OSQAR chameleon afterglow search experiment

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on behalf of OSQAR collaboration
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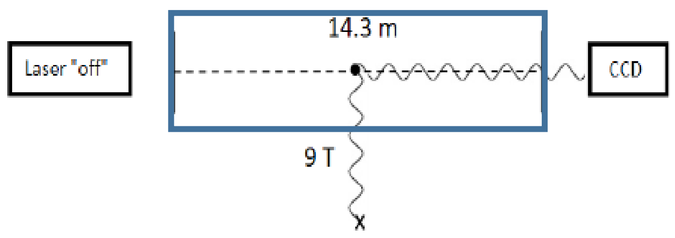
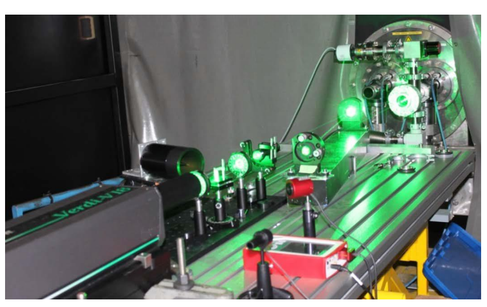
OSQAR experiment has been extended to the quest of chameleon particles with environment-dependent mass from the search of a magnetic afterglow effect. OSQAR-CHASE (chameleon afterglow search) has been run in 2017 using one spare LHC dipole providing a 9 T transverse magnetic field with an 18.5 W laser and state-of-the art CCD detector.

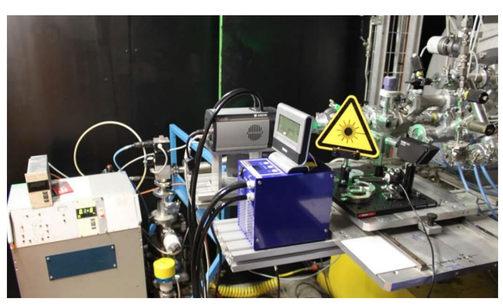
Chameleon is hypothetical new kind of scalar particle with a variable effective mass, which is an increasing function of the ambient energy density. It can explain origin of dark energy as a scalar field.
Chameleons can be produced by Primakoff effect when photons interact with magnetic field in vacuum chamber. Chameleon can escape from closed chamber only by inverse Primakoff effect which manifest as afterglow signal coming from chamber after switch-off photon source.

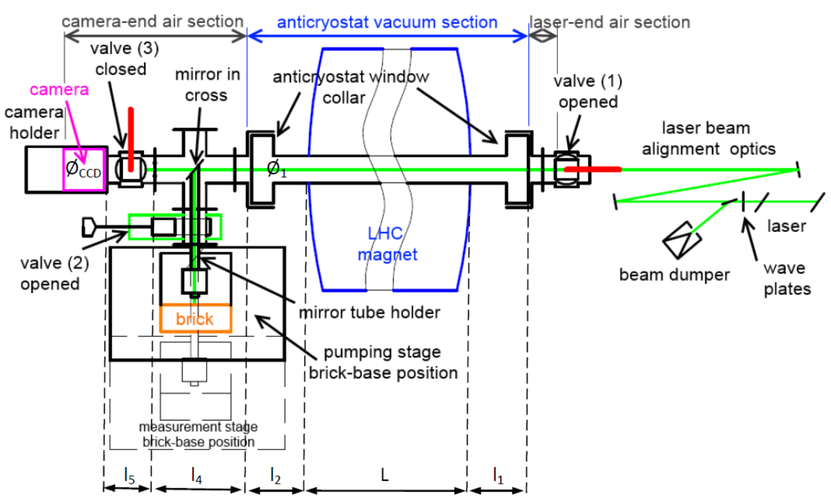


$$\dot{N}_{afterglow}(t) = \frac{\eta\, P\, f_{esc}\, f_{vol}\, \mathcal{P}_{\gamma\leftrightarrow\varphi}{}^{2}\, c}{\omega\, \Gamma\, L_{total}}(1 - e^{-\Gamma\Delta t})e^{-\Gamma t}$$

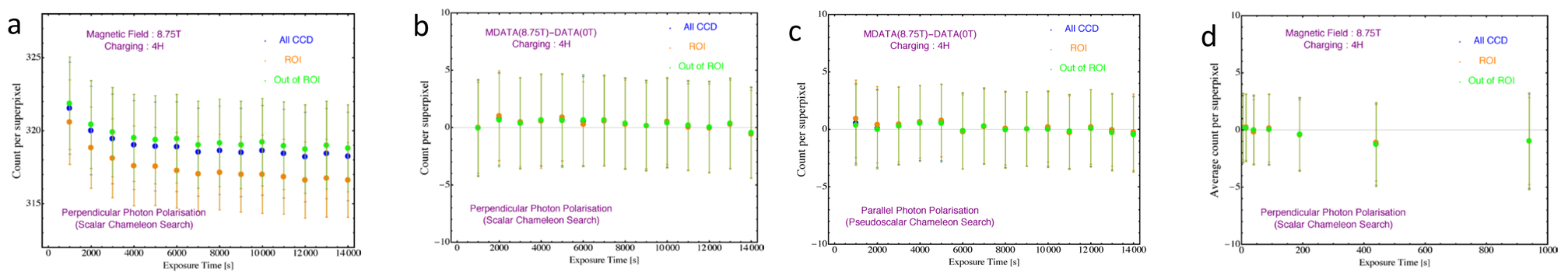
OSQAR-CHASE experiment has followed the pioneering work of the GammeV collaboration but it used spare LHC magnet 8.5 T with evacuated pipe, 18 W laser (532 nm) and sensitive, low noise CCD detector.







Preliminary results of the OSQAR-CHASE 2017 experimental run. a) Data for scalar Chameleon search recorded with the magnetic field, b) after substraction of the background determined without magnetic field, c) Data for pseudoscalar Chameleon search recorded with the magnetic field after subtraction of the background, d) Data for scalar Chameleon search with short exposure time after subtraction of the background.



$$g_{\gamma\gamma} \sim B^{-1}\, P^{-1/4}\, \eta^{-1/4}\, f^{1/4}$$

No magnetic afterglow signal was observed at the frequencies higher than 0.65 Hz.
The exclusion coupling constant limits was deduced from the quantitative analysis.

Increasing of the sensitivity of the OSQAR-CHASE experiment over the previous GammeV reference experiment B from 5 T to 9 T, P from 3.5W to 18.5W, η from 0.29 to 0.65, decay rate sensitivity from 1.35 Hz to 0.6 Hz assumes that the present coupling constant limit will be reduced lowered by a factor of 4.