Turbulence and fossil turbulence lead to life in the universe

Carl H Gibson

Buckingham Centre for Astro-Biology, University of Buckingham, Buckingham, UK
E-mail: cgibson@ucsd.edu

Received 24 July 2012
Accepted for publication 27 January 2013
Published 16 July 2013
Online at stacks.iop.org/PhysScr/T155/014023

Abstract

Turbulence is defined as an eddy-like state of fluid motion where the inertial-vortex forces of the eddies are larger than all the other forces that tend to damp the eddies out. Fossil turbulence is a perturbation produced by turbulence that persists after the fluid ceases to be turbulent at the scale of the perturbation. Because vorticity is produced at small scales, turbulence must cascade from small scales to large, providing a consistent physical basis for Kolmogorovian universal similarity laws. Oceanic and astrophysical mixing and diffusion are dominated by fossil turbulence and fossil turbulent waves. Observations from space telescopes show turbulence and vorticity existed in the beginning of the universe and that their fossils persist. Fossils of big bang turbulence include spin and the dark matter of galaxies: clumps of $10^{12}$ frozen hydrogen planets that make gobbled star clusters as seen by infrared and microwave space telescopes. When the planets were hot gas, they hosted the formation of life in a cosmic soup of hot-water oceans as they merged to form the first stars and chemicals. Because spontaneous life formation according to the standard cosmological model is virtually impossible, the existence of life falsifies the standard cosmological model.

PACS numbers: 47.27.−i, 47.51.+a, 98.10.+z, 92.10.Lq, 96.50.Tf

(Some figures may appear in color only in the online journal)

1. Introduction

Turbulence clearly dominates mixing and diffusion in natural fluids like the ocean and atmosphere. It also controls the formation of astrophysical objects influenced by self-gravity, like stars, star clusters, galaxies and galaxy clusters and Proto-Globular-star-Clusters (PGCs) of planets. Turbulence provides the large negative stresses required by general relativity theory to drive the big bang and supply the mass-energy of inflation (Gibson 2004, 2005). Space telescopes cover an ever-widening range of frequencies, and show fossil turbulence evidence of turbulence controlling the formation and evolution of the Universe from the beginning of time to the present day.

Applications to cosmology theory of modern fluid mechanics and the revised definition of turbulence and fossil turbulence (Gibson 2011) presented in the Abstract fundamentally change the interpretation of space telescope data. Observations suggest the standard model of cosmology based on dark energy ($\Lambda$), cold dark matter hierarchical clustering ($\Lambda$CDMHC) and collisionless fluid mechanics should be replaced by a new cosmology termed hydrogravitational dynamics (HGD) (Gibson 1996, Gibson and Schild 2011). The dark matter of galaxies is identified by HGD as PGC clumps of frozen primordial gas planets, as first observed and independently claimed as the missing galaxy mass by Schild (1996). Schild’s interpretation and discovery of PGC planets as the dominant galaxy dark matter from quasar microlensing is further confirmed by infrared detections of the 2009 Herschel space observatory and Planck space telescope discussed below. An unanticipated result of the Gibson (1996) HGD prediction of primordial planet PGCs as the source of all stars is that this easily explains how life as observed on Earth was formed by wide and early distribution of PGCs and their planets, and water oceans formed by the planets, on cosmic scales. The controversial Hoyle–Wickramasinghe cometary panspermia hypothesis for the beginning of life on Earth (Wickramasinghe 2010) is conclusively vindicated by HGD cosmology and the new data (Gibson et al 2011b, 2011c, Gibson and Wickramasinghe 2010, Gibson et al 2010).
HGD cosmology rejects the underlying ΛCDM assumptions of collisionless, inviscid, linear, ideal, diffus ionless fluid mechanics. From HGD theory, viscous stresses, turbulence, fossil turbulence and fossil turbulence waves are critical to astrophysics and astronomy, just as they are in oceanography and atmospheric science. Summaries of the theories and observations (Gibson 1991, 2010, 2011, Gibson et al 2011c) are updated in the present paper. Herschel and Planck observations (Juvela et al 2012) are discussed.

2. Theory

Understanding astrophysical turbulence requires that the conservation of momentum equations be applied to collisional fluids; that is, to fluids where the mean free path for collisions is smaller than the separation of fluid particles and the scale of causal connection \(ct\), where \(c\) is the speed of light and \(t\) is the age of the universe since the big bang. The Navier–Stokes equations are arranged so that the rate of change of specific momentum \(v\) equals the sum of forces per unit mass, isolating the negative gradient of the Bernoulli group \(B\) of mechanical energy terms \(v^2/2 + p/\rho + lw\) (kinetic energy, enthalpy and lost work per unit mass). In most cases of interest, \(-\text{grad} B\) may be neglected. Thus the nonlinear inertial vortex force term \(v \times \omega\) is the source of turbulence when the other forces are negligible, where the vorticity \(\omega\) is \(\text{curl} v\).

The best known criterion for turbulence to develop is the Reynolds number, which is the ratio of the inertial-vortex force \(v \times \omega\) to the viscous force. Boundary layers thicken until they reach a critical Reynolds number at five times the Kolmogorov length scale before they become turbulent. In stably stratified fluids the turbulence cascades to larger scales by vortex pairing and merging driven by \(v \times \omega\) forces. The ratio of \(v \times \omega\) to the buoyancy force is termed the Froude number. When this grows to a critical value, fossilization and fossil turbulence wave radiation begins at the largest eddy sizes (Gibson et al 2011a). Transport in the vertical direction in the ocean and atmosphere, and in the radial direction for self-gravitational objects, is termed fossil turbulence wave radiation. The turbulence cascade to large scales thus continues in the vertical direction until limited at a critical Froude number by buoyancy forces at the Ozmidov scale at fossilization, and in the horizontal direction until Coriolis forces cause the waves to fossilize at a critical Rossby number and Rossby radius of deformation. We will be concerned mostly with the weakly turbulent primordial plasma produced by the hot big bang as it expands and cools to form gas.

At the plasma to gas transition from HGD cosmology the Schwarz viscous fragmentation scale \(\sim L_{SV} = (\gamma v/\rho G)^{1/2}\) rapidly decreases from that of proto-galaxies to that of proto-planets because the kinematic viscosity \(v\) decreases by a factor of \(10^{13}\), while the rate of strain \(\gamma_0\) and the density \(\rho_0\) maintain fossil values from the \(10^{12}\) s time of first fragmentation to the \(10^{13}\) s time of transition to gas (300,000 years). From heat transfer considerations, the gas also fragments at the Jeans scale \(V_{\text{sound}}/(\rho G)^{1/2}\), forming PGC clumps of primordial gas (H, He\(^{\text{\#}}\) planets. The size of each PGC clump of a trillion planets is \(\sim (M_{\text{PGC}}/\rho_0)^{1/3}\); that is, about \(3 \times 10^{17}\) m, with planet size \(\sim (M_{\text{Earth}}/\rho_0)^{1/3} = 5 \times 10^{13}\) m. As the planets of a PGC form stars, a cavity \(\sim (M_{\text{Sun}}/\rho_0)^{1/3} = 3.7 \times 10^{15}\) m is formed in the PGC clump, interpreted previously as the Oort cloud of comets, that explains the remarkable cold core filaments observed by the Planck and Herschel satellites discussed in section 3 as proto-planetary-nebulae (PPN).

In astrophysics and cosmology the most distinctive fossil of turbulence is the vorticity, conserved as angular momentum per unit area. Fossil vorticity turbulence of the big bang is preserved as weak spin anisotropies at the largest length scales of the cosmic microwave background (CMB), as shown in figure 1 (Gibson 2012, figure 1). A series of bumps appear in the CMB power spectrum \(C_l\) of figure 1 that reflect vortex dynamics of big bang turbulence and plasma epoch turbulence.

The largest length scale bumps are on the left of figure 1 for \(l = 2–40\). They are labelled ‘Fossil big bang turbulence vortices’ based on the turbulence vortex dynamics model shown at the bottom of figure 1 and the Gibson (2004, 2005) theory of big bang turbulence. Fossil big bang temperature turbulence should follow the indicated Corrsin–Obukhov \((1 + l)C_l \sim l^{3/2}\) spectral form for turbulent mixing. Cascade directions are shown by the arrows (Gibson 2012). The large amplitude bumps of figure 1 for wavenumbers \(l > 200\) reflect secondary vortices produced by expanding supercluster voids from time \(t \sim 10^{12}\) s after the big bang when the large kinematic viscosity of the plasma first permitted gravitational fragmentation of \(10^{12}\) kg supercluster masses. Supercovortexes expand as rarefaction waves limited by the plasma sound speed \(c/3^{1/2}\), where \(c\) is the speed of light. Voids of size \(10^{23}\) m observed by radio telescopes are impossible by the standard ΛCDM cosmological model where superclusters of galaxies and the voids between them are the last objects to be formed rather than the first.

![Figure 1. Cosmic microwave background temperature anisotropy spectrum from WMAP satellite, reproduced from Starkman et al 2011. Starkman et al 2012 find the largest scale CMB energy levels ‘oddly quiet’. However, they match exactly when extrapolated as \(l^{3/2}\) fossils of big bang turbulence and turbulent mixing that gravitationally drive the cascade of turbulence from small scale to large at expanding supervoid boundaries, as shown in figure 1.](image-url)
The main ‘sonic peak’ in figure 1 at \( t \sim 200 \) reflects the size of sonic expansion reached at the time of plasma to gas transition \( t \sim 10^{13} \) s. The fragmented supercluster objects retain the spin and density of the plasma as fossils, and so do the smaller cluster and galaxy fragments produced by further cooling before transition to gas. The fossil density from \( t \sim 10^{12} \) s appears as that of globular star clusters \( \rho_0 \sim 4 \times 10^{-17} \text{ kg m}^{-3} \). The fossil spin appears as the close alignment of rich Abell clusters of galaxies (Godlowski 2012). Because the clusters and galaxies are observed to be aligned, the standard model \( \Lambda \)CDMHC is falsified by Godlowski’s paper. Hierarchical clustering of cold dark matter CDM halos would produce a random orientation of spins for rich Abell clusters. The fossil big bang turbulence spin also appears as a preferred direction on the sky termed the ‘axis of evil’ (Schild and Gibson 2011). Dipole, quadrupole, etc moments of the CMB spherical harmonic directions are found to be all pointing in the same direction; that is, along the axis of evil.

A large amount of gravitational energy remains stored in the PGC clumps of planets formed at plasma to gas transition. As shown in figure 2, the cosmic microwave background radiation appears to be dominated by low frequency synchrotron radiation (Fornengo et al 2011) emitted by merging planets forming larger planets and the first stars soon after the plasma to gas transition.

We see from figure 2 (cartoon left) that polar jet synchrotron radiation from planet-merging can explain the observed CMB radiation at low frequencies. The planets merge on an accretion disc and form a plasma jet with synchrotron radiation as the central planet approaches star mass. The radiation should begin immediately after the plasma to gas transition. The first stars appear in fossil first-fragmentation gravitational free fall time \( t_g = (\rho G)^{-1/2} \sim 10^{12} \text{ s} \) (30 000 years) from hot gas planets at 300 000 years, not after hundreds of millions of years of dark ages according to \( \Lambda \)CDMHC.

### 3. Observations

Recent observations by the Herschel space observatory support the predictions of HGD cosmology. Figure 3 shows an infrared image of PGCs in the Small Magellanic Cloud (SMC), with high resolution images on the left and top. A similar concentration of PGCs is found for the Large Magellanic Cloud. The thousands of identical red objects detected by Herschel at 250 \( \mu \text{m} \) are described in the NASA webpage http://www.nasa.gov/mission_pages/herschel/multimedia/pia15255.html as ‘dust’, but are actually dark matter PGCs weakly glowing as they form larger planets. Cold cores are at precisely the triple point 13.8 K of frozen hydrogen, a clear manifestation of star formation by frozen primordial gas planet mergers, showing the dust must be frozen hydrogen planets as proposed by Gibson (1996) and observed by Schild (1996).

By counting the number of PGCs in the upper right hand image of figure 3 and measuring the area sizes in the left images it is possible to estimate roughly 100 000 PGCs in the SMC, giving a total mass of \( 10^{41} \text{ kg} \) for the object, or
Figure 3. Herschel space observatory images of the dark matter of the Milky Way Galaxy confirms the HGD prediction that the missing mass consists of metastable PGC clumps of frozen primordial gas planets. Red dots seen in the SMC as well as the Large Magellanic Cloud star clouds are interpreted as dark matter PGCs. Image credit: ESA/NASA/JPL-Caltech/STScI and ESO/Juvela et al. 2012.

about 0.1% of the mass of the Galaxy. This is close to the usually assumed value. A somewhat larger mass of PGCs is found for the Large Magellanic Cloud Herschel image on the same web site. Green dots are at the Oort cavity size $6 \times 10^{15}$ m corresponding to the mass of a stellar binary, termed PPN for Proto-Planetary Nebula. According to HGD, planetary nebulae form not from material ejected by the star but from planets surrounding the Oort cavity, evaporated by polar plasma jets from central binaries such as white dwarfs nearing supernova Ia conditions due to overfeeding by cometary planets from the PGC (Gibson and Schild 2007).

Star formation in the interior of a PGC is shown by the more nearby image shown at the lower right of figure 3, from Juvela et al. (2012, figure 7(a)). The PGC is only $1.1 \times 10^{19}$ m distant, 174 times closer than the SMC, which is at $1.9 \times 10^{21}$ m. Warm objects are detected along filaments that originate with cold core objects such as that shown on the left, with temperature 14 K matching the triple point of hydrogen. The length of the filaments are comparable to the size of a PGC, $3 \times 10^{17}$ m. The width of the filaments matches the size of an Oort cavity, $6 \times 10^{15}$ m, as shown in figure 3 (lower right).

The erratic positions of the filaments suggest they reflect planet and star formations induced by tidal force tracks of passing PGC centers of gravity through the observed PGC rather than the wakes of objects. By whatever mechanism, it seems clear that the Herschel images of figure 3 are showing star formation from dark matter primordial planets in PGCs, as predicted by HGD cosmology.

4. Discussion

Figure 4 shows the location of the Magellanic clouds of PGCs and stars in Galactic coordinates, and their interpretation according to HGD cosmology. Protogalaxies are the smallest objects to form during the plasma epoch, just before the transition to gas at $10^{13}$ s. Because the PGCs are initially composed of hot primordial gas planets, they are collisional and sticky, and form large clumps such as the Magellanic clouds. The first stars form in the protogalaxy of size $L_N = 10^{20}$ m at the galaxy center. Most will be the small population II stars of old globular clusters, but some will be larger reflecting significant levels of turbulence, and will soon explode to form the first C, N, O, etc chemical oxides to seed the hot hydrogen gas planets to form water and metallic iron. At 2 million years the universe cools to the critical temperature of water 647 K so deep hot oceans form on the seeded planets. The millions of possible organic chemical reactions begin their competition for the carbon collected gravitationally by the planet. If the complex reactions of DNA life can ever form without a miracle, this is the time. This is the biological big bang (Gibson et al. 2011c).

As shown in figure 4, the protogalaxy-diameter (Nomura scale) $L_N = 10^{20}$ m of the Milky Way (and all galaxies), from
Figure 4. Herschel space observatory images of the dark matter of the Milky Way Galaxy confirms the HGD prediction that the missing mass consists of metastable PGC clumps of frozen primordial gas planets. See http://Journal_of_Cosmology.com/JOC18/indexVol18 CONTENTS.htm. Part of the figure is reproduced with permission from R Powell of www.atlasoftheuniverse.com.

HGD cosmology, is 20–25 times smaller that the dark matter halo (dashed white oval) radius formed by diffusion (white dashed arrows) of the nearly collisionless PGCs resulting when their planets freeze. A sharp reduction of planet size from $10^{14}$ m at fragmentation to $10^7$ m at freezing will occur at time $t$ about 30 million years when the temperature $T$ of the Universe cools to the hydrogen triple point 13.8 K. The mean free path for collisions of frozen planets then becomes much larger than the PGC, so the PGCs and any clumps of PGCs that may have formed in the protogalaxy become nearly collisionless and will begin to diffuse away from the galaxy center to form the dark matter halo. The diameter of the halo shown in figure 4 is the same as that observed for the Tadpole Galaxy, $\sim 10^{22}$ m. This matches the most distant of the Dwarf galaxies, figure 4 (Fornax). An image of Fornax and one of its six globular clusters is shown at the bottom of figure 4.

The fact that globular star clusters such as NGC 1049 are identical from galaxy to galaxy and within our galaxy with a mass density $\rho_0 = 4 \times 10^{-17}$ kg m$^{-3}$ is strong evidence that the time of first fragmentation was $10^{12}$ s when this was the baryonic density of the expanding universe.

Life formation conditions are optimum before the diffusion of PGCs into the dark matter halo of the Milky Way in figure 4. Hot gas planets first formed stars, chemicals and life in the small protogalaxy. The time was 2 million years when the universe temperature decreased to the critical temperature of water 647 K so that liquid water oceans could condense to accelerate the evolution of organic chemistry. Critical temperature water is apolar and dissolves organic chemicals ordinary water will not. A cosmic soup of $10^{80}$ merging planets stirred by exploding stars and active galactic nuclei produced and distributed the complexities of DNA life to every corner of the big bang universe. The dark matter hydrogen planets cooled to the freezing point of water at 8 million years, slowing the speed of life evolution. Life formation according to $\Lambda$CDMHC cosmology cannot begin till the first star appears at hundreds of millions of years. Thus the existence of life anywhere, and on Earth, falsifies $\Lambda$CDMHC cosmology.

5. Conclusions

Modern fluid mechanics is needed to properly interpret the wealth of new information about cosmology provided by modern space telescopes. Gravitational structure formation starting with the big bang is much easier to understand using fluid mechanical concepts of viscosity, diffusion, turbulence,
fossil turbulence and fossil turbulence waves, as employed by HGD cosmology, than it is using highly questionable cold dark matter and dark energy concepts that fail to explain the space telescope observations of figures 1–3. Evidence of spin alignments such as Godlowski (2012) confirms the intrinsically rotational and aligned nature of big bang turbulence vorticity fossils (Gibson 2004, 2005). Figure 4 summarizes the application of HGD cosmology to explain the dark matter of the Milky Way as highly persistent PGC clumps of primordial planets that produce the stars and randomly dim their supernovae. Evidence that gas planets are very near all stars in all galaxies, and may produce systematic dimming errors in all supernovae 1a events, falsifies the 2011 Nobel Prize in Physics (Gibson 2011, Gibson and Schild 2011). From HGD, $\Lambda = 0$. The universe ends in a big crunch.

Perhaps the most important consequence of PGC hydrogen gas planets as the dark matter of galaxies is their crucial role in the formation of life. Because all stars form by mergers of the planets in a binary cascade from Earth mass to Solar, the organic chemistry and biological information preserved in the water oceans formed on the planets is shared on a cosmic scale starting within a few million years after the big bang. The fact that life exists on Earth rules out the possibility that the first stars and planets appeared hundreds of millions of years after the big bang, as predicted by $\Lambda$CDMHC. The Hoyle–Wickramasinghe cometary panspermia hypothesis is inevitable from HGD cosmology. Recent Sri Lanka meteorites containing extraterrestrial life have elevated this much maligned hypothesis to a status approaching observational fact. See http://JournalofCosmology.com/JOC22/indexVol22CONTENTS.htm.

References

Bennett C L et al 2003 First-year Wilkinson Microwave Anisotropy Probe (WMAP) observations: foreground emission Astrophys. J. Suppl. 148 97–117

Fornengo N, Lineros R, Regis M and Taoso M 2011 A dark matter interpretation for the ARCADE excess? Phys. Rev. Lett. 107 271302

Gibson C H 1991 Kolmogorov similarity hypotheses for scalar fields: sampling intermittent turbulent mixing in the ocean and galaxy Proc. R. Soc. Lond. A 434 149–64

Gibson C H 1996 Turbulence in the ocean, atmosphere, galaxy and universe Appl. Mech. Rev. 49 299–315

Gibson C H 2004 The first turbulence and the first fossil turbulence Flow Turbul. Combust. 72 161–79

Gibson C H 2005 The first turbulent combustion Combust. Sci. Technol. 177 1049–71

Gibson C H 2010 Turbulence and turbulent mixing in natural fluids Phys. Scr. T142 014030

Gibson C H 2011 Falsification of dark energy by fluid mechanics J. Cosmol. 17 7597–603

Gibson C H 2012 Turbulence and fossil turbulence lead to life in the universe arXiv:1203.4437v1

Gibson C H, Bondur V G, Keeler R N and Leung P T 2011a Energetics of the beamed zombie turbulence maser action mechanism for remote detection of submerged oceanic turbulence J. Cosmol. 17 7751–87

Gibson C H, Nieuwenhuizen T M and Schild R E 2011b Why are so many primitive stars observed in the Galaxy halo? J. Cosmol. 16 6824–31

Gibson C H and Schild R E 2007 Interpretation of the helix planetary nebula using hydro-gravitational-dynamics: planets and dark energy arXiv:astro-ph/0701474

Gibson C H and Schild R E 2011 Is dark energy falsifiable? J. Cosmol. 17 7345–58

Gibson C H, Schild R E and Wickramasinghe N C 2011c The origin of life from primordial planets Int. J. Astrobiol. 10 83–98

Gibson C H and Wickramasinghe N C 2010 The imperatives of cosmic biology J. Cosmol. 5 1101–20

Gibson C H, Wickramasinghe N C and Schild R E 2010 First life in the oceans of primordial-planets: the biological big bang J. Cosmol. 11 3490–9

Godowski W 2012 Remarks on the methods of investigations of alignment of galaxies Astrophys. J. 747 97–117

Juvela M et al 2012 Galactic cold cores III. General cloud properties Astronun. Astrophys. 541 A12

Schild R 1996 Microlensing variability of the gravitationally lensed quasar Q0957+561 A, B Astrophys. J. 464 125

Schild R E and Gibson C H 2011 Goodness in the axis of evil J. Cosmol. 16 6892–903 (arXiv:0802.5229v2)

Starkman G D et al 2012 The Oddly Quiet Universe: How the CMB challenges cosmology’s standard model arXiv:1201.2459v1 [astro-ph.CO]

Wickramasinghe C 2010 The astrobiological case for our cosmic ancestry Int. J. Astrobiol. 9 119–29