Leaving the EU: Implications and opportunities for science and research inquiry

Summary

1. The Royal Astronomical Society (RAS) has around 4000 members (Fellows) and is the leading UK advocate for the fields of astronomy, space science and geophysics. Our membership includes professional scientists working in academia and industry as well as many people with occupations across diverse sectors of the economy who use the skills and knowledge obtained during their time in academic research.

2. The RAS represents many UK astronomers and geophysicists who depend on public funding, including grants from the EU, for their research, so has an interest in the subject of the inquiry. Although we fund a small number of research fellowships, and those who benefit from this financial support might seek funding from the research councils and the UK Space Agency, we have no direct financial relationship with the bodies referred to in this response.

3. This is the official response from the Society to the Committee inquiry. In framing this submission, we have consulted with our governing Council and our wider Fellowship.

4. The RAS assembled evidence for the House of Lords inquiry into science and the EU in 2015, and our points are similar to those presented in that submission. We are now though primarily concerned with minimising the disruption of 'Brexit', and ensuring that UK science continues to thrive despite the major changes that are likely to take place in the next few years.

5. Overarching priorities for the Society include:

    - Continuing membership of international collaborations derived from EU membership
    - Full access to EU funding schemes including the European Research Council and broader Horizon 2020 Framework Programme
    - For UK scientists to be able to continue to work in the EU27, and for researchers in those countries to be able to enter employment here

6. In this submission we have highlighted a large number of EU-enabled projects as examples of work that enhances the UK scientific base. The Society asks the Committee, and the Government, to take note of these, and consider how we might remain partners in them once the UK leaves the EU. The negotiating team in the new Department for Leaving the European Union should ensure that they are fully apprised of the complex interdependency between the sciences, including astronomy and

geophysics, across the whole EU that is demonstrated by these programmes.

7. We in addition wish to see the Government ensure that nationals of other EU states working in the UK continue to feel welcome, and stand firmly against the well-documented rise in racism and xenophobia that has taken place since the referendum result was declared.

8. Turning to the specific questions raised by the Committee:

   1. The effect of the various models available for the UK's future relationship with the EU on UK science and research, in terms of:

   (i) Collaboration

9. Astronomy, space science and geophysics are all research areas where large numbers of scientists take part in EU-fostered collaborations.

10. These include ASTRONET[1], an EU project established in 2005 by the major European funding agencies and research organisations (the European Space Agency and European Southern Observatory[2]) to prepare long-term scientific and investment plans for European astronomy for the next 10-20 years.

11. A range of EU-funded projects contributed to the ASTRONET vision. These include:

    - The Optical Infrared Coordination Network for Astronomy (OPTICON)[3]
    - Radionet[4], which provided a similar network in radio astronomy
    - Europlanet[5], led by the Open University in the UK, a €10 million (£8.4 million) Horizon 2020 project, which links planetary science researchers in 34 institutions across 19 European countries.

12. Europlanet gives those researchers access to local facilities, pays for the transportation of equipment, covers travel costs, and covers technician time and consumables at the facility in use. A good example is the Planetary Environment Facility at Aarhus in Denmark[6], where scientists can simulate the properties of Martian atmosphere including composition, temperature, levels of ultraviolet radiation, wind and dust.

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[1] http://www.astronet-eu.org/
[2] http://www.eso.org/public/
[3] http://www.astro-opticon.org/
[4] http://www.radionet-eu.org/
[5] http://www.europlanet-eu.org/
[6] http://www.europlanet-2020-ri.eu/europlanet-2020-ri/europlanet-ta-facilities/ta2-distributed-planetary-simulation-facility-dpsf-0

13. Research labs in use by European scientists from different countries are also found in Amsterdam and Munster (isotope facilities) and in Graz (microbial life detection). Post-Brexit, there is a risk that the UK would need to pay for separate access to each facility, rather than being entitled to use through Europlanet.

14. In solar physics, where the UK has many active research groups, European countries collaborate via SOLARNET[7]. This brings together more than 500 scientists from 32 partners in 16 countries, with 24 EU institutions, 6 private companies and 2 US institutions all involved.

15. A project connecting the Sun and the Earth is the H2020-funded FLARECAST[8] project. This will be a fully automated forecasting system for solar flare prediction. FLARECAST will improve efforts to mitigate adverse space weather, which can have serious consequences on electronic technologies and power transmission. (Space weather was added to the National Risk Register in 2010.) The project has significant UK involvement from universities and the Met Office.

16. More widely, the UK has benefited by active participation in the European Strategy Forum on Research Infrastructures (ESFRI[9] - recently providing the chair) and AStroParticle European Research Area (ASPERA[10]), the astroparticle equivalent of ASTRONET. Both ESFRI and ASPERA fed directly into the ASTRONET Science Vision and Infrastructure Roadmap development. ASPERA led to the creation of the Astroparticle Physics European Consortium (APPEC[11]), an international organisation working to deliver the scientific goals in astroparticle physics set out in the earlier roadmap.

17. An example in geophysics is the development of new wave theory, which also feeds into many other fields such as communication, defence and non-destructive testing. Mainland Europe has sophisticated laboratories that test and help to develop the theoretical framework in this area, and an RAS Fellow has an EU-funded project, with 15 PhD students that link this infrastructure with researchers in the UK. Such collaborations are routine and well supported by current arrangements but would be at risk if the UK were no longer involved in these programmes, to the detriment of researchers here.

18. Alongside the ERC, the broader Horizon 2020 programme[12] supports research infrastructures across the EU, with active involvement from the UK. Scientists in astronomy and geophysics recognise that the

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[7] http://www.solarnet-east.eu/
[8] http://flarecast.eu/
[9] http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=esfri
[10] http://www.aspera-eu.org/
[11] http://www.appec.org/
[12] http://ec.europa.eu/programmes/horizon2020/

development of the largest scale, and often most important, facilities of the 21st century is beyond the means of single nations. European infrastructures allow multiple nations to work collaboratively to tackle major questions in science, and to plan the facilities needed to answer those questions.

19. H2020 funds are also used to invest in research infrastructures, through vehicles such as COMPET[13] and PROTEC[14]. After Brexit, UK influence over H2020 and the direction of future Framework Programmes is in question.

20. Participation in these programmes will also undoubtedly depend on the nature of the relationship the UK has with the EU27. Before the referendum the Leave campaign, and specifically Scientists for Britain, stated that continued involvement would be possible irrespective of EU membership.

21. At least some of these collaborations though depend on a financial contribution to the EU. If the UK remains a member of the European Economic Area (EEA) and contributes resources to Horizon 2020 (and the European Research Council) then research groups here will be able to continue to apply for and receive grants, and take a lead role in programmes in the same way as Norway and Iceland.

22. If however the UK ends its contribution, and restricts freedom of movement, then our involvement seems likely to be no better than 'third country' participation, with no automatic right to apply for grants, and no lead role in EU-supported collaborations.

23. The Committee will also be aware that research groups in other EU nations are modifying grant applications to ensure that Brexit does not affect them, by downgrading or removing the UK as a lead partner. At the same time some EU27 citizens have declined job offers, citing the uncertainty in UK science, and more generally around arrangements for foreign nationals. We welcome the announcement by the science minister that these effects will be monitored (and that academics are encouraged to report them).

24. The Society also notes that the uncertainty around the nature of our future relationship with the EU has led to a serious drop in confidence in the research sector, and that taking a clear and positive stance on this relationship could help rebuild the reputation of the UK in the international scientific community.

(ii) Free movement of researchers and students

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[13] http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/744-compet-06-2015.html

[14] http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/775-protec-1-2015.html

25. Like any technically skilled workforce, scientists, technicians and engineers cannot be replaced or retrained quickly. The uncertainty over the positions, or worse still the loss, of skilled individuals can be a profound setback for research projects, which are by their nature international in outlook and composition.

26. Recruiting people with the skills necessary for what are usually tightly focussed, and very specialised scientific projects, demands a search across a large geographical area, rather than being possible solely within the UK. This is the case irrespective of the funding body, whether this is the UK research councils, the EU, or other sources such as charities.

27. Scientists working in astronomy and geophysics thus see the free movement of people as vital to the strength of the European science base. Both disciplines have students and employees who work internationally and are very mobile. Research in the UK depends on the flow of PhD students and postdocs – the most talented early career researchers - between here and the rest of the EU.

28. For projects to be successful, employment of non-UK nationals needs to be fast and efficient. Grants are usually time limited, and research groups only have a few months from the announcement of the award to advertise and recruit people to new posts. RCUK allows no-cost extensions of up to 6 months but if the visa/work-permit process is slow it is easy to imagine scenarios where this is not long enough, something already demonstrated by the difficulties in recruiting scientists from outside the EU.

29. The ability to work in different EU countries is also very beneficial to UK-trained scientists who develop new skills and collaborations, which they often bring back to the UK. Marie Sklodowska-Curie actions individual fellowships[15] are a good example of a programme designed to facilitate this, and the loss of participation in this programme would be an enormous blow to young postdocs. UK academics seeking a permanent position are expected to have international experience and to be part of international networks, which enhances their scientific output, and programmes like Marie Sklodowska-Curie are enormously beneficial to those ambitions.

30. On a more general basis EU membership - and its stipulation that all citizens should be given equal treatment throughout the Union – has greatly reduced the administrative burden on internationally mobile personnel through some degree of harmonisation of access to pensions, healthcare and transparent taxation.

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[15] http://ec.europa.eu/research/mariecurieactions/about-msca/actions/if/index_en.htm

31. Coincidentally, the RAS is currently conducting a demographic survey of the UK astronomy and geophysics communities, and we will share these results in the autumn. In the last such exercise, carried out in 2010 and 2011, 12% of permanent academic staff, 25% of postdoctoral researchers, and 16% of postgraduate students were from other EU countries[16]. This suggests that university and laboratory research groups depend heavily on recruitment from the EU27.

32. A specific example of this in geophysics is the International Seismological Centre (ISC)[17], based in Berkshire and set up by UNESCO in 1964. The Centre employs a number of staff with passports from other EU countries. Its director is concerned that the uncertainty following the referendum is already leading them to consider relocation to other EU countries, which if it takes place will be a significant loss of skills and expertise.

33. Without careful negotiation, withdrawal from the EU inevitably threatens the international mobility of scientists. If the UK retains membership of the European Economic Area (EEA), then there should be only a moderate impact, with perhaps some issues around transfer of rights in areas such as healthcare and pensions.

34. If however the UK chooses to end its association with the EU, and instead negotiates a series of trade agreements without concomitant collaboration in other areas, then this ease of movement for scientists must be at risk, as well as participation in the EU programmes that encourage mobility of researchers. The recruitment of EU staff and the movement of UK researchers between countries has undoubtedly been a factor in the strength of UK research in astronomy and geophysics, a world-leading position that may now be at risk.

35. The Society is already very aware of the difficulties associated with immigration to the UK from outside the EU. To take an example, one of our members, an Indian citizen, is well established in employment in the UK, but comments that the need to obtain visas, even for travel to different countries in the Schengen area, is time consuming and expensive. In most cases these requests are simply to attend conferences or meetings of international collaborations. He further comments that as he does not possess an EEA passport, he is essentially ineligible for employment by the European Southern Observatory (ESO) and European Space Agency (ESA). We would not want to see any of these restrictions in place on UK nationals.

36. On the whole it seems likely that UK nationals will retain visa-free *travel* within the EU27 whatever the terms of our departure from the EU, but if

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[16] http://www.ras.org.uk/images/stories/ras_pdfs/Demographics%20and%20Research%20Interests%20of%20the%20UK%20Astronomy%20and%20Geophysics%20Communities%202010%20-%20Revised%202013.pdf

[17] http://www.isc.ac.uk/

freedom to access employment is restricted, British scientists will find it significantly more difficult to take advantages of opportunities elsewhere, including in ESO and ESA facilities outside the UK, and thus our role in those and similar organisations will be diminished.

37. If the Tier-based points system in operation for non-EU nationals, or a similar method, is applied to immigrants from the EU27 countries, as mooted during the referendum campaign, then it will need to ensure that migrants such as early career scientists are able to take up posts here and remain for a reasonable period of time. For example, the current stipulation that non-EU migrants need to earn at least £35k after five years in order to remain here would exclude many talented researchers who hold postdoctoral appointments.

(iii) Access to funding

38. The UK has received significant funding for these disciplines via the Framework Programmes, including Horizon 2020 (H2020). One of the most useful resources has been the European Research Council (ERC), in which the UK wins one of the largest shares of grants[18].

39. For example, astronomy and space science are funded by ERC panel PE9, via starter, consolidator and advanced grants. From 2007-14 UK research groups led 44 projects supported by a total of more than €80 million (£67 million).

40. Geophysics benefits in a similar way. Although grants in this area are covered by the broader framework of Earth sciences (PE10), geophysics made up a large proportion of the substantial sums granted. In the period 2007-14, starter, consolidator and advanced grants in this area gave more than €95 million (£80 million) to UK-led research projects.

41. The Committee should note too that the UK received more grants than any other participating nation, almost twice as many (108 in astronomy and Earth sciences) as our closest competitor, France (56 over that time). In all these areas, the size of grants awarded (often several million Euros) is significantly larger than the majority of those available through the UK research councils, and allows research groups to hire staff on a stable basis for the duration of their projects.

42. Research active astronomers and geophysicists see participation in the ERC and the wider H2020 programme, with its total budget of almost €80 billion, as extremely important. In addition to direct financial support, these programmes are a means to support astronomy and geophysics projects that are beyond the means of one country without complicated agreements between individual national agencies.

[18] https://erc.europa.eu/projects-and-results/statistics

43. These grants are mobile within the EU, giving awardees the flexibility to work wherever they choose. If in future the UK no longer participates in the ERC, there is a risk that current grant holders, who are international scientific leaders in their respective fields, will simply leave the UK to use their grants elsewhere.

44. In geophysics, researchers take a similar view; that ERC funding gives them opportunities that are not available from the main UK funding body, the Natural Environment Research Council (NERC). The ERC starting grant, for example, is not concerned with large collaboration or impact, but encourages 'risky' science and so allows new researchers to really pursue cutting edge projects.

45. ERC funding also allows groups to purchase capital items costing between £50k-£2m, whereas NERC stipulates that these purchases must be matched by funding from the grantholder's higher education institution. The result in the latter case is that the capital budgets in research grants are underspent, as HEIs are simply unable to meet this stipulation.

46. Another major UK organisation, the Tyndall Centre for Climate Change Research[19] at the University of East Anglia (UEA), receives nearly all its income through the EU. This in turn gives the organisation global international prestige, while simultaneously giving its scientists the ability to carry out bigger, more interesting and more policy relevant research for the UK than would be possible with support from domestic research councils alone.

47. Membership of the European Space Agency[20] (ESA) is also of great importance to UK astronomy and space science. This in itself is not contingent upon EU membership.

48. The EU however provides funds for the scientific exploitation of European space missions under H2020, with around 75% of its space budget made up of payments to ESA. The EU contribution makes up around 20% of the overall ESA budget, supporting programmes like the Copernicus Earth Observation satellites and the Galileo programme, where UK scientists and engineers play an extensive role.

49. If the UK no longer participates in H2020, this could thus reduce the scientific return we get from our substantial investment in ESA space technology and astrophysical/planetary space missions. Any new trade barriers resulting from EU withdrawal could also hamper the industrial contract return we receive under 'juste retour' rules.

50. Collaboration via EU programmes has also helped lead to seed-corn funding for early stage development of crucial aspects of several of the

[19] http://www.tyndall.ac.uk/
[20] http://www.esa.int/ESA

UK's highest (non-EU) priority projects, where we have substantial capital investment, such as the Square Kilometre Array (SKA[21]) and European Extremely Large Telescope (E-ELT[22]). Much of that funding has been utilised in the UK.

51. ESFRI identified the SKA and E-ELT as EU strategic facilities, though the national membership of SKA and E-ELT extend beyond the EU member states. The UK in particular has also benefited from trans-national scientific and technological EU funding for these facilities e.g. through the ASTERICS research infrastructure cluster.

52. The Society believes that it is almost impossible to get large scale funding for this type of work through UK-only routes and that creating such international networks would be far more difficult without participation in the overarching EU framework.

53. Astronomy and its associated public engagement also see benefits from participation in regional programmes, such as the European Regional Development Fund (ERDF) and the European Social Fund (ESF). These initiatives offer direct benefit to employment, skills and wider technology development regionally in the UK.

54. A specific example was the ERDF-supported New Generation Astronomical Telescopes (NGAT) project on Merseyside which led to the founding of a university subsidiary company and regional SME supplier chain creating or safeguarding over 150 FTE jobs by designing, building and delivering state-of-the-art large telescopes to an international market. These included the prototype, Liverpool Telescope[23] (LT), which is the world's largest and most capable robotic telescope and is a UK national research facility.

55. Associated with the Liverpool Telescope is the National Schools' Observatory[24] (NSO) which was kick-started by ESF funding as a regional project, but now has the participation of over 2000 schools across the UK, with the aim of using the innate interest of our young people in astronomy and space to enthuse them about the study of Science, Technology, Engineering, Mathematics and Medicine (the so-called STEMM subjects). The NGAT project also spawned the 'Spaceport' visitor centre, showcasing our science to the general public, again part-funded by ERDF, attracting over 60,000 visitors per year and whose establishment led to the creation or safeguarding of an estimated 50 jobs and the injection of over £3m annually into the economy of a deprived area of Merseyside.

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[21] https://www.skatelescope.org/
[22] http://www.eelt.org.uk/
[23] http://telescope.livjm.ac.uk
[24] http://www.schoolsobservatory.org.uk

56. Another public engagement example is the highly successful Discovery Centre at Jodrell Bank radio observatory[25], which received £1 million of its initial £3.1 million construction cost from the ERDF, with the remainder coming from the now abolished North West Development Agency.

57. The examples above demonstrate the risks to science of precipitate withdrawal from the EU, particularly if the end result is a relationship that means the UK can no longer access the Horizon 2020 Framework. We urge the government to negotiate continued participation in this and future Framework Programmes.

(iv) Access to EU-funded research facilities, both in the UK and abroad

58. Collaborations such as Europlanet at present offer UK scientists good access to facilities across the EU. Examples include those referred to earlier in the Netherlands, Germany and Denmark. Here in the UK the Open University laboratories[26] are available to scientists from other EU nations, which is both an appropriate reciprocal arrangement and one that encourages collaboration.

59. Another example is led by SOLARNET, which is now working to build the European Solar Telescope[27], to be sited in the Canary Islands. On completion this will be the most powerful solar facility in the world, and will help scientists better understand the connection between activity on the Sun and the effect of this on the Earth, and contribute to the FLARECAST models for space weather prediction described earlier.

2. What the science and research priorities for the UK Government should be in negotiating a new relationship with the EU.

60. The Society represents one area of science, rather than being able to comment on the wider programme, with priorities set for this by government and by peer review panels of the research councils.

61. We would nonetheless argue that blue skies research in subjects like astronomy and space science, and applied research in geophysics, are areas where the UK excels at a global level[28]. The new relationship with the EU should be negotiated in a way that takes account of and seeks to maintain this strength.

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[25] http://www.jodrellbank.net/
[26] http://www.europlanet-2020-ri.eu/europlanet-2020-ri/europlanet-ta-facilities/ta2-distributed-planetary-simulation-facility-dpsf/open
[27] http://www.est-east.eu/est/index.php
[28] http://www.scimagojr.com/countryrank.php (select search terms for subject specific data)

3. What science and technology-related legislation, regulations and projects will need to be reviewed in the run up to the UK leaving the EU.

62. The sciences we represent are affected less by regulatory frameworks than for example medicine or biology. There are nonetheless some areas where the EU has removed bureaucracy and potential customs duties, such as in the ease of movement of scientific equipment between countries, and it will be important to ensure that this remains in place after Brexit.

4. The status of researchers, scientists and students working and studying in the UK when the UK leaves the EU, and what protections should be put in place for them.

63. There are serious concerns in the astronomy and geophysics community for EU27 nationals studying and working in the UK, and for UK nationals who are studying and working in other EU countries.

64. During the referendum campaign, EU27 nationals were assured that their status was secure as a result of the 1969 Vienna Convention on the Law of Treaties, implying that rights conferred under international agreements are retained after their demise. Although this is a source of debate, any changes in the immigration rules should recognise the full existing rights of EU nationals resident in the UK, including in employment, and the government should seek reciprocal arrangements for UK nationals resident in EU27 countries.

65. Those employees are also concerned for their families, particularly where for example their spouses are not in employment, and are uncertain about whether to apply for UK passports, and whether doing so would risk losing the passport of their home country, or to instead seek opportunities elsewhere in the EU.

66. We further call on the Government to restate its total opposition to the rise in racism and xenophobia that has occurred since the Referendum took place. Although this originates from a small number of individuals, it appears that the outcome has encouraged them to perpetrate this abuse, and research students and employees have suffered as a result.

67. As well as monitoring the impact on grant applications and collaboration, the Government could explore collecting evidence of racist incidents arising from Brexit.

5. The opportunities that the UK's exit presents for research collaboration and market access with non-EU countries, and how these might compare with existing EU arrangements.

68. In astronomy, space science and geophysics, there are many existing collaborations with non-EU countries, including with the United States, India and China. Part of the appeal of the UK as a partner has been our

participation in European projects, so any opportunities that arise as a result of Brexit will be affected by our continuing involvement in those programmes. We would of course though be supportive of efforts to expand UK scientific collaboration with partners around the world.

6. What other measures the Government should undertake to keep UK science and research on a sound footing, with sufficient funding, after an EU exit.

69. The scientific community, including astronomers and geophysicists, has benefited from some certainty in budgetary arrangements for more than a decade. Although the flat cash settlement has been criticised, it did at least provide stability and gave funding agencies the ability to plan activity several years into the future.

70. After the Brexit vote, the community now seeks assurances that the UK government will mitigate the resource and capital funding lost as a result of EU withdrawal. This financial compensation alone would not cover the impact of potential withdrawal from EU programmes, not least the 'added value' of collaboration in international networks. It would though at least send a signal that the UK government acknowledges our strength in science, including in blue skies research, and that it wishes to see this country remain an attractive destination for talented people around the world.

71. In the short to medium term, another risk is the inherent uncertainty in science and research policy while negotiations take place, and how this affects the ability of e.g. the research councils to make long term decisions. The impact of Brexit on the strength of sterling is also an issue for astronomy in particular, as the result will be an increase in the cost of international subscriptions to collaborations like ESO. Although the Treasury protects research councils by covering changes in exchange rates to some extent, as a result of reforms put in place by former science minister Lord Drayson, it nonetheless represents an additional cost that reduces the overall resource for science.