Istituto Nazionale di Fisica Nucleare

CONCORSO PER IL CONFERIMENTO

DI N. 5 BORSE DI STUDIO PER ATTIVITA' DI FORMAZIONE SCIENTIFICA

PER STUDENTI UNIVERSITARI

ISTITUTO NAZIONALE DI FISICA NUCLEARE

Bando 22319

Concorso per il conferimento di 5 borse di studio per attività di formazione scientifica per studenti universitari

IL PRESIDENTE

dell'Istituto Nazionale di Fisica Nucleare

- visto il Regolamento concernente il conferimento delle borse di studio, approvato con deliberazioni del Consiglio Direttivo nn. 1963 e 2097, rispettivamente in data 25 gennaio e 9 luglio 1985;

- vista la Deliberazione del Consiglio Direttivo dell'Istituto in data 26 giugno 2020 n. 15530

D I S P O N E

Art. 1

PARTE GENERALE

È indetto un concorso per titoli ed esame colloquio per n. 5 borse di studio a sostegno della formazione scientifica di studenti universitari nel campo della fisica sperimentale dell'INFN durante lo svolgimento della tesi magistrale, su uno dei temi riportati nell'allegato A del bando. Ciascun tema verrà assegnato ad un solo vincitore secondo l'ordine della graduatoria di merito.

Ciascuna borsa avrà la durata di sei mesi con decorrenza **1° febbraio 2021** e non potrà proseguire oltre la data di conseguimento del titolo di laurea magistrale.

Copia del bando di concorso sarà disponibile sui siti web *http://www.ac.infn.it* e *http://www.roma1.infn.it*.

Per informazioni si prega di inviare un e-mail all'indirizzo di posta elettronica prot@roma1.infn.it .

La borsa non è cumulabile con altre borse di studio, né con assegni o sovvenzioni di analoga natura. Non può essere cumulata neppure con stipendi o retribuzioni derivanti da rapporti d'impiego pubblico o privato.

La borsa non è attribuibile a chi abbia già usufruito di borsa INFN della durata complessiva di ventiquattro mesi.

Ove i vincitori del presente concorso abbiano già usufruito di borse INFN per un periodo inferiore a ventiquattro mesi, la nuova borsa attribuita può essere utilizzata fino al compimento del suddetto limite.

Qualora il candidato della borsa di studio sia parente entro il quarto grado ovvero affine entro il secondo grado di un dipendente o associato con incarico di ricerca nella struttura presso la quale è aperta la selezione, deve darne comunicazione scritta prima delle procedure concorsuali.

Art. 2

DURATA E IMPORTO

Le 5 borse di studio per attività di formazione scientifica per studenti universitari hanno durata semestrale e gli assegnatari ne usufruiscono presso la Sezione di Roma dell'INFN.

L'importo mensile di ciascuna borsa è di euro 500,00 al lordo d'imposta su fondi RM1 PFE OV. Tale importo è corrisposto in rate mensili posticipate.

Art. 3

REQUISITI DI AMMISSIONE

Per la partecipazione al concorso è richiesta:

- conseguimento della laurea triennale nel 2019;

- iscrizione al curriculum di Fisica Nucleare e Subnucleare del I° anno della laurea magistrale nell'anno accademico 2019-2020 con una media voti esame non inferiore a 27/30.

I candidati verranno selezionati sulla base di un concorso per titoli ed esame colloquio che valuterà le loro capacità tecnico-scientifiche.

I candidati, inoltre, non devono aver compiuto il 26^{esimo} anno di età alla data di scadenza del termine di presentazione delle domande, stabilito nell'art. 4.

Art. 4

PRESENTAZIONE DELLE DOMANDE, TERMINI E MODALITA'

Le domande di partecipazione al concorso, redatte in carta semplice secondo lo schema unito al presente bando (Allegato n. 1), sottoscritte dagli interessati, devono essere inoltrate a mezzo raccomandata A.R., al Direttore della sezione di Roma dell'INFN – Piazzale Aldo Moro 2, 00185 Roma c/o Dipartimento di Fisica "Guglielmo Marconi" - entro e non oltre **il 15 ottobre 2020, pena esclusione dal concorso.**

Le domande potranno altresì essere inoltrate, entro il predetto termine, per mezzo di Posta Elettronica Certificata Roma@pec.infn.it nel rispetto delle norme vigenti in materia.

Qualora il termine di presentazione delle domande venga a scadere in giorno festivo, si intende protratto al primo giorno non festivo immediatamente seguente.

Le domande di partecipazione inoltrate a **mezzo raccomandata A.R. dovranno pervenire al Direttore della sezione di Roma entro e non oltre il 31 ottobre 2020.**

È prevista l'esclusione dal concorso nel caso in cui la domanda non sia sottoscritta o sia pervenuta oltre il termine del **31 ottobre 2020**.

Resta esclusa qualsiasi diversa forma di presentazione delle domande.

Della data di inoltro delle domande di partecipazione fa fede il timbro a data apposto dagli uffici postali di spedizione o la data di invio della posta certificata.

Nella domanda, possibilmente dattiloscritta, il candidato deve indicare sotto la propria responsabilità:

- cognome e nome;
- luogo e la data di nascita;
- residenza anagrafica;
- codice fiscale
- di essere in possesso della cittadinanza (indicare il paese);
- di non aver riportato condanne penali, precisando, in caso contrario, quali condanne abbia riportato;
- di essere in possesso del titolo di studio richiesto nel presente bando, indicando lo stesso, la data e il luogo di conseguimento;
- i titoli posseduti tra quelli indicati nel successivo art. 5.

Il candidato deve inoltre indicare nella domanda:

- l'indirizzo di posta elettronica al quale desidera che gli siano fatte pervenire le comunicazioni relative al concorso.

Alla domanda devono essere allegati i seguenti documenti:

1. dichiarazione sostitutiva di certificazioni, ai sensi dell'art. 46 del D.P.R. 28.12.2000 n. 445 (allegato n. 2), relativa ai titoli di studio conseguiti, la votazione riportata e la data di conseguimento;

2. estratto degli esami già sostenuti sia nella laurea triennale che in quella magistrale;

3. fotocopia (non autenticata) di un documento di riconoscimento in corso di validità.

E' prevista l'esclusione dal concorso nel caso in cui alla domanda non siano allegati i documenti di cui ai punti 1) e 2) del precedente comma, redatti secondo le modalità indicate.

In alternativa alla dichiarazione di cui al punto 1) è consentito allegare alla domanda una fotocopia del certificato dei titoli di studio, corredata da una dichiarazione sostitutiva di atto di notorietà attestante la conformità della copia all'originale ai sensi dell'art. 47 del D.P.R. 28.12.2000 n. 445 (allegato n. 3).

Inoltre saranno esclusi, i candidati che non allegano la fotocopia (non autenticata) di un documento di riconoscimento in corso di validità alla dichiarazione sostitutiva dell'atto di notorietà.

La domanda, con la documentazione allegata, deve essere inserita in un unico plico. L'involucro esterno deve recare l'indicazione del nome, cognome e indirizzo del candidato e numero del concorso cui partecipa.

Non si tiene conto delle domande, dei titoli e dei documenti inoltrati all'INFN oltre il termine del *15 ottobre 2020*, né è infine consentito, scaduto il termine stesso, di sostituire i titoli e i documenti già presentati.

Art. 5

COMMISSIONE ESAMINATRICE, PUNTEGGI E TITOLI

La Commissione esaminatrice, nominata dal Presidente dell'INFN dispone complessivamente di 100 punti di cui:

- 30 punti per i titoli;

- 70 punti per l'esame colloquio.

La commissione stabilisce i criteri per la valutazione dei titoli, prima di aver preso visione degli stessi e della relativa documentazione.

I titoli valutabili sono il voto di laurea triennale, la media delle votazioni riportate negli esami relativi al corso di Laurea Triennale, il numero di esami e la media delle votazioni riportate nel corso di Laurea Magistrale (quali risultanti dal certificato di cui al punto 2 dell'art. 4).

Art. 6

EMERGENZA EPIDEMIOLOGICA DA COVID-19

Qualora le misure in materia di contenimento e gestione dell'emergenza epidemiologica da COVID-19 dovessero perdurare, tutte le riunioni della Commissione Esaminatrice e la valutazione per i titoli possono essere svolte, per tutti o alcuni dei componenti della commissione, in modalità telematica, nel rispetto dei principi previsti dall'articolo 247, comma 7 del d.l. 34/2020, e nel caso di esame colloquio, quest'ultimo può svolgersi anche in videoconferenza, per tutti o alcuni dei componenti della commissione e dei candidati, non necessariamente presso le Strutture INFN indicate nel bando, con le modalità di cui all'articolo 247, comma 3 del d.l. 34/2020.

Art. 7

GRADUATORIA

Sono inclusi nella graduatoria, secondo l'ordine della votazione a ciascuno attribuita, soltanto i candidati che abbiano raggiunto un punteggio non inferiore a 70 punti su 100.

A parità di votazione complessiva ha la precedenza in graduatoria nell'ordine:

- Il candidato con il voto di laurea triennale più elevato
- Il candidato con la media più alta nella Triennale
- Il candidato più giovane.

La Commissione deve concludere i lavori entro tre mesi dalla data di nomina, salvo motivato impedimento.

Art. 8

APPROVAZIONE DELLA GRADUATORIA

Risultano vincitori i candidati che sono compresi, entro il numero delle borse messe a concorso, nella graduatoria di cui all'art. 7.

La graduatoria è approvata con deliberazione della Giunta Esecutiva dell'Istituto.

L'INFN notifica a ciascun candidato l'esito del concorso.

I risultati del concorso saranno altresì pubblicati sul sito web della sezione di Roma http://www.roma1.infn.it

Art. 9

CONFERIMENTO DELLA BORSA, UTILIZZAZIONE DELLA GRADUATORIA

Le borse di studio sono conferite con disposizione del Presidente dell'INFN.

Nel termine perentorio di quindici giorni dalla data di ricevimento della lettera con la quale l'INFN dà comunicazione del conferimento della borsa, l'assegnatario deve far pervenire la dichiarazione di accettazione della borsa alle condizioni indicate o l'eventuale rinuncia.

Contestualmente indicherà 5 tra i temi dell'allegato A in ordine di preferenza. Con detta dichiarazione l'assegnatario deve dare esplicita assicurazione, sotto la propria responsabilità che, durante tutto il periodo di durata della borsa INFN, non usufruirà di altre borse di studio, né di analoghi assegni o sovvenzioni, né riceverà stipendi o retribuzioni derivanti da rapporti d'impiego pubblico o privato.

La borsa che resti disponibile per rinuncia o decadenza del vincitore o per altro motivo, può essere assegnata - entro il termine di un mese dalla data di approvazione della graduatoria - con disposizione del Presidente dell'INFN al candidato risultato idoneo e immediatamente successivo secondo l'ordine della graduatoria stessa.

Art. 10

DECORRENZA DELLA BORSA, OBBLIGHI DEL BORSISTA

La data di decorrenza delle singole borse è stabilita insindacabilmente dall'INFN all'atto del conferimento.

L'attività dell'assegnatario è svolta sotto la guida e direzione del relatore della tesi assegnata (vedi Allegato A).

Il borsista ha l'obbligo:

- di iniziare alla data di cui al precedente comma presso la sede della sezione di Roma;
- di continuare regolarmente ed ininterrottamente la propria attività per l'intero periodo di durata della borsa.

Possono essere giustificati ritardi ed interruzioni nello svolgimento dell'attività solo se dovuti a maternità, congedo parentale, gravi motivi di salute o a causa di forza maggiore, debitamente comprovati e autorizzati dal Direttore della Sezione di Roma. In questi casi la borsa si considera sospesa e la durata prorogata per un tempo pari all'interruzione concessa.

Al termine del periodo di godimento della borsa, il borsista deve trasmettere al Direttore della Sezione di Roma una relazione sull'attività svolta e, al conseguimento della Laurea Magistrale, copia della tesi svolta.

Art. 11

TRATTAMENTO DEI DATI PERSONALI

In conformità a quanto disposto dall'art. 13 del Regolamento UE 2016/679, i dati personali richiesti saranno raccolti e trattati, anche con l'uso di strumenti informatici, esclusivamente per la gestione delle attività concorsuali e nel rispetto della disciplina legislativa e regolamentare dettata per lo svolgimento di tali attività.

Il conferimento dei dati è necessario per valutare i requisiti di partecipazione ed il possesso dei titoli e la loro mancata indicazione può precludere tale valutazione.

I dati sono conservati per il periodo necessario all'espletamento della procedura selettiva e successivamente trattenuti ai soli fini di archiviazione.

L'INFN garantisce ad ogni interessato l'accesso ai dati personali che lo riguardano, nonché la rettifica la cancellazione e la limitazione degli stessi ed il diritto di opporsi al loro trattamento; garantisce altresì il diritto di proporre reclamo all'Autorità Garante del Trattamento dei dati personali circa il trattamento effettuato.

Titolare del Trattamento: Istituto Nazionale di Fisica Nucleare: email: presidenza@presid.infn.it

Responsabile della Protezione dei Dati: email: dpo@infn.it

Roma, 20 luglio 2020

ISTITUTO NAZIONALE DI FISICA NUCLEARE
Il PRESIDENTE
(Prof. Antonio Zoccoli)[1]

SF/VC/ADV

[1] Documento informatico firmato digitalmente ai sensi della legge 241/90 art. 15 c 2, del testo unico D.P.R. 28 dicembre 2000, n. 445, del D.Lgs. 7 marzo 2005, n. 82, e norme collegate, il quale sostituisce il testo cartaceo e la firma autografa

ATLAS
Proponente: Stefano Giagu
Titolo tesi: Development and study of the performances of novel algorithms on FPGAs for muon reconstruction and identification in the ATLAS L0 Muon Barrel Trigger
Descrizione: The Level-0 muon trigger system of the ATLAS experiment will undergo a full upgrade for the High Luminosity LHC to stand the challenging requirements imposed by the increase in instantaneous luminosity. The upgraded trigger system will send raw hit data to off-detector processors, where trigger algorithms run on a new generation of FPGAs. To exploit the flexibility provided by the FPGA systems, ATLAS is developing novel algorithms based on both conventional methods and new deep neural network architectures that use quantised weights and activations, optimised to run on FPGAs for efficient reconstruction and identification of muons in the ATLAS "Level-0" trigger. The FPGA represents an optimal solution in this context, because of its flexibility, wide availability of logical resources and high processing speed. In this context the student will work within the ATLAS L0 Muon Barrel trigger group, in the design and deployment of novel fast trigger algorithms based on state-of-the-art machine learning algorithms. The thesis work will include algorithm development and implementation and evaluation of physics performance in terms of efficiency and fake rates and FPGA logic resource occupancy and timing.

ATLAS
Proponenti: Cesare Bini, Francesco Lacava, Stefano Rosati
Titolo tesi: Muon reconstruction with the ATLAS experiment during the next LHC run.
Descrizione: Muon identification and reconstruction is fundamental for a significant part of the LHC physics programme, from probing new physics beyond the Standard Model to precision measurements of the Higgs boson properties. In order to cope with the increasing luminosities and background levels during the coming runs of LHC starting in 2021, the ATLAS Muon Spectrometer will include new detectors. Among those are the MicroMegas, built, installed and commissioned by a collaboration including the ATLAS-Rome group. The chambers are now integrated and continuosly tested. Moreover new algorithms based on machine learning are being developed to fully exploit the potential of the new detectors for pattern recognition and background rejection.The tests and these algorithms will be the topic of the thesis work.

ATLAS
Proponente:Simonetta Gentile
Titolo tesi: Measurement of the top Yukawa coupling through the study of the associated production of the Higgs boson with a top and anti-top quark pair.
Descrizione: Using proton-proton 13 TeV collision up to 79.8/fb collected during 2015-2017, the ATLAS Collaboration has observed the production of the Higgs boson with a top-quark pair (“ttH” production). This result establishes a direct measurement of the interaction between the top quark and the Higgs boson, the top quark Yukawa coupling, and is one of the most sensitive tests of the Higgs mechanism, supporting the Standard Model mechanism whereby the top quark obtains its mass through interaction with the Higgs field. The observed (expected) significance of the signal over the background is 5.8 (4.9) standard deviations. The measured cross section of 670±90(stat.)+110−100(syst.) fb is slightly larger than, but consistent with the Standard Model expectation (507+35–50 fb). The aim of this project is to contribute to the measurement of the top Yukawa coupling using the 140/fb of 13TeV data collected by ATLAS during 2015-2018, by studying the ttH production in the final state with two light leptons of the same sign and a tau which decays into hadrons. Machine learning techniques will be used to improve the signal selection over the background and to increase the sensitivity of this channel, fully exploiting the information derived from many signal-background discriminating variables.

CMS
Proponente: Paolo Meridiani, Emanuele Di Marco
Titolo tesi: Anomalous Higgs Couplings
Descrizione: The ‘golden channel’ of the Higgs decay, H→ZZ→4 leptons, allows the measurement of the Higgs coupling to neutral electroweak gauge bosons thanks to the fully reconstructable final state and very high purity. By using a maximum likelihood method, the Higgs coupling parameters of the Lagrangian can be directly extracted from the data, to search for possible anomalous couplings. This method can be applied to different Higgs production modes (gluon fusion, VBF, tt+Higgs) and extended to other decays (WW or γγ).

CMS
Proponente: Shahram Rahatlou, Chiara Rovelli
Titolo tesi: New Physics Searches in B-Physics

Descrizione: The precise measurement of rare processes is a way to indirectly probe the existence of physics beyond the Standard Model. Recent measurements of observables involving the flavour changing neutral current transition b→s have shown tensions with respect to the predictions. It is crucial to analyze more data to confirm these anomalies or disprove them. The CMS experiment in the past year collected a huge amount of data exploiting the novel data-parking technique, which can help shed light on this topic and allow to investigate other rare B-mesons decays.

CMS
Proponente: Francesco Santanastasio, Livia Soffi
Titolo tesi: MTD Timing Detector And Long-Lived particles
Descrizione: For the High Luminosity phase of LHC, CMS will build a novel timing detector, the MTD, for charged particles with a resolution of 30 ps: a very challenging task. Time information from the MTD will be combined with the data from the CMS inner tracker to perform, for the very first time at colliders, a 4-dimensional event reconstruction. Novel and innovative machine learning algorithms will be exploited. The optimization of the final sensors, LYSO:Ce scintillating crystals readout by SiPMs, will involve: crystals characterization, study of optical cross-talk and tests of crystal radiation resistance. The precise time information for the future timing detector can be used to detect signals of new long-lived particles decaying to photons, leptons or jets. These unusual particles, could leave a distinctive signature in CMS detector and represent a unique opportunity to discover new physics at LHC.

LHCb
Proponente: Alessio Sarti, Roberta Santacesaria
Titolo tesi: Search at LHCb for anomalies in decays containing loops (es: b -> s ll transitions).
Descrizione: The student will join the group involved in LHCb experiment at CERN whose main aim is the study of B Physics at LHC. One of the most relevant ongoing analysis is the study of the anomalies in loop transitions. We propose the exploitation of the large sample of barion to study such anomalies in and decays. Such measurement plays a crucial role in the landscape of New Physics searches as it will provide an information that is complementary to what has been measured so far using the B mesons.

LHCb
Proponente: Roberta Santacesaria, Davide Pinci
Titolo tesi: Exotic charm decays in LHCb
Descrizione: LHCb is one of the main experiments that are collecting data at the LHC with the aim of studying the b quark hadrons properties. The first observed exotic charmed state was the X(3872) (firstly observed by Belle in 2003 and afterwards detected by BaBar, CDF, D0 and LHCb). The X(3872) resonance was assumed, firstly, to be a ccbar excited state. Nowadays, the two hypothesis that are being explored are a D-Dbar bound state or a 4-quark state. However, a full theoretical understanding of the real nature of such state is still missing. LHCb is the best experiment where to perform such studies as such resonances are produced in the b-quark hadrons decays. The student will join the LHCb group, have access to the data sample already collected and join and contribute to the data analysis effort.

LHCb
Proponente: Alessio Sarti, Davide Pinci
Titolo tesi: Search at LHCb for anomalies in tree-level decays (es: b -> c lν).
Descrizione: The student will join the group involved in LHCb experiment at CERN whose main aim is the study of B Physics at LHC. The precise measurement of decay width of B mesons tree-level decays (e.g. the b -> c lν transition) is becoming more and more interesting in the context of the anomalies measurement performed in the search of New Physics at the LHC. The student will exploit the large data sample of semileptonic Bs decays available in LHCb (e.g. and) providing a measurement that could be used, for the first time, to cross check the current results obtained studying the Bd decays.

MEG-II
Proponente: Cecilia Voena
Titolo tesi: Machine learning based algorithm for track finding for the MEG I experiment
Descrizione: The MEG-II experiment is in the commissioning phase at the Paul Scherrer Institut in Villigen (Zurich). The experiment searches for New Physics in the muon decay into a positron and a photon which is forbidden in the Standard Model. The very high muon rate causes a high occupancy in the tracking detector that makes track finding difficult with standard algorithms. Theses on machine learning based track finding algorithms are available.

MEG-II
Proponente: Francesco Renga
Titolo tesi: Searches for New Physics in the mu->egamma decay
Descrizione: The MEG-II experiment is in the commissioning phase at the Paul Scherrer Institut in Villigen (Zurich). The experiment searches for New Physics in the muon decay into a positron and a photon which is forbidden in the Standard Model. Theses on detector calibrations, simulations and data analysis, in particular on the drift chamber, are available.

MEG-II
Proponente: Francesco Renga
Titolo tesi: Search for New Physics in nuclear transitions in the MEG-II experiment
Descrizione: The MEG-II experiment is in the commissioning phase at the Paul Scherrer Institut in Villigen (Zurich). The experiment searches for New Physics in the muon decay into a positron and a photon which is forbidden in the Standard Model. It is also possible to search for New Physics in nuclear transitions generated by a Cockroft-Walton accelerator, normally used for the MEG-II detector calibrations. Theses on measurement set-up, simulation and data analysis on this topic are available.

AMS
Proponente: Alessandro Bartoloni
Titolo tesi: Strategy for preventing radiobiological effects in space. Keyword:SpaceRadiation, AMS02, ISS, Radiobiology. Collaborating Institute:Fisica Sanitaria Policlinico S.Orsola-Malpighi ,Bologna.
Descrizione: The Alpha Magnetic Spectrometer (AMS) is the most powerful and sensitive cosmic-ray detector ever deployed in space to produce a complete inventory of charged particles and nuclei in cosmic rays near Earth in the rigidity (momentum/charge) range from GV to few TVs. Its physics goals are the study of cosmic-ray properties and space radiation environment, indirect search for Dark Matter and direct searches for primordial antimatter, exotic form of matter. To the light of the AMS02 measurements of charged particle in space the student will study possible models for predicting the radiation induced risk for astronauts and identifying possible strategies for its mitigation.

AMS
Proponente: Alessandro Bartoloni
Titolo tesi:Lunar Gateway Applications for Space Radiobiology.Keyword:ARTEMIS project , Space Radiation, AMS02, Radiobiology Collaborating Institute: Fisica Sanitaria Policlinico S.Orsola-Malpighi ,Bologna.
Descrizione: The Alpha Magnetic Spectrometer (AMS) is the most powerful and sensitive cosmic-ray detector ever deployed in space to produce a complete inventory of charged particles and nuclei in cosmic rays near Earth in the rigidity (momentum/charge) range from GV to few TVs. Its physics goals are the study of cosmic-ray properties and space radiation environment, indirect search for Dark Matter and direct searches for primordial antimatter, exotic form of matter. . The student will investigate possible space radiation applications to be proposed for the Lunar Gateway infrastructure. The Lunar Gateway is an in-development space station, intended to serve also as science laboratory and one of the main spacecraft of the ARTEMIS spaceflight program agenda.

AMS
Proponente: Alessandro Bartoloni
Titolo tesi:AMS02 Charged Particle characterization for Space Radiobioloy investigations. Keyword:Cosmic Rays, Space Radiation, AMS02, Radiobiology.Collaborating Institute: CERN – Ginevra.
Descrizione: The Alpha Magnetic Spectrometer (AMS) is the most powerful and sensitive cosmic-ray detector ever deployed in space to produce a complete inventory of charged particles and nuclei in cosmic rays near Earth in the rigidity (momentum/charge) range from GV to few TVs. Its physics goals are the study of cosmic-ray properties and space radiation environment, indirect search for Dark Matter and direct searches for primordial antimatter, exotic form of matter. The student will investigate the potentiality of AMS02 measurements in the field of space radiobiology.

ANTARES
Proponenti: Antonio Capone, Angela Zegarelli, Silvia Celli, Irene Di Palma
Titolo tesi: Evaluation of high energy neutrino fluxes from astrophysical transient gamma, GW, HECR sources: a multimessenger approach
Descrizione: The proposed activity is based on neutrino and gamma emission models for transient astrophysical sources. These models suggest that photon and neutrino fluxes are correlated by astrophysical parameters. The search for high energy astrophysical neutrinos from point like sources is limited by the intense background due to atmospheric neutrinos. Experiments like FERMI have observed several flaring gamma sources, i.e. characterized by short periods of very intense gamma emission. Neutrino are expected also from sources that could origin gravitational waves or very high energy Cosmic Rays. With the proposed work we plan to

characterize these sources of gamma flares, gravitational waves, high energy cosmic rays (using published catalogues of ongoing experiments like FERMI, MAGIC, VERITAS, HAWK, LHAASO, CTA, AUGER, TA, LIGO/VIRGO) and then to proceed to estimate the expected neutrino fluxes in a period of time corresponding to the high intensity state of the source. These fluxes will allow to evaluate the number of events expected in current actual and future high energy Neutrino Telescopes (IceCube, ANTARES, KM3NeT). Neutrino oscillations will be taken into account to estimate the ratio of flavours that will be measured on Earth.

ANTARES
Proponenti: Antonio Capone, Giulia De Bonis
Titolo tesi: Estimate of the neutrino-nucleon cross section at very high energy (100GeV- 1 PeV)
Descrizione: The neutrino-nucleon interaction cross-section at low energy (energy ~ GeV) is so low (~10-38 cm2/nucleon) that the Earth is easily crossed, along a diameter, by such neutrinos. This cross section increases with the energy, ~linearly up to 300-400 GeV then less rapidly for higher energies. The neutrino-nucleon cross section in the "linear" region has been measured at accelerators; for higher energies, it can be only estimated. Atmospheric neutrinos, in first approximation isotropically distributed, offer the possibility to estimate the neutrino-nucleon cross section up to several PeV. Neutrino telescopes, like ANTARES and KM3NeT, Aassuming a standard model for the description of the Earth inner material (the PREM, Preliminary Reference Earth ModelEarth Standard Model), neutrino telescopes like ANTARES and KM3NeT can estimate the neutrino interaction probability in the Earth, comparing the flux of atmospheric neutrinos (at a given energy) as a function of the zenith angle. This research iscomplementary to the promising activity of Neutrino Tomography of the Earth, i.e. to infer the Earth model from assumptions on neutrino-nucleon cross-section. ANTARES data will allow to start this study, KM3NeT data will permit a better definition of the neutrino-nucleon cross section at ~PeV.

ANTARES
Proponenti: Antonio Capone, Paolo Fermani
Titolo tesi: Indirect search for Dark Matter with neutrino telescopes
Descrizione: One of the main goals for neutrino telescopes is the search for neutrinos deriving from Dark Matter annihilation in astrophysical bodies such as the Sun, the Galactic Centre etc. These neutrinos have to be revealed distinguishing them fromin the much abundanthigher background of atmospheric neutrinos produced by the interactions of the Cosmic Rays in the Earth atmosphere. Analysing the KM3NeT data and considering the most accredited Dark Matter models, one can set-up a simulation of Dark Matter neutrino fluxes coming from a specific source and evaluate the sensitivity of the KM3NeT detector to these supposed fluxes. Given the largebig size of the KM3NeT detector, the limits will be competitive with others experiments like IceCube.

ARCHIMEDES
Proponente: Paola Puppo
Titolo tesi : Thermal Modulation of a high Tc superconductor using the radiative exchange for the Archimedes experiment.
Descrizione: The Archimedes project aims to measure the interaction between the electromagnetic vacuum fluctuations and the gravitational field. The experiment can shed light on some question marks still open in cosmology like the dark energy nature. A very sensitive balance has been constructed to weight the vacuum e.m. field energy induced in a multi-Casimir cavity system by temperature modulation techniques. The system is a high TC superconductor like the YBCo material having multilayered structure useful for this purpose. In this thesis, the themperature modulation system will be tested on an YBCo sample. A small scale experimental device has been designed and located in the Archimedes laboratory of the Physics department. Techniques on cryogenics, superconductors and data analysis on thermal behavior will be used.

BULLKID
Proponenti: Marco Vignati, Angelo Cruciani
Titolo tesi: Superconducting detectors for neutrino and Dark Matter search
Descrizione: Low energy events such as Dark Matter interactions and the neutrino-nucleus coherent scattering need high-sensitivity detectors, often operating at low temperatures. This thesis consists in the development of detectors based on cryogenic resonators exploiting the kinetic inductance of superconductors. These detectors, called KIDs (Kinetic Inductance Detectors), are at the forefront in astro, cosmo and particle physics and could represent the technology of upcoming experiments. The activity foresees the design, operation and data analysis of the detectors in the Laboratory of Cryogenic Detectors of the Physics Department.

CUORE-CUPID
Proponenti: Fabio Bellini, Claudia Tomei
Titolo tesi: Search for Lepton Number Violation with CUORE/CUPID at Gran Sasso National Laboratories (LNGS)

Descrizione: The goal of CUORE and CUPID is the search for neutrino-less double beta decay: a rare, not yet observed decay, whose discovery would establish the Majorana nature of neutrino and be the first experimental proof of lepton number violation. The CUORE experiment has been taking data since January 2017 at LNGS, and consists of an array of 988 Tellurium-dioxide cryogenic bolometers. CUPID is a project for a next-generation experiment, using scintillating cryogenic bolometers to enhance the sensitivity to double beta decay. The candidate will participate to data analysis for CUORE and CUPID, the construction of a background model as well as hardware and software activities towards the future project CUPID.

CUORE-CUPID
Proponenti: Fabio Bellini, Laura Cardani
Titolo tesi: Development of cryogenic calorimeters for the CUPID experiment
Descrizione: CUPID is a proposed next-generation experiment searching for neutrinoless double beta decay and other rare processes beyond the Standard Model of Particle Physics. Its detector will be operated in the same cryogenic of the CUORE experiment, that allows to cool one ton of calorimeters at 10 mK and more than 10 tons of copper and lead shields at cryogenic temperatures. Today the collaboration is defining the last details of the baseline design of the CUPID detector, optimising the performance of its single modules. The candidate will participate to the experimental activities by designing, assembling and operating novel cryogenic calorimeters to optimise the performance of the CUPID detectors.

CYGNO
Proponente: Gianluca Cavoto
Titolo tesi: Radioactive Background simulation of gas TPC directional dark matter detectors
Descrizione: The CYGNO project aims to detect few GeV mass dark matter being sensitive to its direction. It develops a time projection chamber gas detector whose radioactive background must be assessed. A study with a simulation based on Geant4 will be performed by using advanced technique of Machine Learning for image processing.

CYGNO
Proponente: Davide Pinci
Titolo: Time projection chamber with optical readout for directional searches of dark matter
Descrizione: The CYGNO project aims to study galactic dark matter with few GeV mass. The construction of 1m3 time projection chamber with GEM-based amplification and optical readout with a high resolution low noise CMOS camera is on going. Smaller scale prototypes data-taking with new prototypes are foreseen. Data analysis will use advanced technique of Machine Learning for image processing.

DARKSIDE
Proponente: Andrea Messina
Titolo tesi: Development of the trigger and data acquisition systems for the 1 Ton DarkSide prototype at CERN
Descrizione: The student will join the team constructing and running at CERN the series of prototypes of increasing size up to the ton-scale detector that will fully validate the Darkside-20k concept, in particular developing the trigger and DAQ systems requiring sophisticated digital signal processing for optimal reconstruction of the tiny scintillation and ionization signals in the Dark Matter energy range. Application of online machine learning algorithms is possible.

DARKSIDE
Proponente: Sandro De Cecco
Titolo tesi: Design and construction of the DarkSide-20k ton-scale prototype Time Projection Chamber at CERN
Descrizione: The student will join the team constructing and running at CERN the series of prototypes of increasing size up to the ton-scale detector that will fully validate the Darkside-20k Time Projection Chamber design concept and performances. He or she will participate to the finalisation of the design, to the simulation, and to the R&D for the construction and assembly procedures of the new design TPC acrylic vacuum vessel core structure. The work will also include detector performance analysis on the first data recorded with the ton-scale liquid argon TPC prototype once assembled at CERN Cryo-lab.

DARKSIDE
Proponente: Valerio Ippolito
Titolo tesi: Reconstruction of scintillation and ionization signals with the 1 Ton prototype of Darkside-20k, and characterization of the performance of a Liquid Argon TPC with novel SiPM photosensors Descrizione
Descrizione: The student will join the team constructing and running at CERN the series of prototypes of increasing size up to the ton-scale detector that will fully validate the Darkside-20k concept, participating to the design and implementation of the algorithms for the online and offline reconstruction of the scintillation and

ionization signals. New machine learning algorithms for the spatial reconstruction and the nuclear/electron recoil discrimination will be developed and compared to the standard ones.

DEMETRA
Proponenti: Laura Cardani, Giulia D'Imperio
Titolo tesi: Study of the effects of radioactivity on superconducting qubits
Descrizione: Superconducting circuits are emerging as leading candidates for qubits as they offer fast gate times and high fidelity, and because of their simple design and fabrication. It was recently proved that these devices are sensitive to the energy deposits due to cosmic rays and to the radioactive decay of the contaminants naturally present in the laboratory. Radioactivity will ultimately prevent the achievement of long coherence times, and limit the potential of quantum error correction. The candidate will develop a GEANT4 simulation to model the energy deposits due to radioactivity in qubits to determine their impact on the performance of the device. He/she will determine the improvement that can be obtained by heavily shielding the facility or by moving the set-up in a deep underground laboratory.

ET
Proponente: Piero Rapagnani
Titolo tesi: Development of cooling systems for cryogenic gravitational wave interferometer
Descrizione: This project aims at developing powerful data analysis techniques able to detect the long duration gravitational waves emitted by compact objects in binary systems or by newly born neutron stars and at their application to the data produced by Virgo and LIGO detectors

ET
Proponente: Piero Rapagnani
Titolo tesi: Systems to suspend and control the detection mirrors of gravitational wave interferometers of new generation.
Descrizione: The goal of the new generation of gravitational wave interferometers is to reach a sensitvity improved by at least a factor ten with respect to the present ones. This thesis work shall deal with the development of new control and suspension systems with performances to meet this experimental challenge.

ET
Proponente: Piero Rapagnani
Titolo tesi: Development of non linear strategies for noise optimization in gravitational wave interferometers of new generation
Descrizione: The laser power circulating in the new generation of gravitational wave interferometers will be greater by a factor ten than today, with a corresponding increase of the associated noises. This thesis will deal with special measurement and filter strategies that are being developed to avoid these effects and reach the goal sensitivity.

KM3NeT
Proponenti: Irene Di Palma, Antonio Capone
Titolo tesi: The acoustic sounds of whales
Descrizione: The proposed project is based on the analysis of acoustic data from a submarine infrastructure at the port of Catania. In particular, sound data relayed by an underwater cable from microphones, or more accurately, hydrophones, placed on the Mediterranean Sea floor 28 km offshore will be analysed to study the largely unknown acoustic environment of the deep sea. In fact, it will be possible to measure not only the whale populations by determining each detected animal's size, speed and direction but also the level of sound pollution as potential cause of stranding for many deep-diving whales.

NA62
Proponenti: Mauro Raggi, Ottorino Frezza
Titolo tesi: NA62 L0 trigger processor upgrade
Descrizione: In view of the the CERN RUN III starting in 2021, the NA62 experiment is upgrading his FPGA based L0 trigger processor board. The system is based on modern fast FPGA technology. The candidate will be involved in the FPGA programming in both VHDL and with modern high level systesis languages, as well as on the hardware tests.

NUCLEUS
Proponenti: Marco Vignati, Nicola Casali
Titolo tesi: Calibration of the neutrino coherent scattering with NUCLEUS
Descrizione: The coherent elastic scattering of neutrinos off nuclei was first observed in 2017. The aim of the NUCLEUS experiment is to explore this process in 2020-22 at the CHOOZ nuclear reactor plant in France using cryogenic detectors able to work with unprecedented low energy threshold. This breakthrough enables a rich

physics program to study the fundamental properties of neutrinos, their interactions, to perform precision tests of the electroweak theory and much more. The precision of the measurement depends on the knowledge of the energy released in the scattering, which is difficult to estimate.The thesis job will focus on the invention, realisation and operation of an experimental setup to calibrate the cryogenic detectors of NUCLEUS.

NUCLEUS
Proponenti: Marco Vignati, Fabio Cappella
Titolo tesi: Background study of the neutrino coherent scattering with NUCLEUS
Descrizione: The coherent elastic scattering of neutrinos off nuclei was first observed in 2017. The aim of the NUCLEUS experiment is to explore this process in 2020-22 at the CHOOZ nuclear reactor plant in France using cryogenic detectors able to work with unprecedented low energy threshold. This breakthrough enables a rich physics program to study the fundamental properties of neutrinos, their interactions, to perform precision tests of the electroweak theory and much more. The reachable sensitivity of NUCLEUS will depend on the achievable background level, which is induced by cosmic rays and by environmental radioactivity of the experimental site and of the setup components. The thesis job will focus on the study, by means of Montecarlo simulations and measurements, of experimental configurations to minimize the background level expected for the experiment.

PADME
Proponente: Mauro Raggi, Paolo Valente
Titolo tesi: Searching for multilepton final states in e+e- collisions at PADME
Descrizione: Annihilation of positrons producing several e+e- pair are rare processes in QED. At present no measurements of these process exit a energy below few GeV. The existence of dark sector particle like dark photons decaying in e+e- final state can significantly enhance the SM rate for these processes. Study of these kind of final state in the alredy acquired and future PADME data set will allow to measure SM rate and to search for dark sector particle.

PTOLEMY
Proponente: Gianluca Cavoto
Titolo tesi: Innovative electromagnetic filter for the cosmological neutrino detection
Descrizione: The cosmological neutrino background emerges from an epoch very close to the Big Bang. It might be detected with tritium-doped graphene targets and requires the identification of electrons of about 18 keV. The PTOLEMY collaboration is designing an innovative electromagnetic filter for electrons (in collaboration with Princeton Univ. and INFN Laboratori Naz. Del Gran Sasso).

PTOLEMY
Proponente: Gianluca Cavoto
Titolo tesi: Cryo-antenna for radio-frequency detection
Descrizione: The cosmological neutrino background emerges from an epoch very close to the Big Bang. It might be detected with tritium-doped graphene targets and requires the identification of electrons of about 18 keV. The PTOLEMY collaboration is designing and testing at the INFN Laboratori Naz. Del Gran Sasso a special antenna to detect the cyclotron radiation emitted by the 18 keV electron in a magnetic field.

PTOLEMY
Proponente: Gianluca Cavoto
Titolo tesi : Development of new light dark matter detector based on carbon nanotubes
Descrizione: The directional search for dark matter in the mass range from few MeV to few 100 MeV requires very innovative detectors. Within the PTOLEMY collaboration a device based on a target of carbon nanotubes is under study.

ReD
Proponente: Marco Rescigno
Titolo tesi: Nuclear recoil calibration in the keVnr energy region in a Liquid Argon TPC for the search of light dark matter candidates using Darkside-50 data.
Descrizione: Design and hands-on setup of a new segmented neutron detector aimed at improving low energy nuclear calibration sensitivity of the ReD experiment at the Laboratori Nazionali del Sud in Catania (LNS). The student will be participating to the data analysis and to the measurement campaigns at LNS and elsewhere using a small liquid argon TPC and neutron detectors.

VIRGO
Proponente: Pia Astone, Paola Leaci, Cristiano Palomba
Titolo tesi: Searching for continuous gravitational waves from compact objects
Descrizione: Continuous gravitational-Waves (CWs) are among the highest priority sources searched for by the LIGO-Virgo community. Such signals are emitted by compact objects, such as neutron stars or black holes, and

have a key role in the comprehension of the Universe. We propose a project aimed at developing powerful data-analysis techniques, which are able to detect CWs and can be applied to the data produced by the LIGO-Virgo detectors.

VIRGO
Proponente: Pia Astone, Paola Leaci, Cristiano Palomba
Titolo tesi: Search for long-transients gravitational waves in the data of Virgo and LIGO detectors
Descrizione: This project aims at developing powerful data analysis techniques able to detect the long duration gravitational waves emitted by compact objects in binary systems or by newly born neutron stars and at their application to the data produced by Virgo and LIGO detectors.

VIRGO
Proponente: Francesco Pannarale
Titolo tesi: Enabling gravitational-wave and gamma-ray-burst joint detections
Descrizione: The coincident detection of gravitational waves and a gamma-ray burst from the same neutron star merger is one of the events with highest impact on fundamental physics, high-energy astrophysics, and cosmology. The student will contribute to designing and implementing a new search to achieve such joint detections, with particular focus on gravitational waves in coincidence with "sub-threshold" gamma-ray-bursts. She/he will directly participate to the analysis of LIGO-Virgo data.

JLab12
Proponente: Guido Maria Urciuoli
Titolo tesi: Identifying correlations and relativistic effects in the nuclear medium
Descrizione: The thesis analyzes the data collected during the experiment E06-007 performed at the laboratory JLab, located at Newport News, Virginia (USA). Its goal is the measurement of the ^{208}Pb(e,e'p)^{207}Tl cross section at quasi-elastic kinematics at relatively high missing momentum in order to understand the role of short and long range correlations and of dynamical relativistic effects in determining nuclear medium properties.

JLab12
Proponente: Evaristo Cisbani
Titolo tesi: Commissioning of the front GEM tracker for high luminosity experiment at JLab.
Descrizione: The National Jefferson Laboratory (JLab) in Virginia/USA offers a unique, high intensity, multi GeV polarized electron beam facility to carry on (sub-)nuclear physics by electron-nucleon/nucleous high luminosity scattering experiments. The thesis will focus on the commissioning of a new charged particle tracker based on the Gas Electron Multiplier (GEM) technology that will be used for the experimental investigation of inner structure of the nucleon (protons and neutrons). The student shall familiarize with the tracker hardware, its data acquisition and analysis frameworks. The thesis activity may require few weeks at JLab for the participation to the GEM installation and test measurements.

EIC-NET
Proponente: Evaristo Cisbani
Titolo tesi: Development of a dual radiator RICH for hadron identification in EIC
Descrizione: The Electron-Ion Collider (EIC) is a USA based project that will offer unprecedented opportunities to study the poorly interpretable QCD: one key, challenging, aspect of the experimental apparatus will be the identification of the hadrons in the final state of the multi GeV electron-ion scattering processes. The dual radiator Ring Imaging Cherenkov is one of the most demanding detector in sub-nuclear physics experiments and its design and construction require extended research and development. The thesis activity can span detailed simulations combined with an original optimization method based on Bayesian inference, construction of a small-scale prototype and its data taking and analysis.

FOOT
Proponente: Giacomo Traini
Titolo tesi: Studies of nuclear fragmentation induced in graphite and polyethylene targets by ion beams used in particle therapy (He, C, O)
Titolo tesi: The student will be joining the ARPG (http://arpg-serv.ing2.uniroma1.it/arpg-site/) group in the framework of the FOOT (FragmentatiOn Of Target) collaboration to measure the fragmentation induced in the principal constituents of the human body (C, O, H) by hadron-therapy ion beams (protons, ^{12}C, ^{4}He,^{16}O). The foreseen activity might imply either the preliminary measurements needed to characterize the response of some detectors of the full FOOT apparatus (now under construction) or the software developments that are needed to perform the simulation studies and/or the data analysis. An experimental campaign at the CNAO centre might take place in late 2020: that would represent an optimal opportunity for the student to understand the operation and integration of several key sub-detectors of the FOOT apparatus that are already operational and the relative data collection and analysis.

LUNA3
Proponente: Carlo Gustavino
Titolo tesi: Mesurements of nuclear cross sections of astrophysical interest at LUNA
Descrizione: The LUNA400 accelerator is a unique facility, operating deep underground at the “Laboratori Nazionali del Gran Sasso” (LNGS). The present experimental program foresees the cross section measurement of the $^{12}C(p,\ )^{13}N$, $^{13}C(p,\ )^{14}Ne$ and $^{20}Ne(p,\ )^{21}Na$ at low energies, to detail our understanding of hydrogen-burning cycles effective in main sequence and AGB stars. The thesis is focused on the simulation of the experimental setup and on direct measurements at LNGS.

N_TOF
Proponente: Carlo Gustavino
Titolo tesi: Study of the $^{3}He(n,e^{+}e^{-})^{4}He$ reaction to probe the existence of the X17 boson
Descrizione: A recent study of the nuclear processes $^{7}Li(p,e^{+}e^{-})^{8}Be$ and $^{3}H(p,e^{+}e^{-})^{4}He$ showed a significant enhancement of the internal pair creation at large angles. This was interpreted as the creation and decay of an intermediate particle with mass near 17 MeV. The existence of the X17 boson can be probed with the study of the $^{3}He(n,e^{+}e^{-})^{4}He$ reaction, by exploiting the neutron beam provided by the n_TOF facility at CERN. The thesis is addressed to define the optimal setup to study the $^{3}He(n,e^{+}e^{-})^{4}He$ process, in order to unambiguously confirm or reject the existence of the X17 “dark photon”.

N_TOF
Proponente: Salvatore Fiore
Titolo tesi: Commissioning of the new high flux detector array for spallation neutron target
Descrizione: The n_TOF experiment will restart its data taking in 2021, with a new spallation target system: Target#3 . In order to measure the neutron yield from the Target#3, an array of Self Powered Neutron Detectors will be installed close to the lead target array, where a flux of $\sim 10^{11}$ n/cm^2 pulse is foreseen together with a photon and charged secondary particles background. The study of performances of the new Self Powered Neutron Detectors, compared with reference detectors, will be the aim of the Master Thesis work. The student will deal with detector signal processing, data analysis, FLUKA Monte Carlo simulation of the setup, in the exciting and challenging environment of the n_TOF experiment at CERN.

APEIRON
Proponente: Alessandro Lonardo, Paolo Cretaro
Titolo: Design and prototyping of a heterogeneous distributed processing framework for AI-based online processing in High-Energy Physics.
Descrizione: Modern High Energy Physics experiments work at high interaction rates and an efficient online data processing is often mandatory to pick potentially interesting events among crowded backgrounds. APEIRON is a framework for the study, prototyping and deployment of intelligent Trigger and Data Acquisition systems. It aims at defining the general architecture of a heterogeneous distributed execution platform along with its software stack, from device drivers to high level programming model. The candidate will study the experimental requirements for the processing system, identify the key aspects of the architecture to be developed (at hardware and/or software level) and prototype them.

APEIRON
Proponente: Alessandro Lonardo, Luca Pontisso
Titolo: Study and implementation of Deep Neural Networks for online processing pipelines in High-Energy Physics with the APEIRON framework
Descrizione: Modern High Energy Physics experiments work at high interaction rates and an efficient online data processing is often mandatory to pick potentially interesting events among crowded backgrounds. The APEIRON framework's goal is to prototype and deploy intelligent Trigger and Data Acquisition systems based on a heterogeneous distributed execution platform. Thanks to a low-latency, modular and scalable network infrastructure (configurable in number of channels, topology and size) data streams from different channels can be recombined through subsequent processing layers. The candidate will study, develop and prototype DNN models within a HW/SW co-design loop between definition of processing, specification of the execution platform and mapping among them through performance evaluation.

ARPG
Proponente: Alessio Sarti, Giacomo Traini
Titolo: Study of the nuclear fragmentation induced by the beams used for hadron-therapy treatments.
Descrizione: The student will be joining the ARPG (http://arpg-serv.ing2.uniroma1.it/arpg-site/) group in the framework of the FOOT (FragmentatiOn Of Target) collaboration to measure the fragmentation induced in the principal constituents of the human body (C, O, H) by hadron-therapy ion beams (protons, 12C, 4He,16O). The

foreseen activity might imply either the preliminary measurements needed to characterize the response of some detectors of the full FOOT apparatus (now under construction) or the software developments that are needed to perform the simulation studies and/or the data analysis.

ARPG
Proponente: Michela Marafini, Giacomo Traini
Titolo: Development of novel detectors for hadron-therapy treatments applications
Descrizione: The student will be joining the ARPG (http://arpg-serv.ing2.uniroma1.it/arpg-site/) group and develop new detection techniques of the secondary radiation produced during hadron-therapy treatments with the aim of developing a device capable of monitoring the dose release. The thesis work will be focused on the study of one or more of the secondary radiation different components: either neutrons, photons or charged fragments. The foreseen activity will be performed covering different fields such as the hardware or software development, and the data analysis.

ARYA
Proponente: Mauro Migliorati
Titolo: Research and Development of a compact cryogenic injector for advanced radiation sources
Descrizione: A new generation of particle sources is foreseen in order to provide beams of unprecedented six-dimensional brightness which can be employed to drive novel radiation sources, such as FELs and Compton sources. Radio-frequency photo-injectors operated at cryogenic temperatures are capable to achieve very high accelerating fields which enhance the peak brightness of the electron beam reducing its emittance. The design of such advanced devices is a challenging task which demands strong efforts, either technologically and for a successful control of the dynamics of the ultra-bright beam itself.

ARYA
Proponente: Mauro Migliorati
Titolo: Research and Development of a medical accelerators for Flash therapy
Descrizione: The Radiation Therapy (RT) is nowadays one of the most common methodology to treat cancer cells. The most important requirement is to destroy the cancer cells and to minimize the damage of the healthy cells as well as any side effect. In this scenario, an innovative technique has been proposed and already tested: the FLASH Therapy, which uses short pulses of electrons at very high dose rates. It foresees millisecond pulses of radiation (beam on time < 100-500ms) delivered at a high dose-rate (>40-100 Gy/s), over 2000 times faster and more than 1000 more intense than conventional RT. These bursts of radiation are less harmful to healthy tissues but just as efficient as conventional dose rate radiation to inhibit cancer growth. We will work on the implementation of this methodology based on an electrons linear accelerator.

EUROEXA
Proponente: Piero Vicini, Andrea Biagioni
Titolo: Analysis and prototyping of a routing mechanism for data transmission optimized for scientific computing
Descrizione: The EuroEXA project is a major European FET research initiative that aims at delivering a fully-working HPC system prototype exploiting state-of-the-art FPGA devices that integrate compute accelerators and low-latency high-throughput interconnect. Exascale-class systems are expected to host a very large number of computing nodes, from 10^4 up to 10^5; as a consequence, capability and performances of the interconnect architecture are critical to achieve high computing efficiency at this scale. The thesis activities should focus on the simulation, design and validation of the routing mechanism for data communication (protocol and routing mechanism) to meet the requirements of the scientific applications, including the promising field of biologically-inspired neural network learning tasks.

EUROEXA
Proponente: Piero Vicini, Andrea Biagioni
Titolo: Analysis and prototyping of low-latency interface towards FPGA accelerators for efficient scientific computing.
Descrizione: Nowadays modern large scale computing systems are built through the integration of high performance general purpose computing processors with tightly coupled computing accelerators, GPUs and more recently, programmable components (FPGAs). In this perspective the use of a low latency, high throughput, effective CPU-accelerators interface is mandatory to exploit the extreme performance of such as computing systems. The thesis activities should focus on the simulation, design and validation of the hardware and software interfacing mechanism between general purpose computing node and custom hardware booster based on programmable components (FPGA) a key element of computing platforms oriented to scientific applications as well as for distributed High Energy Physics systems.

HBP_WAVESCALES
Proponente: Giulia De Bonis
Titolo: Analysis of experimental and simulated cortical activity
Descrizione: The WaveScalES project aims at studying cortical slow wave activity (SWA) and the link between Sleep and Learning, bridging theoretical models, experimental activity and dedicated simulations. The activity of Data Analysis is strongly related to Simulations and Theory, with the goals of: understanding the features of the SWA; defining benchmark observables; designing flexible tools, for comparing and combining different data sets; defining methods and procedures for the validation of theoretical models and simulations; extracting results from experimental recordings for feeding data-driven simulations. The proposed items of activity collocate in this framework and include: analysis of experimental and simulated data; development and improvement of the analysis pipeline; focus on brain states, propagation patterns, connectivity, complexity and consciousness; comparison of anesthetics and natural sleep.

MC-INFN / GeNIALE
Proponente: Carlo Mancini Terracciano, Stefano Giagu
Titolo: Emulate a low energy nuclear interaction model with Deep Learning
Descrizione: A reliable model to simulate nuclear interactions is fundamental for Ion-therapy. Today, Geant4 is the leading tool to develop Monte Carlo simulation in High Energy Physics, and is widely used in many other application areas, including ion-therapy. These applications are hampered, however, as the physics models currently available in Geant4 fail to reproduce the nuclear fragmentation process in interactions below 100 MeV/u. We already showed how BLOB ("Boltzmann-Langevin One Body"), a model developed to simulate heavy ion interactions up to few hundreds of MeV/u, could simulate also 12C reactions in the same energy domain. However, its computation time is too long for any medical application. For this reason we are exploring the possibility of emulating it with a Deep Learning algorithm and with generative algorithms in particular. A preliminary paper is under publication and the student will participate in developing new Deep Learning algorithm, will train them with the BLOB output and finally will compare the Deep Learning prediction with BLOB and experimental data. More information on: http://www.roma1.infn.it/exp/geniale.

NEPTUNE
Proponente: Cecilia Voena
Titolo: Development of 19F Magnetic Resonance Imaging for nuclear enhanced proton therapy of cancer
Descrizione: The NEPTUNE project aims to enhance the radiobiological effectiveness of proton therapy using the nuclear reactions p-B and p-F. Imaging and quantification of fluorinated tracers administered to the patient are being developed using MRI with 19F. Theses on hardware and analysis (machine learning based) improvements to 19-MRI are available.

SL_Comb2Fel
Proponente: Andrea Mostacci
Titolo: Research and Development on plasma accelerators for novel radiation sources
Descrizione: Plasma based accelerator can profit off an extremely high accelerating field, order of magnitude higher than conventional accelerators. Experimental studies have been performed to produce ultra-short driver and witness beams with excellent transverse properties, starting from the optimisation of beam generation device (laser on photocathodes) and then finely tuning the following linear accelerator to produce a high brightness beam at entrance of the plasma cell. Among others, the main activities concern simulation studies for the optimization of plasma density profile, experimental studies for the beam transport optimization, design and construction of an ultra compact beam position monitor, executive design of Cherenkov effect based beam diagnostics as well as studies on graphene-copper photocathodes.

TERA
Proponente: Stefano Lupi, Massimo Petrarca
Titolo: Terahertz Acceleration
Descrizione: The TERA project funded by INFN concerns the developments of terahertz technologies for compact accelerators to be used in medicine and particle physics. This thesis concerns the investigation of high intensity terahertz sources (with an associate THz electric field up to 50 MV/cm) through non linear optical techniques based on high-power lasers at the basis of compact accelerators

TERA
Proponente: Stefano Lupi, Massimo Petrarca
Titolo: Terahertz Diagnostic of Plasma
Descrizione: Plasma (electron/ion interacting gas) are present in a variety of natural phenomena ranging from electric activity in atmosphere, laser/matter interaction, to nuclear fusion. A critical parameters in plasma is the electron density. Here, we propose the study of this quantity by an optical measurement through terahertz

radiation produced by a femtosecond laser. The synchronization of the laser to the plasma formation and the development of optical schemes for measuring the density will be critical parameters to be studied.

TERA

Proponente: Stefano Lupi, Massimo Petrarca
Titolo: Imaging of Skin Cancer Lesions
Descrizione: The increase in skin cancerous phenomena and their severity and danger to health require the development of diagnostic techniques capable of identifying them at an early stage and possibly “in vivo”. This thesis concerns the developments of an apparatus for detecting skin cancers “in vivo” through THz and Infrared Radiation providing information on the spatial extension of the cancer and its chemical and water composition which are critical parameters for establishing its dangerousness.

WIDMapp

Proponente: Riccardo Faccini, Francesco Collamati
Titolo: Feasibility study of a wearable individual dose monitoring apparatus for targeted radionuclide therapy
Descrizione: In Targeted Radionuclide Therapy (TRT), a radio pharmaceutical is injected to the patient, with the aim of delivering destructive radiation selectively to tumors. However, some dose is unavoidably expected also to healthy organs, with large variation from patient to patient. An individual accurate dosimetry system is therefore the key to formulate a personalised treatment. In this context, a Wearable Individual Dose Monitoring Apparatus (WIDMApp) for continuous mapping of the radioactive agent transit and accumulation in the body is under study. The apparatus is based on scintillating detectors, and requires an unfolding algorithm to be developed with a Geant4 simulation of the patient under treatment.

Allegato n. 1

SCHEMA DI DOMANDA PER LA PARTECIPAZIONE AL CONCORSO

Al Direttore
della sezione di Roma dell'INFN
Piazzale Aldo Moro 2
c/o il Dipartimento di Fisica "Guglielmo Marconi"
00185 Roma

Oggetto: Bando 22319/2020 – 5 Borse di studio per attività di formazione scientifica per studenti universitari.

…….. sottoscritt…….. (nome) …… (cognome) ……..……...

nat… a …… Prov. …… il ……..…….

residente in ……. Prov. …… indirizzo…….....

……..……..

codice fiscale .....

studente in Fisica nucleare e subnucleare

presso l'Università di ……fa domanda di essere ammesso/a al concorso in oggetto, per usufruire di una borsa di studio presso la sezione di Roma dell'INFN.

A tal fine dichiara, sotto la propria responsabilità:

- di essere cittadino……..;
- di non aver riportato condanne penali (in caso contrario precisare di quale condanne si tratti);
- di aver usufruito delle seguenti borse di studio (ovvero di non aver usufruito di borse di studio);

Il sottoscritto, dichiara altresì:

- o di essere
- o non essere parente

entro il quarto grado ovvero affine entro il secondo grado di un dipendente o associato con incarico di ricerca nella struttura presso la quale è aperta la selezione.

Allega la seguente documentazione:

…….

…….

…….

Desidera che tutte le comunicazioni riguardanti il concorso gli/le siano inviate al seguente indirizzo:

e-mail ……

Data ……

Firma

……

(firma per esteso e leggibile)

Allegato n. 2

DICHIARAZIONE SOSTITUTIVA DI CERTIFICAZIONI

(art. 46 D.P.R. 28.12.2000 n. 445)

Il/La sottoscritto/a _____

nato/a a _____ prov. _____ il _____

residente in _____via _____n. _____

consapevole della responsabilità penale in cui può incorrere in caso di falsità in atti e dichiarazioni mendaci (art. 76 D.P.R. 28.12.2000 n. 445)

D I C H I A R A

- di aver conseguito la laurea triennale in……..presso l'Università di …….. con la seguente votazione…….

- di essere inscritto al corso di laurea in Fisica Nucleare e Subnucleare

che prevede un totale di …….CFU

presso l'Università di _____

- di aver sostenuto i seguenti esami di profitto:
  (elencare tutti gli esami sostenuti)

_____il_____con votazione_____CFU____

_____il_____con votazione_____CFU____

_____il_____con votazione_____CFU___

In conformità a quanto disposto dall'art. 13 del Regolamento UE 2016/679, i dati personali richiesti saranno raccolti e trattati, anche con l'uso di strumenti informatici, esclusivamente per la gestione delle attività concorsuali e nel rispetto della disciplina legislativa e regolamentare dettata per lo svolgimento di tali attività.
Il conferimento dei dati è necessario per valutare i requisiti di partecipazione ed il possesso dei titoli e la loro mancata indicazione può precludere tale valutazione.
I dati sono conservati per il periodo necessario all'espletamento della procedura selettiva e successivamente trattenuti ai soli fini di archiviazione.
L'INFN garantisce ad ogni interessato l'accesso ai dati personali che lo riguardano, nonché la rettifica la cancellazione e la limitazione degli stessi ed il diritto di opporsi al loro trattamento; garantisce altresì il diritto di proporre reclamo all'Autorità Garante del Trattamento dei dati personali circa il trattamento effettuato.
Titolare del Trattamento: Istituto Nazionale di Fisica Nucleare: email: presidenza@presid.infn.it
Responsabile della Protezione dei Dati: email: dpo@infn.it

luogo e data

_____

Il/La dichiarante

_____

(firma per esteso e leggibile)

Allegato n. 3

DICHIARAZIONE SOSTITUTIVA DI ATTO DI NOTORIETA'

(art. 47 D.P.R. 28.12.2000 n. 445)

Il/La sottoscritto/a _____ nato/a a _____ prov. _____ il _____ residente in _____ via _____n. _____

consapevole della responsabilità penale in cui può incorrere in caso di falsità in atti e dichiarazioni mendaci (art. 76 D.P.R. 28.12.2000 n. 445)

D I C H I A R A

_____

_____

A titolo puramente esemplificativo si riportano alcune formule che possono essere trascritte nel facsimile della dichiarazione sostitutiva di atto di notorietà:

- che la copia del certificato di iscrizione al corso di laurea in Fisica Nucleare e Subnucleare presso l'Università di……..allegato alla domanda, composta di n. …….fogli, è conforme all'originale.
- Che la copia del seguente titolo o documento o pubblicazione…….composta di n……fogli è conforme all'originale.

In conformità a quanto disposto dall'art. 13 del Regolamento UE 2016/679, i dati personali richiesti saranno raccolti e trattati, anche con l'uso di strumenti informatici, esclusivamente per la gestione delle attività concorsuali e nel rispetto della disciplina legislativa e regolamentare dettata per lo svolgimento di tali attività.
Il conferimento dei dati è necessario per valutare i requisiti di partecipazione ed il possesso dei titoli e la loro mancata indicazione può precludere tale valutazione.
I dati sono conservati per il periodo necessario all'espletamento della procedura selettiva e successivamente trattenuti ai soli fini di archiviazione.
L'INFN garantisce ad ogni interessato l'accesso ai dati personali che lo riguardano, nonché la rettifica la cancellazione e la limitazione degli stessi ed il diritto di opporsi al loro trattamento; garantisce altresì il diritto di proporre reclamo all'Autorità Garante del Trattamento dei dati personali circa il trattamento effettuato.
Titolare del Trattamento: Istituto Nazionale di Fisica Nucleare: email: presidenza@presid.infn.it
Responsabile della Protezione dei Dati: email: dpo@infn.it

luogo e data

_____

Il/La dichiarante(1)

_____
(firma per esteso e leggibile

(1)Il/La dichiarante deve inviare la dichiarazione unitamente alla copia fotostatica del documento d'identità in corso di validità.