ESRF	**Experiment title:** A Study of Biological Structural Colour	**Experiment number**: MA-2426
Beamline: ID2	**Date of experiment**: from: 31st October 2014 to: 3rd November 2014	**Date of report**: 12th January 2015
Shifts: 9	**Local contact(s)**: Dr Sylvain Prevost	*Received at ESRF:*

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Report:

For this experiment we were able to use ID2 to structurallly characterise a carefully screened list of Biophotonic structures in detail. We mapped changes in the domain size across macroscale areas of the samples and the amount of order or relative disorder, to understand how this affects the strength and overall quality of the photonic optical properties. Using the newly refurbished ID2 we were able to cover the large lengthscales (100's of nm – 1.5μm) in these highly hierarchically complex biological structures and understand in great detail their structure and morphology from the nanometre range up to the micron scale. Understanding the link between optical properties and the structures that create them is an essential step for a thorough understanding of how they function. This will enable us to faithfully replicate the pertinent optical structures and so manufacture these materials industrially on a large scale.

In this report we highlight just the data from that of a Jay as we have performed a complete analysis on this dataset and already written a draft of a manuscript on what we think is an important new finding concerning this system. Futher papers will follow and these are detailed at the end of this document.

Figure 1 shows an image of the experimental setup we used to map and scan the biological coloured samples.

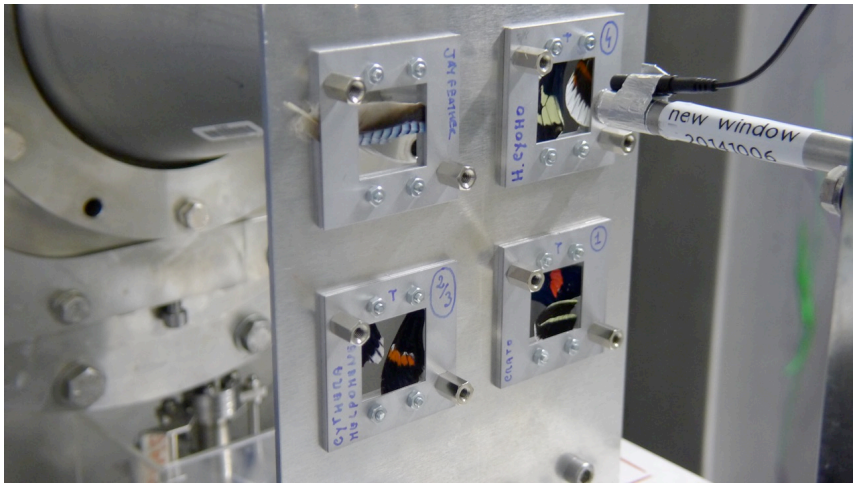

Figure 1. A selection of the samples mounted on ID2, the top left image is that of the Jay feather and the other three samples are Heliconius butterflies from South America.

The scan of a region of the Jay feather (Figure 2) shows a periodic modulation of the domain size as a function of position, which to date has not been seen in these kinds of quasi-ordered feather nanostructures.

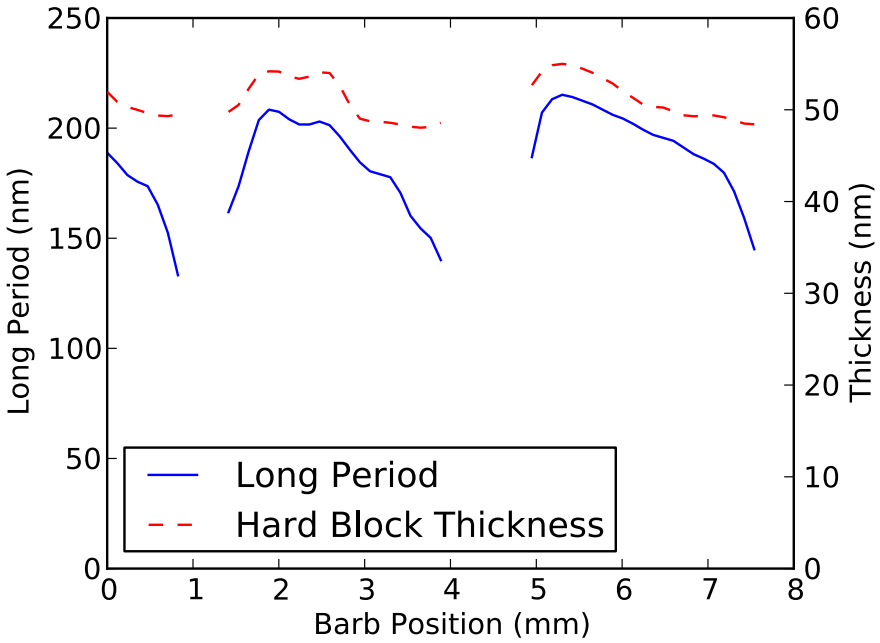

Figure 2. Periodic variation in the Jay feather structure and consequently colour across a single feather barb.

The scan of a single barb of the Jay feather (Figure 2) shows a periodic modulation of the domain size as a function of position, which to date has not been seen in these kinds of quasi-ordered feather nanostructures.

There are a number of papers in preparation based on the results generated from the recent experimental time at ID2; the 1st paper has been sent to all the authors and will be submitted very shortly to a high impact journal, the title is *Spatially modulated structural colour in bird feathers.* The 2nd paper will be a much longer paper detailing the multiple datasets of bird feathers showing structural morphology transitions. The 3rd paper will be an analysis of the Butterfly wing structure lengthscales and correlating this with scanning electron microscopy images, our aim is to highlight the truly unique q range available at ID2. A 4th paper will use data taken on the *Cotinga Maynana* bird feather to show the advantages of SAXS over SEM illustrating the pitfalls when using coventional Fourier analysis of SEM images.