



## Exploratory Workshop Scheme

Scientific Review Group for Physical and  
Engineering Sciences

Scientific Review Group for the  
Humanities

# ESF Exploratory Workshop on **Maths Meets Myths**

Coventry (England), 10-13 September 2014

Convened by:  
**Ralph Kenna**

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# SCIENTIFIC REPORT

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# 1. Executive summary

In recent years, the *Applied Mathematics Research Centre* at Coventry University has been developing a new, mathematical approach to the analysis of ancient texts. Our first foray into this humanities field focussed on comparative mythology. Our first publications generated enormous interest and impact worldwide, including interviews (e.g., *BBC Radio 4*) and newspaper articles (e.g., in the *New York Times*). One paper has been downloaded over 12,000 times so far, a record for Europe's flagship physics journal. In the past couple of years, we have become aware of excellent new work taking place around the world. A significant amount of data have been gathered and we think that these are amenable to new mathematical/statistical/computational approaches. On the latter side, there are new phylogenetic investigations of folktales, quantitative investigations of ancient annals and other fascinating approaches.

Our aim, therefore, is to deepen and broaden quantitative investigations into mythology, annals, folktales and other resources from the past. To do this, we need to learn from, and collaborate with experts nationally and internationally. We need to bring together people who understand humanities and people who understand the new quantitative approaches.

The *European Science Foundation Exploratory Workshop* was designed to do precisely that. The aim was to bring together natural scientists and humanities scholars to explore the applicability of mathematical sciences to current and past cultures. In particular, we wish to explore quantitative modelling for the understanding of textual narratives. Although for us, mathematics and mythology are where we started (hence the title of the workshop), we also wish to explore how to broaden the scope of the project to other disciplines if that is possible.

An international team was assembled for the Workshop, including physicists, applied mathematicians, complexity theorists, computer scientists, anthropologists, psychologists, authors, film makers, artists, historians, medievalists, and other humanities scholars. A focus of the workshop was to generate momentum towards collaboration and obtaining further funding from a suitable source. The aim of such funding will be to support a large scale project over the coming years.

The meeting was held at the Technology Park of Coventry University in England over 3 days. We had 23 participants from 10 countries plus the ESF representative. One person from Ireland pulled out at the last minute and one from England was replaced by another on the second day (so the actual total number of distinct individuals participating was 24). Thus we were able to achieve the ESF conditions that no more than 25% of participants were from a given country. In fact we put a lot of effort into ensuring that the ESF boundary conditions were met. The split into science and humanities was 43:57 and the male:female ratio was also 57:43.

We had 19 presentations in all, 8 from the scientific side and 11 from the humanities. The remit was for the scientists to display their wares (quantitative tools) and the humanities people to present issues which may be susceptible to quantitative approaches. Participants were asked to try to keep their 25-minute talks as non-technical as possible as about half the audience was from the "other side". The idea was that this may aid the promotion of cooperation and collaboration. Questions were invited at the ends of each presentation. In addition we had two long discussion sessions where everybody contributed plus extensive discussions in more relaxed social settings.

All participants embraced the spirit and intentions of the Workshop and information and ideas flowed freely. Discussions were creative and extremely interesting. The main scientific tools presented included from the fields of mathematics & physics (network theory), biology (phylogenetics), psychology, anthropology, complexity science, statistics and computer science. The humanities talks included presentations on classic approaches to comparative mythology and epics from the Anglo-Saxon, Icelandic, Irish, Mongolian, Japanese and native

American traditions. Sources and open questions on medieval Irish annals were present as well as hagiography and folktales.

As the talks progressed, it became quickly apparent that we had successfully matched the two sides. E.g., **Lyle's** work on Indo-European mythical archetypes, **Milne's** research on composite visual structures, **Martin's** modern visual narratives and **Weiss's** considerations of Japanese mythology can clearly benefit from the phylogenetic approaches pioneered by **d'Huy** and **Tehrani**. **Friðriksdóttir's** interests in the *Íslendingasögur* from the humanities side could immediately combine with **P. Mac Carron's** quantitative approach. **M. Tatár**, working on Inner Asian materials, appealed for support from the network theorists of the kind **Gramsch** initiated during the workshop with **Yose**. **M. Mac Carron** and **Ritari** each have data on hagiographic networks which are perfect for analysis. **Kenna** is particularly keen to apply network techniques to the annalistic resources identified by **Johnston**, **McCarthy**, **Roberson** and **Story**. **Dunbar**, **Mryglod** and **Thurner** demonstrated how analyses of the real and virtual worlds can help open new ground in analyses of ancient manuscripts, such as Slavic tales of interest to **Holovatch**, the Hungarian interests of **S. Tatár** as well as to the texts which hold the native mythologies of the Americas discussed in an overview by **Dahmen**.

Discussion continued over the two evening meals and post-dinner drinks. Mutual interest ensured a high degree of cross-disciplinary interaction. The unanimous opinion of the participants is that this was a unique, courageous and pioneering conference, which fits well in the ESF "exploratory" framework.

Participants expressed keenness to establish collaborations. Multiple two- or three-way collaborations have already sprung up in an organic fashion. But we are keen to move forward together too. A number of possibilities were decided upon. Besides two-way collaborative grants, we intend to apply for funding to support us as an international network. Various possibilities were discussed and have yet to be investigated, but the collective opinion was that we should be very ambitious in terms of scale.

We approached *Springer Verlag* prior to the Workshop with the idea for a book on its theme. This will not be a set of proceedings. Rather, we will invite selected chapters. Our hope is that this will establish our ability and commitment to work together and to forge a new community half-way between the sciences and humanities. We hope that this will help convince other funding bodies of our intent and of the potential of our new sub-field. Springer have reacted very positively to the proposal and we will start work on the book shortly.

We are grateful to the ESF for the funding to bring the various participants together for the *Exploratory Workshop*. But the ESF has given us much more than funding alone. The process has focused our minds during the past year to seek out and invite the most appropriate people for this unique and exciting project. Moreover, the prestige associated with the ESF, the very positive comments of its Referees in the feedback to the original proposal and the encouragement given by the Rapporteur have all given us a boost of confidence to seek to develop our fledgling field and to be ambitious in our future collective aims. For all of these we thank the ESF and its staff, including its Administrative Coordinator, Nathalie Geyer-Koehler, for making the bureaucratic side as straightforward and pleasant as possible.

## 2. Scientific content of the event

The opening talk was by **Pádraig Mac Carron** and was designed to introduce complex network theory with an application to mythology. This is the work described above and from which the ideas for the Exploratory workshop came about. Pádraig demonstrated the broad differences between Irish and Icelandic epics from a networks point of view and how a particular Irish narrative (*Bricriu's Feast*) differs in its network structure from other tales of the genre. Lively discussion followed: **Jamshid Tehrani** questioned whether the Icelandic/Irish differences reflected collective/individual cultural emphases in their respective societies. **Louise Milne** recommended a comparison with the Welsh *Mabinogion* and, indeed, Pádraig was able to show these do indeed have similar network features, though they differ in detail. **Daniel McCarthy** suggested a comparison with modern material, which Pádraig was also in a position to demonstrate.

**Silvio Dahmen's** review included a discussion about the *Popol Vuh* mythology of the Mayans as well as tales from the Navajo. His desire is to compare to other indigenous cultures to determine if we can learn about migration within the American continent. **Robin Dunbar** queried if the differences between the two American examples could be picked up using network theory in a similar manner to that demonstrated by **Pádraig Mac Carron** and **Louise Milne** suggested usage of a large data set assembled by Yuri Berezin in St. Petersburg. (Prof. Berezkin was invited but could not attend the Workshop.) **Robert Gramsch** stressed that historians are interested in emergent effects of networks rather than the networks themselves and also in dynamics.

**Louise Milne's** presentation focussed on visual comparative mythology and suggested ways in which this topic can link to network theory. **Jamshid Tehrani** suggested a phylogenetic approach may also be productive. **Julien d'Huy** echoed this remark and suggested one may attempt to reconstruct a proto-myth. **Daniel McCarthy** suggested to look for implications in the world of Christianity and **Robert Gramsch** commented on parallels in modern society. **Julien d'Huy's** own talk focused on the evolution of folktales from a phylogenetic approach. He spoke of attempts to reconstruct a European neolithic proto-tale.

**Johanna Katrin Fridriksdottir** spoke about women's strategies to obtain power and influence in the *Íslendingasögur* through inciting violence or peace, through witchcraft, money or similar. **Joseph Yose** asked an interesting question about how real the supernatural world was to early settlers of Iceland and how this compares to some African cultures in their interpretations of dreams and magic. **Jo Story** spoke about intellectual network in early medieval Europe. She explained there are over 500 insular manuscripts from AD650-850 surviving today and is interested in those as linking people and places in Europe at that time. Jo proposed a network analysis of such data.

**Jamshid Tehrani** gave a history of early work on motifs in folktales and their classification and how this resonated with theories of evolution. He explained how modern phylogenetic techniques can be applied to the study of folklore and the advantages of such approaches. He then took us through ATU333 *Little Red Riding Hood* and ATU123 *The Wolf and the Kids*. **Jamshid's** work on this topic was published in PLOS ONE in 2013 and has been viewed over 70,000 times and generated enormous media interest. **Mats Gyllenberg** pointed out that language evolution is often in one direction, unlike in biology. **Robin Dunbar** pointed out that the motifs in such folktales were often connected to emotional arousal as these are easy to remember. **Louise Milne** pointed out that cultural evolution can often be forced (by conquest). She also suggested that the phylogenetic branches could be labelled with events

such as the invention of printing, the colonisation of America, etc, an idea embraced by **Jamshid**.

In his talk **Robert Gramsch** re-emphasised that historians want to focus on network dynamics, a point made also by **Robin Dunbar**. He then progressed to his own work on the networks formed by 13th century German nobility. This work connected strongly with that being done by **Joseph Yose** and **Ralph Kenna** and a collaboration has now formed. **Katja Ritari** talked about mapping saints and their networks, a topic also of interest to **Máirín Mac Carron**. Katja gave an introduction to the study of saints and their lives and demonstrated the possibilities for quantitative study. She advocated a social network study of early saints and raised related questions which could benefit from a quantitative approach. **Jamshid Tehrani** raised interesting points about popularity of saints at specific times - similar to the waxing and waning of forenames.

In the final talk of the first day, **Stefan Thurner** described the virtual world of *Pardus*, an interactive computer game. He explained how these offer the first examples in human history where there is complete information about an entire human society. A mathematical analysis of the multiplex structures allows to make quantitative, predictive and testable statements about social organisation, formation of social ties, gender differences of social life, reaction times of human interactions, the origin of good behaviour, and the wealth of virtual nations. In the context of the current theme, these offer ideal playgrounds to test out new quantitative ideas and how they may be applied to societies be they virtual, real, historic, mythological or fictional.

In the opening talk of the second day, **David Weiss** illustrated how comparative mythologists traditionally work with an example from Japanese mythology. He then discussed similarities in motifs from mythological narratives across the world and outlined two theories which aim to explain that. He went on to suggest how network theory might help, a point supported by **Emily Lyle**. **Robert Gramsch** suggested to extend such studies to using objects (as well as characters) as nodes. The discussions after made clear that phylogenetics may also offer an interesting way to tackle the question raised by David.

**Daniel McCarthy** gave a fascinating talk about his work on analysing and restoring the chronological structure of Irish annals. There are 8 medieval versions of chronicles covering the 5th to 11th centuries and these exhibit variation in both the sequence of events and dates. Dan showed how he has used computer table structures to correct and synchronise these, a work which we think will be highly valued by future researchers, including from the *Maths Meets Myths* collaboration.

**Maria Magdolna Tarár** also demonstrated the traditional approaches to comparative mythology. She used examples from the Sayan mountains at the centre of Eurasia, which has over 1,000 epic songs. Maria pointed out the necessity of some mathematical techniques to systemise and visualise these and the discussion again pointed to both network theory and phylogenetics.

**Robin Dunbar** spoke about the cognitive limits of the human mind and the boundary conditions that places on story telling, illustrating with examples from Shakespeare and film. **Máirín Mac Carron** gave a presentation on hagiography, examining a sample of medieval texts using network theory to reveal social structures. Our humanities participants agreed that these small networks are very useful for visualisation purposes, something which was not initially obvious to the scientists, more used as they are to quantification. **Olesya**

**Mryglod** displayed a variety of quantitative tools, developed for analysing the virtual world. Her aim was to discover if these could help understand mythological and other societies. The question of the importance of fantasy figures in computer games was raised by **Louise Milne**. Olesya pointed out that while such figures are obviously not real, the human cooperation to defeat them, for example, are.

**Elva Johnston** is interested in the relationship between the literate elite and the general illiterate populations of medieval times. She has mapped these literate networks using data from the Irish annals, largely from death notices and placenames. She asked how network theory can help progress this type of work - to use all the resources at our disposal to map the fullest picture.

**Owen Roberson** is interested in the place of text in Anglo-Saxon culture. He pointed out that manuscript compilations frequently showed a desire for internal consistency. By taking blocks of texts as units, he can consider how they move together. His aim, to some extent, is to recover what has been lost and his talk indicated the potential work that could be done on a small, focussed data set. Finally **Emily Lyle** gave an interesting talk about her theory of ten Indo-European gods and their stories.

In addition to the 19 presentations, we had two long discussion forums, one at the end of each day. These were supplemented by more informal discussions

### **3. Assessment of the results, contribution to the future direction of the field, outcome**

The main objective was to bring like-minded people together from the sciences and the humanities and to bridge the gap between them regarding quantitative studies of ancient texts. A number of collaborations directly resulted from the workshop (see Sec.1). However, an additional benefit was to bring researchers together from within each discipline too. E.g., **Jamshid Tehrani** and **Julien d'Huy** are pioneering experts on applying phylogenetics to folktales. They met at this conference and agreed to co-author a paper directly afterwards.

A topic which quickly emerged in the first discussion forum was how to continue, to strengthen and to formalise our collaboration, now that we have all gotten to know each other. We agreed that we wish to apply for a major grant. **Ralph Kenna** is currently looking into that. Additionally there was a lot of support for a common publication. We discussed the merits of a proceedings volume or special issue of a journal. We also discussed the possibility of a book.

After the conference, **Ralph Kenna** contacted Springer Verlag. They responded with great enthusiasm to what they termed an "enchanted idea". We decided to carefully select specific contributors - those whose work already lies between the sciences and humanities. The book is intended to be a platform for a serious attempt at getting our field more into the mainstream. The volume will not be a set of proceedings from the workshops and authors are free to choose whatever topic they like to write about. However, the criteria for inclusion are that chapters should contain either

- (a) Results of an application of state-of-the-art quantitative approaches (e.g., network theory, phylogenetics, agent-based modelling, etc...) to sources from the past (folktales, myths, legends, sagas, epics and histories);
- (b) A description of a new quantitative method which has been applied elsewhere (e.g., to virtual societies) and could be applied

to the sources we're interested in here;  
(c) a description of sources which would be amenable to quantitative treatment and why they are important.  
For contributions (b) and (c), each would need a clear paragraph about why the material is suitable - in the case of (c), why it would be rich ground for a complexity analysis.

The working title is "*Maths Meets Myths: Complexity-science approaches to folktales, myths, sagas, and histories*". We are aiming to send final versions of chapters by mid 2015.

The book will be our statement that we are serious and we have arrived and we have already started to collaborate. However, it is too early for results to have arisen from collaborations initiated at this workshop. We hope that such collaborations will ensue, starting now. These will, in time, produce new knowledge. Perhaps a second volume of the book would be achievable a few years down the line. In the meantime, obtaining a grant or grants is top priority.

We plan another conference on *Maths Meets Myths* in 2016.

## 4. Final Programme

### Wednesday 10 September 2014

20:00                      *Arrival*  
10 Sept                    *Get-together at the Establishment, Bayley Lane, Coventry CV1 5RN.*

### Thursday 11 September 2014

08.30-09.00              *Refreshments on arrival*  
09.00-09.15              **Welcome by Convenor**  
                                 **Ralph Kenna** (Coventry University)  
09.15-09.30              **Presentation of the European Science Foundation (ESF)**  
                                 **Professor Mats Gyllenberg** (Scientific Review Group for Physical and  
                                 Engineering Sciences / Scientific Review Group for the Humanities)  
**09.30-11.15**              **1st Morning Session (Chaired by Máirín Mac Carron):**  
09.30-09:55              **Presentation**  
                                 **Pádraig Mac Carron** (University of Oxford, England)  
09.55-10.20              **Presentation**  
                                 **Silvio Dahmen** (University of Rio Grande do Sul, Brasil)  
10.20-10.45              **Presentation**  
                                 **Louise Milne** (University of Edinburgh, Scotland)  
10.45-11.15              *Coffee / Tea Break*  
**11.15-12.40**              **2nd Morning Session (Chaired by Robin Dunbar):**  
11.15-11.40              **Presentation**  
                                 **Julien d'Huy** (Sorbonne, Paris, France)

11.40-12.05	<b>Presentation</b> <b>Johanna Katrin Fridriksdottir</b> (The Árni Magnússon Institute for Icelandic Studies, Iceland)
12.05-12.30	<b>Presentation</b> <b>Jo Story</b> (University of Leicester, England)
12.30-12.40	<b>Conference Photo</b>
12.40-14.00	<i>Lunch</i>
<b>14.00-15:40</b>	<b>1st Afternoon Session (Chaired by Jo Story):</b>
14.00-14.25	<b>Presentation</b> <b>Jamshid Tehrani</b> (University of Durham, England)
14.25-14.50	<b>Presentation</b> <b>Robert Gramsch</b> (Universität Jena, Germany)
14.50-15.15	<b>Presentation</b> <b>Katja Ritari</b> (University of Helsinki, Finland)
15.15-15.40	<b>Presentation</b> <b>Stefan Thurner</b> (Medical University of Vienna, Austria)
<b>15.40-17:00</b>	<b>2nd Afternoon Session (Chaired by Yurij Holovatch):</b>
16.00-17.00	<b>Discussion with coffee/tea</b>
19.00	<i>Dinner</i>

## Friday 12 September 2014

<b>09.30-11.15</b>	<b>1st Morning Session (Chaired by Pádraig Mac Carron):</b>
09.30-09:55	<b>Presentation</b> <b>David Weiss</b> (University of Tübingen, Germany)
09:55-10.20	<b>Presentation</b> <b>Daniel McCarthy</b> (Trinity College Dublin, Ireland)
10.20-10.45	<b>Presentation</b> <b>Maria Magdolna Tatár</b> (University of Oslo, Norway)
10.45-11.15	<i>Coffee / Tea Break</i>
<b>11.15-12:30</b>	<b>2nd Morning Session (Chaired by Silvio Dahmen):</b>
11.15-11.40	<b>Presentation</b> <b>Robin Dunbar</b> (University of Oxford, England)
11.40-12.05	<b>Presentation</b> <b>Máirín Mac Carron</b> (National University of Ireland, Galway)
12.05-12.30	<b>Presentation</b> <b>Olesya Mryglod</b> (National Academy of Sciences, Ukraine)
12:30-14.00	<i>Lunch</i>
<b>14.00-15:40</b>	<b>1st Afternoon Session (Chaired by Louise Milne):</b>
14.00-14.25	<b>Presentation</b> <b>Elva Johnston</b> (University College Dublin, Ireland)
14.25-14.50	<b>Presentation</b> <b>Owen Roberson</b> (University of Leicester, England)
14.50-15.15	<b>Presentation</b> <b>Emily Lyle</b> (University of Edinburgh, Scotland)
15.15-15.40	<i>Coffee / tea break</i>
<b>15.40-17:00</b>	<b>2nd Afternoon Session (Chaired by Ralph Kenna):</b>

15.40-17.00

**Discussion on follow-up activities/networking/collaboration**

19.00

*Dinner***Saturday 13 September 2014**

Morning

*Departure***5. Final list of participants** (name and affiliation is sufficient; the detailed list should be updated on-line directly)

<b>Name</b>	<b>University</b>	<b>Expertise</b>	<b>Dates of Attendance</b>
Professor Silvio Dahmen	University of Duisberg-Essen	Mathematics, physics, history of science	10-13 September
Professor Robin Dunbar	University of Oxford	Evolutionary psychology, anthropology, interdisciplinary	10-12 September
Dr Jóhanna Katrín Friðriksdóttir	Árni Magnússon Institute for Icelandic Studies, Reykjavik	Saga literature, eddic heroic poetry and manuscripts	10-13 September
Dr Robert Gramsch	University of Jena	History, networks	10-13 September
Professor Mats Gyllenberg (ESF Rapporteur)	University of Helsinki	History, network analysis	10-12 September
Professor Yuriy Holovatch	Institute for Condensed Matter Physics, National Academy of Sciences of Ukraine	Physics, mathematics, networks	07-13 September
Dr Julien d'Huy	Université Paris-Sorbonne	Mythology, Folklore, Archaeology, Phylogenetics	10-13 September
Dr Elva Johnston	University College Dublin	School Of History & Archives	11-13 September
Professor Ralph Kenna	Applied Maths Research Centre, Coventry	Mathematics, physics	10-13 September
Dr Emily Lyle	University of Edinburgh	Mythology	11-13 September
Dr Máirín Mac Carron	National University of Ireland, Galway	Medieval history, theology	10-13 September
Dr Pádraig Mac Carron	Department of Experimental Psychology, University of Oxford	Maths, physics, mythological networks	10-13 September
Sean Martin	Edinburgh Napier University	Author, Filmmaker	10-13

			September
Dr Daniel McCarthy	Trinity College Dublin	Computing, chronology, Irish annals, Paschal tables	10-13 September
Dr Louise Milne	Edinburgh College of Art, University of Edinburgh, and School of Arts & Creative Industries, Edinburgh Napier University	Visual anthropology and comparative mythology	10-13 September
Dr Olesya Mryglod	Institute for Condensed Matter Physics, National Academy of Sciences of Ukraine	Maths, computing	06-14 September
Dr Katja Ritari	University of Helsinki	History, archaeology, theology, other humanites	10-13 September
Dr Owen Roberson	University of Leicester	Medieval poetry, literary and religious imagery	10-13 September
Professor Jo Story	University of Leicester	Medieval History	10-11 September
Dr Maria Magdolna Tatár	University of Oslo	Mythology	10-13 September
Dr Sarolta Tatár	Pázmány Peter Catholic University, Doctoral School of History Science, Alumna	History, Mythology, Folklore	10-13 September
Dr Jamshid Tehrani	University of Durham	Phylogenetics, folktales	10-13 September
Professor Stefan Thurner	Medical University of Vienna	Complexity	11-13 September
Professor David Weiss	University of Tübingen	Comparative mythology	10-14 September
Joseph Yose	Applied Maths Research Centre, Coventry	Applied mathematics, networks	10-13 September

## 6. Statistical information on participants

We had 24 persons as follows: England (7); Germany (3); Ireland (3); Scotland (3); Ukraine (2); Austria (1); Finland (1); France (1); Hungary (1); Iceland (1); Norway (1).

One of the English participants was replaced by another for Day 2. So the total numbers on any given day amounted to 23 participants. This means the maximum participation was  $7/23 = 26\%$  from England.

We had 14 males and 10 females. Only two participants (from Ukraine) represented non-ESF countries. They were supported in part by other funds.

We did not gather information on ages.

## 7. Conference Photo

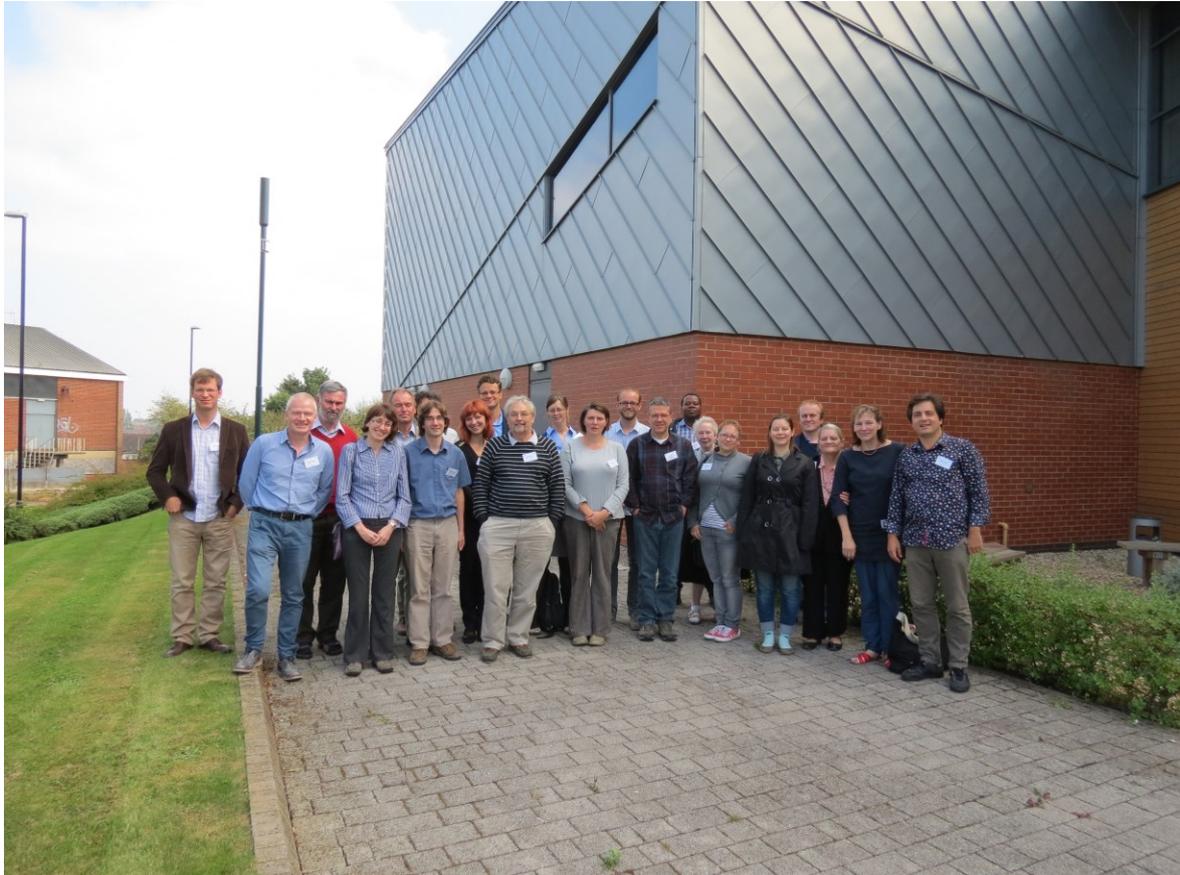


Fig 1: Photo of participants on Day 1 of the ESF Exploratory Workshop Maths Meets Myths. Left to right: Julien d'Huy, Ralph Kenna, Daniel McCarthy, Máirín Mac Carron, Mats Gyllenberg; Yuriy Holovatch; Pádraig Mac Carron; Olesya Mryglod; Robert Gramsch; Robin Dunbar; Jóhanna Katrín Friðriksdóttir; Jo Story; David Weiss; Silvio Dahmen; Joseph Jose; Emily Lyle; Katja Ritari; Sarolta Tatár; Sean Martin; Maria Magdolna Tatár, Louise Milne and Jamshid Tehrani. (Elva Johnston, Owen Roberson and Stefan Thurner also participated.)