Report for SICSA of the activities of Prof. P. J. Scott, SICSA Distinguished Visitor, Sept.-Dec., 2016

My SICSA activities while visiting Informatics at U. Edinburgh and visiting Heriot-Watt were as follows:

- September 9: speaker at the conference GDP70 (in honour of Gordon Plotkin), in conjunction with the British Logic Colloquium (BLC 2016), held at U. Edinburgh Informatics Forum, Sept. 6-8, 2016. Also part of a panel discussion of the BLC 2016, on Sept. 8, entitled "Soluble versus Insoluble : The Legacy of Alan Turing", chaired by Prof. Angus MacIntyre.

- A series of five public talks at Edinburgh, Heriot-Watt, and Strathclyde Universities:

    (i) October 5: public lecture to undergrad and beginning postgrad students at Heriot-Watt (CS). [Local Host: Dr. Murdoch Gabbay]

    (ii) October 18: Research lecture in the LFCS Lecture series (Informatics, U. Edinburgh).

    (iii) October 26: public lecture at Heriot-Watt (CS) [Local Hosts: Dr. Murdoch Gabbay and Prof. Mark Lawson].

    (iv) November 2: research talk at Strathclyde University (CS Department), [Local hosts: Prof. Neil Ghani and Dr. Ross Duncan]

    (v) November 16: Research Talk, Dept. of Mathematics, Heriot-Watt [Local Host: Prof. Mark Lawson).

- I attended a SICSA-sponsored conference, CLAP (Categories, Logic, and Physics, Scotland) workshop, 30 November, 2016, University of Strathclyde, Glasgow.

    `http://homepages.inf.ed.ac.uk/cheunen/clapscotland/`.

- As a direct consequence of my being in Edinburgh for the SICSA fellowship, I was invited to Cambridge Computer Science Department by Dr. Marcelo Fiore (Nov. 8-10) for a research seminar and collaborative talks. Many of the computer scientists I visited there (e.g. Dr. Fiore) have long-time connections with Informatics, University of Edinburgh.

- Research Collaborations:

    I primarily worked with two colleagues (and their students) while in Edinburgh: Dr. Chris Heunen (Edinburgh Informatics) and Prof. Mark Lawson (Heriot-Watt) and we began discussions of joint research projects. I also had research discussions with several other colleagues, including Drs. Murdoch Gabbay and Ekaterina Komendantskaya (Computer Science, Heriot-Watt) and other computer scientists at Heriot-Watt, Professor Neil Ghani and his group (Strathclyde Computer Science) in Glasgow, et. al.

    The two main areas of research were as follows:

    (a) Work with Dr. Chris Heunen (Informatics, U. Edinburgh). This work involves finding models of partially traced categories, in the sense of Haghverdi and Scott and Malherbe, Scott, and Selinger. Such structures are of interest in quantum computing

and wherever one discusses feedback and information flow within networks. The specific model we are exploring is the model of unital C^* algebras and linear, completely positive, subunital maps. However it is hoped this model will lead to new classes of partially-traced models. We enclose the first page of a work-in-progress report.

(b) Work with Prof. Mark Lawson (Heriot-Watt) on MV Algebras, Coordinatization, Duality, and AF C*-algebras. Also, Dr. Chris Heunen is now involved in our discussions and is involved in the Scottish Operator Algebra Research group (SOAR). Related ideas and applications will be discussed in the forthcoming workshop: Applications of Operator Algebras, June 26-30, ICMS (Edinburgh) organized by Prof. Mark Lawson.

During my last SICSA visit (2011), Prof. Mark Lawson (Heriot-Watt) and I began to study MV-algebras, which are models of many-valued logics. These have intimate connections with operator algebra (so-called AF C*-algebras) and the duality theory of certain inverse semigroups studied by Prof. Lawson. There are also many known applications of MV algebras to a wide array of computational phenomena, from quantum structures to error-correcting codes and algorithmic learning theory, as well as rational polyhedral topology. We began a *coordinatization program* to coordinatize countable MV algebras as lattices of ideals of certain AF Boolean Inverse monoids. We are connecting MV-algebras with a kind of non-commutative version of Stone-Duality (actually between pseudo groups and étale groupoids) arising from recent work of M. Lawson and D. Lenz. This is work in progress. In the 1990's, mathematical physicists developed Effect Algebras, as models of quantum measurement. They turn out to be generalizations of MV algebras and they were used in our coordinatization theory for MV-algebras. The coordinatization theory of Effect Algebras and their relationship to C*-algebras in general is part of our current research program, along with Dr. Chris Heunen. We enclose the first page of a work-in-progress with Mark Lawson and P. Scott.

Conclusion: This was a very informative and helpful SICSA grant. I met numerous Scottish computer scientists and mathematicians working in related areas. I am planning on continuing consultation and research contacts with Scottish researchers whom I visited during this period. I intend to continue informal discussions with colleagues Prof. Gordon Plotkin (Edinburgh), Prof. Neil Ghani and his research group (Strathclyde), Professor Angus Macintyre (Edinburgh), Drs. Murdoch Gabbay and Ekaterina Komendantskaya (Heriot-Watt) , as well as my active collaborators Mark Lawson (Heriot-Watt) and Chris Heunen (Edinburgh). I also intend to continue research contacts with the many Scottish postgraduate students I have been talking to during this visit.