Imaging Thermal He\textsuperscript{+} in Geospace From the Lunar Surface

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• First all-remote sensing Geospace mission.
• Auroral imaging in far ultraviolet light of proton and electron precipitation
• Plasmasphere imaging in extreme ultraviolet light at 30.4 nm
• Particle imaging in Energetic Neutral Atoms 10 ev – 500 keV
• Radio imaging of remote plasma density in reflected radio waves at 3 kHz to 3 MHz
The IMAGE Extreme Ultraviolet Imager

- 0.1 $R_E$ resolution at 8 $R_E$
- Sensitive to $n_e \sim 40 \text{ cm}^{-3}$
- 84° x 360° field of view
- 10 minute integrations
- Mass: 15.6 kg
- Power: 9.0 Watts
50-75 metric tons can be eroded
Thermal plasma densities strongly influence energetic wave-particle processes
Is this plasma lost?
Does it change solar wind coupling, substorm triggering, radiation belt loss rates, etc?
Geospace EUV Imager for the Lunar Surface

- Sensitivity >200 times that of IMAGE EUV possible
- Mass: ~25 kg
- One or two imagers to cover the required region
- Even with energization, much He\textsuperscript{+} still observable
- Better filtering of interplanetary background 58.4 nm light
- Flight proven technology

Basic Instrument Optics
Imager Deployment
- No tools are required
- Within EVA Prime Work Envelope
- For polar or equatorial sites
Imager Placement
- Easily transported profile
- Less than 7 kg lunar weight
- Minimal site preparation
Alignment & Checkout
- Stable 3-pt surface contact
- Positioning handle within EVA prime work envelope
- Bore sight alignment on positioning handle
- Minimal astronaut involvement
Crew Departure

- Package protected
- Minimal power required
- Package constrained to <40 kg
- No hazardous materials or sharp edges
Automated Deployment
- Extend array panels
- Deploy aperture cover
- Independent communications; considering optical with modulated corner cube reflector
**Imager Operational**
- Arrays positioned for sun path
- Earth pointing EUV imager
- Passive cooling
- Integral dust & basic charging
- Environment monitoring
At \( \sim 100x \) the IMAGE EUV Sensitivity

The subsolar magnetosheath might light up in He\(^+\) from charge exchanged solar He\(^{++}\). Merging & convected field lines might be directly seen; all due to “tracer” thermal He\(^+\) ions.
A Box Seat for Space Weather Observations

- Thermal plasma strongly influences instabilities & the transport of particles/energy that dominate space weather hazards in Geospace
- Lunar surface has advantages for communication & pointing
- Strong heritage from IMAGE
- Well suited for Lunar Sortie Science
- Pioneer for future optical science packages by understanding dust effects