IOP | Institute of Physics

Food Physics Group

NEWSLETTER **February 2021**

Issue no. 4

@Physicsoffood #Physicsoffood

https://www.iop.org/physics-community/special-interest-groups/food-physics-group#gref

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Chair's report

Welcome to the fourth newsletter of the Food Physics group.

We have just had our fifth conference in the series "Food Physics", on-line of course given the continued impact of the pandemic. Whilst we certainly missed making new connections and renewing old friendships that come with face-to-face meetings, we benefited from 94 registrations and a more international set of speakers. Going forward we see the benefits of a blended conference style, face-to-face and with on-line presentations for the best of both worlds. Read more in the conference report including the prize for best virtual poster.

We had our second AGM. Read the AGM report for more details.

After 5 excellent conferences hosted by Universities (Sheffield Hallam 2017, Edinburgh 2018, Leeds 2020), Industrial-facing institutes (Campden BRI 2019) and this year's virtual conference, I'm delighted to confirm that we plan for our next conference (**Food Physics 2022**) to be held at the IOP HQ London (Feb 2022).

In November 2020, we partnered with the Royal Society of Chemistry's Food Group to run an excellent on-line programme over 2 half-days on "Chemical and Physical Modelling of Food". Read more later in this newsletter.

Prof Sarah Bridle, Food Physics committee member alumna, launched her book "Food and Climate Change without the hot air: Change Your Diet: The Easiest Way to Help Save the Planet". Well worth a read.

I am particularly delighted that Dr Beccy Smith (Principal Scientist at Mondelez International) has written a guest editorial for this newsletter. Beccy has been a committee member since 2018 shortly after the group was inaugurated.

We continue to encourage all readers to engage with Food Physics, whether to discuss joint workshops / conferences, link us to events perhaps outside our normal networks, or just to discuss application of interesting physics to solve food and drink innovation challenges.

John Bows, Chair

Guest Editorial

On longer queues for the toilets, sinking into custard, and other matters…

I knew that studying theoretical physics at university would give me the tools to describe and understand all of the universe. But as a physics fresher, I was really only interested in the 'est's: the smallest (subatomic particles and quantum mechanics), the biggest (the limits of the universe and astrophysics), the fastest (general relativity), and the slowest (superfluids near absolute zero). My four-year masters did not quench my thirst for knowledge so I proceeded straight into studying for a doctorate. However, this was very narrow and specialised: two-dimensional disordered superconductors in a magnetic field. It felt competitive rather than collaborative. And although I knew how to give a two-minute layman's introduction into what I was doing, no-one really understood or cared.

So towards the end of my PhD, I knew I wanted to do something different but I had no clue what that might be. I had also never had any interview practice so when I saw in New Scientist a job advert just 5 minutes away from university, I decided that would be a useful experience. It was for someone who "loved crunching numbers, and chocolate" and it was at Cadbury's, Bournville.

That was many years ago now and I'm still here. Why? So, so many reasons. A physics conference is the only place where the queue for the women's toilets is shorter than the queue for the men's, but I happily traded that advantage for being in a 50:50 split of men and women; and it is lovely to be in an inclusive diverse team of many nationalities. The chocolate is a pretty good perk too, but the main reason is Food Physics.

In order to predict and optimise what will happen to sugars (powder), caramel (liquid) and candies (solid) during manufacture (flow and thermal processes), shelf life (crystallisation) and eating (breakage and chemical processes), many areas of physics have to be understood. I need to collaborate with many different academic experts. I supervised the UK's first EngD and many EngDs & PhDs since then. Several professors have been genuinely and pleasantly surprised that a food topic can lead them to uncovering novel, fundamental science. It is the complexity of our recipes and processes compared to simple, pure compounds that requires different approaches.

'Food' is also a topic that everyone can relate to. When I tell people what my job is, people's eyes no longer glaze over. I am passionate about getting more children, particularly girls, interested in science. During my degree, I started a company making science and maths magazines for children. This also involved

going on science roadshows and being a regular science presenter on Blue Peter. Food is a great vehicle for explaining topics: growing sugar and salt crystals, surface tension of milk visualised with food colouring, vinegar fizzing with bicarb, and I think I was the first person to jump on a pool of cornflour mix on TV!

'Food' is arguably one of the most important topics of our time. Food systems contribute to over a quarter of CO2 emissions. Half of the world's ice- and desert-free land is used for agriculture, threatening 24,000 species with extinction. 70% of global freshwater withdrawals are used for agriculture. 78% of global ocean and freshwater eutrophication is caused by agriculture. 94% of mammal biomass, excluding humans, is livestock. It is critically important to produce and pack our food sustainably. Additionally, a good diet is essential to avoid malnutrition and micronutrient deficiency, to reduce risks of developing diabetes, cancer and heart disease, and even to improve mental health.

Food Physics may not be the smallest, biggest, fastest or slowest. But it scores 'est's on complexity and importance. We need more physicists to move into this area for the sake of the planet and human health; it is a career that I can whole-heartedly recommend as an enjoyable and rewarding one.

Dr Beccy Smith is a Principal Scientist and the Technical Lead for Modelling & Simulation at Mondelez International.

Beccy Smith

Food Physics Group Purpose

Supporting research into areas of physics that impact the food sector, and encouraging collaborative research between academic and industrial physicists.

Promoting the role of physics in the food industry and ensuring that it is more widely understood that this is a field in which there are opportunities to conduct interesting and important research; promoting this fact to early career physicists and policy makers.

Providing a mechanism for physicists in the sector to feed into the IOP and have their views represented to funders and policy makers.

Activities

Organise an annual conference

Engage with physics academia / other IOP groups e.g. host joint events

Bidirectional exchange of physics and problems between industry and academia

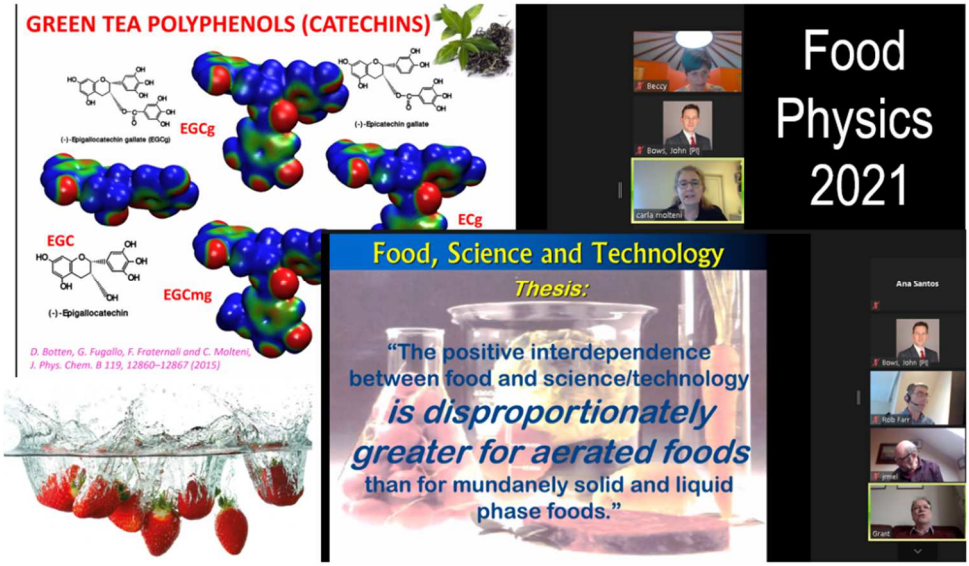
Engage beyond IOP (e.g. IChemE, RSC, STFC Food Network+, IUK)

Publish newsletters

Engage early careers physicists

Report from Food Physics Conference, 2-3 Feb 2021

Conference website with abstracts and programme downloads:
http://foodphysics2021.iopconfs.org/programme



Food Physics 2021 was the fifth in our annual series of conferences (previous events have been held at Sheffield Hallam, Edinburgh, Chipping Campden and Leeds). The original plan for a 2021 conference at the IoP headquarters in London would have required two weeks' quarantine at the registration desk and delegates to sit in their own negative-pressure capsules; so instead, we found ourselves a free space parking spot in hyperspace, and gathered on the "Zoom" platform. With nearly a hundred delegates, this has been one of our best-attended conferences to date (although some took advantage of the flexibility to watch many of the talks live, and catch others later, via recordings; so the number of people online at any moment was between 40 and 70).

The conference opened with Professor Grant Campbell, who reminded us how small a corner of the foams universe is fully understood (dry, static foams); while aerated foods range over a space of volume fractions, continuous phase mobility, and structural dynamism that has been barely touched by theory. Gleb Yakubov and Patricia Lopez Sanchez told us about the complex polymer composites that make up plant cell walls, and how we are learning to disentangle and even predict

their mechanical properties, complemented by two of the posters, from Trey Koev (winner of the poster prize, more later) on starch polymer architecture, and Motolani Sobanwa on mechanics of polysaccharide blends. Holy Linford explained how the cell wall mechanical properties can be probed at the macromolecular level using AFM. We learned about interrogating food mesophases, microstructure and material properties using a wide range of techniques, from neutron scattering (Simon Titmuss, Elliott Gilbert and Lilia Ahrne), ultrasound (Megan Povey), to radio waves (Josh Hamilton); and also how to alter foods with physical fields: microwaves (Ali Taqi), high pressures and cold plasmas (Keshavan Naranjan) and Guy Della Valle showed the material and geometrical changes associated with bread-making. Particulates are a large branch of food structures, and Dan Hardy showed how spray-drying and crystallisation can be captured with high dynamic-range stroboscopic imaging (a technique developed to look at aerosols from nuclear reactor leaks); while Bettina Wolf discussed anti-solvent methods for sustainable particle formation. Plant particulates also featured in Panagiota Mouraka's poster on oil structuring. The interaction of food with people, as we consume it, is perhaps the most complex part of its journey. Jan Engmann took us through a classification of textures, from drinkable all the way to biteable, and how these may be rheologically classified, and Vincent Mathieu spoke about the mechanical interface of the tongue with foodstuffs. Carla Molteni took up the quantum mechanical challenge of molecular interactions of food and proteins, showing evidence for specific, drug-like effects of polyphenols on cardiac cells. The theme of molecular interactions between actives and polymers was picked up in three posters by Mirela Kopja, Ina Ćorković, Josip Lukić, Anita Pichler, and Josip Šimunović.

The talks brought in phenomena from across the broad subject of physics, and tied together problems of academic interest with pressing concerns from the food industry around efficient processing to sustainable materials as food and packaging. Those who kept only a casual ear to the ground could pick up the main points from the @PhysicsofFood twitter feed. Attendees will be able to catch up on any talks they missed, via the IoP recordings, for which links have been sent out.

This was the first online conference we have organised, and it's good to reflect on what benefits and challenges that has brought. We were lucky to get contributions from as a far-separated points as Australia and Croatia, where the internet showed its strength of annihilating distance and travel times. The platform itself worked well, and we are enormously grateful to the presenters who not only brought fascinating material to the audience in an engaging manner, but kept rigorously to time. A huge 'thank you' is also due to Ana Santos of the IoP, for making the mechanics run so smoothly. The break-out rooms allowed some more animated discussion than using just the text-chat functionality, and seemed to

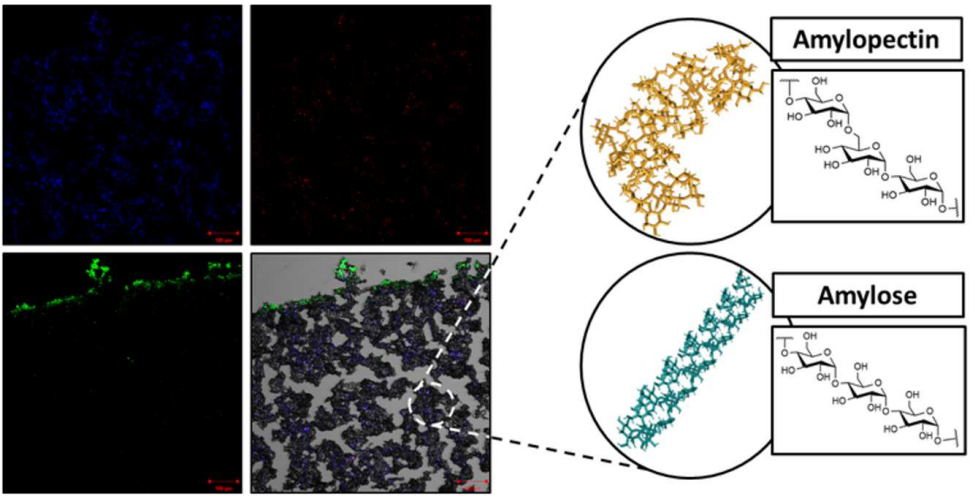
work well with one poster in each room. The online format also let the audience dip in and out of the conference as they saw fit. This can be a huge benefit for convenience, but as a personal note (which I hesitate to admit in public), I get some of my best ideas in talks which are somewhat above my head, but where I'm trapped between two over-sized professors, and have nothing to do but let my mind drift over the earlier talks. Such eccentric side-benefits are difficult to reproduce with the new technology. Despite that, we are keen to preserve all these good aspects of the online format in future conferences. However, I think it is fair to say that everyone present also missed the personal interaction and spontaneity of a physical get-together (not to mention the excellent catering we have enjoyed in past years). The committee will have to be reactive to events, but our plan for 2022 is to have a blended conference, in London, but with online access available as well. It will take planning and gradually accumulated experience to get the balance right, but we look forward to seeing as many of you as possible at Food Physics 2022!

Rob Farr

Poster Session

The zoom platform enabled relative ease for participants to visit breakout rooms where poster authors could go through their poster research.

The Food Physics poster prize this year was sponsored by Unilever. The winner, for his work on starch polymer architecture changes during digestion and their effects on the physico-chemical properties, was **Trey Koev** from the University of East Anglia & the Quadram Institute for Bioscience. (The work was carried out in collaboration with Hannah Harris, Yaroslav Khimyak and Frederick Warren).



Trey writes: Hydrogels have a complex and heterogeneous structure and organisation, making them promising candidates for applications in the biomedical and pharmaceutical industry. Starch is a particularly attractive material for producing hydrogels due to its low cost and biocompatibility, but the structural dynamics of polymer chains within starch hydrogels are not well understood, which has limited their development and industrial utilisation.

Physiologically, starch hydrolysis by α-amylase occurs in several places in the human body and involves host's salivary and pancreatic α-amylase enzymes, as well as amylolytic enzymes of commensal bacterial origin.

In our work, we have probed the structural changes starch hydrogels undergo as they traverse the entire length of the human gastrointestinal tract. We demonstrate how structure governs interactions of starch gel systems with the host's gut microbiota, and the impact of this interplay on the production of physiologically relevant microbial metabolites, such as short-chain fatty acids. We have further demonstrated the viability of these hydrogel platforms as delivery vehicles for targeted colonic release of orally administered drugs. Our findings provide new information on structure-function relationships within starch hydrogels, better enabling the production of application-driven gel-type systems for biomedical and pharmaceutical applications.

Food Physics AGM

The AGM was held on 3rd February 2021 after the close of the conference.

Attended by committee members John Bows (Chair), John Melrose (Secretary), Rob Farr (Treasurer), Martin Whitworth, Beccy Smith, Marco Ramaioli, Megan Povey, Daniel Hodgson, Felix Oppong and Arwen Tyler, with a few other conference attendees.

Chairperson's remarks. John Bows thought that the 2021 on-line conference was a success – for himself and the committee he thanked Robert Farr and Daniel Hodgson for organising this meeting. The IOP had also given good support for the technical set-up and options for meeting on-line, in particular Ana Santos - who also ran the Zoom meeting smoothly. One of the actions from the last AGM was for the group to reach out to more Universities with significant food science departments and it was good to see speakers from Reading and Nottingham in the 2021 meeting. Jointly with the RSC (Royal Society of Chemistry) in November we ran an on-line conference of modelling in food physics. This also was a great success; Robert Cordina was thanked for his work in organising this. The Food Physics group had the following diversity stats: 32% female (c.f. IOP average for groups of 21%) , and 46% of the group's members were under 30 years. Engagement activities by the group were obviously curtailed this year due to the covid restrictions.

Treasurer's report. Robert Farr presented the 2020 accounts; these were dominated by the February meeting; beyond this there were no claims, none for committee travel as all meetings were on-line . Unilever is thanked for donating poster prizes. A budget of £1500 was set for this year.

The **2022 conference** options were discussed, in particular whether it would be on-line, in person or blended. If there was an in-person aspect, we would carry over the 2021 plan and hold this in the IOP meeting rooms in London.

John Melrose

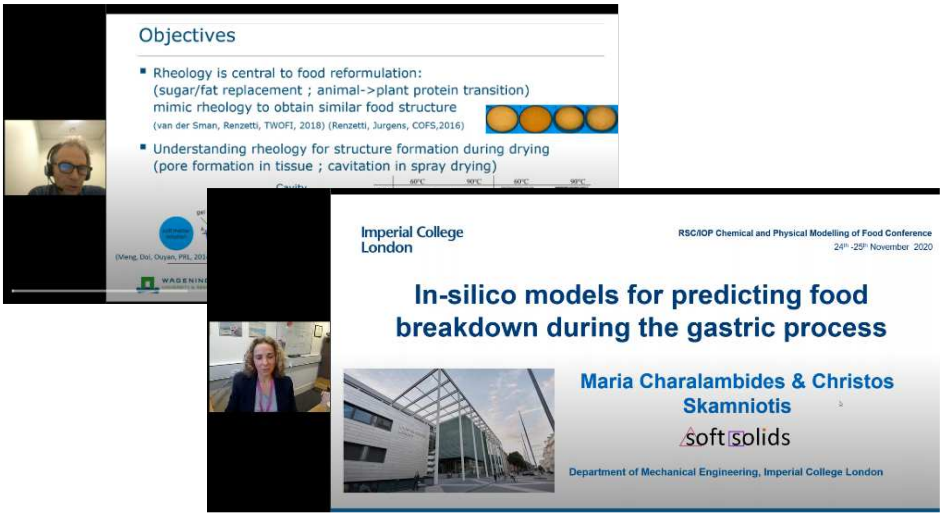
Food Physics Committee at external events during 2020

Usually committee members are active presenting their research at various external events from conferences to career fairs, often with a strong food physics content.

Unsurprisingly, there was little opportunity in 2020 for this, apart from the joint Chemical & Physical Modelling of Food conference. Read the conference chair's report in this newsletter.

Chemical and Physical Modelling of Food conference

On 24 and 25 November 2020, the first Chemical & Physical Modelling of Food conference was held, jointly organised by the RSC's Food Group and the IOP's Food Physics group. This joint conference was organised to foster relations between scientists in different fields, and highlight the importance of cross-disciplinary research, as also highlighted in the Food Physics group 2020 report. Due to the prevailing circumstances the conference was held online, however this actually helped to attract a very wide audience, as well as a range of speakers. There were a total of 15 speakers, hailing from 7 different countries, as well as over 200 registered attendees from over 23 countries globally. This reflected the wide interest that, what can be considered to be a niche area, modelling in food, actually has around the world, with both the speakers and the attendees hailing from both industry and academia.



The conference covered a wide range of topics in both sciences, including presentations such as the physics of microwaving foods, the kinetic modelling of the Maillard reaction, the modelling of chocolate shell drainage, and the modelling of the GI tract, among others (the full programme can be found below). The range of topics highlighted the diverse research being carried out, both by industry and academia, as well as the many facets, and complexity, of food systems. It was interesting to also see the scale and scope of some of the research, from the very specific (such as the talk by Prof. Carl Adams on the modelling of curd formation in commercial milk), to the very broad (such as the talk by Michiel Gribnau on the digital design of foods). This showed the many approaches that can be, and actually are being, taken. The conference also included a Twitter poster session, with the prize for best poster going to Archana Bista from Teagasc in Ireland for her poster titled “Monitoring the Effect of Ultrasonication on Reducing Process Viscosity of Milk Protein Concentrate Using an Inline Flowmeter”.

The feedback received by the organisers was that the conference was very well received by the attendees, owing both to the range of the topics but also with respect to the quality of the speakers. There are already plans to organise further joint conferences between the RSC and IOP, with communications to be sent out in due course. Given the success of the online format, it however still needs to be determined whether these will be held physically, online or a hybrid of the two.

A recording of the talks can be still found at:

https://attendee.gotowebinar.com/recording/4564277687255052546 (24 Nov)

https://attendee.gotowebinar.com/recording/2298089664430799120 (25 Nov)

Conference website:

https://www.rsc.org/events/detail/43711/chemical-and-physical-modelling-of-food

Robert Cordina
Chair, RSC Food Group

Finally Physics

Finally, we highlight exciting food physics stories, experiments, features …

How many times do you have to slap a chicken to cook it?

https://www.boredpanda.com/physics-major-calculates-how-hard-to-slap-chicken-to-cook-it/?utm_source=google&utm_medium=organic&utm_campaign=organic

100 Amazing Food Experiments for Kids

https://www.123homeschool4me.com/100-amazing-food-experiments-for-kids/

Physics Laboratory at Home During the COVID-19 Pandemic

https://aapt.scitation.org/doi/10.1119/5.0020515

Lockdown Challenge: Microwave Steam and Microwave Glue

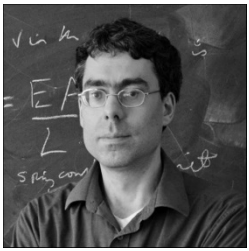
https://eandt.theiet.org/content/articles/2020/06/lockdown-challenge-microwave-steam-and-microwave-glue/

The BBC series “Inside the Factory” featured several food factories in 2020: yoghurt, cider, biscuits, crisps, baked beans.

https://www.bbc.co.uk/programmes/b07mddqk/episodes/player

Group Committee

John Bows, Chair
PepsiCo



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