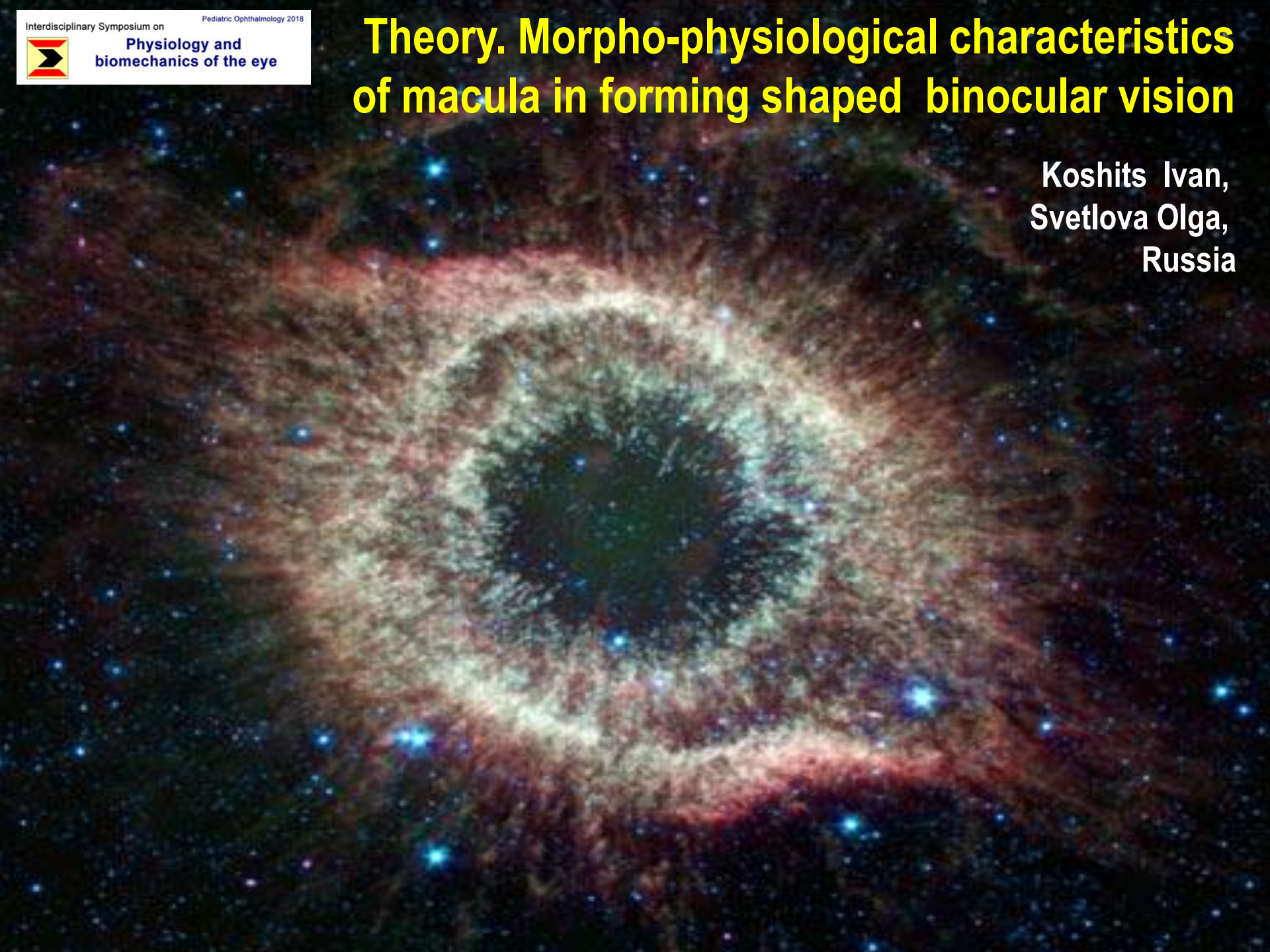
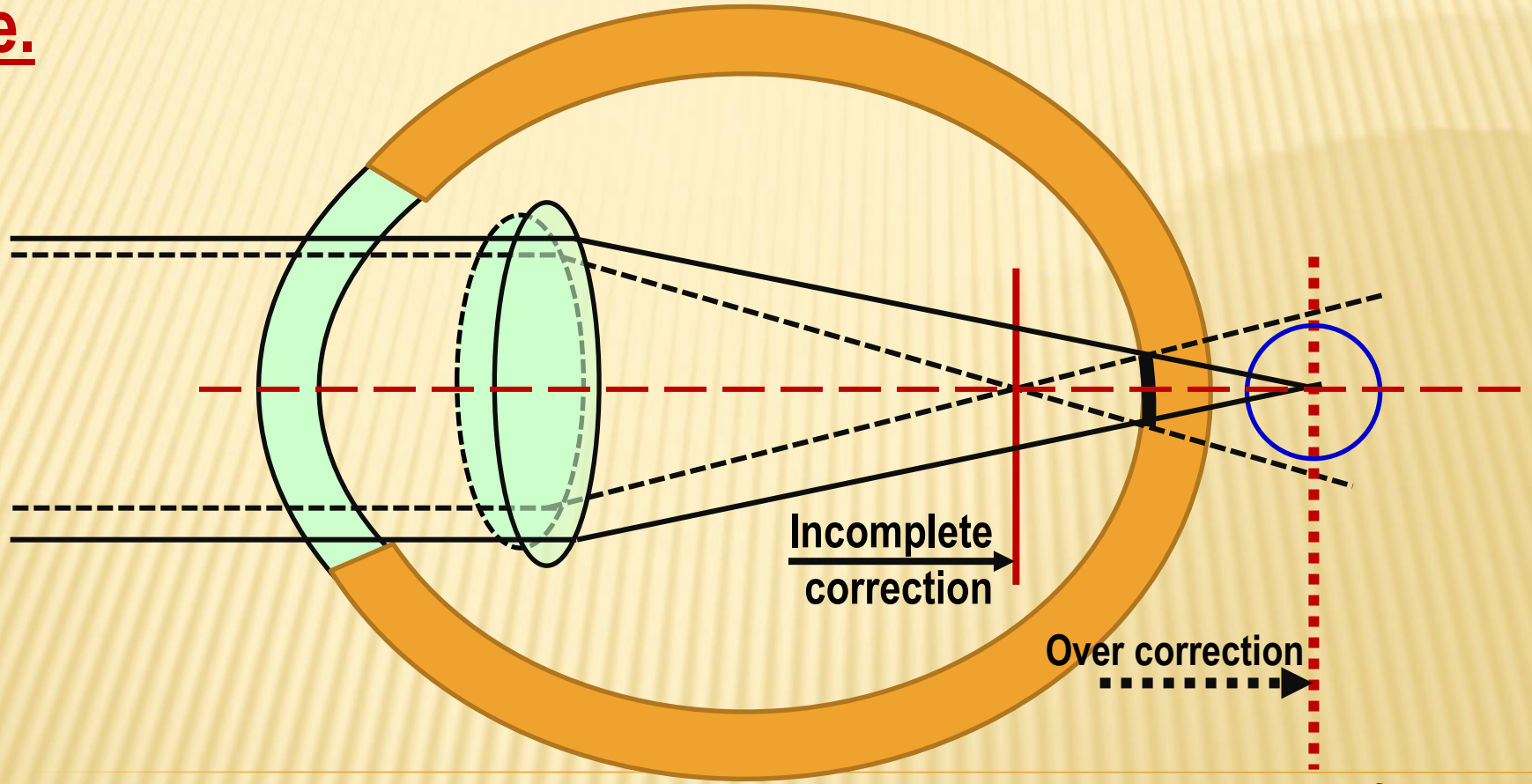
Interdisciplinary Symposium on
Physiology and biomechanics of the eye
Pediatric Ophthalmology 2018

Theory. Morpho-physiological characteristics of macula in forming shaped binocular vision

Koshits Ivan,
Svetlova Olga,
Russia

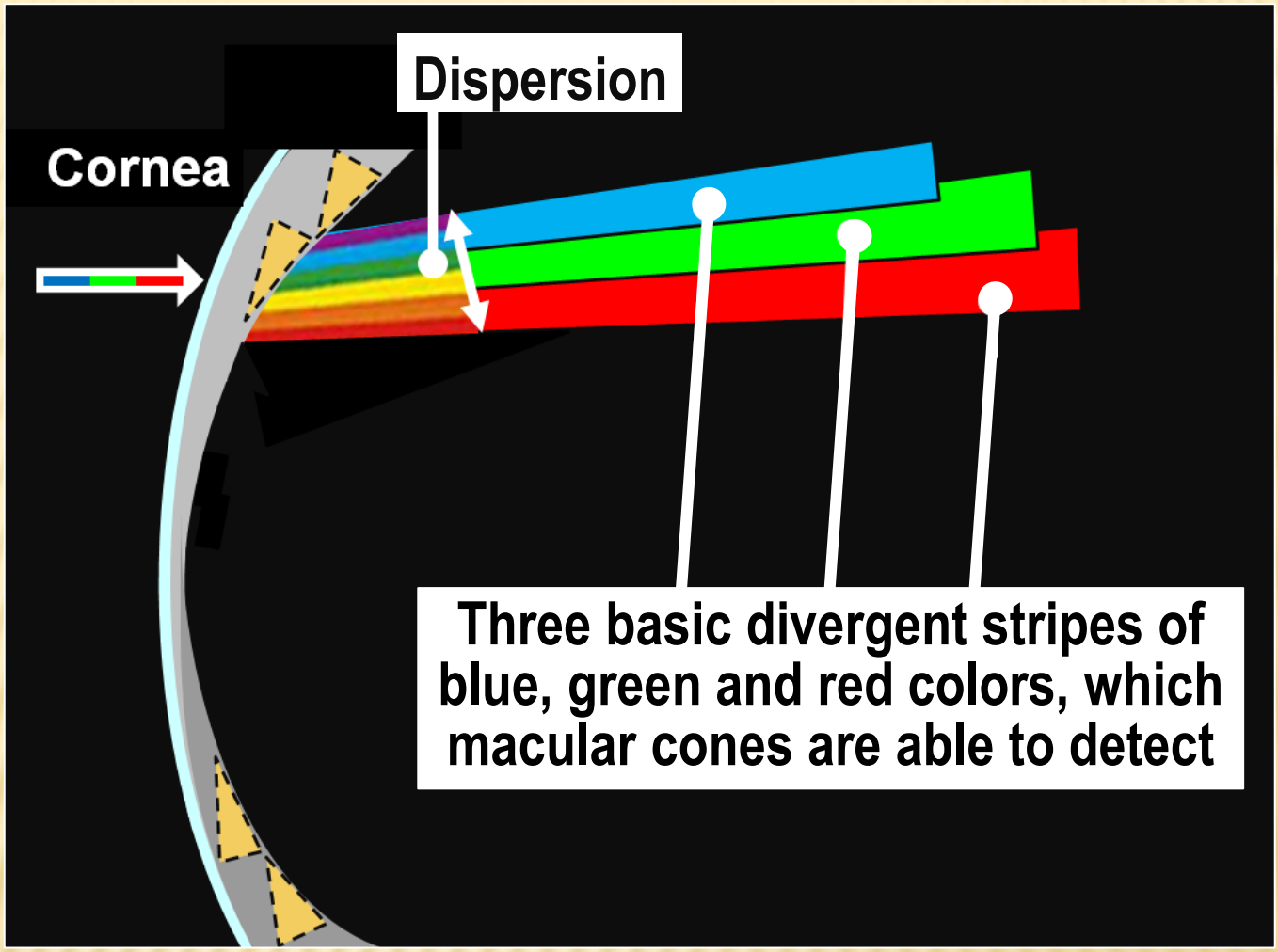


Unfortunately, the modern theory of Optometry is poorly developed. In practice, we use terms which are several centuries old. One of such mantras is the concept of **the focus of the eye.**



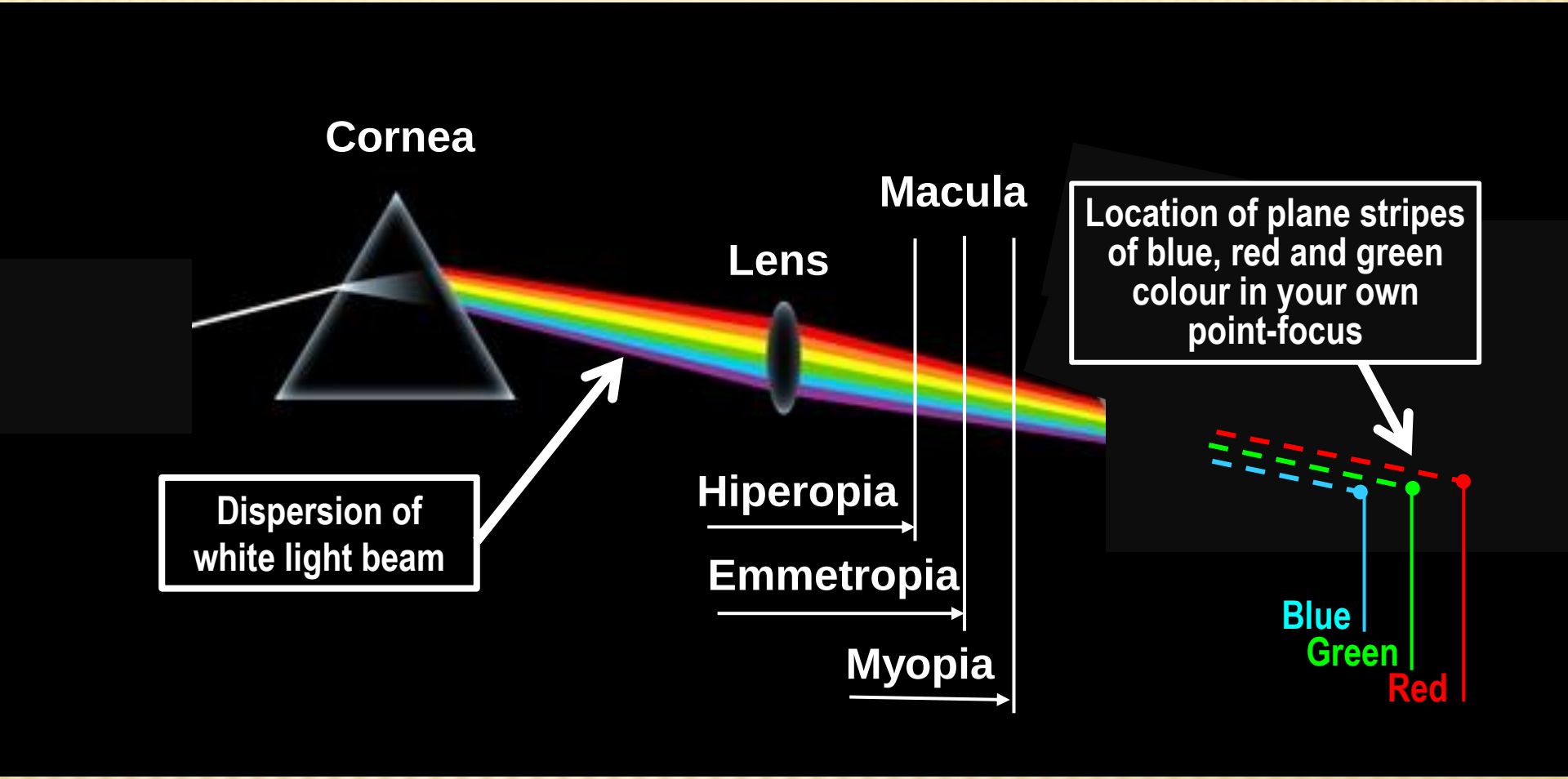
Eye optics always generates the inverse image, because the focus is always inside the eye. However, when we say: ***"focus behind the retina"***, then in this case the image must be direct, not inverse! But then, it's unclear how the eye generally focuses the objects!

Dispersion of white light at the border "cornea-intraocular liquid»



Retina can capture only the blue, green and red rays. Planes to capture these three rays never coincide. We call it an aberration. Therefore, the eye should be able to control the scope of finding not one but three colored tricks.

Dispersion of the white light and the plane of convergence of rays



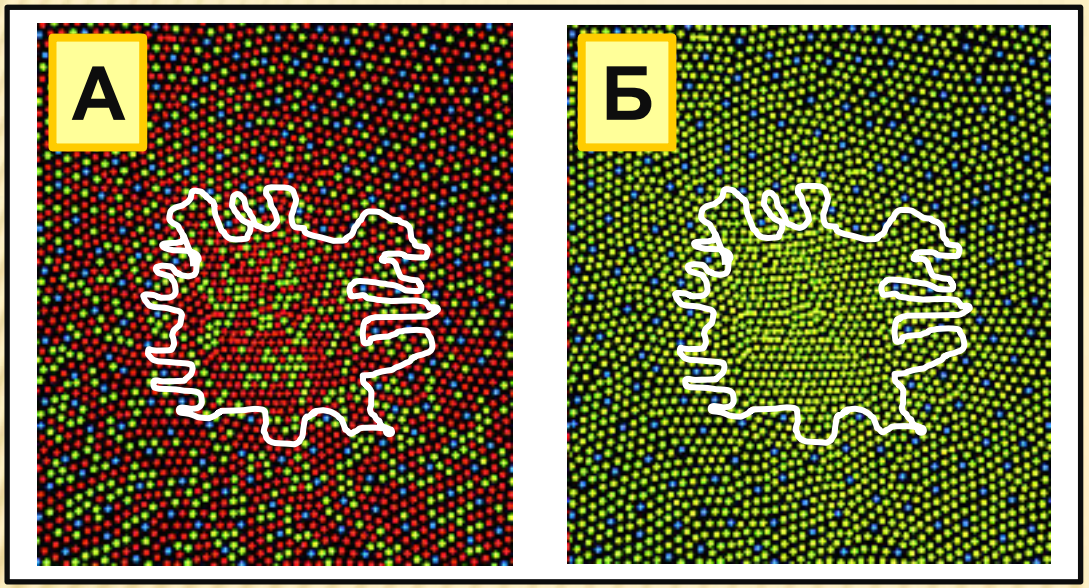
It became clear that the notion of "focus of eye" is not unique and hampers the development of optometry. So you need to look for other mechanisms of the eye sharpening.

We will try to suggest some hypotheses.

Morphology and physiology of the macula

1. Cones in the Fovea are susceptible to three colors: blue spectrum (440-480 nm), green (510-550 nm) and red (620-770 nm).
2. The foveola (2.2 mm diameter) consists from only red and green cones.
3. Dark blue cones are found inside the rings located around the foveola, with an outside diameter of approximately 4.5 mm (stereo-angle of 180^{o}).
4. The density of blue cones within this ring has the highest concentration.
5. This ring apparently plays a leading role in the physiological mechanism of aiming the eye for the highest accuracy of the image.

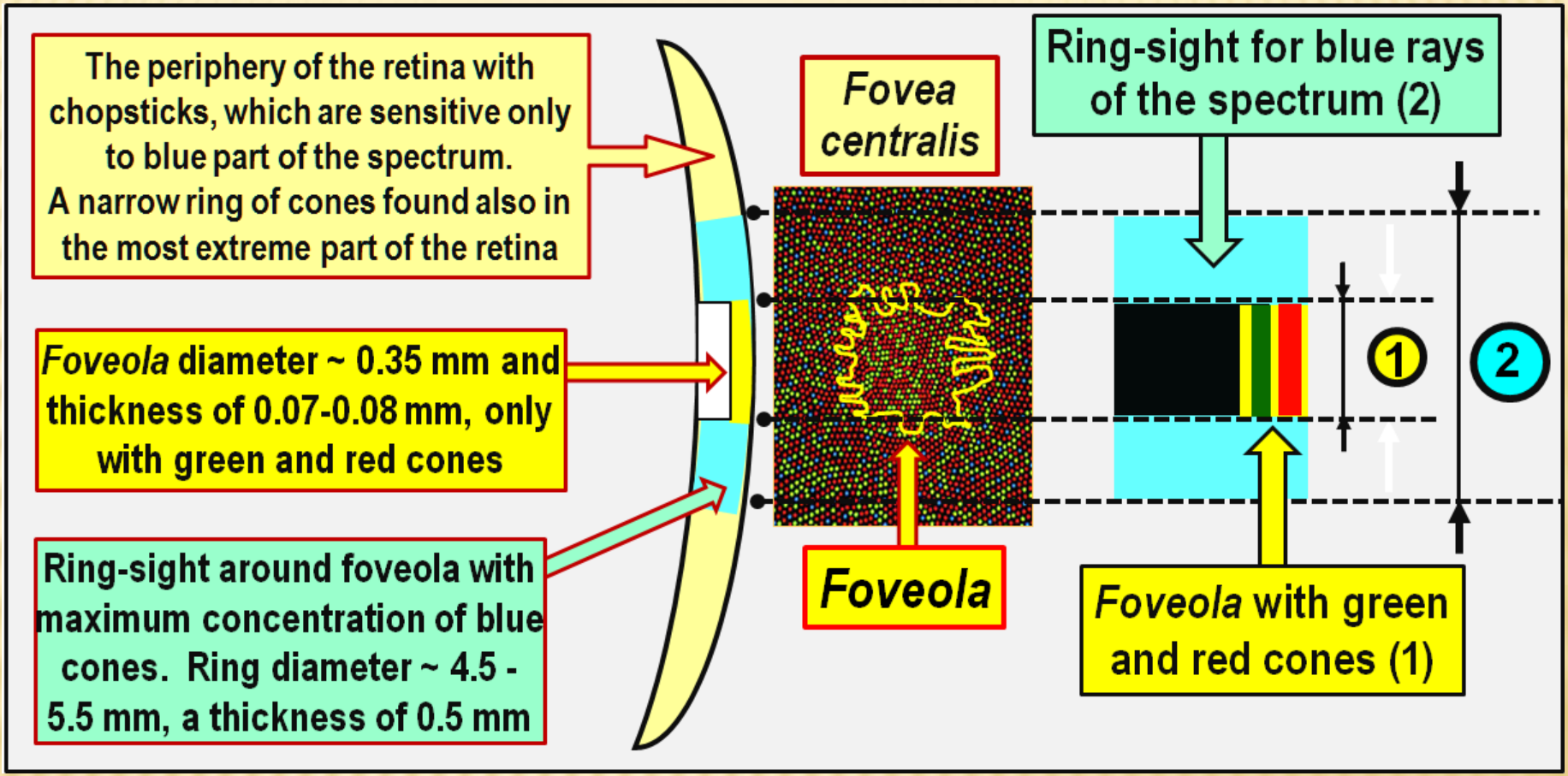
Organization receiving the input optical signal



Electron Microscopy.
Foveola and the ring of blue cones within the macula of the normal eye (A) and in color blind eye (B).

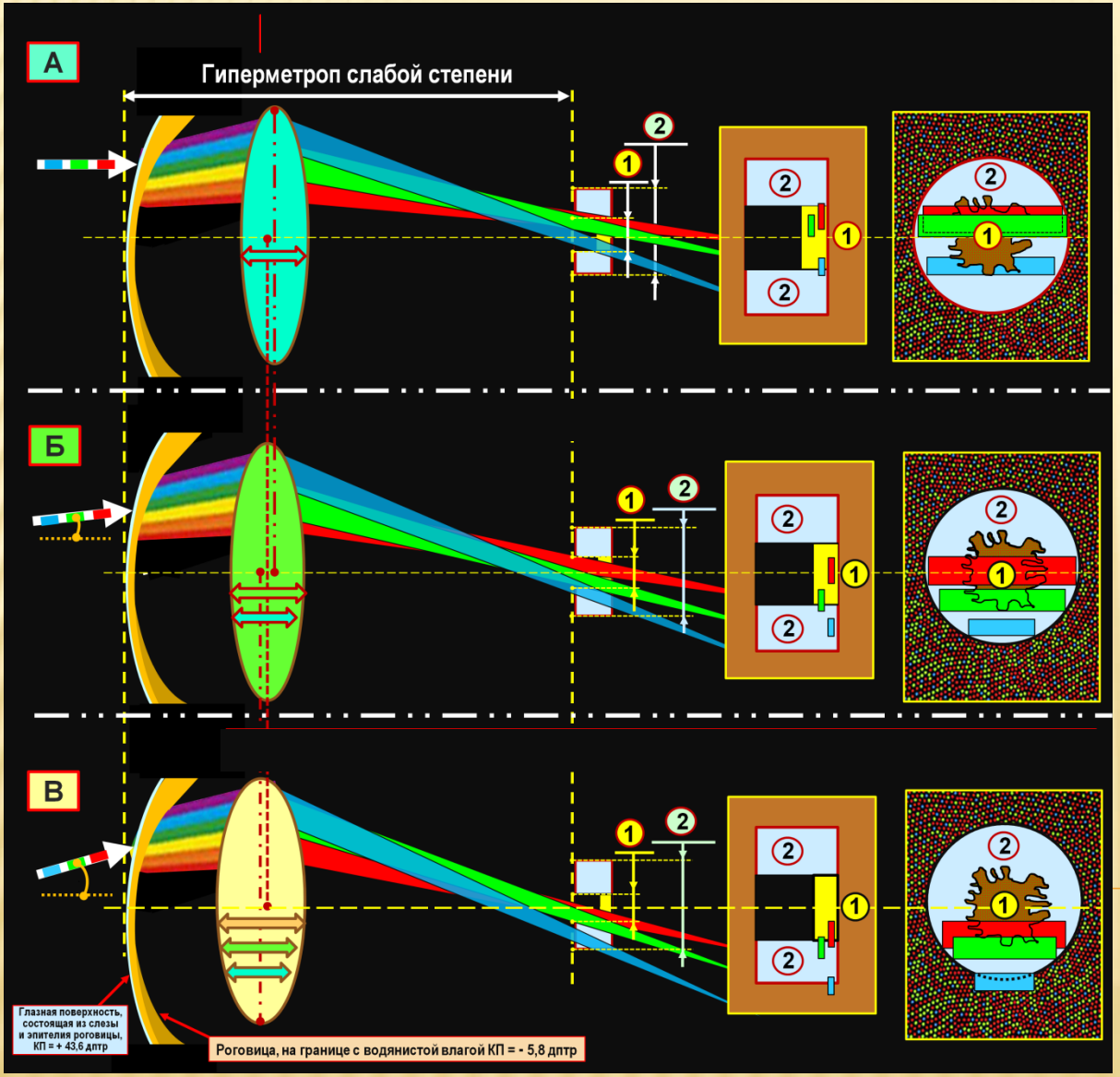
This morphofunctional structure of the macula allows you to reliably "aim" for the area of space even in low-light conditions when the coming light mostly consists from the most powerful violet-blue part of the spectrum.

Scheme of morpho- functional organization of retinal optical Center



This scheme will help you to better understand the organization of the incoming optical signal with the functioning of the accommodation system.

Organization of receiving the input optical signal



Work at a distance. The ciliary muscle tone is minimal.

Hyperopia of weak degree.

Work at the middle distance. The ciliary muscle tone is close to the average.

Work at near distance. The ciliary muscle tone is maximal.

Organization of receiving the input optical signal

This scheme shows that the green and red rays overlap each other. The arrangement of these fields in the fovea may be clearly recorded and analyzed by the brain. This is a wonderful mechanism of aiming the eye due to analysis of the area and relative positions of the excitation fields of green and red. Blue band of light from the Green and red stripes in all phases of accommodation. When working at close distance the area of the blue light is minimal. The minimum signal makes it difficult to use eyes full potential when working at near.

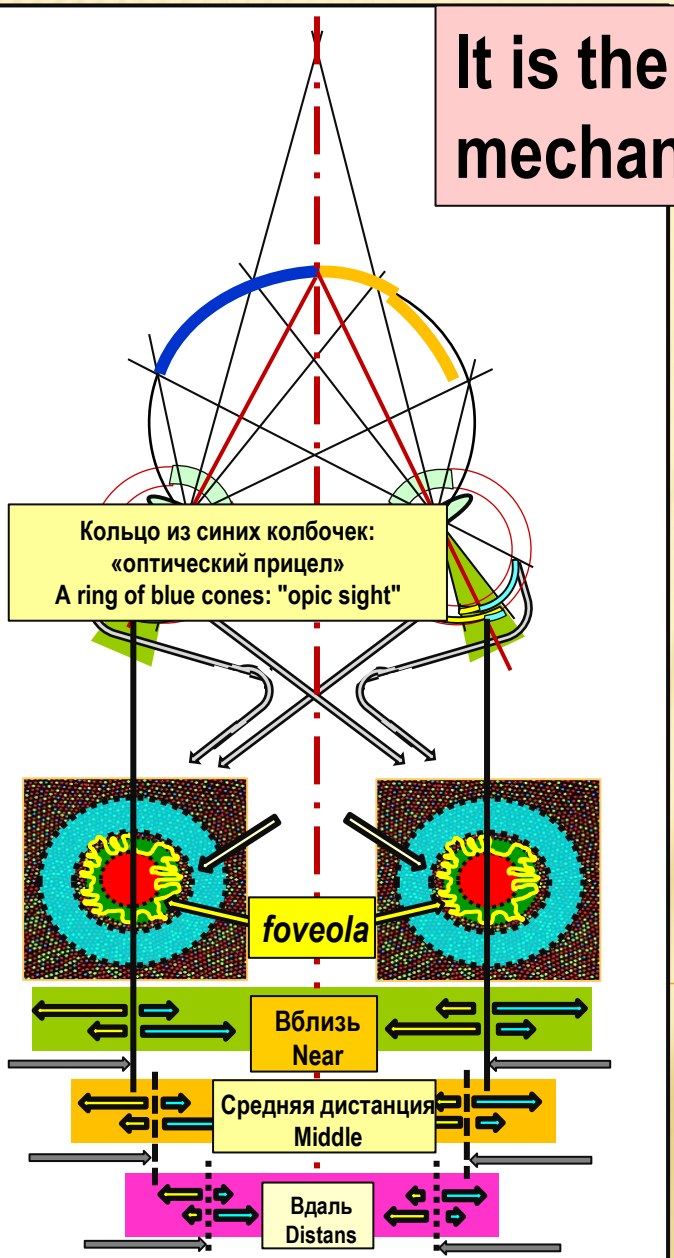
Work at a distance. **The ciliary muscle tone is minimal.**

Hyperopia of weak degree.

Work at the middle distance. **The ciliary muscle tone is close to the average.**

Work at near distance. **The ciliary muscle tone is maximal.**

Physiological mechanism of binocular guidance



It is the scheme of binocular search and aim mechanism of a gradually moving object .

We expect a strong signal from the blue excitation cones located along the ring around the foveola is a borderline "signal of detection" to start the operation of the executive mechanisms more subtle eye command to “aim".

It is possible to define the circular boundary of the fixation of blue rays in the ring-bullzeye of the macula as a mechanism for preliminary search and guidance.

Thank You for Your attention!