1. Programme Identification

Lisbon University Doctoral Program in Integrative Neuroscience

Programa de Doutoramento em Neurociências Integradas da Universidade de Lisboa

Acrónimo: NeurULisboa

Starting: January 2015

Key words:

Translational Neuroscience

Cellular, Functional and Clinical Neuroscience

Neuroinflammation, Neurodegeneration and Ageing

Neural Engineering

Institution and their roles

2.1. Host conditions (max 5000)

The European Union and the European University Association adopted a set of principles (http://www.eua.be/eua/jsp/en/upload/Salzburg_Conclusions.1108990538850.pdf) for high quality PhD training across Europe, which include: (1) original research as the core of the training; (2) high quality supervision; (3) critical mass; (4) interdisciplinarity; (5) internationality. All these are fulfilled by NeurULisboa, which encompasses institutions with consolidated experience in advanced training and research in Neurosciences. Neuroscience/Neurology research is in the top 10 in Portugal (Web of Science), being the 2nd in Biomedical Sciences, the 1st in Centro Académico de Medicina Lisboa (CAML), which integrates three pillars of NeurULisboa: FORMATIVE - Faculdade de Medicine (FMUL), CLINICAL - Hospital de Santa Maria (HSM), and RESEARCH - Instituto de Medicina Molecular (IMM).

NeurULisboa is a coordinated effort of 6 major institutions of the University of Lisbon (ULisboa), all with recognized scientific and formative capacity in Neuroscience. As a whole, they offer a broad range of research and training opportunities, from molecules to brain function and cognition, from membrane excitability to cognition, from the bench to the

bedside; they cover basic knowledge of disease mechanisms and applied research (biomarkers identification, target drug discovery and clinical trials design, neurotechnologies, neuroimaging). Bibliometric data (Web of Knowledge) is elucidative: from a total of 1510 full papers (abstracts excluded) published in Portugal in the last 5 years (2009-2013) in Neurosciences/Neurology, 512(30%) were from ULisboa, which is the leading institution in this field in Portugal, both in publications number and in citations. The leading authors in Neurosciences/Neurology at the ULisboa are team members of NeurULisboa. Some are among the most cited in the world concerning their areas of research.

The proponent Institution, FMUL, has a long track record of achievements in Neuroscience research and training. The FMUL team members belong to IMM (www.imm.fm.ul.pt), awarded with the highest mark for research quality by the Portuguese Government. Neurosciences at IMM focus on the main four pillars of Neuroscience (Insel et al., Nature Neuroscience, 2004): Molecular and Cellular Neuroscience, Neural Circuits and Systems, Cognitive and Behavioural Neuroscience and Translational Research. The close proximity between Basic and Clinical Research, framed by CAML, offers an outstanding opportunity to foster translational integrative PhD projects in Neurosciences, combining molecular and synapses physiology, clinical neurophysiology, cognition and clinical trial methodology. Altogether, the neuroscience research staff at CAML includes over 50 PhDs, with more than 320 full papers published in the last 5 years and over 2500 citations (Web Knowledge). Altogether, the Neuroscience Units at FMUL/IMM gathered more than 5.5 M€ research funding over the last 5 years.

The Neuroscience research potential of the proponent institution is complemented by the expertise of the groups from other participating institutions at NeurULisboa. The groups at Faculdade de Farmácia (FFUL) have strong expertise in molecular and cellular basis of neurodegeneration, neuroinflamation and neuroprotection, blood-brain barrier modulation, target/drug discovery and delivery, including nanotechnology-based solutions. Faculdade de Ciências (FCUL) investigators are deeply involved in electrical and magnetic brain stimulation, which complements the interest of clinically driven groups at FMUL. Instituto Superior Técnico (IST) has strong links with FMUL in teaching and research; its high specialization in signal analysis, electrotechnical devices, data mining and computational biology, is critical to research development in different groups. Cognitive research carried out at Faculdade de Psicologia (FPUL) is complementary to research in FMUL. Collaborations among the

participating institutions, are already consolidated in joint postgraduate training and joint publications (e.g. Ramalho et al.,Neurobiology of Ageing, 2013; Silva et al,Neuropharmacology,2012; de Carvalho et al,Muscle and Nerve,2000; Bernas et al,Nature Protocols 2010; Brito et al,J Child Neurol 2012; Mariano et al,Cell tissue Res,2013; Brito et al,Pediatr Neurol 2013).

NeurULisboa team members cooperate with national and international research groups, are involved in European Projects and consortia (ESTEEM; SOPHIA; EUROMYASTHENIA; NEUROCLINOMICS; BIOMARKAPD; GENFI–GENetic; RHAPSODY; COST Action BM1302, EADC, HIVE, Rede Glial Luso-Brasileira, INOVAFUNAGEING, etc). These collaborations will be paramount in providing opportunities for internationalization of the PhD students engaged in NeurULisboa program.

In summary, NeurULisboa involves internationally recognized researchers, with complementary competences and previously established collaboration in postgraduate training and research projects.

2.2. Expertise in advanced training (max 4000)

The well established training capacity of FMUL allowed a total of 118 completed PhD thesis over the last five years, 36 (30%) of which were in Neurosciences. The Neuroscience training experience of FMUL is also underscored by its post-graduate training program in Neurosciences (Master and PhD, both credited by A3ES) presently in its 15th consecutive annual edition (started in 1999-2000), to which the number of candidates is more than two fold the number of available positions, every year. Integrative research at FMUL has naturally emerged from the interaction between basic neuroscientists, clinical neurophysiologists and neurologists.

The program Director (PD), Ana M Sebastião (FMUL/IMM) has strong expertise in mentoring research at post-graduate level. In total, she supervised/is supervising 17 PhD students; some are now scientifically recognized University Professors, and others are active investigators at international institutions. Most of her Master Students progressed to PhD; several came

from/went to other national or international institutions. She has been actively involved, being frequently the proponent, of international collaborations with near 20 groups from Europe and USA, all these leading to joint publications. In most cases these collaborations have been fostered by reciprocal mobility of PhD students. She has over 100 peer reviewed papers and more than 4.000 quotations (h index 34, Web of Science). She belongs to the Coordinating Board of the post-graduate program in Neurosciences at FMUL (credited by A3ES).

The main investigators from each participating institution have also large experience in PhD training and international collaborations, and some have strong cooperation with the industry for drug development, clinical trials (Phases II and III), technological (e.g., Neuroelectrics) development for noninvasive brain stimulation, drug delivery, signal analysis. As a whole the faculty members range from young researchers with an already relevant scientific curriculum, to senior researchers with a highly reputed international scientific and training career. Moreover, they have supervised the PhD of several reputed Professors working in the best universities of Portugal; some others continued a research career abroad. FMUL and IST team members are involved in the joint (FMUL/IST) degrees (pre and postgraduate) of Biomedical Engineering, where the PD of NeurULisboa serves in the coordination board. Also well established are common post-graduation training between FMUL/FCUL, FMUL/ FPUL and FFUL/IST and FFUL/IST.

In summary, being highly productive and internationalized, the research/teaching staff of NeurULisboa provides a 'creative prone' neuroscientific atmosphere where the students can develop their thesis, interact with researchers and PosDocs with different backgrounds and expertise, while cooperating with other colleagues at different levels of their career. In this environment students have excellent conditions to shape their scientific skills and to conclude their PhD successfully.

2.3 Complementarity and synergies between the host institutions (max 4 000)

Since the Decade of the Brain there has been an explosion of knowledge on neurosciences, which require integration of data across studies, as well as integration of different approaches

and levels of understanding. A modern example of the potentialities of large-scale data sharing has been provided by the Human Brain Project.

The importance of large-scale integration of information in neurosciences has been recognized (Insel et al., 2004 – Nature Neurosci 7, 426), acknowledging the need to intensify and integrate three levels of research: a) deeper insight in molecular pathophysiology; 2) information management improvement, namely from imaging studies; 3) to understand the commonalities of brain disorders. An integrative framework for linking the great diversity of specializations within contemporary neuroscience, including Molecular and Cellular Neuroscience, Neurofunctional Anatomy, Neurophysiology, Signal Analysis, Image Analysis, Biocomputation, Cognition, Ageing, is thus needed. This framework exists when the research potential and team of NeurULisboa is taken as a whole.

FMUL has strong teams in basic functional neurosciences, animal models of neurodegenerative diseases (such as, Parkinson's Disease, amyotrophic lateral sclerosis), computational models of neuroimaging, neurophysiology, and clinical research (in particular, Alzheimer's disease, Parkinson's Disease, amyotrophic lateral sclerosis, stroke, language disorders, fronto-temporal dementia and epilepsy). The groups at FFUL/Research Institute for Medicine are complementary due to their expertise in the biochemical pathways involved in neurodevelopmental and neurodegenerative disorders, in ageing-related blood-brain barrier disruption, apoptosis, oxidative stress, neuroinflammation and target directed drug research/delivery. Regarding cognition, the groups at FPUL are devoted to memory and language processing, which match the work of some investigators working at FMUL. The expertise of the groups at IST and at FCUL on instrumentation, measurement and processing of bioelectric, hemodynamic and electromagnetic signals expands the current research scope of a large group of active investigators of the FMUL. The expertise in mathematical analysis of complex data at IST is highly valuable to clinical groups dealing with large population of patients.

2.4. Collaboration with other Institutions (max 3000)

One condition to act as a PhD supervisor is to have recognized international collaborations. The research carried out by the team members is highly internationalized involving a high number of institutions, where students can improve their skills and increase their possibilities

of high quality research. The following list of active collaborations consolidated in joint papers and/or financed research projects, clearly illustrates the great potential for interactions with other Institutions: UK: Univ.Oxford; Univ.Cambridge; UCL; Univ.Edinburgh; Univ.Bristol; Univ.Leicester; Univ.Manchester; Univ.Newcastle; Univ.York; Univ.Sheffield; Univ.Dundee; Univ.Warwick. GERMANY: Universitätsklinikum Erlangen; Merz Pharmaceuticals GmbH, Frankfurt; Technische Univ.München; Univ.Tübingen; Max-Delbrück-Center Molec.Med,Berlin; Max Plank Inst,Leipzig; Univ.Aachen; Hannover Med.Sch; Univ.Ulm; Kantonsspital St.Gallen. FRANCE: Univ.Lille; Univ.Bordeaux; Univ.Rennes; Univ.Toulouse; Collège de France; Univ.Bordeaux. SPAIN: Univ.Barcelona; Univ.Autonoma Barcelona; Univ.Hospital Saint Joan de Déu,Barcelona; Hospital Clinic I Provincial,Barcelona; Neuroelectrics,Barcelona, Univ.Complutense Madrid; Univ.Pablo-de-Olavide,Sevilla; ITALY: Sapienza Univ.Roma; Inst.Scientifico H S. Raffaele,Milano; Univ.Trieste; Univ.Politecnica delle Marche,Ancona; Univ.degli Studi di Milano. THE NEDERLANDS: Univ.Rotterdam; Univ.Amsterdam; Univ.Medical Center Utrecht; SWEEDEN: Univ.Uppsala; Karolinska Institutet; Univ.Umeå; DENEMARK: Aarhus Univ.Hospital; Univ.Copenhagen. FINLAND: Univ.Helsinki; Univ.Kuopio. SWITZERLAND: Ecole Polytechnique,Lausanne; BELGIUM: SCD-SISTA KU,Leuven; Univ.Libre,Bruxelles; Cath.Univ.Leuven. HUNGARY: Hungarian Acad.Sci; JAPAN: Univ.Kyoto; Univ.Osaka. CANADA: West Toronto Hospital. USA: Harvard Medical School; Legacy Res.Inst,Portland; NIH(Bethesda and Baltimore); Johns Hopkins Medicine,Baltimore; Salk Inst,San Diego; Univ.California(San Diego and Irvine); Univ.Arizona; Univ.Pittsburgh; Washington Univ.St. Louis; Columbia Univ; Brown Univ; Univ.Minnesota. CHINA: Univ.Hong Kong; BRASIL: Univ.Federal Rio Janeiro; Univ.Federal Bahia. AUSTRALIA: Univ.Queensland.

NeurULisboa team members of are also actively involved in postgraduate studies abroad: GGNB PhD program(Goettingen), Molec.Med.PhD Program(Goettingen), U4 PhD Network Program Ageing Brain(Gent,Gottingen,Groningen,Uppsala), ESO European Master in Stroke Med(Krems), Pós-Graduação em Ciências Morfológicas-PCM-ICB-UFRJ(Univ.Federal Rio de Janeiro).

NeurULisboa will be part of the Network of European Neuroscience Schools(NENS) (http://www.fens.org/Training/NENS/), which provides support to PhD students including exchange grants to gain methodological training or develop specific tasks. The Neuroscience postgraduate program at FMUL has already benefited from these facilities.

3. Research team

3.1. Lista de membros (já está no site de candidatura)

3.2. Criteria for supervision of PhD students (max 3000)

The quality of supervision is critical for a successful PhD work plan. The establishment of rigorous criteria for a given researcher to be supervisor is therefore crucial to ensure high quality standards. To act as a supervisor of NeurULisboa the researcher has to meet the following criteria:

- Excellent track record of scientific publications, being a major author (first or last author, or having a key role in a collaborative publication) of peer-reviewed papers in high profile international Journals for the last 5 years.
- Actively involved in supervision or co-supervision of PhD students in the last 5 years. Previous experience in advanced training programs is highly appreciated.
- Available budget for a successful implementation of projects
- International collaborations.

Exceptionally, young researchers who have finished their PhD thesis in the last 5 years are exempted for meeting some of the above listed criteria; however, they are restricted to act as co-supervisors, together with an experienced supervisor. Previous experience of the young supervisors in advanced training and in Master thesis supervision is recommended.

To foster interdisciplinarity, students are encouraged to have two supervisors from different and complementary research fields relevant for the project. The definition of the lead supervisor and the role of each supervisor should be clear in the submission of the research project. To ensure effective supervision, it is suggested that each supervisor does not act as leader supervisor of more than 3 PhD Students.

The Directive Board (DB, see 6.1) will check if these criteria are properly met.

4. Characterization of the Program

4.1. Strategy and aims (5000)

The ultimate goal of NeurULisboa is to form highly qualified investigators in neuroscience through integrative research, who are expected to pursue a professional career in the field. To achieve this goal we will foster strong interactions and discussions among different research groups and students, namely by stimulating co-supervision from different and complementary research fields relevant for the PhD project, by promoting seminars with integrative character (e.g. fundamental-clinically applied), through Journal Clubs to incentive critical reading and debate of literature, by promoting collective meetings with all students and supervisors, by encouraging lab rotations in groups with complementary approaches, by promoting regular critical evaluation of the Program, students, and supervisors.

With the aim to understand the human nervous system, neuroscience is one of the most challenging areas of biomedical research with an increasing number of students applying to postgraduate training in the field. This growing interest mostly resides in the large impact of neurosciences upon the understanding of neurologic and mental disorders, which nowadays are leading causes of disability. Neuroscience encompasses complementary fields of knowledge, ranging from basic to clinical sciences, all highly dependent of cutting edge technological developments. Thus, neurosciences emerge as a multidisciplinary science, where integrated knowledge is a key factor to move the field forward.

The University of Lisbon (ULisboa) is in a privileged position to run a PhD program in Integrative Neuroscience. It encompasses leading groups in basic and in clinical neuroscience and technically oriented groups able to provide sophisticated tools to foster neuroscience research. As a whole, ULisboa provides a profitable atmosphere to develop translational research towards disease fighting strategies. Reputed patient-oriented research groups have been interacting with the industry in the design of multicentre innovative clinical trials. Beneficial interactions between the industry and technology oriented groups occur. The profitable collaborations between groups in FMUL, FFUL, FPUL, FCUL, IST, documented in joint publications and projects, constitute an irrefutable cement of the Program. The large number of collaborations with other research groups, in the country and abroad, is a guaranty of openness and internationalization, greatly enlarging the research training possibilities.

The aims of the program are therefore:

1. To offer a broad but integrative approach to Neuroscience, taking advantage of the scientific excellence and complementary diversity at ULisboa.
2. To give students a core background knowledge in fundamental neuroscience, ensuring reciprocal interactions with applied (translational) and technological developments in the field.
3. To develop individualized high standard internalized curricula.

Central concepts of this PhD program are:

1. MULTIDISCIPLINARITY and INTERDISCIPLINARY. The close proximity with the clinical environment propitiates translational research projects. The strong presence of advanced diagnostic tools stimulates technology innovation.
2. A FLEXIBLE CURRICULAR DESIGN, tailored to students profile, to provide the necessary instruments to productive research.
3. PERSONAL DEVELOPMENT through a stimulating learning environment.
4. EXPERT AND DYNAMIC SUPERVISION, promoting interinstitutional and international cooperation.
5. RESEARCH EXPERIENCE and training in a wide range of options designed to qualify students to become research leaders.

These concepts will be developed through the following lines.

1. Guided tailoring of the individual curriculum to allow personal development. Each student, under supervisor's guidance will design his/her curriculum as a function of his/her background and project requirements. A short core curriculum directed to the Fundaments, the Methods, the Ethics of Research, and on scientific communication and writing, will however be mandatory for all students.
2. A wide range of curricular options. Taking advantage of the broad spectrum of Neuroscience research topics and post-graduate teaching at the participating institutions, the program will integrate a variety of post-graduate Curricular Units already running. By making them available to the PhD Students of NeurULisboa we will foster high quality multidisciplinary teaching while assuring the necessary critical mass for effective learning.

3. Direct contact with multiple research topics and approaches. Taking advantage of the large number of Laboratory meetings, Clinical meetings and Technology oriented meetings, run weekly by the different groups, the students will be able to contact with the specific ongoing activities in different groups. Participation in seminars focusing on topics/methodologies not covered in the student host lab will be encouraged to promote multidisciplinarity and intergroup fertilization.

4.1b. Enquadramento e Objectivos (5000)

O objetivo do NeurULisboa é formar investigadores altamente qualificados em neurociências através de investigação integrada, que almejem prosseguir uma carreira científica profissional na área. Para o atingir, promoveremos forte interação entre estudantes e diferentes grupos de investigação, nomeadamente estimulando a co-supervisão em áreas complementares relevantes para o projeto de doutoramento, promovendo seminários de caracter integrativo (e.g. básico-clínico), 'Journal Clubs' para incentivar a leitura crítica e debate da literatura, encorajando rotações laboratoriais complementares, promovendo avaliação do Programa, de estudantes e de supervisores.

Com o objetivo de perceber o sistema nervoso, as neurociências são uma das mais desafiantes áreas da investigação biomédica, com um número crescente de estudantes interessados em prosseguir estudos pós-graduados na área. Este interesse deve-se ao impacto das neurociências na compreensão das doenças neurológicas e psiquiátricas, atualmente uma causa maior de incapacidade. As neurociências englobam áreas complementares do conhecimento, das ciências básicas às clínicas, todas fortemente dependentes de desenvolvimentos tecnológicos de ponta. Assim, as neurociências emergem como uma ciência multidisciplinar onde o conhecimento integrado é o fator chave para impulsão do avanço científico.

A Universidade de Lisboa (ULisboa) tem uma posição privilegiada para implementar um programa de Doutoramento em Neurociências Integradas. Engloba grupos destacados em neurociências básicas e clínicas, e grupos com capacidade de inovação tecnológica que podem fornecer ferramentas sofisticadas potenciadoras da investigação. No seu todo, a ULisboa propicia uma atmosfera que facilita a investigação de translação e a procura de estratégias inovadoras de combate a doenças. Grupos de investigação orientados para o doente têm

interagido com a indústria para o desenho de ensaios clínicos multicêntricos. Grupos de investigação tecnológica têm igualmente mantido relações profícuas com a indústria. As colaborações entre grupos FMUL, FFUL, EPUL, FCUL, IST, documentadas em publicações e projetos conjuntos, constituem um cimento irrefutável do Programa. O grande número de colaborações com outros grupos de investigação, no país e no estrangeiro, é uma garantia de internacionalização, amplificando as possibilidades de investigação e treino.

Os Objetivos do Programa são, portanto:

1. Oferecer uma visão vasta mas integrada das Neurociências, tirando partido da investigação científica de excelência e complementaridade existente na ULisboa.
2. Proporcionar aos estudantes um núcleo de conhecimento em aspetos fundamentais das neurociências, assegurando interações reciprocas de translação e tecnológicos.
3. Desenvolver curriculum individuais altamente especializados e internacionalizados.

Conceitos centrais neste programa de Doutoramento são:

1. MULTIDISCIPLINARIDADE e INTERDISCIPLINARIDADE. Tendo como vantagem a proximidade com a clínica, encorajam-se projetos de translação. A forte presença de tecnologias avançadas de diagnóstico estimulará a inovação tecnológica
2. FLEXIBILIDADE CURRICULAR, ajustada à formação prévia do aluno fornecendo-lhe os instrumentos necessários para investigação produtiva
3. DESENVOLVIMENTO PERSONALIZADO através de um ambiente de aprendizagem estimulante
4. SUPERVISÃO ESPECIALIZADA e dinâmica, promovendo a cooperação interinstiticional e internacional
5. INVESTIGAÇÃO CIENTÍFICA e treino com uma ampla variedade de opções, desenhadas para qualificar os estudantes permitindo-lhes virem a constituir-se como líderes na área.

Estes conceitos serão desenvolvidos através das seguintes linhas de ação:

1. Ajuste do currículo individual. Cada estudante, guiado pelo supervisor, desenhará o seu currículo escolar em função da sua formação prévia e necessidades do projeto pessoal de investigação. Um núcleo curricular sobre Fundamentos, Métodos, Ética da

Investigação, e escrita e comunicação científica, serão contudo obrigatórios para todos.

2. Uma grande variedade de opções curriculares. Tomando partido do espetro muito alargado de investigação em Neurociências e ensino pós-graduado nas instituições participantes, o programa integrará uma multiplicidade de Unidades Curriculares já existentes. Disponibilizando-as aos alunos do NeuroULisboa, promove-se o ensino multidisciplinar especializado assegurando a massa crítica necessária para uma aprendizagem eficaz.
3. Contacto direto com múltiplos tópicos de investigação com diferentes abordagens. Tendo como vantagem o número elevado de reuniões e debates clínicos e de investigação básica ou tecnológica que ocorrem semanalmente nos diferentes grupos de investigação, os estudantes contactarão com as atividades específicas de diversos grupos. Será encorajada a participação em seminários que foquem tópicos/metodologias diferentes das do grupo de acolhimento, promovendo a multidisciplinariedade e a fertilização intergrupo.

4.2. Curricular structure (4000)

NeurULisboa is a 4 year program (240 ECTS) focused in a supervised research project (204 ECTS) complemented by a flexible modular postgraduate training (36 ECTS), tailored to the student background training, career goal, expectations and needs.

The curricular period will develop mostly during the 1st year where students will fulfill a minimum of 24 ECTS. A minimum of 6 ECTS are to be fulfilled in the 2nd year; the remaining to be accomplished over the following years. Hands-on project development should start as early as possible in parallel with the formal training, but not later than the 6th month.

The 1st week, obligatory to all students, will be devoted to ‘Get Inside’ workshops (1.5 ECTs) where the different groups will present their research goals and tools, the students will present themselves and be briefly acquainted with the facilities available at each of the participating institutions.

Students will then have 1 week to organize their curricular plan for the next 6 month. It is expected that some students might have already identified a project and a supervisor, which will guide the choices. For those students that are not yet identified with a specific project and supervisor, the DB will nominate a tutor to guide these initial steps.

Curricular choices will be based on a menu of existing post-graduate Curricular Units (UCs) in the participating institutions, listed in the NeurULisboa e-platform. Those UCs, as a whole, cover a broad range of topics some of them being available at different levels of complexity, so that each student can choose the topics and the complexity levels most adequate to his/her previous background and research needs. Available UCs include: molecular and cellular neurosciences, neuroinflammation, neurodegeneration and regeneration, developmental neuroscience, gene expression regulation, advanced neurophysiology, neuroanatomy, neuropharmacology, neuropathology, clinical research in neurosciences, clinical trials design, neuroethics, neuroimaging, signal analysis and processing, robotics, nanomedicine, stem cell engeneering, bioinformatics, bioelectricity, complex network analysis, computational neuroscience, cognitive neuroscience, advanced technologies for neurosciences, among others. CORE TOPICS, namely on ethics, lab animal handling and lab safety, statistics, scientific communication and writing, and principles of clinical research, are obligatory for all students.

Students will be encouraged to perform Lab Rotations (1.5 ECTs/week) to get a deeper insight of the research projects running and to promote interdisciplinarity. A calendar (updated monthly) with lectures, seminars, lab meetings and workshops of interest will be provided. Each student will have a training record book where attendance to these events will be recorded, which altogether should fulfill at least 6 ECTs, credited by the supervisor under acceptance of the DB.

Detailing and writing the PhD project will be accomplished during the first 4 months. Students and supervisors are encouraged to enroll a co-supervisor in the project that should bring complementary expertise into it. Projects will be presented and discussed orally in a workshop (month 4), written projects will then be delivered to the Thesis Committee (see 6.2) and DB, and either accepted, or suggested to be revised. The final version will then be sent to the ethics committee for approval.

A meeting organized by the students will take place every 2 weeks to promote interaction among students and develop their management capacities. They will have a flexible format: journal club, research data presentation, industry perspectives, prototype development, patent registration, invited lectures. Students will select and invite 2 foreign and 2 external national speakers per year. Choice of interdisciplinary topics and presentation of interdepartmental research projects is encouraged. Teaching staff will attend these meetings to foster discussion.

4.3 Mobility (3000)

The structure of the program (see 4.2) is designed to foster mobility within the participating institutions. In addition, all participating groups have collaborations in the country and abroad (see 2.4). The PhD Students will have a mandatory period (minimum 1 month, ideally at least 6 months) to spend in other research institutions, preferentially abroad. All NeurULisboa proponents are committed and engaged in serving as enablers of national and international contacts for PhD Students mobility. Together, they represent an extensive network of effective, already consolidated, contacts with groups from basic, technologic or clinically oriented expertise, as illustrated by the following examples in which the proponents have exchanged PhD students and/or have financed collaborative research projects:

Neurodegeneration (molecular basis): F Giorgini,Leicester; J Klucken,Erlangen; A Kazantsev,Harvard; A Lleo,Barcelona; M Ingelsson,Uppsala; B de-Strooper,Leuven; CJ Steer and W.C.Low,Minnesota; I Bjorkhem,Karolinska Inst; K.Schoonjans,Lausanne; CR Wolf,Dundee; R D'Hooge,Leuven; MA Deli,Szeged;B Castellano(Barcelona); E Aronica, Amsterdam; JJ Toulmé,Bordeaux; P Shaw,Sheffield; C Ffrench-Constant,Edinburgh; C Tiribelli,Trieste; KS Kim,Baltimore; DJ Brick,Irvine;C Lemere,Harvard;R Tukey,San Diego; E Ponomarev,Hong Kong; V Moura-Neto(Rio de Janeiro).

Neurodegenerative diseases (patient oriented studies): Y Moreau,Leuven; J Rohrer,London; B.Winblad,Karolinska Institutet; AF Kurz,München; H Graessner,Tuebingen;V Bonifati,Rotterdam;C Lang,West Toronto Hospital; A Berthier,Toulouse;L Van-Der-Bergh,Utrecht; P Andersen,Umea; M Otto,Ulm.

Synaptic basis of diseases: A García-Cazorla,Barcelona; C Parsons,Frankfurt; D Boison,Portland; E Castren,Helsinki; D Blum,Lille; J Henley,Bristol; J Baufreton,Bordeaux; C Limatola,Rome; K-Lamsa,Oxford; R Franco,Barcelona; S Ferré,Baltimore; M Bader,Berlin; B Frenguelli,Warwick; G Sadri-Vakili,Harvard.

Neurophysiology: A Fulgsang-Fredericksen,Arhus; J Valls-Solé,Barcelona; M Weber,St.Galen; E Stalberg,Uppsala; M Baker,Newcastle; R Dengler,Hannover.

Cognitive Neurosciences: S Dehaene,Gif-sur-Yvette; J Morais,Bruxelles; S Mattys,York; A Santi,London; M Lambon-Ralph,Manchester; S Cappa,Milano; S Ahmari,Pittsburgh; V Voon,Cambridge.

Functional Brain Imaging: K Nakamura,Kyoto; I Dobbins,St. Louis; B Peterson,R Marsh,HB Simpson,Columbia; A Friedericci,Leipzig; K Wilms,Aachen; R Gil-da-Costa, San Diego.

Computational Neurosciences: M Frank,Rhode Island; F Riverola,Vigo; J Dopazo,Valencia; J Gonçalves,Amesterdam.

Most of the above listed are engaged in PhD programs at their own institutions, facilitating inter-program interchange. Mobility will be financed by running collaborative projects, by the NeurULisboa budget, by European funded mobility actions, by NENS mobility funding facilities (see 2.4). Some of these will also be used to attract foreign students to NeurULisboa.

4.5.1. Justify your choice of language

The official language of NeurULisboa will be English due to the strong international networking of the program and to R&D globalization. Lectures, workshops, seminars, reports, papers and PhD Thesis will be in English. This is already a routine in most of the scientific events in the participating institutions. Foreign students enrolled in NeurULisboa will nevertheless encouraged to learn Portuguese in the first year for cultural enlargement. They will have access to Portuguese courses which will allow a smoother integration and a deeper discovery of the Portuguese culture. All necessary efforts will be made by the Program Director (PD) and Directive Board (DB) to minimize language barriers so that NeurULisboa students will all be in equal position as expected in a truly international program. The School of Languages (Faculdade de Letras) of the University of Lisbon provides courses of English and Portuguese for foreigners that will be available to all students on an individual basis, if needed.

5. Recruitment strategy

5.1. Target population (max 3000)

NeurULisboa intends to recruit very motivated and skilled young people of any nationality who have completed a Bologna Masters degree or equivalent in areas related to Biomedicine, from biology and biophysics to medicine and pharmaceutical sciences, from computational science and engineering to psychology and cognition. They should be committed to acquire knowledge and develop skills in neurosciences and to full-time dedication to their project.

Among the foreign candidates, we will also stimulate the participation of those from other Portuguese speaking countries, which are expanding their investment in science. As an example, Ciência sem Fronteiras Program (Ministério da Ciência, Tecnologia e Inovação, Ministério da Educação, CNPq and CAPES) provides conditions for Brazilian student to join PhD programs abroad (Doutorado Pleno).

The DB, formed by investigators from different areas participating in this PhD program, will select the best candidates taking into account the criteria detailed in 5.3.

5.2. Admission criteria (max 3000)

Admission to NeurULisboa requires Bologna Masters degree or its equivalent from a recognized National or International University. Although we anticipate a more significant interest from people formed in Health and Life Sciences, this PhD program aims to attract also students from other areas of knowledge, as Computer Sciences, Engineering, Biophysics and Chemistry, providing that they intend to be involved in neuroscience research. A minimum score of 14/20 (or equivalent grade in foreign universities) is mandatory (except in cases of relevant achievements in research), 16 or above being desirable. The CV of the applicants should include previous research experience, at least at the Master level, and scientific production (if any). However, exact individual profile is the most relevant criterion, as identified from the motivation letter and standardized interviews. The motivation letter should include preliminary choices of PhD projects and supervisors (maximum 3 options) as selected from the options present in the call announcement, or original ones proposed by the applicants themselves. Reference letters are welcomed but not an obligatory document. Good spoken and written English is a mandatory condition.

The application is made online. The DB will act as a selection committee, will analyze the uploaded documents and perform the interview. Applicants with inappropriate profiles will be informed that they were not selected for an interview.

The admissions cycle will start every year in January with the preparation of the call announcement and the list of project/supervisors. Previously, an internal call will be open to identify 20 PhD Project topics/Supervisors for the current year; following selection by the DB, the project topics will be available in the PhD program site in due time. Proposed projects topics/supervisors should cover all areas involved in this doctoral program.

The call to select PhD candidates opens in April and closes in June. Interviews should occur early in July. The applicants are selected and notified by the end of July. The selected candidates will start the PhD program on the 1st of October. Selected students will be registered as FMUL PhD Students (CAML). Double registry in two of the participating institutions may occur, if obviously relevant, and if accepted by the DB and by the Scientific Councils of both institutions. In those cases, co-supervision (one supervisor from each institution) is mandatory. This double appointment possibility is in line with procedures used in joint degrees by the participating institutions, as it is the case of Biomedical Engineering.

5.3. Selection and ranking criteria (max 3000)

Applicants should register in the PhD program website and to upload the requested documents (diplomas, CV, motivation letter, reference letters, and additional documents if relevant). The process of registration and uploading of documents, as well as the process of selection will be explicitly detailed in the webpage. Following automatic confirmatory system validation, the process administrative-academic validation will proceed over the following days.

The DB will act as a selection committee. The selection will consider CV, motivation letter, interview (minimum of 3 members of the board), in particular the candidate profile taking into account his/her potentialities, additional value for the research project, innovation and creativity, as well as the conviction that the candidate will be able to finish successfully the

selected/proposed research topic within the dedicated time frame. Twelve candidates will be selected each year, unless less than 12 offer sufficient quality for selection.

The raking process will respect international recommendations (*Standards for PhD Education in Biomedicine and Health Sciences in Europe*), in particular it will consider that this competitive process will be transparent; all information will be available in the website. The following selection criteria will be applied with approximate equal weight: 1) CV appreciation; 2) motivation, including proposed projects; 3) interview.

5.4. Advertising (max 3000)

A large number of accessible competitive PhD programs are available, which implies that information regarding NeurULisboa should be largely provided in order to attract high quality students. To be effective, this program will benefit from the previous experience of FMUL to announce post-graduate courses, master and PhD degrees (Instituto de Formação Avançada – IFA), as well as from its website and international connections. A website dedicated to NeurULisboa will be created, linked to www.fm.ul.pt (official webpage of the Faculty of Medicine). We aim to advertise NeurULisboa calls through the FCT website, Sociedade Portuguesa de Neurociências (http://www.spn.org.pt/), Sociedade Portuguesa de Neurologia (http://www.spneurologia.com/), and in other relevant national scientific societies, anúncios sapo (http://anuncios.sapo.pt/), Expresso (http://aeiou.expressoemprego.pt/); internationally we plan to share this information through ERA Careers website (http://www.eracareers.pt/), Euraxess web portal (http://ec.europa.eu/euraxess/), Federation of European Societies of Neurosciences (http://www.fens.org/), Network of European Neuroscience Schools (http://www.fens.org/Training/NENS/), Society for Neuroscience (http://www.sfn.org/awards-and-funding/global-funding-sources/europe), Sociedade Brasileira de Neurociências (http://www.sbneurociencia.com.br/html/sociedade.htm), International Brain Research Organization (IBRO, http://ibro.info/), New Scientist jobs (http://jobs.newscientist.com/en-gb/) and Nature jobs (http://www.nature.com/naturejobs/science/). Announcements will also be made at international meetings. We will contact the Portuguese Foreign Affairs in order to approach the Portuguese speaking African countries. Personal contacts with investigators working in Spanish speaking South American countries will be tracked. In addition, mailing to institutions and investigators involved in neurosciences will be done. Finally, we propose to create LinkedIn and Facebook interfaces to approach students prone to use these tools.

5.5. Number of students to admit in each edition

12

5.5.1. Please justify your answer (max 3000)

NeurULisboa PhD Program requests 12 scholarships/year. This is based on:

1) The much larger number of PhD students normally supervised by the whole team of investigators involved in NeurULisboa.
2) The possibility to accept new PhD students taking into account the supervisors workload. 32 experienced researchers, all with potential to act as supervisors are directed involved in NeurULisboa. More will be enrolled due to the number of internationalized reputed neuroscience researchers in the Participating Institutions.
3) Institutional and investigator budget available for research (see 2.1. concerning FMUL budget in Neurosciences during the last 5 years; other participating institutions and groups also well financed).
4) Great potential to recruit very motivated candidates in Brazil and Portuguese speaking African countries.
5) Probable recruitment of candidates in Spanish speaking South American countries.

6. Management and Governance

6.1. Governance (3000)

The Program Director (PD), Ana M Sebastião, heads the Directive Board (DB), which is fully responsible for the selection of the PhD students, and for the overall running of the NeurULisboa program according to the principles described in this proposal.

The DB includes, besides the PD, one responsible researcher of each participating institution: Mamede de Carvalho (FMUL); Isabel Pavão Martins (IMM); Dora Brites (FFUL), Raúl Martins (IST); Pedro Cavaleiro Miranda (FCUL/IBEB), Leonel Garcia Marques (FPUL). In addition, José Ferro, will join the DB as responsible of neuroscience research at the University Hospital (HSM).

The NeurULisboa DB will meet regularly every 3 months, but at shorter intervals when advisable (recruiting and evaluation periods). The DB prepares an annual report, which includes quantitative and qualitative information on several items, namely: recruitment process, thesis Committees progress and actions taken to implement the annual evaluation of students, courses and other formative activities implementation, PhD Student's Commission activities, student's evaluation of the program, and thesis completed. This information will be used as a basis for the External Supervisory Committee (ESC, see 7.1). The annual DB report, together with the ESC report will be sent by the PD to the Scientific Council of FMUL and to the Director of FMUL and made available to the scientific and directive councils of the other participating institutions.

The students annually elect a PhD Student Committee (SC) to coordinate their activities and to facilitate the interaction with the NeurULisboa managing structure. The PD will meet monthly with the PhD Students Commission.

The administrative activities of NeurULisboa will be under charge of IFA (see5.4), a FMUL office with consolidated experience in dealing with post-graduate activities. One IFA staff will be the administrative coordinator and will be in direct contact with the PD. NeurULisboa will contract a part-time secretary to keep webpage updated and to allow faster communication between students and all the Faculty members and institutional structure.

6.2. Monitoring of the students (3000)

NeurULisboa PhD students will be accompanied by a SUPERVISOR, a THESIS COMMITTEE (TC), and a MENTOR. Whenever appropriate (see 4.1, 4.2 and 5.2), a co-supervisor will also be involved.

The SUPERVISOR is responsible for monitoring the research project and the scientific development of the student. It will regularly meet with the student to provide scientific guidance in all aspects of the research activity. The supervisor acts to potentiate the scientific culture and critical thinking of the student, promoting progressive increase in maturity.

The MENTOR will be either from clinical or basic/technology areas, in a crossed way to the predominant approach of the PhD project (clinically driven projects with a basic/technology mentor, basic/technology oriented research with a clinical mentor). The mentor will strengthen the contact between different practices, their language and particularities to accelerate the path to translational research. The mentor will be selected among researchers from any of the participating Institutions.

The THESIS COMMITTEE (TC) will monitor and review the progress made by the student. It consists of 3 members: 1) the Supervisor, 2) a senior researcher from a research Unit outside the host institution where the student performs his/her research work, and 3) another researcher chosen by the Student; the TC is approved by the DB. The members of the TC are specialists in areas relevant to the theme of the thesis. The TC will mostly act in four phases: 1) upon initial project presentation (middle of the 1st year); 2) by the beginning of the 2nd year, were first results should already appear; 3) by the end of the 3rd year, where data are expected to be prepared for submission to a relevant Journal and be matter of criticisms and suggestions by the TC; 4) by submission of the Thesis draft to the Faculty. At each stage, the development of the project should be assessed according to one of three options: 1) move to the next phase, 2) improve the report and resubmit it within a certain time, 3) stop the process because the student did not demonstrate the essential capabilities to develop a valuable Thesis within the assigned time.

An ANNUAL MEETING, where students present their results. All students, supervisors and mentors will participate. The ESC (see 7.1) will also be present. The annual meeting will immediately precede the annual retreat.

An ANNUAL RETREAT organized in collaboration with the SC. Besides being devoted to overall thinking on scientific development, the retreat will also offer opportunities for informal contact between staff and students fostering friendship and crossed creativity.

7. Monitoring

7.1. External Supervisory Committee (3000)

Three senior investigators with a long experience in similar functions have accepted to take part of the External Supervisory Committee (ESC) to supervise this PhD program.

Prof Fernando Lopes da Silva, Emeritus Professor of University of Amsterdam, working at Center of Neurosciences, Swammerdam Institute for Life Sciences, and Research Coordinator of the Department of Bioengineering, Lisbon Institute of Technology (IST, University of Lisbon, Portugal. His research activity includes investigation of the origin and dynamics of cortical electrical signals, epilepsy and cortical networks. He was the founder of the PhD program of Amsterdam, and is Chair of the Advisory Board of this program of 2 Amsterdam Universities and the Netherlands Institute of Neurosciences. He is author of nearly 300 publications and a large number of book chapters (h index: 60).

Prof Michael Swash, Emeritus Professor at Queen Mary University of London. He is an expert in neuromuscular disorders and neuropathology. He has been visiting Professor of 45 Universities worldwide, has edited 17 books and published 400 papers (h index: 62) . He was Medical Director of the Royal London NHS Trust within 1991-1994 and has a large experience in advisory boards.

Prof. Vicenzo Crunneli. Professor of Neuroscience, Neuroscience Division, School of Biosciences, Cardiff University. Director of the PhD Programme of Integrative Neurosciences of Cardiff University. He is expert in cellular neurophysiology and neuropharmacology, has over 150 publications, many in top Journals (h index: 44), served in the boards of several International Societies, has large experience in advisory boards and in post-graduate teaching.

Supervision by the ESC will be attained by their participation at the Annual PhD Students Meeting, allowing a direct contact with students, supervisors, Program leaders and other members of the faculty in open or private meetings, as well by evaluation of the annual DB report. A final report will be prepared by the ESC and discussed with the DB. The final recommendations will be followed by the DB.

7.2. Self-monitoring (3000)

The internal supervision will be performed by analyzing a number of targets:

A – Delivery of individual PhD student work plan, monitored by the thesis committee;

B – Individual PhD student success/dropout, monitored by the thesis committee;

C – Number of recruited PhD students over the number of applications;

D – Number of papers published in international peer-reviewed journals: total number/year (in journal > and < impact-factor of 5) and numbers of papers /PhD student;

E - Number of communications in national and international meetings: total number/year and numbers of communications/PhD student;

F – Number of patents (national and international): total number/year and numbers of patents/PhD student;

G – New techniques implemented in the different laboratories involved: total number/year and numbers of patents/PhD student;

The degree of satisfaction of PhD students, supervisors and members of the Faculty will be accomplished by:

- Online confidential annual feedback forms (enquiries)
- Permanently open online comments area to address specific issues (including regular evaluation about the interest and quality of modules, Lectures and Lab rotations).
- Informally, the students and supervisors can contact the DB or the ESC whenever they feel it as being useful. A major rule is to solve problems before they grow into any kind of conflict, this being done by listening and talking with an open mind to all people involved.

The DB will promote the annual inquiries and monitor students' comments and proposals. Inquiries will be ratified by the ESC before application.

The results of the inquiries and comments/proposals will be reported to the ESC and discussed at the annual meeting.

ESC recommendations, internal monitoring workload and satisfaction measures should be included in the regular BD Annual Report of the PhD program to be submitted to the funding agency - FCT.

8.1 Budget

FMUL 58400

- 3000/y (total 12000) for the annual meeting and annual retreat

- 1800/y (total 2400) for the annual External Advisory Committee Meeting, including travelling and subsistence of the Committee members

- 600/y (total 1800) for the opening lecture, including international travelling and subsistence of an invited speaker

- 1800/y (total 7200) for advertisement

- 4800/y (total 19200) to contract a part-time web manager/secretary to implement and run the webpage and to allow faster communication between students and all the Faculty members and institutional structure.

- 2600/y (total 10400) to invite speakers or to cover a few expenses with student´s mobility (see also 4.3)

FFUL, FPUL, IBEB/FCUL, IST 10400

- 2600/y (total 10400) to invite speakers or to cover a few expenses with student´s mobility (see also 4.3)

IMM 0

IMM is a research institute in FMUL and its budget is therefore included in the FMUL budget

8.2 Other Financial Support

All the Participating Institutions and groups are very active in research, promoting multiple activities that are an indirect but invaluable source of income to NeurULisboa. Some are listed below:

Most of the UCs attended by the Students are already running at the participating institutions (see 4.1 and 4.2)

All Participating Institutions have regular lectures, seminars, lab meetings and workshops with interest for NeurULisboa, constituting a continuous stream of scientific events for NeurULisboa to attend

All groups have a network of international contacts, facilitating student mobility

All groups and supervisors have their own research budget to support successful project development

As a whole the Participating Institutions have good access to international relevant literature, including subscriptions of top Journals not accessible through b-on