Fig. 1 – Schematic description of the Cerenkov Radiation.

Fig. 2a – Experimental Evidences for NPICR-pions presented in Fig. 3 of the Ref. [37].
Fig. 2b – (a) An example of experimental evidence for Cerenkov pions emission via HMCR-mechanism in hadronic media. (b) Experimental statistical test of HMCR mechanism dominance in hadron-hadron collisions. The number of reactions fitted with HMCR for integrated cross sections versus $\chi^2/n_{\nu}$ (see text).

Fig. 3a – Examples of anomalous Cerenkov rings from Vodopianov *et al.*, Ref. [53].
Fig. 3b – Possible interpretation of observed concentric Cerenkov rings as “fermionic boom”.

Fig. 4a – Schematic description of SCR-components and SCR-signatures.
The quantum theory of SCR is similar to the quantum theory of CR [5] and here we present only some final results for the case of a transparent non-porous medium. As in the case of the TR theory, the spin interaction Hamiltonian is with some modifications of source fields in medium can also describe the coherent γ-emission in all sectors (E1 and E2). Then it is easy to see that the intensity of Super-Cerenkov radiation can be given in the following form [50]:

\[
\frac{dN}{do} = \frac{\omega^2}{\nu_1 n_1^2 n_2^2} \frac{k}{d\omega} \delta(1 - \cos \theta_{\text{SCR}}) S \cdot \Omega
\]

where the spin factor \( S \), for a two body electromagnetic “decay” of a spin \( \frac{1}{2} \) particle in medium is given by

\[
S = \frac{(E_1 + M(E_2 + M)}{4E_1E_2} \left( \frac{p_1^2}{E_1 + M} + \frac{p_2^2}{E_2 + M} \right) + \left( \vec{\epsilon}_1 \cdot \vec{\nu}_1 \right) \left( \vec{\epsilon}_2 \cdot \vec{\nu}_2 \right) - \left( \vec{\epsilon}_1 \times \vec{\nu}_1 \right) \left( \vec{\epsilon}_2 \times \vec{\nu}_2 \right)
\]

\[
= \frac{(E_1 + E_2)(E_1 + M)}{E_1 + M} \left( \frac{\vec{p}_1}{E_1 + M} + \frac{\vec{p}_2}{E_2 + M} \right) - \left( \vec{\epsilon}_2 \times \vec{\nu}_2 \right) \left( \vec{\epsilon}_1 \times \vec{\nu}_1 \right)
\]

Now, one can see that \( (1 - \cos \theta_{\text{SCR}}) \) Heaviside step function is 1 in two (or many) physical regions defined by the constraint \( \cos \theta_{\text{SCR}} < \frac{1}{2} \left( E_2/E_1 \right) \). The spin factor \( S \) in the above formulas is defined just as in the usual CR quantum theory but with the particle’s momentum \( p_1 = 1/2 \), considered in medium. The vector \( \vec{\epsilon}_1 \) is the photon polarization for a given photon momentum \( k \). For a given \( k \) we choose two orthogonal photon spin polarization directions, corresponding to a polarization vector perpendicular and parallel to the SCR-decay plane \( Q \).

Fig. 4b – A brief description of quantum theory of SCR-decay.

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Fig. 4c – A brief description of the quantum theory of SCR-decay.
Fig. 5a – Schematic description of the SCR fundamental tests based on the SCR-ring radii predictions.

Fig. 5b – Experimental Čerenkov ring radii of the particles e, μ, π, K, obtained by Debbe et al., [52] with RICH detector, are compared with the theoretical Super-Čerenkov prediction (solid curve), and also with the Čerenkov prediction (dashed curves).
Fig. 5c – Scaling law of the SCR ring radii.

The radius of rings produced by the Super-Creolon radiation modulator SCR scaling law given by the following relation [50, 51]:

\[ \frac{r_m}{\lambda} = \frac{B}{2} \left[ \frac{(p/\lambda)^2 - (a/\lambda)^2}{(p/\lambda)^2 + 1} \right] - 1 \]

This scaling property must be independent of particle rest mass.

The SCR scaling prediction is verified with high accuracy for all experimental data on ring radii of the electron-mass, proton and krypton, respectively.
Fig. 6 – Schematic description of the Mesonic Super Cerenkov-like Radiation.

Fig. 7 – Schematic description of the classification of SCR-effects.
Fig. 8 – Possible Super-Cerenkov-like Radiations suggested by particle classification.

Fig. 9 – Schematic description of the gluonic SCR-components.