Galaxy Education in the 21st Century

Galaxy Forum China

Beijing Planetarium, Beijing, China

Thursday, October 8, 2009 – 2-5 pm
International Lunar Observatory Association (ILOA) October 2009 Update

Steve Durst, ILOA / Space Age Publishing Company
Hawai`i and California, USA

- Galactic / Inter-Stellar
- Earth-Moon / Inter-Global
- Hawaiian
- Multi-Functional
ILOA – 3 Missions

- ILO-1 Polar Mission (NET 2012)
- ILO Precursor Mission (NLT 2012)
- ILO Human Service Mission
International Lunar Observatory (ILO)

ILO-1 Polar:

- ILO to be Located at ‘Malapert’ Mountain
- ‘Electrification’ of the Moon
Fig. 1: Top View of the First part of the Scenario

Graphic: Paul van Susante
Lunar South Pole – Chang’e
Lunar South Pole – Kaguya

Mons Malapert

Shackleton Crater

© JAXA/NHK
Lunar South Pole - Chandrayaan
Primary and Secondary ILO Mission Objectives:

• First Light Galaxy Imaging
• Initial landing site observation, local surveillance
• Earth observations: albedo, geocorona, etc.
• Search for Earth-like planets
• Search for Extra-Terrestrial Intelligence (SETI)
• Analyze interstellar molecules to determine origin of Solar System
• VLF observation
• Observe signs of life on Mars, Europa, Titan, etc.
• Search for dangerous NEOs
• Sun-Earth observations, solar storm warnings
• More
ILO Galaxy First Light Imaging
Why Galaxy Education, Consciousness & Awareness is Important for the 21st Century:

• Education – for primary, secondary higher, and highest education: Knowledge, understanding of humanity’s place in the Universe – our Milky Way Galaxy occupies a mid-position domain between Solar System finiteness and Cosmos infinity

• Astrophysics / Astronomy – Galaxy studies internationally are of increasing interest and value; study of our local stellar neighborhood for familiarity; center / central 10 parsecs with supermassive black hole is most dynamic region of Milky Way

• History of Human Civilization / Archaeoastronomy

• NASA, World Space Agencies – 21st Century Program and Policy Development Advance through Galaxy understanding

• Galacticity – may be as important for the 21st Century, as is Relativity to 20th
We are here
Two Major Spiral Arms:
Scutum-Centaurus & Perseus
Two Minor Spiral Arms:
Norma & Sagittarius
Far-3 Kiloparsec Arm Minor Spiral Arm just identified via radio-telescope Survey
2008 – Robert Benjamin, University of Wisconsin, Whitewater

The Milky Way: Spitzer Infrared Space Telescope
Multiwavelength Milky Way
Galaxy First Light Imaging Program – Average Color of the Galactic Plane

- 1 million pixel visible imager, 2.5° field of view, 2 polarizers and 6 color filters
- Limiting magnitude of ~12 for reasonable sample of Galactic plane from stars between 6th and 12th magnitudes
- Further weight of images by the known spectral response combined composite color image should be able to measure average color of galactic plane as perceived by human eye on a dark night
Andrea Ghez
UCLA Galactic Center Group
Keck Observatory

Stellar Orbits in the Central Arcsec

Adaptive Optics

The Galactic Center at 2.2 microns

Keck/UCLA Galactic Center Group
1995-2006
Galaxy Education Resources:

1. Federation of Galaxy Explorers: Seeks to inspire and educate kids in space related science and engineering, including Moon Base One Initiative.
   - Nicholas Eftimiades, Founder / Chairperson of the Board

2. Challenger Center: Learning Center Network gives students hands-on experience in science, engineering, research and space missions.
   - June Scobee Rodgers, Founding Director and Chairman

3. International Space University: Graduate-level training to future leaders of the emerging global space community at locations around the world.
   - Michael Simpson, President

   - Alex Karl / Ben Baseley-Walker, Co-Chairperson

5. Students for the Exploration and Development of Space: Dedicated to expanding the role of human exploration through education.
   - Joshua Nelson, Chair
6. Galaxy Zoo: ‘Citizen Science’ online astronomy project that invites members of the public to assist in classifying over a million galaxies.
   - Dan Andreescu, Kate Land, Chris Lintott, etc.

7. UCLA Galactic Center Group: Leading Galactic Center research group, dedicated to researching the innermost regions of the Milky Way.
   - Andrea Ghez, Principal Investigator

8. Teachers in Space, Space Frontier Foundation: Giving teachers the opportunity to experience space firsthand via NewSpace companies.
   - Edward Wright, Project Manager

9. The Planetary Society: Inspires and involves the world's public in space exploration through advocacy, projects, and education.
   - Louis Friedman, Executive Director
Galaxy Education Resources

International Lunar Observatory Association
Space Age Publishing Company

Galaxy Zoo.org

Federation of Galaxy Explorers

GALAXY ZOO.org

Challenger Center

The Planetary Society

International Space University

Space Generation Advisory Council

Teachers in Space

UCLA Galactic Center Group

SEDS
Portrait of the Milky Way – Smithsonian National Air & Space Museum, Washington DC

International Lunar Observatory Association

Space Age Publishing Company
Barbara Morgan
1st Teacher in Space
# Lunar Commercial Communications:

The International Lunar Observatory requires communications capacity to transmit astrophysical data to satisfy its primary mission. Bandwidth not utilized for astrophysical data transmission can be made available on a commercial basis.

## Commercial Usage of Additional Bandwidth

<table>
<thead>
<tr>
<th>Pre-sold Bandwidth</th>
<th>Bandwidth Available Upon Emplacement (May be pre-sold when launch date set)</th>
<th>Future Need</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Space Calendar Broadcast</strong></td>
<td><strong>Internet Search Engine Giants</strong></td>
<td><strong>Specialty Advertising Opportunities</strong></td>
</tr>
<tr>
<td>This Space Calendar will be transmitted from the Moon. Advertisers will pay a premium rate for transmission of their ads from the lunar surface.</td>
<td>Search engine giants, such as Google and Yahoo, as well as other internet businesses, will be able to purchase bandwidth and use it to provide special services from the lunar surface, which might include local imagery. Interactive games may be developed which actually take place on the Moon.</td>
<td>Large corporations will be able to use a Moon email system to capture the attention and interest of consumers for products which may relate to any of the numerous associations modern culture attributes to Luna.</td>
</tr>
</tbody>
</table>

## In Situ Communications and Monitoring Capabilities for Robotic Project Operators

As the wave of robotic and mining/excavation missions arrive on the lunar surface, they will do so with the knowledge that communications and surface monitoring capabilities in the region of Malapert Mountain and Shackleton Crater will be in place and available for purchase.
‘The First, Best Space Calendar in the Business’
International Lunar Observatory (ILO)

ILO-X Precursor:

• Odyssey Moon / MDA
• US$30M Google Lunar X Prize
• ILO 2 Kg Technology Demonstrator Payload
  • AMIE Camera / Space-X
• Equatorial Mission
• Galaxy First Light Imaging, Lunar / Earth Observation
• Communications / Broadcasting
Instrumentation

• Candidate Instrument – AMIE Camera

• UV / Vis / NIR CCD Imaging Array of 1024 x 1024 pixels

• Field of View – 5.3° x 5.3° = 738 parsecs on a side (0.72 pc / pixel)

• Mass = 2 kg
Human Service Mission

SpaceDev Inc – Dream Chaser, ALOHA Chair
Inter-Global / Earth-Moon / Cislunar System

ILOA: Hawai`i

ILO: Malapert Mountain
A Global / Interglobal Mission
A Global / Interglobal Mission

- **Canada** – Canada France Hawai`i Telescope Corporation, MDA, Optech, University of British Columbia Astronomy Department, CASCA, National Research Council, Canada Space Agency
- **China** – National Astronomical Observatory of China, Chinese Academy of Sciences, Shanghai Astronomical Observatory, Chinese Society of Astronautics, CNSA, Beijing Planetarium
- **India** – India Space Research Organization, Physical Research Laboratory, Indian Institute of Astrophysics
- **Japan** – JAXA / JSPECS, Shimizu Corporation
- **Europe** – Space-X Space Exploration Institute, European Space Agency
- **Russia** – Keldysh Institute, Vernadsky Institute, Sternberg State Astronomical Institute, Russia Space Agency
- **Hawai`i / USA** – Kimo Pihana, UH Hilo Astronomy / Space Age Publishing Company, SpaceDev, NASA
ILOA Affiliates
International Lunar Observatory Association

ILOA / ILO Assets …

• 6 SpaceDev Studies 2003-2008 (ILO / Human Service Mission)
• Master / Business Plan
• MoUs with CFHT, NAOC / International Partnerships
• AMIE Camera, Cisco Systems Router
• ILOA Updates / Website / Office
• Lunar Commercial Communications Workshops
• Galaxy Forum 2008, Galaxy Forum 2009
• Non-Profit 501(c)3 Status
• Board of Directors, Exec. Committee with Operating Reserves
• Next Board of Directors Meeting 5-6 December 2008, Hawai‘i Island
International Lunar Observatory Association

• ILOA to be Based in Hawai`i
• Center of Pacific Hemisphere
• Global Support Centers
• Maintain Hawai`i Preeminence in Astrophysics for Next 100 Years
Why Is Hawai`i Important to Space Exploration?

Geographic Advantages:

• Center of Pacific Hemisphere
• Southern-most site in USA / equatorial proximity
• Mid-Pacific islands bi-directional launch capacity (equatorial or polar)
• Mauna Kea – highest point in Pacific

And Aloha!
Mauna Kea Summit Observatories

- 4206 meters / 13,796 feet elevation – tallest mountain in Pacific Ocean
- Global center of Earth-based astronomy
- 12 nations represented – Argentina, Australia, Brazil, Canada, Chile, France, Japan, The Netherlands, Taiwan / China, United Kingdom, Hawaii / USA
Multi-Functional

The ILO is a Multi-Functional …

• Astrophysical Observatory
• Power Station
• Communications Center
• Site Characterizer
• Property Rights Agent
• Virtual Dynamic Nexus Website
• Hawai`i Astronomy Booster
• Toehold for Human Lunar Buildout
ILOA Institutional Membership

- **Observation**: In-situ lunar characterization; Stars, Moon, Earth; Science, Research, Development
- **Communication**: uplink / downlink nodes for surface and Earth line-of-sight relay
- **Education**: supports Galaxy Forum 21st Century architecture

Open to: Science and astronomy institutes, space and government agencies, Aerospace and NewSpace companies, private individuals, universities

Enterprise: establish 21st Century permanent lunar presence
ALOHA!

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