We use cookies to ensure that we deliver the best user experience of our website. If you would like to, you can change your cookie settings at any time. Continue

Professor Steve Busby FRS

Professor of Biochemistry
Head of School

School of Biosciences (/schools/biosciences/index.aspx)

Contact details

Telephone +44 (0)121 41 45402 (tel:+44 121 41 45402)

Email s.j.w.busby@bham.ac.uk (mailto:s.j.w.busby@bham.ac.uk)

School of Biosciences
University of Birmingham
Edgbaston
Birmingham
B15 2TT
UK

About

Research in Steve Busby's lab is concerned with understanding the molecular mechanisms that control gene expression in bacteria, with particular attention to studying the regulation of transcription initiation in *Escherichia coli*. Much of the recent work has focussed on the expression of virulence determinants in pathogenic strains.

Qualifications

- BA 1972 University of Cambridge, Natural Sciences
- DPhil 1975 University of Oxford

Biography

- Postdocs 1975-1979 Institut Pasteur, Paris & NIH, Bethesda
- 1979-1983 Staff Scientist at Institut Pasteur, Paris
- 1983 Lecturer at the University of Birmingham
- 1988 Senior Lecturer
- 1990-1995 Royal Society EPA Fund Research Fellow & Reader in Biochemistry
- 1995-present Professor of Biochemistry
- 2005 FRS
- 2006 Fellow of the American Academy of Microbiology

Teaching

I teach on undergraduate courses at all levels. My biggest contributions are a second year course on bacterial genes and genomes and a third year course on bacterial gene regulation

Postgraduate supervision

For a list of possible PhD projects offered by Prof Busby **www.findaphd.com/search/customlink.asp?inst=birm-Biol&supersurname=Busby (http://www.findaphd.com/search/customlink.asp?inst=birm-Biol&supersurname=Busby)**

Former PhDs from the Busbylab include: Vas Ponnambalam (1984-1987), Bernard Chan (1985-1988), Sheela Jayaraman (1985-1988), Tim Peakman (1985-1988), Kevin Gaston (1986-1989), Andrew Bell (1987-1990), Matt Downham (1989-1992), Roy Williams (1989-1992), Jackie Williams (1990-1993), Kerry Tyson (1990-1993), David West (1991-1994), Virgil Rhodius (1992-1995), Jennifer Keen (1993-1996), Helen Wing (1993-1996), Steve Williams (1994-1997), Hui-chung Wu (1994-1997), Emma Law (1995-1999), David Lee (1996-2000), Tom Burr (1996-2000), Paolo Landini (1996-2000),Tamara Belyaeva (1996-2001), John Tebbutt (1997-2000), Andrew Sanderson (1998-2001), Joseph Wade (1998-2001), Mohamed Samir el Robh (1999-2002), Lars Westblade (1999-2002), David Grainger (2000-2003), Nora Miroslavova (2001-2004), Christina Kahramanoglou (2001-2004), Jennie Mitchell (pt time 2002-2009), Shivanthi Rodrigo (2004-2007), Sarah Piper (2004-2007), Meng Xu (2004-2008), Kerry Hollands (2005-2008), David Chismon (2006-2009)

Research

Research Theme within School of Biosciences: **Molecular and Cell Biology (/research/activity/cellbiology/index.aspx)**

Transcriptional regulation in bacteria

Steve Busby's work concerns the mechanisms by which the expression of different genes is regulated in bacteria. Working with *Escherichia coli* K-12, over the past 25 years, the lab has elucidated some of the basic rules of promoter recognition by RNA polymerase and some of the fundamental mechanisms by which transcription activators function (see reviews listed below).

The work with RNA polymerase has focused on the roles of the alpha and sigma subunits, whilst the work on transcription activation has developed from studies of the cyclic AMP receptor protein (known as CRP or CAP), which have established a paradigm for understanding transcription activation in bacteria. Early work with CRP, and with the related activator, FNR was concerned with simple promoters, such as the *E. coli lac* or *gal* promoters, where one molecule of activator is sufficient for full induction. Recently, the lab has turned its attention to more complicated promoters that are regulated by many different factors. Because bacterial gene expression is

exquisitely sensitive to the environment, the majority of promoters are complex and the lab has focused on cases where one molecule of activator is insufficient for full induction.

The work has identified two distinct and novel mechanisms for co-activation of a promoter by multiple activators.

Current active projects concern:

- Analysis of the molecular mechanisms whereby activation at CRP- and FNR-dependent promoters is coupled to other activators. These promoters function as integration devices that coordinate transcriptional responses to different environmental signals.
- How the activity of the major *E. coli* housekeeping sigma factor is regulated.
- The application of chromatin immunoprecipitation methods to bacteria to monitor the distribution in vivo of RNA polymerase, transcription factors and nucleoid-shaping proteins.
- Promoters that regulate the expression of some of the major virulence determinants of pathogenic *E. coli* (in collaboration with Mark Pallen and Ian Henderson).
- The relation between the activity of bacterial promoters and their location in bacterial folded chromosomes.

Collaborators

We collaborate with different groups on the UB campus, notably with Jeff Cole (on regulation of gene expression by oxygen and nitrate/nitrite), Dave Grainger (on bcacterial chromosome folding), Josh Rapopport (on imaging), Mark Pallen (on LEE region regulation), Ian Henderson (on the enteroaggregative *E. coli* toxin) and Laura Piddock (on multidrug resistance in *Salmonella*). Overseas collaborators include Akira Ishihama (Tokyo), P-S Gunasekaran (Madurai), Kathleen Marchal (Leuven), Dom Schneider (Grenoble) and Victor de Lorenzo (Madrid). Recent overseas visitors have included: Marie-Carmen Martin (Badajoz), Kaneyoshi Yamamoto (Tokyo), Sandra van Puyvelde (Leuven) & Matej Butala (Ljubljana).

Current members of lab

- David Lee, Research Fellow (BSc, PhD, Birmingham): Interactions of bacterial RNA polymerase
- Jennie Mitchell, Research Fellow (BSc, PhD, Birmingham): Interactions of bacterial RNA polymerase
- Maritoni Sanchez-Romero, Research Fellow (BSc, PhD, University of Extramadura): *E. coli* chromosome biology
- Md Shahidul Islam, (BSc, MSc, Bangladesh Agricultural University): Regulation of LEE gene expression
- Jack Bryant, PhD student (BSc, Birmingham): Consequences of location on transcription in bacteria
- Patchawaran Ruanto, PhD student (BSc, Chiang Mai University; MSc, Birmingham): Genomics of NarL
- Laura Rowley, PhD student (BSc, York): CRP-dependent promoters
- Ghadah AlSharif, PhD student (BSc, King AbdulAziz University; MSc, Aberdeen): Regulation of LEE gene expression
- Rita Godfrey, Technician

Other activities

Vice Chair of the Biochemical Society

External Examiner for University of Cambridge Part II Biochemistry

Chair of CNRS-INSERM ATIPE-AVENIR Fellowship Microbiology Committee

Chair of Royal Society Dorothy Hodgkin Fellowships B panel

In 2010, Steve Busby gave invited lectures at:University of Glasgow (Wellcome Trust Centre); Old Swinford Hospital School (6th form); Trinity College, Dublin (Moyne Institute); University of Nottingham (Institute of Genetics); University of Pablo Olavida (Seville); University of Seville (Dept Genetics); CNRS Gif-sur-Yvette (CGM); University of Leicester (Dept Microbiology); Indian Institute of Science Bangalore (Dept Microbiology & Cell Biology); Peking University (Beijing, China); Chinese Academy of Agricultural Science, Plant Protection Laboratory (Beijing, China).

In 2010, Steve Busby spoke at the following international meetings: Belgian Society for Microbiology Annual Symposium (Brussels); US-EC Biotechnology Task Force Workshop (Segovia); BACNET meeting (St Feliu); 15th Nitrogen Cycle Meeting (Birmingham); Ecole Thematique Microbiologie Moleculaire (Giens, France); 80th IBPC Anniversary Symposium (Paris); Vijyoshi Camp 2 (Bangalore, India). US-EC Biotechnology Task Force Workshop (Segovia); BACNET meeting (St Feliu); 15 Nitrogen Cycle Meeting (Birmingham); Ecole Thematique Microbiologie Moleculaire (Giens, France); 80 IBPC Anniversary Symposium (Paris); Vijyoshi Camp 2 (Bangalore, India).

Publications

Key reviews

- Busby, S & Ebright, R (1994) Promoter structure, promoter recognition and transcription activation in prokaryotes. Cell 79 743-746
- Ebright, R & Busby, S (1995) Escherichia coli RNA polymerase alpha subunit: structure and function. Current Opinion in Genetics and Development 5 197-200
- Busby, S & Kolb, A (1996) The CAP Modulon. In Regulation of Gene Expression in E. coli (Lin, E & Lynch, S, eds) chapter 12, pp 255-279, R.G. Landes, New York
- Busby, S & Ebright, R (1997) Transcription activation at Class II CAP-dependent promoters. Molecular Microbiology 23 853-859
- Rhodius, V. & Busby, S. (1998) Positive Activation of Gene Expression. Curr. Opinion in Microbiology 1 152-159
- Busby, S & Ebright, R (1999) Transcription activation by catabolite activator protein (CAP). J. Mol. Biol. 293 199-213.
- Lloyd, G, Landini, P, & Busby, S (2001) Activation and repression of transcription initiation in bacteria. Essays in Biochemistry, vol 37, chapter 2, pp 17-32.
- Browning, D, Lee, D, Green, J & Busby, S (2002) Secrets of bacterial transcription initiation taught by the Escherichia coli FNR protein, in "Signals, Switches, Regulons & Cascades: Control of Bacterial Gene Expression" SGM Symposium volume 61 pp 127-142
- Browning, D & Busby, S (2004) The regulation of bacterial transcription initiation. Nature Reviews Microbiology 2 57-65
- Barnard, A, Wolfe, A & Busby, S (2004) Regulation at complex bacterial promoters: how bacteria use different promoter organisations to produce different regulatory outcomes. Current Opinion in Microbiology 7 102-108
- Busby, S & Savery, N (2007) Transcription activation at bacterial promoters. Online Encyclopaedia of Life Science, **http://www.els.net/ (http://www.els.net/)** , John Wiley & Sons, Ltd, Chichester
- Wade, JT, Struhl, K, Busby, SJW & Grainger, DC (2007) Genomic analysis of protein-DNA interactions in bacteria: insights into transcription and chromosome organization. Molecular Microbiology 65 21-26
- Grainger, D & Busby, S (2008) Global regulators of E coli transcription: mechanisms of action and methods for study. Advances in Applied Microbiology 65 93-113

- Butala, M, Zgur-Bertok, D & Busby, S (2009) The bacterial LexA transcriptional repressor. Cellular and Molecular Life Sciences 66 82-93
- Minchin, S & Busby, S (2009) Analysis of mechanisms of activation and repression at bacterial promoters. Methods 47 6-12
- Browning, D, Savery, N, Kolb, A & Busby, S (2009) Assays for transcription factor activity. Methods in Molecular Biology: DNA-Protein interactions 3rd Edition (Benoit LeBlanc & Tom Moss, eds.) Volume 543, Chapter 23, pp 369-387, Springer Science
- Grainger, D, Lee, D & Busby, S (2009) Direct methods for studying transcription regulatory proteins and RNA polymerase in bacteria. Current Opinion in Microbiology 12 531-535
- Browning, D, Grainger, D & Busby S (2010) Effects of nucleoid-associated proteins on bacterial chromosome structure and gene expression. Current Opinion in Microbiology 13 773-780

Selected Publications since 2005

- Browning, D, Grainger, D, Beatty, C, Wolfe, A, Cole, J & Busby, S (2005) Integration of three signals at the Escherichia coli nrf promoter: a role for Fis protein in catabolite repression. Molecular Microbiology 57 496-510
- Grainger, D, Hurd, D, Harrison, M, Holdstock, J & Busby, S (2005) Studies of the distribution of Escherichia coli cAMP receptor protein and RNA polymerase along the E. coli chromosome. Proc Natl Acad Sci USA 102 17693-17698
- Kahramanoglou, C, Webster, C, El-Robh, M, Belyaeva, T & Busby, S (2006) Mutational analysis of the Escherichia coli melR gene suggests a two-state concerted model to explain transcriptional activation and repression in the melibiose operon. J. Bacteriol. 188 3199-3207
- Grainger, D, Hurd, D, Goldberg, M & Busby, S (2006) Association of nucleoid proteins with coding and non-coding segments of the Escherichia coli genome. Nucl. Acids Res. 34 4642-4652
- Browning, D, Lee, D, Wolfe, A, Cole, J & Busby, S (2006) The Escherichia coli K-12 NarL and NarP proteins insulate the nrf promoter from the effects of integration host factor. J. Bacteriol. 188 7449-7456
- Wade, J, Roa, D, Grainger, D, Hurd, D, Busby, S & Struhl, K (2006) Extensive functional overlap between sigma factors in Escherichia coli. Nat. Struct. Mol. Biol. 13 806-814
- Grainger, D, Hurd, D, Goldberg, M & Busby, S (2007) Transcription factor distribution in E coli: studies with FNR protein. Nucl. Acids Res. 35 269-278
- Grainger, D, Goldberg, M, Lee, D & Busby, S (2008) Selective repression by Fis and H-NS at the Escherichia coli dps promoter. Molecular Microbiology 68 1366-1377
- Shimada, T, Ishihama, A, Busby, S & Grainger D (2008) The Escherichia coli RutR transcription factor binds at targets within genes as well as intergenic regions. Nucl Acids Res. 36 3950-3955
- Butala, M, Busby, S & Lee, D (2009) DNA sampling: a method for probing protein binding at specific loci on bacterial chromosomes. Nucl Acids Res doi:10.1093/nar/gkp043
- Xu, M, Busby, S & Browning, D (2009) Activation and repression at the Escherichia coli ynfEFGHI operon promoter. J Bacteriol 191 3172-3176
- Squire, D, Xu, M, Cole, J, Busby, S & Browning, D (2009) Competition between NarL-dependent activation and Fis-dependent repression controls expression from the Escherichia coli yeaR and ogt promoters. Biochem J 420 249-257
- Piper, S, Mitchell, J, Lee, D & Busby, S(2009) A global view of Escherichia coli Rsd protein and its interactions. Molecular BioSystems 5 1943-1947
- Lee, D, Bingle, L, Heurlier, K, Pallen, M, Penn, C, Busby, S & Hobman, J (2009) Gene doctoring: a method for recombineering in laboratory and pathogenic Escherichia coli strains. BMC Microbiology 9 252
- Hollands, K, Lee, D, Lloyd, G & Busby, S (2010) Activation of sigma 28-dependent transcription in Escherichia coli by the cyclic AMP receptor protein requires an unusual promoter organisation. Molecular Microbiology 75 1098-1111
- Lloyd, G, Godfrey R & Busby S (2010) Targets for the MalI repressor at the divergent Escherichia coli K-12 malX-malI promoters. FEMS Letters 305 28-34
- Sánchez-Romero, M-A, Busby, S, Dyer, N, Ott, S, Millard, A & Grainger, D (2010) Dynamic distribution of SeqA protein across the chromosome of Escherichia coli K-12. mBio 1 e00012-10.doi10.1128/mBio00012-10
- Browning, D, Lee, D, Spiro, S & Busby, S (2010) Down-regulation of the Escherichia coli K-12 nrf promoter by binding of the NsrR nitric oxide sensing transcription repressor to an upstream site. J. Bacteriol 192 3824-3828
- Chismon, D, Browning, D, Farrant, G & Busby, S (2010) Unusual organization, complexity and redundancy at the Escherichia coli hcp-hcr promoter. Biochem J 430 61-68
- Islam, M, Bingle, L, Pallen, M & Busby, S (2011) Organization of the LEE1 operon regulatory region of enterohaemorrhagic Escherichia coli O157:H7 and activation by GrlA. Molecular Microbiology **79** 468-483

Expertise

Bacterial genomes: particularly genes that enable bacteria to survive in stressful habitats and genes that make bacteria dangerous to humans

Alternative contact number available for this expert: **contact the press office (http://www.birmingham.ac.uk/news/contacts/index.aspx)**

Expertise

Bacterial genomes; genes that enable bacteria to survive in stressful habitats; genes that make bacteria dangerous to humans

Alternative contact number available for this expert: **contact the press office (http://www.birmingham.ac.uk/news/contacts/index.aspx)**

© University of Birmingham 2014