# ENDURANCE

## A New NASA Mission To Gauge Earth's Polar Wind Ambipolar Electric Field

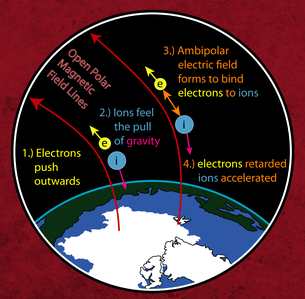
Glyn Collinson, Alex Glocer, Robert Pfaff, Aroh Barjatya, Robert Michell, Jim Clemmons, Frank Eparvier, Suzie Imber, Mark Lester, David Mitchell, Max King, Scott Bissett

## Why Is Earth Habitable?

A planet's energy fields must be in balance such that the atmosphere neither is stripped to space (Mars), or builds up (Venus), making a breathable atmosphere, and allowing liquid water to exist at the surface for long periods

- **Gravity Field [Galileo & Viviani, 1717]**
- **Magnetic Field [Gauss, 1832]**
- **Ambipolar Electric Field [Never Measured]**

  An energy field generated by all planetary ionospheres, thought to play a crucial role in ionospheric outflow and escape

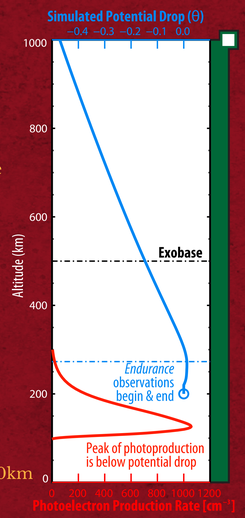


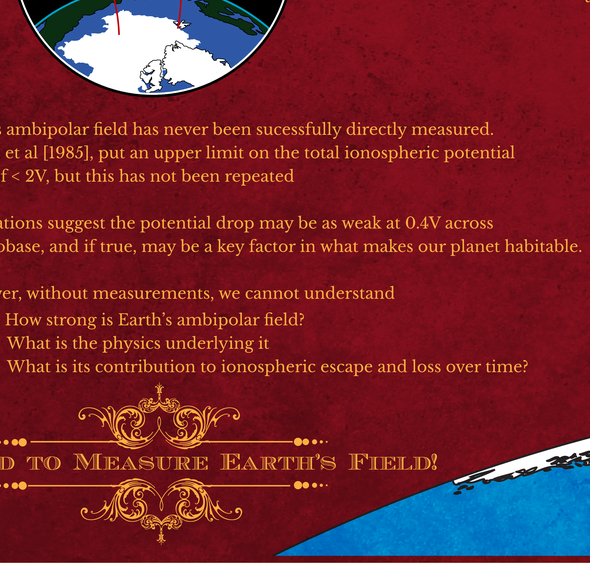

- Earth's ambipolar field has never been sucessfully directly measured. Coates et al [1985], put an upper limit on the total ionospheric potential drop of < 2V, but this has not been repeated
- Simulations suggest the potential drop may be as weak at 0.4V across the exobase, and if true, may be a key factor in what makes our planet habitable.
- However, without measurements, we cannot understand
  1.) How strong is Earth's ambipolar field?
  2.) What is the physics underlying it
  3.) What is its contribution to ionospheric escape and loss over time?

**We need to Measure Earth's Field!**

## Gauging Earth's Field

- Photoelectrons, generated in Earth's ionosphere, are created with specific known energies that are dictated by atomic physics
- As the photoelectrons escape Earth, they are slowed by the ambipolar field
- Endurance will measure the subtle energy shift resulting from Earth's field, and thus measure the ambipolar field.
- Endurance will launch near vertically along Earth's open magnetic field lines in the north pole, to over 800km and aim to make the first measurement of Earth's ambipolar field

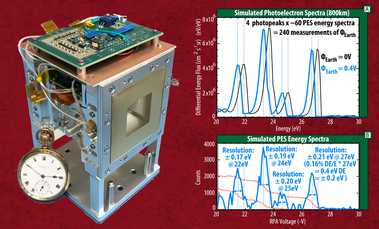



## Endurance Instrumentation

### Photoelectron Spectrometer

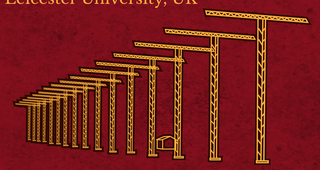
Dr. Robert Michell - University of Maryland / NASA Goddard Space Flight Center, MD, USA




Eight dual spectrometers with <1% energy resolution measure the precise energy of photopeaks during the flight of the Endurance.

### R.A.D.A.R.

Dr. Mark Lester and Dr. Suzie Imber
Leicester University, UK



Ensures conditions are correct for launch and maps the struture of the ionosphere during the flight of the Endurance

### Langmuir Probe

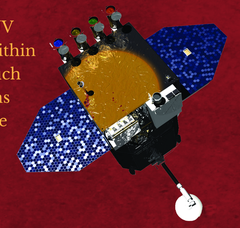
Dr. Aroh Barjatya - Embry Riddle, Florida, USA

Measures the plasma potential and the structure of the ionosphere

### Solar Dynamics Observatory

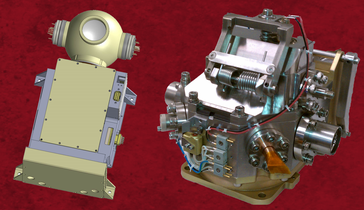
Dr. Francis Eparvier - Laboratory for Space and Atmospheric Physics (LASP), Colorado, USA

Ensures solar EUV conditions are within normal limits, such that all conditions in the ionosphere are conducive for a successful mission.



### Neutrals Package

Dr. Jim Clemmons - University of New Hampshire, USA



Neutral Mass Spectrometer and Ionization Gauges monitor the density and composition of Earth's thermosphere during the flight of Endurance, so that the scattering of photoelectrons can be calibrated

### Fields Package

Dr. Robert Pfaff - NASA GSFC, USA

Four double-double electric field antennae to measure DC electric fields and waves during the flight of Endurance. Monitors the relative changes in plasma potential, and scans for polar cap patches

**Contact:** glyn.a.collinson@nasa.gov