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Nitrogen and Oxygen Budget ExpLoration (NOBEL) for ESA M5-call: Measurement requirements to understand the atmospheric escape/budget

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The NOBEL mission aims to study the thermal and non-thermal escape of major atmospheric components (nitrogen, oxygen, and their isotopes) from the Earth, a magnetized planet. This requires the first-time exploration of the Earth's entire exosphere as well as the first-time examination of isotope ratios in an extended altitude range from the upper ionosphere (800 km high) up to the magnetosphere.

The measurement quality should allow connecting the various types of escape from the Earth to the different gravity mass-filtering and chemical reactions on a geological time scale, such that the result will be used as a good reference to understand the atmospheric/ionospheric evolution of magnetized planets based on their $^{17,18}O/^{16}O$ isotope ratio and N/O ratio. Since the solar EUV and solar wind conditions during solar maximum at present are comparable to the solar minimum conditions 1-2 billion years ago, the escaping amount and the isotope and N/O ratios should be obtained as a function of external forcing (solar and geomagnetic conditions) to allow a scaling to the past.

To achieve these goals, the ion measurements in this mission should be able to separate nitrogen species (N, N_2, N^+ and N_2^+) from oxygen (O, O^+), near the exobase, in the exosphere (for modelling thermal escape, hydrodynamics escape, and the pre-acceleration amount of non-thermal escape) and up in the magnetosphere (for modelling non-thermal escape and circulation of all ions). Furthermore, these aims require the capability to measure isotope ratios of cold oxygen ions and neutrals. We briefly discuss why we focus on the exosphere, on isotope ratios, and nitrogen measurements, and finally describe the current idea of a mission profile using a spinning satellite in a 500 km $\times$ 33000 km altitude high-inclination orbit.