“Endurance”, a new NASA mission to gauge Earth’s polar wind ambipolar electric field

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Earth’s primary ionospheric loss process is the polar wind, which flows outwards along open magnetic field lines above our polar caps. One key component critical to the formation of this outflow is thought to be a weak ambipolar electric field. The potential drop resulting from this electric field is thought to assist terrestrial atmospheric escape since it reduces the potential barrier required for heavier ions (such as O⁺) to escape and accelerates light ions (such as H⁺) to escape velocity. Although a key component to atmospheric loss, Earth’s ambipolar electric field has never been measured due to its weak strength.

We announce the NASA Endurance mission, launching in 2022, which will attempt to make the first direct in-situ observations of Earth’s ambipolar electric field. Endurance launch from Ny-Ålesund, Svalbard, and soar across the exobase to altitudes greater than 800km. The spacecraft will be equipped with a new type of scientific instrument which will enable the Endurance to measure the total electric potential drop below her. She will also be equipped with a full array of sensors that will enable the science team to self-consistently model the polar wind during the flight to test our current theoretical understanding of the physical processes which generate Earth’s ambipolar electric field.

Endurance will perform groundbreaking discovery science, measuring a fundamental property of Earth for the first time: the strength of the ambipolar electric field generated by its ionosphere. The results will provide us with a better understanding of atmospheric escape at Earth, and why our planet is habitable.

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