A new type of telecommunication by neutrons

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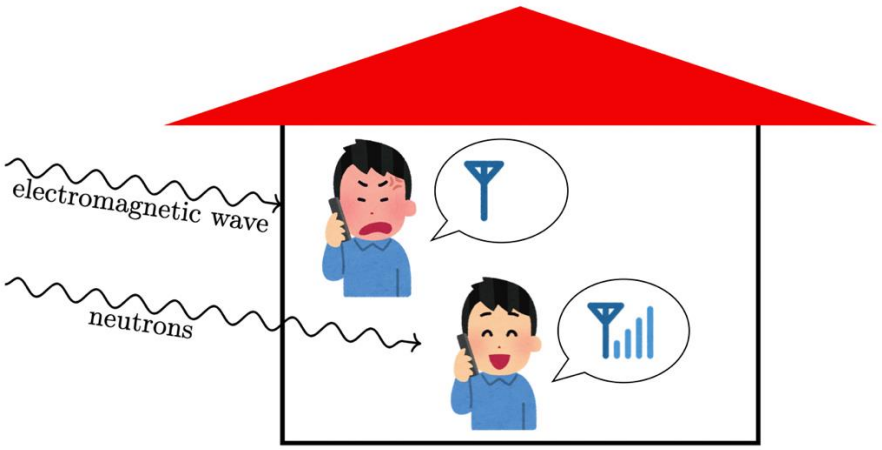
What do you think is the essential key which have advanced the mankind's lifestyle? I would answer that it is the communication technology. First and foremost, the symbol of human beings is language. The complex communication by language made it possible for humans to share their emotion and helped them to be the highest degree of social animals. After a long time, letters were found to be useful to communicate with others separated spatially and temporally. Communication by drums or flares was also a good means to transfer information quickly. The biggest revolution was the emergence of electric communication in 1800s. This gave us the ability to share information instantly with people on not only the other side of the earth but also the outside. And now, we may be in the transition of history with a new communication tool, "neutrons". This may give humanity some new values and lifestyle as well as other communication media did.

One of problems that may be solved by the neutron communication is a bad network connection in buildings. Such bad connection is usually caused by the fact that electromagnetic waves, which are used in the ordinary wireless information transfer, cannot penetrate concrete or metals. We might be free from such network connection issues by using neutrons as a transfer medium instead of electromagnetic waves. Neutrons are electrically neutral particles included in nuclei of atoms. Because they do not feel the electromagnetic force, they can penetrate dozens of centimeters of concrete or metals. Therefore, neutrons might make us possible to communicate with inside of any buildings surrounded by thick walls. However, neutron radiation is known to be

harmful to creatures because neutron exposure can cause some isotopes to activate to become radioactive variants. This fact had kept researchers from studying neutron radiation as a medium of communication. Is it possible to transfer information by neutrons precisely and safely?



Joyce et al. answered the question affirmatively [1]. They discovered that it is possible to send and receive signals perfectly by using the fast neutron radiation as a medium. In their experiment, californium-252 was adopted as a source of neutrons. It continuously emits neutrons, and so the amount of emission itself cannot be controlled. In order to adjust the number of received neutrons instead, a holed wall made of material which blocks neutron radiation was put between the neutron source and the receiver. By moving the position of the hole, they could control the number of neutrons which arrive at the receiver via the hole. Then, they tried to transfer information by binary, considering a signal as “1” if the receiver detected many neutrons, otherwise “0”. Several examples of information, i.e., a word, an alphabet and a random number, were encoded into binary. As a result, the receiver succeeded in receiving and decoding all signals precisely! Furthermore, they also found that the level of neutron radiation

necessary for the communication is low enough not to be harmful to our bodies. The research group anticipates that even the radiation whose level is several orders of magnitude less than that of their experiment can work in practical applications.

The important aspect of this finding is that the proposed method is not only accurate but also free from danger. Because the biggest reason that has kept neutrons away from a candidate of a transfer medium is its harmfulness, this discovery will encourage many researchers to study the neutron communication.

Let us think concretely what the neutron communication can do. It has the potential to solve more than just the network connection problems. First example is communication with the inside of reactor containments or maritime structures. Today, when we communicate with such place, we must make holes in order to pass communication cables since electromagnetic waves cannot reach there. In that case, no slight gaps are allowed because such gaps cause in a leak of radiation or water. The wireless communication by neutrons, which can penetrate their thick walls or water and therefore do not need cables, can solve this problem.

Another case in which neutrons will be preferable to electromagnetic waves is emergency rescue operations. For example, in the scene of a fire site or interior of a collapse house, the rubble may interrupt the electromagnetic wireless communication. Since there is no time to place cables in such emergent scene, the information transfer by neutrons might be able to play an important role to realize quick and accurate communication.

As described above, the neutron communication provides a key to give solutions to problems that cannot be solved by conventional wireless communication methods. It may not be realistic to replace all the electric communication by the neutron communication, but I believe that when these two types of transfer are combined, we can get an unprecedented powerful communication tool. If it is realized, there will come a transition of human history.

References

[1] M. J. Joyce *et al.*, "Wireless information transfer with fast neutrons," *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment,* vol. 1021, 2022, Art no. 165946.