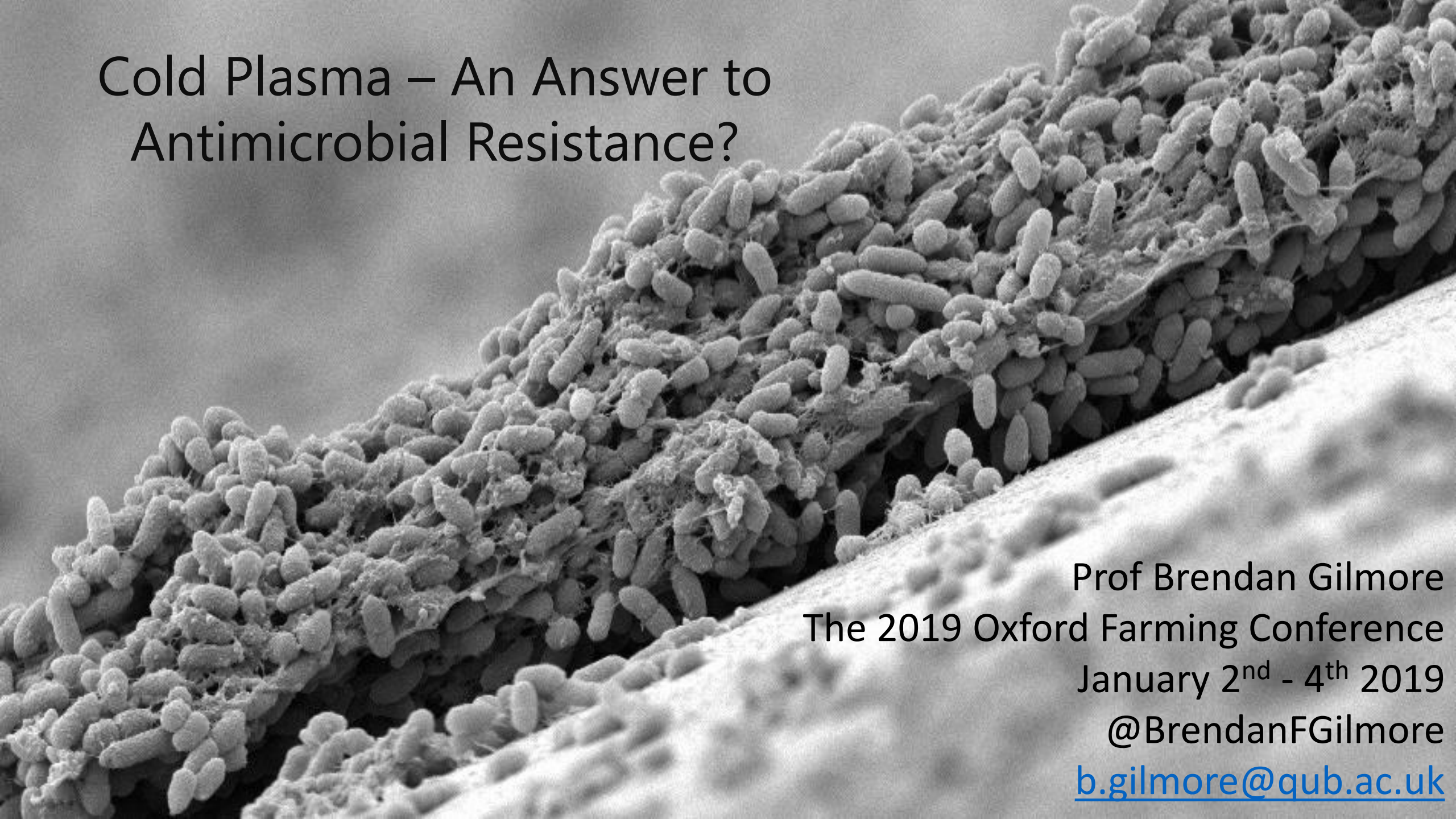
Cold Plasma – An Answer to Antimicrobial Resistance?



Prof Brendan Gilmore

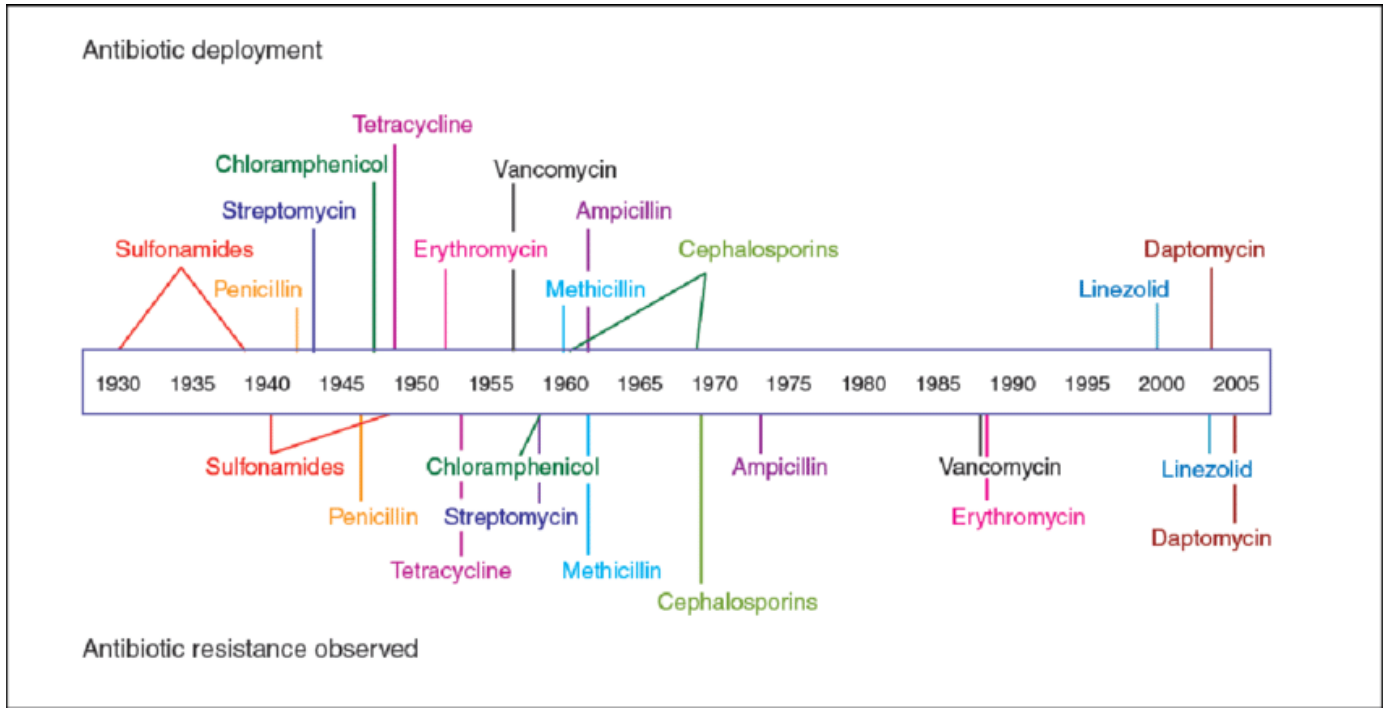
The 2019 Oxford Farming Conference

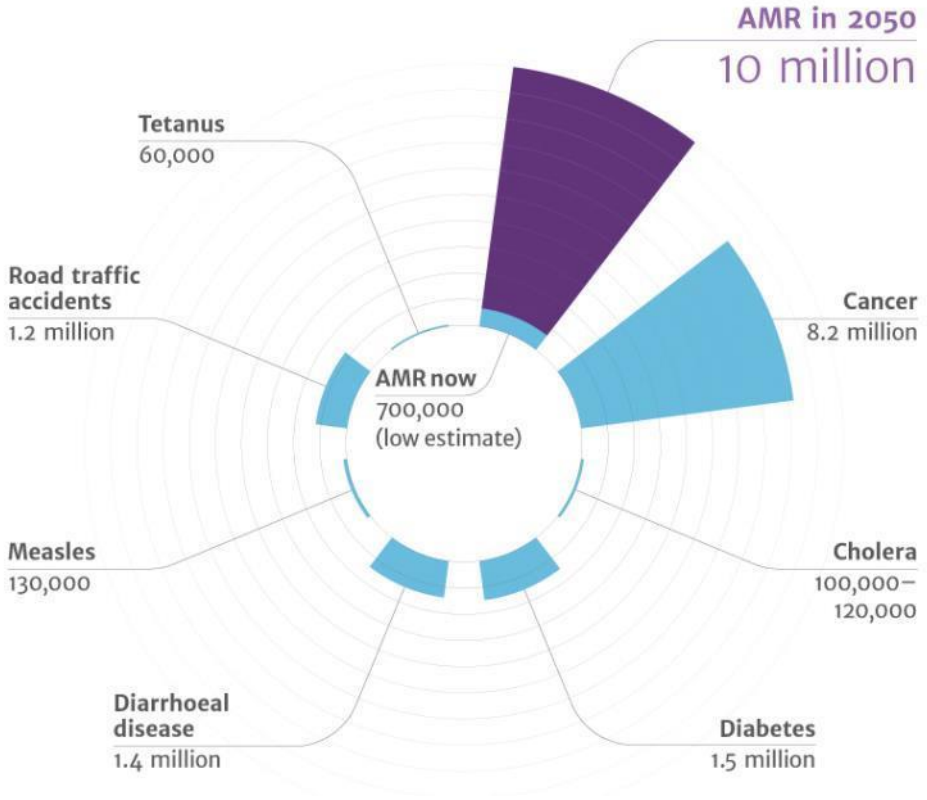
January 2nd - 4th 2019

@BrendanFGilmore

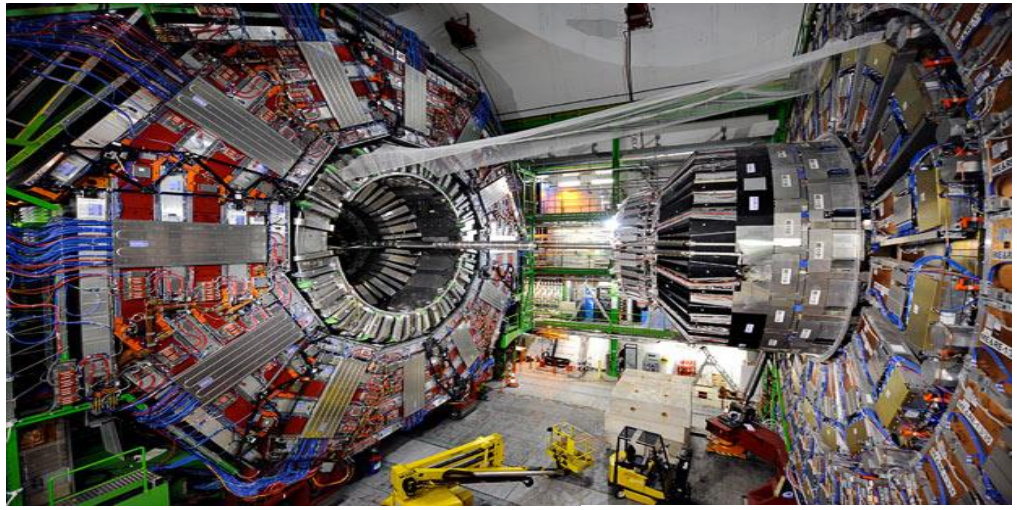
b.gilmore@qub.ac.uk

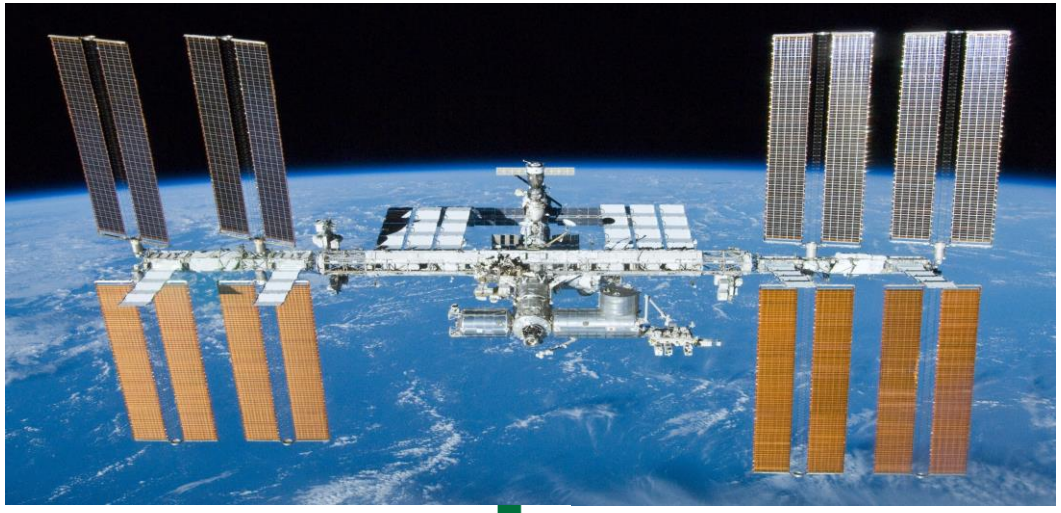
The Post-Antibiotic Era?





The Post-Antibiotic Era – The alternatives?





Review

Alternatives to antibiotics—a pipeline portfolio review

Lloyd Czaplewski, Richard Bax, Martha Clokie, Mike Dawson, Heather Fairhead, Vincent A Fischetti, Simon Foster, Brendan F Gilmore, Robert EW Hancock, David Harper, Ian R Henderson, Kai Hilpert, Brian V Jones, Aras Kadioglu, David Knowles, Sigríður Ólafsdóttir, David Payne, Steve Projan, Sunil Shaunak, Jared Silverman, Christopher M Thomas, Trevor J Trust, Peter Warn, John H Rex

Antibiotics have saved countless lives and enabled the development of modern medicine over the past 70 years. However, it is clear that the success of antibiotics might only have been temporary and we now expect a long-term and perhaps never-ending challenge to find new therapies to combat antibiotic-resistant bacteria. A broader approach to address bacterial infection is needed. In this Review, we discuss alternatives to antibiotics, which we

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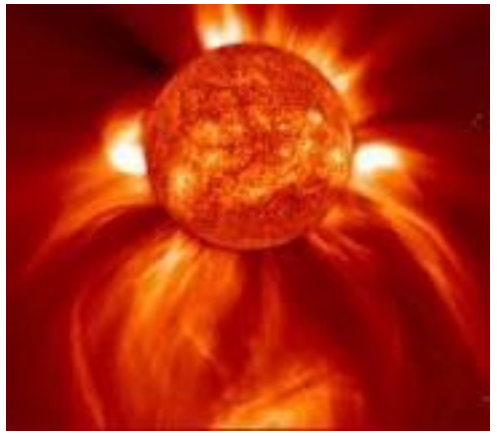
Published Online January 12, 2016
http://dx.doi.org/10.1016/

Alternatives to antibiotics – a pipeline portfolio review. *Lancet Infect. Dis*. 16(2):239-51. (2016)

NON THERMAL PLASMAS FOR BIOFILM CONTROL

- Plasmas are partially or wholly ionized gases
- Are referred to as the fourth state of matter,
- Form when gases are energized, leading to ionization
- Removal of electrons from atoms creates a plasma but the electrons also
    - Excite atoms and molecules, which in turn excite others by collisional energy
    - Cause dissociation of molecules leading to new chemistry



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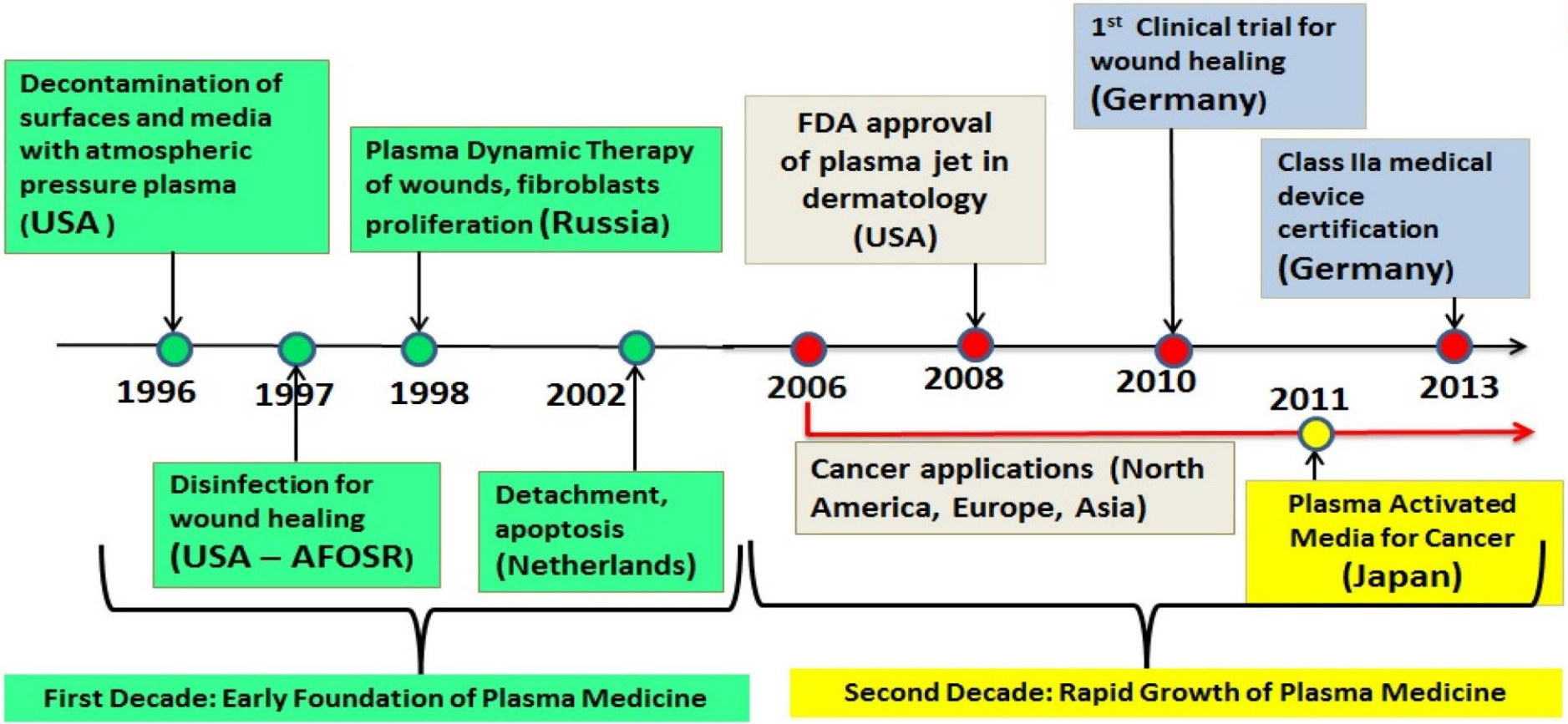
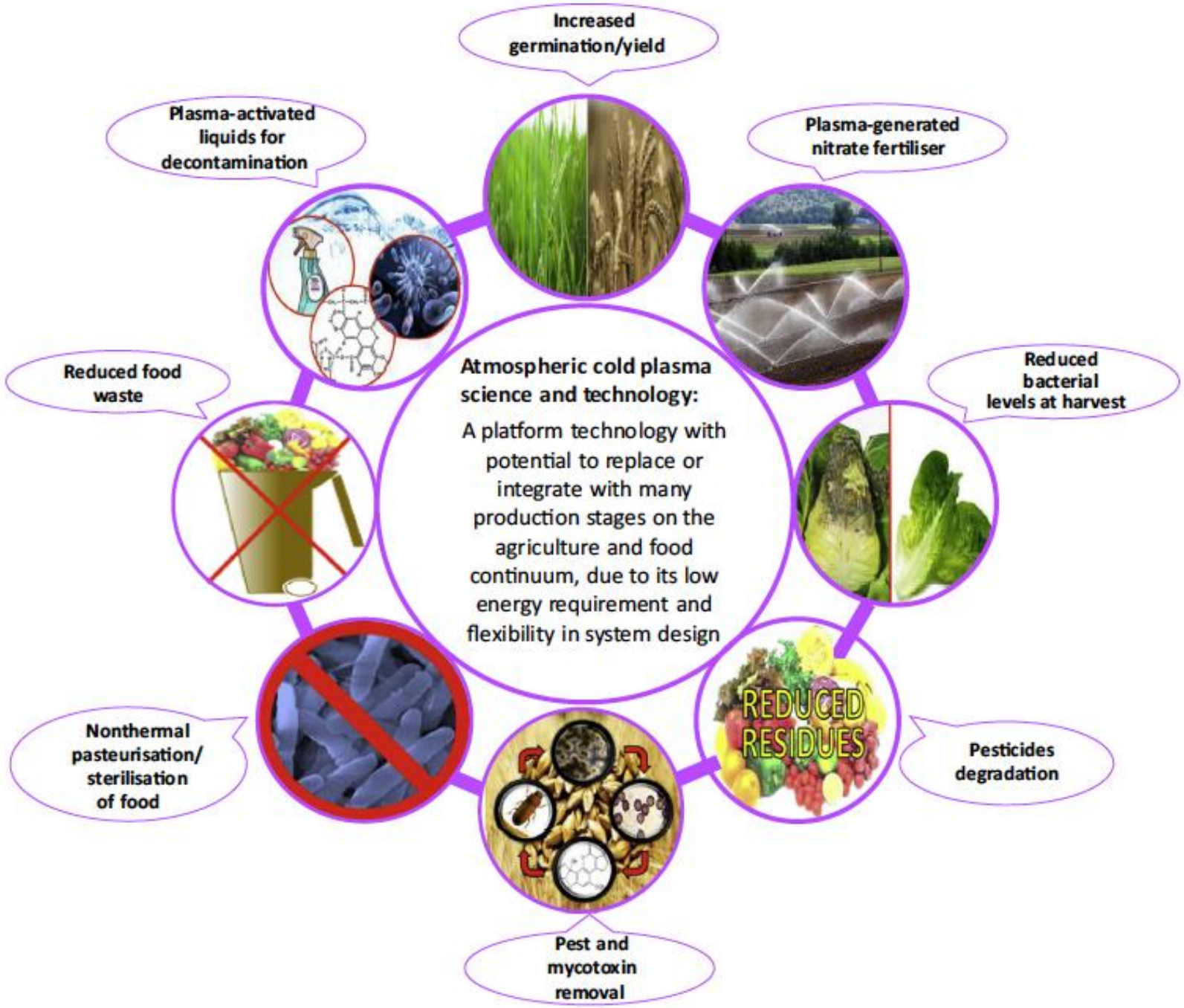
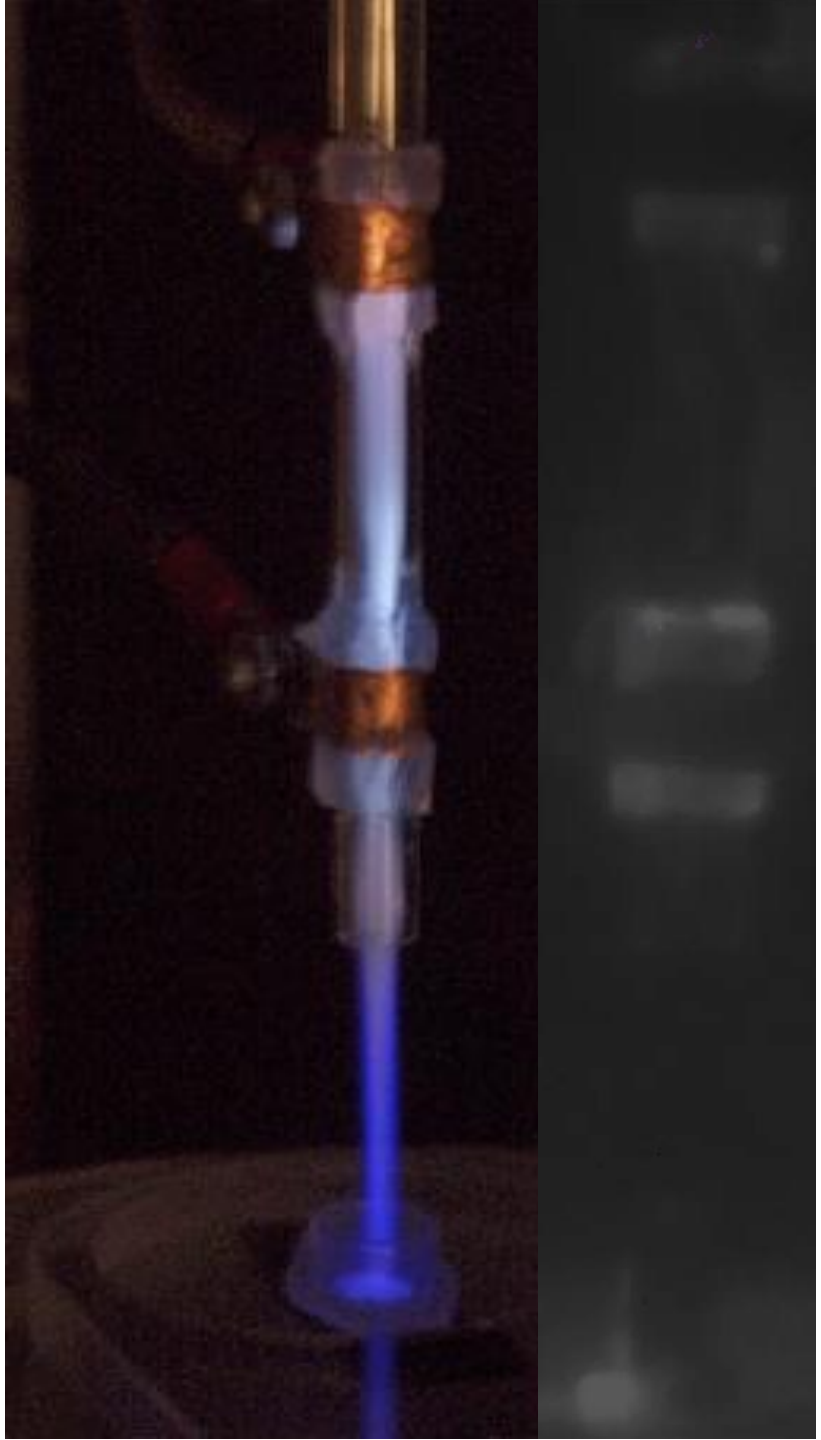
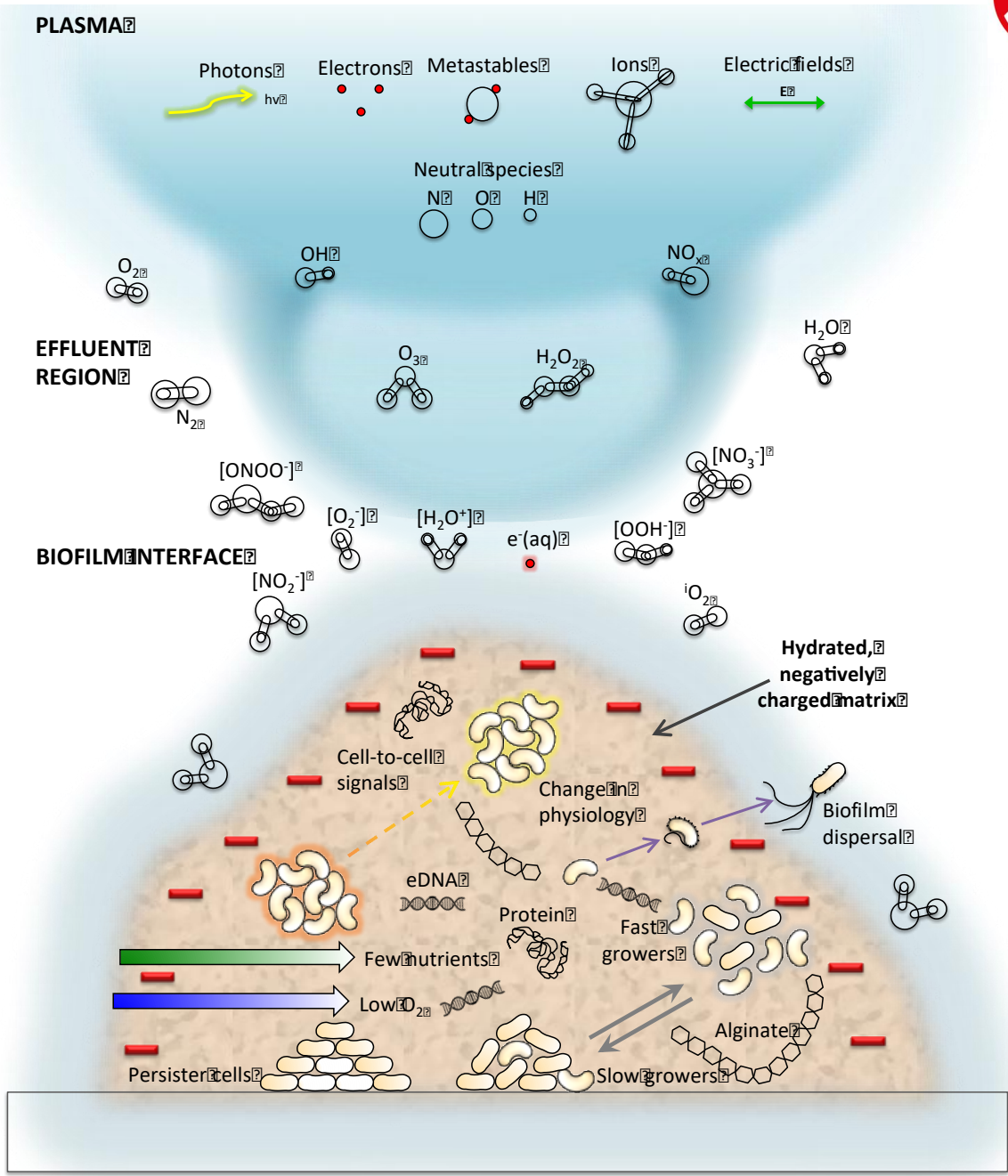


The Cold Plasma Market will be worth US$51.3Bn by 2026 and is predicted to expand at a CAGR of 16.3% between 2018 and 2026

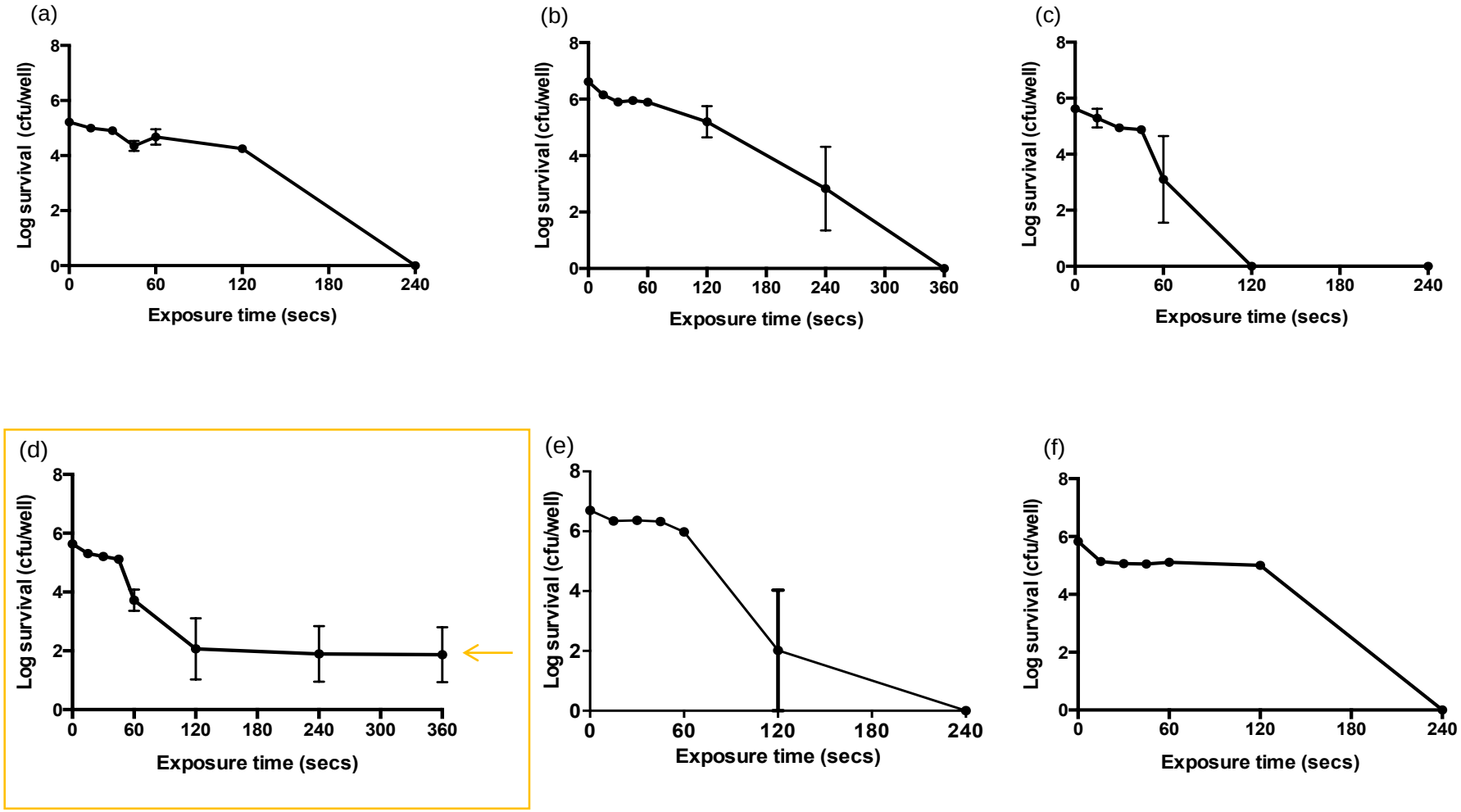


Trends in Biotechnology



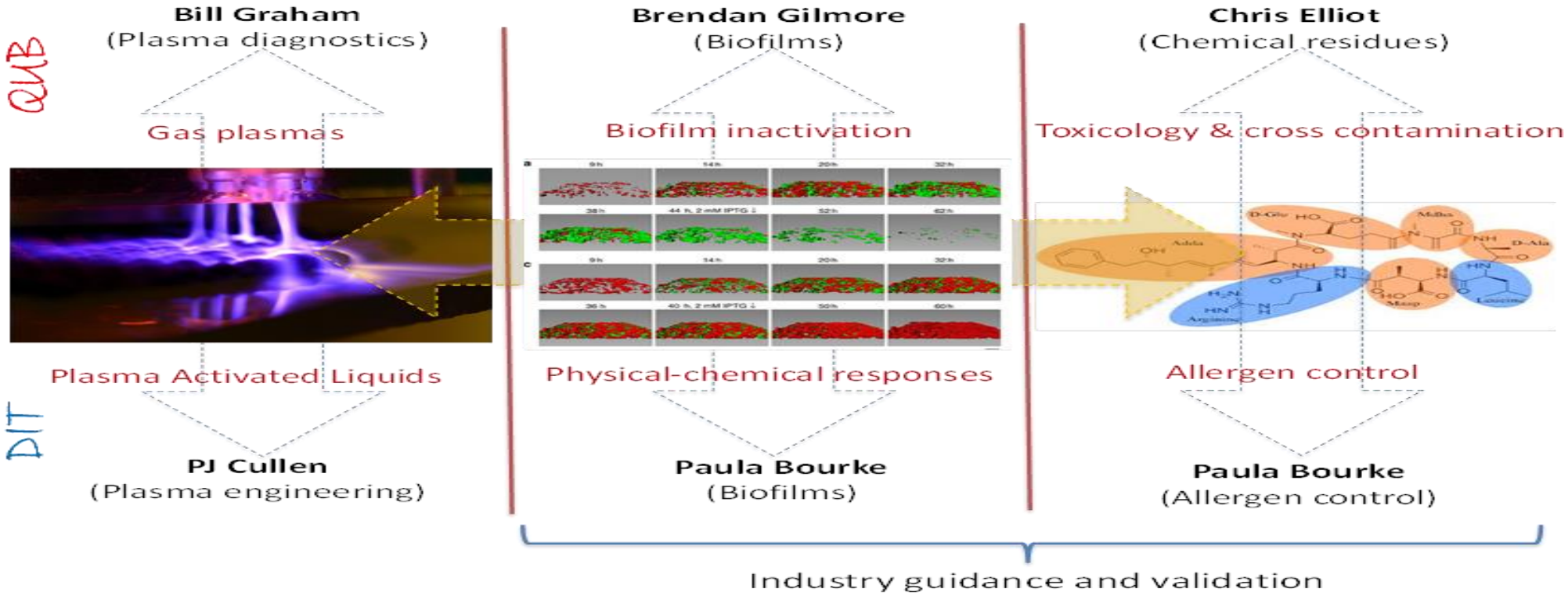

PLASMA
Photons
hv
Electrons
Metastables
Ions
Electric fields
E
Neutral species
N
O
H
OH
O_2
NO_x
H_2O
EFFLUENT REGION
O_3
H_2O_2
N_2
$[ONOO^-]$
$[NO_3^-]$
$[O_2^-]$
$[H_2O^+]$
$e^-(aq)$
$[OOH^-]$
BIOFILM INTERFACE
$[NO_2^-]$
$^iO_2$
Hydrated, negatively charged matrix
Cell-to-cell signals
Change in physiology
Biofilm dispersal
eDNA
Protein
Fast growers
Few nutrients
Low O_2
Alginate
Persister cells
Slow growers

Cold Plasma – The future of Pathogen Control?



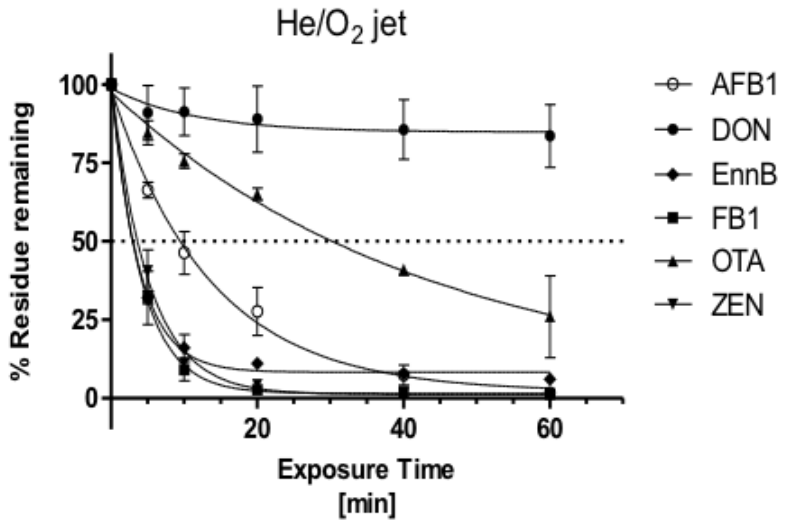
BBSRC-SFI EnvironSafe QUB-DIT

- BBSRC-SFI Project £1.1M
- The overall aim is to *understand and develop atmospheric cold plasma based approaches to control and mitigate the ingress of key risk factors to the food chain leading to enhanced food safety and sustainability*

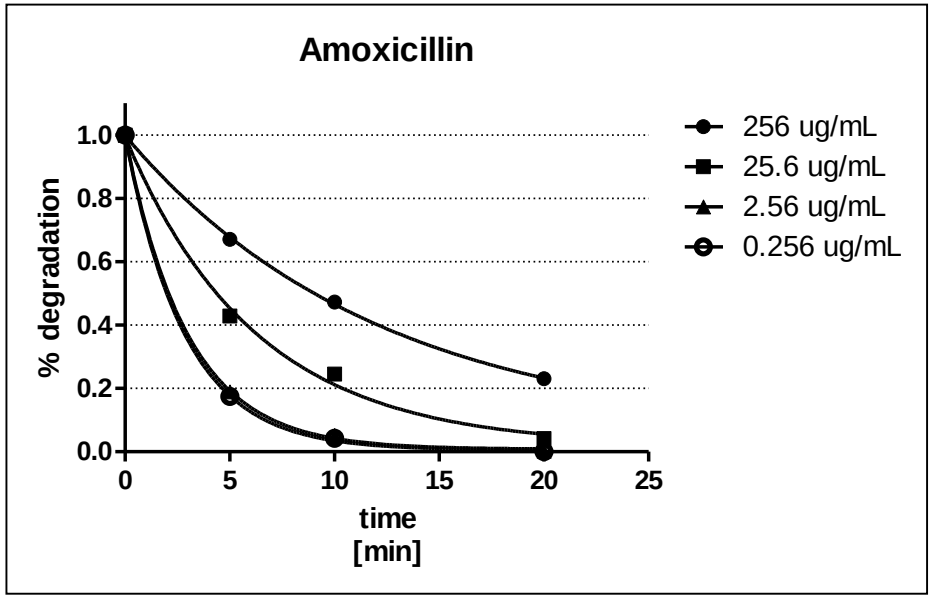


BBSRC-SFI EnvironSafe QUB-DIT

- Key Objectives: demonstrate the feasibility of cold plasma technologies to mitigate both microbiological and chemical risks in the fo



First order decomposition curves of aflatoxin B1 (AFB1), deoxynivalenol (DON), enniatin B (EnnB), fumonisin B1 (FB1), ochratoxin A (OTA) and zearalenone (ZEN) exposed to a helium (He, 2SLM, 6kV) or helium/ oxygen (He/O_2, 99.25:0.75%, v/v) CAPP jet at 10, 1000, 50, 200, 50 and 200 ng/mL respectively (n=3, mean±SD)



Establishing a Centre for Plasmas in Agriculture ('AgriPlas')

- Establishment of a cold plasma facility at IGFS to undertake cutting edge research in novel methods to
  - **reduce** animal disease,
  - **reduce** antibiotic use,
  - **reduce** feed and food contamination and
  - **reduce** food waste

- A range of laboratory- and pilot-scale plasma systems will be available to the research community

Acknowledgements