Cloud Power.

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Definition of the scope of discussion – PeTa idea.

Before emission

After emission

Before emission

During emission

After emission

\[ E_2 - E_1 = \Delta E = h\nu \]
LiF crystallization in Ar
LiF characteristic radiation peak

\[ \lambda_1 = 2.80 \mu m; \quad \lambda_2 = 3.45 \mu m; \quad \lambda_3 = 4.05 \mu m; \quad \lambda_4 = 4.35 \mu m. \]
Sapphire characteristic radiation peak

Differential spectrum of radiation flare (dashed curve).
1. Emission spectrum of cooled sapphire, first heated to the temperature less than 2050°C.
2. Emission spectrum of crystallizing melt.
Sodium Thiosulfate Pentahydrate (STP) crystallization.

As grown sapphire shaped crystals (Variable shaping technique).
KDP Crystal (max. 310 kg) for LMJ and Cutting Scheme.
Clouds formation (Nichols and Lamar, 1968)
The air cooling (Nichols and Lamar, 1968)
PeTa effect.

This presentation demonstrates experimental evidence for a new physical phenomenon—infrared characteristic radiation (IRCR) under first order phase transitions, especially the crystallization of melts and the deposition and condensation of vapors/gases. In the 70th, the effect was theoretically predicted by M. Perel’man, as well as it was predicted and experimentally proved by the author of this presentation for crystallization of several alkali halides and sapphire. In 2006 two scientists combined their efforts and published the mutual papers in the Journal “Physics Letters A”. In 2010, M. Perel’man deceased. In memory of Prof. Perel’man and to simplify the title “IRCR under first order phase transitions”, the term “PeTa (Perel’man- Tatartchenko’s) effect” is used in this paper as it had been proposed during discussion of this problem in the “New Scientists” in 2010. Up to now, the author of this presentation published 25 papers in this field.
Experiments with the liquid nitrogen cooling.

PerkinElmer Frontier MIR spectrometer was used. Here are its main characteristics: Dynascan interferometer; cooled with a liquid nitrogen MCT detector; sealed and desiccated Ge-coated KBr optics; scan range $\Delta \lambda$ from 1.2 to 28 $\mu$m; resolution $\Delta S = 0.4$ cm$^{-1}$. 
Experiments with the liquid nitrogen cooling.
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Experiments with the liquid nitrogen cooling
Comparison of PeTa and Planck’s radiations.
Conclusions on the basis of our experiments with water vapour deposition

With using high sensitive MCT detector the PeTa radiation has been recorded during cooling of objects by the liquid nitrogen. The PeTa radiation intensity reaches 50 mW/cm². How did we get this value? Plastic cup of 329K (56°C) temperature has the same radiation intensity as the cup with liquid nitrogen. Let us calculate the blackbody radiation at a temperature of 329K:

\[ P_{329} = 5.672 \cdot 11.716 \cdot 10^{-3} \text{ W/cm}^2 = 66.5 \text{ mW/cm}^2 = 665 \text{ W/m}^2 \]

What is the degree of blackness \( \varepsilon \) for a plastic cup in the range of 56°C? Here is what we found on the internet:

- 0 - 100°C water \( \varepsilon = 0.95 - 0.96 \); 22°C Glass smooth \( \varepsilon = 0.937 \)
- 22°C glazed porcelain \( \varepsilon = 0.934 \); Ice \( \varepsilon = 0.97 \); 20°C Ebonite \( \varepsilon = 0.92 \)

Thus, if we take for plastic \( \varepsilon = 0.75 \), PeTa radiation intensity is 50 mW/cm² and 500 W/m².

The PeTa radiation is located at a rather large range between 4 \( \mu \text{m} \) and 20 \( \mu \text{m} \) with the maximum near 13 \( \mu \text{m} \).
PeTa radiation during artificial cloud formation.

Ponomarev and Tarishkin (Tomsk, Institute of Optics RAS), in 2010 realized a search of the PeTa radiation on the basis of our publications (Tatartchenko, 2008; Tatarchenko, 2010). Experiments were carried out with an installation that allowed water vapor condensation under different super-saturations. It was designed on the basis of an atmospheric optical cell - a tube of 0.7 m in inner diameter and 112 m in length made of stainless steel. In this setup, water vapor is supersaturated through pressure release from the working chamber of a comparatively small volume to the vacuum chamber of a large volume (it is something like to the second type of Wilson chamber) that allows achieving significant degrees of water vapor super-saturation. For the PeTa effect investigation, a special photo-recording cell was added to the installation. The cell accepted a radiation from condensing water vapor through a window that is transparent in visible and infrared ranges. The radiation was recorded by the infrared detector MG – 30 that is sensitive in the range from 2 to 14 µm. It was found that the integral intensity of the PeTa radiation exceeded the Planck radiation by a factor of ten.
Distribution of bright temperature on the slopes of mountains: left - Taibai west slope (California, USA); right - Primorsky fault (Siberia, Russia).
Definition of the scope of discussion.

Between the years 1979 – 1984, in the Soviet journal “Kristallografia” (A translation into English existed), three papers were published presenting a rather unusual experimental finding: The appearance of characteristic infra-red radiation accompanying crystallization from the melt of some infra-red transparent substances (alkali halides, sapphire). These results were not casually obtained. They were preceded by a long search for the radiation of crystallization on the basis of a new approach to the latent heat energy liberation.
New energy source: PeTa radiation during cloud formation.

Infra-red lasers could be made on the basis of water vapor condensation or freezing in atmosphere. Let us imagine a system of two parallel mirrors (one of them is semitransparent) of area of 1m² on the distance of 1m each from other. Let us place this system in the atmosphere were the water vapor is saturating but is not condensed yet (For instance, on the slope of Mont Blanc). Let us provoke condensing of the vapor (it is possible often to see a tail of water vapor behind a flying airplane). In this case about 5g of water vapor will be condensed in our system. It means that 12.5kJ of energy will be liberated. If the characteristic radiation exists, the system would work as a laser. For the 8% laser efficiency the energy of 1kJ would be accumulated. A movement of the air inside the system with the speed 1m/s would provide an impulse generator of 1kW power and 1Hz frequency. For comparison, a silicon solar cell of 1m² area provides approximately 100W power.
What alien planet's bizarre landscape lurks below these fiery-looking clouds? It's only Planet Earth, of course -- as seen on the Water Vapor Channel. Hourly, images like this one (shown in false color) are brought to you by the orbiting GOES 8 satellite's multi-channel imager. This instrument can produce images at the infrared wavelength of 6.7 microns, recording radiation emitted by water vapor in the upper troposphere. Bright regions correspond to high concentrations of water vapor while dark spots are relatively dry areas. Atmospheric water vapor is invisible to the eye and produced by evaporation from the oceans. Convected upward in the tropical zones it affects the climate by contributing substantially to the greenhouse effect.
Let us consider an excited particle near a phase transition boundary. For phase transition radiation to occur, the probability of excitation energy being converted to light emission by this particle at phase transition must be equal to, or greater than the probability of the excitation energy being converted to heat. It has been generally thought that this probability is negligibly small. An example of probability estimation: For a free molecule in the excited state, its optical life-time (the longitudinal relaxation time) is equal to \( t_1 = 10^{-7} - 10^{-8} \) s. For transitions in the near-infrared range at the temperature \( T \approx 1000 \) K, the non-radiative multi-phonon relaxation time in solids is \( t_2 \leq 10^{-9} \) s. Then, the probability of light emission \( p \sim \frac{t_2}{t_1} \ll 1 \), thus non-radiative phase transitions occur.
Appendix 2b: PeTa effect probability.

For a radiative phase transition with $p \sim 1$, the time $t_1$ of the optical transition between the melt and the crystal ground states has to be less than, or comparable to the non-radiative relaxation time $t_2$. We believe that this may occur only in a large number of particles, such as nuclear fission reactions, where a critical mass, depending on the system geometry, is needed for the reaction’s realization. Similarly, laser radiation depends on population density. It follows from the theory of super-radiation. The phenomenon of super-radiation is that a system of excited particles undergoes optical transition to a lower level due to their interaction with each other through the common radiation field, the transition time being much shorter than the radiative decay time of an individual particle.
Appendix 2c: PeTa effect probability.

The feasibility of radiative phase transition in an ensemble of particles was treated in terms of quantum electrodynamics (QED) by M. Perelman and V. Tatartchenko. The problem of characteristic radiation yield has not been solved in the frame of the theories mentioned above. It is evident that the yield, first of all, depends on the transparency of both phases. But here the transparency problem is a very specific one. Indeed, our system contains the main level and the exited one. For the supersaturated phase, the exited level is a filled one. Thus, it can work as an optical amplifier for the characteristic radiation and, consequently, to be transparent for it. This is the only explanation for the detection of the characteristic radiation of phase transitions for water, ice, Te and Cu.
Appendix 3: Other perspectives.

1. Fog formation may be observed as a result of PeTa effect in atmosphere.
2. Infra-red lasers could be made on the basis of phase transitions (We have the evidence for the vapor water condensation, the crystallizing of lithium fluoride, sapphire, Te and metals).
3. PeTa effect could be used for prediction and warning of damaging hail falls.
4. A program could also be suggested to use this effect in the study of climate problems.
5. PeTa effect may explain Jupiter’s red spot’s color, as well as the orange color of its satellite Io. It is well known that Jupiter emits more energy than it receives from the Sun. Circulation in Jupiter’s atmosphere lifts the heated ammonium and water vapors which are condensed and solidified in the upper part of the atmosphere. CR of these processes may be the reason for the emission in the red range of Jupiter’s radiation.
6. A similar process could be realized for the cooling of the Earth: provocation of upper clouds by the characteristic radiation and, as a result, a heat radiation in the space environment.
Appendix 4: Conclusions.

1. **PeTa effect** - Characteristic radiation corresponding to the first order phase transitions exists.

2. A window of transparency for the characteristic radiation in the supersaturated (super-cooled) phase has to be taken in account.
Appendix 5a. Publications.


Appendix 5b. Publications.


Appendix 5d. Publications.

Thank you for your attention.

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