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Dust optical properties in antarctic ice cores: application of the Single Particle Extinction and Scattering (SPES) method

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From the point of view of light scattering each particle is characterized by several parameters, the size being by far the most important in determining the amount of radiated power. Nevertheless, composition, internal structure, shape do slightly affect the way light is scattered, and in turn also prevent the possibility to extract the correct size. Recovering the whole information is of paramount difficulty, if not impossibile for single particles. A trade off can be obtained by introducing the optical thickness, i.e. the product of the size and the refractive index, which determines the optical properties. Here we focus at studying the optical thickness of dust particles from the EPICA Dome C ice core. We provide for the first time a direct measurement of dust optical parameters that is the most direct information needed by climate models, and highlight important differences among samples.
The SPES method is named after its capability to access both the extinction cross section and the forward scattered field amplitude for each particle. This method is well working with extremely dilute suspensions, such as Antarctic ice core samples.
The SPES method is based upon combined and simultaneous measurements of the power reduction of a laser beam in presence of the particle (extinction by definition) and the interference between the intense transmitted beam and the much fainter forward scattered wave (scattering). In such a way it is possible to access both the amplitude and phase of the scattered wave, which means both the real and imaginary parts of the complex field amplitude. This makes the difference with traditional approaches. We show some preliminary results from glacial and interglacial samples from the EPICA ice core and suggest a method to extract information which is important for the light scattering properties of the ensemble of dust particles contained in each sample.