DEMETRA

DiElectric and **MET**allic **R**adiofrequency **A**ccelerator

3 giugno 2015

Outline

Outline

LINAC: Scientific motivation and challanges

Linear is better (no sincroton radiation, better emittance and luminosity)
. . . but high gradient, compact accelerating structures are mandatory.

Imperative:

- high energies
- shrinking ($\rightarrow$ high-gradient)
- efficient acceleration (to reduce power consumption)

Future Challenges:
- Big physics gets small
- Toward table-top sources for ...

Outline

Planned Working Packages (WPs)

WP1 Metallic RF Linear Accelerator

WP2 Dielectric Laser Linear Accelerator

Outline

Design and Technological breakthrough

Innovative design to limit the maximum surface fields
Understand the source of damage

- Design of structures:
  - standing wave (SW) versus traveling wave (TW).
  - low $\frac{E_{\mathrm{peak}}}{E_{\mathrm{acc}}}$
- Novel materials
- Innovative technologies and fabrication process.

X-band (11.4 GHz)
3-cell structure

Activity

1. Design and construction of dedicated SW structures
   - Triple choke cavity
   - Open structures
   - Mode launcher
   - Dedicated structure to study and separate the effect of magnetic and electric fields
   - 3-cell structure
2. Identify appropriate manufacturing technologies
   - Sputtering
   - Electron Beam Welding (EBW)
3. Test of new materials
   - Molybdenum
4. Test of RF structure (high power test at SLAC).

Outline

Design and Technological breakthrough

Manipulation of the electromagnetic properties of materials

Control the Flow of Electromagnetic Waves (axial accelerating field, phase and group velocity) through Photonic Crystals (no metal).

Hollow core dielectric guiding structure.

Phase velocity control for synchronous acceleration.

Group velocity and timing control (interaction length).

DLA

- Electrical breakdown of dielectric $>$ multi-GV/m
- Low Ohmic losses
- Possible suppression of HOM
  - ⋆ Material transparent at higher frequencies
  - ⋆ PBG intrinsically mono-modal (and hence HOM-free)

Activity

1. Study and design of appropriate band-gap dielectric accelerating structures (traveling or side pumping).
   - Theoretical study
   - Full wave 3D virtual experiment
     for electron source
     for low-energy pre-accelerator
     and/or for relativistic electron accelerator
2. Identification of appropriate fabrication technologies (if necessary for a scaled accelerator).
3. Identification of electromagnetic pump sources (lasers) and timing/synchronization across accelerating structure.
4. Experimental characterization of the proposed e.m. accelerating structure

Outline

FTE and Collaborations

	FTE	
G. Castorina	100%	LNF
L. Di Donato	30%	ric. UniCT
T. Isernia	20%	prof. Ordinario UniRC
G. Galzerano	30%	Ricercatore CNR, PoliMI
P. Laporta	30%	prof. Ordinario PoliMI & CNR
S. Lupi ?		prof. Associato Dip. di Fisica, Università di Roma "La Sapienza"
S. Pennisi	30%	prof. Associato UniCT
G. Sorbello	30%	prof. Associato UniCT (Resp. Nazionale)
B. Spataro	30%	Direttore Tecnologo e Associato INFN

Collaborations: F. Priolo group, UniCT & CNR (G. Franzò, F. Iacona, M. Miritello).

Outline

Planning

100k €/ anno

- Inventariabile 10k€ (workstation)
- Licenze SW 3k€ (1 year license)
- Consumo (RF cabling, . . .)
- Lavorazioni 80k€ ? (triple choke cavity, sputtering deposition, dielectric photonic band gap structure)
- Missioni

Milestones: