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Coincidental Role of Water Cluster Alignment Frequency at Rainfall and Water Vapour Events

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Abstract: *$(H_2O)_{1352}$water cluster alignment frequency coincides with the 48 GHz frequency significantly attenuated by rainfall as well as $(H_2O)_{1259}$, $(H_2O)_{1256}$, $(H_2O)_{1247}$, $(H_2O)_{1241}$ and $(H_2O)_{1235}$ water clusteralignment frequencies coincide withthe absorption spectra peaks of water vapourbetween 0.1 and 1.8 THz.*

Keywords: *Alignment energy of water clusters,gigahertz (GHz) frequency attenuated by rainfall, terahertz (THz) frequencyabsorption spectra of water vapour*

1. INTRODUCTION

The atmosphere and rainfall significantly limit the performance of millimeter wave links what is true mainly for high altitude platform networks working at a frequency of 48 GHz. [1] Let us see if this fact could be explained by the alignment energy of some water clusters[2].Following just mentioned alignment energy concept, for instance, we can show that cluster $(H_2O)_{1352}$possessesthe same frequency equivalent of 48 GHz which is remarkably small one amongst frequencies of clusters $(H_2O)_n$for n=2 to n=1352.

2. FORMING WATER CLUSTER $(H_2O)_{1352}$

The easiest way of forming such a water cluster goes through three stages:

Stage 1: forming cluster $(H_2O)_{39}$ from H_2O by adding threemolecules of H_2O in each step

Stage 2: forming cluster $(H_2O)_{1313}$from$(H_2O)_{39}$ by adding one cluster $(H_2O)_{13}$ in each step

Stage 3: forming cluster $(H_2O)_{1352}$from $(H_2O)_{1313}$by addingthreemolecules of H_2O in each step

2.1. Forming cluster $(H_2O)_{39}$from H_2O

Cluster $(H_2O)_{39}$can be formed from H_2O by adding three molecules of H_2O in each step. Only in the first step a minimal energy is needed. Contrarily, in all subsequent steps the energy is released as shown in Table1.

Table1. *Forming cluster $(H_2O)_{39}$ fromH_2O*

Water cluster	Frequency (THz)	Water cluster	Frequency (THz)	Water cluster	Frequency (THz)
H_2O	683,9947961	$(H_2O)_{14}$	50,43716050	$(H_2O)_{27}$	**26,96567994**
$(H_2O)_2$	684,1421749	$(H_2O)_{15}$	**92,68729666**	$(H_2O)_{28}$	50,43791243
$(H_2O)_3$	**684,1694673**	$(H_2O)_{16}$	129,6561822	$(H_2O)_{29}$	72,29137770
$(H_2O)_4$	129,6446684	$(H_2O)_{17}$	31,79778338	$(H_2O)_{30}$	**18,75045847**
$(H_2O)_5$	240,5555618	$(H_2O)_{18}$	**68,04172263**	$(H_2O)_{31}$	40,21618707
$(H_2O)_6$	**314,4957221**	$(H_2O)_{19}$	100,4705248	$(H_2O)_{32}$	60,34031397
$(H_2O)_7$	50,43415281	$(H_2O)_{20}$	18,75018557	$(H_2O)_{33}$	**12,02891046**
$(H_2O)_8$	129,6538794	$(H_2O)_{21}$	**50,43771747**	$(H_2O)_{34}$	31,79829332
$(H_2O)_9$	**191,2692060**	$(H_2O)_{22}$	79,24457684	$(H_2O)_{35}$	50,43800263
$(H_2O)_{10}$	18,74871178	$(H_2O)_{23}$	9,106290995	$(H_2O)_{36}$	**6,427618291**
$(H_2O)_{11}$	79,24335887	$(H_2O)_{24}$	**37,23470067**	$(H_2O)_{37}$	24,74546188
$(H_2O)_{12}$	**129,6555852**	$(H_2O)_{25}$	63,11284770	$(H_2O)_{38}$	42,09921324
$(H_2O)_{13}$	1,687028244	$(H_2O)_{26}$	1,687900285	$(H_2O)_{39}$	**1,688061771**

The alignment frequency of water clusters $(H_2O)_3$, $(H_2O)_6$, $(H_2O)_9$, $(H_2O)_{12}$, $(H_2O)_{15}$, $(H_2O)_{18}$, $(H_2O)_{21}$, $(H_2O)_{24}$, $(H_2O)_{27}$, $(H_2O)_{30}$, $(H_2O)_{33}$, $(H_2O)_{36}$ and $(H_2O)_{39}$ decreases step by step from 684,169 to 1,688 THz. The last cluster $(H_2O)_{39}$is a triple multiple of the cluster of the lowestalignment frequency $(H_2O)_{13}$:

$$(H_2O)_{39} = 3\ x\ (H_2O)_{13}. \quad (1)$$

At reaching cluster $(H_2O)_{39}$this way of clustering water molecules ends. Since each further addition of three molecules of water requires the input of considerable energy. Therefore, another pattern of aggregation comes into play.

2.2. Forming cluster $(H_2O)_{1313}$from$(H_2O)_{39}$

Cluster $(H_2O)_{1313}$can be formed from cluster $(H_2O)_{39}$ by adding 98 clusters of $(H_2O)_{13}$step by step:

$$(H_2O)_{1313} = (H_2O)_{39} + 98\ x\ (H_2O)_{13}. \quad (2)$$

For this kind of clustering only a minimal input of energy is needed as can be seen from Table2.

Table2. *Forming cluster $(H_2O)_{1313}$ from $(H_2O)_{39}$*

Step	Water cluster	Frequency (THz)
3 x 13	$(H_2O)_{39}$	1,688061771
4 x 13	$(H_2O)_{52}$	1,688118288
…	…	…
94 x 13	$(H_2O)_{1222}$	1,688190828
95 x 13	$(H_2O)_{1235}$	1,688190856
98 x 13	$(H_2O)_{1274}$	1,688190883
101 x 13	$(H_2O)_{1313}$	1,688190828

The alignment frequency of water clusters from $(H_2O)_{39}$to $(H_2O)_{1313}$slightly increases step by step from 1,688061771 to 1,688190883 THz and at the last step slightly falls to 1,688190828THz so only a little input of energy is required for water clustering of this kind.The frequency belonging to all concerned clusters equal on the third decimal:

$$f[(H_2O)_{39}] \approx f[(H_2O)_{1313}] = 1.688\,THz. \quad (3)$$

2.3. Forming cluster $(H_2O)_{1352}$from $(H_2O)_{1313}$

At this stage, clustering water by adding three water molecules is again smoothly possible, as it releases considerable alignment energy.Cluster $(H_2O)_{1352}$ can be formed from cluster$(H_2O)_{1313}$ by adding three molecules of H_2O in each step as can be seen in the last column of Table3.

Table3. *Forming cluster $(H_2O)_{1352}$ from $(H_2O)_{1313}$*

Water cluster	Frequency (THz)	Water cluster	Frequency (THz)	Water cluster	Frequency (THz)
$(H_2O)_{1235}$	**1,688190856**	$(H_2O)_{1274}$	1,688190883	**$(H_2O)_{1313}$**	**1,688190828**
$(H_2O)_{1238}$	1,550367884	$(H_2O)_{1277}$	1,554577028	**$(H_2O)_{1316}$**	**1,558536754**
$(H_2O)_{1241}$	**1,413211241**	$(H_2O)_{1280}$	1,421589555	**$(H_2O)_{1319}$**	**1,429472381**
$(H_2O)_{1244}$	1,276716180	$(H_2O)_{1283}$	1,289223965	**$(H_2O)_{1322}$**	**1,300993786**
$(H_2O)_{1247}$	**1,140877819**	$(H_2O)_{1286}$	1,157475978	**$(H_2O)_{1325}$**	**1,173097017**
$(H_2O)_{1250}$	1,005691519	$(H_2O)_{1289}$	1,026341231	**$(H_2O)_{1328}$**	**1,045778070**
$(H_2O)_{1253}$	0,871152535	$(H_2O)_{1292}$	0,895815446	**$(H_2O)_{1331}$**	**0,919033104**
$(H_2O)_{1256}$	**0,737256257**	$(H_2O)_{1295}$	0,765894478	**$(H_2O)_{1334}$**	**0,792858139**
$(H_2O)_{1259}$	**0,603998077**	$(H_2O)_{1298}$	0,636573994	**$(H_2O)_{1337}$**	**0,667249418**
$(H_2O)_{1262}$	0,471373495	$(H_2O)_{1301}$	0,507849959	**$(H_2O)_{1340}$**	**0,542203182**
$(H_2O)_{1265}$	0,339377956	$(H_2O)_{1304}$	0,379718205	**$(H_2O)_{1343}$**	**0,417715563**
$(H_2O)_{1268}$	0,208006962	$(H_2O)_{1307}$	0,252163230	**$(H_2O)_{1346}$**	**0,293782856**
$(H_2O)_{1271}$	0,077256150	$(H_2O)_{1310}$	0,125215267	**$(H_2O)_{1349}$**	**0,170401385**
				$(H_2O)_{1352}$	**0,047567474**

The frequency of cluster $(H_2O)_{1352}$ equals 0,047567474 THz what coincides with the frequency of 48 GHz significantly attenuated by the rainfall:

$$f[(H_2O)_{1352}] = 0{,}0476\ \text{THz} \approx 48\ \text{GHz} = f_{attenuated}\ . \quad (4)$$

2.4. Forming cluster $(H_2O)_{1271}$ from $(H_2O)_{1235}$

Interesting are frequencies of water clusters from $(H_2O)_{1235}$ to $(H_2O)_{1271}$ in water vapour, too, as presented in the first frequency column in Table 3. The frequency values coincide with the peak values in Figure2[3]:

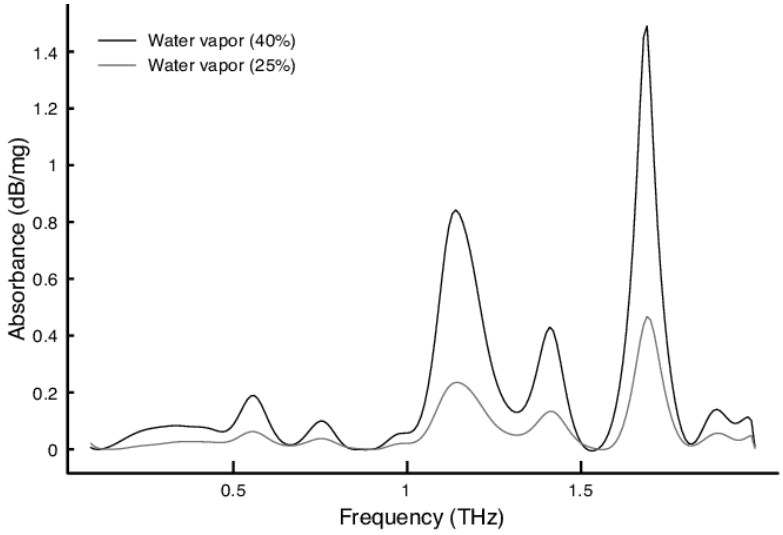

Figure2[3]: Absorption spectra of water vapour (25% and 40% humidity) between 0.1 and 1.8 THz. Observed peaks lie at 0.56, 0.75, 1.14, 1.41 and 1.69 THz and coincide with the alignment frequencies of water clusters $(H_2O)_{1259}$, $(H_2O)_{1256}$, $(H_2O)_{1247}$, $(H_2O)_{1241}$ and $(H_2O)_{1235}$ presented in the first frequency column of Table 3.

3. CONCLUSION

Water cluster alignment frequency may play a role in rainfall and water vapour events.

DEDICATION

To Ukraine and the song of my childhood: "Singing in the rain"

Figure1. Singing in the rain[4]

REFERENCES

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[2] JanezŠpringer (2022) "Destabilisation of (H2O)13 Water Cluster at 71°C" International Journalof Advanced Research in Physical Science (IJARPS) 9(3), pp.1-3, 2022.

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[4] Singing in the rain stock illustration. Illustration of umbrella - 21812603 (dreamstime.com)

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