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Debye: design for an ESA F-Class mission to study electron heating in space and astrophysical plasma.

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Debye is a mission concept proposed in response to ESA's F-Class call in collaboration with JAXA ISAS. The key science question for the Debye mission is: How are electrons heated in space and astrophysical plasmas? In order to answer this top-level science question, Debye's first objective is to identify the nature of electron-scale turbulent fluctuations. Then it will study the transfer of energy between electromagnetic fields and electrons through high-cadence and high-resolution electron velocity distribution measurements. Finally, Debye will study the partition of energy between particle species and the dependence of the energy transfer on plasma parameters.
In order to do this, Debye will consist of a main spacecraft with instrumentation to measure electrons, ions, electric fields, and magnetic fields; and three deployable small-sat spacecraft that measure magnetic fields only. The small-sats will fly in a tetrahedral formation with the main spacecraft. In this configuration, Debye will measure electron-scale fluctuations in 3D, resolving both wavenumber and frequency of modes from a few hundred metres up to thousands of kilometres, over the two-year mission lifetime. Rapid and detailed measurements of the electron velocity distribution function will allow the observation of wave-particle correlations and the quantification of energy transfer from the electromagnetic fields to the electron distribution function.
Here we present technical details of the mission design and payload complement to provide measurements able to answer the science questions posed above.