion gave birth to space and time as the scaffold for constructing energy, mass, and matter. Non-symmetry of space–time created interfaces for the physical structure with non-uniform properties that shift in time, known in mechanics as non-equilibrium and non-homogeneity (NENH). The interfaces shall be referred to as the space–time non-symmetry gap (STNSG), across which the trade-offs of energy, mass and matter take place. The direction opposing arrows are symbolic of the trade-off of energy ⇌ mass, matter ⇌ energy, etc. which is fundamental to the irreversibility of physical processes [1,2].

Different languages have been used to address NENH and STNS associated with the behavior of space–time differing in scale ranges. Ambiguities have resulted in the meaning of field energy and surface traction. What appeared locally as a negligible difference quantitatively, the global and qualitative diversity, however, can be significant. Even though field energy and surface traction are clearly different, terminologies used in continuum mechanics and particle physics, still leave much to be desired, especially when referring to local and global effects. To begin with, the scale segments for the SI system of measurement are too coarse for analyzing subatomic structures. The STNS is suited for sizing the atomic scale range even though it may be over refined for some applications. Engineers, however, can benefit by frog leaping from technology to sophisticated applications with a rudimentary

E-mail address: gcs@ecust.edu.cn

http://dx.doi.org/10.1016/j.tafmec.2015.05.010
0167-8442/

Acronyms

EFE	Einstein field equation
EPM	Einsteinian–Planckian model
IDM	Ideomechanics
NENH	non-equilibrium and non-homogeneous
SNS	space non-symmetry
STNS	space–time non-symmetry
STSNG	space–time non-symmetry gap
STS	space–time symmetry
SVI	surface–volume interaction
TNS	time non-symmetry

knowledge of particle physics. To this end, it is expedient to adopt multiscaling à la **S**TNS.

What is not clear is whether nature is really that complex or whether the complexity has been created by the incorrect use of the mathematical solutions. The experimental data are neither right nor wrong. They contain all of the facts that may not be included in the mathematical model. The scaling of space–time. Non-symmetry may be one of the culprits. *A higher order and more superior approach can show the effect of neglecting the NENH and STNS effects to determine corrective measures.* The incorrect diagnose cannot be blamed on the medicine. To this end, some of the nitty-gritties will be reviewed. To begin with, the field energy and point mass are not unrelated if non-unity of volume and surface is invoked. NENH and STNS can thus be reflected in the mathematics. This can be realized in the *isoenergy density space* [3,4]. Multi-dimensionality and non-symmetry of space–time were implemented. Trade-offs of energy, mass, and matter, are also shown to depend on shifting of space–time scale ranges. Cosmological models for the solar-system scale are known not to apply for the galactic scale, even less on the scale of a black hole. Mechanical models of large structures are known not to apply for laboratory specimens [5]. Particle models at the atomic scale are known not to hold at the subatomic scale or scale smaller than the Higgs particle. Scale dependency [6] is inherent of space–time non-symmetry. *Nature possesses its own hierarchy of space–time non-symmetry scaling and will not be compromised by the oversimplifications.*

The size, shape and structure of entities are often omitted in light of the "point-like" description. Such a notion is consistent with the law of higher symmetry [7]:

"Objects tends to higher geometrical symmetry

regardless of size, shape and their internal constituents."

Planets and sand pebbles follow the same law of nature tending toward spherical symmetry by means of erosion and/or abrasion. Point-like infers spherical symmetry such that mass or field can be assumed to be concentrated at a point. The interchange of energy, mass, and matter maintains the character of time dependency. No physical processes are at standstill. They may transform and interchange into different forms.

To reiterate, energy and mass or matter have trade-offs as they are said to be indestructible in the sense that they are trapped within the universe. Vanishing into nothingness is unthinkable.

Last but not the least, the raison d'être of Ideomechanics [8] was to connect NENH and STNS of modern physics [3] with identifiability of ancient I-Ching (The Book of Changes [9]). The trade-offs of energy, mass, and matter reached another height. Trade-off of matter and energy [8] as the "*product of energy and mass*" was found in addition to that of the quotient of mass and energy. These implications have relevance to the miniscuity of the dark matter of the mind connected with physicalizing and mathematilizing consciousness.

2. Space–time non-symmetry: directional dependency

Space–time non-symmetry gap (STNSG) is directional dependent. With reference to the normalcy (0), there prevails the (+) and (−) direction. Excluded is time instantaneity and space infinitesimality such that the time and space increments, Δt and Δs, are finite. They are then physically measurable. A body cannot be "here" and "there" at the same time and occupy the same space. STNSG prohibits the *instant* conversion of one physical quantity to another. Energy, mass and matter can thus be said as all aspects of the same thing when the NENH and SNS–TNS [3,4] are scaled accordingly.

To emphasize, a finite volume is needed for field energy and a finite area is needed for surface traction. The condition $\Delta V/\Delta A \neq 0$ is a prerequisite. It follows that

Interchangeability requires a finite amount of space–time non-symmetry (STNS).

STNS is manifested in the non-symmetricity of the long past (−) and the short future (+) with reference to the present. Past, present and future cannot be unrelated. Knowledge is predicated on knowing the past and the strong likelihood of existence of the immediate future. Predictions are assured only after the fact. As the parts make up the whole, all physical quantities cannot be unrelated. One of the inter-relations is the field energy and surface traction. Their conversion is directional dependent [2]. The same holds for energy $\rightleftharpoons$ mass, matter $\rightleftharpoons$ energy, and so on. In simple terms, the trade-off of energy, mass, or matter is not the same in the (+) and (−) direction because of STNS. Up to this date, energy and mass can trade-off as a quotient and product. The quotient corresponds to "velocity squared" and the product corresponds to "momentum squared", both of which have been derived mathematically and discussed physically [8]. The quote of Earman 1995, "To exist is to exist in space and time", can be complemented with "*To live is to live with trade-offs of space–time non-symmetry*".

2.1. Field $\rightleftharpoons$ force

The trade-off relevant to field energy and traction force entails identifying the STNSG in NENH continuum mechanics, known as thermomechanics [3] of the '80s. The non-symmetrical incremental change of energy density ΔW may be designated by $t\text{-}\Delta t^{(-)}$ and $t + \Delta t^{(+)}$. The former and latter are, respectively, the dissipated and available energy density $\mathcal{D}$ and $\mathcal{A}$. Note that $\mathcal{W} = \Delta W/\Delta V$ is the energy density function. Eq. (1), corresponding to Eq. (2) [3], assumes that $\Delta\mathcal{D}$ and $\Delta\mathcal{A}$ can be added via the STNSG:

$$\Delta\mathcal{W} = \Delta\mathcal{D} + \Delta\mathcal{A} \tag{1}$$

Eq. (2) embeds the gap of STNS in Δt. The finiteness of volume and surface has been invoked together with time non-symmetricity, where $\Delta t^{(-)}$ differs from $\Delta t^{(+)}$:

$$\Delta\mathcal{W}_t = \Delta\mathcal{W}_{t-\Delta t^{(-)}} + \Delta\mathcal{W}_{t+\Delta t^{(+)}} \tag{2}$$