The formation of coherence domains for aerosolized water molecules at alpine waterfalls – Part-1

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Abstract

The size distributions of ion clusters, their mobility and their intermediate progenies near waterfalls have been measured with three aspirated Gerdien Cylindrical Ion Detector (GCID) in combination with an Scanning Mobility Particle Sizer (SMPS). It was observed that the concentration of negative 0.9–6nm ions was 2-3 orders of magnitude higher than at the reference points 100s of meters away from the waterfalls. Apart from a classical interpretation of the observed phenomenon, here we present a quantum electrodynamic approach to demonstrate that water in this size range is highly structured and coherent. With the help of some additional ultra-weak photon emission measurements (UWPED) of waterfall samples the significance of this approach could be demonstrated.

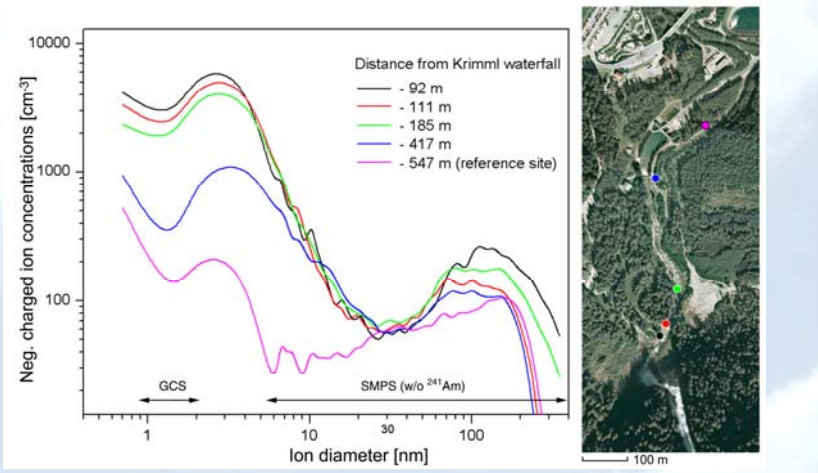

Fig.1: Composite plot of the size distribution of negatively charged particles as measured with distance from the waterfall in Krimml, (Austria). Indices denote sampling locations at the falls (with the satellite view revealing the positions in the field). Size distribution till 2.5nm were recorded with the CDI, particles from 5-350nm have been obtained using the SMPS instrument; in-between GCID and SMPS measurements the interpolated region. For SMPS-measurements it was assumed that each particle carries a single charge.

Methods

The field setup included a triplet set of GCID - each assigned to a size channel of 0.9, 1.5 and 2.0nm and an SMPS that covers a continuous size range of 5.5 to 350nm. Coherence measurement were done in the lab using an UWPED.

GCID: It consists of three cylindrical and coaxially arranged electrodes. A fan ventilates the space between the centremost and middle electrodes. In the inter-electrode space air-ions of desired polarity and mobility are forced by the electric field across the electrostatic gradient to deliver their ion-related charges to a faraday cup electrometer (FCE).

SMPS: It is capable of measuring a particle size distribution of in-between 5 to 350nm. Particles are classified with an Electrostatic Classifier that utilizes electrical mobility to discriminate diameters. The concentrations are measured with the attached Condensation Particle Counter. In order to detect negative waterfall ions, the SMPS was operated without neutralizer, assuming that particles carrying single charges only.

UWPED: The study of coherence uses a photo-multiplier-tube (PMT) coupled to a discriminator unit operating in a discrete count mode. A first batch of samples used shock-frozen nano-aerosols cooled with liquid N_2 to -196°C right at the falls, followed by rockpool pondwater of the falls that was placed and kept in the freezer at -20°C. A third waterfall sample was aerosolised in the lab using a standard atomizer driven with HEPA-filtered pressurized air, whereby a N_2-cooled Petri-dish was used as the collecting surface for the precipitated aqueous aerosol. These samples were then placed into the UWPE-detector using the induced illumination mode (i.e.: exposing the samples to a white light source for 60 seconds and recording their delayed "afterglow"). In a second approach a live lichen sample near the falls (*Peltigera* sp.) was also measured using the same UWPE-setting. In order to get rid of coherent structures in this biological specimen, a 5% household vinegar solution was sprayed onto it, prior to the final measurement.

Results

Fig. 1 shows the negatively charged particle size distribution for various distances from the falls. As shown in Fig. 4, coherent water cluster formation occurs below 100nm, thus measuring the nano-aerosols of the waterfall yields differences in delayed luminescence between frozen/liquid and shock-frozen nebulised water samples (Fig. 2). An almost four-fold gain (48-55 vs. 10-13cts/sec) was obtained when illuminating the shockfrozen nano-crystallized aerosol (both samples obtained at the waterfall, as well as for the lab-sample) in comparison with the liquid and fridge-frozen samples. An even better reading has been obtained with the untreated lichen sample (Fig. 3). The readings between the healthy and the "damaged" or stressed (5% vinegar treated) colony are significant. The healthy decay line reveals an initial UWPED count of almost $80 \cdot E^3$cts/sec. The UWPED-count-rate of the same colony treated with vinegar collapsed by almost two orders of magnitudes to about 100cts/sec – a result well in line with the prediction as stated by coherence theory (Rattemeyer, 1978). This lower count rate is characteristic for more decoherent systems. As already outlined by Scholz et al. (1988), the decay-kinetics after excitation should follow a hyperbolic rather than an exponential law. While the latter is characteristic for chaotic processes, the former is characteristic for coherent systems.

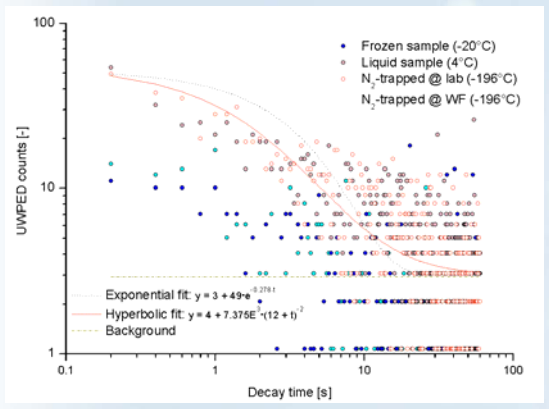

Fig. 2: UWPED-readout for a liquid water sample involving two N_2-shock-frozen samples and a rockpool sample (kept in the freezer) – all samples taken at the falls. For sake of clarity, the superimposed hyperbolic trend is shown along with the less-fitting exponential trend line only for the N_2-trapped @ lab (-196°C) sample .

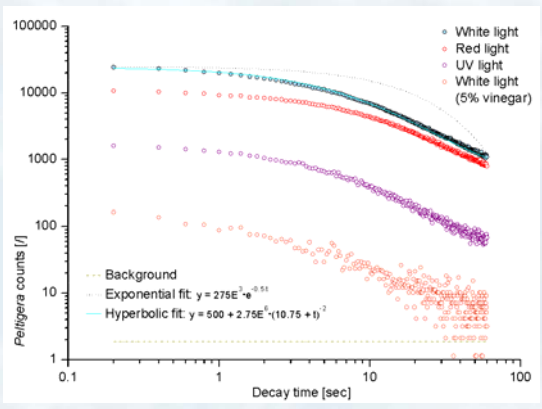

Fig. 3: UWPE-readout for the lichen *Peltigera* sp. using various illumination wavelengths. Decoherence was induced by exposing it to a 5% vinegar aerosol. For sake of clarity, the superimposed hyperbolic trend in decay is shown along with the poorly-fitting exponential trend line (shown only for the trial employing illumination with white light).

Interpretation

According to Fig.1, peak concentrations are found in the 0.9-6 nm range. Therein, clusters of particles are subject to effects of quantum electro dynamics. Here, water reveals extreme features since the coherent oscillation connects two electronic configurations (Arani et al., 1995). The first one is the ground configuration where all electrons are tightly bound. The second one is the excited configuration state that corresponds to an energy threshold of E = 12.06eV – that is only 0.54eV below the ionization threshold of 12.60eV (Fig. 5). This implies that for each molecule involved in the formation of a Coherence Domain (CD) there is one electron so loosely bound to be considered almost free; that is, the formation of CDs provides a reservoir of free electrons.

Coherence arises out of the electromagnetic fluctuations of the quantum vacuum and from the exchange of radiation at the natural photo-absorption resonances of water molecules. Such coherence is confined to domains whose size is different for molecules and electromagnetic fields (EMF). The field is trapped in a region whose diameter corresponds to $2 \cdot r_{CD\,f}$, the wavelength of the spectral line involved ($r_{CD\,f} = \lambda/2$). The involved spectral line is in the far-UV, close to the ionisation potential of water (Fig. 5). CDs obtained in this way are the liquid droplets produced by the condensation of water vapour. Permanent coherence becomes established in water and gives rise to a long-range-order within domains 75nm in diameter (Fig. 4).

As long as the "vapor" density remains below the smallest of the critical densities of 0.31g/cm^3 (belonging to 12.06eV) the system of water molecules remains in the perturbative ground state. This is the state where quantum fluctuations are not tuned together and consequently molecules are uncorrelated; characteristic for vapor. As soon as such a critical density is reached, the oscillation starts to "run away". When this happens, the electromagnetic "zero-point" fluctuations with the corresponding frequency ω = 12.06eV begins to build up and the water molecules will oscillate between the ground state and the excited level at 12.06 eV (Fig. 5). At this runaway-state, all the other excitation levels of the affected water molecules will be from now on totally ignored by the dynamic evolution of the physical system, which is made of water molecules plus the EMF (Preparata, 1995). It is important to note here that we speak of a two-phase system, in which not all the water molecules take part in the formation of CDs (Fig. 4). In other words, at room-temperature the coherent versus the non-coherent fraction in the vapor phase is split into a 0.4 to 0.6 ratio, in favor of the latter – since the temperature at the falls (e.g. Krimml) was only about 15°C, this balance is slightly biased towards coherence, i.e. 0.425 vs.0.575 (Buzzacchi et al., 2002).

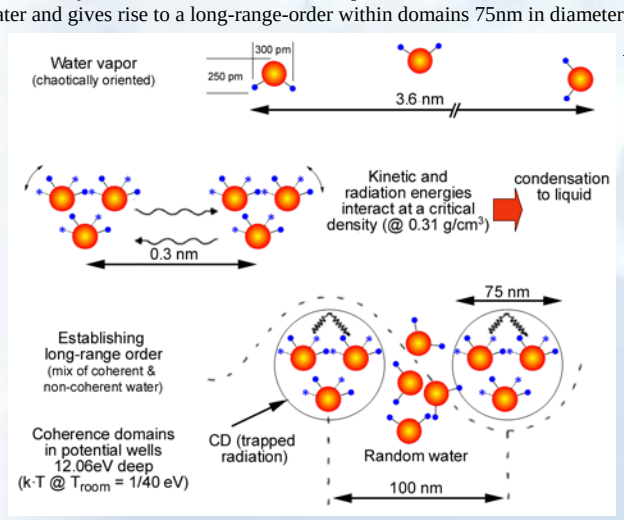

Fig. 4: Formation of coherence domains (CDs) of aerosolized water molecules. The free-floating dipoles start to feel mutually attracted and establish coherent resonance clusters that result in the formation of 75 nm large CDs in which molecules resonate unisono and in phase. CDs themselves become entrapped by the newly formed coherent polarizing field and reveal a characteristic wavelength of about 100nm. The formation of CDs is a fundamental property of liquid water and unlike the laser, no energy pumping is required to establish coherence (Preparata, 1995).

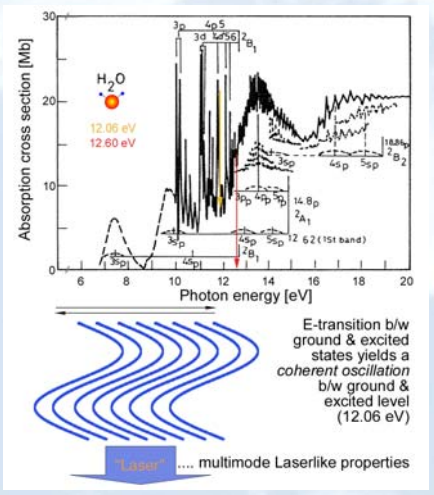

Fig. 5: Formation of the multimode laser properties within a CD as a result of the pumping mechanism, synchronized excitation and relaxation patterns between the ground level and excitation at 12.06eV of the involved water molecules.

Conclusion

The investigation carried out at several waterfalls in Central Europe opened up some new and interesting aspects in waterspray electrification. The electrostatic field gradient with its prevailing negatively charged aerosols and their minute size (<30nm) facilitate formation of Coherence domains (CD). As will be outline in Part-2, co-resonating molecules can join water-CDs and participate in the coherent dynamics as they can receive energy in a collective way and in one stroke just as in multimode lasers. CD-water reveals peculiar properties as density anomaly, altered viscosity / surface tension and a different heat capacity (Willis et al., 1969).

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