Docket #: S14-070

Traveling wave linear accelerator with rf power flow outside of accelerating cavities

Stanford researchers have developed a novel traveling wave accelerating structure which is a critical component of a particle accelerator. It has high shunt impedance similar to that of side-coupled standing-wave accelerating structure, but without its drawbacks. It does not need a waveguide isolator and has no deflecting on-axis fields or power flow through the accelerating cell. Additionally, it is simple to tune and characterize electrically. This design improves efficiency while reducing cost and enhancing operational flexibility of particle accelerators for medical, security and industrial applications. This approach is suitable for both electron and proton linacs.

Figure 1

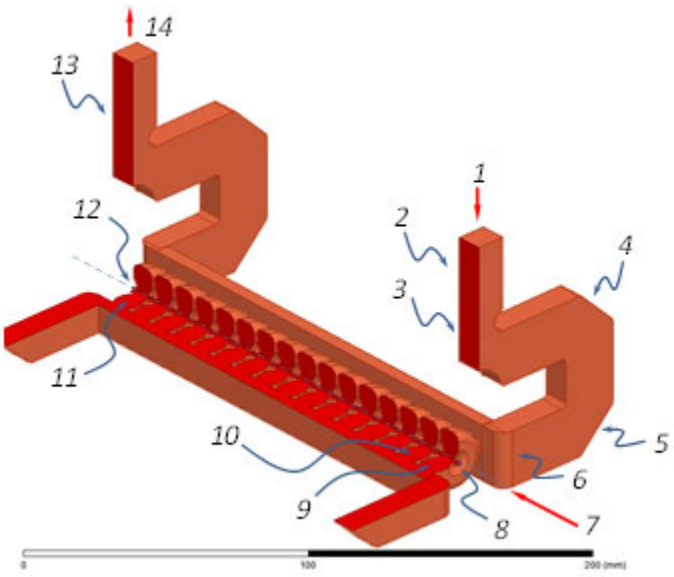

Figure 1 - Schematic view of the vacuum region of the TW accelerating structure. Upper left part is cut to show internal geometry. The scale is for 9.3 GHz, 2pi/3 phase advance structure. The structure consists of stack of regular cells, input and

output couplers and input and output waveguide splitters. Notation as follows: 1 – input RF power; 2 – input waveguide; 3 matched 3dB splitter; 4, 5 – matched H plane bends; 6 –matched E-pane bend; 7 – direction of electron beam; 8 – input beam pipe; 9 – input matching cell; 10 – first regular cell; 11 –output matching cell; 12 – output beam pipe; 13 – output waveguide; 14- output RF power.

Figure 2

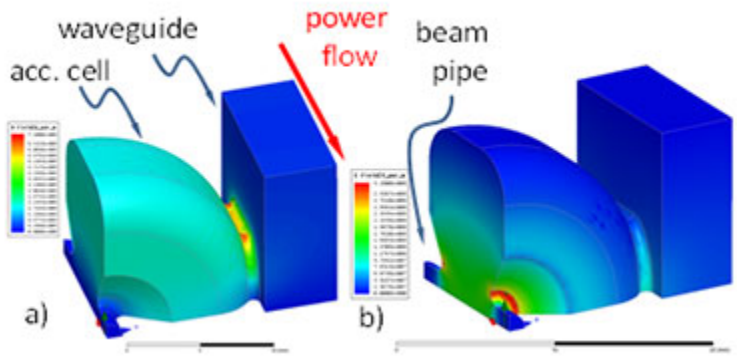

Figure 2 - Quarter-cell finite element model of the traveling wave accelerating structure. Surface electric fields are normalized to 100 MV/m accelerating gradient: a) magnetic fields with peak magnitude of 0.71 MA/m; b) electric fields with peak magnitude ~325 MV/m.

Stage of Research:

- Detailed simulations of the proposed traveling wave (TW) structure and typical side-coupled standing wave structure which showed almost the same shunt impedance for the same beam aperture, specifically 144 MOhm/m for 9.3 GHz structure. Such high shunt impedance is impossible to reach with traditional on-axis coupled TW structures.
- Analysis of dispersion characteristics shows stable, single low-group velocity accelerating mode.
- Work is ongoing at SLAC on manufacturing techniques suitable for production of the proposed structure.

Applications

- **For use in particle accelerators where rf power is premium:**
  - Compact accelerators for radiation therapy

    - Compact and high repetition rate accelerators for security and imaging applications
    - Compact, high dose industrial accelerators for sterilization

Advantages

- Cost efficient
- Easier to manufacture and tune than existing high-efficiency accelerating structures
- Enhances operational and design flexibility
- Does not need circulator to operate
- Combines the simplicity of tuning and manufacturing of traveling wave waveguide with high shunt impedance of side-coupled standing wave accelerating structure

Patents

- Issued: 9,380,695 (USA)

Innovators

- Valery Dolgashev

Licensing Contact

Evan Elder

Senior Licensing Associate

Email