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Four geometrical-optics illusions

physikalisches

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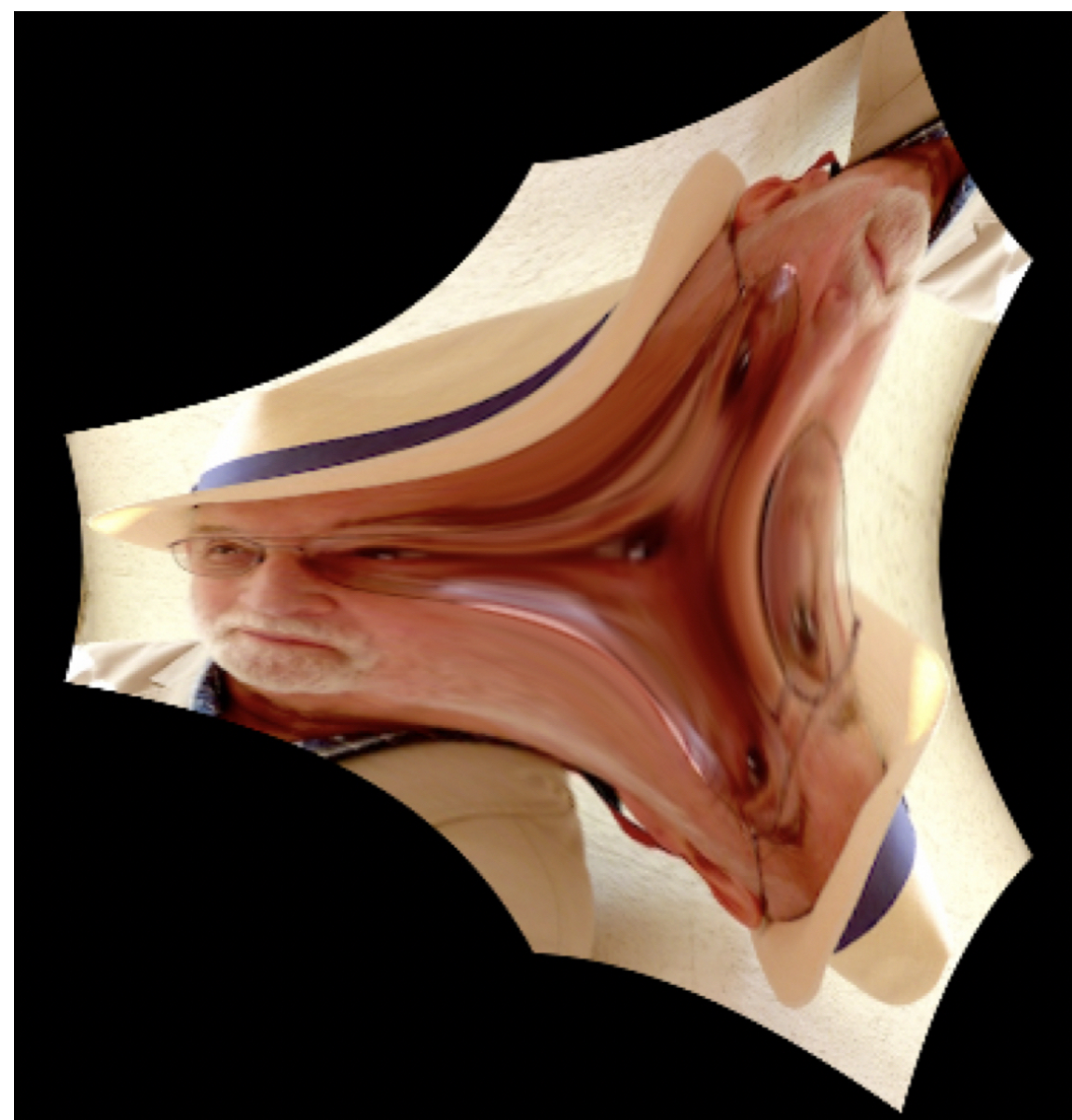
Centuries after the laws of geometrical optics were established, they still have nontrivial and varied applications. Illustrating this are some illusions:

Mirages, and Raman's error. Understanding why he denied the applicability of geometrical optics requires careful exploration of the continuum limit of a discretely-stratified medium, to reveal its nonuniform convergence.

Oriental magic mirrors and the Laplacian image. The optics of these several-millennia-old objects involves the unfamiliar regime of pre-focal brightening. The transmission analogue ('Magic windows') raises a challenge for freeform optics.

The squint moon and the witch ball. The moon sometimes appears to point the wrong way because we perceive the sphere of directions as a distorted 'skyview', on which geodesics appear curved. This can be conveniently viewed and analysed by viewing the sky in a reflecting sphere.

Distorted and topologically disrupted reflections in curved mirrors. Mirror-reflected rays from each point of a continuous object form caustic surfaces in the air. Images are organised by those points whose caustics intersect our eyes, and can be systematically understood in terms of the elementary catastrophes of singularity theory.



Distorted reflection in doubly curved mirror.