

The development of an humidity controlled electrodynamic balance for liquid crystal studies



EPSRC CDT in Aerosol Science

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Abstract:

An electrodynamic balance (EDB) is currently being developed to study the timescale of self-assembly of liquid crystal phases in aerosols. Droplets are levitated in a controlled relative humidity environment before being X-rayed to extract information about their phase.

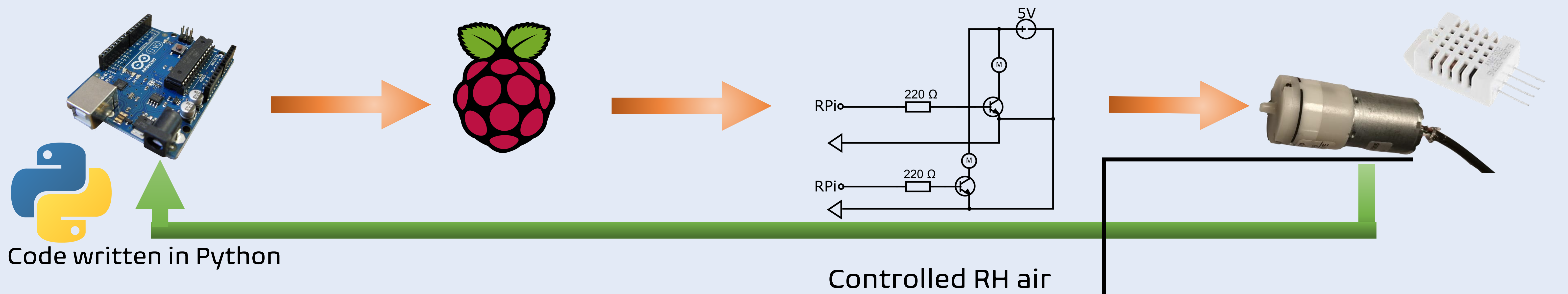
Controlling the relative humidity

Reads RH sensor, sends data to Raspberry Pi

Logs and plots data, takes user inputs and controls transistors

Switches the pumps on or off according to the signal received at transistors

The pumps blow wet or dry air and the sensor closes the feedback loop



Aspects of the electrodynamic balance

Controlled RH environment

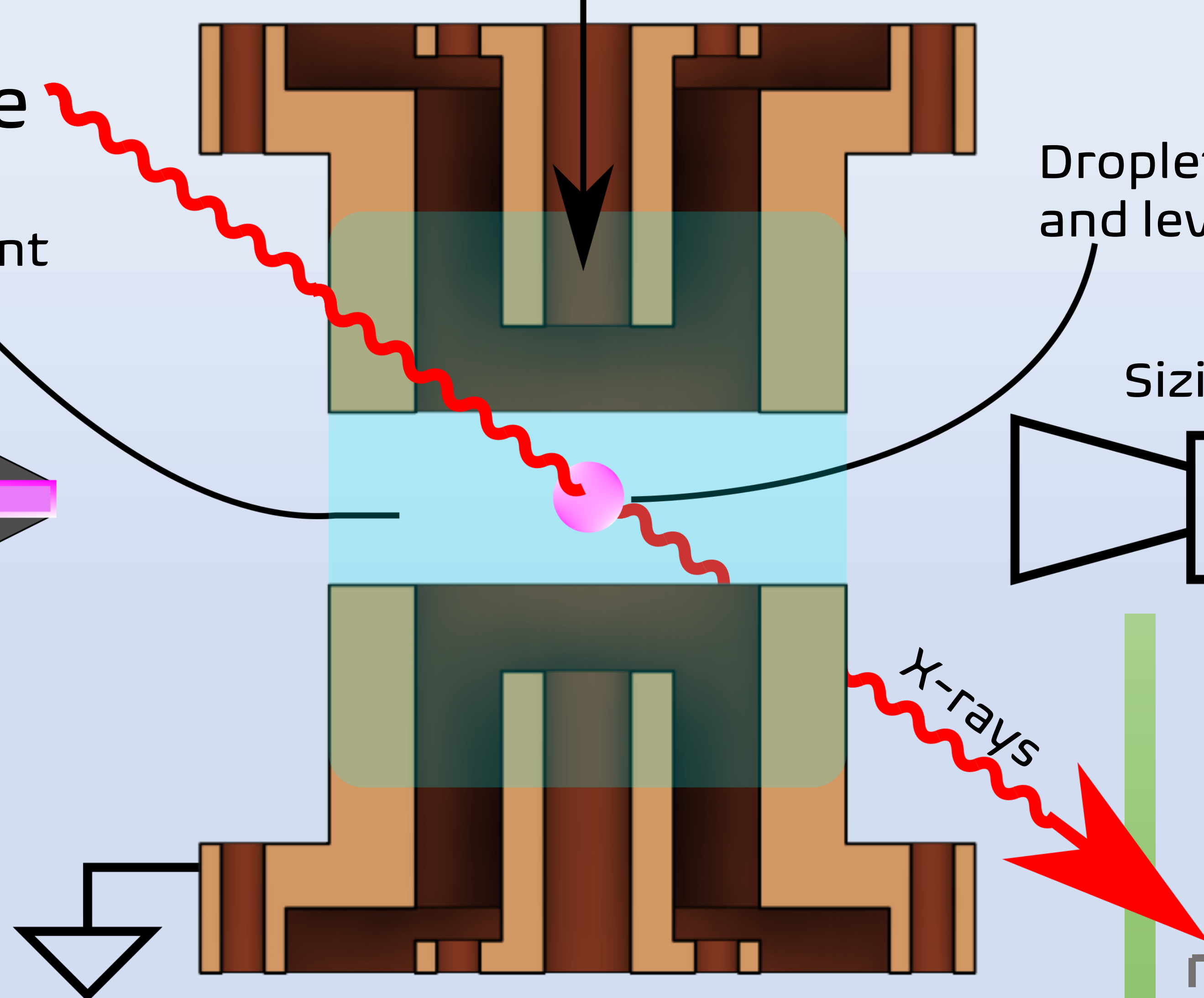
Droplet dispenser

Droplet captured and levitated

Sizing and tracking of droplet

Optics

Droplet sizes and position are measured optically. The stabilising voltages are adjusted to keep the droplet trapped. A new droplet is dispensed only when the previous one is no longer levitated.



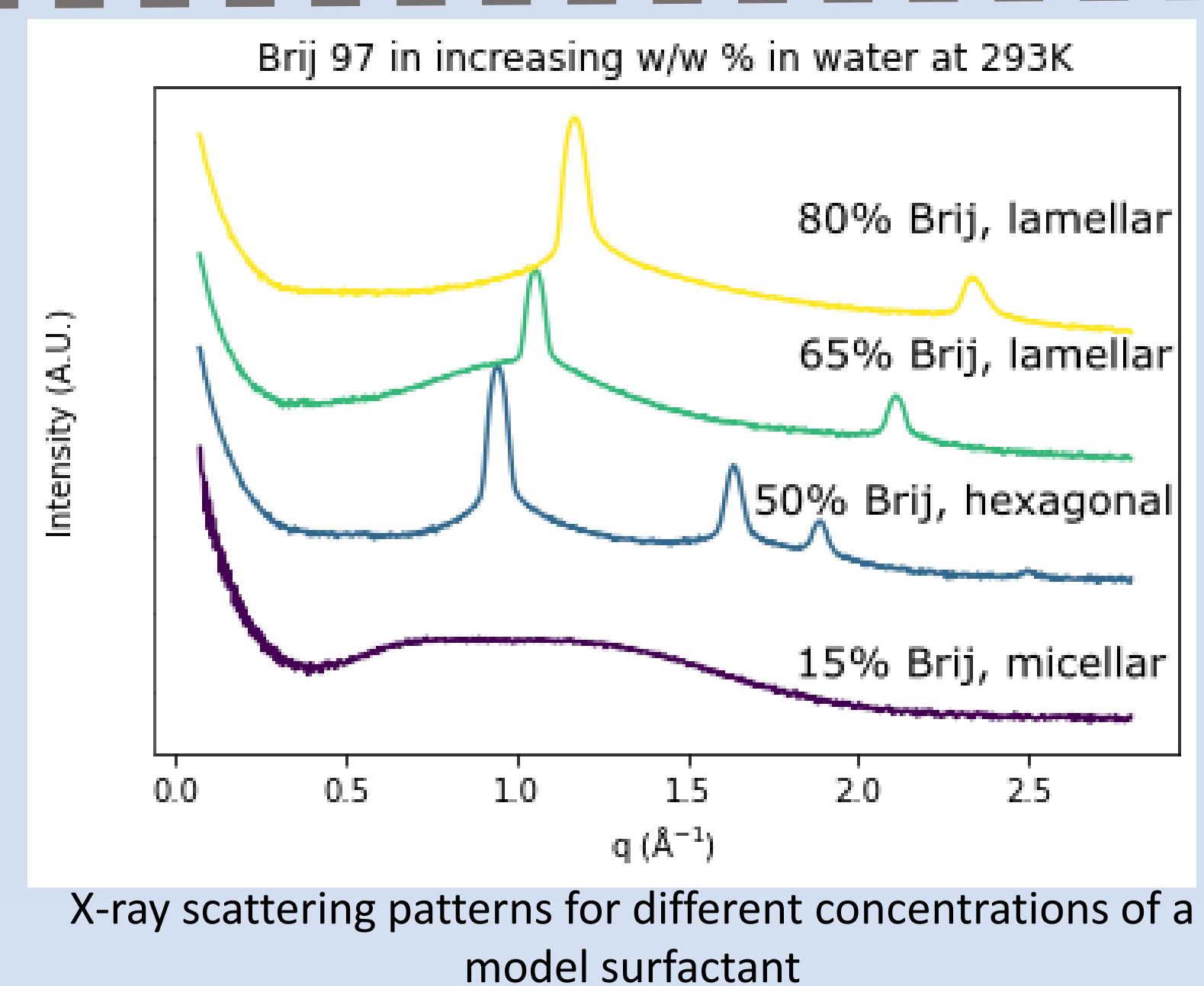
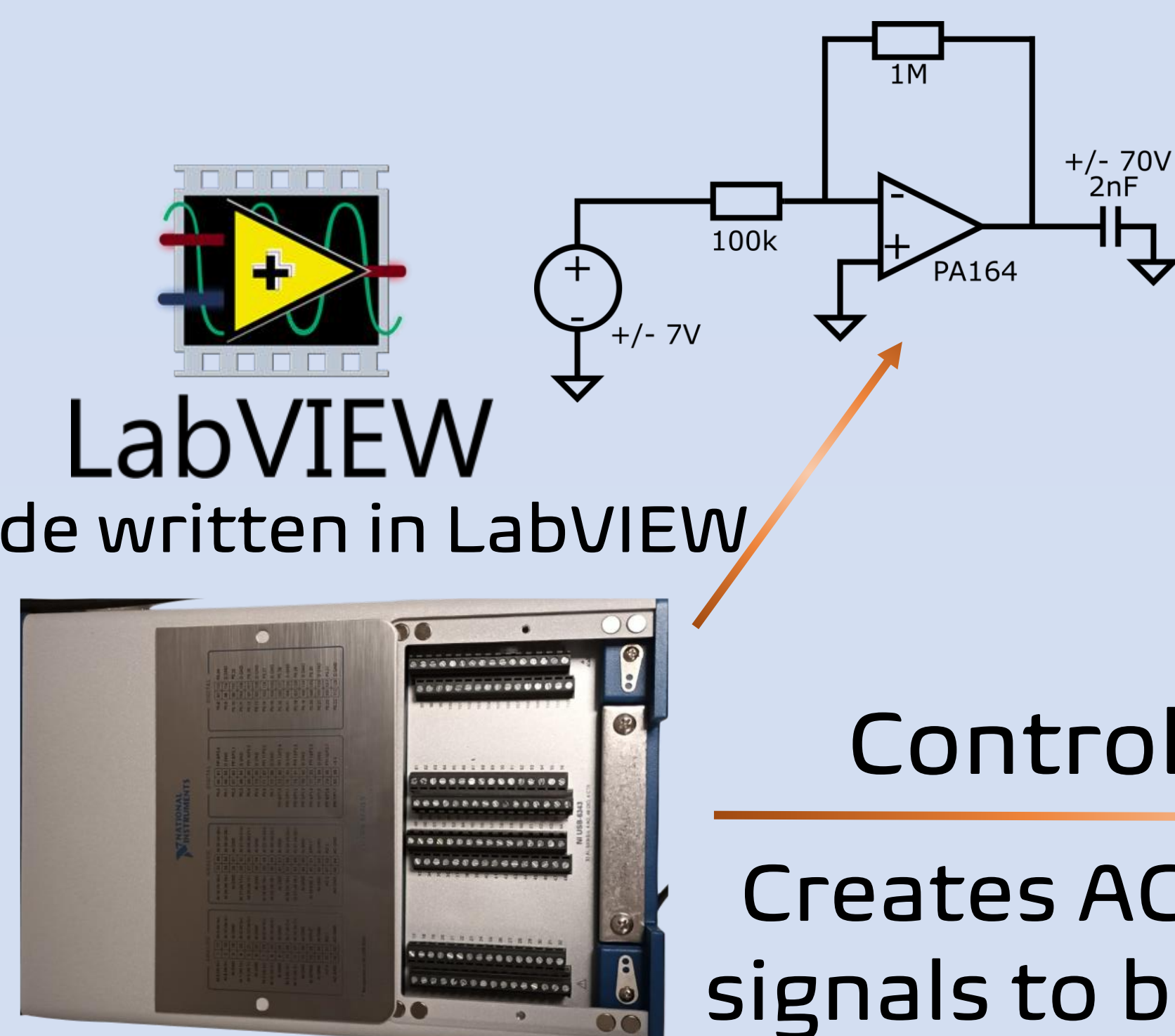
LabVIEW

Code written in LabVIEW

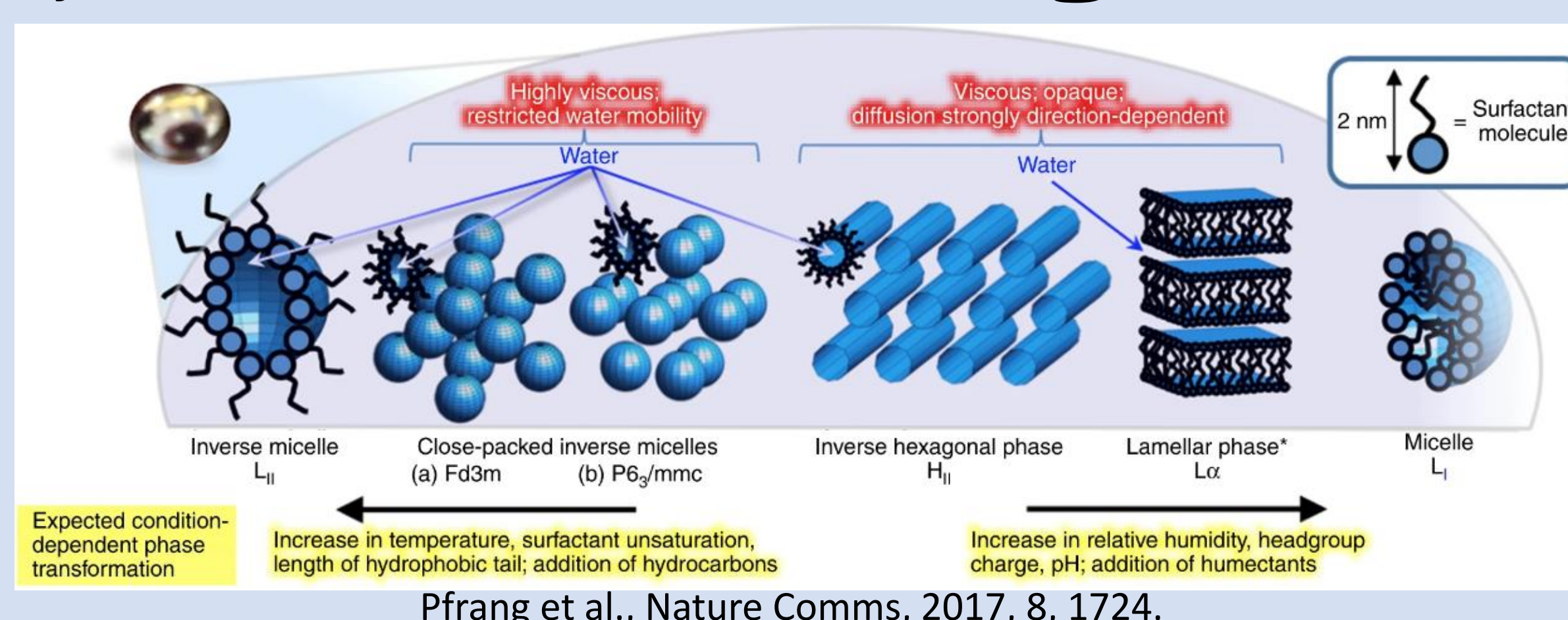
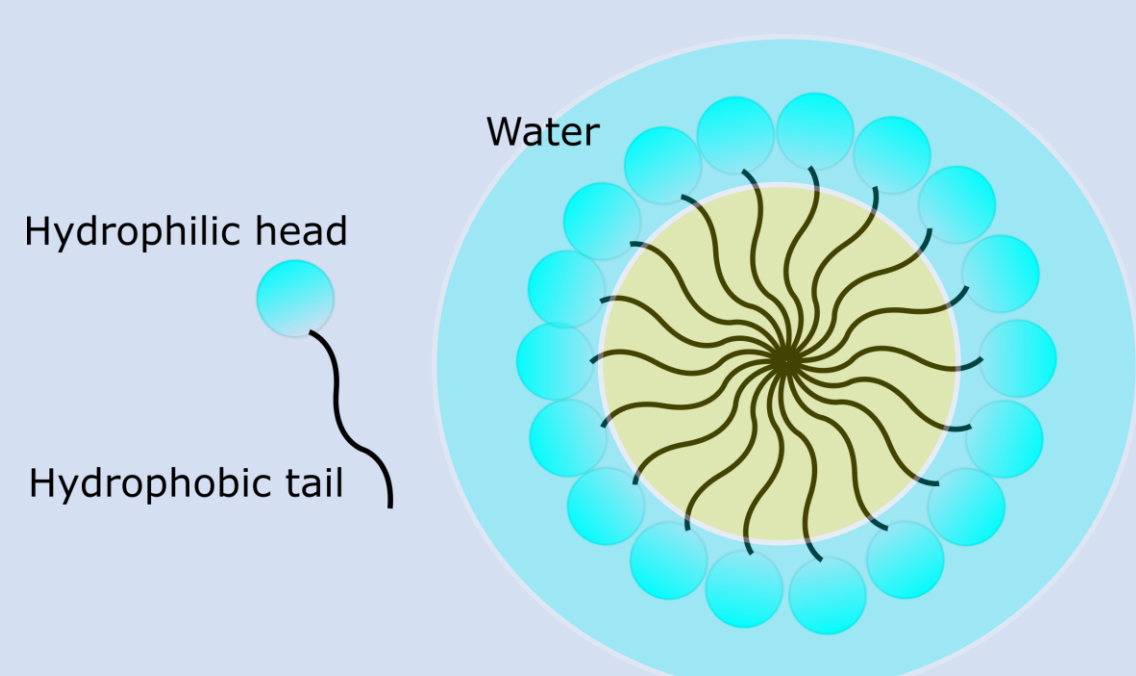
Controller

Creates AC and DC signals to be sent to the amplifiers

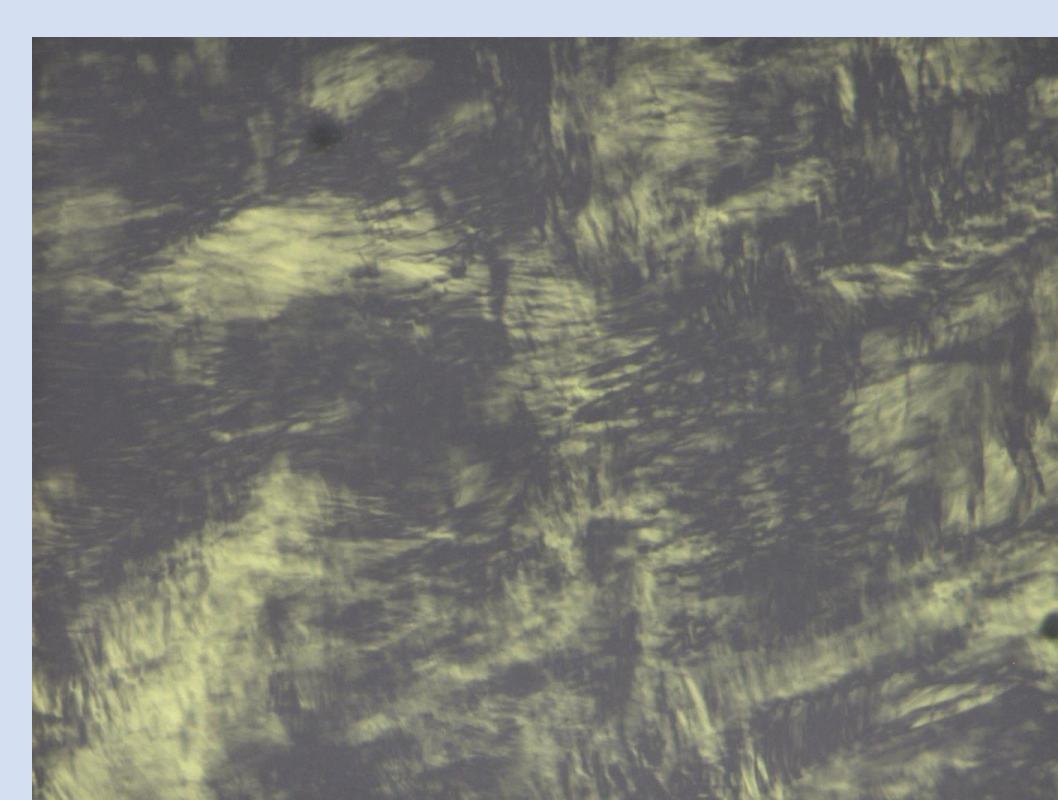
Amplifies the signals generated by the controller



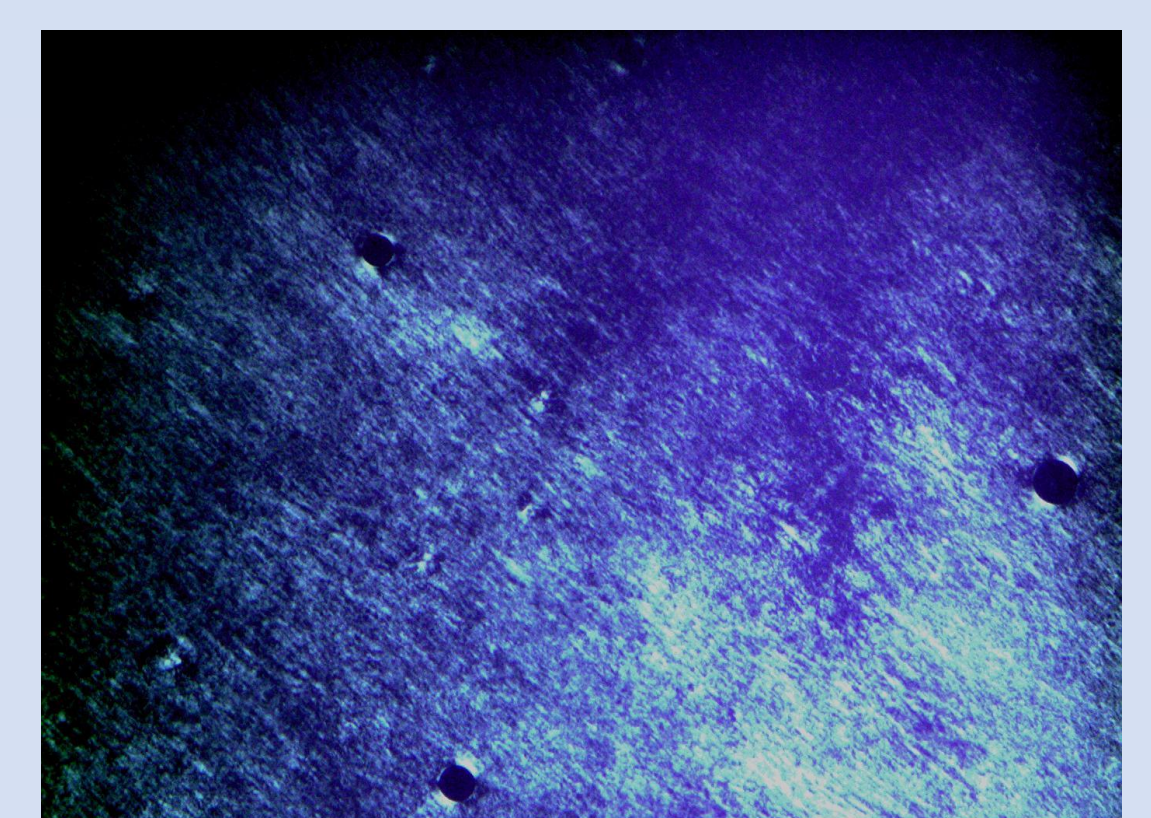
Preliminary materials testing – atmospherically relevant lipids



Pfrang et al., Nature Comms, 2017, 8, 1724.



Brij 97 50% w/w water, hexagonal phase



Brij 97 80% w/w water, lamellar phase

Amphiphiles self-assemble into complex phases. The exact phase depends on many conditions such as the relative humidity. Brij-97 is used as a model surfactant

The phase present can be determined through techniques such as Small Angle X-Ray Scattering (SAXS) and polarising microscopy