2016 YCCSA SUMMER SCHOLARSHIP PROJECT SUBMISSION

This form is for prospective project supervisors to submit their projects to be included in the YCCSA Summer Scholarships Programme for 2016.

It is the purpose of the Summer School that any projects submitted are interdisciplinary in nature.

Date	*15 Jan 2016*
Supervisors' Names and Departments	Matthew Collins (Archaeology), Julie Wilson (Maths/Chemistry), Simon Hickinbotham (Computer Science)
Project Title	Fibres and follicles: high resolution analysis of parchment
Project Description	*Please aim for around 2 paragraphs. Remember that this must be pitched at prospective project scholarship students.* In the Middle Ages the first truly modern European economic system developed on the backs of sheep and textiles, as a consequence of the separation between sources of production of wool (in England and Spain) and textiles (in the Low countries and Italy) and their markets. The economic system that developed is written on parchment, the skins of animals. The project aims to investigate if it is possible to use these parchments to directly assess the fibre quality which is documented in the parchment record, the finer the fibre the higher the price paid for the wool. Patterns in the follicles can be observed in the parchment and have been shown to differ between primitive hairy fleeces and modern types, particularly fine wool breeds. Follicle patterns vary with position on the animal, but also with the age of the animal. Inter follicle differences were explored in a series of pioneering publications by Mooney and Nagorcka (1982; 1985; 1985) used a Turing class of reaction–diffusion system (Turing 1952) to explain the emergence of primary and secondary patterns of hair follicles in sheep. In this model (Marcon and Sharpe 2012) two chemical species can react with each other (e.g. A is an activator of both species, I is an inhibitor of both species and I diffuses faster than A) and diffuse through the tissue, periodic patterns of concentration are generated. Prospective activators and inhibitors (Wnt as an activator and Dkk as an inhibitor) were first described only twenty years later (Sick et al. 2006). More recently Cheng et al. (2014) have argued for a simpler expansion–induction (EI) model for the formation of secondary patterns in the developing mouse. We are preparing parchment from modern sheepskins of different ages and breeds. Fibres taken from these skins will be imaged by optical microscope, and analysed to provide estimates for fibre diameters from different regions of the fleece from animals of different ages. The follicle patterns within the sheep will be matched to these regions, the aims to match the density (age) and diameter of the follicles (quality) with the fibres taken from the same animals. Image analysis techniques (e.g. Deng and Ke 2010) will be used to extract relevant information from images taken by optical microscope. Although no previous

	experience in image analysis is required, the project is computational and some programming ability is required. The project is suitable for a single student
Required Skills	*A short synopsis of the necessary skills for the summer student. Please be careful to specify the skills rather than requiring students to have followed a particular degree programme.* Some programming experience is required.
Project Dates	*To create a cohort of students who can work and learn together, ideally all projects would run for 9 weeks, starting on Monday, 11 July 2016 and finishing on Friday, 9 September 2016. If you have any special requirements regarding the dates of your project, please indicate these here.*
Other Information	*Anything that doesn't easily fit above.* No special dates
References	*Please include at least one relevant journal reference.* Cheng, C.W. et al. (2014). Predicting the spatiotemporal dynamics of hair follicle patterns in the developing mouse. Proceedings of the National Academy of Sciences of the United States of America, 111(7), 2596–2601. Deng, Z. and Ke, W. (2010). A new measuring method of wool fiber diameter based on image processing. In Signal Processing Systems (ICSPS), 2010 2nd International Conference on. pp. V2–587–V2–590. Marcon, L. and Sharpe, J. (2012). Turing patterns in development: what about the horse part? Current opinion in genetics & development, 22(6), 578–584. Mooney, J.R. and Nagorcka, B.N. (1985). Spatial patterns produced by a reactiondiffusion system in primary hair follicles. Journal of theoretical biology, 115(2), 299–317. Nagorcka, B.N. and Mooney, J.R. (1982). The role of a reactiondiffusion system in the formation of hair fibres. Journal of theoretical biology, 98(4), 575–607. Nagorcka, B.N. and Mooney, J.R. (1985). The role of a reactiondiffusion system in the initiation of primary hair follicles. Journal of theoretical biology, 114(2), 243–272. Sick, S. et al. (2006). WNT and DKK determine hair follicle spacing through a reactiondiffusion mechanism. Science, 314(5804), 1447–1450. Turing, A.M. (1952). The chemical basis of morphog

When complete, please email the form to sarah.christmas@york.ac.uk