Institution: Coventry University

Unit of Assessment: 10

a. Overview

There are two main research strands: **Magnetohydrodynamics (MHD)** and **Statistical Physics**. The Unit has a vibrant research environment with **17** staff currently supervising **18** PhD students and postdocs, and a stream of long-term visitors, many world-leaders in their fields. The overall team has doubled in size since 2008 to exceed the critical mass quantitatively identified in [**RK2**]. The nine researchers returned to this UoA represent a 29% increase over RAE2008. Co-location promotes scientific cooperation between the two strands. Further University investment is planned to commence in 2014, including for PhD students and postdocs, reflecting the continued thematic and strategic importance of the Mathematical Sciences.

b. Research strategy

The Unit blends curiosity-driven, fundamental science with impact-generating, cross-disciplinary research. Four of the nine staff submitted are early-career researchers (ECRs) representing long-term investment in the future of the Unit. The strategy is to balance senior staff and ECRs with commensurate numbers of PhD students, strengthened by a large number of funded visitors to ensure vibrancy and sustainability. The research environment is further enhanced through funded partnerships with leading international universities, including co-tutelle PhD supervisions, the *International Doctoral College on the Statistical Physics of Complex Systems* with Leipzig, Lorraine and Lviv, as well as the Ilmenau *Doctoral Research Training Group on Lorentz Force Velocimetry*.

Magnetohydrodynamics Achievements: The **MHD** group (**Molokov**, **Pothérat**, **Priede**, **Pringle**, **Teaca** with experimental input from Pedcenko) has a strong reputation in the field of liquid-metal MHD flows. More than half of the outputs submitted have been published in *J. Fluid Mech*. and *Physical Review Letters (PRL)*. The group's achievements focus on four themes:

i) *Flows in static magnetic fields* (**Molokov, Priede**, **Pothérat**): **Priede** and **Molokov** working with Kinet and Knaepen (ULB, Brussels), studied linear stability and transition to turbulence in MHD flows in rectangular ducts. This is important for fusion reactor blankets. The main feature of these flows is that part or all of the volumetric flux is carried by thin, high-speed jets. **Priede** and **Molokov** [**JP4**], carried out the first linear stability analysis of Hunt's flow. The intense wall-jets in this flow were found to be unstable to 3D disturbances of four different symmetries. For weak jets [**SM4**] the flow is more stable. Direct Numerical Simulation (DNS) led to the discovery of a new type of instability/transition of flows in a duct with thin electrically conducting walls, involving mixing of the fluid between the core of the flow and near-wall region [**SM1**]. **Pothérat** focused on DNS of MHD turbulence. He was able to resolve fully these flows using a spectral decomposition in eigenmodes of the linear part of the governing equations (funded by the Deutsche Forschungsgemeinschaft (DFG) and Leverhulme Trust (grant total £133k)). This entirely new method has provided Kolmogorov-style laws for the smallest scales of MHD turbulence and paves the way for the simulation of channel and duct MHD flows in currently inaccessible nuclear fusion-relevant regimes [**AP2**]. With Gelfgat (Tel Aviv) **Molokov** studied the linear stability of quasi-two-dimensional (Q2D) buoyant convection in a box in a transverse magnetic field [**SM3**]. In this paper, he has shown that convective flow and instabilities strongly depend on the aspect ratio of the box and on the Hartmann number, and that several different types of instability exist.

ii) *Turbulence and transition* (**Pothérat**, **Pringle**, **Teaca**): **Pothérat** has been working on the transition between 2D and 3D turbulence. He built a modular experimental platform where the dimensionality of electrically driven liquid metal flows is controlled by an external magnetic field (DFG grant, total £136k). He has discovered two distinct mechanisms governing the 2D-3D transition [**AP1**], thus solving a long-standing problem of fundamental physics, with major implications for processes involving mixing and heat or mass transfer. This high profile achievement attracted long-term support from the Grenoble High Magnetic Field Laboratory (estimated value €30k/year), and a new co-tutelle PhD student based there. In driving this joint numerical and experimental research effort, together with the DNS mentioned above [**AP2**], **Pothérat** has contributed significantly to the emergence of a coherent understanding of Low *Rm* MHD turbulence. **Pothérat** also unveiled numerically the mechanisms by which the flow past a cantilever generates a row of hairpin vortices interwoven with the secondary Ω-vortices. This resolved a long-standing controversy [**AP3**]. He further showed that this wake structure progressively reverted to a classical von Kármán vortex street under the influence of an increasingly high magnetic field [**AP4**]. **Pringle** has worked on fully nonlinear approaches to turbulence transition modelling. He has performed high profile work on the problem of describing transition to turbulence in terms of exact solutions of the underlying equations [**CP1**]. His work incorporating nonlinearity into the classical problem of transient growth has been field-leading [**CP2**]. Furthermore, the work has also demonstrated how these techniques can be applied to wider problems. **Teaca** was the first to analyse the locality and universality of the nonlinear interactions in the framework of gyro-kinetic plasma turbulence [**BT3**]. This paper is important in the field of controlled fusion research, as it provides knowledge of the fundamental nature of nonlinear interactions that govern the transport problem in magnetized plasmas. A more extensive investigation into the problem of locality was done for MHD turbulence [**BT2**]. Together with the study of energy redistribution in anisotropic MHD turbulence [**BT1**], **Teaca**'s research offers insight into the problem of nonlinear energy transport and identifies the route to be taken in the development of physical models.

iii) *Fundamentals of Electromagnetic Processing of Materials (EPM)* (**Molokov, Priede** with Pedcenko): In collaboration with Helmholtz Research Centre Dresden-Rossenforf (HZDR), Germany, **Priede** has developed and patented two flowmeters for liquid metals (**case study 10.1**). One of the flowmeters consists of a single, freely rotating permanent magnet which is magnetized perpendicularly to the axle on which it is mounted [**JP3**]. When such a magnet is placed beside the tube carrying liquid metal flow, it spins with a frequency that depends directly on the flow rate but *not* on the electrical conductivity of the metal or the magnet strength. The design of this flowmeter is based on the theory describing the force and torque produced by eddy currents on slowly rotating and translating magnetic dipoles [**JP3**]. **Priede** developed a theory for the shape oscillations of liquid metal drops in high magnetic fields [**JP2**]. This theory provides the basis for methods of measuring surface tension, viscosity and electrical conductivity of liquid metals using the oscillating drop technique. **Molokov** with El (Loughborough) and Lukyanov (Reading) studied instabilities in aluminium reduction cells - a two-fluid system with normal current and magnetic field [**SM2**]. They showed that there are only two types of instabilities. One is classical, as proposed by *Sele* in 1977, and was shown to lead only to a weak instability. It cannot explain instabilities in real cells. The second is very strong, originating at the vertical boundary of the cell. **Molokov, Priede**, Pedcenko in collaboration with Thomas (Warwick) developed a unique experimental facility, funded by Carbon Trust UK and Rio Tinto Alcan (£282k). The facility was able to generate, for the first time, an instability dynamically similar to that in the real cells (**case study 10.1**).

iv) *Helical Magnetorotational Instability (HMRI)*: **Priede** worked on HMRI, which is thought to be responsible for the fast formation of stars in certain types of accretion discs. Using the theory of absolute instability, he showed rigorously that HMRI can be self-sustained and thus experimentally observable without external excitation [**JP1**]. This theory was instrumental in the first successful identification of HMRI in the PROMISE (Potsdam-ROssendorf Magnetic InStability Experiment) experiment carried out at the HZDR, Germany, in 2009.

Statistical Physics Achievements: The **Statistical Physics** group comprises **Fytas, Kenna, Platini** and **Weigel**, as well as Foster (newly appointed Head of Department), Izmailian (Marie Curie International Incoming Fellow), von Ferber and Yavors'kii. In total, 50% of the group's submitted outputs have been published in *EPL* or *PRL*. The group's achievements lie within four themes:

i) *Critical phenomena (involving the entire group)*: **Fytas**, with Berker (MIT), Malakis (Athens) and Martin-Mayor (Madrid), solved problems in quenched, random systems e.g., universality in the 3D random-field Ising model - a question which had defied theorists for 40 years [**NF1**]. **Fytas** and **Kenna**, with Ruiz-Lorenzo (Extremadura) resolved separate controversies about critical effects of impurities by combinations of new theoretical insights and numerics. **Kenna** studied realistic, impure systems with long-range interactions under constraints as well as critical phenomena on scale-free networks with Hsu (Mainz), Folk (Linz) and Holovatch (Lviv) [**RK1**]. He authored papers on non-equilibrium transitions as well as the black-hole geometrothermodynamics with Blythe (Edinburgh), Johnston (Heriot Watt) and Janke (Leipzig). **Kenna** challenged the existing paradigm regarding scaling in high dimensions. He showed, with Berche (Lorraine) and Walter (Leiden/Leuven), that the fundamental hyperscaling relation, which was believed to hold only below the upper critical dimension, in fact holds in high dimensions if length scales and boundary effects are properly accounted for [**RK3**]. This work continues with support from M.E. Fisher (Maryland). With Izmailian, **Kenna** studied universal and size effects in spin models and dimer models as well as non-local phenomena, magnetic films, conformal field theory, and exactly solvable models.

Platini's work is focused on non-equilibrium quantum spin chains. In the context of the Jarzynski and Crooks equalities, his research includes the study of fluctuations of integrable and non-integrable isolated systems [**TP1**]. In addition, his research as part of the national French project on open quantum systems led to an exact description of their stationary states [**TP2**]. This work was applied to Fourier's law in the framework of quantum transport phenomena. J.L. Lebowitz identified the derivation of this law as "a challenge to theorists". **Platini** has considered experimentally realisable optical lattices and derived Fourier's law for dynamical disordered systems. His paper [**TP2**] was selected by IOP's editors to appear in a special collection (IOPselect) because of its novelty, quality, significance and impact. **Platini**'s research on the characterisation of non-equilibrium steady states has led to a measure of the violation of detailed balance and exact results for some of the most important models in the field. Novel techniques developed by **Weigel** and large-scale simulations on HPC facilities led to an understanding of the scaling of defect energies in 2D XY spin glasses, and the physics of vector spin glasses on hypercubic lattices. In collaboration with Moore FRS, **Weigel** presented a comprehensive analysis of the physics of the one-dimensional vector spin glass with long-range interactions [**MW4**]. **Weigel**, together with Stevenson (Cambridge), has shown the applicability of Stochastic Loewner Evolution (the subject of two recent Fields medal awards) to systems with random disorder. **Weigel**, with Schilling (Mainz), presented exact results on packing of non-spherical bodies relevant to fields including structural glasses, granular material and plastic crystals [**MW3**].

ii) Polymers and bio-physics (**Fytas** and **Platini**, with support from von Ferber and Foster)*:* **Platini**, with colleagues in Virginia Tech and Virginia Bioinformatics Institute, developed new analytical approaches to stochastic modelling of gene expression [**TP3**]. **Fytas**'s research into linear multi-block copolymers has led to new insights into the phase behaviour of macromolecular complexes of biological interest.

iii) Computational physics (**Fytas, Weigel** with support from Yavors'kii): **Fytas** and **Weigel** have solved optimisation problems in disordered magnetic systems by using techniques from theoretical computer science. They have addressed long-standing problems of universality with respect to the coupling distribution in the random-field Ising model [**NF1**] as well as spin-chirality decoupling in planar spin glasses. This novel approach enables them, and others, to undertake sophisticated, experimentally relevant computations that had previously not been possible. In a series of pioneering works at the interface of physics and high-performance computing, **Weigel** has showed how graphics processing units (GPUs) can be used as general computational devices for simulations of lattice-spin systems, resulting in up to 1000-fold speed increases compared to CPUs. **Weigel** has pointed out flaws in the conventional analysis of simulation data and proposed a correct scheme for a wide range of problems in computer simulations [**MW1**]. This paper was featured in a *Synopsis* article of the American Physical Society in 2009.

iv) Sociophysics and humanities (**Kenna, Platini, Weigel** with support from von Ferber): Papers by **Kenna** and Berche (Lorraine) on the relationship between quality and quantity in research, which defined for the first time 'critical mass' in research groups, has attracted much attention in academic and non-academic circles ([**RK2**] and **case study 10.2**). **Kenna** has pioneered an application to the humanities, through the first ever quantitative study of medieval epic literature [**RK4**]. This Leverhulme-supported research (£86k) also gained enormous interest in the media and public at large. Inside a year, article [**RK4**] became the most downloaded in the history of *EPL*, the flagship journal of the European Physical Society (over 8,500 downloads currently). Both [**RK2**] and [**RK4**] were featured as *"Best of" EPL*, placing them in the top 5% of papers published in the European Physical Society's flagship journal. **Weigel** completed work on goal distributions in ball sports, explaining distributions from an elegant, exactly solvable microscopic model which uses an element of self-affirmation to account for the observed deviations from Poisson distributions [**MW2**]. This research was covered by a wide range of media, including Nature News, the BBC, Austrian and German television stations.

Future Strategy: The aim is to enhance further the Unit's reputation in MHD, fluid dynamics and statistical physics, aligning with priority areas of strategic national and international funders. For example: addressing priorities in the EU's Horizon 2020, in particular smart transport and innovative societies; EPSRC priorities in complex fluids, complexity science, soft matter and mathematics in ICT; and NERC priorities of using mathematical expertise to enhance environmental science. The Unit's aims will be achieved by the following strategy:

- Establish an *International Doctoral Training College (IDTC) in Statistical Physics and Fluid Dynamics* with University investment. The Unit will continue to participate in the EU-funded International Doctoral Colleges with Leipzig, Lorraine, Lviv, and TU Ilmenau. It will also increase its research collaborations with leading groups, through University investment and external funds. This includes growing co-tutelle PhD supervision with the leading institutions with whom we have long-term research collaborations, such as Bangalore, Grenoble, Leipzig, Monash, Nancy and Yerevan.
- The statistical physics group will continue to expand into cross-disciplinary research in sociology, humanities, urban development and public transport, and scientific computing, whilst maintaining its research into classical and quantum critical phenomena.
- The MHD group (**Molokov**, **Priede**, **Teaca,** with input from Pedcenko) will focus on theoretical studies of instabilities, transition and turbulence in liquid metals as a major theme of research. The group will further develop and use asymptotic methods, new quasi-two-dimensional flow models, and DNS tools. Fundamental studies of flows in ducts, convection and Alfvén waves in a strong magnetic field will be performed in collaboration with Karlsruhe Institute of Technology (KIT) and Culham Centre for Fusion Energy (£69k already obtained), both members of EURATOM Association. These theoretical studies will be accompanied by a corresponding experimental programme. Our newly-funded 8T superconducting magnet is the largest entirely dedicated to MHD experiments in the UK. It will serve as a platform to further develop collaborations in the fields of MHD, geophysics, material processing, with potential application to medical fluid mechanics. The group's theoretical and experimental programme on studies of MHD instabilities in aluminium reduction cells will continue involving topics of major fundamental and applied significance. The work will be performed in collaboration with Rio Tinto Alcan, which funds research on a rolling basis (£132k to date). **Molokov** (with Pedcenko) will undertake a series of experiments on transparent fluids to visualise Q2D convection patterns in the related Hele-Shaw flows.
- Boosted by the IDTC, research in fluid dynamics will build on current strengths, international partnerships and new appointments to broaden the group's expertise to problems including MHD (**Priede**, **Pothérat**, **Teaca**), geophysical flows (Lawler, submitted to UoA7, **Pothérat**), rotating flows (**Pothérat**, **Priede**), plasmas (**Teaca**), instabilities (**Priede**, **Pringle**) and turbulence (**Pothérat**, **Priede**, **Pringle**, **Teaca**). Methods will combine theoretical, numerical and experimental approaches, with in particular two major on-going experimental programs: the first, on turbulence, is based at the Grenoble High Magnetic Field Laboratory (GHMFL). The second is the only UK experiment dedicated to simulation of the liquid core of the Earth and reproduces rotating magneto-convection in a transparent electrolyte placed inside Coventry's 8T magnet (work started in 2012, supported by Leverhulme Trust, Royal Society and Royal Academy of Engineering with funding of £105k).
- A University initiative will combine expertise in hydrology (Lawler, UoA7) and fluid dynamics led by **Pothérat** to drive high-quality research on river dynamics.

c. People, including:

i. Staffing strategy and staff development

Since RAE2008, the University has invested in new mathematical-sciences researchers (**Fytas, Platini, Pringle, Teaca, Weigel,** and Yavors'kii). Foster has been newly appointed as Head of the associated Department of Mathematics and Physics. In addition, the Unit is hosting a Marie Curie International Incoming Fellow (Izmailian) for two years.

Research staff are given substantially reduced teaching and administrative loads, typically with two contact hours per week plus supervision of two final-year projects. All submitted staff are on permanent, full-time contracts. The submission comprises three Professors, two Readers and four ECRs. Regular meetings ensure all staff contribute to decision-making in a collegiate manner. These meetings help staff to further develop their careers by providing a forum to discuss research directions and external funding opportunities and applications.

Coventry University is a Diversity Champion in **Stonewall** and has received the **Athena SWAN** bronze award. It was also awarded the European HR Excellence in Research Award in 2013. All staff receive equality and diversity training. **Equality** is monitored through pay audits. Most recently the gender pay gap for academic staff at Coventry was 2.81% against 13.5% for the HE Sector (ECU, 2010). The University has relevant policies in areas including: flexible working; paternity schemes; child care; on-site nursery; job share. It uses the 19 agreed measures of progress drawn from CROS, PIRLS and HESA to implement the principles of the **Concordat** to support researcher career development. These are overseen by the Research Concordat Committee, which includes staff from across the research career spectrum. Priorities include a career development web portal and career progression pathway. Biannual reviews are used to support performance and career development needs, and to agree objectives. Research staff development is supported by a CPD programme which offers workshops and training on career and research specific skills, including research management, leadership and media skills. Staff and PhD students can also access the Epigeum on-line training research modules. ECRs are mentored by senior colleagues, and given support in areas such as writing grant applications and PhD supervision, e.g. **Teaca** is mentored by **Molokov**. PhD Supervisors initially join an experienced team and are supported to become Directors of Studies.

An open promotion scheme operates on the basis of published performance and progression criteria linked to the biannual reviews. A Readership and Professorial Conferment Committee considers senior promotions, for which external peer review is required. Promotion is based solely on meeting criteria, there are no budgetary limits or other constraints. **Kenna** and **Pothérat** were promoted to Chairs in 2012 and 2013 respectively, and von Ferber and **Weigel** to Reader in 2013.

The Unit provides individual support (approximately £3k per year) which facilitates conference participation and research visits. University funding, such as the Research Sabbatical Fellowships and Visiting Fellowship scheme, supports the development of new areas of enquiry and collaboration, e.g. **Kenna** and **Pothérat** both benefitted from taking research sabbaticals. In addition, to support ongoing collaboration, **Pothérat** spends five months per year in Grenoble, **Weigel** spends around two months per year in Mainz, **Kenna** spends about one month per year in Lorraine, and **Molokov** spends two weeks per year in Riga.

The Unit runs a weekly seminar series, and hosts seminars from the Institute of Mathematics and its Applications (IMA). Notable speakers included Professor Sir Roger Penrose FRS, Professor Berker (MIT), Professor Budd (Vice President of the IMA), Professor Cardy FRS, Professor Moore FRS, Professor Mullin FRS, and Professor Stewart FRS. The Unit actively encourages visits from academics and scholars (averaging two person years of visits per year) funded by grants, including three Marie Curie International Research Staff Exchange Schemes (IRSES) and University-funded International Visiting Professorships. This exchange also extends to postgraduate students and we have hosted eight PhD students from Leipzig, Nancy, Ilmenau and Lviv under Doctoral College and similar schemes (see section (e)).

ii. Research students

The University offers studentships at the same financial level as those from the EPSRC. The Unit offers additional funding, including internships and overseas fees, to attract the best international applicants to Coventry. Six students have been supported by these schemes, and in addition one has been supported by the EPSRC, two by the Leverhulme Trust and three by the Deutsche Forschungsgemeinschaft. The Unit has hosted PhD students through initiatives including COST, IRSES and two International Doctoral Colleges, typically for periods of three months. The Unit has a co-tutelle, split-site PhD agreement with Université de Lorraine, France. Similar co-tutelle agreements are currently being established with Grenoble, Monash (Melbourne), Leipzig and Lviv. The Unit is currently negotiating three funded PhD studentships from the National Engineering Laboratory (NEL) for collaborative research.

Since 2008, the University has built a robust PhD-support programme. This starts with a formal induction process, which defines the support that students will receive and the expectations placed on their supervisors. Each student develops an initial research plan and ongoing progress is monitored at annual Review Panels at which students present their research and receive feedback. To ensure effective communication with supervisors and to facilitate their integration into the Unit and academia, research students are co-located with staff. Students are seen as equal members of the research team, attending meetings and receiving training. Students complete 40 taught credits including an 'Introduction to Research' module. Taught modules, cohort performance, student feedback and action plans are reviewed by a Research Committee which includes student members. Independent advocacy is provided by a Faculty Postgraduate Research Tutor. Research students are encouraged to develop further by participation in summer/winter-schools and international conferences, including for example, the Wroclaw Winter School on Statistical Physics, the Ilmenau Summer School on MHD, Warwick Mathematics Institute's Winter School and the School for Complex Systems Modelling and Networks at MIT.

d. Income, infrastructure and facilities

Since 2008 the University has invested £4M into research in the mathematical sciences, ten times its RAE2008 funding. The Unit has almost tripled its income per FTE per year since RAE2008. Amongst its successes are: four Leverhulme grants (£385k); three Marie Curie International Research Staff Exchange Schemes (£0.8M), including two which we lead; one Marie Curie FP7 International Incoming Fellowship grant (£236k), and one EPSRC/Culham grant (£69k).

The Unit has been strengthened further by a £530k investment in its MHD laboratory with three major facilities. The first is an 8T superconducting large bore magnet, which is one of the most powerful magnets used for MHD research in the world. The magnet will be used for fundamental studies of MHD convection and turbulence, geophysical flows, flows in elements of fusion reactor blankets (duct flows) and divertors (free surface flows). It will also be made available for collaborative work with academic and industrial partners. The second is an experimental facility to study the Earth's liquid metal core, initially funded by the Leverhulme Trust (£92k). On project completion, this will become the only platform available to the UK geophysics community where further aspects of Earth-core dynamics can be experimentally studied. The third unique facility is for experimental investigation of MHD instabilities in aluminium reduction cells funded by Carbon Trust (UK) and Rio Tinto Alcan (RTA, £180k). RTA funds work with this facility on a rolling basis.

Research income generation is supported by the University's Business Development Support Office. The Office provides proactive support, and offers development workshops, consultation on bidding for funding, expertise in knowledge transfer, Intellectual Property advice and support to exploit research commercially.

The Unit is the main user of the University's extensive HPC facilities. An additional £400k investment has recently been made, giving the Unit access to a total of 1900 cores on cluster machines. This investment also included a significant extension to GPU facilities which are heavily used by **Weigel** and co-workers.

In 2012, the University provided the Unit's research team with its own dedicated space. The co-location of individual offices with working spaces for PhD students, emeriti and academic visitors, as well as freely configurable meeting spaces, has created a thriving research hub and an atmosphere conducive to high quality research.

e. Collaboration or contribution to the discipline or research base

Examples of Academic Collaboration: The Unit's research is enhanced by strong links with several world-leading centres. This is realised through: IRSES grants (£0.8M linking to 20 universities from Argentina to Ukraine); an International Incoming Fellowship, a funded International *Doctoral College on the Statistical Physics of Complex Systems* with Leipzig, Lorraine and Lviv; a *Doctoral Research Training Group on Lorentz Force Velocimetry* at Ilmenau; formal co-tutelle agreements with Lorraine and Grenoble-INP; as well as through exchange grants. These agreements result in the Unit hosting up to five senior visiting researchers at any given time.

Fytas works with Berker (MIT) on spin models (with Turkish government funding); with Martin-Mayor (Madrid), Sourlas and Picco (Paris) on random magnets (Spanish government funding); Malakis (Athens) on phase transitions; Theodorakis (ICL) on soft matter; Selke (Aachen) on critical interfacial phenomena. **Kenna** and Izmailian are working with F.Y. Wu (Boston) on integrable models (with FP7 funding); Foster and Pinettes (Cergy) on polymer models, Ruiz-Lorenzo (Extremadura) on critical phenomena (FP7); Berche (Lorraine) on scaling in high dimensions (Franco-German funds); Berche, von Ferber, Holovatch and Mryglod (Lviv) on scientometrics and models on networks (FP7). **Molokov** collaborates with the Culham Centre for Fusion Energy and with Bühler in Karlsruhe on MHD. **Platini** works with Kulkarni (Boston) on gene expression, Karevski (Lorraine) on open quantum systems, Dorosz (Luxembourg) on hard spheres. **Pothérat** works with Thess and Lüdtke (Ilmenau) on free surface liquid metal MHD and Lorentz force velocimetry (DFG); Botton (INSA Lyon) on acoustic streaming and on turbulence with Davoust and Debray (Grenoble INP & CNRS). **Priede** works with Gerberth at HZDR and in a partnership with the German Liquid Metal Technology project 2013-2016. **Teaca** is associated with the Max-Planck/Princeton Center for Plasma Physics and works with Jenko (IPP Garching) on plasma physics, leading a project on gyrokinetic turbulence in collaboration with Brunner (EPF Lausanne). **Weigel** works with Moore (Manchester) on spin glasses, with Janke (Leipzig) on explosive percolation problems, with Puri (Delhi) on phase ordering kinetics and ageing, and with Katzgraber (Texas A&M) on GPU simulations of spin glasses (funded by FP7).

Examples of Industrial Collaboration: The Unit collaborates with research users including Corus Technology BV (£105k), the HZDR (£22k), Saint-Gobain (in-kind £60k) as well as Carbon Trust and Rio Tinto Alcan (£282k). Thompson Reuters (which owns the ISI Web of Science), and the Institute of Physics, have provided data for analysis by a Coventry-led consortium. Research on transport networks has resulted in a collaboration with the West Midlands public transit operator, Centro. Research on high-performance computing led to contacts with NVIDIA and AMD (GPU vendors), and grants from Volkswagen Foundation to fund two international conferences.

Examples of Hosting Conferences and Workshops: The MHD group has been organising national and international events at Coventry, attended by leading scientists in the field, since being established in 1998. For example, it organised the UK MHD meeting in 2009. The Unit has been selected to host the EUROMECH 561 Colloquium on Dimensionality in Turbulence in 2014, chaired by **Pothérat**, van Heijst (Eindhoven) and Plihon (ENS-Lyon). **Weigel** organised a symposium on energy landscapes at the 2010 spring meeting of the German Physical Society (DPG), and two international Symposia on Computer Simulations on GPU in 2011 and 2013. Also in 2013 the statistical physics group ran two University-funded workshops, including one on applying statistical physics techniques to humanities, under the title ‘Maths Meets Myths’. This inspired a similar workshop, ‘Physics meets Humanities’, in Ukraine. A Coventry-led consortium, including Oxford and UCLA, will seek funding to continue this pioneering work. The Unit will continue to attract distinguished visitors and host high profile conferences, for example, the UK MHD Meeting. In April 2014, Coventry will host the 39th Middle European Cooperation on Statistical Physics (MECO), with circa 150 participants. This will be the first time a UK university has been selected to host the conference, marking Coventry’s international significance in the field.

Examples of Invited Presentations: Staff have given many invited presentations since 2008, including at CompPhys10 in Leipzig, plenary talks at Statistical Physics and Low Dimensional Systems in Nancy, the Royal Statistical Society, the StatPhys-2012 conference in Lviv, the Beijing Workshop on Critical Behaviour (each by **Kenna**); the VI Brazilian Meeting on Simulational Physics in Cuiabá 2011, at the meeting on Monte Carlo Algorithms in Melbourne and the Conference on Computational Physics in Moscow 2013 (**Weigel**); invited plenary talks at the two main tri-annual conferences in liquid metal MHD (**Molokov:** EPM-2009, **Pothérat**: PAMIR-2011, EPM-2012). Members regularly give seminars at top-class universities world-wide, including Oxford (**Kenna**), ETH Zurich, Kings College London, Heidelberg, (**Weigel**) Warwick (**Kenna** and **Pothérat**), ETH Zurich, ENS-Lyon, Grenoble-INP, INSA Lyon, Ilmenau, Academica Sinica (**Pothérat**).

Examples of Contribution to Professional Bodies: Molokov and **Kenna** are Fellows of the Institute of Mathematics and its Applications. **Kenna** and **Weigel** are members of the Institute of Physics. **Pothérat** belongs to the Societé Francaise de Physique, European Physical Society and EUROMECH. **Kenna** and **Weigel** are Marie Curie Fellows. **Weigel** is member of the Gutenberg Centre of Excellence at Mainz.

Examples of Journal Editorships: Kenna and von Ferber are on the Editorial Board of Condensed Matter Physics. **Weigel** has acted as Editor for the European Physical Journal Special Topics, and **Molokov** and **Priede** are on the Editorial board for Magnetohydrodynamics.

Examples of Reviewing for Grant Applications and Journals include the EPSRC, the Royal Society, NSF, ERC, as well as American, Chilean, Czech, Dutch, French, German, Israeli, and Romanian funding bodies. Staff review for many journals, including *Phys. Rev. Lett.*, *Physical Review, EPL, Nucl. Phys. B, Scientific Reports, Phys. of Fluids* and the *J. of Fluid Mechanics*.

Examples of Invited Posts: Staff have held invited professorship posts at Université Lorraine, Nancy, France (**Kenna** in 2007, 2008, 2009, 2011), Cergy-Pontoise (**Kenna** 2011), Ilmenau (**Pothérat**, 2013), INSA-Lyon (**Pothérat**, 2011), Université de Grenoble (**Pothérat**, 2013).

Examples of External Examiners/Supervisors: **Weigel** has supervised three postdoctoral fellows since 2008, one of whom is now a Marie Curie fellow at Cambridge, the second a physics Professor in Brazil. **Kenna** is supervising a student in Lviv. External examiner duties for PhD vivas included at Nancy (**Kenna**), Brussels (**Molokov**), Barcelona, Lyon and Melbourne (**Pothérat**).