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The Baikal-GVD neutrino telescope as an instrument for studying Baikal water luminescence

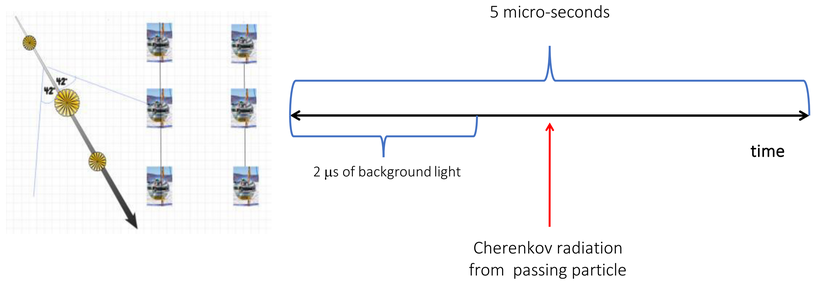
Rastislav Dvornický

on behalf of the Baikal-GVD Collaboration

DLNP, JINR, Dubna, Russia & Comenius University, Bratislava, Slovakia

Light detection by the Baikal-GVD telescope

Apart of **Cherenkov** radiation, also the ambient background light is registered. Signals from each optical module (OM) in a time window of 5 μs are stored, if a **trigger** condition is fulfilled: two neighbor OMs record charge > 1.5 p.e. and > 4 p.e. in a time window of 100 ns.
(see poster of M.Sorokovikov for more details)

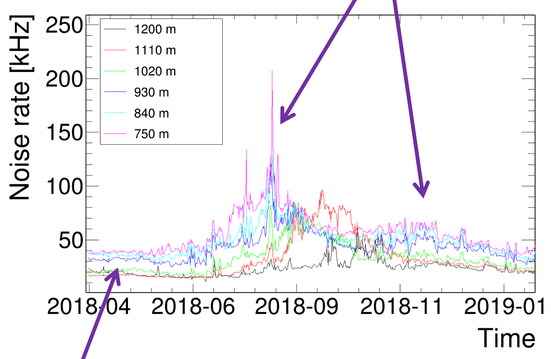


The amount of the registered background light is derived from the photo-multiplier tube **noise rates** from each OM.

Ambient light field evolution of Baikal water

Two relatively stable plateaus are intermitted with an increase of highly luminescent water :

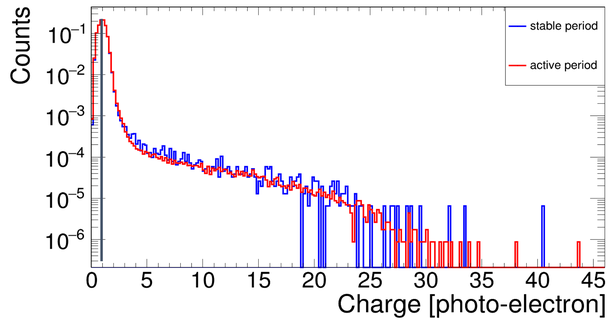
•high noise rates period ~ summer
•calm period ~ autumn, winter



•stable period ~ spring, early summer

Charge distribution

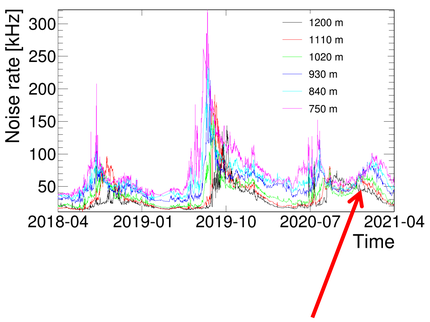
Charge distribution remains unchanged in different periods of the optical activity of the lake.

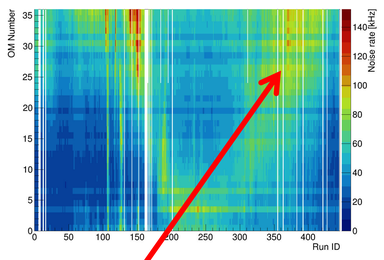


The major contribution comes from **single photo-electron** pulses. If discrimination level is set to one p.e., noise rates decrease by one half.

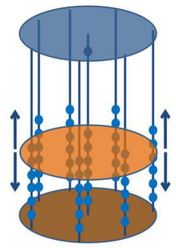
Luminescent layer propagation

Annual optical activity exhibits periods of **increased** optical activity on a relatively **stable plateau**. By comparing the outbreak maximum for different depths, we obtain velocity profile of the luminescent layer propagation.



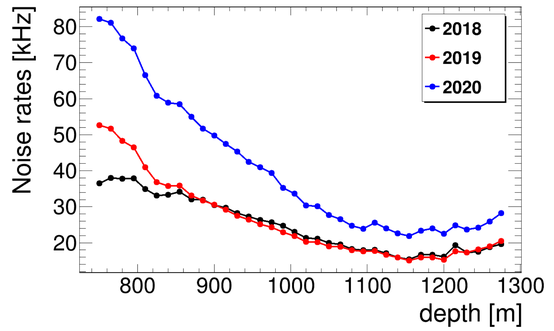


A unique event of highly luminescent layer moving **upwards** has been observed in January 2021 for the first time. The estimated speed reached its maximal value of about **28 m/day.**



Depth profile

By averaging the noise rates over the OMs at the same horizon, we obtain depth profile. Data are from stable period (spring or early summer) of years 2018, 2019, and 2020.



Fit performed with $f \sim \exp(-H/H_0)$ yields H_0 = 461, 312, and 292 meters for the seasons 2018, 2019, and 2020, respectively. The photon flux from the sunlight below a depth of ~ 700 m is negligible.

Summary

Presentation of data on the luminescence in Lake Baikal:

• The increases of the luminescence activity intermitting periods of relatively stable optical background in 2018, 2019, and 2020 was reported.

• For the first time, the maximum of the optical activity was observed in January 2021 propagated from bottom to the top with the maximal speed of 28 m/day.

•The maximal amplitude of noise rates modulations during the active period in 2019 reached almost 150 kHz.