Dielectric Spectrometers II & III

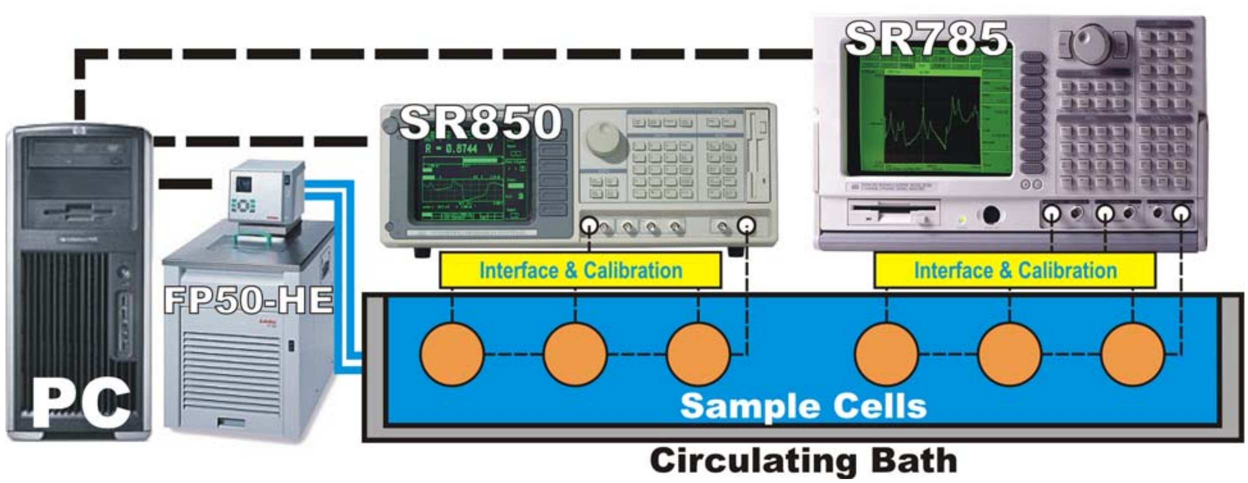
Infinite Quanta, Inc.

A Non-Profit 501(c)(3) Scientific Research Organization

It is becoming obvious that federal funding from organizations such as the National Science Foundation (NSF) will require published results from the Peptide Dynamics Project (PDP). Although the PDP has generated data and results, Lukacs [1] and iquanta.org, as similarly reported by Bruni *et. al.* (2005) [2], publishing the data in a prominent scientific journal will elevate the status and perception of the PDP, and prove our motivation, intention, and persistence, and the project's scientific and technical merit. Therefore, it is the nature of this proposal to overview the implementation of the Dielectric Spectrometer II and III (DS2 and DS3). The DS2 and DS3 should deliver publishable results at a minimum cost.

Essentially, three pieces of hardware are required: a refrigerated/heated circulator to freeze or heat the samples, and two highly sensitive detectors to measure the dielectric signals. The temperature controller is the Julabo FP50-HE circulator which has a temperature range of –50 to 200°C and a stability of 0.01°C. This controller will gently and precisely warm the protein samples to loosen the bonds between the α-helices and allow them to move more freely. Or, by decreasing the viscosity within the protein, the effective torque will increase on a particular α-helix applied by the external electric field, thus increasing the probability of observing and resolving the various dielectric signals from each of the α-helices within the protein. These experiments have never been performed on proteins and are therefore highly publishable once the data and results are observed.

The measurements of the dielectric signals for these temperature-dependent experiments will be carried out with the Stanford Research SR850 Dual-Phase DSP Lock-In Amplifier and the Stanford Research SR785 Dual-Channel Dual-Phase Dynamic Signal Analyzer. This SR850 lock-in amplifier comes complete with a voltage source to excite the samples to the proper voltage and frequency and a highly sensitive lock-in detector to measure the dielectric signals. The effective frequency range will be 1 mHz to 102 kHz, a frequency and phase resolution of 0.1 mHz and 0.001°, respectively, and a dynamic reserve of 120 dB. This detector is the most sensitive and stable detector available on the market.



The SR785 dynamic signal analyzer also comes complete with a voltage source to excite the samples, however, it is designed to measure extremely fast, or transient, changes of the dielectric responses. Therefore, when the voltage is first applied to the samples, the SR785 will observe the fast "snap" that may occur to the protein, and the SR850 will observe the long-term changes-in-state as the voltage is continually applied to the protein. Additionally, the SR785 analyzer will efficiently find frequency or temperature areas-of-interest in which more detailed and thorough studies will be performed with the SR850 amplifier. The effective frequency range of the SR785 dynamic signal analyzer is DC to 102 kHz and a dynamic reserve of 90 dB.

The above temperature controller and detectors form the heart of the DS2 and DS3. These devices will be interfaced to a computer and controlled using National Instruments LabView. A custom software application will be created to control the temperature, voltage, and frequency of the experiments while monitoring and collecting the data, thus forming two complete scientific instruments, as shown above. Custom interface circuits will be implemented which will allow low-noise switching of the electrical signals to multiple sample cells and calibration circuits to ensure absolute measurements. And finally, the instruments will be completed with the fabrication of an insulated circulating bath for the temperature-dependent studies and cylindrically-symmetric capacitive sample cells.

The proposed budget for the DS2 and DS3 is

Qty.	Make	Model	Description	Unit	Req'd	Extended
1	SRS	SR850	Dual-Phase DSP Lock-In Amplifier	$7,500	Yes	$7,500
1	SRS	SR785	Dual-Channel Dual-Phase Dynamic Signal Analyzer	$14,350	Yes	$14,350
1	Julabo	FP50-HE	Refrigerated/Heated Circulator, Bath Fluid, Connectors, and PT100 Inline Temperature Sensor	$8,860	Yes	$8,860
1	Tektronix	TDS5104	1-GHz 4-Channel Digital Oscilloscope	$18,500	No	$0
1	Fluke	PM6306/563	RCL Meter	$6,580	No	$0
1	Millipore	Elix5&MilliQ	Ultra-High-Purity RO Water Filtration	$18,000	No	$0
1	Mettler-Toledo	AT261	Analytical Balance	$8,500	No	$0
1	Nemetschek	VectorWorks	VectorWorks 12 CAD Mechanical	$1,885	No	$0
1	Compaq	AP250	Professional Workstation (PC)	$2,400	No	$0
1	NI	LabView	LabView Full v7.1 with GPIB Interfacing	$4,800	No	$0
1			Insulated Circulating Bath, Interface and Calibration Circuits, and Sample Cells Materials and Fabrication	$5,000	Yes	$5,000
1			Peptides, Proteins, Gels, Agaroses, Etc.	$1,500	Yes	$1,500
			REQUIRED PROPOSED BALANCE			**$37,210**

where the Required (Req'd) entries labeled "No" indicate those necessary pieces of equipment that have been donated to the PDP and received by infinite quanta from scientific and electronic manufacturers.

The principle investigator for the PDP is Stephen Lukacs. He has three B.S. degrees in the natural sciences and a Ph.D. in biophysical chemistry. He has specialized in the design and implementation of scientific instruments for biological systems for the last sixteen years.

For questions or further discussions regarding this project, its scientific merit, or to contribute to the research, please contact Dr. Lukacs at (904) 321-2231. An extensive presentation of the research and the corporation is located at http://iquanta.org. All contributions, whether equipment or financial, are fully tax deductible under I.R.C. 501(c)(3).

1. Lukacs, S.J., *The PDP 2005 Annual Progress Report*. (2005). Infinite Quanta, Inc.
2. Pagnotta, S.E., R. Gargana, F. Bruni, and A. Bocedi, *Glassy Behavior of a Percolative Water-Protein System*. Physical Review E, (2005). **71**: p. 031506-1-4.