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On the illumination parameters of convex bodies

Let $\mathbf{K}$ be a convex body of $\mathbf{E}^d$. We say that a point, *i.e.*, a light-source l, illuminates the boundary point p of $\mathbf{K}$ if the half-line starting at l and passing through p intersects the interior of $\mathbf{K}$. Furthermore we say that the light-sources $\{l_1, l_2, \dots\} \subset \mathbf{E}^d \setminus \mathbf{K}$ illuminate $\mathbf{K}$ if each of its boundary points is illuminated by at least one of the light-sources $\{l_1, l_2, \dots\}$. The well-known illumination conjecture of Hadwiger (1960) says that any d-dimensional convex body can be illuminated by 2^d light-sources. In this talk we consider some quantitative versions of Hadwiger's problem. If $\mathbf{B}$ is a centrally symmetric body about the origin o of $\mathbf{E}^d$, then let the illumination parameter of $\mathbf{B}$ be defined as

$$b(\mathbf{B}) = \inf\Big\{\sum_i d(o, l_i) : \{l_i\} \text{ illuminates } \mathbf{B}\Big\}.$$

This ensures that far-away light-sources are penalised. K. Bezdek proved (1992) that $b(\mathbf{B}) < 6$ holds in $\mathbf{E}^2$. He also proved (2005) that $b(\mathbf{B}) = 6\sqrt{3}$ if $\mathbf{B}$ is the unit ball $\mathbf{E}^3$.

We prove some theorems about the illumination parameters in $\mathbf{E}^3$, and give some possible generalizations in $\mathbf{E}^d$, when we consider the illumination by r-dimensional linear light-sources instead of points.