



Fellowships for Training in Accelerator-based technologies relevant to Hadrontherapy

Hosted by

The National Center for Oncological Hadrontherapy (CNAO)
Pavia, Italy

2024

Ref. No.: FE-RER6039-EVT2305624

Information Sheet

Purpose

The IAEA, through its Regional Technical Cooperation (TC) project RER6039 “Developing Human Resources for Setting Up an Ion Beam Therapy Centre within the Joint South East European International Institute for Sustainable Technologies”, will support up to three (3) fellowships aimed at training young scientists in accelerator-based technologies relevant to Hadrontherapy. The training objective is to prepare them for future participation in the design and operation of a Hadron accelerator facility within the Joint South East European International Institute for Sustainable Technologies (SEEIIST).

Working Language(s)

The working language of the Fellowship will be English.

Project Background

Objective of the project RER6039 is to share knowledge and build critical mass of human resources initially needed for the merits of the emerging hadron tumour therapy and research facility, in particular the South East European International Institute for Sustainable Technologies (SEEIIST).

Scope and Nature

Fellowships will have a duration of 12 months and will take place at the Centro Nazionale di Adroterapia Oncologica (CNAO) in Pavia, Italy. Candidates are free to choose among five training topics, which are outlined below together with the required necessary qualifications and skills.

Training topics

Training Venue: CNAO, Pavia, Italy.

The National Center for Oncological Hadrontherapy (CNAO, Pavia) is one of the four cancer treatment facilities in Europe delivering proton and carbon ion beams for cancer treatment. The CNAO main accelerator is a synchrotron of the “PIMMS” family.

Topic 1: Study of Slow Beam Extraction at CNAO

a) Training scope:

The mechanism of extraction of the beam from the CNAO synchrotron is based on a third-order resonance driven by a sextupole. Two beam extraction mechanisms for slow extraction are commonly used in this type of accelerators, i.e. the betatron-core and the Radio Frequency Knock-Out (RFKO); both are presently available at CNAO, but while the former is presently used for cancer treatment, the latter is still in a commissioning phase.

The proposed activity consists in simulating the beam extraction driven by either mechanism with the aim of optimizing key parameters, like frequency and strength of the driving kicker for the RFKO. The simulations will be performed with top-quality codes like MADX, PTC and XSuite, all developed by teams in world-class accelerator facilities. With the existing hardware and without hindering the treatment schedule, dedicated tests of the simulated procedures with beam could be foreseen.

b) Candidate’s Profile, competencies and skills required:

The candidate must have a MSc degree in Physics, Nuclear engineering, or similar field. Technical competence and skills required: accelerator physics, mechanical statistics, basic knowledge of coding (python, C/C++, Fortran, MatLab) and Linux system.

Topic 2: Characterization of a new acquisition system for the Schottky Monitor of the CNAO Synchrotron

a) Training scope:

The CNAO synchrotron is equipped with a Schottky monitor capable to measure collective quantities of the circulating beam (e.g., revolution frequency, tune, chromaticity, etc...) in a non-destructive way; therefore, its use is of great operational interest, especially in the perspective of monitoring treatment beams. The acquisition system, although successfully tested with particle beams at CERN, has not so far allowed a routine use of the monitor, not even as part of the regular machine checks.

The proposed activity aims to develop a new acquisition set-up for the Schottky monitor, based on a digital oscilloscope with high sampling frequency and an off-line frequency analysis of the acquired signals. The activity is based on two pillars: the first one is the characterization of the new acquisition system and of the key aspects of the Schottky analysis by means of measurements carried out at a test bench with simulated signals; the actual measurements with beams circulating in the synchrotron will be the second one.

b) Candidate’s Profile, competencies and (soft) skills required:

The candidate must have a MSc degree in Physics, Nuclear Engineering, or Electronics Engineering
Technical competence and skills required: Basic knowledge of FFT algorithms and Schottky noise, methods of signal treatment, electronics, MatLab/Python.

Topic 3: Development of a monitor for low intensity beams.

a) Training scope:

The Dose Delivery System at CNAO is presently based on ionization chambers measuring online the beam intensity. For many physics experiments, low intensity beams are often required, whose intensity is many orders of magnitude below the clinical ones. For this reason, a dedicated monitor is being developed in collaboration with INFN and Univ. La Sapienza (Rome). The monitor is based on scintillating fibers acquired via SiPM and a dedicated acquisition board from CAEN.

The subject of this work is to contribute to the monitor development and to its integration into the Dose Delivery System of the experimental room. The work foresees both hardware development (PCB debugging, system cabling, mechanical fixation and so on) and software development. The software used is mainly LabView from NI.

b) Candidate's Profile, competencies and (soft) skills required:

The candidate must have a MSc degree in Physics, Nuclear Engineering, or Electronics Engineering
Technical competence and skills required: Basic knowledge of digital and analog electronics, advanced knowledge of Labview, basic knowledge of the use of scintillating fibers and SiPM, basic knowledge of radiation detection.

Topic 4: Development and test of electronics boards.

a) Training scope:

RF fields and RF power electronics are needed along the CNAO accelerator chain in the injector LINAC and in the synchrotron RF cavity. The subject of this work consists in developing, assembling, and testing electronic and/or RF boards for the various systems of the CNAO accelerator.

b) Candidate's Profile, competencies and (soft) skills required:

The candidate must have a MSc degree in Physics (Electronics) or RF engineering. Technical competence and skills required: Advanced knowledge of digital, analog and RF electronics, advanced knowledge of measurement instrumentation (scopes and so on).

Topic 5: Control system development.

a) Training scope:

The CNAO accelerator control system is mainly an in-house development and is mostly based on the NI architecture and developed with NI Labview. Developments and upgrades are ongoing in many sectors of the accelerator, from the beam diagnostics to the power supply controls to data analysis.

The work will consist in developing parts of the software under the coordination of a CNAO senior developer and in writing the corresponding documentation.

b) Candidate's Profile, competencies and (soft) skills required:

The candidate must have a MSc degree in Physics, Computer Engineering or Electronics Engineering.
Technical competence and skills required: Advanced knowledge of Labview.

Participation

The event is open to designated Member States for RER6039.

Participants' Qualifications and Experience

All candidates have to be designated by an IAEA Member State participating in RER6039.

Applicants should hold a Master's degree in a relevant field related to their chosen training topic, as listed above. The essential soft skills required by all candidates are: Problem-solving mindset, initiative, eagerness to learn, and openness to discussions.

Fellowships are awarded to professionals who have the appropriate academic (university graduates or equivalent), technical (individuals at technician level in the requested field) and language skills in which the training will be conducted, with at least two years of work-related experience.

Application Procedure

Candidates wishing to apply for this fellowship should follow the steps below:

1. Access the InTouch+ home page (<https://intouchplus.iaea.org>) using the candidate's existing Nucleus username and password. If the candidate is not a registered Nucleus user, she/he must create a Nucleus account (<https://websso.iaea.org/IM/UserRegistrationPage.aspx>) before proceeding with the event application process below.
2. On the InTouch + platform, the candidate must:
 - a. Finalize or update her/his personal details, provide sufficient information to establish the required qualifications regarding education, language skills and work experience ('Profile' tab) and upload relevant supporting documents;
 - b. Search for the relevant technical cooperation event (EVT230564) under the 'My Eligible Events' tab, answer the mandatory questions and lastly submit the application to the required authority.
3. Nominations should reach the IAEA through Intouch plus by 30 January 2024.

NOTE: Completed applications need to be approved by the relevant national authority, i.e. the National Liaison Office, and submitted to the IAEA through the established official channels by the provided designation deadline.

For additional support on how to apply for an event, please refer to the [InTouch+ Help page](#). Any issues or queries related to InTouch+ can be addressed to InTouchPlus.Contact-Point@iaea.org.

Should online application submission not be possible, candidates may download the nomination form for the training course from the [IAEA website](#).

NOTE: A medical certificate signed by a registered medical practitioner dated not more than four months prior to starting date of the event must be submitted by candidates when applying for a) events with a duration exceeding one month, and/or b) all candidates over the age of 65 regardless of the event duration.

Administrative and Financial Arrangements

Nominating authorities will be informed in due course of the names of the candidates who have been selected and will at that time be informed of the procedure to be followed with regard to administrative and financial matters.

The selected IAEA fellows are provided with economy-class air tickets for the travel from their home country to the training institution in the host country, and an allowance to cover the fellow's own expenses for accommodation, meals, local transportation and incidentals while being trained.

Disclaimer of Liability

The organizers of the event do not accept liability for the payment of any cost or compensation that may arise from damage to or loss of personal property, or from illness, injury, disability or death of a participant while he/she is travelling to and from or attending the course, and it is clearly understood that each Government, in approving his/her participation, undertakes responsibility for such coverage. Governments would be well advised to take out insurance against these risks.

Note for female participants

Any woman engaged by the IAEA for work or training should notify the IAEA on becoming aware that she is pregnant.

The Board of Governors of the IAEA approved new International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources. The Standards deal specifically with the occupational exposure conditions of female workers by requiring, inter alia, that a female worker should, on becoming aware that she is pregnant, notify her employer in order that her working conditions may be modified, if necessary. This notification shall not be considered a reason to exclude her from work; however, her working conditions, with respect to occupational exposure shall be adapted with a view to ensuring that her embryo or foetus be afforded the same broad level of protection as required for members of the public.

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