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## Improved laser wakefield acceleration-based system for cancer diagnostics and treatment

Tech ID: 33242 / UC Case 2019-921-0

### BRIEF DESCRIPTION

Researchers at UC Irvine have developed methods to facilitate the delivery of a high dose, low energy electron beam or X-ray in a compact manner.

### SUGGESTED USES

- Diagnosis and treatment of cancer
- Intraoperative radiation therapy

### FEATURES/BENEFITS

- Small size of the laser-driven electron beams and their targets
- Fine spatiotemporal control of electrons
- High repetition rate of lasers
- High laser wall plug efficiency of 30%

### TECHNOLOGY DESCRIPTION

The use of radiation in healthcare has a long history, with relevant applications in diagnostic imaging and radiation therapy. For diagnostics, kilovolt X-ray beams are used for imaging application such as radiography, mammography, fluoroscopy, and computer tomography. While effective, it requires bulky imaging apparatuses and the use of radioisotopes, whose accompanying logistics (production, transportation, storage, export laws) impact its convenience. Regarding therapeutics, radiation has recently benefitted from various improvements to its source. Megavolt X-ray and electron beams generated by a linear accelerator are routinely used to treat cancerous tumors in any part of the body, but again require bulky and inconvenient apparatuses. The development of compact laser wakefield acceleration (LWFA) has paved way for the production of low-energy/ultra-high dose electrons and high energy electrons for diagnostic and therapeutic applications, respectively, without the need for bulky equipment.

Researchers at UC Irvine have developed the systems, devices, and methods to facilitate the generation of a low-intensity high-dose laser, electron beam, and X-rays for the medical treatment and diagnosis of cancer. The LWFA is used to generate compact electron beams or X-rays. The resulting high dose is achieved via a combination of effects including (1) a plurality of fiber lasers, (2) a low energy (high plasma density) regime of LWFA (~1MeV with  $10^{20}$ ~ $10^{21}$  electrons/cm<sup>3</sup>), (3) a high-energy (low plasma density) regime of LWFA (~1-20MeV with  $10^{18}$ ~ $10^{19}$  electrons/cm<sup>3</sup>), (4) a high repetition rate of the laser (>100,000Hz), (5)targeting of the tumor at a closer distance and smaller volume, and (6) personalized therapy via optimization of fiber shape to match the shape of the tumor. The LWFA electron beams may also be used to sterilize instruments, components, and material surfaces.

### CONTACT

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### INVENTORS

» Tajima, Toshiki

### OTHER INFORMATION

### CATEGORIZED AS

- » **Biotechnology**
  - » Health
- » **Imaging**
  - » Medical
- » **Medical**
  - » Diagnostics
  - » Disease: Cancer
  - » Imaging
  - » Therapeutics
- » **Sensors & Instrumentation**
  - » Medical

## STATE OF DEVELOPMENT

Prototype in development.

## RELATED CASES

2019-921-0

## RELATED MATERIALS

» [Systems and methods for compact laser wakefield accelerated electrons and x-rays - 04/14/2022](#)

## PATENT STATUS

| Country                  | Type                  | Number      | Dated      | Case     |
|--------------------------|-----------------------|-------------|------------|----------|
| United States Of America | Published Application | 20220117075 | 04/14/2022 | 2019-921 |

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