

Queen's chemists work with NASA to develop liquids for lunar telescope

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Chemists at Queen's University Belfast are working with NASA and scientists in Canada and the United States to design a telescope that can be stationed on the Moon.

The instrument will have a mirror consisting of a liquid with a thin metal film on its surface that rotates to form a bowl shape, known as a parabola. When the liquid spins in a perfect parabola, it will be able to reflect infrared light from distant stars and galaxies that cannot be picked up by telescopes on Earth because of atmospheric interference and light pollution.

Telescopes with parabolic liquid mirrors are much cheaper and easier to make and maintain than conventional telescopes with glass mirrors. Liquid mirror telescopes employed in observatories on Earth traditionally use mercury as the reflective liquid. However, mercury cannot be used for a lunar liquid mirror telescope as the high-vacuum conditions on the Moon would cause the mercury to boil.

The Queen's team has been investigating the possibility of preparing a reflective liquid for the telescope consisting of an ionic liquid that can be coated on its surface with a thin layer of a reflective metal.

Ionic liquids are liquid salts. They consist essentially of ions (electrically-charged atoms or groups of atoms). Ionic liquids generally have negligible vapour pressures which mean that they do not boil, even under vacuum. Many ionic liquids do not freeze at the sub-zero temperatures

found on the Moon. They have the added advantage that they are much lighter than mercury - a key consideration for transporting a telescope to the Moon.

In a report in the June 21 issue of the science journal *Nature*, the Belfast, Canadian, and U.S. scientists showed that a commercially-available ionic liquid can be coated with silver and that the coated fluid is stable over several months.

"The discovery that an ionic liquid can be coated with a very thin metal layer is a major breakthrough," said chemistry professor, Ken Seddon, who is one of the authors of the report and Director of Queen's University Ionic Liquids Laboratories (QUILL).

The authors also reported that the ionic liquid does not evaporate in a vacuum and remains liquid at temperatures down to 175 K (-98°C). The lunar liquid mirror telescope, however, will require a liquid with an even lower melting point.

Fortunately, there is a phenomenal choice of ionic liquids. More than 1,500 have been described in the scientific literature over the past ten years or so and about 500 are available commercially. According to Seddon, around one million simple ionic liquids are theoretically possible and they can be designed for a wide variety of applications. But most have yet to be prepared.

"We now plan to design and prepare ionic liquids with melting points of around 100 K that can be coated with a reflective metal for the lunar telescope" said Assistant Director of QUILL, Maggel Deetlefs.

Source: Queen's University Belfast

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