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Introduction: The biyearly International Conference on the Exploration and Utilisation of the Moon (ICEUM) meetings are organised by the International Lunar Exploration Working Group (ILEWG). This Working Group contains representatives from major space agencies around the world, including most ESA member nations, and is charged with developing an international strategy for the exploration of the Moon (http://www.estec.esa.nl/ilewg). ICEUM4 took place from July 10th to 14th 2000 at ESA’s science and technology centre, ESTEC, in the Netherlands. The meeting brought together lunar enthusiasts from many backgrounds to discuss and review recent lunar activities and to prepare for our future exploration of the Moon. There were a broad range of active sessions throughout the conference, from historical exploration through current and near future mission plans and on to the political, engineering and scientific aspects of establishing long-term robotic or Manned outposts on the lunar surface [1].

Young Lunar Explorers (YLE): Young professionals (aged 35 or less) were well represented and extremely active throughout ICEUM4, and the first day of the conference was primarily dedicated to presentations and discussions from this group. Presentations from members of the Lunarsat (Lunar Academic and Research Satellite) team were a major aspect of this [e.g. 2,3,4,5]. Lunarsat is a low cost mission that is being developed and driven primarily by young professionals from around Europe. The mission aims to launch as an auxiliary payload on an Ariane 5 and enter an elliptical polar orbit about the Moon carrying a suite of instruments that will, among other things, aid the search for water ice deposits at the lunar poles [4].

Also presented were the results of the Space generation Forum (SGF) discussions at the UNISPACE III Conference on the Exploration and Peaceful Use of Outer Space, held in Vienna in July 1999. A series of recommendations were developed from the two weeks of discussion, and ten of these were voted as those which should be carried forward to form the ‘Declaration of the Space Generation’ [6].

The afternoon of the Young Lunar Explorer session was devoted to group discussions aimed at producing recommendations for the final conference declaration. Separate task groups were established to discuss and debate various aspects of lunar exploration, and each produced a series of recommendations. These were then collated and refined to produce the final Young Lunar Explorer recommendations (the top 5 recommendations from the YLE are presented at http://sci.esa.int/content/doc/52/22610.htm).

It was clear from these discussions that there is wide support in the lunar community for a long-term exploration programme, evolving from robotic missions (including sample return) through complementary robotic/Manned exploration and ultimately working towards a permanent human presence on the Moon.

Lunar Science and Technology: Science and technology were strong themes at ICEUM4 with the presentation of some key results from recent missions such as Clementine and Lunar Prospector. Clementine data were presented in a study of the stratigraphy and volcanic history of southern Oceanus Procellarum on the lunar nearside [7]. The region was mapped in detail using compositional data from the UVVIS camera, showing a number of previously unmapped basalts and outlining variations in basalt thickness across the region. Clementine’s UVVIS camera data were also presented in a study of the mafic deposits in the South Pole-Aitken (SPA) Basin [8]. Evidence for probable deposits of olivine in the SPA were presented to support the suggestion that mantle material may be exposed in the area. Lunar Prospector data were presented in an integrated approach with Clementine results in order to investigate the distribution of iron, titanium and thorium across the lunar surface [9].

Near Future Missions: Both the European and Japanese lunar communities were given time to present and discuss the details of their upcoming missions. ESA’s SMART-1 mission [10] will test new technologies that will be used on future cornerstone missions [11]. Of prime importance is the solar electric propulsion system, which will gradually propel the craft from a standard GTO out to lunar capture over a period of approximately 15 months. SMART-1 is due for launch at the end of 2002 and will orbit the Moon for a nominal period 6 months, with three main planetary remote sensing instruments. The D-CIXS X-ray Spectrometer [12,13] aims to provide global X-ray coverage of the Moon for the first time and will obtain a global map of Mg, Si and Al. The SIR Infrared Spectrometer [14,15] will obtain near infrared
spectra across the lunar surface and aid in the mapping of olivines and pyroxenes across the Moon. High resolution imaging of around 30 m/pixel will be provided by the micro-imaging camera AMIE [16], which will also acquire limited spectral information at visible/near-infrared wavelengths.

The Japanese penetrator mission, Lunar-A [17], will be launched in 2003, and will conduct the first surface science measurements since the days of Apollo and Luna. Two penetrators will be fired into the surface to give a firm estimate of the size of the Moon’s core and conduct heat flow measurements. The Japanese also plan to launch the SELENE-A orbiter in 2004, which will carry a wide variety of remote sensing instruments [18]. Fourteen different science experiments are planned during the nominal 1-year lifetime of SELENE-A [19].

ICEUM4 Task Groups and Final Declaration: During the ICEUM4 conference, task groups were set up to discuss a diverse range of subjects related to lunar exploration, and the key points from each group were included in the final ‘ILEWG 2000 Lunar Declaration’. Task groups debated a wide number of topics, including ‘Science of and from the Moon’, ‘Living on the Moon’, ‘Key technologies’, ‘Utilisation of lunar resources’, ‘Infrastructures for lunar bases’, ‘Lunar role in human expansion in the solar system’, and ‘Social, cultural, artistic and economical aspects’. Some highlights from the final ‘ILEWG 2000 Lunar Declaration’ are below:

• The space agencies of the world are urged to focus their efforts to promote lunar exploration and development initiatives.
• Governments are encouraged to promote and support the creation of technologies, resources and infrastructure required for lunar research and development.
• Important scientific objectives are the characterisation of the lunar interior and the return of samples from key locations. Opportunities for higher resolution chemical and mineralogical mapping via remote sensing should be pursued.
• The Moon is an important test bed for demonstration of technologies to be used in the exploration of Mercury and other solid bodies.
• Technology for further investigations of lunar resources and their potential exploitation should be developed, including investigations of the potential deposits of water ice at the lunar poles.
• The protection of the lunar environment is important, but it appears that localised resource exploration and utilisation can be conducted without global adverse effects.
• Future lunar exploration and development must be a global endeavour, and should include the younger generation.

The full declaration can be found at http://sci.esa.int/content/doc/89/22665.htm. The final statement of the declaration is ‘Development of human capability on the Moon will be the next major step in humanity’s emergence into the Universe’. The declaration will be used as a focus for the efforts of the Lunar Explorer’s Society (LUNEX), which was founded during the meeting. Progress will be reported at ICEUM5, to be held as part of the World Space Congress in Houston in October 2002.

Lunar Explorers Society (LUNEX): An important step in the implementation of the ICEUM4 declaration was the creation of the Lunar Explorers Society (LUNEX). The purpose of LUNEX is to promote programmes of research, exploration and outreach that will work towards the realisation of the goals outlined in the ICEUM4 declaration. The society is open to all individuals interested in any aspect of lunar science and exploration (http://www.lunarexplorers.org). The first LUNEX convention will occur in March 2001, starting in Paris at the Palais de la Decouverte and moving to LPSC at Houston before closing during the EGS meeting in Nice.