

**UK Space Agency: Call for Ideas and Evidence
Response from the Royal Astronomical Society**

Your information:

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Organisation: Royal Astronomical Society

Your location (city or county within the UK): London, but we are a national and international organisation

Is this response from an individual or a collective response from an organisation or group? This is the official response from an organisation.

If this is a collective response, from which organisation/group is it from? The Royal Astronomical Society

With 4,000 members ('Fellows'), the Royal Astronomical Society (RAS, see <http://www.ras.org.uk>) represents professional and amateur astronomers, space scientists and geophysicists, as well as teachers, writers and journalists, and historians of science. Around three quarters of our membership is based in the UK, and so a large number have a professional interest in the work of the UK Space Agency and how it impacts on science and wider society.

This response draws on the views of our elected officers and governing Council, some of whom are currently in receipt of UK Space Agency funding. Our overarching aim is to stress the importance of scientific research in astronomy and geophysics, beneficiaries of and contributors to the UK's world-leading position in space.

Principle: Space is of strategic importance to the UK because of the value that space programmes deliver back to public services, national security, science and innovation and the economy.

Proposed actions:

The RAS strongly supports UK 'blue skies' space science and exploration programmes, through *continued major involvement in the European Space Agency and other collaborations*. In space science, astronomy, and planetary science, researchers here are working on, and have worked on, the development of missions such as Gaia, Planck and JWST (space science), and Rosetta, JUICE and ExoMars (planetary science). UK scientists lead much of the work exploiting their findings, and UK companies such as Airbus Defence and Space, and E2V have taken full advantage of this involvement, winning contracts to supply different components of the missions.

In geophysics, UK scientists' expertise in earth observation enabled them to take similar leadership roles in those missions, such as the satellites in the Copernicus programme. This activity has a well-documented wider impact with for example companies like ARGANS exploiting these data.

Space weather is a similar example, in this case demanding cross-disciplinary involvement of solar physicists, solar-terrestrial physicists, and engineers who understand the consequence of induced

current surges on sensitive electronic systems (such as satellites in orbit) and power infrastructure (the national grid).

A UK lead in these sciences, including in imaging technology in astronomy, weather observation, climate change, air pollution, other terrestrial hazards, efficient land use, and space weather are all important to national security, as is maintaining the human capital in these areas. Astronomy and space science are also particularly good vehicles for inspiring young people to pursue careers in STEM in general.

Alongside international collaboration, we see value in enabling the UK Space Agency to fund relatively small national missions. These programmes could increase the cadence at which space science missions can be flown, and therefore help maintain scientific and public interest in space exploration, while also helping train (and retain) a skilled scientific and industrial workforce in the UK space sector.

UK space science might also benefit from exploring synergies with the 'New Space' entrepreneurs with a view to increasing flight opportunities, reducing launch costs, and, ultimately, utilising space resources to further increase the scale of space exploration activities without increasing the cost to the taxpayer.

Evidence:

The UK strength in astronomy, space science and geophysics is indicated through international citation indices. See <http://www.scimagojr.com/countryrank.php?category=3103&area=3100> for astronomy and astrophysics from 1996-2015, <http://www.scimagojr.com/countryrank.php?area=1900&category=1912> for space and planetary science in the same period, and <http://www.scimagojr.com/countryrank.php?area=1900&category=1908> for geophysics. In all three cases the UK is ranked third in the world after the United States and Germany.

The RAS monitors and promotes the wider societal and economic impact of the sciences we represent. The two most recent publications covering this area are:

The Business of Astronomy, 2016

<http://www.ras.org.uk/publications/other-publications/2798-astronomy-means-business>

Going Underground (geophysics), 2014

<http://www.ras.org.uk/publications/other-publications/2410-going-underground-geophysics>

The UK government formally recognised the hazard of adverse space weather in 2010, when it was added to the National Risk Register.

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/419549/20150331_2015-NRR-WA_Final.pdf

The multiple scientific, industrial and social benefits of space science and exploration are outlined in the following documents:

<http://www.globalspaceexploration.org/wordpress/wp-content/isecg/Scientific%20opportunities%20beyond%20LEO.pdf>

<http://www.globalspaceexploration.org/wordpress/wp-content/uploads/2013/10/Benefits-Stemming-from-Space-Exploration-2013.pdf>

In April 2017 the RAS held a meeting dedicated to exploring the possible use of space resources to facilitate space science and exploration and a number of potential synergies with 'new space' companies were identified

http://www.homepages.ucl.ac.uk/~ucfbiac/RAS_space_resources_meeting_abstract_booklet.pdf.

Principle: Cooperating internationally to create the legal frameworks for the responsible use of space, and to collaborating with other nations to deliver maximum benefit from UK investment in space.

Proposed actions

The Society argues strongly that the UK should continue to be a major player in ESA's space science and exploration programmes. We support the development of ESA's European Exploration Envelope Programme (E3P) as agreed at the Dec 2016 ESA Ministerial Council.

In parallel, the UK Space Agency should open up funding opportunities for bi-lateral space science programmes in addition to ESA participation. Acting through both UKSA and ESA, the UK should support the continued development of the Global Exploration Roadmap currently being developed by the International Space Exploration Coordination Group (ISECG;

<http://www.globalspaceexploration.org/wordpress/>).

Evidence

In order for the UK to maximise these benefits it needs to be fully engaged in ESA's space science and exploration programmes, the European Exploration Envelope Programme (E3P;

http://m.esa.int/About_Us/Ministerial_Council_2016/Human_Spaceflight_and_Robotic_Exploration_Programmes), and the Global Exploration Roadmap

(<https://www.globalspaceexploration.org/news/2013-08-20>)