Concise Urdu to English Dictionary and The Graphical Law

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Abstract

We study the entries of the Concise Urdu to English Dictionary compiled by M. Zaman, Naved Akhtar, 2015. 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,$\beta H = 0.04$) i.e. a magnetisation curve for the Bethe-Peierls approximation of the Ising model with four nearest neighbours with $\beta H = 0.04$. β is $\frac{1}{k_B T}$ where, T is temperature, H is external magnetic field and k_B is the Boltzmann constant.

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alif	be	pe	te(1)	te(2)	se	jim	che	he(1)	khe	dal	dāl	zāl	re(1)	re(2)	ze	zhe	sin
386+2080	2000	1368	1373	242	63	828	773	465	549	776	189	90	673	0	265	20	1003
shin	sad	zad	toe	zoe	ain	ghain	fe	qaf	kaf	gaf	lam	mlm	nun	vao	he(2)		ye
437	253	90	203	50	409	187	325	348	1100	582	409	3053	502	274	588	0	235

TABLE I. Concise Urdu to English Dictionary entries: the odd rows represent letters of the Urdu alphabet,[1], in the serial order; the even rows represent the number of entries of the Concise Urdu to Englsh Dictionary[1].

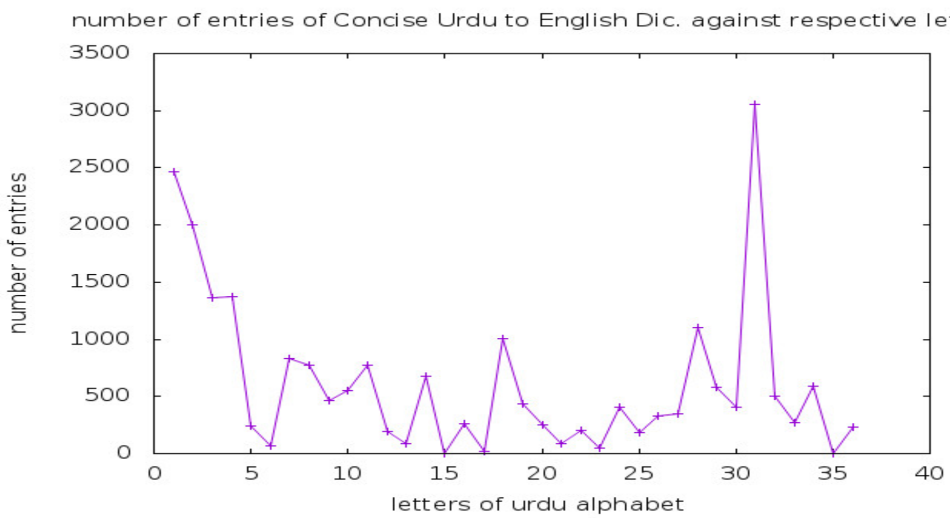

FIG. 1. The vertical axis is the number of entries of the Concise Urdu to Englsh Dictionary[1]. The horizontal axis is the letters of the Urdu alphabet. Letters are represented by the sequence number in the alphabet as it appears in the dictionary, [1].

I. INTRODUCTION

Urdu is the language of large number of people, in particular in the Indian subcontinent. We study a Urdu to English Dictionary. This is the Concise Urdu to English Dictionary compiled by M. Zaman, Naved Akhtar, 2015, [1]. We count one by one all the entries, in this Dictionary,[1]. The result is the table, I. To visualise we plot the number of entries against the respective letters in the dictionary sequence,[1], in the adjoining figure, fig.1.

Looking for the Graphical Law in this dictionary, we proceed narrating the development. 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 the 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 in references from [4] to [71].

The planning of the paper is as follows. In the next section, we describe the Graphical Law analysis of the entries of the Concise Urdu to Englsh Dictionary[1]. The section III, we give an introduction to the standard curves of magnetisation of Ising model. The section IV is Acknowledgment. The last section is Bibliography.

II. THE GRAPHICAL LAW ANALYSIS

For the purpose of exploring graphical law, we assort the letters according to the number of entries, in the descending order, denoted by f and the respective rank, [72], denoted by k. k is a positive integer starting from one. Moreover, the minimum non-zero number of entries is twenty. Hence, we attach a limiting entry number one. The limiting rank is maximum rank plus one, here it is thirty three. 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,II, and plot $\frac{lnf}{lnf_{max}}$ against $\frac{lnk}{lnk_{lim}}$ in the figure fig.2. We then ignore the letter with the highest of entries, tabulate in the adjoining table,II,and redo the plot, normalising the lnfs with lnf_{n-max}, and starting from $k=2$ in the figure fig.3. Normalising the lnfs with lnf_{2n-max}, we tabulate in the adjoining table,II, and starting from $k=3$ we draw in the figure fig.4. Normalising the lnfs with lnf_{3n-max} we record in the adjoining table,II, and plot starting from $k=4$ in the figure fig.5. In this way we obtain up to the figure fig.7.

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}
1	0	0	3053	8.024	1	Blank	Blank	Blank	Blank	Blank
2	0.69	0.197	2466	7.810	0.973	1	Blank	Blank	Blank	Blank
3	1.10	0.314	2000	7.601	0.947	0.973	1	Blank	Blank	Blank
4	1.39	0.397	1373	7.225	0.900	0.925	0.951	1	Blank	Blank
5	1.61	0.460	1368	7.221	0.900	0.925	0.950	0.999	1	Blank
6	1.79	0.511	1100	7.003	0.873	0.897	0.921	0.969	0.970	1
7	1.95	0.557	1003	6.911	0.861	0.885	0.909	0.957	0.957	0.987
8	2.08	0.594	828	6.719	0.837	0.860	0.884	0.930	0.930	0.959
9	2.20	0.629	776	6.654	0.829	0.852	0.875	0.921	0.921	0.950
10	2.30	0.657	773	6.650	0.829	0.851	0.875	0.920	0.921	0.950
11	2.40	0.686	673	6.512	0.812	0.834	0.857	0.901	0.902	0.930
12	2.48	0.709	588	6.377	0.795	0.817	0.839	0.883	0.883	0.911
13	2.56	0.731	582	6.366	0.793	0.815	0.838	0.881	0.882	0.909
14	2.64	0.754	549	6.308	0.786	0.808	0.830	0.873	0.874	0.901
15	2.71	0.774	502	6.219	0.775	0.796	0.818	0.861	0.861	0.888
16	2.77	0.791	465	6.142	0.765	0.786	0.808	0.850	0.851	0.877
17	2.83	0.809	437	6.080	0.758	0.778	0.800	0.842	0.842	0.868
18	2.89	0.826	409	6.014	0.750	0.770	0.791	0.832	0.833	0.859
19	2.94	0.840	348	5.852	0.729	0.749	0.770	0.810	0.810	0.836
20	3.00	0.857	325	5.784	0.721	0.741	0.761	0.801	0.801	0.826
21	3.04	0.869	274	5.613	0.700	0.719	0.738	0.777	0.777	0.802
22	3.09	0.883	265	5.580	0.695	0.714	0.734	0.772	0.773	0.797
23	3.14	0.897	253	5.533	0.690	0.708	0.728	0.766	0.766	0.790
24	3.18	0.909	242	5.489	0.684	0.703	0.722	0.760	0.760	0.784
25	3.22	0.920	235	5.460	0.680	0.699	0.718	0.756	0.756	0.780
26	3.26	0.931	203	5.313	0.662	0.680	0.699	0.735	0.736	0.759
27	3.30	0.943	189	5.242	0.653	0.671	0.690	0.726	0.726	0.749
28	3.33	0.951	187	5.231	0.652	0.670	0.688	0.724	0.724	0.747
29	3.37	0.963	90	4.500	0.561	0.576	0.592	0.623	0.623	0.643
30	3.40	0.971	63	4.143	0.516	0.530	0.545	0.573	0.574	0.592
31	3.43	0.980	50	3.912	0.488	0.501	0.515	0.541	0.542	0.559
32	3.47	0.991	20	2.996	0.373	0.384	0.394	0.415	0.415	0.428
33	3.50	1	1	0	0	0	0	0	0	0

TABLE II. Urdu to English Dictionary Entries: ranking,natural logarithm, normalisations

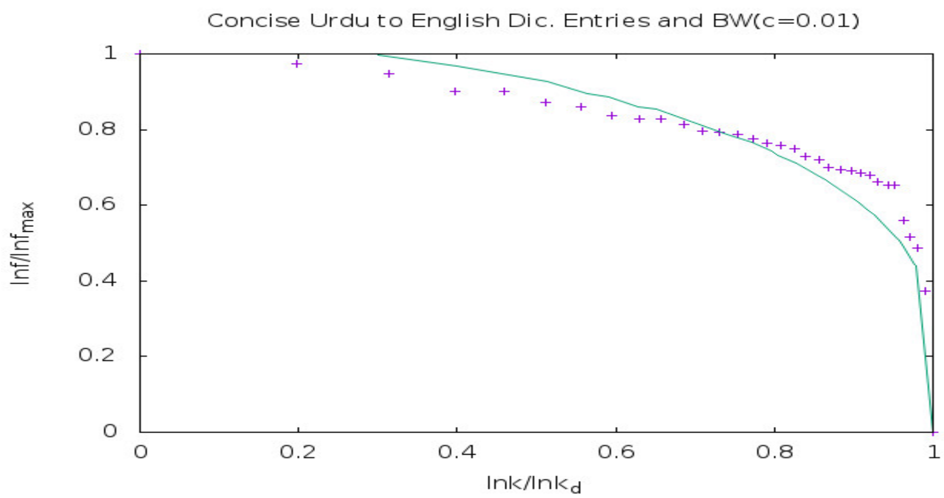

FIG. 2. The vertical axis is $\frac{lnf}{lnf_{max}}$ and the horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the entries of the Concise Urdu to Englsh Dictionary with the fit curve, BW(c=0.01), being the Bragg-Williams curve in the presence of external magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$.

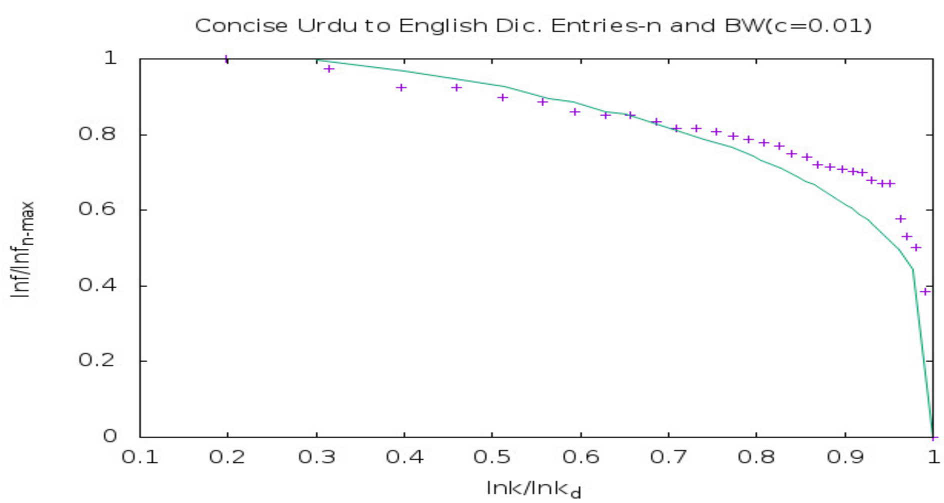

FIG. 3. The vertical axis is $\frac{lnf}{lnf_{n-max}}$ and the horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the entries of the Concise Urdu to Englsh Dictionary with the fit curve, BW(c=0.01), being the Bragg-Williams curve in the presence of external magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$.

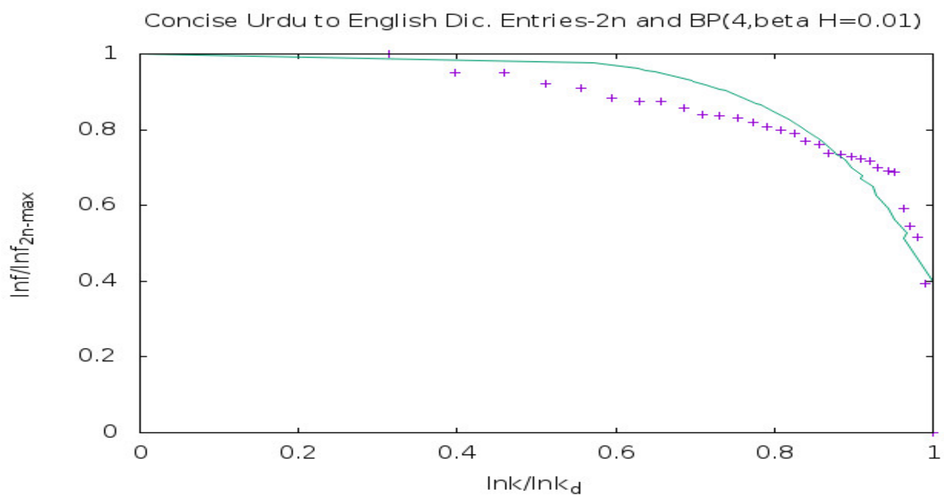

FIG. 4. The vertical axis is $\frac{lnf}{lnf_{2n-max}}$ and the horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the entries of the Concise Urdu to Englsh Dictionary with the fit curve, BP(4,$\beta H = 0.01$), being the Bethe-Peierls curve in the presence of four nearest neighbours and external magnetic field, $m = 0.005$ or, $\beta H = 0.01$.

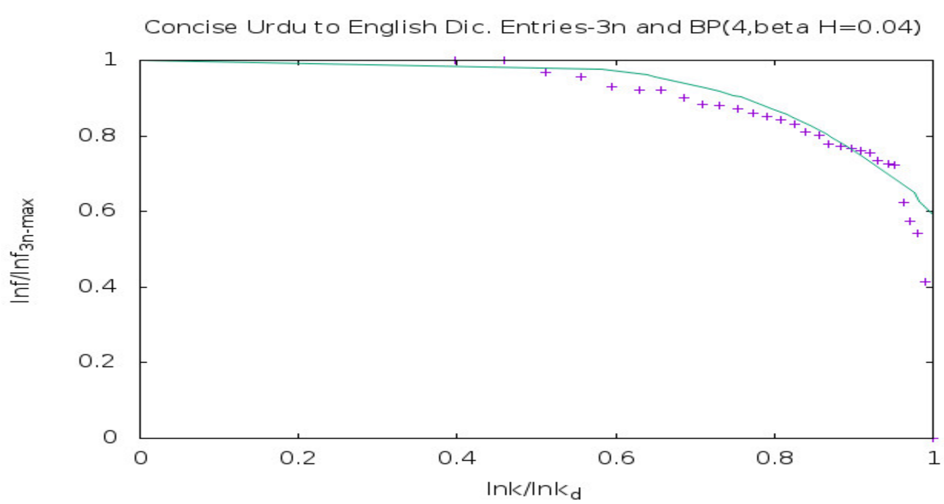

FIG. 5. The vertical axis is $\frac{lnf}{lnf_{3n-max}}$ and the horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the entries of the Concise Urdu to Englsh Dictionary with the fit curve, BP(4,$\beta H = 0.04$), being the Bethe-Peierls curve in the presence of four nearest neighbours and external magnetic field, $m = 0.02$ or, $\beta H = 0.04$.

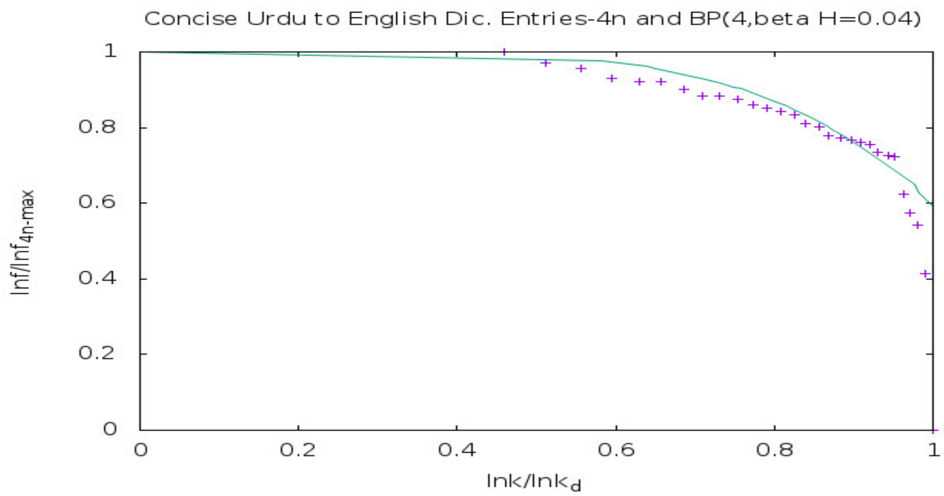

FIG. 6. The vertical axis is $\frac{lnf}{lnf_{4n-max}}$ and the horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the entries of the Concise Urdu to Englsh Dictionary with the fit curve, BP(4,$\beta H = 0.04$), being the Bethe-Peierls curve in the presence of four nearest neighbours and external magnetic field, $m = 0.02$ or, $\beta H = 0.04$.

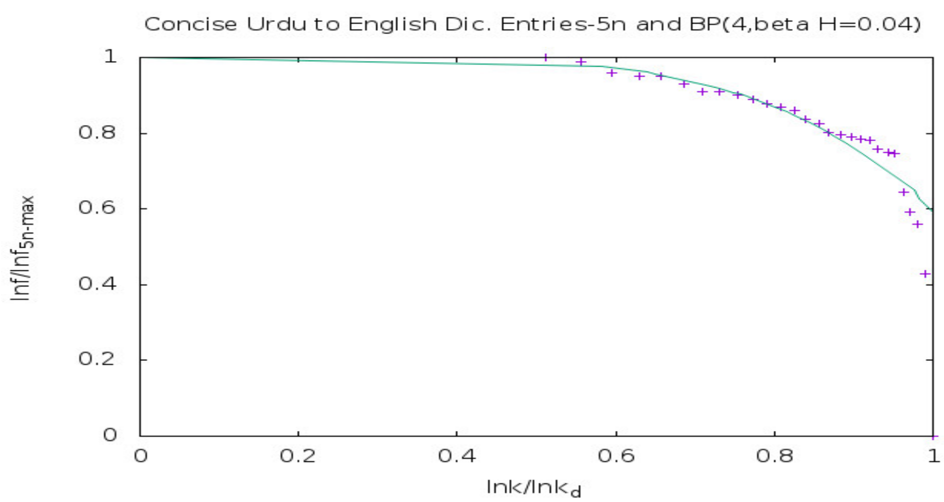

FIG. 7. The vertical axis is $\frac{lnf}{lnf_{5n-max}}$ and the horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the entries of the Concise Urdu to Englsh Dictionary with the fit curve, BP(4,$\beta H = 0.04$), being the Bethe-Peierls curve in the presence of four nearest neighbours and external magnetic field, $m = 0.02$ or, $\beta H = 0.04$.

A. conclusion

From the figures (fig.2-fig.7), we observe that there is a curve of magnetisation, behind the entries of the Concise Urdu to English Dictionary,[1]. This is the magnetisation curve in the Bethe-Peierls approximation of the Ising model, in the presence of four nearest neighbours and external magnetic field, BP(4,$\beta H = 0.04$).
Moreover, the associated correspondence is,

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

$$lnk \longleftrightarrow T.$$

k corresponds to temperature in an exponential scale, [79].

III. APENDIX: 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 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,[73], 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, [74], $2\epsilon\gamma\bar{\sigma} + 2H$, where γ is the number of nearest neighbours of a spin. According to Boltzmann principle, $\frac{N_-}{N_+}$ equals $exp(-\frac{\triangle E}{k_B T})$, [75]. In the Bragg-Williams approximation,[76], $\bar{\sigma} = L$, considered in the thermal average sense. Consequently,

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

where, $c = \frac{H}{\gamma\epsilon}$, $T_c = \gamma\epsilon/k_B$, [77]. $\frac{T}{T_c}$ 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 [74]. 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, [73],[74],[75],[76],[77], due to Bethe-Peierls, [78], reduced magnetisation varies with reduced temperature, for γ neighbours, in absence of external magnetic field, as

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

$ln\frac{\gamma}{\gamma-2}$ 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 III. Reduced magnetisation vs reduced temperature data s 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.

data s generated from the equation(1) and the equation(2) in the table, III, and curves of magnetisation plotted on the basis of those data s. 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.8. Empty spaces in the table, III, mean corresponding point pairs were not used for plotting a line.

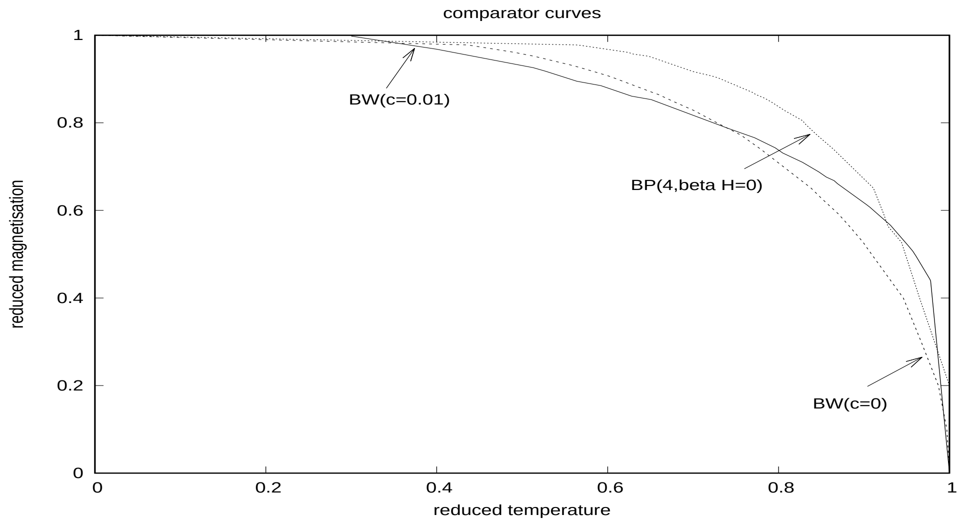

FIG. 8. Reduced magnetisation vs reduced temperature curves for Bragg-Williams approximation, in absence(dark) of and presence(inner in the top) of magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$, and Bethe-Peierls approximation in absence of magnetic field, for four nearest neighbours (outer in the top).

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

In the Bethe-Peierls approximation scheme , [78], reduced magnetisation varies with reduced temperature, for γ neighbours, in presence of external magnetic field, as

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

Derivation of this formula ala [78] 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,

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

In the following, we describe datas in the table, IV, 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.9. Empty spaces in the table, IV, 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 IV. Bethe-Peierls approx. in presence of little external magnetic fields

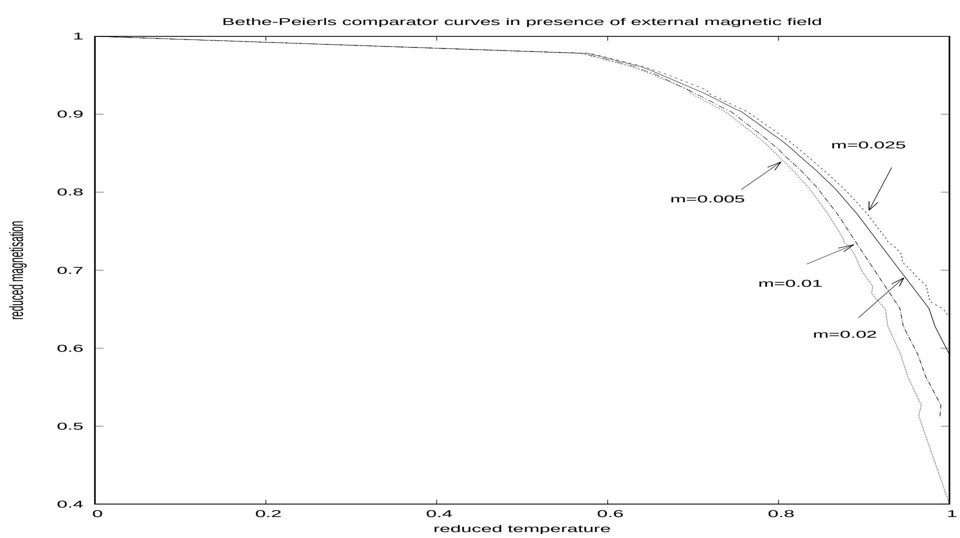

FIG. 9. Reduced magnetisation vs reduced temperature curves for Bethe-Peierls approximation in presence of little external magnetic fields, for four nearest neighbours, with $\beta H = 2m$.

IV. ACKNOWLEDGMENT

We have used gnuplot for plotting the figures in this paper.

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