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Analysis of solar surface and flus tubes

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Abstract
The sum is a major source of inexhaustible free energy C i.e. solar energy for the planet earth. A cluster formation in seen in the diffusion of flux tubes across the solar surface. A random walk technique is used to find the fractal dimension of such a cluster. Also using a suitable algorithm the diffusion coefficient for the movement of these flux tubes across the surface is found. In the present algorithm, no site occupation probability is assumed as done by others, instead an algorithm for selection of direction and acceptance or rejection of a site is employed suitably.

Keywords: Solar Surface and Flus Tubes

Introduction

A Major prospect with required to solar research is associated with the current drive toward reducing global carbon emissions which has been major global environment in re–recent year. The concentrations of magnetic flux diffuse across the solar surface. A-Statistical fractal geometry was generated by Schrijver and Lawrence by populating the sites on lattice with a uniform probability. A random walker was allowed to jump only between occupied nearest neighbor sites. Such random walks to the nearest neighbor were highly restricted by defining a site occupation probability. In this way, a percolation, cluster was generated by bonds between the sites with a uniform probability. In. the present work, without assigning occupation, probability for each site the percolation cluster is generated, such as:

a) Select a particular direction from the reference site by using the decision making algorithm.
b) If the particular site is accepted, the reference site is redefined. If the particular site is not accepted, the reference site is maintained as the same.

In the present work, no critical value for the comparison of the site occupation probability is used as used in Schrijver and Lawrence, (2013) [6]. In the present work center is defined once and the cluster is constructed. One of the more interesting geometrical properties of the objects is their shape. A new fractal geometry was developed (Benoit B. Mandel brot) to describe ramified objects. One quantitative measure of the structure of these objects is the fractal dimension. The percolation cluster is an example of a statistical fractal, since the mass length relation is satisfied only “on the average”. The fractal dimension is calculated using the following equation.

$$D = \frac{\log(M)}{\log(L)} \tag{1}$$

Where
D – Fractal dimension
M – Mass of the grown percolation cluster
L – Lattice length
A square of lattice length L is drawn on the monitor and percolation cluster is generated inside the square. Since the areal density is uniform, the area of the percolarion cluster is assumed for mass of the cluster in equation (1). This procedure is repeated for various lattice lengths. In case, the origin for the generation of the percolation cluster is defined according to the lattice length. The graph 1 is drawn between the log value of lattice length and log value of the area of grown percolation cluster.

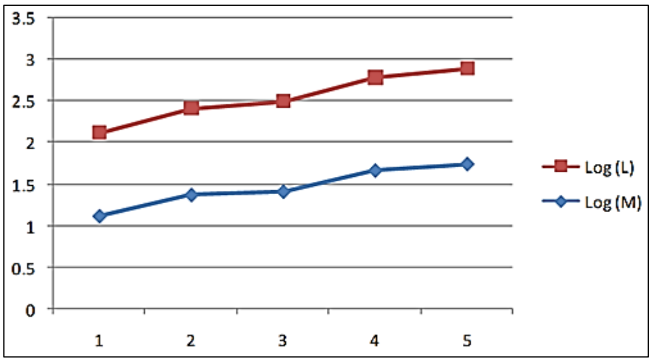

Fig 1: Graph between log (Lattice length) and log (Area)

The data so simulated from the developed percolation cluster are shown in Table–I.

Table 1: Calculation of fractal dimension for the formed cluster

S. No.	Lattice length cm	Area cm^2	Log (L)	Log (M)	Fractal dimension (D)
1.	10	13.1	1	1.120	1.120
2.	11	23.50	1.041	1.370	1.313
3.	12	25.72	1.078	1.410	1.304
4.	13	45.95	1.112	1.661	1.492
5.	14	54.5	1.145	1.737	1.511

Diffusion coefficient

In this work, the average mean square displacement value is in "tick" value on the monitor. The radius of the photosphere is assumed 75 "tick" on the monitor and hence the calculation is assumed as 75 "tick" on monitor = 695 Mm on the solar surface and hence 1 tick = 9.0 Mm. The mean square displacement value for each magnetogram is tabulated in Table –II.

Table 2: Calculation of mean square displacements

S. No.	Mean square displacement in each magnetogram	r in tick	Means square displacement in each magnetogram in mM^2
1	1530	39.10	126408.2
2	1620	40.26	133844.2
3	1851	43.02	153094.6
4	2156	46.44	178293.7
5	1996	44.70	165074.74
6	1803	42.44	148963.4
7	1704	41.26	140784.2
8	1700	41.21	140454.0
9	1685	41.01	139214.3
10	1659	40.71	137066.1
11	1660	40.71	137149.2

In this work, the time is 5 days for all eleven magnetograms. The time interval between each magnetogram at is 0.5 days approximately. The diffusion coefficient is calculated using the following equation

$$\langle r^2 \rangle = 4Kt \qquad (2)$$

where $\langle r^2 \rangle$ – the average mean square displacement
K – Diffusion coefficient
t – Time for all 11 magnetograms

Using the r values from Table (2), threshold displacement value R is estimated and $R^2/4t$ is calculated. Consider the total number of events with displacement r less than some threshold value R, the cumulative distribution is given by

$$F(r < R, t) = 1 - e^{R1/4Kt} \qquad (3)$$

The cumulative frequency is calculated by using Eqn. (3). The values of – 1n (1–f) and $R^2/4t$ are tabulated in Table–III.

Table 3: Calculation of threshold displacement and cumulative distribution of movements of filaments 1 tick = 9.1 Min

S. No.	r in tick	R in tick	$12^2/4t$ in km^2/s	–ln (1–f)
1.	39.10	39.10	73.301	0.870
2.	40.21	79.34	301.814	3.591
3.	40.71	120.07	691.116	8.223
4.	40.71	160.82	1239.730	14.754
5.	41.01	201.87	1953.297	23.251
6.	41.20	243.10	2832.567	33.721
7.	41.24	284.41	3876.127	46.142
8.	42.22	326.64	5113.647	60.784
9.	43.02	369.70	6549.947	77.972
10.	44.70	414.40	8229.598	97.970
11.	46.42	460.84	10178.342	121.024

The graph–2 is drawn between –ln (1–f) and $R^2/4t$.

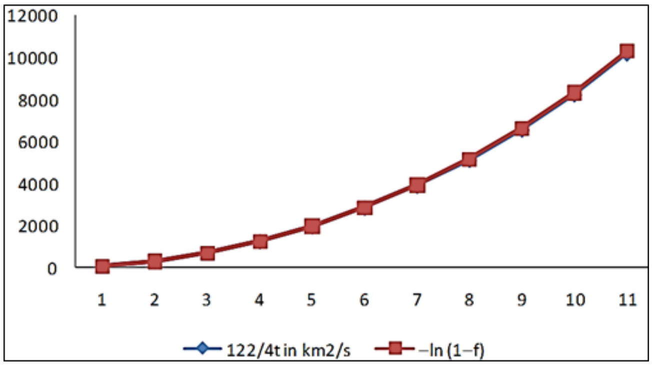

Fig 2: Graph between – In (l–f) and $R^2/4t$ in Km^2/s

This is in good agreement with linear relationship predicted by Schrijver and Martin (1990) [6] as

$$\frac{R^2}{4t} = -K\ln(1-f) \qquad (4)$$

Results and Discussion

Solar energy technologies have become well-established and popular technologies throughout the world. The fractal dimension of percolation cluster was reported as 1/D = 1.55 ± 0.07. In the present work, the fractal dimension of the formed percolation cluster is 1.3496. From this result we can conclude that the fractal dimension of the formed percolation cluster is always lie between 1-2. The graph–1 indicated the linear relationship of log value of lattice length and log value of area of the grown percolation cluster. In the present work, the diffusion coefficient of random motions of flux tube concentration is 84.01 km^2/sec. The slope of the graph–2 is the value of the diffusion coefficient. The value of –ln (l–f), bears a linear relationship with there sold diffusion coefficient.

Conclusion

We concluded that despite a few drawbacks solar energy technology is one of the most promising renewable energy sources to meet the future global energy demand. In the present report, investigation on diffusion of magnetic flux elements on the solar surface are attempted.

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