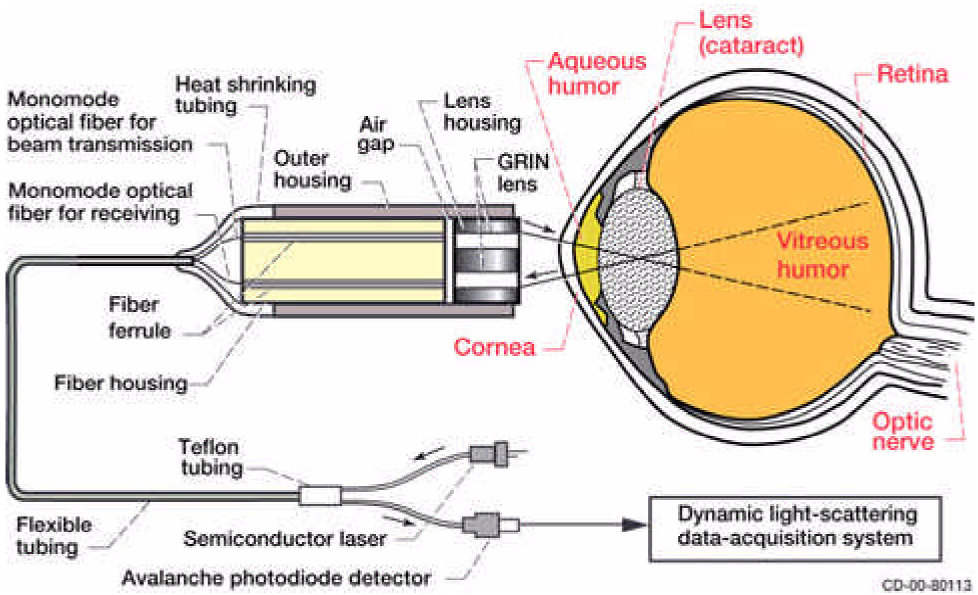
# Dynamic Light-Scattering Probe Used for the Very Early Detection of Cataracts and to Measure Response to Therapy (or Treatment)

Half of all blindness worldwide is due to cataracts, and 34 million Americans over the age of 65 have cataracts. This figure is expected to rise to 70 million by the year 2030. Currently, no medical treatment is available to prevent or halt the progression of a cataract; nor is there any way to reverse a cataract once it has been detected by conventional methods. The only known treatment is surgical removal of the lens. It is estimated that over $5 billion will be spent this year for the treatment of cataract patients in the United States alone.

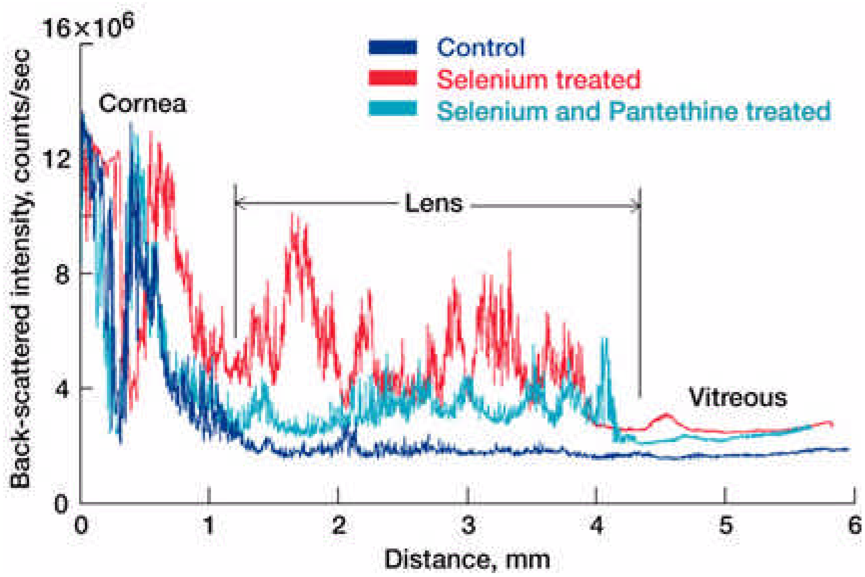
According to Carl Kupfer, M.D., former Director of the National Eye Institute at the National Institutes of Health, "A delay in cataract formation of about 10 years would reduce the prevalence of visually disabling cataracts by about 45 percent." However, this vision remains a dream because of the lack of objective methods that can be used to detect cataracts very early and, hence, can be used for screening potential anticataract drugs. This is about to change. The National Eye Institute and NASA entered into a formal interagency agreement in late 1996 to develop and test a dynamic light-scattering (DLS) device to detect the earliest changes due to cataract formation. The new DLS probe developed by Dr. Ansari at the NASA Glenn Research Center is several orders of magnitude more sensitive than conventional clinical systems. This ultrahigh sensitivity enables the probe to detect the onset of a cataract before it has any effect on vision and allows researchers to test the effectiveness of anticataract drugs in reversing cataracts. This device (see the following illustration) was originally designed to study transport phenomena in microgravity fluid physics experiments onboard the space shuttle orbiters and space station. It will be very useful in testing anticataract drugs to halt or reverse the progression of cataracts during longitudinal clinical trials.




*Fiber-optic probe for the early diagnosis of eye diseases.*

Long description Illustration showing eye with optic nerve, retina, vitreous humor, lens (cataract), aqueous humor, and cornea being imaged through a GRIN lens, lens housing, air gap, outer housing, heat shrinking tubing, monomode optical fiber for beam transmission, monomode optical fiber for receiving, fiber ferrule, fiber housing, flexible tubing, teflon tubing, semiconductor laser and avalanche photodiode detector to a dynamic light-scattering data-acquisition system.

In light of this development, can we find a medical cure for cataracts? According to preliminary experimental data obtained recently in collaboration with the University of Washington School of Medicine in Seattle, the answer is likely yes. Professor John Clark has been advocating the use of the drug Pantethine as an anticataract agent for many years. Determination of its efficacy has remained elusive because of the lack of reliable techniques for noninvasive and quantitative detection of early cataracts. Experiments conducted with 12 rodents using the DLS probe show promising results. The probe was used in the static mode, in which the eye of the animal (cornea to retina) was scanned at a very low, safe laser power of 80 µW to collect photons, or scattered intensity, in steps of 10 µm (see the graph). The rodents studied were control, selenite injected, and selenite plus Pantethine injected animals.[1] Selenite was used to induce cataracts. Changes (increase in light scatter) could be seen in the eye lens as early as 1 day after the selenite injections. Pantethine injections slowed down these changes. Detailed data analysis is yet to be done, and more experiments are planned to confirm these findings. It is of significant importance that these subtle molecular changes are not noticeable when the animals are examined with conventional ophthalmic instruments because their lenses are completely transparent.



*Cataract treatment in rats.*

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**Programs/Projects:** Microgravity Science
**Special recognition:** STAIF (Space Technology and Applications International Forum) 2001 Outstanding Paper Award for the Conference on Space Radiation and Environment Effects for the paper entitled "Non-Invasive, Quantitative, and Remote Detection of Early Radiation Cataracts for Applications in Bio-Astronautics and Bio-Informatics" by Rafat R. Ansari, Frank Giblin (Oakland University), and James F. King (QSS/Glenn). U.S. Patent 5973779 awarded Oct. 26, 1999.

[1]Animal studies were conducted at the University of Washington in Seattle under the National Institutes of Health guidelines following the safe use of laboratory animals.