



## **IAEA Technical Meeting on Advanced Accelerator Technology**

**Institute of Nuclear and Particle Physics, NCSR “Demokritos”**

**13 -17 June 2016**

**Ref. No: F1-TM-52447**

### **Announcement and Call for Papers**

#### **A. BACKGROUND**

Accelerators have been developed initially to shed light on fundamental questions posed by scientists investigating the inner structure and properties of the atomic nucleus and the physical laws that govern the interactions of radiation with matter. Nowadays, the benefits from the worldwide application of tens of thousands of accelerators in industry, environment, medicine and basic research including subatomic physics and astrophysics, affect directly or indirectly millions of people within their day-to-day life's. In addition, they are still making key contributions to the most significant scientific discoveries of our time. The main function of accelerators is to generate a beam of energetic particles (electrons, protons, charged atoms, stable or radioactive isotopes) propagating in the same direction with highly controlled properties such as energy, intensity, position, spatial or/and time resolution and coherence. In some important applications, the accelerated particles are only used to produce a secondary radiation with exceptional properties as it happens for example at synchrotron radiation and Free Electron Laser (FEL) facilities, sources of brilliant, coherent, broadband and ultra-short light pulses.

To keep responding to the great demand for accelerators in cutting-edge scientific research and to sustain or even extend the broad range of applications with strong socio-economic benefits, it is vital to further improve and advance accelerator technology. Technological innovations push accelerators to reach challenging limits in terms of the energy and type of accelerated particle and to reduce size and cost in particular for industrial and medical applications. In addition, compact accelerators could more easily find a place within a university campus promoting advanced training and research within an academic environment.

The fourth generation synchrotron light sources like MAX IV in Lund, Sweden and forthcoming Sirius in Brazil thanks to recent progress in accelerator technology will offer low emittance radiation and thus higher brightness and coherence that will advance high resolution X-ray imaging applications. At FEL facilities in particular, the various

developments in accelerator technology, X-ray optics and optical lasers aim to produce low femtosecond pulses for single shot timing experiments and high-coherence X-ray beams that can unlock exotic research capabilities into the ultrafast and high resolution scale of molecular and atomic dynamic processes.

The requirement to produce compact and cost-effective accelerators, maintaining if possible the required energy for the particle beam, meets a major technological challenge, i.e., to increase considerably the gradient of the accelerating electric field, i.e. the energy per meter of beamline gained by the particle beam. Conventional Radio-Frequency (RF) machines have an upper limit of tens of MeV per meter of beamline since at higher energies; the RF electric fields will break down. Plasma wakefield acceleration is an extremely promising technology that can offer as much as 1000 times more acceleration potential per length of accelerator, reducing accelerator size and maintain its power. The basic concept of the plasma wakefield accelerator involves the passage of an almost light-speed electron bunch through a stationary plasma formed by ionizing a gas with a laser or through field-ionization by the incoming electron bunch itself. The system effectively operates as a transformer, where the energy from the particles in the front is transferred to those in the back, through the plasma wake.

Another promising approach that was recently demonstrated experimentally is the so called particle accelerator on a chip. Micro-fabricated Dielectric Laser Accelerators (DLAs) can support accelerating fields one to two orders of magnitude higher (beyond  $250 \text{ MeV m}^{-1}$ ) than radio-frequency cavity-based accelerators. The basic element of a DLA is a glass chip straight channel modified to reveal a nanoscale pattern of ridges and gaps. Exposing the chip to an infrared laser with a wavelength double the height of the channel, the electric field along the ridges boosts considerably the speed of the electron stream. DLAs use commercial lasers as a power source, and are fabricated via low-cost, lithographic techniques that can be used for mass production. The first results look promising for the development of future multi-staged DLA devices composed of integrated on-chip systems. This may enable compact table-top accelerators on the MeV–GeV scale for security scanners and medical therapy, university-scale X-ray light sources for biological and materials research, and portable medical imaging devices. Finally, in the direction of the development of tabletop synchrotrons, the collision of a high-intensity accelerated electron beam with a very intense laser beam can produce a unique very bright high energy (up to 20 MeV) X-ray photon beam through Compton back-scattering (Inverse Compton Scattering). This tabletop synchrotron could support both fundamental studies of nuclear physics and astrophysics topics, but also various interdisciplinary applications.

## **B. OBJECTIVES**

The Technical Meeting aims at providing a forum for technical discussions amongst specialists with the following objectives:

1. To review the current status, and trends in the development of advanced compact accelerators;
2. To identify and propose promising accelerator technologies need to be prioritized in terms of research, development and utilization of resources;
3. To support exchange, sharing and dissemination of cross-cutting information and know-how between scientists working in the development of advanced compact accelerators;

4. To provide recommendations to the IAEA and Member States on how to increase utilization of emerging accelerator technologies by the IAEA and its Member States.

### C. PARTICIPATION

A person will be eligible to participate only if nominated by the Government of an IAEA Member State (Ministry of Foreign Affairs or National Atomic Energy Authority) or by an Organisation invited to participate. **Nomination** for participation (see **Form A**) and title of contribution (**Form B**) with **abstract** should be received by the IAEA not later than **15 April 2016**. The participant should be a developer and/or user of advanced analytical techniques for laboratory and industrial applications.

### D. SUBMISSION OF ABSTRACTS AND PAPERS

A contribution from the participant in the **form of a 1 page abstract** covering his/her work **relevant to the objectives of the meeting** will be necessary in order to be considered for participation. Please see the guidelines on formatting papers.

**Important:** Contributors of material to be included in the Agency proceedings are required to assign all copyrights or rights to publish to the Agency.

The authors should make sure that the files do not include copyrighted fonts or other impediments for reproduction.

**The abstract** shall be prepared according to the following instructions:

- 1) Page size: A4 (21 cm by 29.7 mm) – vertical orientation
- 2) Margins 25mm all around
- 3) Layout:
  - Title: single-spaced, 14-point size, Times New Roman Font (TNR), **bold**
  - Authors: single-spaced, 12-point size, TNR Font
  - Affiliation: single-spaced, 12-point size, TNR Font, *italic*
  - Text: 1.5 spaced, 12-point size, TNR Font
  - Length: one page

**Important:** In case of sending Microsoft Word files, authors should use True Type Embedded Fonts (when saving the file, click Tools, then Options, and tick Embed True Type fonts. This will help to prevent change of fonts when the file is read in a different system, as it will be in most of the cases).

### E. FINANCIAL SUPPORT

As a general rule, the IAEA does not pay the costs for attendance to the meeting. However, limited funds may be made available to assist the attendance of selected participants and approved in accordance with the current Agency rules and regulations. Generally, not more than one financial grant will be awarded to any one Member State. If Governments wish to apply for financial support on behalf of their nominees, they should address specific requests to the IAEA Scientific Secretary (see **Form C**).

## F. MEETING FORMAT

To facilitate proceedings, participants are invited to contribute an oral presentation on a subject relevant to the scope and objectives of this meeting. Participants should submit an abstract of their proposed presentation along with their nomination. The official language of the meeting is English. No interpretation will be provided. It is expected that the meeting will start at 09:00 on Monday, 13 June 2016 and conclude by 13:00 on Friday, 17 June 2016.

The output of discussions will be recorded for possible dissemination to Member States as an IAEA technical publication. Contributors of material to be included in the Agency proceedings are required to assign all copyrights or rights to publish to the Agency. Please complete and sign the **Form B and attach it to your abstract** and send it to the IAEA Scientific Secretary by post or email. The authors should ensure that material they make available for possible publication by the IAEA does not include copyrighted material or other impediments for reproduction.

## G. LOCAL ARRANGEMENTS

It is the responsibility of all participants to make their own travel arrangements to/from Athens, Greece. Detailed information on accommodation, local transport to/from the meeting venue, and other organisational details, will be sent to all designated participants well in advance of the meeting.

## H. VISA

Designated participants who require a visa to enter Greece should submit the necessary application to the nearest diplomatic or consular representative of Greece well in advance of entry. An official letter of invitation will be issued to all designated participants by the IAEA Scientific Secretary. Letters of support from the Local Organizer will be provided on request to the Local Organizer's Secretariat.

## I. DEADLINES

- **15 April 2016:** Submission of requests to the IAEA for participation (Forms A and B), financial support (Form C) and of paper contribution, **including abstract**.
- **22 April 2016:** Participants informed of their acceptance of participation and request for financial support.

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