

EXHIBIT 1

CURRICULUM VITAE

DR MICHAEL ANTONIOU

Date of birth: 20th February 1955
Nationality: British [Cypriot by birth].
Marital status: Widowed
Current work address: **Head: Gene Expression and Therapy Group**
King's College London
Faculty of Life Sciences & Medicine
Department of Medical and Molecular Genetics
8th Floor, Tower Wing
Guy's Hospital
Great Maze Pond
London
SE1 9RT, UK

Tel: +44 (0)20 7188 3708
Fax: +44 (0)20 7188 2585
Email: michael.antoniou@kcl.ac.uk
Skype: michaelantoniou
Web: <https://www.kcl.ac.uk/lsm>

Secondary School Education:

1966-1973: Hampstead Comprehensive School, London.

A (Advanced) level GCE (General Certificate of Education):
Physics
Chemistry
Mathematics

S (Special) level:
Chemistry.

University Education:

1973-1977: BA (Oxon), Biochemistry, 2:1
University of Oxford (Hertford College).

1977-1980: PhD: University of Reading, Department of Physiology and Biochemistry.
Molecular mechanisms of fatty acid synthetase biosynthesis in the
rabbit mammary gland.

Postdoctoral experience:

- 1980-1983: University of Nebraska, Lincoln, Nebraska, U.S.A.
Hormonal regulation of milk protein gene expression in murine mammary gland.
- 1984-1994: Laboratory of Gene Structure and Expression, National Institute for Medical Research, The Ridgeway, Mill Hill, London.

Faculty positions:

- October 1994 - October 1996 Lecturer, Department of Experimental Pathology, UMDS, Guy's Hospital, London, Bridge, London, SE1 9RT, U.K.
- October 1996 - August 2003 Senior Lecturer
Department of Medical and Molecular Genetics,
King's College London School of Medicine, Guy's Hospital, London.
- September 2003 - present Reader in Molecular Genetics
Department of Medical and Molecular Genetics,
King's College London Faculty of Life Sciences & Medicine
Guy's Hospital, London.

Current Main Areas of Research:

- The isolation, characterisation and application of genetic regulatory elements with a dominant chromatin remodelling (opening) capability.
- Defining the ubiquitous chromatin opening function associated with the human housekeeping *HNRPA2B1-CBX3* locus.
- Exploitation of the ubiquitous-acting chromatin opening element (UCOE) from the *HNRPA2B1-CBX3* locus in the construction of efficient expression vectors for gene therapy and industrial biotechnological (bioprocessing) applications.
- Exploitation of the UCOE from the *HNRPA2B1* locus in lentiviral gene therapy vectors.
- Gene therapy approaches for the haemoglobinopathies.
- Development of lentiviral vectors targeting haematopoietic stem cells for the treatment of thalassaemia and sickle cell disease.
- Biosafety evaluation of GMO foods and their associated pesticides.
- Use of molecular profiling methods to determine perturbations in that may underpin observed impacts on health.

Teaching Responsibilities:

- Programme organiser of the Department of Medical and Molecular Genetics Intercollegiate BSc (iBSc) in Medical Genetics. Teaching module organiser and examiner.
- Extensive undergraduate lecturing experience at KCL and elsewhere.
- Extensive BSc and MSc project student supervisory experience.
- 19 years experience in the supervision of PhD students both in my own group and with collaborators within the UK and abroad. Have acted as examiner in over 20 PhD *viva voce* examinations for PhD students.
- Member of the King's College London Undergraduate Board of Examiners for the Faculty of Life Sciences & Medicine.
- External Examiner: Hong Kong University: PgD/MSc in Human Nutrition and Dietetics; Advanced Certificate in Human Biochemistry and Physiology and "Academic Assessor" for the PgD in Human Nutrition (Research Designs and Statistics/Nutrition and Metabolism sections).

Other Activities:

- Member of the UK Government's Biotechnology and Biological Sciences Research Council grant review committee dealing with "Genes and Developmental Biology", 2000-2003.
- Executive board member and treasurer of British Society for Gene and Cell Therapy, 2006-2011.
- Departmental Biological Safety Officer.
- Member of current King's College London Genetic Modification Safety Committee for the Faculty of Life Sciences & Medicine.

Patents:

1. Expression Systems (1992)
Co-inventor with: Prof Frank Grosveld
Zeneca Pharmaceuticals UK (Formerly ICI Pharmaceuticals).
European Patent No 92901357.1
2. Transfection Process (1993)
Co-inventor with Therexsys Ltd., UK.
GB No 9317380.5
3. Self-replicating Episomal Expression Vectors Conferring Tissue-Specific Gene Expression (1996).
Co-inventor with Frank Grosveld and Therexsys Ltd., UK.
International Patent Application Number: PCT/GB97/02213
Patent Granted: 7th March 2001
European Patent No.: EP 0 918 874 B1

4. A polynucleotide: Ubiquitous chromatin opening elements - UCOE. 21.7.99
International Patent Application Number: PCT/GB99/02357.
Co-inventors: Michael Antoniou, ML Laboratories plc
Granted in all major territories.
5. Polynucleotide: artificial UCOEs.
International Patent Application Number: PCT/GB01/04210.
Co-inventors: Michael Antoniou, ML Laboratories plc
Granted in all major territories.

Title	Country	App Number	Patent No	Status	Expiry Date
UCOE	Australia	50534/99	771,111	Granted	21/Jul/2019
UCOE	USA	09/358,082	6,689,606	Granted	21/Jul/2019
UCOE	USA	10/225,418	6,964,951	Granted	21/Jul/2019
UCOE	USA	10/225,073	6,881,556	Granted	21/Jul/2019
Improved Gene Expression	USA	10/117,960	6,949,361	Granted	05/Apr/2022

Publications:

1. Antoniou, M., Craig, R. and Dils, R. (1981). Identification of fatty acid synthetase mRNA on free polyribosomes isolated from lactating rabbit mammary gland. *Biochem. J.* **199**: 789-793.
2. Banerjee, M. R., Antoniou, M., Joshi, J. B. and Majumder, P. K. (1983). Recent advances in hormonal regulation of milk protein gene expression. In: *Understanding Breast Cancer; Clinical and Laboratory Concepts* (M. Rich, J. Hager and P. Furmanski, eds.) Marcell Dekker Inc., N.Y., Chapter 27, pp. 335-364.
3. Banerjee, M. R., Majumder, P. K., Antoniou, M. and Joshi, J. B. (1983). Hormone inducible specific gene expression in an isolated whole mammary organ in serum free culture. In: *Hormonally Defined Medium* (G. Fischer & R. J. Weiser, eds.) Springer Verlag, Berlin, pp. 234-249.
4. Banerjee, M. R. and Antoniou, M. (1984). Serum-free culture of the whole mammary organ of the mouse: A model for the study of differentiation and carcinogenesis. In: *Methods in Molecular and Cell Biology* (D. Barnes, D. Sirbasku and G. Sato, eds.), Alan R. Liss Inc., N.Y., pp. 143-169.
5. Banerjee, M. R. and Antoniou, M. (1985). Multiple hormonal interactions in regulation of milk protein gene expression. In: *Biochemical Actions of Hormones*. (G. Litwack, ed.) Academic Press, N.Y.
6. Antoniou, M., Guzman, K., Chakraborty, S. and Banerjee, M. R. (1985). A generally applicable improved method for preparation of single stranded cDNA probes from clones constructed in M13 vectors. *J. Biochem. Biophys. Methods* **11**: 203-212.

7. Wright, S., Taramelli, R., Rosenthal, A., deBoer, E., Antoniou, M., Kioussis, D., Wilson, F., Hurst, J., Bartram, C., Athanassiadou, A. and Grosveld, F. (1985). DNA sequences required for regulated expression of the human β -globin gene. In: *Experimental Approaches for the study of Hemoglobin Switching. Progress in Clinical and Biological Research*. Eds. A. Nienhuis and G. Stamatoyannopoulos. Alan R. Liss, Inc. New York, Vol. **191**: 251-268.
8. Antoniou, M., deBoer, E. and Grosveld, F. (1986). Fine mapping of genes: the characterization of the transcription unit. In: *Human Genetic Diseases, a practical approach* (K. E. Davies, ed.). IRL Press, Oxford.
9. Grosveld, F., Antoniou, M., Blom van Assendelft, M., deBoer, E., Hurst, J., Kollias, G., MacFarlane, F. and Wrighton, N. (1987). The regulation of expression of human β -globin genes. In: *Developmental Control of Globin Gene Expression* (G. Stamatoyannopoulos and A. W. Nienhuis, eds.). Alan R. Liss Inc., N.Y., pp. 135-144.
10. Khazaie, K., Gounari, E., Antoniou, M., deBoer, E. and Grosveld, F. (1986). β -globin gene promoter generates 5' truncated transcripts in the embryonic/foetal erythroid environment. *Nucleic Acids Res.*, **14**: 7199-7212. Corrected: Antoniou, M., deBoer, E. and Grosveld, F. (1987). *Nucleic Acids Res.*, **15**: 1886.
11. Grosveld, F., Antoniou, M., deBoer, E., Habets, G., Hurst, J., Kollias, G., MacFarlane, F. and Wrighton, N. (1987). The Regulation of expression of human β -globin genes. *UCLA Symposia (Proceedings) on Molecular and Cellular Biology*. in: *Molecular Approaches to Developmental Biology*. Eds. R. A. Firtel and E. H. Davidson. Alan R. Liss Inc., N.Y., **51**: pp. 483-500.
12. Grosveld, F., Antoniou, M., Blom van Assendelft, G., deBoer, E., Greaves, D., Hurst, J., Kollias, G., MacFarlane, F. and Wrighton, N. (1987). The Regulation of Expression of Human β -globin genes. *Biochem. Soc. Trans.*, Leicester, 1987.
13. Grosveld, F., Antoniou, M., Blom van Assendelft, M., Catala, F., Collis, P., deBoer, E., Greaves, D., Hanscombe, O., Hust, J., Kollias, G., Siew, L-K., Talbot, D., Wall, L. and Wrighton, N. (1987). Regulation of the human β -globin gene in transgenic mice and cultured cells. In: *Molecular Biology in Hematology*, pp. 139-147.
14. Antoniou, M., deBoer, E., Habets, G. and Grosveld, F. (1988). The human β -globin gene contains multiple regulatory regions: identification of one promoter and two downstream enhancers. *EMBO J.* **7**: 377-384.
15. deBoer, E., Antoniou, M., Mignotte, V., Wall, L. and Grosveld, F. (1988). The human β -globin gene promoter; nuclear protein factors and erythroid specific induction of transcription. *EMBO J.* **7**: 4203-4212.
16. Grosveld, F., Antoniou, M., Blom van Assendelft, G., Catala, F., Collis, P., deBoer, E., Greaves, D., Hanscombe, O., Hurst, J., Kollias, G., Mignotte, V., Siew, L. K., Talbot, D., Vogels, R., Wall, L. and Wrighton, N. (1988). Regulation of the human β -globin gene in transgenic mice and cultured cells. In: *Gene Transfer and Gene Therapy on Molecular and Cellular Biology*. Eds. A. L. Beaudet, R. Mulligan and I. M. Verma. Alan R. Liss Inc., New York. Vol. **87**: pp. 35-45.

17. Wall, L., Catala, F., Antoniou, M., deBoer, E. and Grosveld, F. (1988). The regulation of the human γ - and β -globin domain. In: Hemoglobin Switching Part A: Transcriptional Regulation. Progress in Clinical & Biological Research. Vol. **316A**: pp. 1-13.
18. Talbot, D., Collis, P., Antoniou, M., Vidal, M., Grosveld, F. and Greaves, D. R. (1989). A dominant control region from the human β -globin locus conferring integration site-independent gene expression. *Nature* **338**: 352-355.
19. Grosveld, F., Antoniou, M., Blom van Assendelft, G., Catala, F., Collis, P., deBoer, E., Dillon, N., Greaves, D., Hanscombe, O., Hurst, J., Lindenbaum, M., Spanopoulou, E., Talbot, D. and Wall, L. (1989). The regulation of the human β -globin domain. In: Tissue Specific Gene Expression Ed. R. Renkawitz, VCH., Verlagsgesellschaft mbH., Germany, pp. 123-126.
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21. Grosveld, F., Antoniou, M., Blom van Assendelft, G., Collis, P., Dillon, N., Greaves, D.R., Hanscombe, O., Hurst, J., Lindenbaum, M., Talbot, D. and Vidal, M. (1990). The β -globin dominant control region. In: Protein Production by Biotechnology. Ed. T. J. R. Harris, Elsevier, pp. 141-148
22. Collis, P. Antoniou, M. and Grosveld, F. (1990). Definition of the minimal requirements within the human β -globin gene and the dominant control region for high level expression. *EMBO J.* **9**: 233-240.
23. Antoniou, M. and Grosveld, F. (1990). The β -globin gene dominant control region interacts differently with distal and proximal promoter elements. *Genes and Dev.* **4**: 1007-1012.
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26. Antoniou, M. (1991). Induction of erythroid-specific expression in murine erythroleukaemia (MEL) cell lines. In: Methods in Molecular Biology, Vol. 7: Gene Transfer and Expression Protocols. Ed. E. J. Murray, Humana Press Inc., Clifton, NJ, U.S.A. pp. 421-434.
27. Talbot, D., Philipsen, S., Pruzina, S., Hanscombe, O., Antoniou, M., deBoer, E., Imam, A., Ellis, J. and Grosveld, F. (1991). Characterization of hypersensitive site 4 and the role of NF-E2 in hypersensitive site 2 of the human β -globin locus control region. Proceedings of 7th Hemoglobin Conference, Eds. G. Stamatoyannopoulos and A. W. Nienhuis. Johns Hopkins University Press, Maryland. pp.85-102.

28. Fraser, P., Talbot, D., Philipsen, S., Pruzina, S., Antoniou, M., Lindenbaum, M., Hanscombe, O., Dillon, N. and Grosveld, F.(1991). The regulation of human globin gene switching. Int. Workshop on Human Gene Transfer, John Libbey Eurotext Ltd.
29. Grosveld, F., Antoniou, M., Berry, M., deBoer, E., Dillon, N., Ellis, J., Fraser, P., Greaves, D., Hanscombe, O., Hurst, J., Lindenbaum, M., Mignotte, V., Philipsen, S., Pruzina, S., Strouboulis, J., Talbot, D. and Whyatt, D. (1991). The human β -globin Locus Control Region. Stohlmann Lecture In: Modern Trends in Human Leukemia, ed. R. Neth.
30. Grosveld, F., Antoniou, M., Berry, M., deBoer, E., Dillon, N., Ellis, J., Fraser, P., Greaves, D., Hanscombe, O., Hurst, J., Lindenbaum, M., Mignotte, V., Philipsen, S., Pruzina, S., Strouboulis, J., Talbot, D. and Whyatt, D. (1991). The Regulation of the Human β -globin locus. In: Application of Basic Science to Hematopoiesis and Treatment of Disease. Ed. Donnall Thomas, Raven Press, Ltd., New York. pp.21-38.
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33. Shelton, P. A., Davies, N. W., Antoniou, M., Grosveld, F., Needham, M., Hollis, M., Brammar, W. J. and Conley, E.C. (1993). Regulated expression of K⁺ channel genes in electrically silent mammalian cells by linkage to β -globin gene activation elements. *Receptors Channels*, **1**: 25-37.
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35. Antoniou, M., Carmo-Fonseca, M., Ferreira, J. and Lamond, A.I. (1993). Nuclear organisation of splicing snRNPs during differentiation of MEL cells in vitro. *J. Cell. Biol.*, **123**: 1055-1068.
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37. Antoniou, M., deBoer, E. and Grosveld, F. (1993). Fine mapping of genes: the characterization of the transcriptional unit. In: Human Genetic Disease Analysis. A Practical Approach (second edition) Ed. K. E. Davies, IRL Press, Oxford, 83-108.
38. Pruzina, S., Antoniou, M., Hurst, J., Grosveld, F. and Philipsen, S. (1994). Transcriptional Activation by hypersensitive site three of the human β -globin Locus Control Region: analysis of protein binding sites and promoter elements. *Biochim. Biophys. Acta*, **1219**: 351-360.

39. Guy, J., Drabek, D. and Antoniou, M. (1995). Delivery of DNA into mammalian cells by receptor mediated endocytosis and gene therapy. *Mol. Biotechnol.*, **3**: 237-248.
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Research Grants:

1. EU Human Capital and Mobility Programme
The cell and molecular biology of RNA processing.
1994-1998.
ECU 140,000 (~£112,000)

2. Medical Research Council (UK)
The mapping and characterisation of a locus control region specific for human endothelial cells.
1995-1998.
£200,027.

Special Trustees for St Thomas' Hospital
Supplementary grant to allow transgenic animal studies of this project to be conducted.
1996-1997.
£15,888.

3. The Wellcome Trust (UK).
The mapping and characterisation of a locus control region specific for human muscle cells.
1995-1996 (initially).
£46,816.

4. DTI/MRC LINK Programme (UK).
The construction of expression vectors with a ubiquitous, chromatin opening capability for gene therapy applications.
1995-1998.
£158,909 (personal allocation).
MRC Collaborative Studentship - included in this project.
1995-1998.
£22,500.
Industrial partner: Cobra Therapeutics Ltd (nee Therexsys,UK).

5. Muscular Dystrophy Group (UK).
Development of new vectors for gene therapy of neuromuscular diseases.
1995-1998.
£103,131.

6. EU BIOMED 2 Programme.
Development of globin gene expression vectors for human gene therapy.
1996-1999.
ECU 180,000 (~£144,000).

7. EU BIOTECHNOLOGY Programme
A search for novel drugs to treat the haemoglobinopathies.
1996-1999.
ECU 278,000 (~£222,400)
8. Guy's Hospital Special Trustees
Optimising the Structure of Transcription Units for Muscle Gene Therapy.
1996-1997.
£38,194.
9. Special Trustees for St Thomas' Hospital
Localising the Endothelial Specific Locus Control Region Associated with the Human α -globin Gene.
1998.
£32,091
10. EU BIOMED 2 Programme.
Cellular and Animal Models for the Investigation of Gene Regulation in the Native Environment of the Living Cell Nucleus.
1998-2001.
ECU 204,000 (~£163,200).
11. Muscular Dystrophy Group (UK).
Development of new vectors for gene therapy of neuromuscular diseases.
1998-2000.
£71,652
12. Muscular Dystrophy Group (UK).
The Mapping and Characterisation of the Muscle Specific Locus Control Region Associated with the Human Desmin Gene Domain.
1st Oct. 1997- 30th Sept. 2000.
Staff: £97,792
Consumables: £45,000
£142,792
13. Wellcome Trust (053634)
With Lanchbury JS, Panayi GS, Lewis CM
The role of genetic variation at the corticotropin-releasing hormone locus in rheumatoid arthritis.
£177,126
16.9.98-15.9.2001
14. Molecular mechanisms of expression from ubiquitous chromatin gene domains.
Cobra Therapeutics Ltd.
£200,000
1.2.1999-31.1.2001

15. Medical Research Council (G9800001)
With Solomon E, Bates G, Lewis C, Mathew C, Giannelli F, Ragoussis I, Sharpe P, Francis-West P
MRC Co-Operative Group: Genetic Approaches to Human Disease
£249,012
1.3.99-28.2.2003
16. BBSRC
Mechanism and exploitation of ubiquitous chromatin opening elements - UCOEs.
£335,084
Sept. 2000-Nov. 2003.
17. Muscular Dystrophy Campaign (UK).
Mechanisms of Action of the Human Desmin Gene Locus Control Region and its Exploitation in
Muscle Gene Therapy Vectors.
£242,223
1.10.00-30.9.2003
18. UK Thalassaemia Society
The Assessment of Novel α -globin Transcription Units within Retroviral/Lentiviral and AAV Vectors
for Gene Therapy of the Haemoglobinopathies.
£60,115
1.8.2000-31.7.2003.
19. EU Framework 5 Programme
Oculopharyngeal muscular dystrophy: a paradigm to investigate new pharmaco-therapeutic approaches
to trinucleotide-expansion diseases and muscular dystrophies.
€382,380
January 2002-June 2005.
20. Medical Research Council (G9800001)
Solomon E, Antoniou M, Bates G, Francis-West P, Grigoriadis A, Lanchbury J, Lewis C, Mathew C,
Sharpe P, Thein SL
MRC Co-operative Group: Genetic approaches to human disease (renewal)
£221,733
1.3.04 - 28.2.09
21. Association Francaise contre les Myopathies (AFM), France.
Development of Plasmid and Lentiviral Muscle Gene Therapy Vectors Incorporating the Human
Desmin Locus Control Region.
€19,500
July 2004-June 2005
Grant reference number: 10637

22. EU Framework 6 Programme - Specific Targeted Research Project
Insights to novel therapeutic strategies for a nuclear inclusion disease caused by polyalanine expansion - PolyALA.
€368,290 (~£246,754)
Oct. 2005 - Sept. 2008
Grant reference number: LSHM-CT-2005-018675

23. Medical Research Council
Development of an enhanced lentiviral vector for gene therapy of ADA-SCID.
Co-applicant with: Dr Bobby Gasper and Prof Adrian Thrasher (Institute of Child Health).
£332,000
2007-2010

24. Fundação para a Ciência e a Tecnologia (FCT), Portugal
Development of an integration deficient lentiviral vector for gene therapy of the haemoglobinopathies.
PhD Studentship. (Candidate's name Ms Sonia Ferreira)
€136,080 (£91,728)
October 15th 2006 - 14th October 2010

25. Department of Trade and Industry (DTI)/Biotechnology and Biological Sciences Research Council (BBSRC) - Knowledge Transfer Partnership (KTP) Award
Development of new c-myc-ERTAM conditional immortalising technologies of primary human somatic stem cells employing homologous recombination and lentiviral vectors
Industrial Partner: ReNeuron Ltd, Guildford, Surrey, UK)
£184,132
1st April 2007 - 31st March 2009

26. Biotechnology and Biological Sciences Research Council (BBSRC)
UCOE-based lentiviral vectors for effective and safe gene therapy.
Co-applicant with: Prof Adrian Thrasher (Institute of Child Health)
£714435
1st March 2008 - 28th Feb 2011

27. UK Thalassaemia Society
Development of an *in utero* approach for thalassaemia gene therapy
£70,000
May 2008-April 2011

28. Sustainable Food Trust
Assessing effect of dietary interventions on multiple organ systems by molecular profiling.
\$850,000
July 2012-June 2015

29. Advancing Gene Therapy Vectors for Thalassaemia
Principal Investigator: Dr. Marina Kleanthous
Funding Body: RPF, Cyprus (YTEIA/BIOΣ/0311(BE)/20)
Amount: Total 144,000 Euros
Period: 1/9/2012–31/8/2014

30. Sheepdrove Trust, UK/Safe Food Institute, Australia.
Glyphosate & AMPA Biomonitoring across America (GAMBA)
Collaborator: Dr Roy Gerona, UCSF, USA.
\$200,000.
2014-2016