



don't throw away that microwave

How are physicists using the technology of microwave ovens to cure cancer?

Prof. Charles V. Sammut and his team in the electromagnetics research group speak to **Dr Claude Bajada**.

Mobile phones, wi-fi routers, televisions, and microwave ovens emit electromagnetic radiation. Every one of them has been subject to safety controversies.

Electromagnetic radiation has worried people for years; a good friend of mine refuses to use a microwave oven. She would never accept someone implanting a tiny microwave oven into her body to 'improve her health'. After all, we all know that radiation causes cancer. Don't we? There is another side to electromagnetism. One where radiation does not cause, but cures, cancer.

Prof. Charles Sammut leads a team of scientists at the University of Malta that studies the effects of radiation on the human body. The

electromagnetism research group started off in 2001 when the Malta Communications Authority asked Sammut to investigate the radiation emitted from mobile phone base stations. This research had a simple result: there is no convincing evidence for any long term, harmful effects of microwaves and radio waves on human health. Conversely, microwave technology might improve health and lengthen our life. The team studies microwave radiation that is used to diagnose and cure diseases. Researcher Lourdes Farrugia explained that their lab answers the fundamental questions regarding how microwaves can aid health. 'I've characterised different type of tissue: muscle, liver, kidney and bone. [...] Our group is focusing on [...] how electromagnetic fields interact with



Equipment used to measure how living tissue is affected by an electromagnetic field (permittivity).

biological tissues, then we can feed this data to numerical simulations.' These simulations help biologists, doctors, and engineers to develop and optimise machines that can find cancerous tumours and kill them.

The results of their research help develop cutting edge technology in healthcare. They told me about two ongoing projects. The first one is microwave imaging. This is a three-dimensional radar imaging technique that may, one day, produce images similar to MRI. I can imagine my friend cringing. Unless they are so high powered that they cook you, ➡

WHAT IS ELECTROMAGNETISM?

Strangely, magnets and electricity are always linked. The two spread through the environment as a wave (like a wave of water but invisible to our eyes) which 'is a transfer of energy', said Julian Bonello, a researcher in Sammut's team. A wave can have any number of frequencies. At the low end of the electromagnetic spectrum, extremely low frequency waves oscillate at a rate of 3 per second (or 3 Hertz). At the other extreme, gamma rays have frequencies of about 100,000,000,000,000,000,000 Hertz or 10 Exahertz. Radio-waves, microwaves, light, and X-rays lie in the vast in-between.

WHICH FREQUENCIES OF ELECTROMAGNETIC RADIATION ARE HARMFUL?

The electromagnetic spectrum can be divided into two sections.

Ionising and non-ionising radiation. Ionising radiation includes high frequency electromagnetic radiation such as ultraviolet light, X-rays and Gamma rays. '[All these] are proven to increase the risk of getting cancer [...] the mechanism is understood, [...] ionising radiation knocks off some electrons that may cause irreparable damage to the DNA molecule. That can lead to cancer,' explained Sammut. This is the reason that doctors advise you not to stay out in the sun for too long. The sun's ultraviolet (UV) light can cause DNA damage that leads to skin cancer.

The fact that ionising radiation causes cancer makes people assume that all radiation is harmful. This is not true. Sammut says that 'in the case of electromagnetic fields at lower frequencies, let us say below 300 GHz, there isn't enough energy to [damage DNA], and no long-term effects have been found but some people are still terrified of their mobile phone's radiation'.

microwaves are harmless, but visible light can also do this. Think of military lasers. Microwave imaging works because biological tissues exhibit something called permittivity. Sammut tells me that this complex phenomenon gives researchers information about how much a tissue '[reduces] the electromagnetic field'. Imagine a liver cancer. The tumour has a certain permittivity, while the surrounding liver has a different permittivity. The tumour will appear darker or lighter: a contrast which a machine can detect, just like in photography.

The second project uses microwave radiation to treat cancer. One of the current standard treatments for cancer is using ionising radiotherapy. This treatment uses harmful ionising electromagnetic waves to kill cancer cells. Unfortunately, healthy tissue ends up being caught in the crossfire. Because of this, alternatives to conventional radiotherapies are needed. One alternative is to use non ionising radiation like microwaves. Microwave radiation does not cause long term damage to healthy tissue. In order to kill cancer, researchers use microwaves as a sort of hi-tech ray gun. The microwave energy targets the tumour. The tumour heats up, it cooks, and dies. If a person has a liver tumour the 'ray gun' must penetrate the healthy tissue in its path. This causes a problem because no one wants their healthy tissue burnt. There are many ways of overcoming this problem. The first way uses low energy sources that attack the tumour from different angles. Sammut explained that '[each

individual source] would not be sufficient to cause much damage to the [healthy] tissue but if [multiple rays] meet at the same point, [they will burn the tumour]'. Another method involves a surgeon inserting 'a microwave applicator that actually penetrates into the tumour'. The applicator works like a little microwave oven that generates microwaves inside the tumour. In this way, the treatment can be precisely targeted to the cancer.

In the future, tiny microwave ovens could find their way inside you. Doctors may insert them into people's tumours in order to cure them, but as yet a substantial portion of the public is still terrified of the one sitting in their own kitchen. How will they accept this new form of medical treatment? Changing the name 'microwave imaging' might help. Sammut disagrees, 'let us not be too afraid of making things clear to people... Ever since the advent of mobile phone technology people have been afraid ... It's time to look at the advantageous aspect of electromagnetic fields.'

Electromagnetic radiation is everywhere and cannot be avoided; nor should it be. Light is a type of electromagnetic radiation after all. Some of it can harm us, most of it does not. 'Where would we be without [these] fields?' ends Sammut, 'No mobile phones, no radio, no television, we'd have nothing, life is unimaginable without wireless technology.' Do not throw away your microwave oven. Do not be afraid of it. It will not harm you. Electromagnetic radiation may lengthen your life. **T**