A Dictionary of Tibetan and English and the Graphical law

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Abstract

We study a Dictionary of Tibetan and English by Alexender Csoma de Koros. We draw the natural logarithm of the number of entries, normalised, starting with a letter vs the natural logarithm of the rank of the letter, normalised. We conclude that the Dictionary can be characterised by BW(c=0.01) i.e. a magnetisation curve for the Bragg-Williams approximation of the Ising model with spin to next spin coupling ϵ, in the presence of γ nearest neighbours, and extenal magnetic field H, obeying $\frac{H}{\gamma\epsilon} = c = 0.01$.

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I. INTRODUCTION

The glorious Himalaya comes with it, magnificient peaks, habitable valleys, diverse flora and fauna. It is home to various linguistic races. One is Tibetan. An essay into the classical Tibetan language was made way back in eighteen hundred, by a Hungarian. Hungarian Alexender Csoma de Koros assisted by a tibetian lama, Sangs-Rgyas Phun-Tshogs, completed the dictionary of Tibetan language, [1], in 1834. These two like Edmund Percival Hillary and Tenzing Norgay scaling the Mount Everest, went on to comprehend, catageroise and compile the Tibetan dictionary nearly two hundred years back. He came from Hungary. He often lived life almost that of a ”Buddha Bhiksu”. Having been driven and guided by pure pursuit of knowledge and to find how the world looked like, he landed in Tibet. There from his journey started into the world of Tibetan language, almost ”empty handed”. There came in the form of an aide the second person, the tibetian lama, Sangs-Rgyas Phun-Tshogs. The inner aim was to find any relationship of the Tibetan with the Hungarian language. He ended up with the conclusion of the Tibetan literature being entirely of Indian origin.

To have a quick journey through the dictionary,[1], we reproduce few entries in the following. Ka in the Tibetan means one, k′ha means two, .., na means twelve,..., a means thirty. ni means forty two, nu means seventy two, ne' means one hundred two, no means one hundred thirty two. Moreover, ”kar-mo’” means white rice, ”vasil-yab” means a cooling fan, ”braga-ri” means a rock or, a rocky mountain, ”dran-srong” means a sage, ”vazo-rig-pa” means technology, ”gase'r” means gold, ”dadul” means silver, ”rnul” means he sweats, ”mar-yul” means Ladak, ”mi-lus” means a human body, ”ga-lchu” means cow dung, ”chi” means quality, ”gazigasa-mo” means a spectacle, ”Lhag-pa” means planet mercury, ”gazi-byin” means brightness, ”bargya-dapon” means a captain of hundred men, ”gachog-pa” means to break, ”me-tog-gi-tshas” means a flower garden, ”tshogas-badag” means the Lord of Ho(S. Ganesa), $^{s\cdot}$Tsanda means the moon, hod-dapaga-me'd means immense light or, name of a fancied Buddha or. S. Amita'bha, gazon-nur-gyur-pa means the youthful or, S. Kumar bhu'ta, se'm-pa means a thinking, them-skasa means a ladder, sbyun-pa means alms, mihur-po means a clever man, ut-pa-la is the name of a flower of blue colour, kun-gazhi means the mind, ka-thama means oats, zhu-hod means sunshine, thig means a pencil, tshla-thoga means a red line, ganam-lchagas means s.a thunderbolt, mi-po means the man, chhu-po means the river, spyun means a cloud, hor or, hor-pa means a Turk, ka-ra means s.sugar, ku-cho means s.noise, ku-shu means s.an apple, kun-da is name of a flower, k′hrama means s.cabbage, k′ha-ba means s.snow, k′ha-ba-chan means s.Tibet, k′hal-k′ha means Mongol, k′hu-bo means uncle, k′hroma means a market place, nya-k′hroma means a fish market, gadugasa means noon, ganam means sky, gatsang-po means s.a river, gasola-ja means tea, gasom or, gasom-po means a pine or, fir, habu-thagas means a cob-web, chhos-pa means a monk, ta-lahi-bla-ma means the DALAI LAMA, thang-ka means a picture, dam-pa means holy, dur-byang means an epitaph, dagaha-ma is the name of a goddess, LÆTITIA and so on.

In this article, we study magnetic field pattern behind this dictionary of the Tibetan,[1]. We have started considering magnetic field pattern in [2], in the languages we converse with. We have studied there, a set of natural languages, [2] and have found existence of a magnetisation curve under each language. We have termed this phenomenon as graphical law. Moreover, counting number of pages for a letter and multiplying by average number of words, number of words was deduced for each letter for another dictionary of Tibetan language in the preliminary work, [2].

Then, we moved on to investigate into, [3], dictionaries of five disciplines of knowledge and found existence of a curve magnetisation under each discipline. This was followed by finding of the graphical law behind the bengali language,[4] and the basque language[5]. This was pursued by finding of the graphical law behind the Romanian language, [6], five more disciplines of knowledge, [7], Onsager core of Abor-Miri, Mising languages,[8], Onsager Core of Romanised Bengali language,[9], the graphical law behind the Little Oxford English Dictionary, [10], the Oxford Dictionary of Social Work and Social Care, [11], the Visayan-English Dictionary, [12], Garo to English School Dictionary, [13], Mursi-English-Amharic Dicionary, [14] and Names of Minor Planets, [15], respectively.

We describe how a graphical law is hidden within the Tibetan language Dicionary, [1], in this article. The planning of the paper is as follows. We introduce the standard curves of magnetisation of Ising model in the section II. In the section III, we describe analysis of the entries of Tibetan language,[1]. Next section IV is acknowledgement section. The last section is bibliography.

II. MAGNETISATION

A. Bragg-Williams approximation

Let us consider a coin. Let us toss it many times. Probability of getting head or, tale is half i.e. we will get head and tale equal number of times. If we attach value one to head, minus one to tale, the average value we obtain, after many tossing is zero. Instead let us consider a one-sided loaded coin, say on the head side. The probability of getting head is more than one half, getting tale is less than one-half. Average value, in this case, after many tossing we obtain is non-zero, the precise number depends on the loading. The loaded coin is like ferromagnet, the unloaded coin is like paramagnet, at zero external magnetic field. Average value we obtain is like magnetisation, loading is like coupling among the spins of the ferromagnetic units. Outcome of single coin toss is random, but average value we get after long sequence of tossing is fixed. This is long-range order. But if we take a small sequence of tossing, say, three consecutive tossing, the average value we obtain is not fixed, can be anything. There is no short-range order.

Let us consider a row of spins, one can imagine them as spears which can be vertically up or, down. Assume there is a long-range order with probability to get a spin up is two third. That would mean when we consider a long sequence of spins, two third of those are with spin up. Moreover, assign with each up spin a value one and a down spin a value minus one. Then total spin we obtain is one third. This value is referred to as the value of long-range order parameter. Now consider a short-range order existing which is identical with the long-range order. That would mean if we pick up any three consecutive spins, two will be up, one down. Bragg-Williams approximation means short-range order is identical with long-range order, applied to a lattice of spins, in general. Row of spins is a lattice of one dimension.

Now let us imagine an arbitrary lattice, with each up spin assigned a value one and a down spin a value minus one, with an unspecified long-range order parameter defined as above by $L = \frac{1}{N}\Sigma_i\sigma_i$, where σ_i is i-th spin, N being total number of spins. L can vary from minus one to one. $N = N_+ + N_-$, where N_+ is the number of up spins, N_- is the number of down spins. $L = \frac{1}{N}(N_+ - N_-)$. As a result, $N_+ = \frac{N}{2}(1+L)$ and $N_- = \frac{N}{2}(1-L)$. Magnetisation or, net magnetic moment , M is $\mu\Sigma_i\sigma_i$ or, $\mu(N_+ - N_-)$ or, μNL, $M_{max} = \mu N$. $\frac{M}{M_{max}} = L$. $\frac{M}{M_{max}}$ is referred to as reduced magnetisation. Moreover, the Ising Hamiltonian,[16], for the lattice of spins, setting μ to one, is $-\epsilon\Sigma_{n.n}\sigma_i\sigma_j - H\Sigma_i\sigma_i$, where n.n refers to nearest neighbour pairs. The difference $\triangle E$ of energy if we flip an up spin to down spin is, [17], $2\epsilon\gamma\bar{\sigma} + 2H$, where γ is the number of nearest neighbours of a spin. According to Boltzmann principle, $\frac{N_-}{N_+}$ equals $exp(-\frac{\triangle E}{k_B T})$, [18]. In the Bragg-Williams approximation,[19], $\bar{\sigma} = L$, considered in the thermal average sense. Consequently,

$$ln\frac{1+L}{1-L} = 2\frac{\gamma\epsilon L + H}{k_B T} = 2\frac{L + \frac{H}{\gamma\epsilon}}{\frac{T}{\gamma\epsilon/k_B}} = 2\frac{L+c}{\frac{T}{T_c}} \quad (1)$$

where, $c = \frac{H}{\gamma\epsilon}$, $T_c = \gamma\epsilon/k_B$, [20]. $\frac{T}{T_c}$ is referred to as reduced temperature.
Plot of L vs $\frac{T}{T_c}$ or, reduced magentisation vs. reduced temperature is used as reference curve. In the presence of magnetic field, $c \neq 0$, the curve bulges outward. Bragg-Williams is a Mean Field approximation. This approximation holds when number of neighbours interacting with a site is very large, reducing the importance of local fluctuation or, local order, making the long-range order or, average degree of freedom as the only degree of freedom of the lattice. To have a feeling how this approximation leads to matching between experimental and Ising model prediction one can refer to FIG.12.12 of [17]. W. L. Bragg was a professor of Hans Bethe. Rudlof Peierls was a friend of Hans Bethe. At the suggestion of W. L. Bragg, Rudlof Peierls following Hans Bethe improved the approximation scheme, applying quasi-chemical method.

B. Bethe-peierls approximation in presence of four nearest neighbours, in absence of external magnetic field

In the approximation scheme which is improvement over the Bragg-Williams, [16],[17],[18],[19],[20], due to Bethe-Peierls, [21], reduced magnetisation varies with reduced temperature, for γ neighbours, in absence of external magnetic field, as

$$\frac{ln\frac{\gamma}{\gamma-2}}{ln\frac{factor-1}{factor^{\frac{\gamma-1}{\gamma}} - factor^{\frac{1}{\gamma}}}} = \frac{T}{T_c}; factor = \frac{\frac{M}{M_{max}}+1}{1-\frac{M}{M_{max}}}. \quad (2)$$

$ln\frac{\gamma}{\gamma-2}$ for four nearest neighbours i.e. for $\gamma = 4$ is 0.693. For a snapshot of different kind of magnetisation curves for magnetic materials the reader is urged to give a google search "reduced magnetisation vs reduced temperature curve". In the following, we describe

BW	BW(c=0.01)	BP(4,βH = 0)	reduced magnetisation
0	0	0	1
0.435	0.439	0.563	0.978
0.439	0.443	0.568	0.977
0.491	0.495	0.624	0.961
0.501	0.507	0.630	0.957
0.514	0.519	0.648	0.952
0.559	0.566	0.654	0.931
0.566	0.573	0.7	0.927
0.584	0.590	0.7	0.917
0.601	0.607	0.722	0.907
0.607	0.613	0.729	0.903
0.653	0.661	0.770	0.869
0.659	0.668	0.773	0.865
0.669	0.676	0.784	0.856
0.679	0.688	0.792	0.847
0.701	0.710	0.807	0.828
0.723	0.731	0.828	0.805
0.732	0.743	0.832	0.796
0.756	0.766	0.845	0.772
0.779	0.788	0.864	0.740
0.838	0.853	0.911	0.651
0.850	0.861	0.911	0.628
0.870	0.885	0.923	0.592
0.883	0.895	0.928	0.564
0.899	0.918		0.527
0.904	0.926	0.941	0.513
0.946	0.968	0.965	0.400
0.967	0.998	0.965	0.300
0.987		1	0.200
0.997		1	0.100
1	1	1	0

TABLE I. Reduced magnetisation vs reduced temperature datas for Bragg-Williams approximation, in absence of and in presence of magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$, and Bethe-Peierls approximation in absence of magnetic field, for four nearest neighbours .

datas generated from the equation(1) and the equation(2) in the table, I, and curves of magnetisation plotted on the basis of those datas. BW stands for reduced temperature in Bragg-Williams approximation, calculated from the equation(1). BP(4) represents reduced temperature in the Bethe-Peierls approximation, for four nearest neighbours, computed from the equation(2). The data set is used to plot fig.1. Empty spaces in the table, I, mean corresponding point pairs were not used for plotting a line.

C. Onsager solution

At a temperature T, below a certain temperature called phase transition temperature, T_c, for the two dimensional Ising model in absence of external magnetic field i.e. for H equal to

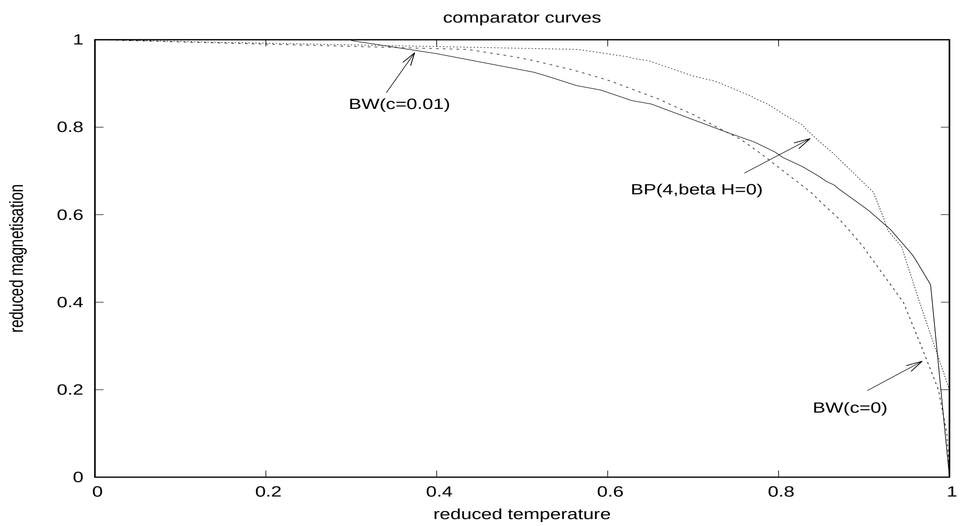

FIG. 1. Reduced magnetisation vs reduced temperature curves for Bragg-Williams approximation, in absence(dark) of and presence(inner in the top) of magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$, and Bethe-Peierls approximation in absence of magnetic field, for four nearest neighbours (outer in the top).

zero, the exact, unapproximated, Onsager solution gives reduced magnetisation as a function of reduced temperature as, [22], [23], [24], [21],

$$\frac{M}{M_{max}} = [1 - (sinh\frac{0.8813736}{\frac{T}{T_c}})^{-4}]^{1/8}.$$

Graphically, the Onsager solution appears as in fig.3.

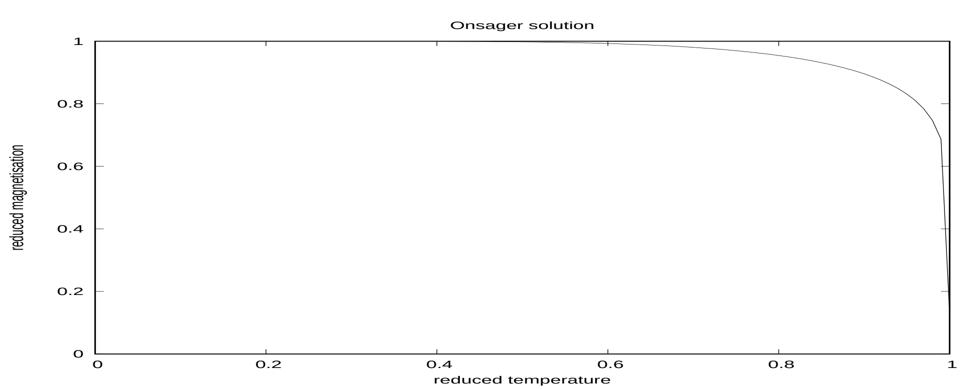

FIG. 2. Reduced magnetisation vs reduced temperature curves for exact solution of two dimensional Ising model, due to Onsager, in absence of external magnetic field

III. ANALYSIS OF ENTRIES OF TIBETAN LANGUAGE

The Tibetan language alphabet is composed of thirty letters. We take the dictionary of Tibetan and English ,[1]. Then we count all the entries, [1], one by one from the beginning to the end, starting with different letters. This has been done in two steps for the dictionary. First, we have counted all entries initiating with a letter, say K, from the section for the letter K. The number is two hundred sixty three. Second, we have enlisted all entries initiating with K from the sections for the letters K'h, G,..A. Then we have removed from the list entries already appearing in the section belonging to K. Then we have counted the number of the entries in that list. The number is forty three. As a result total number of words beginning with K is three hundred and six. This exercise was then followed for K'h, G,..A. The result is the table, II or, the figure fig.3.

letter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
number	306	643	1719	200	126	372	51	209	54	308	1404	359	111	562	2783
splitting	263+43	552+91	1401+318	175+25	100+26	252+120	41+10	180+29	49+5	233+75	1151+253	285+74	96+15	430+132	2103+680
letter	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
number	1410	54	420	16	14	310	308	2931	386	2158	1200	473	3291	108	95
splitting	1139+271	50+4	361+59	16+0	11+3	275+35	274+34	2742+189	329+57	1866+292	1000+200	384+89	2965+326	104+4	85+10

TABLE II. Tibetan words: the first row represents letters of the Tibetan alphabet,[1] in the serial order

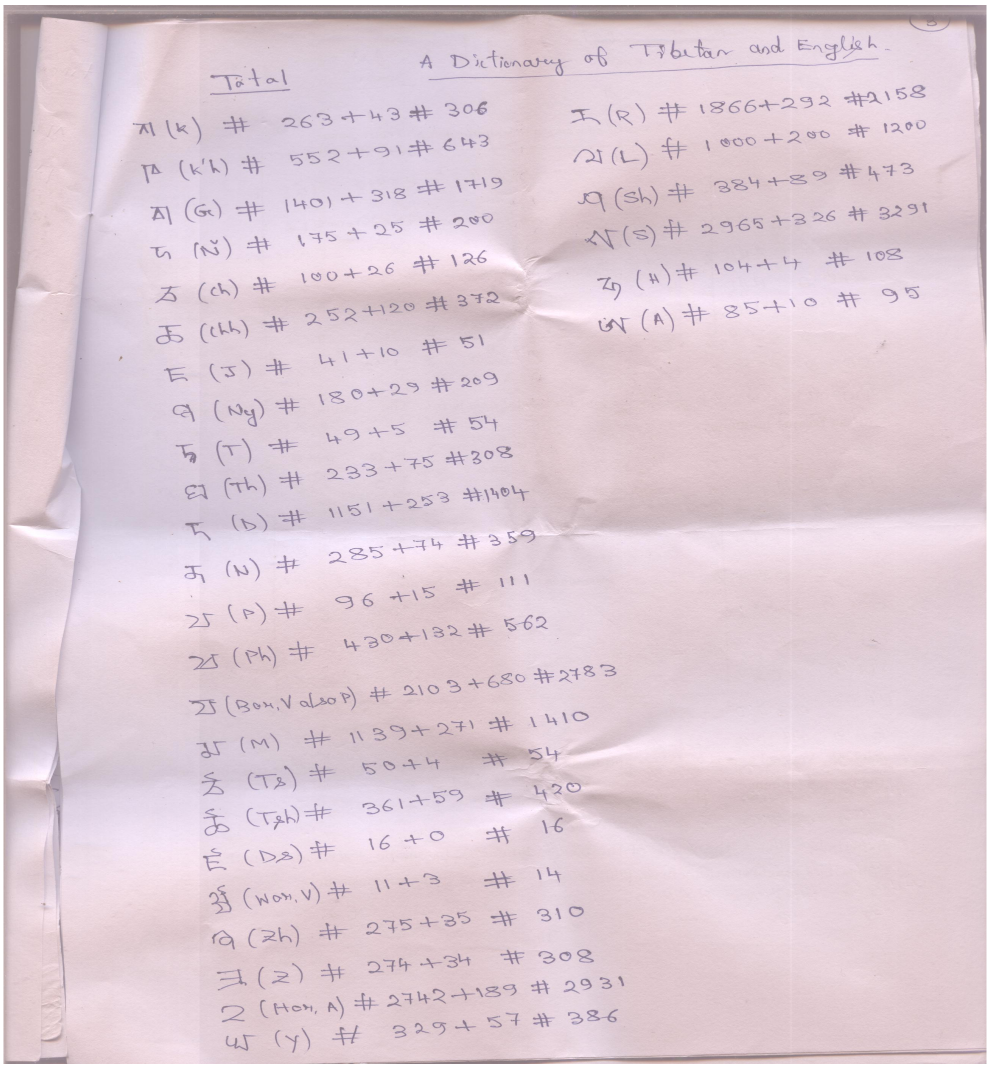

FIG. 3. Number of entries starting with various letters of the Tibetan alphabet

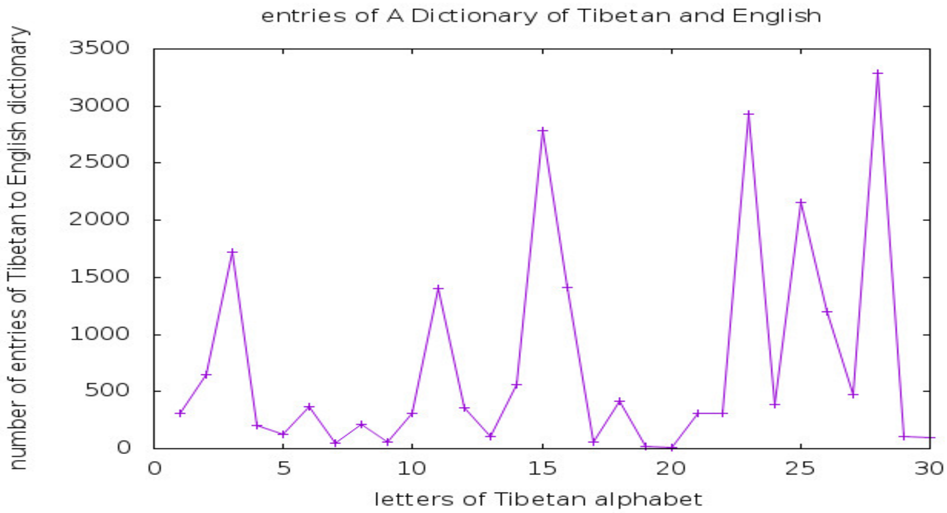

FIG. 4. Vertical axis is number of entries and horizontal axis is respective letters. Letters are represented by the number in the alphabet or, dictionary sequence,[1].

Highest number of entries, three thousand two hundred ninety one, start with the letter S followed by entries numbering two thousand nine hundred thirty one beginning with H, two thousand seven hundred eighty three with the letter B etc. To visualise we plot the number of words against respective letters in the dictionary sequence,[1] in the figure fig.4.

For the purpose of exploring graphical law, we assort the letters according to the number of words, in the descending order, denoted by f and the respective rank, denoted by k. k is a positive integer starting from one. Moreover, we attach a limiting rank, k_{lim}, and a limiting number of words. The limiting rank is maximum rank plus one, here it is twenty eight and the limiting number of words is one. As a result both $\frac{lnf}{lnf_{max}}$ and $\frac{lnk}{lnk_{lim}}$ varies from zero to one. Then we tabulate in the adjoining table, III and plot $\frac{lnf}{lnf_{max}}$ against $\frac{lnk}{lnk_{lim}}$ in the figure fig.5.

We then ignore the letter with the highest of words, tabulate in the adjoining table, III and redo the plot, normalising the lnfs with next-to-maximum $lnf_{nextmax}$, and starting from $k=2$ in the figure fig.6. Normalising the lnfs with next-to-next-to-maximum $lnf_{nextnextmax}$, we tabulate in the adjoining table, III, and starting from $k=3$ we draw in the figure fig.7. Normalising the lnfs with next-to-next-to-next-to-maximum $lnf_{nextnextnextmax}$ we record in the adjoining table, III, and plot starting from $k=4$ in the figure fig.8. Normalising the lnfs with next-to-next-to-next-to-next-to-maximum $lnf_{nnnnmax}$ we record in the adjoining table, III, and plot starting from $k=5$ in the figure fig.9. Normalising the lnfs with

k	lnk	lnk/lnk_{lim}	f	lnf	lnf/lnf_{max}	lnf/$lnf_{nextmax}$	lnf/lnf_{nnmax}	lnf/lnf_{nnnmax}	lnf/$lnf_{nnnnmax}$	lnf/$lnf_{nnnnnmax}$	lnf/$lnf_{nnnnnnnnnnmax}$
1	0	0	3291	8.099	1	Blank	Blank	Blank	Blank	Blank	Blank
2	0.69	0.205	2931	7.983	0.986	1	Blank	Blank	Blank	Blank	Blank
3	1.10	0.326	2783	7.931	0.979	0.993	1	Blank	Blank	Blank	Blank
4	1.39	0.412	2158	7.677	0.948	0.962	0.968	1	Blank	Blank	Blank
5	1.61	0.478	1719	7.449	0.920	0.933	0.939	0.970	1	Blank	Blank
6	1.79	0.531	1410	7.251	0.895	0.908	0.914	0.945	0.973	1	Blank
7	1.95	0.579	1404	7.247	0.895	0.908	0.914	0.944	0.973	0.999	Blank
8	2.08	0.617	1200	7.090	0.875	0.888	0.894	0.924	0.952	0.978	Blank
9	2.20	0.653	643	6.466	0.798	0.810	0.815	0.842	0.868	0.892	Blank
10	2.30	0.682	562	6.332	0.782	0.793	0.798	0.825	0.850	0.873	Blank
11	2.40	0.712	473	6.159	0.760	0.772	0.777	0.802	0.827	0.849	1
12	2.48	0.736	420	6.040	0.746	0.757	0.762	0.787	0.811	0.833	0.981
13	2.56	0.760	386	5.956	0.735	0.746	0.751	0.776	0.800	0.821	0.967
14	2.64	0.783	372	5.919	0.731	0.741	0.746	0.771	0.795	0.816	0.961
15	2.71	0.804	359	5.883	0.726	0.737	0.742	0.766	0.790	0.811	0.955
16	2.77	0.822	310	5.737	0.708	0.719	0.723	0.747	0.770	0.791	0.931
17	2.83	0.840	308	5.730	0.707	0.718	0.722	0.746	0.769	0.790	0.930
18	2.89	0.858	306	5.724	0.707	0.717	0.722	0.746	0.768	0.789	0.929
19	2.94	0.872	209	5.342	0.660	0.669	0.674	0.696	0.717	0.737	0.867
20	3.00	0.890	200	5.298	0.654	0.664	0.668	0.690	0.711	0.731	0.860
21	3.04	0.902	126	4.836	0.597	0.606	0.610	0.630	0.649	0.667	0.785
22	3.09	0.917	111	4.710	0.582	0.590	0.594	0.614	0.632	0.650	0.765
23	3.14	0.932	108	4.682	0.578	0.586	0.590	0.610	0.629	0.646	0.760
24	3.18	0.944	95	4.554	0.562	0.570	0.574	0.593	0.611	0.628	0.739
25	3.22	0.955	54	3.989	0.493	0.500	0.503	0.520	0.536	0.550	0.648
26	3.26	0.967	51	3.932	0.485	0.493	0.496	0.512	0.528	0.542	0.638
27	3.30	0.979	16	2.773	0.342	0.347	0.350	0.361	0.372	0.382	0.450
28	3.33	0.988	14	2.639	0.326	0.331	0.333	0.344	0.354	0.363	0.427
29	3.37	1	1	0	0	0	0	0	0	0	0

TABLE III. Tibetian words: ranking, natural logarithm, normalisations

nextnextnextnextnext-maximum $lnf_{nnnnnmax}$ we record in the adjoining table, III, and plot starting from $k = 6$ in the figure fig.10. Normalising the lnfs with 10n-maximum lnf_{10nmax} we record in the adjoining table, III, and plot starting from $k = 11$ in the figure fig.11.

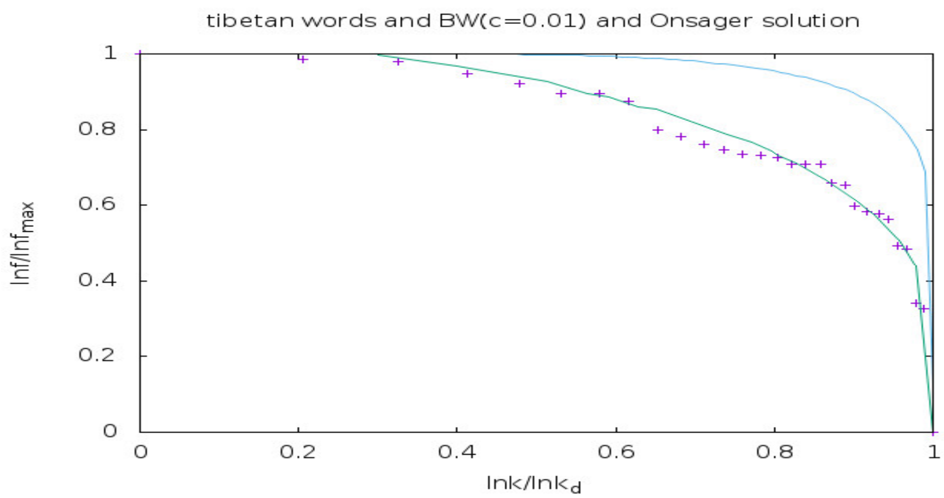

FIG. 5. Vertical axis is $\frac{lnf}{lnf_{max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Tibetan language with the fit curve being Bragg-Williams approximation curve in the presence of magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$. The uppermost curve is the Onsager solution.

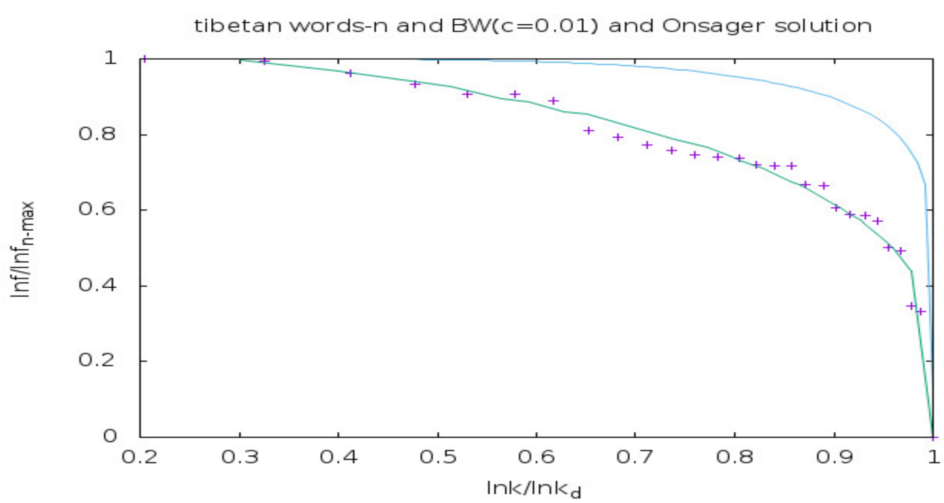

FIG. 6. Vertical axis is $\frac{lnf}{lnf_{next-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Tibetan language with the fit curve being Bragg-Williams approximation curve in presence of magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$. The uppermost curve is the Onsager solution.

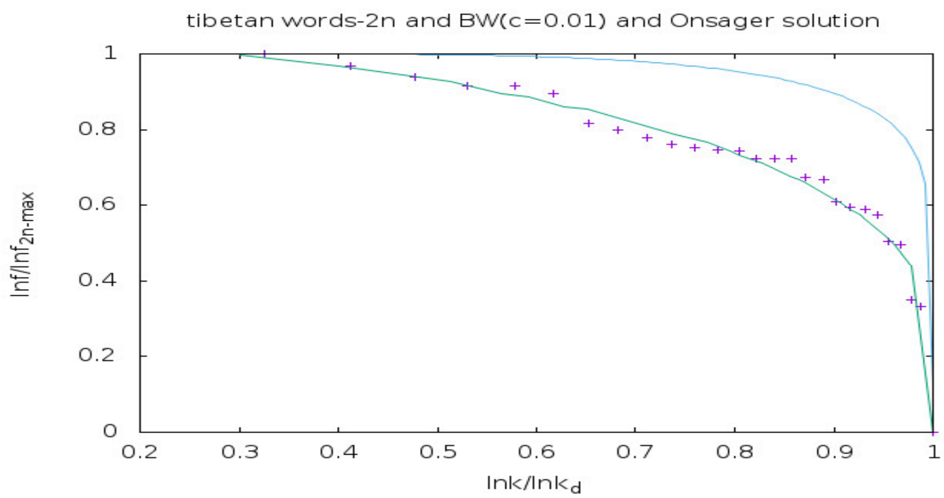

FIG. 7. Vertical axis is $\frac{lnf}{lnf_{nextnext-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Tibetan language with the fit curve being Bragg-Williams approximation curve in presence of magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$.The uppermost curve is the Onsager solution.

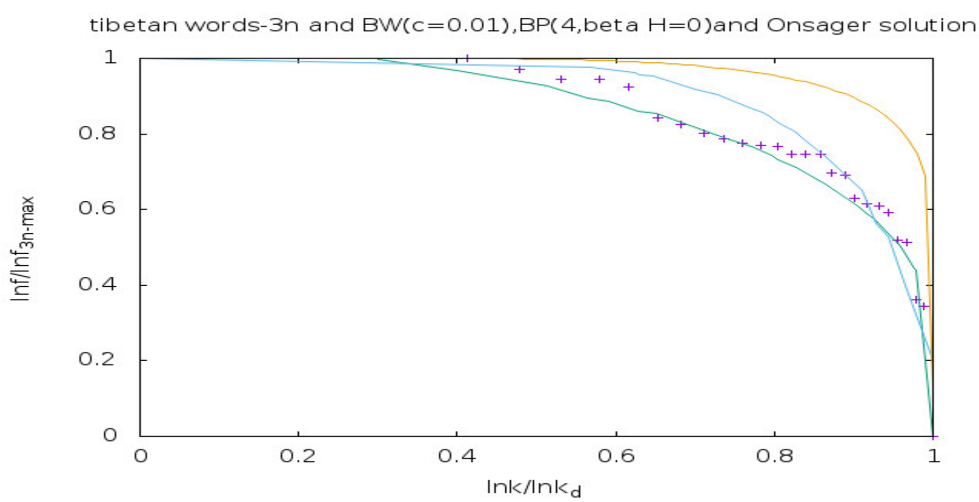

FIG. 8. Vertical axis is $\frac{lnf}{lnf_{nextnextnext-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Tibetan language with the fit curve being in between Bragg-Williams approximation curve in presence of magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$ and Bethe-Peierls curve in presence of four neighbours. The uppermost curve is the Onsager solution.

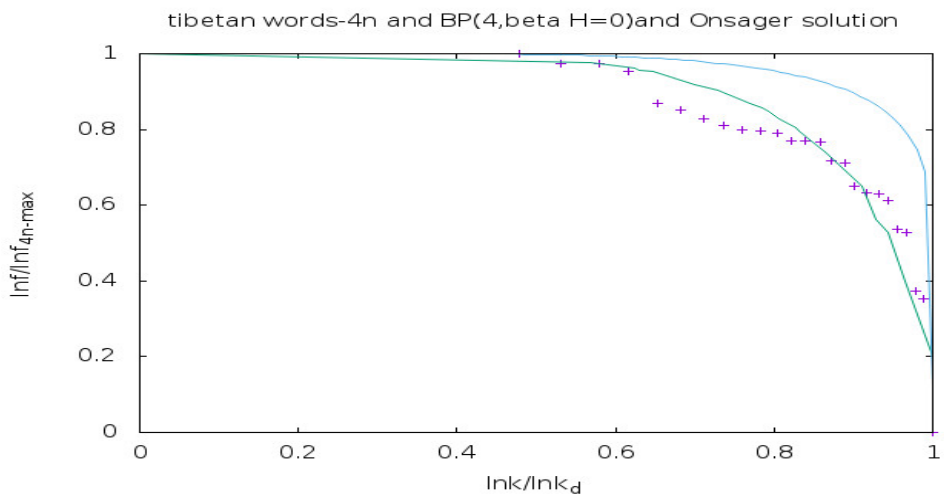

FIG. 9. Vertical axis is $\frac{lnf}{lnf_{nextnextnextnext-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Tibetan language with the fit curve being Bethe-Peierls curve in presence of four neighbours. The uppermost curve is the Onsager solution.

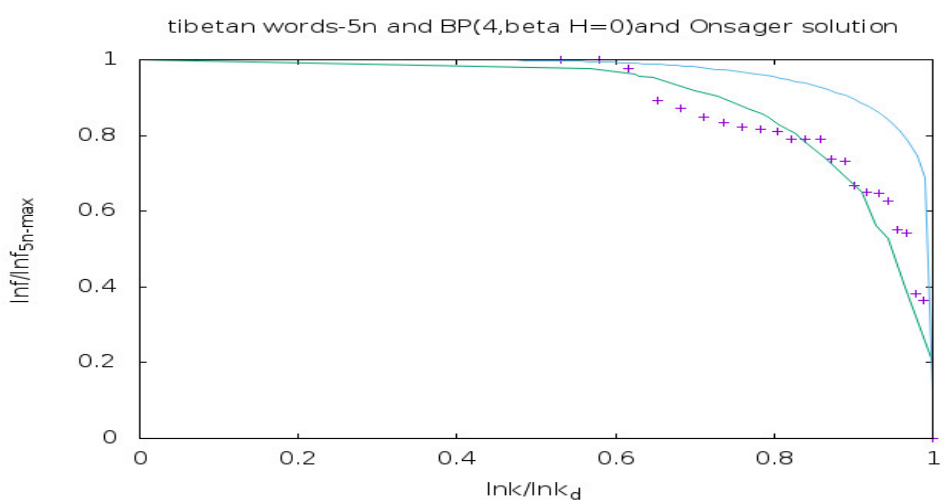

FIG. 10. Vertical axis is $\frac{lnf}{lnf_{nnnnn-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Tibetan language with the fit curve being Bethe-Peierls curve in presence of four neighbours.The uppermost curve is the Onsager solution.

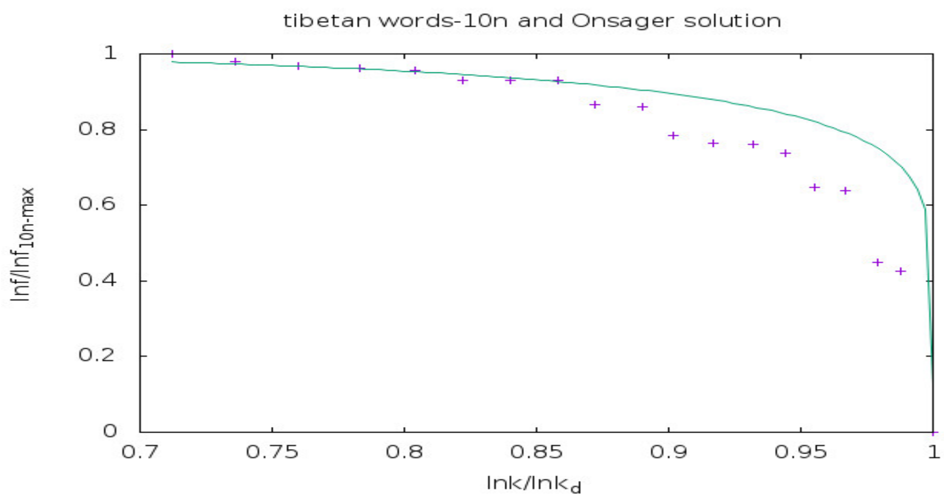

FIG. 11. Vertical axis is $\frac{lnf}{lnf_{10n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Tibetan language. The reference curve is the Onsager solution. The words of the Tibetan language do not go over to the Onsager solution.

A. conclusion

From the figures (fig.5-fig.11), we observe that there is a curve of magnetisation, behind the entries of Tibetan language,[1]. This is magnetisation curve, BW(c=0.01), in the Bragg-Williams approximation in presence of external magnetic field.

Moreover, the associated correspondance is,

$$\frac{lnf}{lnf_{next-maximum}} \longleftrightarrow \frac{M}{M_{max}},$$

$$lnk \longleftrightarrow T.$$

k corresponds to temperature in an exponential scale, [26]. Moreover, on successive higher normalisations, the entries of Tibetan language, [1], do not go over to, the Onsager solution.

IV. ACKNOWLEDGEMENT

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