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Backward-Wave Amplifier Realisation at 1000 GHz

Progress within EU FP7 OPTHER project

Paoloni, C.; Di Carlo, A.; Brunetti, F.; Mineo, M.; Ulisse, G.; Durand, A.; Krozer, Viktor; Kotiranta, M.; Fiorello, A.M.; Dispenza, M.; Secchi, A.; Zhurbenko, Vitaliy; Bouamrane, F.; Bouvet, T.; Megtert, S.; Cojocaru, C.-S.; Gohier, A.

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Proceedings of the

**4th Europe/UK-China Workshop on Millimetre Waves
and Terahertz Technologies**

1st-3rd September, 2011, Glasgow, UK

4th Europe/UK-China Workshop on Millimetre Waves and Terahertz Technologies

1st-3rd September, 2011, Glasgow, UK

Host: University of Strathclyde, Glasgow, UK

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Conference Programme

Registration & Reception 31st August, 19:00-21:00

McCance Building, University of Strathclyde

Thursday 1st September, 2011

Registration	08:30 onwards		Morning coffee
Session 0	09:30		Welcome address
	10:00	Keynote talk	Electromagnetic Excitation of Waveguide or Periodic Structure by Uniformly Moving Electron Beam Liu Shenggang, Zhang Yaxin, Hu Min, Zhang Ping, Liu Weihao and Zhou Jun <i>Univ. of Electronic Sci. and Tech. of China</i>
Chair: Dr Wenlong He			
Coffee break	10:30-11:00		
Session 1 High power sources	11:00	Keynote talk	Backward-Wave Amplifier Realisation at 1000 GHz - Progress within EU FP7 OPTHER project C. Paoloni ⁽¹⁾ , A. Di Carlo ⁽¹⁾ , F. Brunetti ⁽¹⁾ , M. Mineo ⁽¹⁾ , G. Ulisse ⁽¹⁾ , A. Durand ⁽²⁾ , V. Krozer ⁽³⁾ , M. Kotiranta ⁽³⁾ , A.M. Fiorello ⁽⁴⁾ , M. Dispenza ⁽⁴⁾ , A. Secchi ⁽⁴⁾ , V. Zhurbenko ⁽⁵⁾ , F. Bouamrane ⁽⁶⁾ , T. Bouvet ⁽⁶⁾ , S. Megtert ⁽⁶⁾ , C.-S. Cojocaru ⁽⁷⁾ , and A. Gohier ⁽⁷⁾ <i>(1) Univ of Rome Tor Vergata, Italy</i> <i>(2) Thales Electron Devices, France</i> <i>(3) Physikalisches Institut, Germany</i> <i>(4) Selex-SI, Italy</i> <i>(5) Technical Univ. of Denmark, Denmark</i> <i>(6) UMR137 CNRS/Thales, France</i> <i>(7) LPICM – École Polytechnique, (UMR 7647) CNRS, France</i>
	11:30	Talk 3	Numerical Simulations of Novel Gyro-multiplier Schemes D.A. Constable ⁽¹⁾ , I.V. Bandurkin ⁽²⁾ , A.V. Saviolov ⁽²⁾ , W. He ⁽¹⁾ , A.D.R. Phelps ⁽¹⁾ , A.W. Cross ⁽¹⁾ , V.L. Bratman ⁽²⁾ and K. Ronald ⁽¹⁾ <i>(1) Univ. of Strathclyde, UK</i> <i>(2) Institute of Applied Physics, Russia</i>
Co-chairs: Prof. Xiaodong Chen & Prof. Yubing Gong			

	11:45	Talk 4	W-band Gyro-BWO with a Four-stage Depressed Collector Liang Zhang, Wenlong He, Craig R. Donaldson, Adrian W. Cross, Alan D. R. Phelps and Kevin Ronald <i>Univ. of Strathclyde, UK</i>
	12:00	Talk 5	The Influence of Ridge-loading for W-band Folded Waveguide Traveling-wave Tube Guo Guo, Yanyu Wei, Lingna Yue, Yubin Gong, Xiong Xu, Zhigang Lu, G.Q.Zhao, and Gun-Sik Park ⁽¹⁾ <i>Univ. of Electronic Sci. and Tech. of China;</i> <i>(1) Seoul National Univ., Korea</i>
	12:15	Talk 6	Lab Demonstration of Auroral Radiation S.L. McConville ⁽¹⁾ , K. Ronald ⁽¹⁾ , D.C. Speirs ⁽¹⁾ , K. M. Gillespie ⁽¹⁾ , A.D.R. Phelps ⁽¹⁾ , A.W. Cross ⁽¹⁾ , R. Bingham ^(1,2) , M.E. Koepke ⁽³⁾ , C.W. Robertson ⁽¹⁾ , C.G. Whyte ⁽¹⁾ , K. Matheson ⁽¹⁾ , I. Vorgul ⁽⁴⁾ , R.A. Cairns ⁽⁴⁾ and B.J. Kellett ⁽²⁾ <i>(1) Univ. of Strathclyde, UK</i> <i>(2) STFC, Rutherford Appleton Laboratory, UK</i> <i>(3) Univ. of West Virginia, USA</i> <i>(4) Univ. of St Andrews, UK</i>
Lunch	12:30-13:30		Lunch and Poster session 1
Session 2 High power sources Co-chairs: Dr Byron Alderman & Prof. Guozhong Zhao	13:30	Keynote talk	Overview of High Power Millimetre-wave generation in Strathclyde Univ. Alan Phelps <i>Univ. of Strathclyde, UK</i>
	13:45	Talk 8	Two-Dimensional Cylindrical Periodic Lattices: Review of the Progress I.V. Konoplev, A. J. MacLachlan, A.R. Phipps, A.W. Cross, C.W. Robertson, A. R. Young, C.G. Whyte, K. Ronald, A.D.R. Phelps, and M. Thumm ⁽¹⁾ <i>Univ. of Strathclyde, UK</i> <i>(1) Karlsruhe Institute of Technology, Germany</i>
	14:00	Talk 9	Interaction between Mimicking Surface Plasmon and Electron beams in a 3- mirror quasi-optical cavity Zhang Yaxin, Hu Min, Zhang Ping and Liu Shenggang <i>Univ. of Electronic Sci. and Tech. of China</i>

	14:15	Talk 10	Microwave Compression Using 5-fold Helical Waveguide A.W. Cross, L. Zhang, W. He, C.W. Robertson, A. R. Young, C.G. Whyte, K. Ronald, S. Samsonov, S. Meshaka, and A.D.R. Phelps <i>Univ. of Strathclyde, UK</i>
	14:30	Talk 11	Development of a 0.42 THz Second Harmonic Gyrotron Yang Yan, Wenjie Fu, Xiaoyu Li, Xuesong Yuan, Diwei Liu and Shenggang Liu <i>Univ. of Electronic Sci. and Tech. of China</i>
	14:45	Talk 12	Pseudospark-sourced Micro-sized Electron Beams for High Frequency Klystron Applications H. Yin, A.W. Cross, W. He, D. Bowes, K. Ronald, and A.D.R. Phelps <i>Univ. of Strathclyde, UK</i>
	15:00	Talk 13	Numerical Simulation of Beam-wave Interaction on Gyroklystron Guo Jianhua, Yu sheng , Li xiang, Li Hongfu and Liu Shenggang <i>Univ. of Electronic Sci. and Tech. of China</i>
Coffee break	15:15-15:45		
Session 3 High power sources and QO components	15:45	Talk 14	Research on W-band Folded Waveguide BWO Ye Tang, and Jinjun Feng <i>Beijing Vacuum Electronics Research Institute, China</i>
Co-Chairs: Prof. Yong Fan & Dr Richard Wylde	16:00	Talk 15	Particle-in-cell Simulations of Electron-induced Surface Plasmons in Metal Films Jun Zhou, Min Hu, Yaxin Zhang, Weihao Liu, Ping Zhang, and Shenggang Liu <i>Univ. of Electronic Sci. and Tech. of China</i>
	16:15	Talk 16	Characterisation of Terahertz Beam Profile and Propagation through Complex Quasi-Optic Systems J.F. Molloy, M. Naftaly, and R.A. Dudley <i>National Physical Laboratory, UK</i>

	16:30	Talk 17	<p>Extending Diffracted Gaussian Beam Analysis (DGBA) to 3D Asymmetrical QO Systems Junsheng Yu⁽¹⁾, Zejian Lu⁽¹⁾, Liang Xu⁽²⁾, Cheng Yang⁽¹⁾, Hongbin Ge⁽¹⁾, Yuan Yao⁽¹⁾, Xiaoming Liu⁽²⁾, and Xiaodong Chen⁽²⁾ <i>(1) Beijing Univ. of Posts and Telecommunications</i> <i>(2) Queen Mary Univ. of London</i></p>
	16:45	Talk 18	<p>A Broadband Quasi-Optical System for Plasma Radiometer Hongbin Ge⁽¹⁾, Junsheng Yu⁽¹⁾, Zejian Lu⁽¹⁾, Cheng Yang⁽¹⁾, Yuan Yao⁽¹⁾, Shaohua Liu⁽¹⁾, Xiaodong Chen⁽²⁾, and Xiaoming Liu⁽²⁾ <i>(1) Beijing University of Posts and Telecommunications</i> <i>(2) Queen Mary Univ. of London</i></p>
	17:00	Talk 19	<p>Design of a Broadband Corrugated Horn for a W-band Gyro-TWA P. McElhinney, C. R. Donaldson, W. He, L. Zhang, K. Ronald, A. D. R. Phelps and A. W. Cross <i>Univ. of Strathclyde, UK</i></p>
	17:15		Conference photos
	18:00		Reception, Conference Dinner, Ceilidh Dance, Barony Hall

Friday 2nd September, 2011

<p>Session 4 Applications</p> <p>Co-Chairs: Dr Adrian Cross & Prof. Junsheng Yu</p>	08:30	Invited talk	<p>High Power Pulsed EPR at mm-wave Frequencies Graham Smith, Paul Cruickshank, David Bolton, Duncan Robertson, Rob Hunter, Richard Wylde, Hassane El Mkami, Gunnar Reginsson, Olav Schiemann, and David Norman <i>University of St Andrews, UK</i> <i>Thomas Keating Ltd, UK</i></p>
	09:00	Invited talk	<p>Review of Solid state Millimetre Wave and THz Sources Peter Huggard <i>Rutherford Appleton Laboratory</i></p>

	09:30	Keynote talk	SPICA-SAFARI: the FIR Camera and Spectrometer for the SPICA Space Observatory Matt Griffin, on behalf of the SPICA-SAFARI Consortium <i>Cardiff Univ.</i>
	10:00	Talk 23	KIDCAM - Status Report Ken Wood, Simon Doyle, Enzo Pascale, Sam Rowe, Will Grainger, Peter Hargrave, and Philip Mauskopf <i>Cardiff Univ.</i>
	10:15	Talk 24	Study on Multi-channel Frontends for Millimetre-wave/Terahertz Imaging Applications LV Xin, YU Weihua, MOU Jinchao, and YUAN Yong <i>Beijing Institute of Technology, China</i>
Coffee break	10:30-11:00		
Session 5 Applications Co-Chairs: Prof. Yi Huang & Dr Hui Wang	11:00	Keynote talk	Millimetre Wave Outreach in the UK David G Macfarlane, and Duncan A Robertson <i>Univ. of St Andrews, UK</i>
	11:30	Talk 26	Terahertz Time-Domain Spectroscopy and Its Applications Guozhong Zhao <i>Capital Normal Univ., China</i>
	11:45	Talk 27	A Dual-Gregorian Design for a Tri-Reflector Compact Antenna Test Range (CATR) Cheng Yang ⁽¹⁾ , Junsheng Yu ⁽¹⁾ , Zejian Lu ⁽¹⁾ , Hongbin Ge ⁽¹⁾ , Yuan Yao ⁽¹⁾ , Shaohua Liu ⁽¹⁾ , Xiaoming Liu ⁽²⁾ , and Xiaodong Chen ⁽²⁾ <i>(1) Beijing Univ. of Posts and Telecommunications, China</i> <i>(2) Queen Mary Univ. of London</i>
	12:00	Talk 28	Metallic Meshes as Biochemistry Sensor Chip in Terahertz Range Li Binbin, and Shen Jingling <i>Capital Normal Univ., China</i>
	12:15	Talk 29	Measurements of Schottky-Diode Based THz Detectors Hairui Liu ⁽¹⁾ , Peter Huggard ⁽²⁾ , Byron Alderman ⁽²⁾ <i>(1) Beijing Univ. of Posts and Telecommunications, China</i> <i>(2) Rutherford Appleton Laboratory, UK</i>

Lunch	12:30-13:30		Lunch and Poster session 2
Session 6 Applications and components Co-Chairs: Prof. Peter Ade & Prof. Jingling Shen	13:30	Keynote talk	Research Advances in Millimetre Wave Communications Wei Hong, Jixin Chen, Haiming Wang, Chen Yu, Zhe Chen, Fang Zhu, Nianzu Zhang, Guangqi Yang, and Hui Zhang <i>Southeast Univ., China</i>
	14:00	Talk 31	THz Acoustic Optical Modulator and its Application on Free Space Communication Yong Ma, Shimul .C. Saha, Anne. L. Bernassau and David R.S. Cumming <i>Univ. of Glasgow, UK</i>
	14:15	Talk 32	Demystifying Material Parameters for Terahertz Electromagnetic Simulation Elpida Episkopou, Stergios Papantonis, William J. Otter and Stepan Lucyszyn <i>Imperial College London, UK</i>
	14:30	Talk 33	Recent Progress on Ground Penetrating Radar Research and Development Yi Huang, Di Li, Qing Zhang and Asger Erikson <i>The Univ. of Liverpool, UK</i>
	14:45	Talk 34	Millimetre Wave Substrate Integrated MIMO Filtenna Array Chen Yu, Wei Hong, Jixin Chen, Haiming Wang, Zhe Chen, Fang Zhu, Nianzu Zhang, Guangqi Yang, and Hui Zhang <i>Southeast Univ., China</i>
Coffee break	15:00-15:30		
Session 7 Solid state sources and components Co-Chairs: Prof. Jixin Chen & Dr Kevin Ronald	15:30	Keynote talk	Instrumentation for Metrology from MMW to THz T.W. Crowe, B. Foley, S. Durant, D. Koller, K. Hui, and J.L. Hesler, S. Singh, and K. Andersson <i>Virginia Diodes Inc.</i> <i>Agilent Technologies</i>
	16:00	Talk 36	Advances on Polarization Modulator Technology and Methodology for Future Improvements G. Savini ⁽¹⁾ , J. Zhang ⁽²⁾ , P. Ade ⁽²⁾ , and P.D. Mauskopf ⁽²⁾ <i>(1) Univ. College London, UK</i> <i>(2) Cardiff Univ., UK</i>

	16:15	Talk 37	Time Varying Source Conductance in THz Photoconductive Antennas Neda Khiabani, Yi Huang, and Yao-chun Shen <i>The Univ. of Liverpool, UK</i>
	16:30	Talk 38	Transmission Properties of Sub-wavelength Planar Fractals for THz Wavelengths Jin Zhang ⁽¹⁾ , Peter Ade ⁽¹⁾ , Carole Tucker ⁽¹⁾ , Giorgio Savini ⁽²⁾ , Guozhong Zhao ⁽³⁾ , and Nicola Whitehouse ⁽¹⁾ <i>(1) Cardiff Univ., UK</i> <i>(2) Univ. College London, UK</i> <i>(3) Capital Normal Univ., China</i>
	16:45	Talk 39	Dielectric Property Measurement of Gold Nanoparticle Suspensions in the Millimetre Wave Range Using a Quasi-optical Bench Xiaoming Liu, Hui-juan Chen, Bin Yang, Daohui Li, Xiaodong Chen, Dongsheng Wen, Rob Donnan, and Clive Parini <i>Queen Mary Univ. of London, UK</i>
	17:00	Talk 40	Local Oscillator System Development for the ALMA Band 5 Receiver Manju Henry, Hui Wang, Brian Ellison, Byron Alderman, Peter Huggard, Bhushan Billade, Alexey Pavolotsky and Victor Belitsky <i>Rutherford Appleton Laboratory, UK</i> <i>Chalmers Univ. of Technology, Sweden</i>
	17:15	Talk 41	Excess Noise Generation from Solid State Tunable Local Oscillators Hui Wang ⁽¹⁾ , Brian Ellison ⁽¹⁾ , Manju Henry ⁽¹⁾ , Bhushan Billade ⁽²⁾ , Alexey Pavolotsky ⁽²⁾ and Victor Belitsky ⁽²⁾ <i>(1) Rutherford Appleton Laboratory, UK</i> <i>(2) Chalmers University of Technology, Sweden</i>
	17:30	Talk 42	The Design of a 210-245-GHz Sub-Harmonic Mixer Based on RAL's Planar Schottky Diodes Bo Zhang ⁽¹⁾ , Byron Alderman ⁽²⁾ , Zhe Chen ⁽¹⁾ , Yong Fan ⁽¹⁾ , and Xiaofan Yang ⁽¹⁾ <i>(1) Univ. of Electronic Sci. and Tech. of China</i> <i>(2) STFC Rutherford Appleton Laboratory, UK</i>
	17:45	Closing remarks	
	18:00	Glasgow City Hall Reception	

Poster session 1 (Thursday 1st September, 2011)

The exhibition area will be available from 8:30 on 1st September

Poster 1	<p>Investigation of 220GHz Clinotron HF Structure Dapeng Ren, Jinjun Feng <i>Beijing Vacuum Electronics Research Institute, China</i></p>
Poster 2	<p>Optically Controlled FSS Using Photoconducting switches Hansheng Su, Xiaoming Liu, Daohui Li, Xiaodong Chen and C. G. Parini <i>Queen Mary Univ. of London, UK</i></p>
Poster 3	<p>Terahertz Concise Sine Rectangular Waveguide Bandpass Filter Xiaofan Yang, Yong Fan, Bo Zhang and Xiong Xu <i>Univ. of Electronic Sci. and Tech. of China</i></p>
Poster 4	<p>170GHz High-efficiency Four-Anode Frequency Doubler based on RAL's Varactor Diodes Fuqun Zhong, Bo Zhang, Yong Fan, M.H Zhao, and X.F. Yang <i>Univ. of Electronic Science and Technology of China</i></p>
Poster 5	<p>Design of a 220-GHz Subharmonic Amplitude Shift-Keying Modulator Zhe Chen⁽¹⁾, Bo Zhang⁽¹⁾, Yong Fan⁽¹⁾, Xiaofan Yang⁽¹⁾, and Byron Alderman⁽²⁾ <i>(1) Univ. of Electronic Sci. and Tech. of China</i> <i>(2) STFC Rutherford Appleton Laboratory, UK</i></p>
Poster 6	<p>Three-dimensional Broadband Zone Plate Lens Design Rui Yang^(1,2), Wenxuan Tang⁽¹⁾, and Yang Hao⁽¹⁾ <i>(1) Queen Mary Univ. of London, UK</i> <i>(2) Xidian Univ., China</i></p>
Poster 7	<p>High power laser-driven Terahertz sources at the Central Laser Facility James Green, Daniel Symes and Peter Huggard <i>STFC Rutherford Appleton Laboratory, UK</i></p>
Poster 8	<p>Experiment of THz Transmission through Plasma J. H. Sun^(1,2,3), J. Gallacher⁽²⁾, R. Issac⁽²⁾, Z. X. Huang⁽³⁾, and D. Jaroszynski⁽²⁾ <i>(1) Sci. and Tech. on Electromagnetic Scattering Laboratory, China</i> <i>(2) Univ. of Strathclyde, UK</i> <i>(3) Communication Univ. of China, China</i></p>
Poster 9	<p>The Influence of Josephson Pair Tunnelling on the Sensitivity of an SIS mixer Near the Superconducting Gap Boon-Kok Tan and Ghassan Yassin <i>University of Oxford, UK</i></p>

Poster 10	<p data-bbox="384 203 1034 237">A Novel Sine Waveguide Slow-Wave Structure</p> <p data-bbox="384 241 1342 320">Xiong Xu, Yanyu Wei*, Hairong Yin, Fei Shen, Jin Xu, Wenxiang Wang and Yubin Gong</p> <p data-bbox="384 324 948 358"><i>Univ. of Electronic Sci. and Tech. of China</i></p>
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Poster session 2 (Friday 2nd September, 2011)

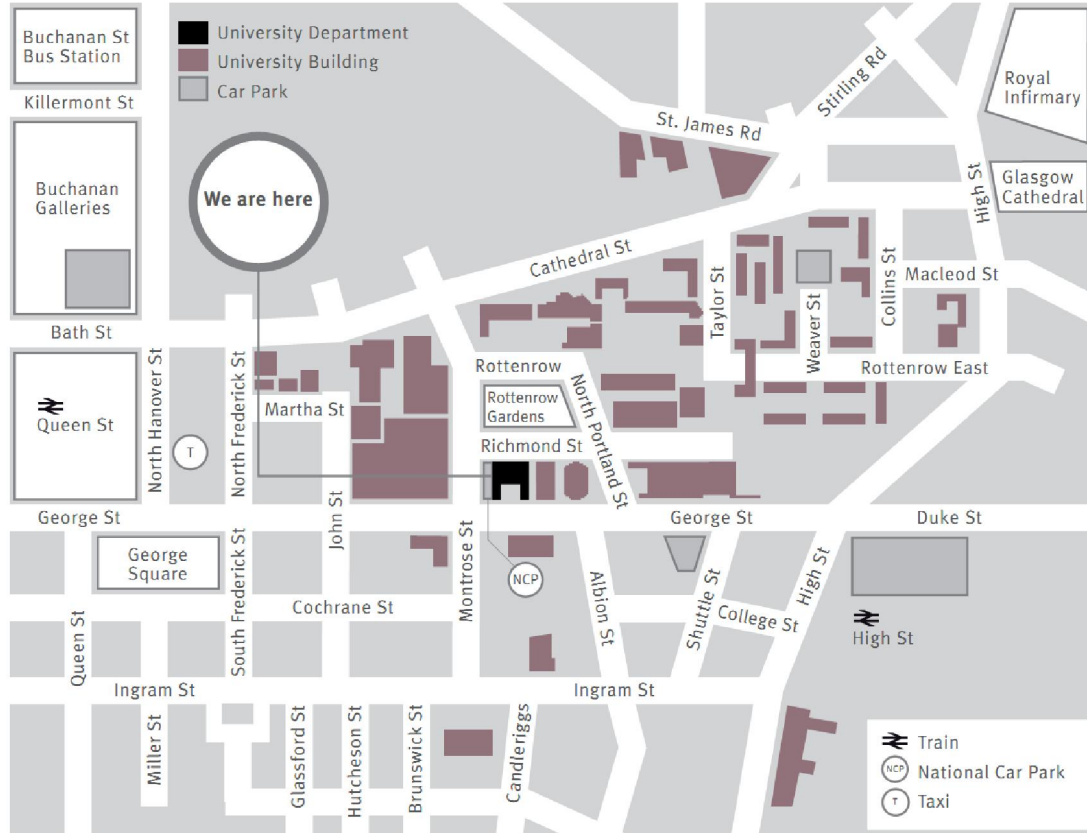
The exhibition area will be available from 8:30 on 2nd September

Poster 11	<p>Numerical Simulations of Intense Charged-particle Beam Propagation in a Dielectric Rectangular Waveguide Jie Xu <i>Univ. of Electronic Sci. and Tech. of China</i></p>
Poster 12	<p>Efficiency Enhanced Fast-wave Amplifiers for Terahertz Applications K. Matheson⁽¹⁾, K. Ronald⁽¹⁾, A. R. Young⁽¹⁾, A. D. R. Phelps⁽¹⁾, A. W. Cross⁽¹⁾ and A. V. Savilov⁽²⁾ <i>(1) Univ. of Strathclyde, UK</i> <i>(2) Institute of Applied Physics, Russia</i></p>
Poster 13	<p>A W-band gyrotron traveling wave amplifier W. He, C. R. Donaldson, L. Zhang, A. W. Cross, P. McElhinney, A. D. R. Phelps, and K. Ronald <i>Univ. of Strathclyde, UK</i></p>
Poster 14	<p>Experimental and Numerical Investigations of Auroral Radiation Mechanisms K.M. Gillespie⁽¹⁾, S.L. McConville⁽¹⁾, D.C. Speirs⁽¹⁾, K. Ronald⁽¹⁾, A.D.R. Phelps⁽¹⁾, A.W. Cross⁽¹⁾, C.W. Robertson⁽¹⁾, C.G. Whyte⁽¹⁾, R.Bingham^(1,2), I. Vorgul⁽³⁾, R.A. Cairns⁽³⁾, W. He⁽¹⁾ and B.J Kellett⁽²⁾ <i>(1) Univ. of Strathclyde, UK</i> <i>(2) STFC, Rutherford Appleton Laboratory, UK</i> <i>(3) Univ. of St Andrews, UK</i></p>
Poster 15	<p>Components Design and Optimization for Gyro-TWA Craig W. Robertson <i>Univ. of Strathclyde, UK</i></p>
Poster 16	<p>Design of W-Band Experimental Set-up to Form TEM Mode in Oversized Coaxial Waveguide A.R. Phipps, I.V. Konoplev, A.W. Cross, C.W. Robertson, A.R. Young, C.G. Whyte, K. Ronald and A.D.R. Phelps <i>Univ. of Strathclyde, UK</i></p>
Poster 17	<p>Numerical Study of Pseudospark Discharged Electron Beam and Propagation for W-Band Radiation D. Li, X. Chen⁽¹⁾, Xiaodong Chen⁽¹⁾, H. Yin⁽²⁾, D. Bowes⁽²⁾, W. He⁽²⁾, A. W. Cross⁽²⁾, A. D. R. Phelps⁽²⁾, K. Ronald⁽²⁾ <i>(1) Queen Mary, Univ. of London, UK</i> <i>(2) Univ. of Strathclyde, UK</i></p>

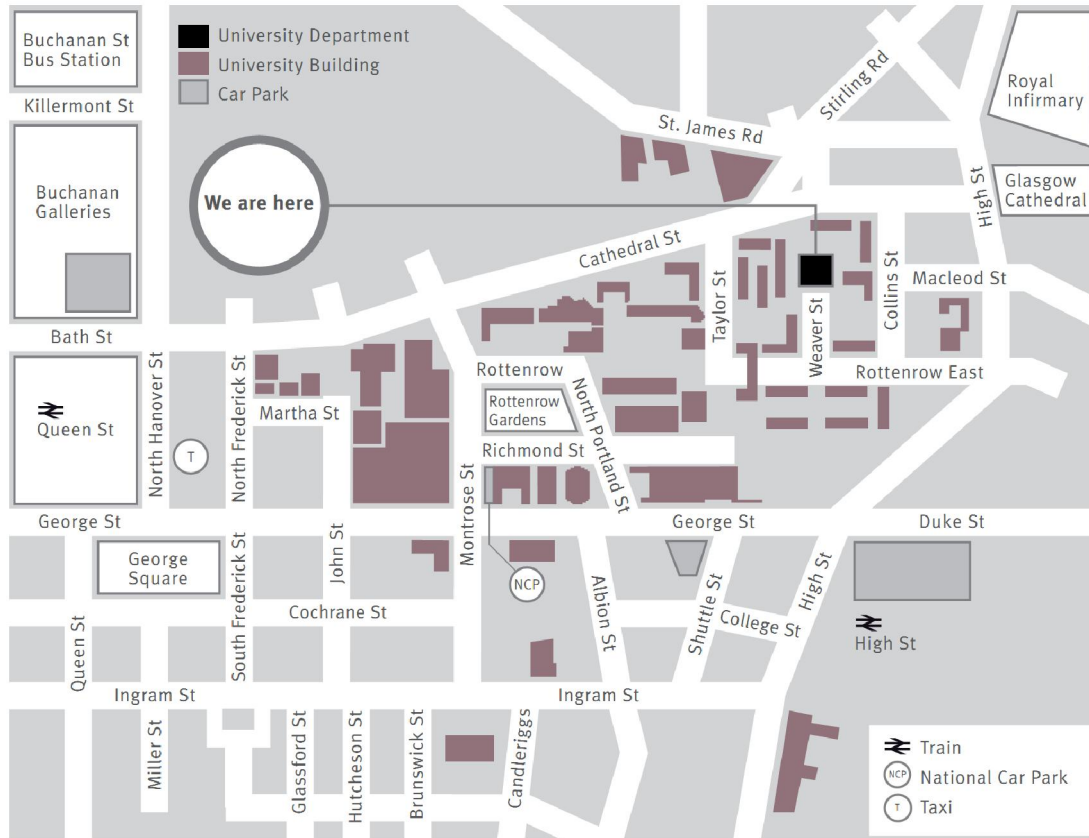
Poster 18	<p>Stray Magnetic Field Effects on the Operation of the ITER Electron Cyclotron System</p> <p>F. Li⁽¹⁾, I. Gr. Pagonakis⁽²⁾, S. Alberti⁽¹⁾ and J. –Ph. Hogge⁽¹⁾ <i>(1) Ecole Polytechnique Fédérale de Lausanne, Switzerland</i> <i>(2) Karlsruhe Institute of Technology, Germany</i></p>
Poster 19	<p>High-Power Free-Electron Masers Utilising 2D – 1D Bragg Lasing Cavities</p> <p>P. MacInnes, I. V. Konoplev, A. W. Cross, W. He, K. Ronald, C. R. Whyte, C. W. Robertson and A. D. R Phelps <i>Univ. of Strathclyde, UK</i></p>
Poster 20	<p>The design of a 230GHz unilateral finline SIS mixer</p> <p>Yangjun Zhou, Paul Grimes, Ghassan Yassin and Jamie Leech <i>University of Oxford, UK</i></p>

Maps

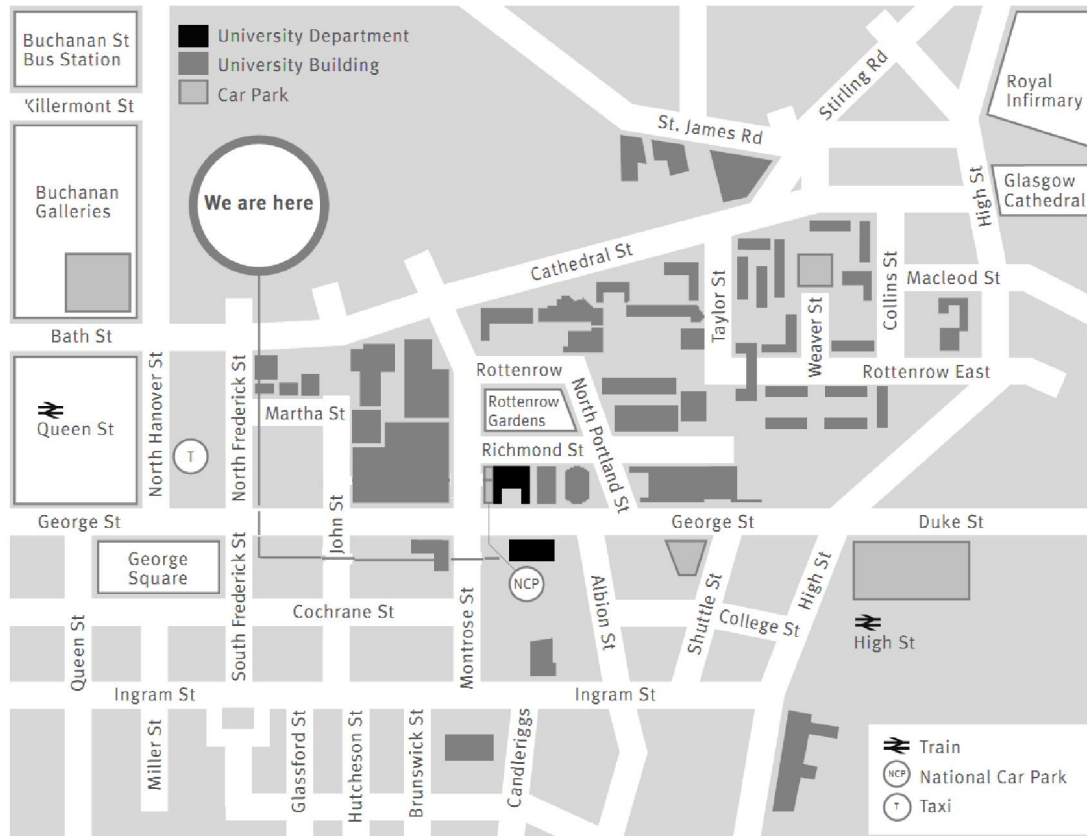
The conference will take place at the McCance building, University of Strathclyde.
The entrance is on the north side of the building.



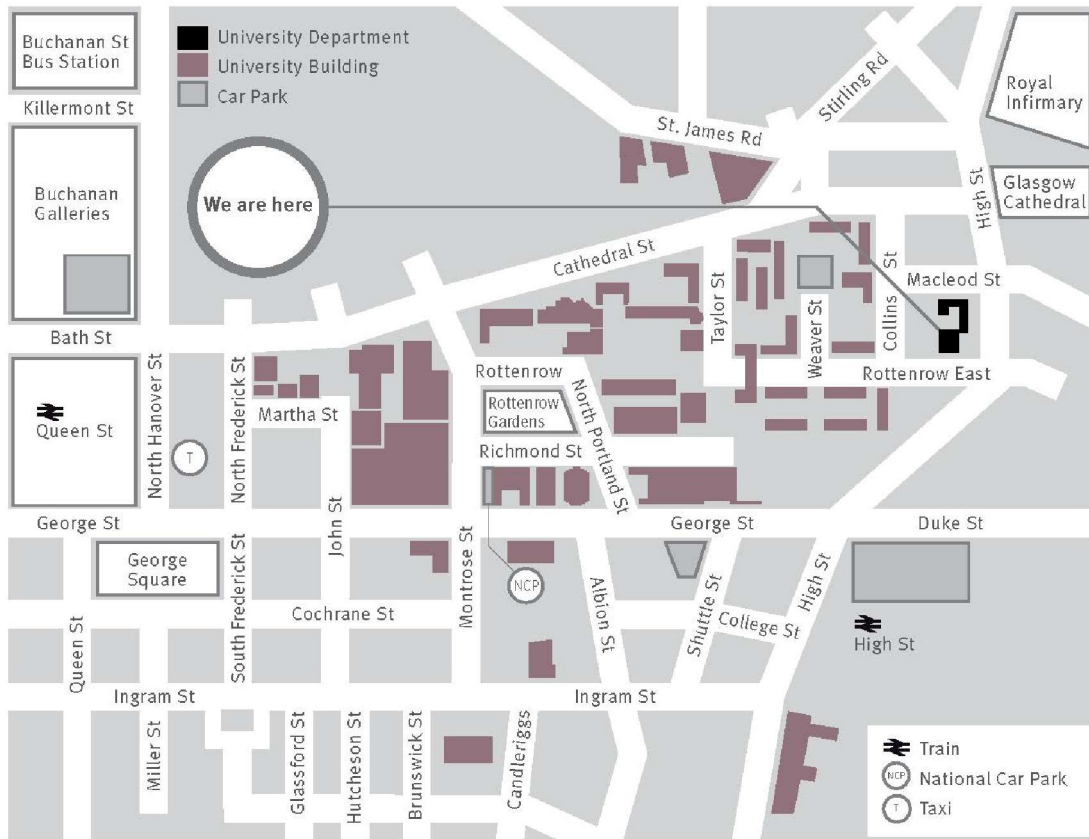
The Campus Village of the University of Strathclyde is within 100 metres of the McCance building. The entrance is on the north side of the building.



The Premier Inn Glasgow City Centre (George Square) is just at the corner. The entrance is on the north side of the building.



The conference dinner will be held at 6:00pm on Thursday, 1st September in the magnificent Barony Hall. An after-dinner Ceilidh dance session will be held in the building. It is about 8 minutes walk from the McCance building. The entrance is on the east side of the building.



A civic hospitality will be held in Glasgow City Chambers at 6:00pm on Friday, 2nd September. It is about 5 minutes walk from the McCance building.



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