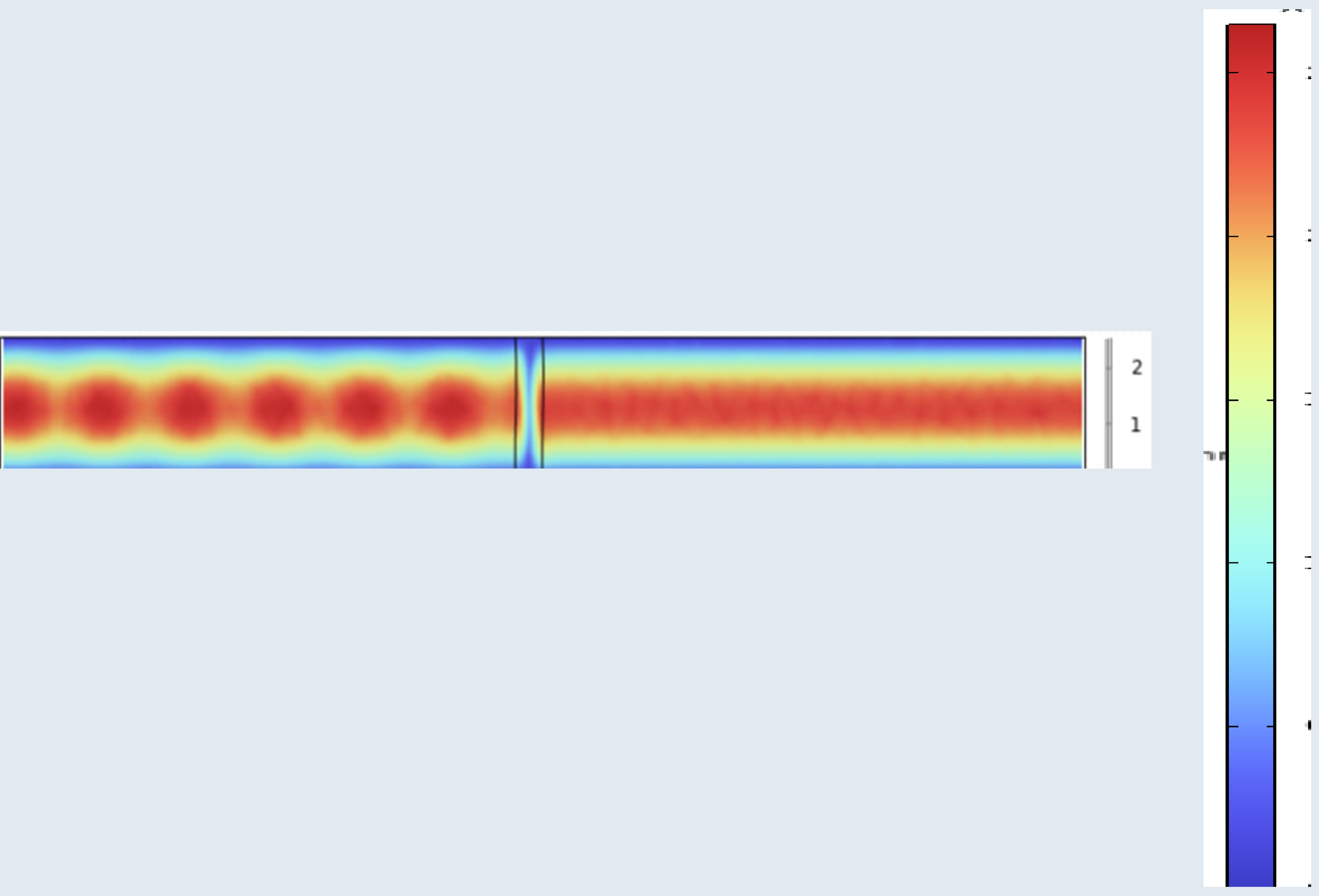

Analysis of Cancer cell behaviour using sub-THz excitation in COMSOL Multiphysics

To differentiate between cancer cell and normal cell using THz Technology in COMSOL Multiphysics software. The simulation model is carried out by positioning the ports at different angle.

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ABSTRACT

In this paper, analysis of cancer cell using Sub-THz technology have been studied. Sub-THz technique for cancer detection is a much reliable and safer technique as compared to conventional methods [1,2]. To study the behavior of cancer cells and normal cells using Sub-THz technology, a simulation model has been developed using COMSOL software [3]. In COMSOL Multiphysics, the 3D modeling of the cancer cell kept inside the waveguide has been designed using RF module. The waveguide taken in the simulation model is WR-10, with frequency range of 75 GHz to 110 GHz with step size 0.1 GHz, while the cancer cell is placed in center of waveguide. The difference in transmissive and reflective property of cancer cells and normal cells have been analyzed. The comparative analysis has been performed for these different cells by shining the sub-terahertz signal. The resultant S-parameter clearly depicts the difference in reflection and transmission parameter property of cells.

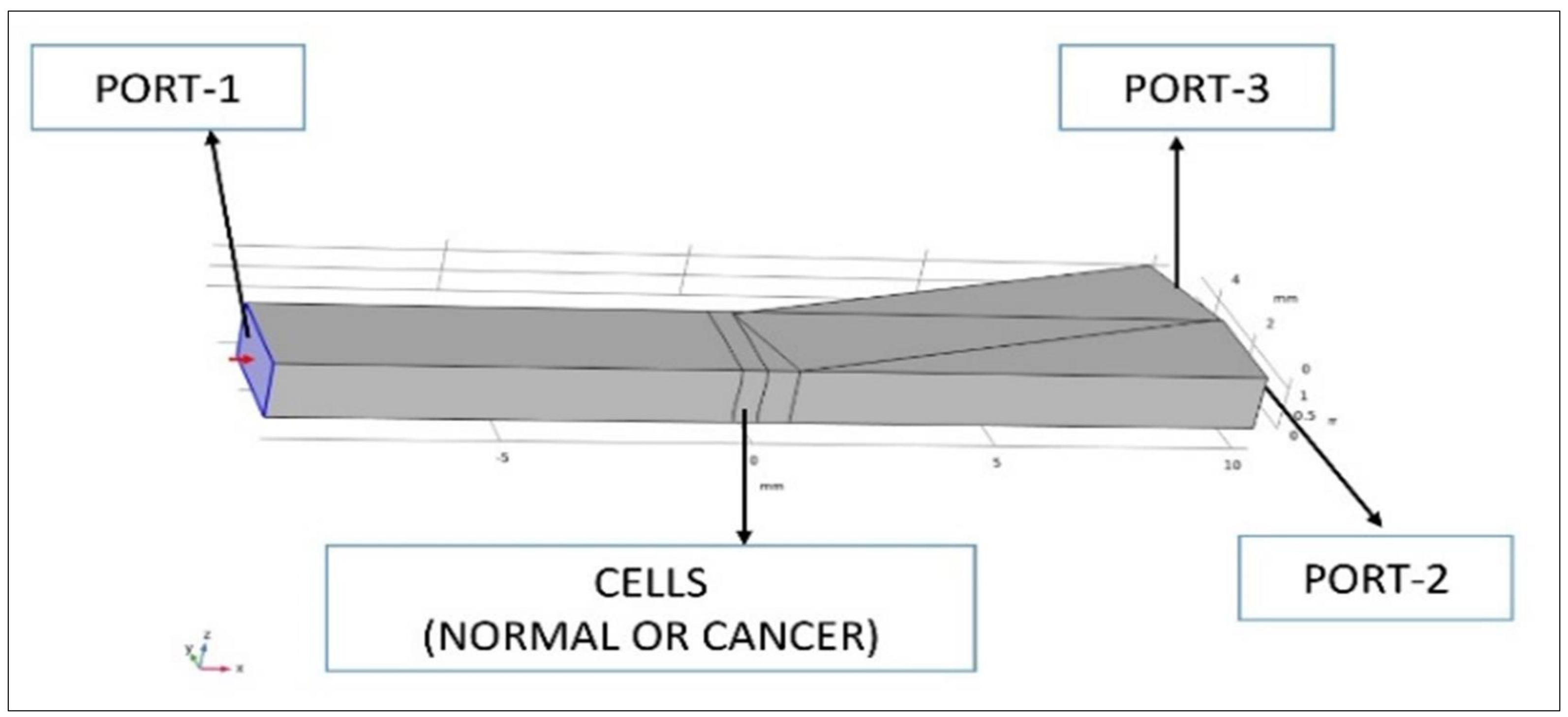

Fig 1: 3-D Schematic of THz based simulation model containing cells.

Methodology

Cancer is the leading disease in the world. Every year many cancer patients are suffering from lack of proper diagnostic techniques or delayed treatment. There are many techniques that can detect cancer but there is a requirement of safe and accurate diagnostic technique for early-stage cancer detection. The design consists of two ports and addition port at different angle with WR-10 dimensions to excite and both two ports to receive the signal. The cancer cell with exact matching to waveguide dimensional size has been placed in between the two ports. The wave has been launched with the frequencies ranging between 75 GHz - 110 GHz. The properties of cancer cells have been defined in accordance with the published literature. The absorption of the excited THz waves by the cancer cells and normal cells have been analyzed and compared. There is significant difference has been observed between the normal and cancer cells behavior towards the excited THz waves.

RESULTS

The reflected, transmitted signals, for the detector placed at 0° and the detector placed at 15° has been developed using simulation models for normal and cancer cell respectively. In Fig 4 there is the transmission of sub-THz signal for normal cells and cancer cells except at the frequency near about 0.1 THz. However, there is minimum reflection beyond 0.1 THz has been observed for cancer cells as normal cells.

The electric field profile developed in the simulation model. There is a uniform periodic field pattern before the cancer cells are placed inside the simulation model. However, non-periodicity has been observed after cancer cells due to the absorption of the sub-THz signal.

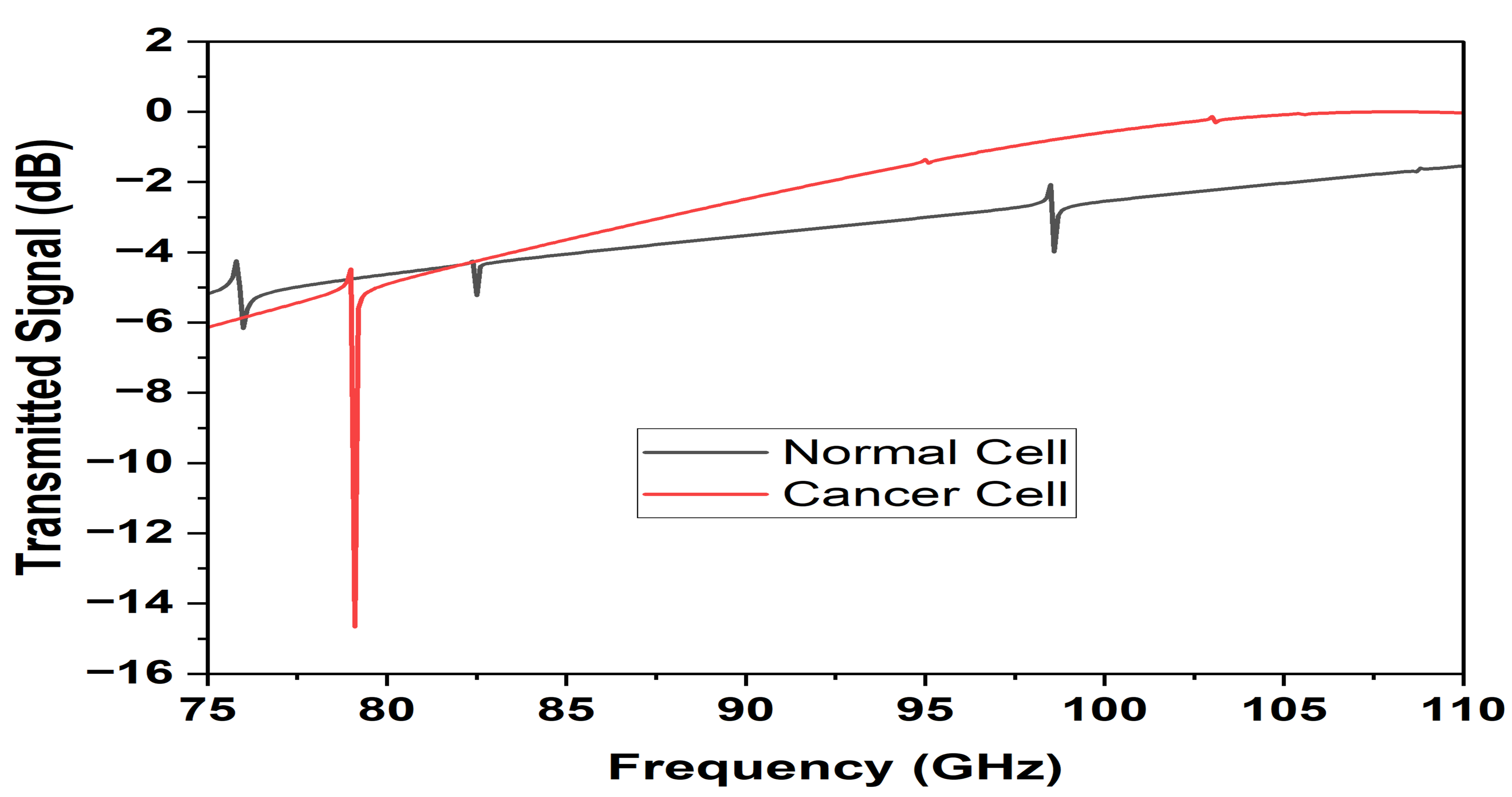

Fig 2: Comparison of reflection and transmission parameter in normal and cancer cells at 0°

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