# A REPORT ON THE OBSERVATION OF 40 KHz SIGNAL DURING THE EARTHQUAKE OF 2004 DECEMBER 26

**T. K. Das[(1)+] A. Saha[(2)+] & B. K. De[(3)]**

*[(1)] Centre for Space Physics*
*43, Chalantika*
*Garia Station Road*
*Kolkata – 700084*
*email : tukada2@vsnl.net*
*[(2))] As (1) above*
*[(3)]Department of Physics*
*Tripura University*
*Tripura – 799130*
*email: barin_de@yahoo.com*

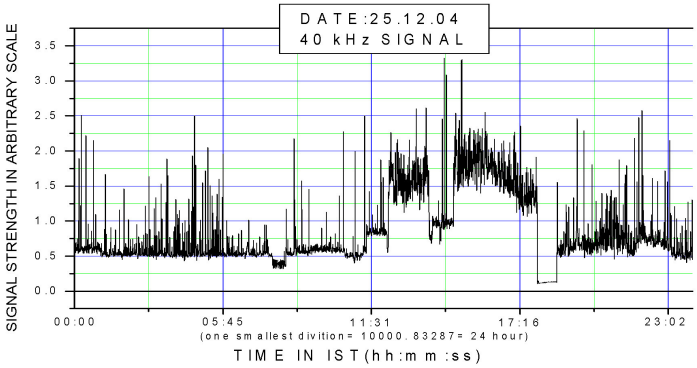
## ABSTRACT

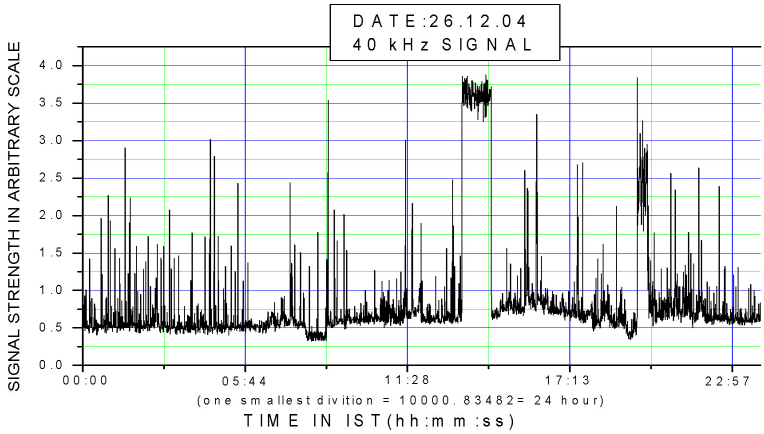
We observed the fluctuation of baseline level of 40 KHz signals during the earthquakes of December 26, 2004 onwards which occurred off the west Coast of Northern Sumatra and adjoining region. These observed data were compared with the earthquake data registered by U. S. Geological Survey. It is found that the number of spikes in the LF signals has one to one correspondence with the energy output (designated by M-values) of the earthquakes in a particular day. The analysis is still going on for coming into a definite conclusion.

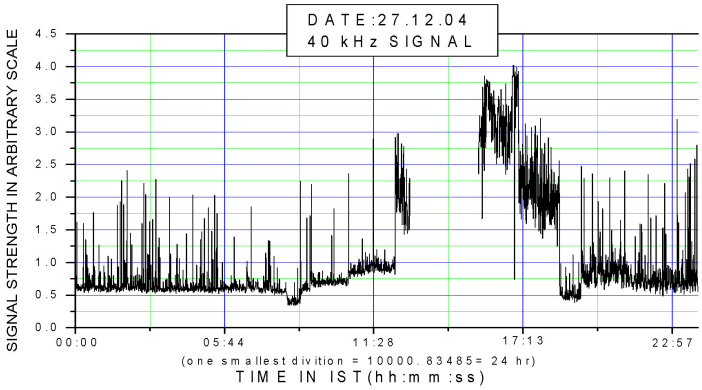
## INTRODUCTION

Recently the earthquakes are being predicted by various experimental observations of electromagnetic emission associated with impending earthquakes [1-4]. The observing frequency ranges of these phenomena spread from ELF (Extra-low frequencies: 3 milli Hz – 3 KHz) to VHF (very high frequency : 30-300 MHz). Some of these observations are passive ground-based [5], some use transmitter signals for watching fluctuation of baseline level of signals during earthquakes [6], and some are satellite based observations.

In our experimental set up we have developed a receiver to detect 40 KHz signal. At first the induced voltage at the antenna is passed through a band pass filter (BPF) and then the desired frequency is selected by a series resonant circuit. The tuned voltage is then detected and amplified using quasi-logarithmic amplifier. The data is finally recorded by data acquisition system in order to store the data in a computer. The antenna is a horizontal wire of length 20 meter placed 10.1 meter above the ground level. The gain of the band pass filter at cut-off frequency can be varied from 1 to 10, but currently, it is fixed at 8. The Q-factor of the tuned circuit is 35. This set is in operation since October, 2004 in order to detect 40 KHz signal transmitted by Miyakoji station, Japan ($37.4^0$N, $140.8^0$E). Our receiver stationed at Agartala, Tripura University campus ($23^0$N, $91.4^0$E) collected the data of the earthquake of M9 on December 26, 2004 at 6:28:50 IST and after shocks thereafter which occurred off the West coast of Northern Sumatra ($3.3^0$N, $95.8^0$E) and adjoining region.






**OBSERVATION**

After a preliminary examination of the data of the observations taken during the period from 20.12.2004 to 31.1.2005, we have made a concise report which is displayed through the following Table 1. The Table 1 contains only the results for the period from 25.12.2004 to 11.1.2005. Figure 1 showing observations of 26.12.04 and 27.12.04 and Table 1 giving the observational data make us to conclude that :

***Observation 1*** The signal level is higher (greater than 0.5 in arbitrary scale) on 27.12.04, 28.12.04, 30.12.04 and 04.01.05. The signal level is found to be less than 0.5 on 02.01.05. On 25.12.04, 26.12.04 and 29.12.04 the signal level is found to be almost equal to 0.5 in arbitrary scale.

***Observation 2*** A rise in the signal strength is observed daily in between 11 hr and 17 hr. The duration of the rise with peaks approximately 3.75 in arbitrary scale and is found to be very small on 26.12.04. The duration is also found smaller on 25.12.04 and 02.01.05 than the other days.

***Observation 3*** A peak is observed on 26.12.04, 28.12.04, 29.12.04 and 31.12.04 at 19:26 hr. But the maximum height of the peak is high on 29.12.04 and 31.12.04 (4 in arbitrary scale approximately) and on 26.12.04 (3.5 in arbitrary scale approximately).

***Observation 4*** The number of spikes are found to be much more prominent on 26.12.04, 28.12.04 and 01.01.05. It is significant to mention that the number of spikes are very less on 30.12.04, 04.10.05, and 05.01.05.

+ T.K.D & A.S. acknowledge DST, Govt. of India for financial support of this research work.

Table 1 Observational Data

| Date of observation | Number of earth quakes | Number with magnitude M > 5 | Number of spikes | Number of spikes / hr. (approx) | Occurrence time of spikes in IST | Duration in hr : min |
|---|---|---|---|---|---|---|
| 25.12.04 | Not available | _ | 76 | 3 | 00-11:13, 19:18-23:02 | 14:57 |
| 26.12.04 | Not available | _ | 116 | 5 | 00-05:44, 07:10-13:30, 14:56-23:16 | 20:24 |
| 27.12.04 | 29 | 22 | 65 | 3 | 00-05:27, 19:32-23:51 | 9:46 |
| 28.12.04 | 30 | 21 | 104 | 4 | 00-07:10,17-46-22:22 | 14:46 |
| 29.12.04 | 22 | 20 | 39 | 2 | 00-05:10 | 5:10 |
| 30.12.04 | 24 | 9 | 19 | 1 | 21:52-23:54 | 2:02 |
| 31.12.04 | 12 | 11 | 83 | 3 | 00-06:54,,18:42-19:34,21 : 17-23:52 | 9:41 |
| 01.01.05 | 20 | 10 | 99 | 4 | 00-04:52, 18:40-23:50 | 10:02 |
| 02.01.05 | 4 | 3 | 53 | 2 | 00-6:12, 18:36 23:59 | 11:35 |
| 04.01.05 | 12 | 8 | 33 | 1 | 00:34-04:53, 21:51-23:51 | 6:19 |
| 05.01.05 | 7 | 7 | 27 | 1 | 00:17-05:45 | 5:28 |
| 06.01.05 | 11 | 6 | 69 | 3 | 00:17-5:40, 7-29-7:55, 17:17-18:35, 19:44-23:12 | 10:35 |
| 07.01.05 | 7 | 3 | 61 | 2 | 00-08:44,20:44-23:36 | 11:36 |
| 08.01.05 | 11 | 2 | 77 | 3 | 00-05:44, 11:29-22:50 | 17:05 |
| 09.01.05 | 5 | 2 | 44 | 2 | 01:36-5:44, 17:13-20:49,22:24-,23:15 | 8:35 |
| 11.01.05 | 5 | 0 | 39 | 2 | 00:20-10:48,20:56-23:38 | 13:10 |

## DISCUSSION

The average height of the ambient spikes is found to be 1 in arbitrary scale approximately. So, while counting the number of spikes, the spikes whose levels are above 1 in arbitrary scale is taken into consideration & their heights are calculated taking their base at 1 in arbitrary scale. It is observed from the Table 1 that the number of spikes have one to one correspondence with the number of aftershocks which happened in the surrounding region of Sumatra earthquake, such as, Andaman-Nicobar Islands, Northern Sumatra, Indonesia etc. But this does not hold true for all the days. This is probably, due to the fact that the different earthquakes are of different magnitudes as examined by us. And also, their hypo-centers are located at different depths, as a consequence of which the electromagnetic signals thought to be generated during earthquakes are attenuated differently for different sources.

Moreover, according to the position of our antenna we received the main lobe of the signal transmited by Miyakoji station. But the signals from the different source locations are received as the side lobes of the antenna pattern. Hence, the signal levels would vary accordingly for the aftershocks whose locations are different. So a correction factor is to be introduced in the received signals for a comparative study.

## REFERENCES


[1] M. Hayakawa, and Y. Fujinawa, editors, Electromagnetic phenomena related to Earthquake prediction, *TERRAPUB,* Tokyo, Japan, 1994.

[2] M. Hayakawa, editor, Atmospheric and Ionospheric Electromagnetic phenomena associated with earthquakes, *TERRAPUB,* Tokyo, Japan, 1999.

[3] M. Hayakawa, and O. A. Molchanov, editors, Seismo Electromagnetics, Lithosphere- Atmosphere-Ionosphere Coupling, *TERRAPUB,* Tokyo, Japan, 2002.

[4] M. Hayakawa and Y. Fujinawa, editors, Electromagnetic phenomena related to Earthquake prediction, *TERRAPUB,* Tokyo, Japan, 1994.

[5] M. Hayakawa, O. A. Molchanov, T. Ondoh and E. Kawai, *J. Comm. Res. Lab*., 43, pp. 169-180, 1996.

[6] O. A. Molchanov and M. Hayakawa, *J. Geophys. Res*., 103, pp.17489-17504, 1998.