UK Research and Innovation

Cross-cutting research for exascale software and algorithms

Opportunity status:	Open
Funders:	Engineering and Physical Sciences Research Council (EPSRC)
Funding type:	Grant
Total fund:	£5,000,000
Award range:	£900,000 - £1,000,000
Publication date:	26 February 2021
Opening date:	26 February 2021
Closing date:	15 April 2021 16:00 UK time

Last updated: 17 March 2021

Start application ▶

Apply for funding to research issues that impact the development of exascale software and algorithms. This should address one of the following cross-cutting research themes:

- future computing paradigms
- coupling
- verification, validation and uncertainty quantification
- domain-specific languages.

You must be either:

- a researcher at an eligible research organisation
- an employee of an eligible public sector research establishment.

You can be from any area of the UK research community. You do not need to be a researcher working within EPSRC's remit.

Your project must be three years long, starting on 2 August 2021. We'll fund 80% of its full economic cost.

Up to five awards are available.

This funding is through the Exascale Computing: Algorithms and Infrastructures Benefiting UK Research (ExCALIBUR) programme, which is part of the Strategic Priorities Fund.

Open all

Who can apply

You can apply if you are a researcher at a higher education institution, research institute, or independent research organisation accredited by UKRI. You can also apply if you are employed at an eligible public sector research establishment.

Read **guidance on institutional eligibility**.

Holders of postdoctoral level fellowships are not eligible to apply for an EPSRC grant.

Applicants across the UK research landscape are invited to apply to this opportunity, including mathematicians, computer scientists and domain experts.

Applicants must engage with the ExCALIBUR Programme Hardware and Enabling Software Group to discuss process of accessing their facilities. Engagement and collaboration with other projects funded by the ExCALIBUR programme is a requirement for proposals.

Applicants to collaborate with researchers, businesses and international collaborators.

We expect a high demand of applications, therefore two proposals will be accepted per institution and an institutional statement of support is required.

Submissions to this opportunity will count towards the EPSRC repeatedly unsuccessful applicants policy.

Grants must start by 2 August 2021.

What we're looking for

Synopsis

The themes of the cross-cutting research opportunity were defined following a market engagement event jointly held by the Met Office and EPSRC in November 2020.

The community were invited to comment on cross-cutting themes proposed by the programme and submit ideas on areas of importance to be addressed for this opportunity.

The results of these submissions have defined the scope of the EPSRC and Met Office opportunities.

The cross-cutting research is a core tranche within ExCALIBUR, and funded grants are expected to:

- utilise the lessons learnt from the use cases and design and development working groups to address common issues that impact scientific code under development for use at exascale
- deliver knowledge integration with ExCALIBUR projects currently funded and those that will be funded across the duration of the programme
- establish two-way knowledge exchange with the wider research community, industry and internationally for your chosen theme on the behalf of the programme
- applicants should consider how they will integrate and optimise their findings in parallel with the scientific code development carried out by the ExCALIBUR use cases and design and development working groups.

Scope

The ExCALIBUR programme has defined cross-cutting research as: a coordinated approach addressing a known technology or infrastructure issue, which, if resolved, will lead to significant progress across a range of exascale software development challenges.

The scope of the ExCALIBUR cross-cutting research opportunities for the Met Office and EPSRC were defined to enable the research community's decision on where their research is best suited.

Applications to this opportunity are welcomed from across UKRI's remit and from eligible research establishments.

Cross-cutting research is either identified as a potential disruptor or a common approach or solution. A potential disruptor is not currently utilised to address challenges of software development for exascale and requires research to assess feasibility of this approach. A common approach or solution is a technology which can be implemented or modified to maximise efficiency, capability and expertise required for exascale software and architecture.

Proposals must identify which of the four themes they are submitting to as proposals will be reviewed by theme.

Potential disruptors

Future computing paradigms

Proposals within this theme must be potential disruptors to the current practices within the development and optimisation of exascale software and architecture.

Potential disruptors include, but are not limited to:

- quantum technology
- artificial intelligence
- neuromorphic computing.

These approaches may simulate future exascale systems, investigate data analysis or mixed-precision performance.

Common approaches or solutions

Coupling

Applicants should submit proposals that investigate and research coupling technologies that address the complexity of concurrently running multiple applications required to produce unified results for heterogeneous systems.

Verification, validation and uncertainty quantification (VVUQ)

Proposals that will develop and implement VVUQ to be utilised across ExCALIBUR, specifically the mentioned use cases. VVUQ is essential to establishing actionable and trusted software for future systems.

Domain specific languages

The programme seeks to bring together a range of domain experts across mathematical sciences and computer sciences in the UK research landscape to address exascale software and architecture requirements.

Various existing and upcoming programming languages are utilised or under development which requires some standardisation.

Proposals to provide solutions that drive efficient practices for exascale; identify resolutions of barriers for co-design across domain-specific languages or consider interoperability between languages.

Integration with ExCALIBUR Use Cases

The output of each project should be applicable to at least two out of:

- the Met Office weather and climate prediction use case
- the UK Atomic Authority Agency fusion modelling use case
- any collection of the UKRI design and development working group use cases.

Code should be developed for one of these and a report prepared on the applicability to one or more of the others.

Knowledge exchange coordinator

Knowledge exchange (KE) is a vital component of achieving the objectives of the ExCALIBUR programme. It will ensure integration across the programme activities where researchers are developing software and algorithms in preparation for future exascale systems.

Additionally, connections are required with potential beneficiaries in academia, public sector research establishments (PSREs) and industry to contribute to these designs and the dissemination of outcomes.

Therefore, proposals must include a named co-investigator or research co-investigator who will have the role of a KE coordinator to lead these endeavours. Flexible funds can be requested to deliver activities to aid KE and will be managed by the principal investigator and KE coordinator. Expectations for this role include, but are not limited to:

- identify opportunities for KE within their project or grant, with other ExCALIBUR programme projects or grants, and with other relevant national and international projects
- identify opportunities for KE to develop and maintain a two-way flow of engagement and dissemination with industry and relevant national and international research communities
- develop a plan to increase the awareness of the proposed activity and the ExCALIBUR programme – the plan should include a rationale of the flexible funds requested to support this and timescales to accomplish this
- collaborate with other ExCALIBUR KE coordinators as a network to deliver the programme's knowledge dissemination strategy.

Collaboration with industry and internationally is encouraged for this opportunity. Applicants should engage with the ExCALIBUR Hardware and Enabling Software Group or the EPSRC team for information on facilities which are available.

Funding available

£5 million is available to fund five projects for a duration of three years at 80% fEC.

Financial profiles must be confirmed with EPSRC before grants can begin. Costs should include:

- flexible funds for KE activities (expected to be equivalent to 10% of the total funds requested)
- researcher time
- consumables
- technical staff time
- support staff.

Equipment over £10,000 in value (including VAT) is not available through this opportunity. Smaller items of equipment (individually under £10,000) should be in the 'directly incurred – other costs' heading.

See more information on **equipment funding**.

How to apply

Applicants should ensure they are aware of and comply with any internal institutional deadlines that may be in place.

You should prepare and submit your proposal using the research councils' **Joint Electronic Submission system (Je-S)**.

When adding a new proposal, you should go to documents, select New Document, then select:

- council: EPSRC
- document type: Standard Proposal
- scheme: Standard Research

And, on the project details page, you should select: SPF ExCALIBUR Cross-Cutting Research.

After completing the application:

- you must 'submit document' which will send your application to your host organisation's administration
- your host organisation's administration is required to complete the submission process. Applicants should allow sufficient time for your organisation's submission process between submitting your proposal to them and the closing date.

EPSRC must receive your application by 16:00 on 15 April 2021

As well as the Je-S application form, the following documents must be submitted:

- case for support: eight pages – two on your track record and six on the scientific case
- workplan: one page
- justification of resources: two pages
- CVs: up to two A4 sides each only for named post-doctoral staff, researcher co-investigators (research assistants who have made a substantial contribution to the proposal and will be employed on the project for a significant amount of time), and visiting researchers
- letters of support from all project partners included in the Je-S form: no page limit
- technical assessments for facilities listed as requiring one in the Je-S guidance: no page limit
- host organisation letter of support: two pages.

You should attach your documents as PDFs to avoid errors. They should be completed in single-spaced Arial 11 font or similar sized sans-serif typeface.

Read our **advice on writing proposals**.

EPSRC will not fund a project if it believes that there are ethical concerns that have been overlooked or not appropriately accounted for. All relevant parts of the ethical information section must be completed.

See guidance on **completing the ethical information section of the Je-S form**.

EPSRC guidance can be found under additional information.

How we will assess your application

Assessment process

This opportunity will go through a two-stage assessment process:

Stage one: expert prioritisation panel

The expert panel membership is expected to comprise multidisciplinary academics, PSRE, industrial and international expertise.

The panel members will act as postal peer reviewers to provide applicants with the right to reply.

- PI response sent out: week beginning 17 May 2021
- PI response submission: week beginning 24 May 2021.

Proposals will then be assessed by the panel at an expert prioritisation panel meeting resulting in a rank ordered list and recommendations for interview.

Stage two: expert interview panel

Applicants will be invited to an expert interview, the principal investigator and up to two others identified on the proposal will be invited to the attend the interview. It is expected that the KE coordinator will participate in this interview.

Full guidance will to be sent to candidates prior to the interview.

EPSRC reserve the right to alter this process subject and will inform applicants of changes.

Assessment criteria

The standard criteria below will primarily be addressed by the expert prioritisation panel, whilst opportunity criteria will be an assessed at the expert interview panel. Further guidance will be provided to applicants invited to interview.

Quality (primary)

The research excellence, making reference to:

- the novelty, relationship to the ExCALIBUR programme, timeliness and relevance to identified stakeholders
- the ambition, adventure, transformative aspects or potential outcomes for exascale software and algorithms
- the suitability of the proposed methodology and the appropriateness of the approach to achieving impact.

National importance (secondary major)

How the research:

- contributes to, or helps maintain the health of other disciplines contributes to addressing key UK societal challenges or contributes to future UK economic success and development of emerging industry(s)
- meets national needs by establishing a unique world leading activity
- complements other UK research funded in the area, including any relationship to the UKRI portfolio.

Applicant and partnerships (secondary)

The ability to deliver the proposed project, making reference to:

- appropriateness of the track record of the applicant(s)
- balance of skills of the project team, including collaborators.

Resources and management (secondary)

The effectiveness of the proposed planning and management and whether the requested resources are appropriate and have been fully justified, making reference to:

- any equipment requested, or the viability of the arrangements described to access equipment needed for this project, and particularly on any university or third-party contribution
- any resources requested for activities to either increase impact, for public engagement or to support responsible innovation.

Opportunity specific criteria

Fit to opportunity

- alignment of research programme to aims and objectives of the opportunity
- applicability of proposed research to the Met Office, UK Atomic Authority and UKRI use cases.

Knowledge exchange

- plan for integration and exchange of knowledge across the programme and the dissemination of knowledge with academia, PSREs and industry
- identified opportunities and barriers to knowledge exchange within programme and external beneficiaries and routes to mitigate these.

Feedback

Feedback will consist of postal peer review and information on GOW, if the panel request specific feedback is given to an applicant this will be supplied.

Guidance for reviewers

Find out more about the **EPSRC peer review process and guidance for reviewers**.

See **guidance for reviewing standard grants**.

Contact details

For any other opportunity specific information:

- Elizabeth Bent, **elizabeth.bent@epsrc.ukri.org**
- Billy McGregor, **billy.mcgregor@epsrc.ukri.org**
- Research infrastructure inbox, **researchinfrastructure@epsrc.ukri.org**.

For help and advice on costings and writing your proposal please contact your research office in the first instance, allowing enough time for your organisation's submission process.

Any queries regarding the submission of proposals through Je-S should be directed to:

- Je-S helpdesk, **jeshelp@je-s.ukri.org** or 01793 444164

Additional info

Supporting documents

- **equality impact assessment (PDF, 167KB)**
- **hardware and enabling software brochure (PDF, 1.95MB)**

Background

The ExCALIBUR programme

ExCALIBUR is a £45.7 million Strategic Priorities Fund (SPF) programme led by the Met Office and UKRI to meet this challenge by delivering research and innovative algorithmic development to harness the power of exascale HPC.

Radical changes to supercomputer architectures are on the horizon. The current simulation codes, that much of UK science relies on, are designed for current supercomputer architectures.

These codes will, at best, not be able to fully exploit the power that the supercomputers of the mid-2020s will deliver; at worst, they will run slower on those machines than they do now.

Future computers will be more energy efficient and so the longer we rely on the current approach, the more expensive the solution will be. Therefore, it is essential

that we invest now in redesigning those simulation codes so that they perform well on the future generations of supercomputers.

ExCALIBUR will be delivered over five years and will meet this challenge by delivering research and innovative algorithmic development to redesign the high priority simulation codes to fully harness the power of future supercomputers across scientific and engineering applications.

It will achieve this by bringing together an unprecedented range of UK domain experts, mathematicians and computational scientists who will identify common issues and opportunities in the high priority simulation codes and focus their combined scientific expertise and resources to accelerate toward interdisciplinary solutions.

The programme objectives have been designed to specifically address the benefits sought:

- efficiency: the UK's most important scientific simulation codes will be able to harness the power of the supercomputers of the mid-2020s resulting in an increase in scientific productivity for a given investment.
- capability: capitalising on this efficiency will enable the UK to continue to push the boundaries of science across a wide range of fields delivering transformational change in capability.
- expertise: a new, forward-facing, interdisciplinary approach to RSE career development will position the next generation of UK software engineers at the cutting-edge of scientific supercomputing.

ExCALIBUR is built around four pillars:

- separation of concerns
- co-design
- data science
- investing in people.

These pillars describe the fundamental principles that guide the development of research within the ExCALIBUR programme and are designed to ensure that the outcomes are future proofed against the constantly evolving landscape of hardware design.

It will be delivered through six main activities:

- the redesign of a core set of simulation codes (use cases) chosen to span a wide range of science domains
- knowledge integration across the programme through widely applicable cross-cutting themes
- application of learning from these activities to a second wave of use cases
- exploratory research to identify and develop emerging high-performance algorithms in areas with significant potential impact
- an interdisciplinary Research Software Engineer knowledge integration activity
- an annual capital investment to support the development of novel test beds to enable co-development with industry.

Design and development working groups

In April 2020, UKRI funded 10 design and development working groups for 15 months. These groups cover a breadth of disciplines and were funded to:

- develop a coherent community of practice comprising subject matter experts, RSEs, computational or mathematical scientists, and any other relevant individuals and groups
- enable effective engagement between the computational research community and research communities that can benefit from exascale computing.

A subset of these groups will be funded to continue research and development of a scientific code as a high priority use case and build upon their initial engagement with the wider research communities following a peer reviewed process; this will take place later this year.

An ExCALIBUR high priority use case is defined as: a co-ordinated range of activities, which aims to develop simulation code with a focus on an application or applications pre-identified by the relevant communities as benefitting from exascale software development.

Timeline

26 February 2021
Opening date

15 April 2021 16:00
Closing date

Early June 2021
Invitations to interview following panel assessment

Late June 2021
Expert interview panel

2 August 2021
Grant start date

Related content

ExCALIBUR programme aims and cross-cutting research calls (PDF, 207KB)

Met Office cross-cutting research call

- Design and development working groups
- Weather and climate prediction use case (PDF, 402KB)
- Fusion modelling use case (PDF, 642KB)
- Resubmissions
- Repeatedly unsuccessful applications
- Equipment on research grants
- Use of animals (PDF, 34KB)
- Framework for responsible innovation
- Ethics
- Equality, diversity and inclusion
- Reviewer selection
- Conflicts of interest
- DORA

NOTE This is the first phase of our new website – let us know if you have **feedback** or would like to **help us test new developments**.