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*Advancing Astronomy and Geophysics*

The Clerk
Science and Technology Committee
House of Commons
7 Millbank
London SW1P 3JA

12th April 2013

Dear Sir or Madam

**Inquiry into the European and UK Space Agencies: Submission from the Royal Astronomical Society (RAS)**

I have enclosed the response from the RAS to the Committee inquiry.

Please do not hesitate to contact us if you need any further information and please also note that representatives of the Society would be very happy to give oral evidence in support of our written submission.

Yours faithfully

R. M. Massey

Dr Robert Massey
Deputy Executive Secretary
(Media, Public Affairs, Policy, Education and Outreach)

**House of Commons Science and Technology Select Committee: Inquiry into the European and UK Space Agencies: Response from the Royal Astronomical Society**

**Declaration of interests**

This is the official submission from the Royal Astronomical Society to the Select Committee inquiry into the European and UK Space Agencies. The Society itself has no financial relationship with either the European Space Agency or the UK Space Agency. Many of our Fellows however are either employed by these organisations, receive grant funding from them or are involved with them in advisory roles.

**Introduction**

1. With more than 3700 members (fellows), the Royal Astronomical Society is the UK body representing professional astronomers, space scientists and geophysicists. As such we are pleased to respond to this inquiry, as the concerns raised are of direct relevance to all of these communities.

**Executive summary**

2. The RAS submission includes the following points:

    - The European Space Agency (ESA) has enabled European space scientists to carry out work at the same level as their peers in the United States and elsewhere in the world
    - We welcome the involvement in and interest of the EU in space policy. That involvement however should acknowledge the interests of the ESA member states that are not members of and are unlikely to join the EU in the foreseeable future
    - The formation of the UK Space Agency was an important and positive step and welcomed by the space science and astronomy communities
    - Research scientists nonetheless remain concerned that instruments and space missions developed by the UK Space Agency may not be fully exploited, a consequence of resource constraints in the research councils and the Agency itself
    - The explicit reference to space activity and support for scientific research in the Horizon 2020 programme is welcome, but this is not straightforwardly compatible with ESA
    - UK involvement in the ESA Space Situational Awareness (SSA) programme allows British scientists to be part of the effort to protect space- (and some ground-) based infrastructure from the impact of severe space weather

**What are the strengths and weaknesses of the funding, organisation, and work of the European Space Agency?**

3. Since its formation in 1975, the European Space Agency (ESA) has enabled scientists from its member states to develop and exploit the results of world-class scientific missions. ESA missions have covered planetary exploration (from the Giotto mission to Halley's Comet in 1986 to forthcoming spacecraft to Mars and Mercury); observation of the Sun (SOHO, jointly with NASA) and the wider Universe (good examples being the infrared Herschel telescope and Planck satellite). Its satellites have also played and continue to play a key

role in Earth observation (including the ice monitoring satellite Cryosat and the SWARM satellite that will study the terrestrial magnetosphere) and have given us a real insight into the processes that shape our planet.

4. ESA appears to be largely effective as an organisation, in that with a total budget of €4.3bn, less than one third that of NASA, it has delivered world-class space missions for scientific and civil applications. In 2011, the ESA allocation for science was €465m, whilst €129.4m was set aside for robotic exploration, €844m for Earth observation and €410.9m for human spaceflight. The largely efficient use of these resources has allowed Europe to take the lead in a number of areas, for example in the ESA Euclid mission to explore dark energy, where NASA cancelled its proposed equivalent project but later elected to support the European spacecraft.

5. Unlike bilateral arrangements between states, ESA has no dominant partner and member states are free to opt in (or not) to the majority of programmes. This lets the UK focus its investment on national priorities and then exert influence in those areas.

6. ESA, unlike NASA, has the capability to take longer term financial decisions. UK space scientists see this continuity as being of vital importance for a sector where projects can easily last 20 years from inception to end of operations.

7. The weaknesses that the scientific community perceive in ESA are often a result of funding restrictions that in turn limit the scientific programme. A recent example is the selection of the L1 (large) class mission, where the JUICE probe to Jupiter was selected in competition with the gravitational wave observatory NGO and the X-ray observatory ATHENA. The three proposals related to very different areas of science and yet were tensioned against each other, inevitably leading to some controversy around the final decision.

8. One area that may not be as efficient is the requirement to use ESA facilities to do work such as the processing of data from ESA missions. An example cited by geophysicists is the SWARM mission, where the projected cost is €100m, a figure that compares unfavourably with other projects. ESA expect member states to find the resources for this work but at least in the UK this is proving difficult to deliver.

9. In the overall context of the inquiry, MPs may also wish to consider the ambitions for space exploration set out in the 2007 Global Exploration Strategy and the 2011 Global Exploration roadmap[1]. Both of these policy documents are products of discussions between space organisations from around the world, including ESA and the UK Space Agency.

[1] http://esamultimedia.esa.int/docs/GES_Framework_final.pdf and http://www.nasa.gov/pdf/591067main_GER_2011_small_single.pdf

**In light of the European Commission's recent Communication on relations between the ESA and EU (COM 2012 671), what relationship between ESA, the EU and the UK would provide the most effective governance regime? Why?**

10. The Communication sets out areas where oversight is poorly aligned, from the differing memberships of the EU and ESA to the ways in which the two organisations are politically accountable. The two full member states of ESA outside of the EU are Norway and Switzerland, neither of which seem likely to accede to EU membership in the near future and the same applies to Canada, the main associate ESA member.

11. Over the 40 years of its existence ESA has been accountable to its member states through its governing Council. That relationship makes it responsive to national interests. With the increase in EU funding of ESA and the importance of the Horizon 2020 programme, there is a case for an enhanced EU governance role, but this should not be at the expense of the interest of the non-EU member states.

**How effective is the EU's support for research and innovation in the space sector? What effect have changes to the Multi-Annual Financial Framework had on ESA and support for the space sector from the Horizon 2020 programme?**

12. The sheer size of the Horizon 2020 programme (with an agreed budget of almost €70 billion) and the explicit reference to space activity within it represent a major EU commitment to the space sector, as does the contribution of 20% of the ESA budget.

13. As well as funding research, the existing Framework 7 Programme has supported work such as the Europlanet initiative, which brings together more than 100 institutes engaged in Solar system science[2].

14. The different aspects of Framework Programmes are however not always aligned with the strategies of the scientific and engineering communities, such as the space exploration aspects of the ASTRONET roadmap[3].

15. Perhaps as a consequence of its administration by the DG Enterprise and Industry rather than the DG Research and Innovation branch of the European Commission, Framework Programme funding also places demands on scientists to acquire two industrial partners. For blue skies projects, this can be a challenge and it sits uneasily alongside the ESA model.

**How effective has the UK Space Agency been and what improvements could be made? Is the UK effectively exploiting opportunities for growth in the space sector or could more be done?**

16. In the 2007 Committee inquiry into Space Policy, the RAS argued strongly for the creation of a space agency in the UK. We therefore welcomed the formation of the UK Space Agency and continue to see this as a positive step for space science.

17. The 30% increase in the UK contribution to ESA agreed in the 2012 Ministerial Council was a welcome development for space science and

[2] http://www.europlanet-eu.org/
[3] http://www.astronet-eu.org/IMG/pdf/Astronet-Brochure_light.pdf

demonstrated the renewed commitment to the UK Space Agency. This uplift has also helped to increase UK influence on ESA strategy to a level comparable with other major industrialised nations such as France and Germany.

18. At the time of its establishment the way in which the Agency and the research councils relevant to RAS interests (i.e. STFC and NERC) would work together were not clear. The implementation of the so-called 'dual key' approach, whereby the Space Agency supports the development of scientific missions and the research councils support the exploitation of mission data, is still a matter of concern for some members of the scientific community, particularly in geophysics.

19. These researchers are critical of that relationship, where they are asked to find funding for exploitation from the normal research council grants programme. Taking the example of the SWARM mission, scientists are struggling to become involved with the early processing of data from the spacecraft, meaning that the UK misses out on this aspect of 'georeturn' (see the next section). The capital investment in mission development through the UK Space Agency is then not necessarily being realised in access to its scientific output. Rather than being a matter of process, this seems to reflect constrained resources in both the Space Agency and the research councils.

**Does the UK get good value for money from its membership of ESA? How does its return on investment compare to other countries?**

20. Solely on the basis of the 'georeturn' rule, which aims to apportion the value of industrial contracts in each ESA member state in proportion to the contributions of their governments, UK membership is good value for money. According to the UK Space Agency, georeturn stood at 0.99 in 2012 (i.e. contract values were 99% of the funds available for this purpose), above the target of 0.96 set for 2014. There are some countries which do better than this, notably the Netherlands with a georeturn value of 1.10, but on the whole the UK georeturn is as expected. There is also significant variation between programmes, with the UK receiving a return as low as 0.34 from activities at the Guyana Space Centre and as high as 3.34 for launchers. The UK also has some industrial contracts in areas where it does not make a direct public contribution.[4]

21. Alongside the simple financial return from the subscription is the opportunity for British scientists and engineers to take part in projects that the UK could not support alone. Until recently the UK made one of the smallest contributions to ESA relative to GDP and yet British scientists have been involved in many flagship missions, a clear demonstration that our investment represents excellent value for money.

22. The scientific aspect of this investment has also delivered serendipitous returns to the economy and wider society, with technology spin-offs in a diversity of areas from security and oil exploration to car disc brakes. Space and astronomy are also widely recognised as 'STEM attractors' that encourage the study of and pursuit of careers in science, technology, engineering and medicine.

[4] European Space Agency: Industrial Policy Committee: Geographical distribution of contracts (4 March 2013)

**How resilient is the UK's space-based infrastructure? Are threats from space debris or solar activity being appropriately mitigated? What role do, or should, ESA and the UK Space Agency play in addressing these issues?**

23. The RAS highlighted the threat of severe space weather to UK space-based and ground-based infrastructures in our contribution to the 2010 Science and Technology Select Committee report on Scientific Advice and Evidence in Emergencies. This was recognised through its inclusion in the 2012 National Risk Register.

24. This assessment was reinforced in the severe space weather report published by the Royal Academy of Engineering in February 2013[5]. This report was the outcome of a year's study by a team of UK experts, both engineers and scientists, and including several RAS Fellows. Their report noted that, whilst our space infrastructure is built and operated to high standards, it would be at risk during a severe space weather event such as those observed in 1859 and 1956[6], but not experienced by our planet in recent decades. Such events can produce conditions that exceed the specifications normally used to design spacecraft.

25. Thus there is a need for research to better understand the scale and frequency of severe space weather events, so that satellite designs and operating procedures can be fully prepared for these rare but extreme events. In dealing with such extremes (whether space weather or other natural hazards) it is vital to exploit the long-term view and insight that research can provide. That view transcends individual and organisational memory and can significantly improve resilience against natural hazards.

26. Severe space weather falls firmly in this frame as shown by the recommendations of the Royal Academy for a range of research activities, including better measurements of space weather conditions on the Sun, in interplanetary space and at the Earth, and better modelling of those conditions in order to improve our forecasting capabilities.

27. This is where the role of ESA and the UK Space Agency are crucial. The Agency's recent decision to participate in the ESA space situational awareness (SSA) programme is opening up new opportunities for British scientists to develop space weather services and technologies, exploiting our world-leading skills in space-based and ground-based measurements of space weather conditions and in physics-based models of space weather phenomena.

28. The UK is making the second biggest financial contribution to the SSA programme, so we have the opportunity to influence the programme so that it meets the national needs being identified as part of Government preparation for a space weather emergency and that it supports the research activities of the UK space weather community. The engagement of the UK Space Agency

[5] Space weather: impacts on engineered systems, infrastructure and society, http://tinyurl.com/burj2xy
[6] These events are well-documented in the scientific literature through the efforts of RAS Fellows and other scientists working at the time of those events.

with the ESA SSA programme is a good step forward. It should enable the UK expert community to play a major role in developing space weather services that address national, European and global needs.