Turkmen-English Dictionary and the Graphical law

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Abstract

We study the Turkmen-English Dictionary by Jonathan Garrett, Greg Lastowka, Kimberly Naahielua and Meena Pallipamu. 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 BP(4,βH=0.04) i.e. a magnetisation curve for the Bethe-Peierls approximation of the Ising model with four nearest neighbours with βH=0.04. H is external magnetic field, β is $\frac{1}{k_B T}$ where, T is temperature and k_B is the Boltzmann constant.

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I. INTRODUCTION

From the Caspian sea in the west to the Amur Dariya river in the east, spans a sparsely populated country of the size of Spain, sandwiched between Iran, Afganistan pair and Kazakhstan, Uzbekistan pair, in the south central Asia. Dotted with oases in the Karkum desert, producing finest carpets and once upon a time placing the biggest city of the world, Merv, with a very big market on the ancient silk route, the country comes with the name Turkmenistan. stan means place. Turkmen is the name of the people, apparently originating from Oguz Han tribe hailing from eastern steppe off the Amur Dariya river. Name of the language is Turkmen, meaning either almost Turk or, pure Turk. The capital city Ashgabat(Aşgabat), nearing the border of Iran towards south, is a disciplined array of white marble structures.

Jonathan Garrett, Greg Lastowka, Kimberly Naahielua and Meena Pallipamu have written, apparently the first, Turkmen-English dictionary, [1], in the year 1996, under the auspicies of Peace Corps Turkmenistan, Ashgabat. We take a quick journey through the dictionary,[1], by reproducing few entries in the following. adam in Turkmen means person, alañ is hill, amal is action, aman is safe, arada is recently, arzan is inexpensive, baki? is glance, bärik is here, burun is nose, çigit is sunflower seed, çigit ÿag is sunflower oil, çuññur is profound, dalda is aid, dañ means dawn, del means unusual, derek means information, dini means religious, don means robe(traditional Turkmen), doñ means frozen, gala means fortress, gar means snow, gara means black, garagu? means epilepsy, giri? means introduction, giñi means spacious, görkana means picturesque, göwre means torso, göru means vision, gülaby is a kind of melon, gülzar is a flower bed, gün is sun, günin means one day, gür means dense, gyÿa means oblique, häli means long ago, habar is news, hünär means trade, internat means r.boarding school, kaka is uncle(Balkan dialect), käbir is some, kär is profession, kärde? is colleague, konki is r.horse, matematika is r.mathematics, mämi? is orange, mön is naive, näzik is tender, oba is village, oglan is boy, ogul is son, orun is place, öññil is year before last, ömür is life, önüm is product, palas is r.thin rug, pata is blessing, parlak is sunshine, pul is money, sala is advice, sim means wire, sil means food, surat means picture, süri means herd, tarap means direction or, side, tarapdar means supporter, tegelek means round, tom is r.volume, tulum means wineskin, tümlük means obscurity, tylla is gold, ÿalta is still, ÿaz is spring, ÿürek is heart, ykbal is fate, zompa is suddenly and so on.

In this article, we study magnetic field pattern behind this dictionary of the Turkmen,[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.

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 Dictionary, [14] and Names of Minor Planets, [15], A Dictionary of Tibetan and English, [16], Khasi English Dictionary, [17], respectively.

In our first paper, [2], we have studied the Turkmen-English Dicionary,[1]. There we took resort to average counting i.e. finding an average number of words par page and multiplying by the number of pages corresponding to a letter we obtained the number of words starting with a letter. We deduced that the dictionary,[1], is characterised by BP(4,βH=0.02). Here, in this paper we leave behind the approximate method. We count thoroughly, one by one each word. Moreover, we augment the analysis. We conclude here, that the dictionary can be characterised by BP(4,βH=0.04).

The planning of the paper is as follows. We give an introduction to the standard curves of magnetisation of Ising model in the section II. In the section III, we describe analysis of the entries of the Turkmen language, [1]. Sections IV, V are Acknowledgment and Bibliography respectively.

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 ferro magnet, the unloaded coin is like para magnet, 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, $\mu N L$, $M_{max} = \mu N$. $\frac{M}{M_{max}} = L$. $\frac{M}{M_{max}}$ is referred to as reduced magnetisation. Moreover, the Ising Hamiltonian,[18], 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, [19], $2\epsilon\gamma\bar{\sigma} + 2H$, where γ is the number of nearest neighbours of a spin. According to Boltzmann principle, $\frac{N_-}{N_+}$ equals $exp(-\frac{\triangle E}{k_B T})$, [20]. In the Bragg-Williams approximation,[21], $\bar{\sigma} = L$, 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, $c = \frac{H}{\gamma\epsilon}$, $T_c = \gamma\epsilon/k_B$, [22]. $\frac{T}{T_c}$ 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 [19]. W. L. Bragg was a professor of Hans Bethe. Rudolf Peierls was a friend of Hans Bethe. At the suggestion of W. L. Bragg, Rudolf 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, [18],[19],[20],[21],[22], due to Bethe-Peierls, [23], 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.

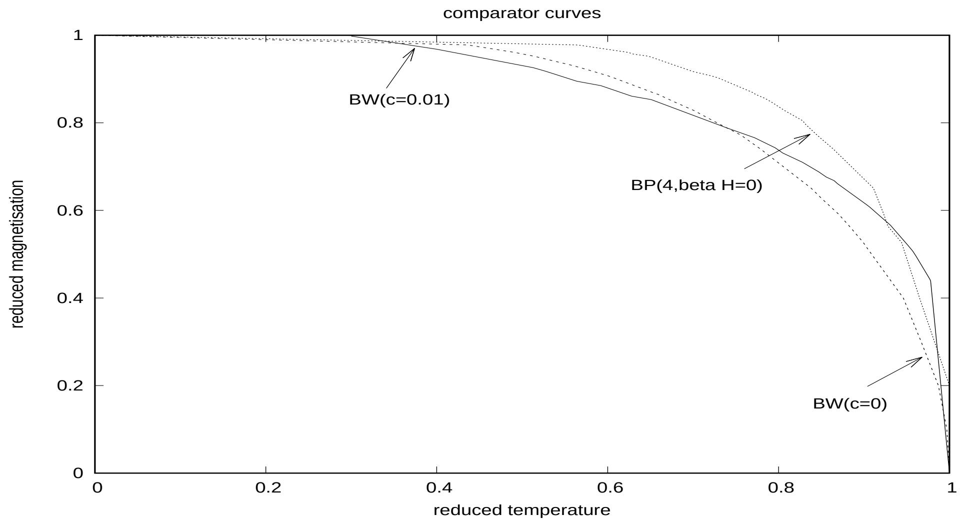

FIG. 1. Reduced magnetisation vs reduced temperature curves for Bragg-Williams approximation, in absence(dark) of and presence(inner in the top) of magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$, and Bethe-Peierls approximation in absence of magnetic field, for four nearest neighbours (outer in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

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

In the Bethe-Peierls approximation scheme , [23], reduced magnetisation varies with reduced temperature, for γ neighbours, in presence of external magnetic field, as

$$\frac{ln\frac{\gamma}{\gamma-2}}{ln\frac{factor-1}{e^{\frac{2\beta H}{\gamma}}factor^{\frac{\gamma-1}{\gamma}}-e^{-\frac{2\beta H}{\gamma}}factor^{\frac{1}{\gamma}}}} = \frac{T}{T_c}; factor = \frac{\frac{M}{M_{max}}+1}{1-\frac{M}{M_{max}}}. \tag{3}$$

Derivation of this formula ala [23] is given in the appendix of [7].

$ln\frac{\gamma}{\gamma-2}$ for four nearest neighbours i.e. for $\gamma = 4$ is 0.693. For four neighbours,

$$\frac{0.693}{ln\frac{factor-1}{e^{\frac{2\beta H}{\gamma}}factor^{\frac{\gamma-1}{\gamma}}-e^{-\frac{2\beta H}{\gamma}}factor^{\frac{1}{\gamma}}}} = \frac{T}{T_c}; factor = \frac{\frac{M}{M_{max}}+1}{1-\frac{M}{M_{max}}}. \tag{4}$$

In the following, we describe datas in the table, II, generated from the equation(4) and curves of magnetisation plotted on the basis of those datas. BP(m=0.03) stands for reduced temperature in Bethe-Peierls approximation, for four nearest neighbours, in presence of a variable external magnetic field, H, such that $\beta H = 0.06$. calculated from the equation(4). BP(m=0.025) stands for reduced temperature in Bethe-Peierls approximation, for four nearest neighbours, in presence of a variable external magnetic field, H, such that

$\beta H = 0.05$. calculated from the equation(4). BP(m=0.02) stands for reduced temperature in Bethe-Peierls approximation, for four nearest neighbours, in presence of a variable external magnetic field, H, such that $\beta H = 0.04$. calculated from the equation(4). BP(m=0.01) stands for reduced temperature in Bethe-Peierls approximation, for four nearest neighbours, in presence of a variable external magnetic field, H, such that $\beta H = 0.02$. calculated from the equation(4). BP(m=0.005) stands for reduced temperature in Bethe-Peierls approximation, for four nearest neighbours, in presence of a variable external magnetic field, H, such that $\beta H = 0.01$. calculated from the equation(4). The data set is used to plot fig.2. Similarly, we plot fig.3. Empty spaces in the table, II, mean corresponding point pairs were not used for plotting a line.

BP(m=0.03)	BP(m=0.025)	BP(m=0.02)	BP(m=0.01)	BP(m=0.005)	reduced magnetisation
0	0	0	0	0	1
0.583	0.580	0.577	0.572	0.569	0.978
0.587	0.584	0.581	0.575	0.572	0.977
0.647	0.643	0.639	0.632	0.628	0.961
0.657	0.653	0.649	0.641	0.637	0.957
0.671	0.667		0.654	0.650	0.952
	0.716			0.696	0.931
0.723	0.718	0.713	0.702	0.697	0.927
0.743	0.737	0.731	0.720	0.714	0.917
0.762	0.756	0.749	0.737	0.731	0.907
0.770	0.764	0.757	0.745	0.738	0.903
0.816	0.808	0.800	0.785	0.778	0.869
0.821	0.813	0.805	0.789	0.782	0.865
0.832	0.823	0.815	0.799	0.791	0.856
0.841	0.833	0.824	0.807	0.799	0.847
0.863	0.853	0.844	0.826	0.817	0.828
0.887	0.876	0.866	0.846	0.836	0.805
0.895	0.884	0.873	0.852	0.842	0.796
0.916	0.904	0.892	0.869	0.858	0.772
0.940	0.926	0.914	0.888	0.876	0.740
	0.929			0.877	0.735
	0.936			0.883	0.730
	0.944			0.889	0.720
	0.945				0.710
	0.955			0.897	0.700
	0.963			0.903	0.690
	0.973			0.910	0.680
				0.909	0.670
	0.993			0.925	0.650
		0.976	0.942		0.651
	1.00				0.640
		0.983	0.946	0.928	0.628
		1.00	0.963	0.943	0.592
			0.972	0.951	0.564
			0.990	0.967	0.527
				0.964	0.513
			1.00		0.500
				1.00	0.400
					0.300
					0.200
					0.100
					0

TABLE II. Bethe-Peierls approx. in presence of little external magnetic fields

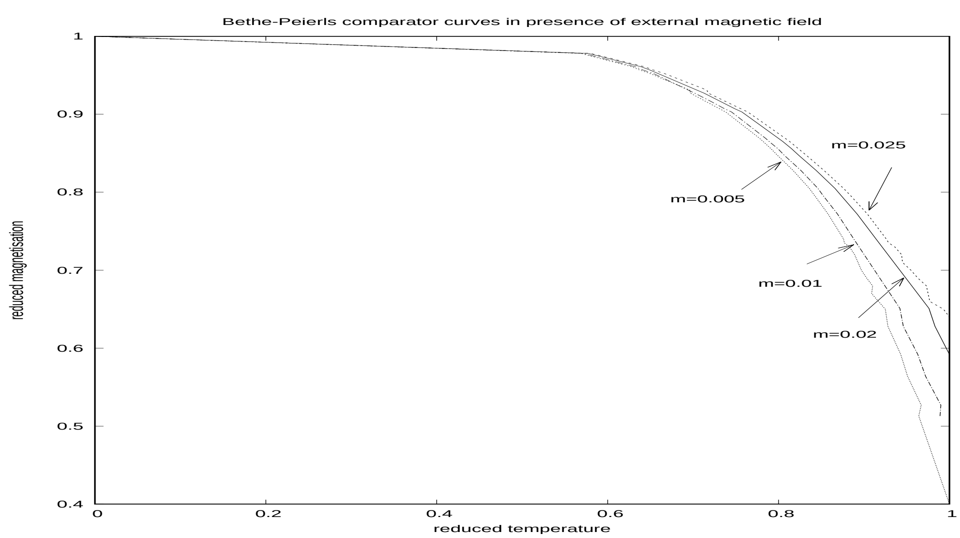

FIG. 2. Reduced magnetisation vs reduced temperature curves for Bethe-Peierls approximation in presence of little external magnetic fields, for four nearest neighbours, with $\beta H = 2m$.

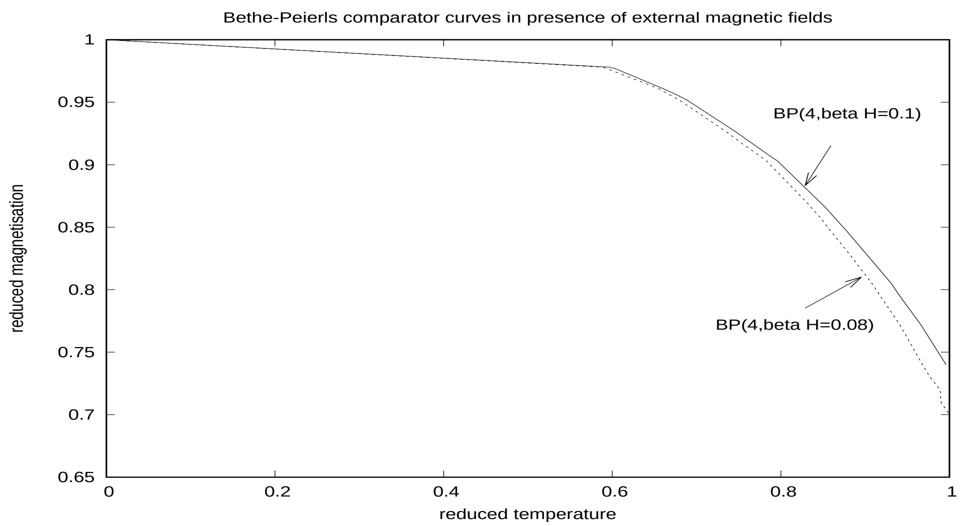

FIG. 3. Reduced magnetisation vs reduced temperature curves for Bethe-Peierls approximation in presence of little external magnetic fields, for four nearest neighbours, with $\beta H = 2m$.

D. 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 zero, the exact, unapproximated, Onsager solution gives reduced magnetisation as a function of reduced temperature as, [24], [25], [26], [23],

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

Graphically, the Onsager solution appears as in fig.4.

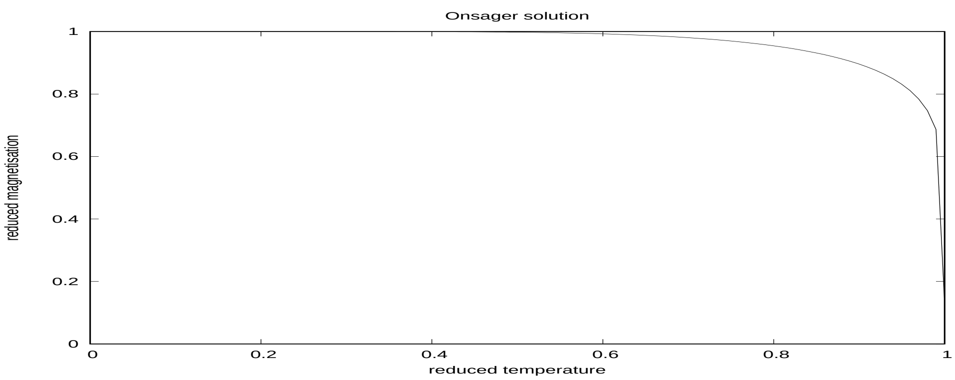

FIG. 4. Reduced magnetisation vs reduced temperature curves for exact solution of two dimensional Ising model, due to Onsager, in absence of external magnetic field

letter	A	B	Ç	D	E	Ä	F	G	H	I	J	£	K	L	M
number	406	484	406	513	248	47	54	1048	393	257	154	9	544	78	364
splitting	402+4	475+9	405+1	509+4	245+3	46+1	54+0	1038+10	391+2	253+4	153+1	9+0	541+3	78+0	363+1
letter	N	O	Ö	P	R	S	?	T	U	Ü	W	Ÿ	Y	Z	
number	173	217	159	370	120	653	218	555	123	70	94	505	114	91	
splitting	172+1	215+2	158+1	370+0	120+0	649+4	216+2	552+3	122+1	70+0	94+0	501+4	112+2	91+0	

TABLE III. Turkmen words: the first(fourth) row represents letters of the Turkmen alphabet,[1], in the serial order.

III. ANALYSIS OF ENTRIES OF TURKMEN-ENGLISH DICTIONARY

The Turkmen language alphabet is composed of twenty nine letters like Tibetan. We take Turkmen-English dictionary,[1]. Then we count all the entries, [1], one by one from the beginning to the end, starting with different letters, refraining from counting full sentences appearing as examples. This has been done in two steps for the dictionary. First, we have counted all entries initiating with a letter, say A, from the section for the letter A. The number is four hundred two. Second, we have enlisted all entries initiating with A from the sections for the letters B,Ç, D,..Z. Then we have removed from the list entries already appearing in the section belonging to A. Then we have counted the number of the entries in that list. The number is four. As a result total number of words beginning with A is four hundred and six. This exercise was then followed for the letters B,Ç, D,..Z. The result is the table, III.

Highest number of entries, one thousand forty eight, starts with the letter G followed by entries numbering six hundred fifty three beginning with S, five hundred fifty five with the letter T etc. To visualise we plot the number of words against respective letters in the dictionary sequence,[1] in the figure fig.5.

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 nine 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, IV and plot $\frac{lnf}{lnf_{max}}$ against $\frac{lnk}{lnk_{lim}}$ in the figure fig.6.

We then ignore the letter with the highest of words, tabulate in the adjoining table, IV and

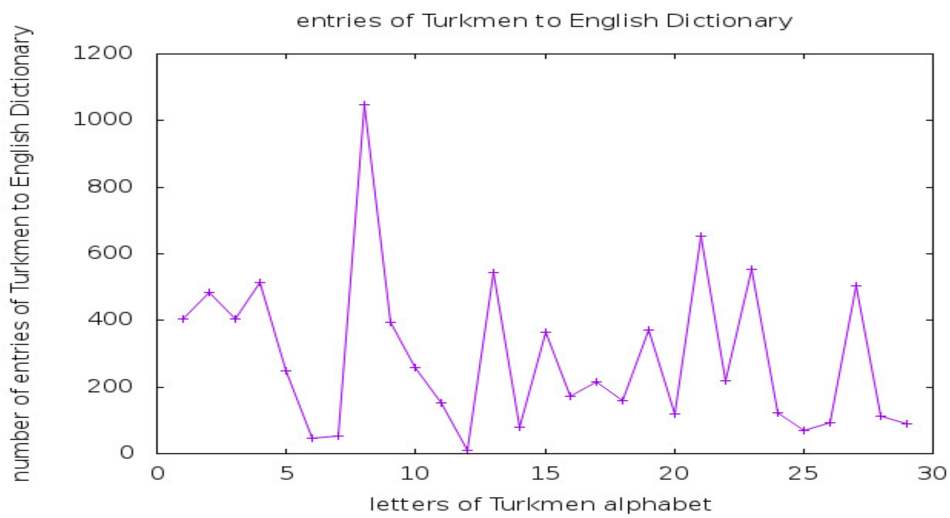

FIG. 5. Vertical axis is number of entries and horizontal axis is respective letters. Letters are represented by the number in the alphabet or, dictionary sequence,[1].

redo the plot, normalising the lnfs with next-to-maximum $lnf_{nextmax}$, and starting from $k = 2$ in the figure fig.7. Normalising the lnfs with next-to-next-to-maximum $lnf_{nextnextmax}$, we tabulate in the adjoining table, IV, and starting from $k = 3$ we draw in the figure fig.8. Normalising the lnfs with next-to-next-to-next-to-maximum $lnf_{nextnextnextmax}$ we record in the adjoining table, IV, and plot starting from $k = 4$ in the figure fig.9. Normalising the lnfs with next-to-next-to-next-to-next-to-maximum $lnf_{nnnnmax}$ we record in the adjoining table, IV, and plot starting from $k = 5$ in the figure fig.10. Normalising the lnfs with nextnextnextnextnext-maximum $lnf_{nnnnnmax}$ we record in the adjoining table, IV, and plot starting from $k = 6$ in the figure fig.11. We continue upto normalising the lnfs with 12n-maximum lnf_{12nmax} we record in the adjoining table, IV, and plot starting from $k = 13$ in the figure fig.18.

k	lnk	lnk/lnk_{lim}	f	lnf	lnf/lnf_{max}	lnf/lnf_{n-max}	lnf/lnf_{2n-max}	lnf/lnf_{3n-max}	lnf/lnf_{4n-max}	lnf/lnf_{5n-max}	lnf/lnf_{6n-max}	lnf/lnf_{7n-max}	lnf/lnf_{8n-max}	lnf/lnf_{9n-max}	lnf/$lnf_{10n-max}$	lnf/$lnf_{11n-max}$	lnf/lnf_{n-max}
1	0	0	1048	6.955	1	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank
2	0.69	0.205	653	6.482	0.932	1	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank
3	1.10	0.326	555	6.319	0.909	0.975	1	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank
4	1.39	0.412	544	6.299	0.906	0.972	0.997	1	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank
5	1.61	0.478	513	6.240	0.897	0.963	0.987	0.991	1	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank
6	1.79	0.531	505	6.225	0.895	0.960	0.985	0.988	0.998	1	Blank	Blank	Blank	Blank	Blank	Blank	Blank
7	1.95	0.579	484	6.182	0.889	0.954	0.978	0.981	0.991	0.993	1	Blank	Blank	Blank	Blank	Blank	Blank
8	2.08	0.617	406	6.006	0.864	0.927	0.950	0.953	0.963	0.965	0.972	1	Blank	Blank	Blank	Blank	Blank
9	2.20	0.653	393	5.974	0.859	0.922	0.945	0.948	0.957	0.960	0.966	0.995	1	Blank	Blank	Blank	Blank
10	2.30	0.682	370	5.914	0.850	0.912	0.936	0.939	0.948	0.950	0.957	0.985	0.990	1	Blank	Blank	Blank
11	2.40	0.712	364	5.897	0.848	0.910	0.933	0.936	0.945	0.947	0.954	0.982	0.987	0.997	1	Blank	Blank
12	2.48	0.736	257	5.549	0.798	0.856	0.878	0.881	0.889	0.891	0.898	0.924	0.929	0.938	0.941	1	Blank
13	2.56	0.760	248	5.513	0.793	0.851	0.872	0.875	0.883	0.886	0.892	0.918	0.923	0.932	0.935	0.994	1
14	2.64	0.783	218	5.384	0.774	0.831	0.852	0.855	0.863	0.865	0.871	0.896	0.901	0.910	0.913	0.970	0.977
15	2.71	0.804	217	5.380	0.774	0.830	0.851	0.854	0.862	0.864	0.870	0.896	0.901	0.910	0.912	0.970	0.976
16	2.77	0.822	173	5.153	0.741	0.795	0.815	0.818	0.826	0.828	0.834	0.858	0.863	0.871	0.874	0.929	0.935
17	2.83	0.840	159	5.069	0.729	0.782	0.802	0.805	0.812	0.814	0.820	0.844	0.849	0.857	0.860	0.913	0.919
18	2.89	0.858	154	5.037	0.724	0.777	0.797	0.800	0.807	0.809	0.815	0.839	0.843	0.852	0.854	0.908	0.914
19	2.94	0.872	123	4.812	0.692	0.742	0.762	0.764	0.771	0.773	0.778	0.801	0.805	0.814	0.816	0.867	0.873
20	3.00	0.890	120	4.787	0.688	0.739	0.758	0.760	0.767	0.769	0.774	0.797	0.801	0.809	0.812	0.863	0.868
21	3.04	0.902	114	4.736	0.681	0.731	0.749	0.752	0.759	0.761	0.766	0.789	0.793	0.801	0.803	0.853	0.859
22	3.09	0.917	94	4.543	0.653	0.701	0.719	0.721	0.728	0.730	0.735	0.756	0.760	0.768	0.770	0.819	0.824
23	3.14	0.932	91	4.511	0.649	0.696	0.714	0.716	0.723	0.725	0.730	0.751	0.755	0.763	0.765	0.813	0.818
24	3.18	0.944	78	4.357	0.626	0.672	0.690	0.692	0.698	0.700	0.705	0.725	0.729	0.737	0.739	0.785	0.790
25	3.22	0.955	70	4.248	0.611	0.655	0.672	0.674	0.681	0.682	0.687	0.707	0.711	0.718	0.720	0.766	0.771
26	3.26	0.967	54	3.989	0.574	0.615	0.631	0.633	0.639	0.641	0.645	0.664	0.668	0.675	0.676	0.719	0.724
27	3.30	0.979	47	3.850	0.554	0.594	0.609	0.611	0.617	0.618	0.623	0.641	0.644	0.651	0.653	0.694	0.698
28	3.33	0.988	9	2.197	0.316	0.339	0.348	0.349	0.352	0.353	0.355	0.366	0.368	0.371	0.373	0.396	0.399
29	3.37	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE IV. Turkmen words: ranking, natural logarithm, normalisations

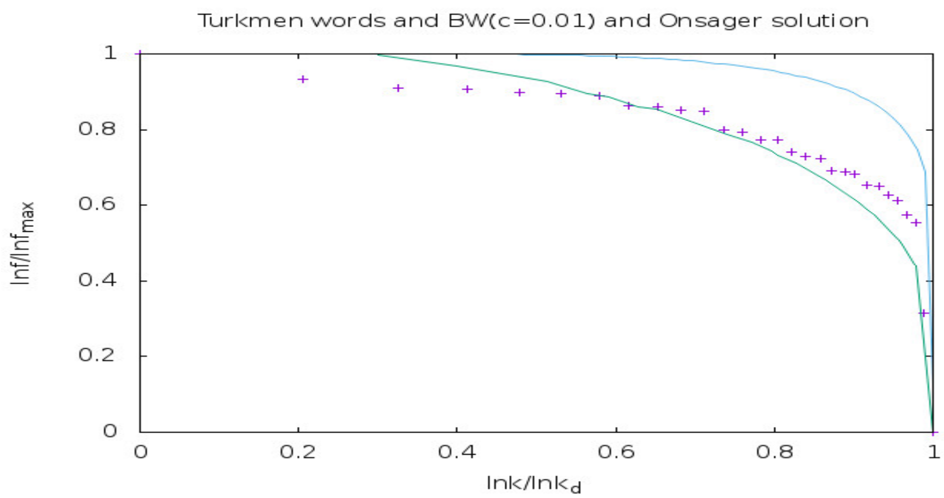

FIG. 6. Vertical axis is $\frac{lnf}{lnf_{max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Turkmen language with the fit curve being Bragg-Williams approximation curve in the presence of magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$. The uppermost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

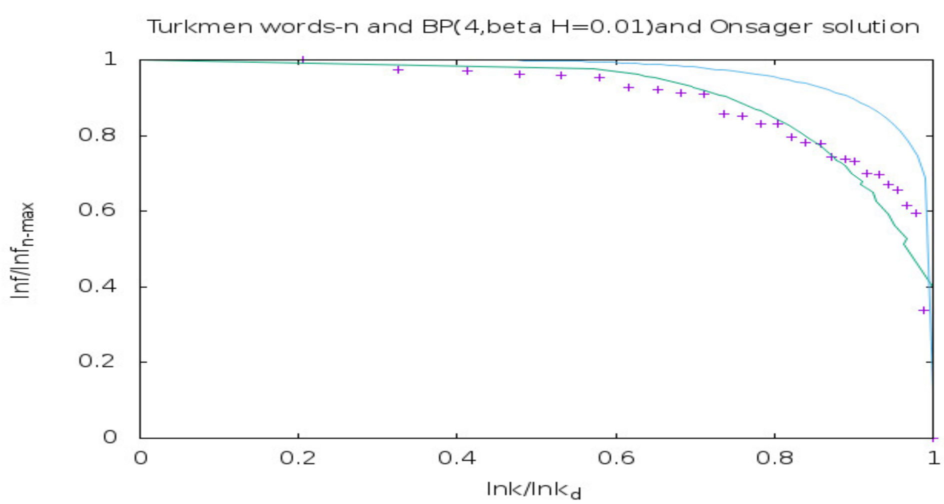

FIG. 7. Vertical axis is $\frac{lnf}{lnf_{next-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Turkmen language with fit curve being Bethe-Peierls curve with four nearest neighbours, in presence of little magnetic field, m=0.005 or, $\beta H = 0.01$. The uppermost curve is the Onsager solution.

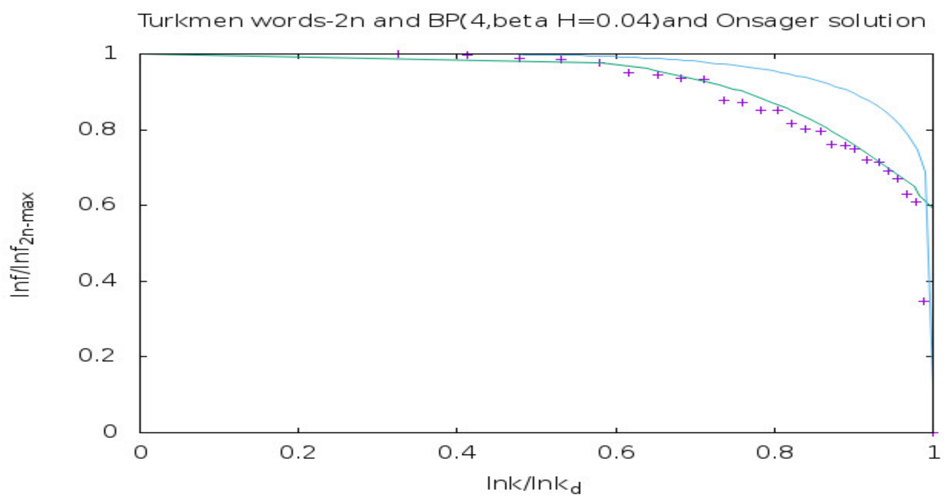

FIG. 8. Vertical axis is $\frac{lnf}{lnf_{nextnext-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Turkmen language with fit curve being Bethe-Peierls curve with four nearest neighbours, in presence of little magnetic field, m=0.02 or, $\beta H = 0.04$. The uppermost curve is the Onsager solution.

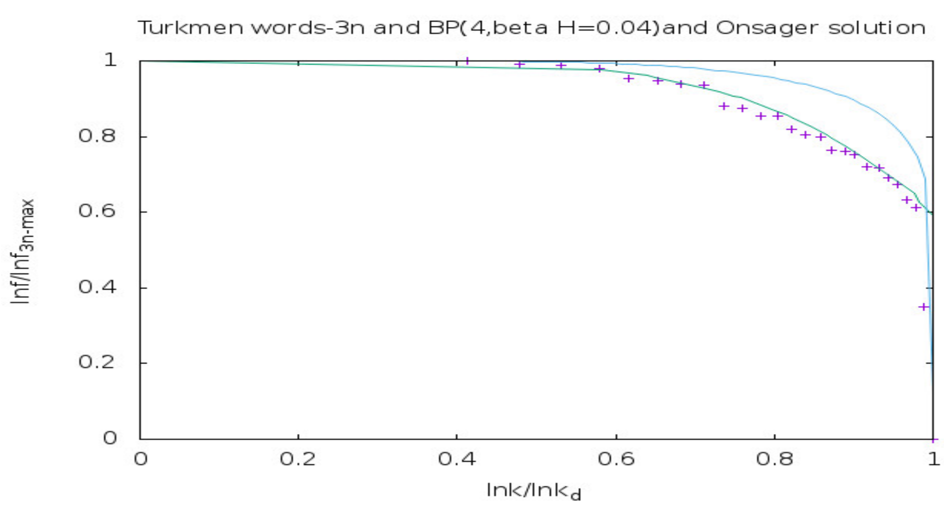

FIG. 9. Vertical axis is $\frac{lnf}{lnf_{nextnextnext-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Turkmen language with fit curve being Bethe-Peierls curve with four nearest neighbours, in presence of little magnetic field, m=0.02 or, $\beta H = 0.04$. The uppermost curve is the Onsager solution.

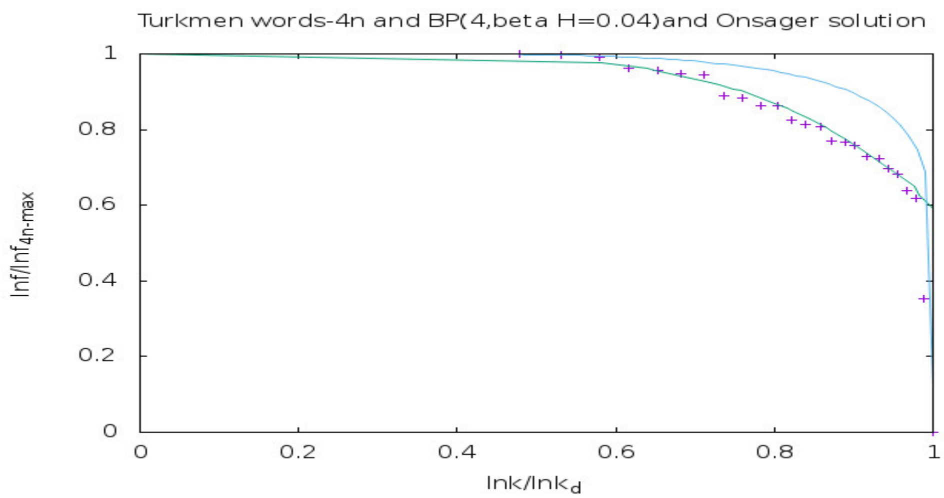

FIG. 10. Vertical axis is $\frac{lnf}{lnf_{nextnextnextnext-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Turkmen language with fit curve being Bethe-Peierls curve with four nearest neighbours, in presence of little magnetic field, m=0.02 or, $\beta H = 0.04$. The uppermost curve is the Onsager solution.

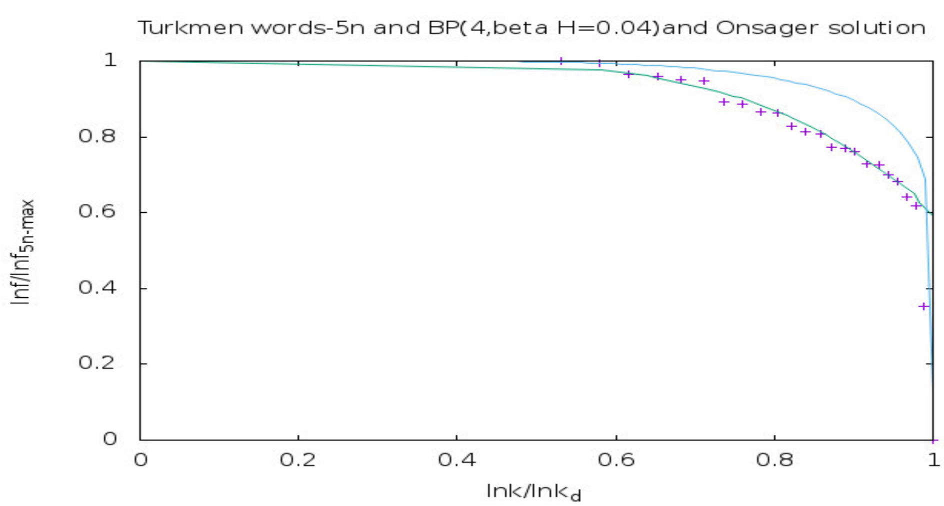

FIG. 11. Vertical axis is $\frac{lnf}{lnf_{nnnnn-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Turkmen language with fit curve being Bethe-Peierls curve with four nearest neighbours, in presence of little magnetic field, m=0.02 or, $\beta H = 0.04$. The uppermost curve is the Onsager solution.

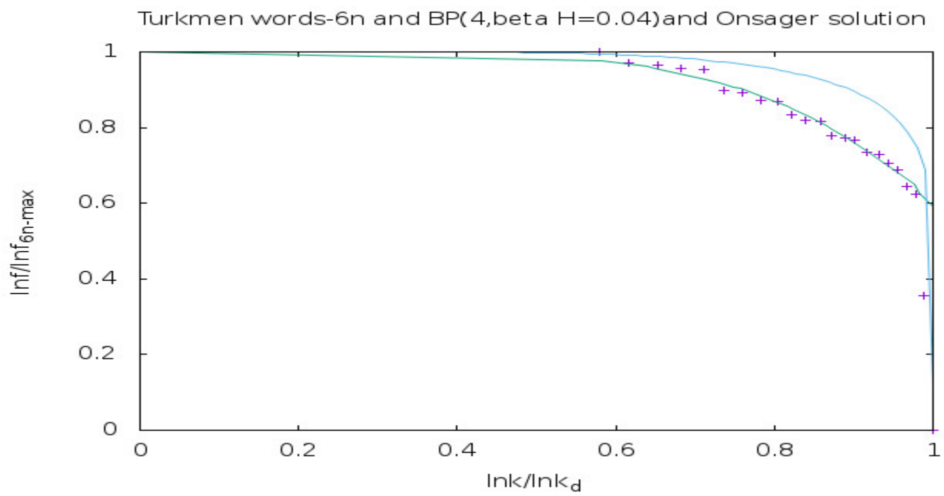

FIG. 12. Vertical axis is $\frac{lnf}{lnf_{6n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Turkmen language with fit curve being Bethe-Peierls curve with four nearest neighbours, in presence of little magnetic field, m=0.02 or, $\beta H = 0.04$. The uppermost curve is the Onsager solution.

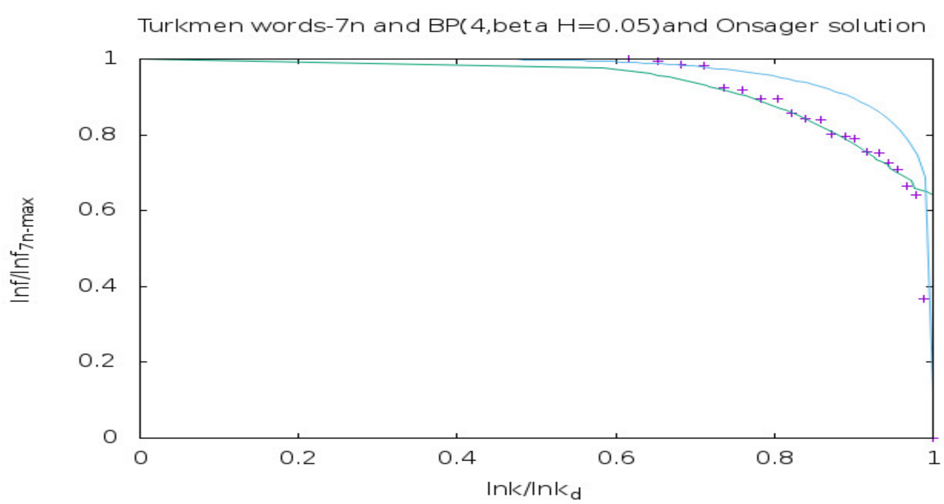

FIG. 13. Vertical axis is $\frac{lnf}{lnf_{7n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Turkmen language with fit curve being Bethe-Peierls curve with four nearest neighbours, in presence of little magnetic field, m=0.025 or, $\beta H = 0.05$. The uppermost curve is the Onsager solution.

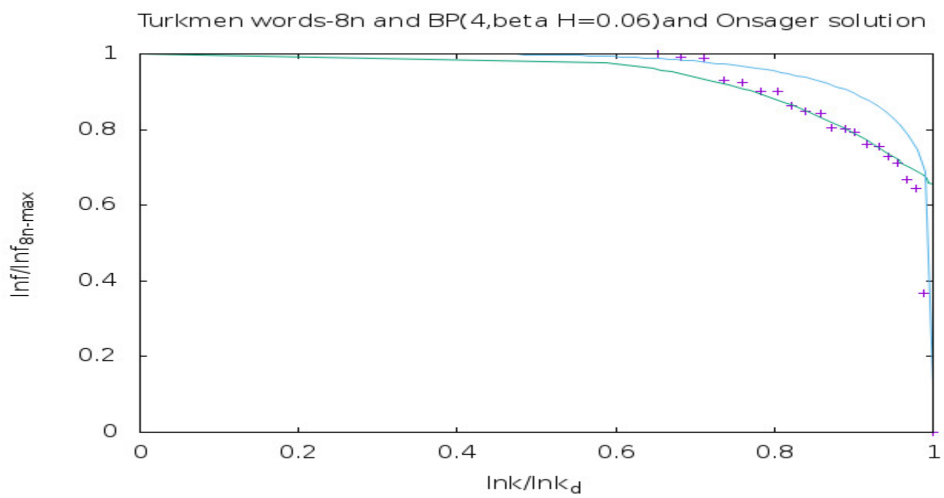

FIG. 14. Vertical axis is $\frac{lnf}{lnf_{8n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Turkmen language with fit curve being Bethe-Peierls curve with four nearest neighbours, in presence of little magnetic field, m=0.03 or, $\beta H = 0.06$. The uppermost curve is the Onsager solution.

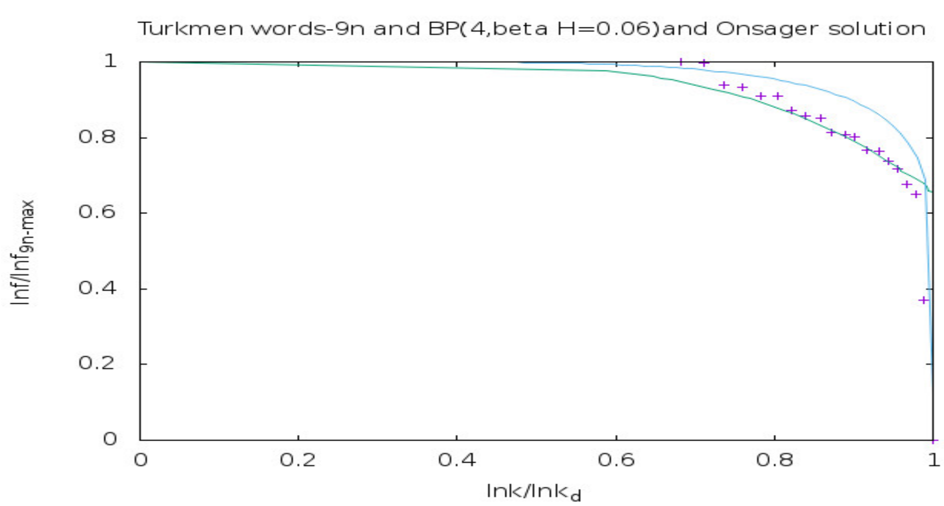

FIG. 15. Vertical axis is $\frac{lnf}{lnf_{9n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Turkmen language with fit curve being Bethe-Peierls curve with four nearest neighbours, in presence of little magnetic field, m=0.03 or, $\beta H = 0.06$. The uppermost curve is the Onsager solution.

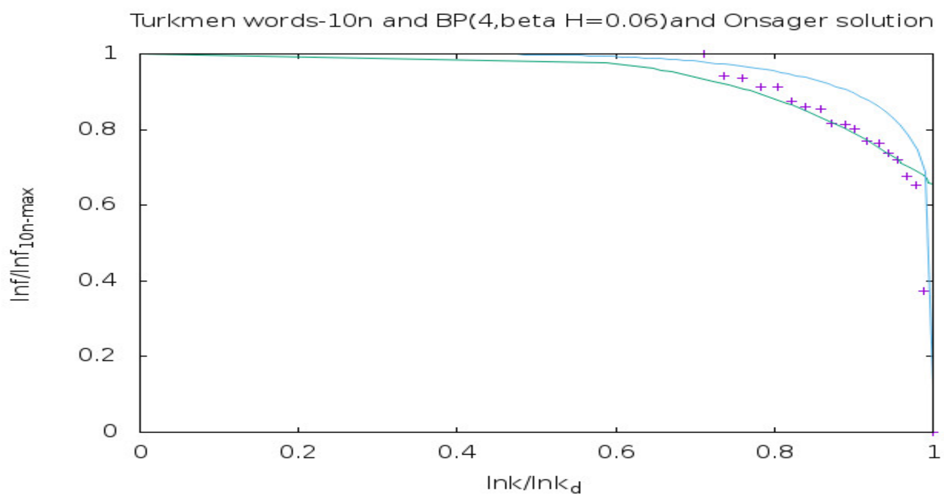

FIG. 16. Vertical axis is $\frac{lnf}{lnf_{10n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Turkmen language with fit curve being Bethe-Peierls curve with four nearest neighbours, in presence of little magnetic field, m=0.03 or, $\beta H = 0.06$. The uppermost curve is the Onsager solution.

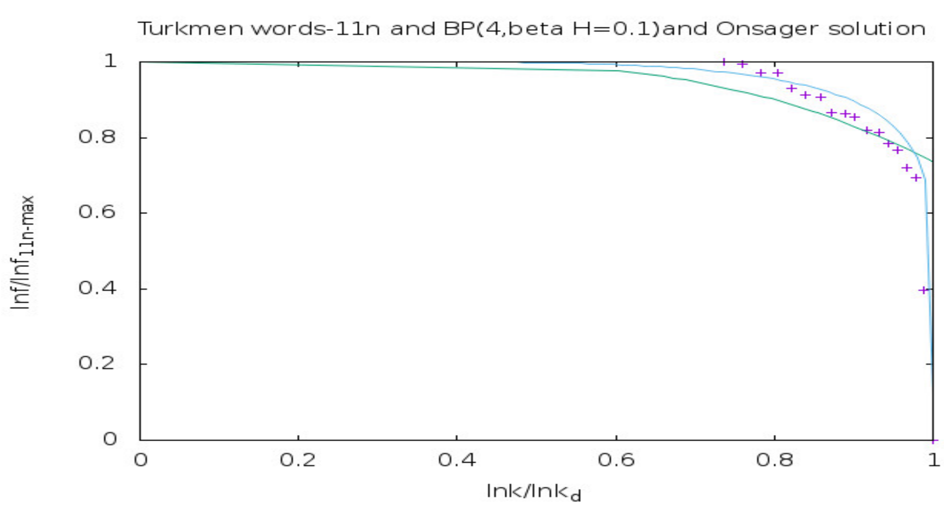

FIG. 17. Vertical axis is $\frac{lnf}{lnf_{11n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Turkmen language with fit curve being Bethe-Peierls curve with four nearest neighbours, in presence of little magnetic field, m=0.05 or, $\beta H = 0.1$. The uppermost curve is the Onsager solution.

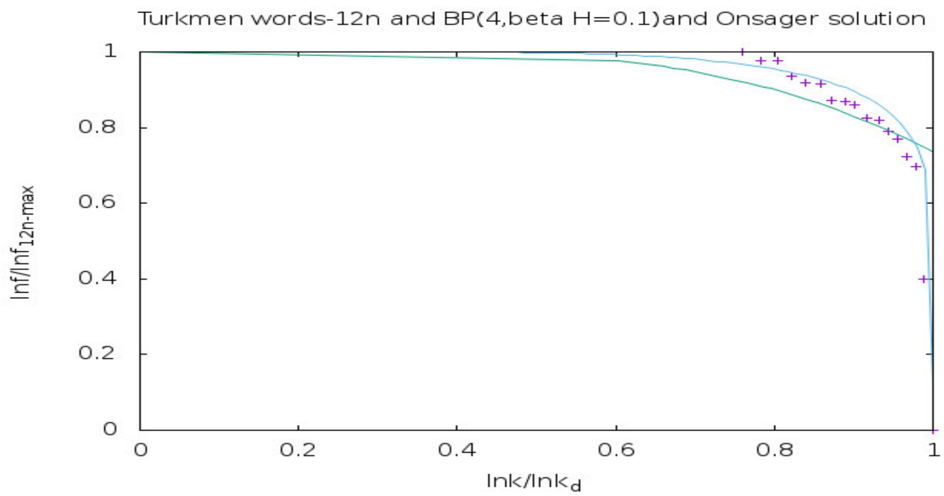

FIG. 18. Vertical axis is $\frac{lnf}{lnf_{12n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Turkmen language with fit curve being Bethe-Peierls curve with four nearest neighbours, in presence of little magnetic field, m=0.05 or, $\beta H = 0.1$. The uppermost curve is the Onsager solution. The words of Turkmen language, [1], do not go over to, the Onsager solution

A. conclusion

From the figures (fig.6-fig.18), we observe that there is a curve of magnetisation, behind the entries of Turkmen language,[1]. This is magnetisation curve, BP(4,βH=0.04), in the Bethe-Peierls approximation in presence of little external magnetic field.
Moreover, the associated correspondence is,

$$\frac{lnf}{lnf_{5n-maximum}} \longleftrightarrow \frac{M}{M_{max}},$$

$$lnk \longleftrightarrow T.$$

k corresponds to temperature in an exponential scale, [28]. Moreover, on successive higher normalisations, the words of Turkmen language, [1], do not go over to, the Onsager solution. Interestingly, $\frac{lnf}{lnf_{max}}$ vs $\frac{lnk}{lnk_{lim}}$ is matched by BW(c=0.01) as in the Tibetan, Basque, Romanian, Khasi languages.

IV. ACKNOWLEDGEMENT

We have used gnuplot for plotting the figures in this paper. We have benefited from reading related web pages of wiki travel and Wikipedia

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[1] Jonathan Garrett, Greg Lastowka, Kimberly Naahielua, Meena Pallipamu, ”Turkmen-English Dictionary”, 1996, Ashgabat, Turkmenistan; a SPA project of Peace Corps Turkmenistan.

[2] Anindya Kumar Biswas, ”Graphical Law beneath each written natural language”, arXiv:1307.6235v3[physics.gen-ph]. A preliminary study of words of dictionaries of twenty six languages, more accurate study of words of dictionary of Chinese usage and all parts of speech of dictionary of Lakher(Mara) language and of verbs, adverbs and adjectives of dictionaries of six languages are included.

[3] Anindya Kumar Biswas, ”A discipline of knowledge and the graphical law”, IJARPS Volume 1(4), p 21, 2014; viXra: 1908:0090[Linguistics].

[4] Anindya Kumar Biswas, ”Bengali language and Graphical law ”, viXra: 1908:0090[Linguistics].

[5] Anindya Kumar Biswas, ”Basque language and the Graphical Law”, viXra: 1908:0414[Linguistics].

[6] Anindya Kumar Biswas, ”Romanian language, the Graphical Law and More ”, viXra: 1909:0071[Linguistics].

[7] Anindya Kumar Biswas, ”Discipline of knowledge and the graphical law, part II”, viXra:1912.0243 [Condensed Matter],International Journal of Arts Humanities and Social Sciences Studies Volume 5 Issue 2 February 2020.

[8] Anindya Kumar Biswas, ”Onsager Core of Abor-Miri and Mising Languages”, viXra: 2003.0343[Condensed Matter].

[9] Anindya Kumar Biswas, ”Bengali language, Romanisation and Onsager Core”, viXra: 2003.0563[Linguistics].

[10] Anindya Kumar Biswas, ”Little Oxford English Dictionary and the Graphical Law”, viXra: 2008.0041[Linguistics].

[11] Anindya Kumar Biswas, "Oxford Dictionary Of Social Work and Social Care and the Graphical law", viXra: 2008.0077[Condensed Matter].

[12] Anindya Kumar Biswas, "Visayan-English Dictionary and the Graphical law", viXra: 2009.0014[Linguistics].

[13] Anindya Kumar Biswas, "Garo to English School Dictionary and the Graphical law", viXra: 2009.0056[Condensed Matter].

[14] Anindya Kumar Biswas, "Mursi-English-Amharic Dictionary and the Graphical law", viXra: 2009.0100[Linguistics].

[15] Anindya Kumar Biswas, "Names of Minor Planets and the Graphical law", viXra: 2009.0158[History and Philosophy of Physics].

[16] Anindya Kumar Biswas, "A Dictionary of Tibetan and English and the Graphical law", viXra: 2010.0237[Condensed Matter].

[17] Anindya Kumar Biswas, "Khasi English Dictionary and the Graphical law", viXra: 2011.0011[Linguistics].

[18] E. Ising, Z.Physik 31,253(1925).

[19] R. K. Pathria, Statistical Mechanics, p400-403, 1993 reprint, Pergamon Press,© 1972 R. K. Pathria.

[20] C. Kittel, Introduction to Solid State Physics, p. 438, Fifth edition, thirteenth Wiley Eastern Reprint, May 1994, Wiley Eastern Limited, New Delhi, India.

[21] W. L. Bragg and E. J. Williams, Proc. Roy. Soc. A, vol.145, p. 699(1934);

[22] P. M. Chaikin and T. C. Lubensky, Principles of Condensed Matter Physics, p. 148, first edition, Cambridge University Press India Pvt. Ltd, New Delhi.

[23] Kerson Huang, Statistical Mechanics, second edition, John Wiley and Sons(Asia) Pte Ltd.

[24] S. M. Bhattacharjee and A. Khare, "Fifty Years of the Exact solution of the Two-dimensional Ising Model by Onsager", arXiv:cond-mat/9511003v2.

[25] L. Onsager, Nuovo Cim. Supp.6(1949)261.

[26] C. N. Yang, Phys. Rev. 85, 809(1952).

[27] A. M. Gun, M. K. Gupta and B. Dasgupta, Fundamentals of Statistics Vol 1, Chapter 12, eighth edition, 2012, The World Press Private Limited, Kolkata.

[28] Sonntag, Borgnakke and Van Wylen, Fundamentals of Thermodynamics, p206-207, fifth edition, John Wiley and Sons Inc.