

## Novel Terahertz-Based Radiation Treatment of Alzheimer Disease

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**Abstract**

*Alzheimer's Disease Facts and Figures, an annual report released by the Alzheimer's Association, reveals the burden of Alzheimer's and dementia on individuals, caregivers, government and the nation's health care system. Per the special report, More Than Normal Aging: Understanding Mild Cognitive Impairment (MCI), it is estimated 10% to 15% of individuals with MCI go on to develop dementia each year.*

*Because of the narrow brain-blood barrier every medicine designed to treat Alzheimer's failed due to inability of complex and large molecules to penetrate this barrier.*

**Four steps of Alzheimer's treatment by using proprietary Magtera Technology.**

**First step:** Detect the THz modes for A $\beta$ 42 Oligomer. or any other micro bio structures proven to be responsible for Alzheimer's. The most probable THz modes would be intermolecular modes: librations, low frequency bond vibrations; hydrogen bond stretches and distortions; molecular rotations. There are plenty of such modes.

**Second step:** detect the THz modes of healthy brain tissue.

**Third step: Second step:** Find a THz window of penetration in brain fluids that corresponds to one of these modes by using the highly tunable THz Magnon Laser that bridges the THz Gap and covers the whole THz spectrum.

**Fourth step:** Apply high power THz radiation by using the THz Magnon Laser at resonance frequencies that correspond to A $\beta$ 42 Oligomer molecular excitations but do not coincide with THz modes of healthy brain tissue, and eradicate A $\beta$ 42 Oligomer molecules.

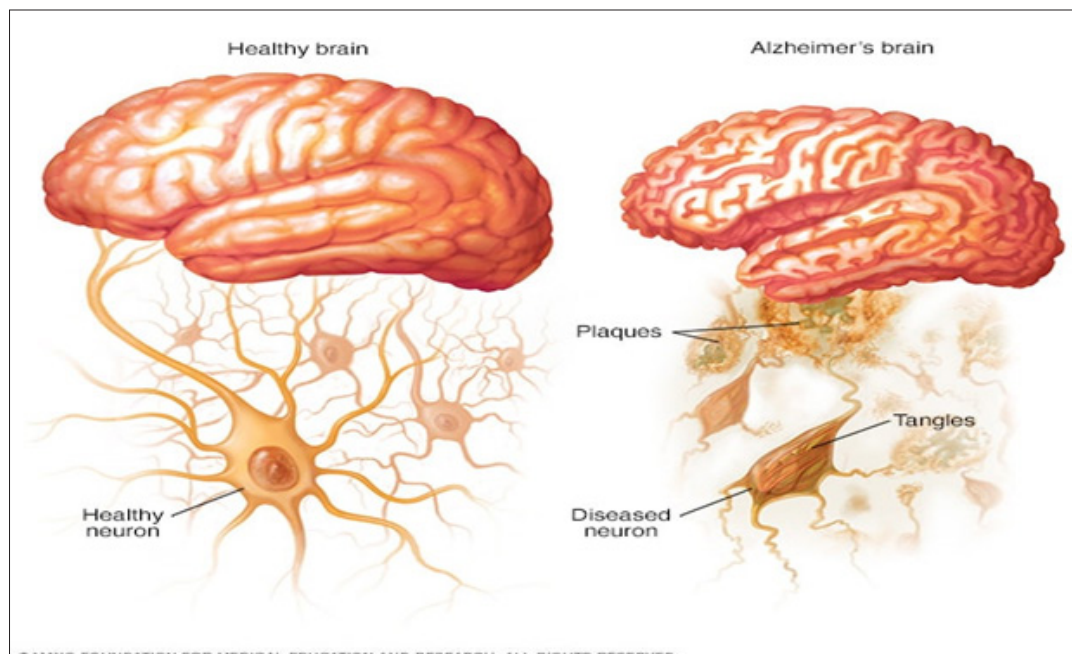
**Overview from Mayo Clinic**

Alzheimer's disease is a brain disorder that gets worse over time. It's characterized by changes in the brain that lead to deposits of certain proteins. Alzheimer's disease causes the brain to shrink and brain cells to eventually die. Alzheimer's disease is the most common cause of dementia — a gradual decline in memory, thinking, behavior and social skills. These changes affect a person's ability to function.

About 6.5 million people in the United States age 65 and older live with Alzheimer's disease. Among them, more than 70% are 75 years old and older. Of the about 55 million people worldwide with dementia, 60% to 70% are estimated to have Alzheimer's disease.

The early signs of the disease include forgetting recent events or conversations. Over time, it progresses to serious memory problems and loss of the ability to perform everyday tasks.

## Healthy brain v. Alzheimer's brain



### Causes

Researchers trying to understand the cause of Alzheimer's disease are focused on the role of two proteins:

**Plaques:** Beta-amyloid is a fragment of a larger protein. When these fragments clump together, they appear to have a toxic effect on neurons and to disrupt communication between brain cells. These clumps form larger deposits called amyloid plaques, which also include other cellular debris.

**Tangles:** Tau proteins play a part in a brain cell's internal support and transport system to carry nutrients and other essential materials. In Alzheimer's disease, tau proteins change shape and organize into structures called neurofibrillary tangles. The tangles disrupt the transport system and cause damage to cells.

### Main Diagnostic technique-MRI

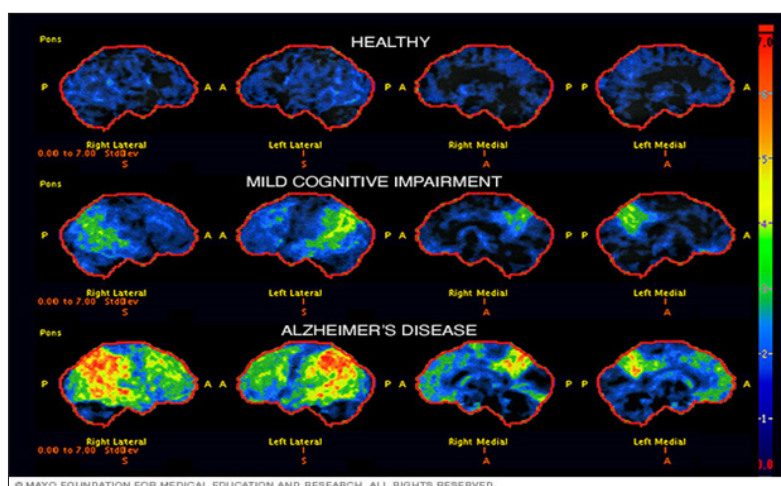
Magnetic resonance imaging (MRI). MRI uses radio waves and a strong magnetic field to produce detailed images of the brain. While they may show shrinkage of some brain regions associated with Alzheimer's disease, MRI scans also rule out other conditions. An MRI is generally preferred to a CT scan to evaluate dementia.

### Positron emission tomography (PET) can capture images of the disease process

Amyloid PET imaging can measure the burden of amyloid deposits in the brain. This test is mainly used in research but may be used if a person has unusual or very early onset of dementia symptoms.

Tau PET imaging, which measures the tangles in the brain, is generally used in the research setting.

### Diagnosis: Brain scan images for diagnosis of Alzheimer's disease



## Medications

**Cholinesterase inhibitors:** These medicines work by boosting levels of cell-to-cell communication. The medicines preserve a chemical messenger that is depleted in the brain by Alzheimer's disease. These are usually the first medicines tried, and most people see modest improvements in symptoms.

**Memantine (Namenda):** This medicine works in another brain cell communication network and slows the progression of symptoms with moderate to severe Alzheimer's disease. It's sometimes used in combination with a cholinesterase inhibitor. Relatively rare side effects include dizziness and confusion.

In June 2021, the Food and Drug Administration (FDA) approved aducanumab (Aduhelm) for the treatment of some cases of Alzheimer's disease. This medicine was approved in the United States because it removes amyloid plaques in the brain. But studies about how effective it is at slowing cognitive decline were mixed and coverage is limited. Therefore, it's not widely used.

Another Alzheimer's medicine, lecanemab (Leqembi), has shown promise for people with mild Alzheimer's disease and mild cognitive impairment due to Alzheimer's disease. The FDA approved the medicine in 2023. A phase 3 clinical trial found that the medicine slowed cognitive decline in people with early Alzheimer's disease by 27%.

## Why Alzheimer's Drugs Keep Failing?

Drug candidates have a 99.6 percent failure rate, and poor early detection methods make clinical trials difficult and costly.

Dementia has become a graveyard for a large number of promising drugs. A recent study looked at how 244 compounds

in 413 clinical trials fared for Alzheimer's disease between 2002 and 2012.

The researchers findings paint a gloomy picture. Of those 244 compounds, only one was approved. The researchers report that this gives Alzheimer's disease drug candidates one of the highest failures rates of any disease area – 99.6%, compared with 81% for cancer.

Narrow Blood-Barrier barrier makes it difficult to deliver large med molecules to the brain by blood channel.

## Mortality

Alzheimer's disease is the sixth-leading cause of death in the U.S. killing more people than breast cancer and prostate cancer combined. Since 2000, deaths from Alzheimer's disease have increased by 89 percent while those from heart disease have decreased.

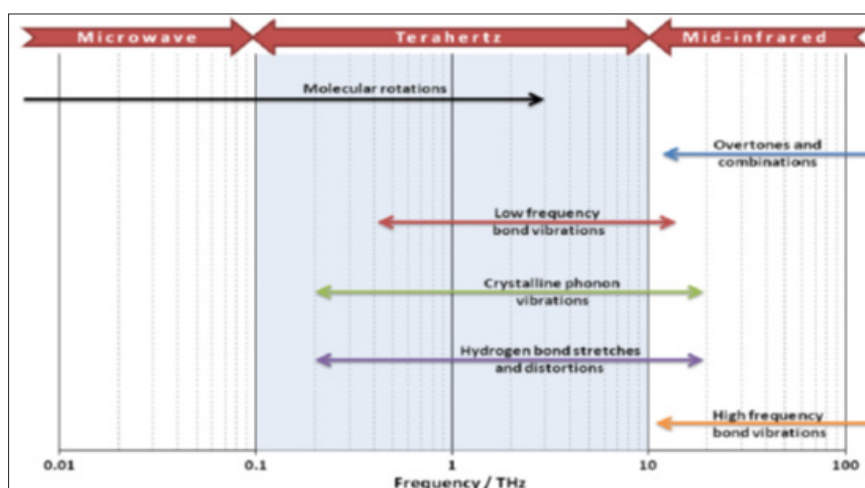
Alzheimer's disease is the fifth-leading cause of death among those aged 65 and older and a leading cause of disability and poor health. Typical life expectancy after an Alzheimer's diagnosis is four to eight years.

## Magtera Approach to Curative Treatment of Alzheimer's

Applying THz radiation to the sculp of the patient to destroy plaques including A $\beta$ 42 oligomers that cause ALZHEIMER'S without destroying the healthy brain tissue.

Indeed, every bio molecule can be characterized and "fingerprinted" by providing the full spectrum of its terahertz resonance frequencies including but not limited to rotational modes, vibrational modes, etc.

## Various molecular interactions in THz region. THz Gap highlighted (Parrott et al., 2011)



### Example. Intermolecular THz modes for Tryptophan

The terahertz (THz) absorption and index of refraction of brain tissues from a mouse model of Alzheimer's disease (AD) and a control wild-type (normal) mouse were compared using THz time-domain spectroscopy (THz-TDS). Three dominating absorption peaks associated to torsional–vibrational modes were observed in AD tissue, at about 1.44, 1.8, and 2.114 THz, closer to the peaks of free tryptophan molecules than in normal tissue. A possible reason is that there is more free tryptophan in AD brain tissue, while in normal brain tissue more tryptophan is attached to other molecules. The study suggests that THz-absorption modes may be used as an AD biomarker fingerprint in brain, and that THz-TDS is a promising technique for early diagnosis of AD (Shi et al., 2016).

### Primary toxic species in Alzheimer's disease-A $\beta$ 42 dodecamer

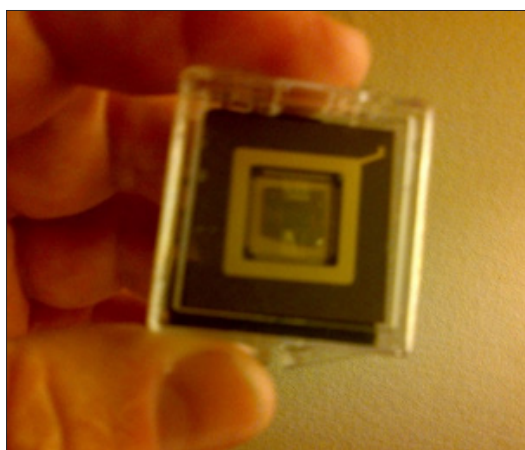
In the context of biochemistry, an oligomer usually refers to a macromolecular complex formed by non-covalent bonding of a few macromolecules like proteins or nucleic acids.

In recent years, small protein oligomers have been implicated in the etiology of a number of important amyloid diseases, such as type 2 diabetes, Parkinson's disease and Alzheimer's disease.

For example, it was recently demonstrated that A $\beta$ 42 dodecamer is the primary toxic species in Alzheimer's disease. (Bernstein et al., 2009).

A $\beta$ 42 oligomer includes vibrational and rotational frequencies in THz spectrum. The higher the tunability of the THz generator the higher the probability of finding a THz penetration window in THz spectrum that corresponds to the most favorable intermolecular mode of A $\beta$ 42 oligomer.

### Magtera approach-curative treatment of Alzheimer's



Here is an actual size of a chip of THz Magnon Laser. (Tankhilevich et al., 2020)

### Four steps of Alzheimer's treatment by using proprietary Magtera Technology (Tankhilevich et al., 2023).

**First step:** Detect the THz modes for A $\beta$ 42 Oligomer. or any other micro bio structures proven to be responsible for Alzheimer's. The most probable THz modes would be intermolecular modes: librations, low frequency bond vibrations; hydrogen bond stretches and distortions; molecular rotations. There are plenty of such modes.

**Second step:** detect the THz modes of healthy brain tissue.

**Third step:** Find a THz window of penetration in brain fluids that corresponds to one of these modes for A $\beta$ 42 Oligomer but that does not coincide with the healthy brain tissue by using the highly tunable THz Magnon Laser that bridges the THz Gap. There are plenty of such modes.

**Fourth step:** Apply high power THz radiation by using the THz Magnon Laser to A $\beta$ 42 Oligomer and eradicate it.

### Conclusion

This is a theoretical work. Magtera is actively seeking collaboration with pharmaceutical companies, academic and research institutions, private funds to fund and explore the experimental steps needed to transform these new ideas into potentially curable treatment for Alzheimer's.

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