*i*Diagnostics (*i*TIRF Array)
TIRF Spectroscopy
TIRF Microscopy
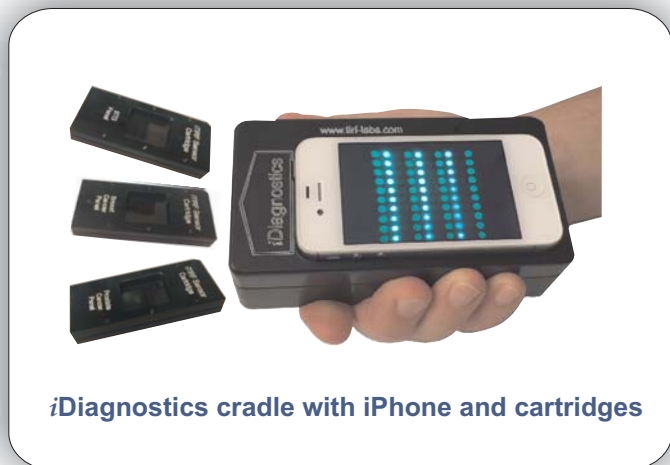
TIRF Labs
Total Internal Reflection Fluorescence

*i*Diagnostics - the Cellphone Future of Medicine
Open Innovation Platform for Collaborative Development of Advanced Molecular Diagnostics

*i*Diagnostics cradle with iPhone and cartridges

*Turn your cell phone into rapid, accurate, yet affordable molecular diagnostics, using *i*Diagnostics cradle*
***i*Diagnostics works with iPhone, HTC One, and other smartphones**

Molecular *i*Diagnostics (*i*TIRF Array)

TIRF Labs introduces *i*Diagnostics (*i*TIRF Array) - a novel molecular diagnostics platform, which is supersensitive, accurate, and rapid, yet affordable for home use. If you are developing fluorescence or electro-chemi-luminescence (ECL) bioassays for diagnosis or prognosis, we invite you to collaborate. We will help you to interface your assays with the *i*Diagnostics platform and will be delighted to license your technology. Ask about our *i*Diagnostics Application Development Kit (ADK).

*i*Diagnostics features a novel type of real-time microarray that simultaneously detects protein, nucleic acid, and metabolite biomarkers. *i*Diagnostics requires no or minimal sample preparation and is capable of detecting from a single to several thousands of molecular markers in a 50-microliter sample of biological fluids, including whole blood. The Limit of Detection (LOD) for micro-RNA is ~10^{-18}M. For proteins and metabolites, the LOD depends on the assay; for certain antibody-based assays, the LOD is at the level of ~10^{-15}M. The broad dynamic range of *i*Diagnostics sensor covers the entire spectrum of clinically significant concentrations.

Classical TIRF microarrays operate with small, sub-monolayer amounts of antibodies and DNA probes immobilized on the surface. In classical TIRF fluorescence, the signal is small, thus a low light photodetector, e.g. EMCCD camera is necessary. In *i*Diagnostics the signal of *i*TIRF arrays is enhanced with silk fibroin. Silk captures the excitation light and becomes an integral part of the lightguide. Classical TIRF is virtually 2-dimensional. One can say that silk extends TIRF into the 3rd dimension. Silk allows for the usage of larger amounts of antibodies per unit area of bioassay spot. The signal from *i*TIRF arrays is a thousand-fold greater than that in classical TIRF. Therefore, CCD cameras of cell phones are sensitive enough to detect the signal. Silk-enhanced *i*Diagnostics is an ideal platform for interfacing antibody-based bioassays for detecting proteins and molecular beacon assays for measuring nucleic acids. See page 2 for more information.

Real-time protein, nucleic acid, and metabolite iTIRF microarrays
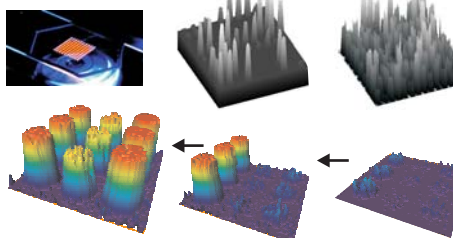
Data Acquisition and Processing

The *i*Diagnostics app selects respective Regions of Interest (ROI), builds sensorgrams for each bioassay, and determines the concentrations of protein, nucleic acid, and metabolite markers. the limit of detection for micro-RNA ~10^{-18}M, proteins and metabolites ~10^{-15}M.
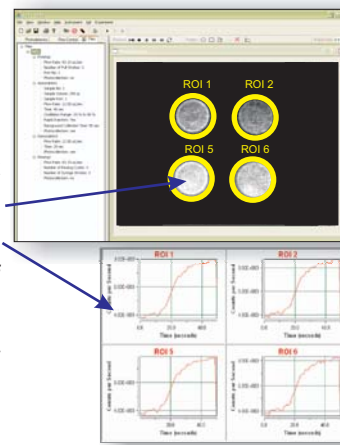
*i*Diagnostics Application Development Kit
Open Innovation Molecular Diagnostics Platform

*i*Diagnostics - the cellphone future of precision medicine
accurate, rapid, personalized, yet affordable diagnostics

OPEN INNOVATION APPROACH
for collaborative development of *i*Diagnostics applications

If you are developing a molecular diagnostics (MDx) system based on fluorescence or electro-chemi-luminescence assays, we invite you to collaborate. We will help you with hardware, software, cartridge blanks, development tools, reagent kits, methods and protocols to facilitate the interfacing of your assays with the iDiagnostics platform. We will be delighted to license your Intellectual Property (IP) and offer you the opportunity to license our IP to develop precise and rapid, yet affordable devices for molecular diagnosis and prognosis.

The iDiagnostics platform provides unprecedented precision and rapid diagnosing due to its superior sensitivity, multiplicity, and fast response rate. The platform is several orders of magnitude more sensitive and more accurate than alternative methods. One of the advantages of iDiagnostics sensors involves the simultaneous detection of multiple molecular markers of different *classes,* including proteins, nucleic acids, and metabolites. The detection of different classes of markers minimizes the rate of false positive responses.

iDiagnostics employs silk-enhanced real-time microarrays that include internal controls and standards for normalization and calibration, which provides high reliability and broad dynamic range to iDiagnostics analyses. The platform also supports other luminescence assays, including Electro-Chemi-Luminescence (ECL). iDiagnostics integrates optics, microfluidics, electronics, electrochemical systems, and nanoengineered assays into a small handheld device. Real-time microarrays are capable of parallel detection of up to thousands of analytes, including proteins, nucleic acids, toxins and chemical agents.

iDiagnostics requires no or minimal sample preparation, and can analyze complex biological fluids, including whole blood, saliva, and urine. iDiagnostics employs reagentless bioassays based on molecular beacons or sandwich-format antibody-based assays. Typically, molecular markers are detected in several seconds or a few minutes after the sample is applied.

Applications for the iDiagnostics platform include early diagnosis of cancer, heart diseases, STD, influenza, other infectious diseases, food safety, biodefense, forensic, military, environmental, and agricultural analyses.

Our goal is to make precise, rapid, yet inexpensive iDiagnostics available to everyone. This goal involves numerous challenges and requires the efforts of multiple research groups. The Open Innovation Approach, which we use in this project, is well suited for the collaborative development of advanced diagnostic products. If you are interested in becoming a part of this community please send us an email to <info@tirf-labs.com>.

Business Opportunity in the Area of Molecular Diagnostics

Our goal is to make precise and rapid *i*Diagnostics available and affordable to every one around the globe. At the initial stage, we will distribute *i*Diagnostics Application Development Kit (ADK) to the diagnostics research community. In our laboratories in North Carolina we will be developing the tests for breast, prostate, and pancreatic cancer, as well as Alzheimer's disease. We are seeking private and institutional donations, U.S. government and international grants to develop these applications.

Market. *i*Diagnostics tests are targeting the rapidly growing market. In 2006 the MDx market was $16B, in 2011 - $37B. It is anticipated that the market will attain $92B by 2016.

Social impact. iDiagnostics will change the history of medicine, improve the precision of diagnosis and prognosis, make it affordable for all, help to prevent spreading of infectious diseases such as Ebola, and enable personalized medicine. We will become the owners of information about our health; we will decide what to do with the diagnostic data - email them to our doctor or keep in our files for the future.

Competition. After 9/11 followed by anthrax letters attack, the U.S. government spent over $70 Billion on biodefense. There is no analytical technique which has not been tried for diagnostics. Competition in the MDx area is intense. However, all existing and emerging methods are inaccurate, slow, bulky, or costly. The *i*Diagnostics platform is several orders of magnitude more sensitive, accurate*,* and offers a rapid response**,** compared to the competition. *i*Diagnostics biosensors have good chances to become a significant part of the large and rapidly growing MDx market.

Open Innovation Approach. TIRF Labs offers the *i*Diagnostics Application Development Kit (ADK) for the collaborative development of *medical* molecular diagnosing, and for use in many other areas of life sciences. We have received a large response from the diagnostics community, and will use the feedback from our collaborators to further advance the *i*Diagnostics platform. We envision rapid progress, and plan to support our collaborators 24/7 to facilitate the interfacing of bioassays, sample preparation, and data analysis.

Applications for the *i*Diagnostics platform will include the diagnosis and prognosis of cancer, heart diseases, infectious diseases, food safety, environmental, and agricultural applications.

Accurate and Rapid Cell Phone Based Molecular Diagnostics