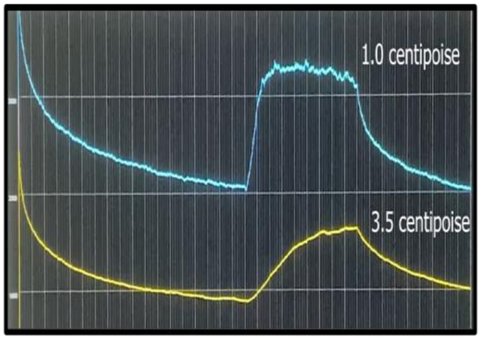
Executive Summary

Solaris BioSciences has developed and patented optically based technologies for the measurement of blood plasma viscosity with pin-prick volumes and for the high sensitivity detection of proteins, and other biomolecular moieties using sample volumes comparable to those of human cells. Both technologies utilize optical forces on nanoscale particles which are either naturally present, or added to the samples.

The LaserDrag™ viscometer can make measurements on pin-prick volumes of blood in under two minutes using hematocrit separating test strip consumables. The compact hardware utilizes low-cost lasers to drag naturally occurring bilirubin-albumin complexes to determine the viscosity of blood plasma.

Current shear-based viscometers require several milliliters (1ml-4ml) of blood plasma while advances in microfluidics-based approaches require extreme surface cleanliness of the capillaries and require time consuming calibrations involving liquid handling in the measurement setting to undertake viscosity measurements on very small samples. Other novel approaches to viscosity measurement in small samples using viscosity dependent fluorescence yield of molecular rotor dyes suffer from extreme sensitivity to dye concentration, sample turbidity, and temperature, which have kept this technology out of commercial use.

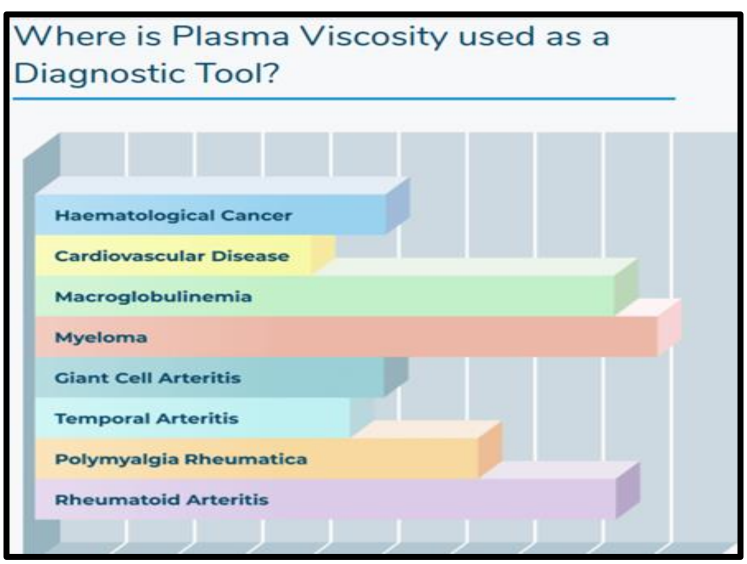
LaserDrag™ technology moves nanoparticles *within* the fluid and therefore the interaction of the fluid with the walls of a capillary plays no part in the measurement. The system measures viscosity (typically in centipoise) by the risetime of signals which evolve in time due to the light forces dragging the nano-particles to a position of local equilibrium. The longer this process takes, the more viscous the solution. The figure shows raw data which is analyzed by the instrument algorithms to calculate viscosity at a set temperature.



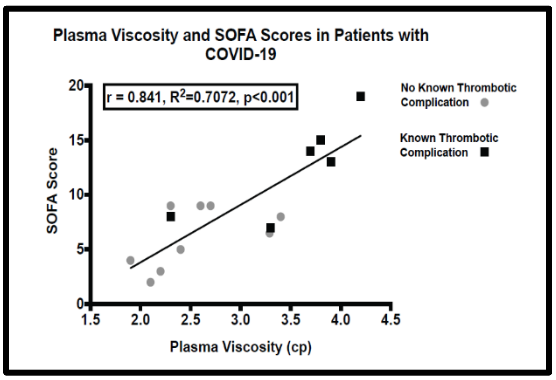
In recent studies from 2018 to the present, there has been a rapidly growing body of evidence that correlates the viscosity of blood plasma to disease states. Blood plasma viscosity is linked to a number of chronic diseases, infections, and inflammations (ranging from myocardial infarction, venous thrombosis, venous thromboembolism, to a variety of blood cancers, and infectious diseases like malaria), hyper-viscosity, cardio-metabolic risk factors, proteinuria, and myeloma.

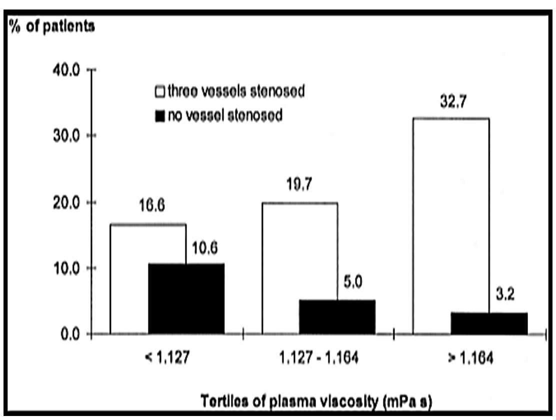
The body produces paraproteins in response to infection or inflammation, and these responses consequently affect blood viscosity; measuring this viscosity may aid in diagnosing, detecting and monitoring a variety of illnesses.

Blood plasma viscosity testing is "non-specific," as it does not determine the reason why hyperviscosity is occurring, nor locate where it's happening in the body, but can serve as a powerful early-stage diagnostic which leads to more biologically specific laboratory testing. Senior Cambridge University biomedical scientist, Dr. Daniel Gleghorn stated:" "It is a cost-effective test compared with other expensive biochemical methods….". There is also the benefit of a less complicated and reliant supply chain for consumables and reagents. This has been significantly affected for other tests (CRP, procalcitonin and Interleukin-6) where this is not the case due to a worldwide increase in demand and the effects of lockdowns on distribution networks." The figure illustrates some of the more traditional disease states where blood plasma viscosity is used as a diagnostic tool.



Since the SARS-2 pandemic, a number of medical researchers have reported on thrombic complications in patients with coronavirus disease, including ones receiving anticoagulation drugs. Researchers at Emory University School of Medicine have established a link between Covid-19-associated hyperviscosity of blood plasma with potentially severe medical consequences in patients with SARS-2 infections ("Covid-19-associated hyperviscosity: a link between inflammation and thrombophilia", The Lancet, Volume 395, 2020). These measurements were performed using standard capillary viscometers and found that all studied patients had plasma viscosity levels >95% of normal. The figure shows Emory University work on how the Sequential Organ Failure Assessment (SOFA) score correlates with blood plasma viscosity in Covid-19 patients. The viscosity of whole blood depends on hematocrit, erythrocytes deformability and plasma viscosity, which in turn depends primarily on the protein profile. The rapid, pin-prick sample, simultaneous measurement of blood plasma viscosity can provide a useful picture of what the levels of fibrinogen are in a patient, respective of blood thinner medication which do not address this type of clotting risks. Based on full rheological studies of blood, it has been suggested that plasma viscosity may be a more sensitive than whole blood viscosity to changes in the plasma proteins associated with cardiovascular disease risk and mortality and a valid clinical marker for these situations. The figure shows data which correlates the population of patients with stenosed vessels with their blood plasma viscosity (Junker, et. al. "Relationship Between Plasma Viscosity and the Severity of Coronary Heart Disease", Arteriosclerosis, Thrombosis, and Vascular Biology, Vol. 18, No. 6, 19880).

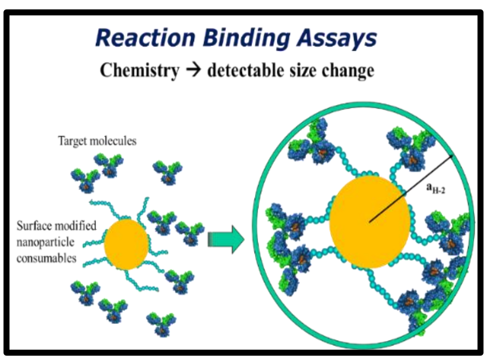




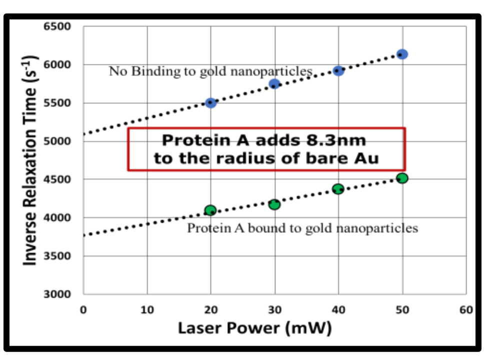
The successful demonstration of blood plasma viscosity measurement with the LaserDrag technology has also led to the possibility of using the same platform with target specific test strips to measure the levels of cancer markers such as CEA (carcino-embryonic antigen), prostate-specific antigen (PSA) and cancer antigen (CA 125) which are an important diagnostic for the re-appearance of cancers in patients who have undergone treatment.

Ultra-sensitive Biomolecule Detection for Drug discovery and Assays

A second patented Solaris BioSciences technology using light forces is based on a nonlinear optical interaction called Non-Degenerate Two Wave Mixing (NDTWM) and the use of customized nanoparticle consumables (gold, silver, polystyrene, and silica) which serve as particles with a precisely defined size and assay binding targets in the measurements. The underlying physics relies on the interaction of moving light intensity patterns to drag nano-particles through extremely small volumes of solutions, thereby determining their "size" through measurements with and without the various molecules of interest attached to their surfaces. Because the method is an exchange of energy between two light beams, rather than weak scattering of light, the signal to noise inherent in this method is millions of times larger than with some other optical methods.



The NDTWM technology has been shown to be a very sensitive method of detecting extremely small (10^{-15} moles) numbers of molecules in very small volumes of solution. This has applications in detection of a large palette of biomolecules for a number of applications ranging from drug discovery to assays for viruses and other pathogens. This application utilizes surface modified nanoparticles as consumables to which target molecules of interest selectively bind, resulting in a change in the effective radius of the particles being dragged through the solution (water) by the moving laser light pattern. This results in an easily measured shift relative to the case of no specific target binding and indicates that reaction has occurred at the smallest concentrations of the target species. Experiments performed to date have resolved the binding of protein A onto gold nanoparticles showing the technology is capable of resolving femtomoles (10^{-15}) of the protein on as few as 1000 nanoparticles and in volumes of 10^{-13} liters.



Intellectual Property Protection:

Solaris BioSciences technology is protected by two issued USPTO patents and foreign fillings (USPTO 9,970,854 and 10,379,114, "Nondegenerate two-wave mixing for identifying and separating macromolecules). A report on the NDTWM technology for use in assays using gold nanoparticle consumables was prepared by Dr. Hadi Shafiee, at the Division of Engineering in Medicine, Brigham and Women's Hospital of the Harvard Medical School.
Dr. Shafiee is a recognized expert in assay technology and particularly as it relates to virus detection. In the report, he commented on the original nature of the technology:
"After surveying the academic and clinical literature, this technology represents a technique that has not seen use previously. In the current medical diagnostic market, there are not diagnostic systems or assays that utilize nondegenerate two-wave mixing approach with gold nanoparticles………."Successful application of nondegenerate two-wave mixing with gold nanoparticles for rapid particle size measurement, especially applied to a medical diagnostic device, may be considered non obvious"

In addition to the issued patents, there are two additional pending patents, one for the LaserDrag™ device and associated consumables, and a patent for the use of using refractive index matched membranes to create transparent lateral flow test trips and consumables which allow for optical analysis of samples.

Solaris Biosciences Board of Directors:

Founder, Chairman, and Inventor of the Technology:

Dr. Nabil Lawandy received a PhD in Chemical Physics from the Johns Hopkins University in 1980. In From 1981 to 1997, Dr. Lawandy was a professor at Brown University in the Division of Engineering and Department of Physics. Professor Lawandy has published over 180 papers in peer reviewed journals holds over 100 published US and international patents in a number of applications spanning optical materials, processes, and devices. Dr. Lawandy is an Alfred P. Sloan Fellow, a recipient of a Cottrell Award, and a recipient of the Presidential Young Investigator Award, the Slater Foundation Innovation Award, and the Rolex Prize for his work on using Random Lasers for Photo-medicine. He is the founder and CEO of Spectra Systems Corporation, SpectraDisc Corporation and Solaris Nanosciences. In July of 2011, Dr. Lawandy and the Spectra management team successfully floated Spectra Systems on the AIM segment of the London Stock Exchange

Non-executive Directors:

Dr. Mark Selker

Dr. Selker is currently CTO and Co-Founder of Jovea Labs, LLC. Before founding Jovea Labs, Mark was Vice President of R&D in the Bioprocessing equipment division of Thermo Fisher Scientific. Finesse Solutions, a company he helped co-found in 2005 was purchased by Thermo Fisher in 2018. Mark and his team developed the world's only viable phase fluorometric single-use pH and dissolved oxygen sensors for large scale bioprocessing, including all the mechanical hardware, as well as the electronic boards, and associated firmware. Before co-founding Finesse, Dr. Selker was a visiting scholar at Stanford working on nano-scale plasmonic waveguides. Mark has worked in many other aspects of the optics industry including laser design, 40 Gb/s optical telecommunications, HFC networks, and nonlinear optics. Dr. Selker holds a BS in engineering from Brown University, an MS from University of Southern California and a PhD in engineering from Brown University.

Mr. Joshua Mandel

Joshua Mandel is a Healthcare Business Development and Product Marketing Executive who has worked at several leading pharmaceutical companies, including Novartis Oncology, Allergan, and Eisai. Joshua is currently Director of Business Development at MyTomorrows, a Dutch company helping patients with unmet medical needs discover and access treatments around the world. Joshua holds a BA with honors from Brown University, and received his MBA as an Austin Scholar from the Kellogg School of Management at Northwestern University

Solaris Biosciences Scientific Advisors:

Professor Anubhav Tripathy, PhD

Professor Tripathi's research group at Brown University develops new pathogen diagnostic platforms by integrating biological and engineering principles. This work has a broad impact on scientists, engineers, physicians, and entrepreneurs. He holds many patents, has over 120 peer-reviewed publications, and delivered more than 90 invited talks. He is a Fellow of the American Institute of Medical and Biological Engineering. Prior to Brown, Tripathi led the development of microfluidics chips for protein and DNA sizing at Caliper LifeSciences (now Perkin Elmer). This technology is sold in over one million chips annually. Tripathi earned a Ph.D. in Chemical Engineering from the City University of New York and was a Post-doctoral Fellow at Massachusetts Institute of Technology.

Frank Selke, MD, Professor and Chief or Cardiothoracic Surgery

Dr Sellke is the Karl Karlson & Gloria Karlson Professor and Chief of Cardiothoracic Surgery and Director of the Cardiovascular Institute at the Alpert Medical School of Brown University and Lifespan Hospitals. He previously served as the Johnson & Johnson Professor of Surgery at Harvard Medical School and Chief of Cardiothoracic Surgery at the Beth Israel Deaconess Medical Center, having been a successful clinician, educator and researcher in the cardiovascular field. His basic research focuses on microcirculation of the heart, brain and other organs as it relates to vasomotor regulation, permeability and collateral development. Dr Sellke has been continuously funded by the National Institutes of Health for the past 28 years. His clinical interests involve neurocognitive decline and other outcomes, quality improvement and reduction of inflammation, bleeding and transfusion after cardiac surgery. He has published over 540 papers and has an H-index of 92 with over 124,000 citations. He is the Associate Editor of the Journal of Thoracic and Cardiovascular Surgery and the Circulation Journal, and serves as a member of several other editorial boards. Dr Sellke is the Editor in Chief of the last 3 editions of Sabiston and Spencers' Textbook "*Surgery of the Chest*" and the Editor of the 1st and 2nd editions of "*Atlas of Cardiac Surgical Techniques*". He chaired the study section for the National Institutes of Health sponsored Cardiac Surgery Network and has served as the Chairman of its DSMB for the past 13 years, in addition to serving many other duties for the NIH. He has served as a full-time member of the Surgery, Anesthesia and Trauma study section and the Bioengineering, Technology and Surgical Science Study section of the NIH. Dr. Selke received his B.A. from Wabash College and his M.D. from Indiana University Medical School. Dr. Selke also holds honorary degrees from Harvard University and Brown University.