The HBP Calls for Expression of Interest for SGA3 "Preparing Cellular-Level Models for Portable HPC Simulation using Arbor"

Guide for Applicants

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More information:	info@opencalls.humanbrainproject.eu

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1. The Human Brain Project and EBRAINS

The Human Brain Project (HBP, https://www.humanbrainproject.eu/) is an ambitious 10-year scientific research and infrastructure initiative that is part of the EU Future and Emerging Technology (FET) Flagship programme[1]. The HBP is developing the European Brain ReseArch INfrastructureS (EBRAINS), an innovative ICT[2] infrastructure that will help neuroscientists and clinical researchers integrate data and knowledge about the brain across all levels of its spatial and temporal organisation. Using detailed digital representations, reconstructions, and simulations, it aims to make ICT tools available to thousands of researchers to advance and accelerate our understanding of the functioning of the healthy and diseased human brain.

EBRAINS comprises three pillars: Data, Models, and Computing Infrastructure. Work Package 5 (WP5), EBRAINS Modelling Services, is one of three infrastructure Work Packages in SGA3 built around these pillars, which will provide a core set of ICT tools and services addressing current and future challenges in brain research and brain-inspired sciences.

WP5 is concerned with the implementation of modelling services as well as the delivery of the necessary software infrastructure for operating these services on the underlying physical infrastructure allocated to them.

More specifically, WP5 includes the delivery of workflows, simulation engines and models for the molecular/subcellular, cellular, network and whole-brain levels of description, as well as the instruments (workflows, protocols and interfaces) for the integration of multiple simulators into multiscale/co simulations. It also delivers an analysis and validation framework to operate on the outcomes of simulations, as well as a visualisation framework for several audiences.

More information is available in the supplementary document HBP_SGA2_CEoI_for_SGA3_Proposal_Summary.

2. Scope of the specific CEoI

This CEoI is for researchers interested in preparing and applying cellular-level models for portable High-Performance Computing (HPC) simulation using Arbor [1, 2]: a performance-portable simulation engine for morphologically detailed neurons, developed under the auspices of the HBP.

Arbor is focused on enabling open standards, workflows and data sources, and promises to deliver significant performance improvements compared to the state of the art.

Expert computational neuroscientists from both outside and inside the HBP are invited to develop models and adapt workflows for Arbor, specifically for networks of detailed cell models that require HPC. Fostering support for Arbor in the EBRAINS ecosystem will enable open, efficient and portable simulations of cellular-level models across a variety of current and emerging supercomputing resources.

> *Background and Ambition:*
>
> HPC simulations based on open standards will enable new neuroscience by facilitating longer simulations and larger ensembles of simulations, and by improving data exchange at scale and in transit between both simulators and analysis tools. Longer simulations will improve our understanding of structural plasticity and learning including the development and optimisation of neuronal circuits. Ensembles of many models permit searching large parameter sets for ion channels, synaptic characteristics and network topologies to solve inverse problems for experimentally opaque values in the light of other, experimentally accessible values such as local field potentials, leveraging improved data flows.

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[1] https://ec.europa.eu/programmes/horizon2020/en/h2020-section/fet-flagships
[2] ICT, Information and Communication Technology

3. Challenge

The EBRAINS infrastructure will support new neuroscience challenges such as the simulation of entire brain regions, multiscale simulation of multiple brain regions, attacking learning and circuit optimisation over long periods, and tackling the inverse problem in quantifying cell characteristics and network features. Within the HBP, two key efforts are being undertaken to provide this support: first, the adoption of simulator- and platform-agnostic model interchange formats; and second, the development of the open simulation engine Arbor.

In SGA3 the HBP modelling activities will focus on porting models and workflows to use platform-agnostic interchange formats such as the SONATA model description format. SONATA aims to be open and simulator-agnostic. To properly support open standards, it is important to further develop such formats for real use cases using multiple simulators.

Arbor [1, 2] is a performance-portable simulation engine for cellular-level models developed in HBP, in addition to the NEURON simulator. Arbor is using open and platform-neutral data exchange formats and providing order-of-magnitude improvements in time to solution and memory consumption. It will enable the use of all HPC systems in the HBP, as well as being ready for emerging technologies and systems, such as those provided through EuroHPC. The adoption of Arbor will have a transformative impact, allowing the simulation of new classes and scales of brain models, however this adoption requires integration into existing and new HBP workflows, and a commitment from early movers in the user community to porting and tuning models. Arbor has prototype SONATA support that will be close to feature-complete at the beginning of SGA3, excepting extensions closely tied to NEURON implementation details.

3.1 Details

The objectives of this CEoI are to:

- Encourage the adoption of open standards in the computational neuroscience community in Europe.
- Increase the target audience of the cellular-level simulation facilities of the HBP simulation platform.
- Validate and improve the HBP-developed simulation technology Arbor.

These objectives will be achieved by porting existing models and workflows designed for NEURON to a simulator agnostic description, and validating their portability using the Arbor simulation engine. Such validation will require commitment from interested parties to update workflows and model descriptions, support from the Arbor developers to add features, and HPC resources for the jointly implemented simulations. Thus, the integration of Arbor aims to achieve both transformative simulation performance and improved support for open standards and development for simulation services on the EBRAINs platform.

To these ends, the specific activities performed by partners in this CEoI will be:

- Adaptation of models and workflows so that simulator-specific components are isolated rather than pervasive;
- Writing Arbor-specific parts of these models and workflows;
- Co-development with the Arbor team of required features.

The following points must be addressed directly in proposals to determine the eligibility of proposed models and workflows:

- Explain the model and workflow, and why it is relevant for HPC.
- Describe scientific outcomes that will be specifically enabled by using state-of-the-art HPC simulation.
- Describe how the models and required datasets will be publicly released.

- Describe how the results of simulation ported to a new model description will be validated against existing results.

- Describe concrete objectives and results to be achieved in the 30-month time frame.

- Describe the Milestones and the tasks required to achieve the objectives.

The focus of this call is on simulation of network models of morphologically-detailed cells that rely on high-performance computing.

A non-exhaustive list of examples of such models is:

- Large network models that require significant simultaneous supercomputing resources including CPUs, GPUs and future accelerators.

- Ensembles of many smaller, or long running, models.

- Multiscale and embedded networks requiring in-transit data-interchange between heterogeneous components, including spikes, voltages, currents and other continuous large-scale data.

In each case, significant parallel computational resources as well as integration into modular software infrastructure and workflows for supercomputing are required.

Improving support for HPC simulation of such models will enable access to emerging challenging domains of neuroscientific research, for example:

- Large networks, that within the time frame of SGA3 will exceed 10^7 neurons, enabling computationally efficient simulations of significant brain regions at full resolution. Coupling these in a multiscale fashion would allow the simulation of multi-region circuits at various characteristic resolutions.

- Long running models needed for investigating theoretical models of structural plasticity, and learning, as well as comparing the optimisation of neuronal processing circuits to variously experimentally imaged and measured circuits.

- Large ensembles of networks can be used to handle inverse problems through large-scale parameter sweeps: comparing experimentally accessible values (such as LFP results) to ion channel characteristics, network topologies, or synaptic parameters and distributions.

- By embedding simulations inside software systems, software tools can be constructed requiring detailed in-transit data transported at scale, such as very large scale LFP prediction and analysis or multi-physics simulations.

References

1) N. A. Akar, B. Cumming, V. Karakasis, A. Küsters, W. Klijn, A. Peyser, and S. Yates. Arbor — A Morphologically-Detailed Neural Network Simulation Library for Contemporary High-Performance Computing Architectures. pages 274–282. 2019 27th Euromicro International Conference on Parallel, Distributed and Network-Based Processing (PDP), Pavia (Italy), 13 Feb 2019 - 15 Feb 2019, IEEE, Feb 2019. ISBN 978-1-7281-1644-0. doi:10.1109/EMPDP.2019.8671560.

2) N. A. Akar, J. Biddiscombe, B. Cumming, F. Huber, M. Kabic, V. Karakasis, W. Klijn, A. Küsters, A. Peyser, and S. Yates. arbor-sim/arbor: Arbor Library v0.2, 4 Mar. 2019. doi:10.5281/zenodo.2583709.

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4. Expected contributions and impact

Applicants are expected to provide a detailed description of the implementation of work plans within the defined timeframe (30 months from 01.10.2020 to 31.03.2023), as well as plans on how to integrate such work into the HBP. In addition, all proposals are expected to briefly describe the long-term vision of the proposed research theme (i.e. in a timeframe of 5 years), as well as how it will contribute to the overall HBP vision and objectives.

Any duplication with existing HBP activities must be avoided.

5. Activities, eligibility and funding

It is highly recommended that a group of partners[3] applies for the CEoI. The group should be represented by a project coordinator with the principal investigator (PI) acting as the main contact person.

Either HBP partners or non-HBP partners[4] are eligible for funding under this CEoI. At least 60% of the proposal budget must be assigned to non-HBP partners, while the HBP partners should not account for more than 40% of the allocation. Please note, a new unit[5] of an existing HBP partner, not receiving any HBP funding, is eligible to participate in the CEoI and can apply for 60% of the allocated budget. The same rule applies to the HBP partners not receiving any SGA3 HBP funding. This rule allows (but does not force) new units to directly start with a close collaboration with already integrated units. All proposals will be subject to the same evaluation criteria, whether it includes HBP partners or not (see Proposal evaluation).

The HBP has committed itself to improve equal opportunities. As such, we explicitly encourage applications from women and groups of applicants who have considered gender equality aspects in their group of applicants (see Equal opportunities).

The European Commission (EC) eligibility and financial rules apply[6]. The new partner organisations must therefore be established in the EU Member States or Horizon 2020 associated countries.

Two (2) proposals will be selected out of this CEoI for EU funding for the HBP SGA3 period. The projects duration should be 30 months maximum (01.10.2020 - 31.03.2023) depending on the inclusion of the new partner in the Consortium, but has a fixed end date which is the end of SGA3, 3 years from the start which is planned for the 1st of April 2020 at the moment of writing of this document.

The selected projects and their partners will become a new Task as part of the overall envisioned HBP Work Plan for SGA3. The project will be located in WP5. The selected partner organisations will be incorporated in the HBP Consortium. The new partners will be requested to sign the relevant agreements with the EC as well as the Consortium Agreement that regulates the relations between the Partners of the Consortium.

The agreements with the EC include a Framework Partnership Agreement (FPA) and a Specific Grant Agreement (SGA). The FPA Consortium Agreement applies to the Consortium during the entire Flagship period and is amended regularly for major changes. The addition of new Partners to the Consortium is subject to the approval of the required FPA Amendment by the HBP Stakeholder Board and the EC.

Success in this CEoI should not be considered as a commitment by the HBP or the EC to continue funding the Partners after the end of the SGA3 period. The continuation of this activity will be subject to the same review as all other HBP activities.

Note: while preparations for the coming phase (HBP SGA3) are going ahead to allow a timely start of new partners, the final approval of the selected projects will be subject to the HBP being successful in applying for funding of the next phase (currently under preparation). Applicants will receive the final confirmation of project funding only, once the HBP SGA3 Proposal has been accepted for funding by the EC.

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[3] Partner = a university or organisation, not an individual

[4] Non-HBP partners are not part of the HBP Consortium, thus not receiving any HBP funding

[5] Unit refers to a laboratory or department of a university or organisation

[6] The countries eligible to apply are all the EU Member States and the H2020 Associated Countries. For eligibility of other countries, see http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/international-cooperation_en.htm.

5.1 Budget of the proposal

The total Call budget is EUR 900,000, plus additionally 25% of Indirect Costs.

The requested budget must not exceed EUR 450,000 per proposal, including a voucher of EUR 45,000 Direct Costs per proposal to fund technical support for integration of project results in EBRAINs, which will be performed by the HBP High Level Support Team (HLST).

Co-funding information (on average 50% of the proposal budget) is expected to be provided. Proposals with no in-kind contributions are not *a priori* excluded, but must be justified.

It is expected that the new partners have the operational capacity to carry out the activities related to the main objectives of this CEoI. Nevertheless, subcontracting is allowed for activities not crucial to the HBP work (see Financial Rules - H2020-amga).

6. Pre-proposal submission

The pre-proposal **must** be submitted via the HBP open call platform. A member of the relevant WP will respond to the applicants within 1 week. The response will be limited to clarifying whether the proposal fits into the scope of the call and how the proposal could be improved.

Note: it is **mandatory** to submit a pre-proposal and it has no influence on the evaluation of the full proposal.

7. Proposal submission

The proposal is submitted via the HBP open call platform. The applicants are required to register a profile, enter the proposal information and partner data, and submit the proposal document as a PDF and the requested budget.

The applicants can edit the proposal before the deadline (e.g. submit revised versions); only the last version will be considered for evaluation.

Shortly after the submission of the proposal, an acknowledgement of receipt will be sent to the e-mail address of the proposal's main contact person, named in the submitted proposal. Sending of an acknowledgement of receipt does not imply that a proposal has been accepted as eligible for evaluation.

For any given proposal, the proposal main contact person will act as the main point of contact between the proposal partners and the HBP.

It is the responsibility of the applicants to ensure timely submission; proposals submitted after the deadline will not be considered. Failure of the proposal to arrive in time for any reason, including communications delays, will automatically leads to rejection of the proposal. The time of receipt of the message as recorded by the submission system will be authoritative.

Upon the call deadline, the proposals have to fulfil the admissibility and eligibility criteria in order to be retained for evaluation. In addition, the proposals have to strictly adhere to the template provided via the HBP open call platform, which defines sections and the overall length. Evaluators will be instructed not to consider extra material in the evaluation.

Note: a proposal submitted without the pre-proposal will be not considered eligible for the evaluation.

The HBP offers an email-based helpdesk system for applicants at info@opencalls.humanbrainproject.eu.

With the upload of the proposal template and the completion of the contact information, the applicants agree that contact names, affiliations and proposal titles of the winning proposals (only) will be announced on the HBP website.

8. Ethical issues

Research activities in Horizon 2020, and particularly in the HBP, must respect fundamental ethical principles, particularly those outlined in the Horizon2020_Ethics_Guidance.

If there are ethical issues specific to your proposal (please see the ethical issue table in the Horizon2020_Ethics_Guidance.pdf above), before and during the runtime of the research activities within the HBP, you must submit an HBP Ethical Issues and Approvals survey and include the documents that you need under national law (e.g. proof of approval by the competent authority).

The HBP Ethical Issues and Approvals survey should describe how the proposal meets the national legal and ethical requirements of the country or countries where the tasks raising ethical issues are to be carried out; and explain, in detail, how you address the issues in the ethical issues table, in particular with regard to research objectives (dual use, etc.), methodology (protection of collected data, etc.) and potential impact of the research (dual use issues, benefit-sharing, misuse, etc.).

Applications, especially from non-European countries, must make sure to comply with the above Horizon2020 Ethics Guidelines and clarify ethical issues before the proposal submission.

Proposers must demonstrate that they are mindful of the fact that the citizens of Europe trust the public R&D endeavour to produce tangible results benefitting society by advancing health, economic growth, and quality of life across all communities.

The applicants are responsible for ethical compliance. They will work with the HBP contact persons, the respective HBP ethics rapporteur and ethics support team to ensure compliance with ethical and legal requirements. Their ethics compliance will be included in the HBP ethics compliance management processes.

9. Equal opportunities

Gender equality concerns all parts of Horizon 2020 (see the Guidance on Gender Equality in H2020). HBP has committed itself to improve equal opportunities, especially to balance the proportion of male and female scientists in leadership positions, as well as among PhD students and post docs. HBP created the Gender Advisory Committee which provides advice and feedback on the Gender Action Plan of HBP on activities planned to improve equality in their respective areas of responsibility.

The HBP aims to demonstrate how diversity drives scientific excellence, innovation, and collaboration and aims to become a European best practice example for fostering equal opportunities across different institutions, member states, disciplinary cultures and intellectual environments.

The applicants are invited to outline in their proposal which measures will be undertaken to foster equal opportunities and how sex, gender or other diversity issues are addressed as part of their research. Equal opportunities represent an evaluation criterion (see Table 1).

10. Proposal evaluation

All submitted proposals will be evaluated by acknowledged external experts from relevant research fields and by reviewers from the broader scientific community (all referred to as 'experts'). To avoid conflicts of interest, the experts are independent of the HBP Consortium and the applicants. The conflict of interest rules for this call are set out here.

Experts will maintain strict confidentiality with respect to the entire evaluation process. Experts perform evaluations in their private capacity, not as representatives of their employer, their country or any other entity. Under no circumstance may an expert attempt to contact an applicant directly, either during the evaluation or afterwards. Experts cannot submit an Expression of Interest (EoI) proposal for the call they are reviewing.

The proposals evaluation will be performed in two steps.

In the **first step**, at least three external experts will review individually each proposal assigned. They evaluate each proposal considering the evaluation criteria in 9.1 - Table 1. The experts score each criterion (0 to 10, detailed in 9.1 - Table 2), with explanatory comments.

In the **second step**, the experts discuss and compare all the proposals during the panel meeting. They establish the final ranking of the proposals, providing a list of proposals being above and below threshold. A proposal is considered as eligible for funding if all thresholds are met or exceeded, however, the highest ranked proposal will be selected for funding. If all proposals fall below threshold, no selection will be made and the CEoI might be reopened.

The experts will be advised by an invited group of HBP members of the Directorate (DIR) and WP leaders, who will clarify the procedure and need of the HBP prior the evaluation, and offer their opinion on the relevance of the proposals to the HBP during the panel meeting.

The ranked list of the proposals will be presented to the HBP Science and Infrastructure Board (SIB) and the DIR for endorsement. The selected proposal will be funded and integrated into the envisaged HBP SGA3 Work Plan.

To ensure transparency, the results of the evaluations will be made available to the EC.

After completion of the call, applicants will receive the evaluation summary report for their proposal. Any request for redress can only be based on procedural grounds and must be submitted by the proposal coordinator within 30 days from the receipt of the official letter.

Note: The addition of new Partners to the Consortium is subject to the approval of the required FPA and SGA amendments by the HBP Stakeholder Board and the EC. Following this process, the partner(s) will be welcomed into the HBP consortium.

10.1   Proposal evaluation criteria and scores

The evaluation criteria for this CEoI are provided in Table 1. The criteria reflect the expected impact of project funded under this HBP CEoI.

The evaluation scores are provided in Table 2.

11. Additional information

You can find more information on the HBP here.

A list of Frequently Asked Questions (FAQ) is available here.

Table 1: Proposal evaluation criteria

1. Scientific excellence	Weight: 40%
• Credibility and soundness of the proposed research theme and degree of conformity to provided specifications • Extent to which proposed work is ambitious, has innovation potential, and is beyond the state of the art (e.g. ground-breaking objectives of the long-term vision of the proposal, novel concepts and approaches and their potential to become a seminal work, etc.) • Quality and effectiveness of the detailed research plan (including appropriateness of tasks and experiments, milestones, and indicators to monitor progress) • Enhancing innovation capacity and generation and integration of new knowledge	*Score: ?/10* *(Threshold: 8/10)*
2. Impact	**Weight: 30%**
• Contribution to the design and development of the HBP research infrastructure • Coordination with the HBP WP5 • Contribution to HBP human neurosciences and to theory development	*Score: ?/10* *(Threshold: 8/10)*
3. Implementation	**Weight: 20%**
• Suitability of planned costs • Co-funding provided by the Partners (in-kind, cash or combination) • Appropriateness of proposed work plan • Quality of the Organisations and of the group of applicants as a whole (including complementarity, balance, involvement of key actors, prior history, relevant experience of the individual partners)	*Score: ?/10* *(Threshold: 8/10)*
4. Equal opportunities	**Weight: 10%**
• For teams, is the diversity aspect (gender, age, career stage, other factors) taken into consideration/ are there any measures in place? If there is a gender imbalance, are measures planned to improve gender equality? • In research activities, when human beings are involved as subjects or end-users, gender differences or other diversity factors may exist. In these cases, is the gender dimension and relevance of scientific questions on gender or other diversity factors (e.g. age) in the research content addressed as an integral part of the proposal?	*Score: ?/10* *(Threshold: 8/10)*
Remarks	
• Ethical implications and compliance with applicable international, EU and national law • Ensure that the study proposed will not promote indications that raise ethical issues	*No Score*
OVERALL SCORE	*Score: ?/10* *(Threshold: 8/10)*

Table 2: Proposal evaluation scores

0	The proposal fails to address the criterion	The proposal fails to address the criterion under examination or cannot be judged due to missing or incomplete information.
1-2	Poor	The criterion is addressed in an inadequate manner, or there are serious inherent weaknesses.
3-4	Fair	While the proposal broadly addresses the criterion, there are significant weaknesses.
5-6	Good	The proposal addresses the criterion well, although improvements would be necessary.
7-8	Very good	The proposal addresses the criterion very well, although certain improvements are still possible.
9-10	Excellent	The proposal successfully addresses all relevant aspects of the criterion in question. Any shortcomings are minor.