Nordic and Baltic Neutron Scattering Communities, 2006-2017

- a bibliometric study

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5 May 2018

0. Perspective and scope of the investigation

In this document, we present and discuss basic information needed to elucidate the present situation in the Nordic and Baltic scientific environment within neutron scattering science. The investigation is a part of a larger effort to support for the Nordic/Baltic involvement in the scientific use of the European Spallation Source, ESS, and to monitor the effect of this support. The investigation is hosted by the Nordic Neutron Science Program, NNSP.

We perform a bibliometric investigation of the publications in the five Nordic countries: Denmark, Norway, Sweden, Finland, and Iceland – as well as the three Baltic countries: Estonia, Latvia, and Lithuania. We consider publications dealing with neutron scattering, including instrumentation, data taking, and data analysis. In addition, theoretical work is included if it lies close to the experiments, i.e. prediction or modelling of experimental data. However, we exclude use of neutrons for fusion, nuclear and particle physics, and for element analysis by nuclear activation (known as PGAA). In addition, we exclude the use of "ultra-cold" neutrons for e.g. fundamental studies of quantum mechanics.

The present report is an update of a series of similar reports, latest from May 2017. The present work cover the full 12 year time span 2006 to 2017, both inclusive.

We show that there is in general a strongly increasing tendency in the publication rate and in the scientific communities in Sweden and Norway, whereas a strong Danish increase 2010-2015 seems to have leveled off. The communities in Finland and Iceland are much smaller and show no increasing tendencies. In the Baltic countries the communities are small, but Estonia has achieved a remarkable increase in activity over the last few years.

1. Neutron Scattering articles

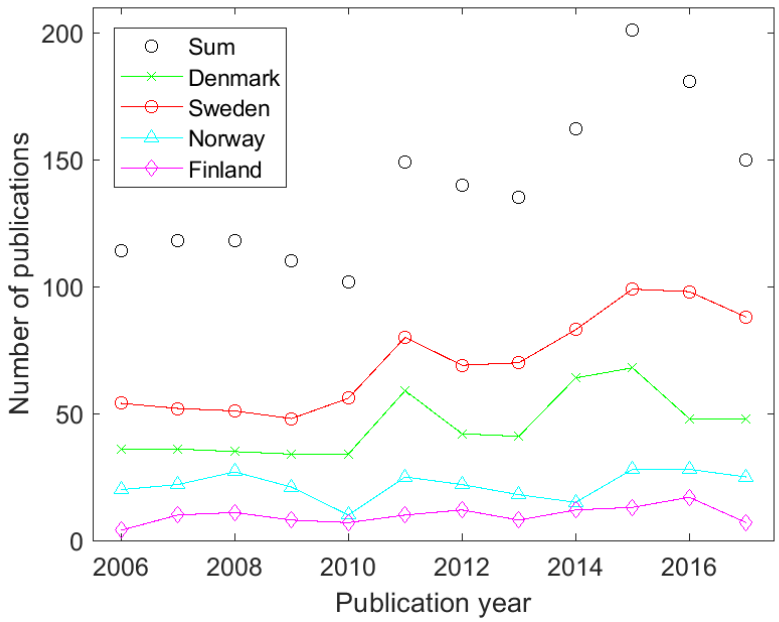
We here present an analysis of the neutron scattering publications published 1/1-2006 to 31/12-2017. We have counted all peer-reviewed articles for each of the Nordic/Baltic countries within each year, and we have further counted how many of these are published in "top 20% high-profile" journals, defined by the Danish official "authority lists" from 2010 and 2015 (we use the 2015 list for the 2015-2017 publications; the 2010 list otherwise). The number of high profile papers is everywhere listed in parentheses.

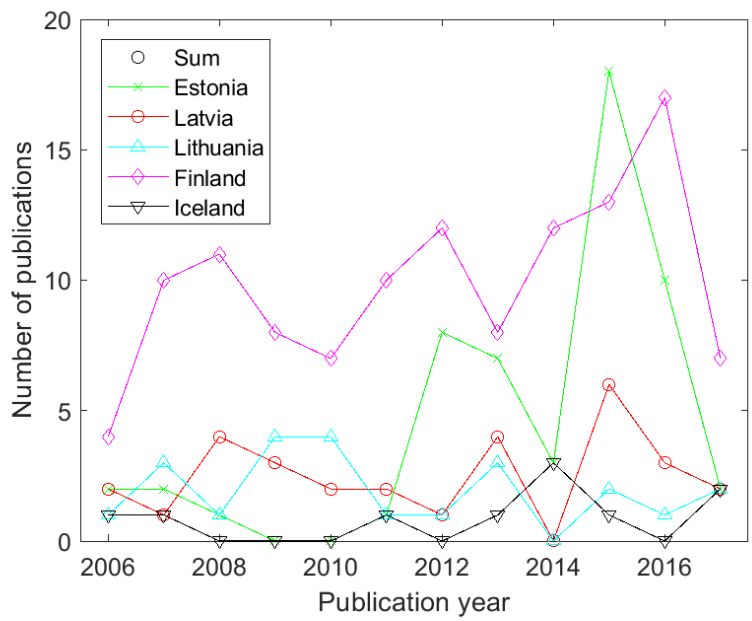
Most data has been found using ISI Web of Science using a selection of neutron-related keywords. Abstracts were read to remove false searches, and potential articles were studied to be classified according to the type of neutron science, and for the use of neutron sources. In addition, the Journal of Neutron Research has been searched manually, since this journal does not appear in ISI Web of Science.

It should be noted that the ISI Web of Science performed an expansion in early 2017 to include a number of conference proceedings for the last around 10 years. We have chosen to update our data with this new information. Hence, the number of publications has in general increased for most years since our 2017 report. This has prompted us to redo the full time series analysis to include the newly available publications. **Therefore, the data in this report are not consistent with earlier reports.**

The table below contains all 1681 publications found in our analysis, divided into country and publication year. In the sum, publications with authors from more than one Nordic/Baltic country is counted only once. This "double count" correction is shown explicitly. Nordic/Baltic collaborations and "double counts" are discussed more in section 3.

Year/ country	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	**SUM**
DK	36 (18)	36 (23)	35 (15)	34 (28)	34 (21)	59 (30)	42 (23)	41 (20)	64 (21)	68 (35)	48 (15)	48 (16)	**545 (265)**
N	20 (6)	22 (7)	27 (3)	21 (6)	10 (4)	25 (10)	22 (6)	18 (8)	15 (9)	28 (8)	28 (9)	25 (9)	**261 (85)**
S	54 (14)	52 (16)	51 (23)	48 (24)	56 (30)	80 (25)	69 (29)	70 (34)	83 (36)	99 (29)	98 (38)	89 (22)	**849 (320)**
FI	4 (2)	10 (5)	11 (2)	8 (1)	7 (5)	10 (5)	12 (4)	8 (3)	12 (6)	13 (3)	17 (8)	7 (1)	**119 (45)**
IS	1 (0)	1 (0)	0 (0)	0 (0)	0 (0)	1 (0)	0 (0)	1 (1)	3 (2)	1 (0)	0 (0)	2 (2)	**10 (5)**
ES	2 (0)	2 (1)	1 (0)	0 (0)	0 (0)	1 (0)	8 (3)	7 (7)	3 (2)	18 (11)	10 (3)	2 (1)	**54 (28)**
LV	2 (0)	1 (0)	4 (0)	3 (0)	2 (1)	2 (0)	1 (0)	4 (1)	0 (0)	6 (0)	3 (1)	2 (1)	**30 (4)**
LI	1 (0)	3 (0)	1 (0)	4 (0)	4 (1)	1 (0)	1 (0)	3 (2)	0 (0)	2 (0)	1 (0)	2 (0)	**23 (3)**
double count	6 (3)	9 (3)	12 (2)	8 (5)	11 (6)	30 (11)	15 (5)	17 (8)	18 (6)	33 (12)	24 (7)	27 (4)	**210 (72)**
SUM	**114 (37)**	**118 (49)**	**118 (41)**	**110 (54)**	**102 (56)**	**149 (59)**	**140 (60)**	**135 (68)**	**162 (70)**	**202 (74)**	**181 (67)**	**150 (48)**	**1681 (683)**





The data from the table are presented in the two figures above. We see that Sweden has the largest publication number with Denmark being on average at 69% of this value. Norway reaches 32% of the Swedish value, Finland at 16%. Estonia is on average at 7% of the Swedish value, but has shown an increase over the last few years, where it equals Denmark and Sweden in publications per capita. Latvia, Lithuania, and Iceland have few neutron publications and are comparable to Finland in publications per capita. There is a an increasing trend in the total publication number over the time span, with the 2015 number being clearly the highest, 50% higher than the period average, followed by 2016. The number for 2017 seems to show a decrease, but it is too early to say if this is a fluctuation or a tendency.

Many publications, 42% on average, are in the top-20% journals. This confirms earlier observations that neutron scattering results are likely to lead to important scientific results. We speculate that this is due to the limited number of neutron sources and the competitive nature of access to experimental time at the international facilities.

2. Neutron community, time development, and present location

We here list the approximate size of the neutron scattering communities in the respective countries. We have here defined the neutron community to consist of authors with at least two neutron-related publication within a 5-year counting period. We divide the authors into three categories:

- **Infrequent users** with 2-4 publications. This would typically cover casual users among staff, scientists new to the field or recently moved to the Nordic/Baltic countries, as well as Ph.D. students close to the end of their studies.
- **Frequent users** with 5-9 publications. This would typically be staff scientists working with neutrons as one of several research techniques, post docs within the field, or very talented Ph.D. students.
- **Expert users** with 10+ publications. This would typically be permanent staff with particular neutron expertise or senior post docs specializing in neutron scattering and with a strong scientific potential.

The list below covers the 5-year period 2013 - 2017. We have separated staff at ESS from the rest of the Swedish scientists to highlight the direct effect of this facility.

Author type	Infrequent (2-4)	Frequent (5-9)	Expert (10+)	**SUM**
Denmark	76	26	13	**115**
Norway	49	4	7	**60**
Sweden, excl. ESS	104	27	9	**140**
Sweden, ESS only	68	18	6	**92**
Finland	13	6	0	**19**
Iceland	0	1	0	**1**
Estonia	4	2	1	**7**
Latvia	12	0	0	**12**
Lithuania	3	0	0	**3**
SUM	**329**	**84**	**36**	**449**

The sizes of the national communities are roughly proportional to the number of publications. The core of the communities (defined as the frequent and expert users) presently counts 120 scientists.

The table below covers the distribution of the communities in DK, S, and N on their (most recent) affiliation. 11 institutions are found to have at least 10 researchers in the community.

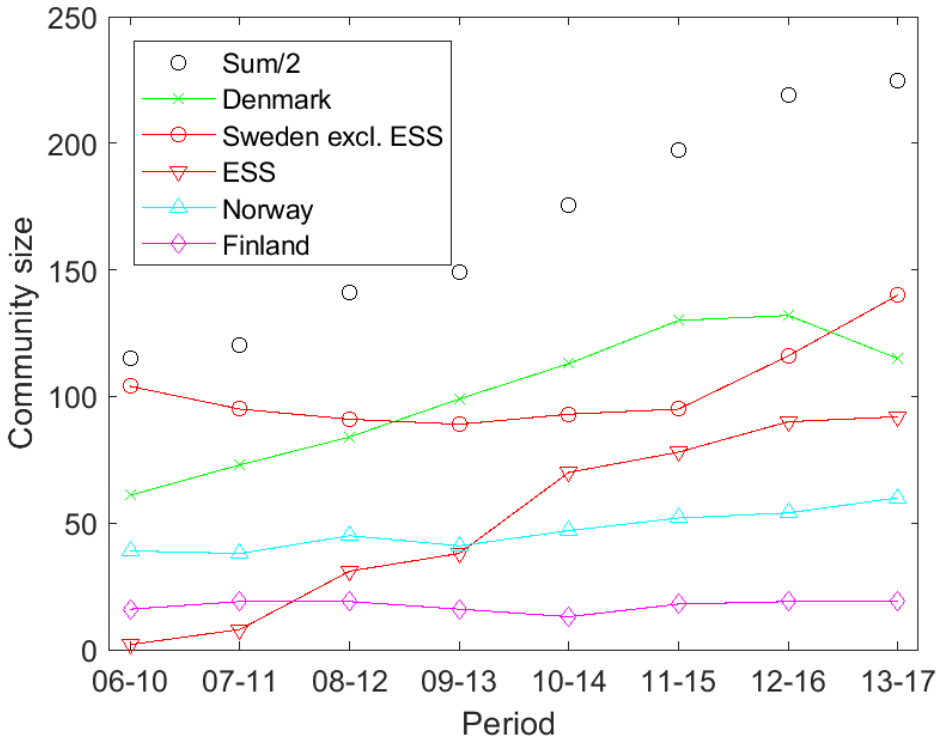
Affiliation	**Infrequent (2-4)**	**Frequent (5-9)**	**Expert (10+)**	**SUM**
DENMARK				
Univ. Aalborg	1			**1**
Univ. Aarhus	8	3	2	**13**
Univ. Copenhagen	36	14	9	**59**
DTU, Lyngby	23	9	2	**34**
ESS-Data Managem.	1			**1**
National Museum	2			**2**
Roskilde Univ.	3			**3**
Univ. Southern DK	1			**1**
Industry	1			**1**
NORWAY				
Inst. Energy Res.	14		5	**19**
NMBU, Ås	4			**4**
NTNU, Trondheim	9			**9**
SINTEF, Trondheim	2			**2**
Univ. Bergen	3			**3**
Univ. Oslo	17	4	2	**23**
SWEDEN				
Chalmers Tech. Univ.	16	4	3	**23**
ESS	68	18	6	**92**
Gothenburg Univ.	2			**2**
KTH, Stockholm	6	1		**7**
Linköping Univ.	8	2		**10**
Lund Univ.	22	3	1	**26**
Malmö Univ.	5	1	1	**7**
Stockholm Univ.	9	6		**15**
Swedish Museum	1			**1**
Uppsala Univ.	31	10	4	**45**
University West	1			**1**
Industry	3			**3**

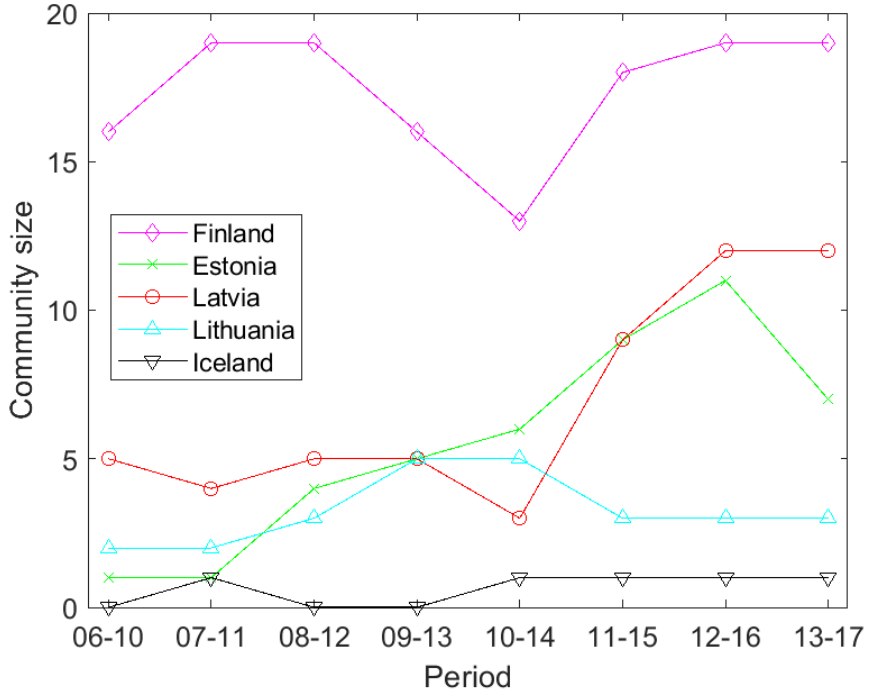
Affiliation	Infrequent (2-4)	Frequent (5-9)	Expert (10+)	SUM
FINLAND				
Aalto Univ. Techn.	7	2		**9**
Finnish Res. Engin.		2		**2**
Lappeenranta Univ. T	1			**1**
Tampere Univ. Techn.	2	1		**3**
Oulu Univ.	2	1		**2**
Univ. Eastern Finland	1			**1**
ICELAND				
Univ. Iceland		1		**1**
ESTONIA				
NICPB, Tallinn	3	1	1	**5**
Univ. Tartu	1	1		**2**
LATVIA				
Inst. Phys. Energetics	3			**3**
Riga Techn. Univ.	1			**1**
Univ. Latvia	8			**8**
LITUANIA				
Vilnius State Univ.	3			**3**

The table above covers Finland, Iceland, and the three Baltic countries. Here are two institutions with a community of almost 10 researchers.

To follow the development of the scientific communities, we have recorded the sizes of the Nordic countries, starting from the 5-year period 2006-2010. The numbers represent the total community, while the number in parentheses denote the sum of frequent and expert users.

Community size	2006-2010	2007-2011	2008-2012	2009-2013	2010-2014	2011-2015	2012-2016	2013-2017
Denmark	61 (22)	73 (23)	84 (28)	99 (29)	113 (32)	130 (38)	132 (40)	115 (39)
Norway	39 (14)	38 (12)	45 (15)	41 (14)	47 (12)	52 (14)	54 (9)	60 (11)
Sweden, not ESS	104 (32)	95 (27)	91 (25)	89 (24)	93 (26)	95 (28)	116 (30)	140 (36)
Sweden, ESS	2 (1)	8 (2)	31 (7)	38 (14)	70 (16)	78 (17)	90 (21)	92 (24)
Finland	16 (1)	19 (1)	19 (0)	16 (1)	13 (2)	18 (4)	19 (6)	19 (6)
Iceland	0 (0)	1 (0)	0 (0)	0 (0)	1 (0)	1 (0)	1 (0)	1 (1)
Estonia	1 (0)	1 (0)	4 (0)	5 (1)	6 (1)	9 (3)	11 (3)	7 (3)
Latvia	5 (1)	4 (0)	5 (0)	5 (0)	3 (0)	9 (0)	12 (0)	12 (0)
Lithuania	2 (1)	2 (0)	3 (0)	5 (0)	5 (0)	3 (0)	3 (0)	3 (0)
SUM	**230 (72)**	**241 (65)**	**282 (75)**	**298 (83)**	**351 (89)**	**395 (104)**	**438 (109)**	**449 (120)**





The data from the table is presented graphically in the two figures above. In the first plot, the black circles represents the sum of the Nordic and Baltic countries divided by two, to make everything visibile on a common scale. The data show a clearly increasing tendency in the Nordic/Baltic communities, a 60% total increase over the last 5 years. The increase is caused by a growth in all categories, in particular ESS. However, Finland, Iceland, and Lithuania show no increase in community size.

By studying the numbers closer, we see a significant Danish increase 2010 to 2015. This was caused equally by additional Ph.D. students and post docs, and attraction of new permanent staff. However, from 2015, the numbers have been decreasing. This could be related to a wear-out of the original "ESS surge" after the site decision in 2009. However, the Danish publication numbers and community count from the first months of 2018 show a return of the increasing tendency.

The decrease of "Sweden not ESS" until 2013 is presumably related to the close-down of the Studsvik reactor in 2005, with a recovery after around 10 years with a 50% increase of community within only 2 years– same effect and time scale as was seen after the close-down of the Danish Risø reactor in 2000. The significant national funding program SwedNess is expected to lift the community further.

The strong increase of the community amoung ESS-employees naturally follows the hiring of personnel at the facility, combined with the fact that the staff need a few years from the hiring until they have collected sufficient publications with a Nordic address.

Also Norway has seen a 50% increase, in this case over the last 4 years. We have not identified a unique source for this effecet.

3. Nordic-Baltic collaborations

We here list the number of articles that feature authors from at least two Nordic/Baltic countries. This number is also used to correct the article sum in the overall count, shown in section 1, and in the following sections. As before, high-impact articles are listed in parentheses.

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	**SUM**
Denmark - Norway-Sweden			1 (0)			2 (1)	1 (0)	2 (1)				1 (0)	**7 (2)**
Denmark - Norway		2 (1)	1 (0)		1 (0)	4 (2)		1 (0)	2 (2)		1 (0)	1 (0)	**13 (5)**
Denmark-Sweden-Lithuania					2 (1)								**2 (1)**
Denmark - Sweden	1 (0)	3 (2)	3 (2)	2 (2)	4 (4)	17 (5)	8 (2)	6 (1)	13 (2)	23(11)	14 (4)	17 (4)	**111 (39)**
Denmark - Finland				1 (0)	1 (0)						2 (0)		**4 (0)**
Norway-Sweden-Finland										2 (0)			**2 (0)**
Norway - Sweden	3 (1)	3 (0)	3 (0)	5 (3)		2 (1)	3 (1)	4 (3)	1 (1)	2 (1)	4 (2)	4 (0)	**34 (13)**
Norway - Finland	1 (1)		1 (0)			1 (0)			1 (0)			1 (0)	**5 (1)**
Sweden - Finland	1 (1)				1 (1)	2 (1)	2 (2)				1 (1)	1 (0)	**8 (6)**
Sweden - Iceland								1 (1)	1 (1)				**2 (2)**
Sweden - Estonia											1 (0)		**1 (0)**
Sweden - Lithuania		1 (0)	1 (0)							1 (0)		1 (0)	**4 (0)**
Estonia - Latvia			1 (0)					1 (1)		3 (0)	1 (0)		**6 (1)**
SUM	**6 (3)**	**9 (3)**	**11 (2)**	**8 (5)**	**9 (6)**	**28(10)**	**14 (5)**	**15 (7)**	**18 (6)**	**31(12)**	**24 (7)**	**26 (4)**	**199 (69)**
Double count corr.	6 (3)	9 (3)	12 (2)	8 (5)	11(6)	30(11)	15 (5)	17 (8)	18 (6)	33(12)	24 (7)	27 (4)	**210 (72)**

We see that there is much collaboration between the countries. 12% of all publications in the investigations are of collaborative nature, with a clearly increasing trend since 2011.

The largest number of collaborative work is on the axis Denmark-Sweden, but also the Norway-Sweden combination is often seen. The large number of Denmark-Sweden collaborations in 2011 is partly explained by the ESS collaboration, where Danish scientists working on ESS project to their affiliation added “ESS, Sweden”. This procedure was changed from 2012, where the additional affiliation would be “ESS, Denmark”. Discarding 2011, the Danish-Swedish collaboration seems to show a steady increase over the whole time span, with a maximum of 23 common publications in 2015.

Analysing the collaborations further, the Danish-Swedish collaboration has a main UCPH/DTU-Lund/ESS axis, both with respect to ESS instrumentation and research in magnetism, as well as soft matter and biological systems, using instruments at ILL and the Danish instruments at PSI. Some

collaboration is seen also between Lund/Chalmers and Århus. The Swedish-Norwegian collaboration is concentrated in a Chalmers-Oslo/Kjeller axis with common use of the powder diffractometers at Kjeller and the Swedish diffractometer Polaris at ISIS. The Norwegian-Danish collaboration is mainly along an Århus-Oslo/Kjeller axis and is concentrated on the use of the Kjeller powder diffractometers.

4. Scientific themes

We here present the distribution of the articles on different scientific themes, as given by the ILL categorizing into "colleges". The categorizing is performed by our own judgement after browsing each article. We have merged the ILL college 6: "glass and liquid dynamics" with college 7: "materials dynamics", and split the ILL college 1 into two: "Engineering/Geology" and "Instrumentation". ILL colleges 2 and 3 deal with "Theory" and "Nuclear Physics", respectively. Theory is in this investigation not a separate field, but distributed on to the corresponding scientific themes, whereas we do not include the topic of Nuclear Physics in this report.

Category	Hard matter Structure	Materials Dynamics	Magnetic structure	Magnetic dynamics	Soft matter	Geology, engineering	Biological sciences	Instrumen-tation	General	**SUM**
ILL coll.	**5a**	**6+7**	**5b**	**4**	**9**	**1 (1st part)**	**8**	**1 (2nd part)**		**-**
Denmark	81 (29)	50 (22)	88 (68)	87 (64)	79 (41)	8 (3)	61 (21)	91 (17)		**545 (265)**
Norway	130 (41)	20 (3)	21 (9)	7 (6)	56 (17)	5 (3)	12 (3)	7 (3)	3 (0)	**261 (85)**
Sweden	213 (71)	82 (44)	104 (51)	33 (27)	163 (65)	54 (10)	92 (27)	108 (25)		**849 (320)**
Finland	35 (15)	14 (9)	19 (6)	3 (0)	25 (10)	6 (3)	16 (1)	1 (1)		**119 (45)**
Iceland		6 (5)	2 (0)		2 (0)					**10 (5)**
Estonia	12 (7)	5 (2)	14 (9)	16 (10)	4 (0)		3 (0)			**54 (28)**
Latvia	5 (1)	3 (2)	9 (1)		2 (0)	5 (0)		6 (0)		**30 (4)**
Lithuania	4 (0)	2 (0)	1 (0)	1 (0)	8 (2)	1 (0)	6 (1)			**23 (3)**
- double count	45 (19)	24 (10)	16 (9)	8 (4)	36 (9)	6 (4)	28 (9)	47 (8)	0 (0)	**210 (72)**
SUM	**435 (145)**	**158 (77)**	**242 (135)**	**139 (103)**	**303 (126)**	**73 (15)**	**162 (44)**	**166 (38)**	**3 (0)**	**1681 (683)**

We see that the Danish activities are evenly spread over the topics – except Geology/Engineering – and that there are a large fraction of high-profile publications, in particular in magnetism and soft matter. Sweden has a similar spread as Denmark, however with more emphasis on materials structure/soft matter and less on magnetic dynamics. Here, high profile publications are abundant also in hard matter dynamics. Norway has a clear strong point in structure of hard materials, and some activities in soft matter. Finland has some activity in hard matter structure, magnetism, and soft matter. Estonia has a relatively large activity in magnetism and a very large fraction of high-impact articles.

Over the Nordic/Baltic countries as a whole, there is an emphasis on hard matter structure, soft matter, and magnetism. Geology/Engineering is largely absent, except for some Swedish activity. Biosciences are well represented with 10% of the total publication volume, comparable to the international level (7-8%). However, given the Nordic tradition of this field, there would be potential for more volume here.

The high-impact (top 20%) publications are frequently found in most categories, the highest fractions are found in magnetism (62%), while hard matter dynamics and soft matter have very respectable high-impact rates of around 50%. Instrumentation has the lowest fraction of high-profile publications (23%).

5. Neutron scattering methods

We here present the distribution of the articles on different neutron scattering methods. This division is mostly based upon instrument classes. However, triple axis machines are grouped after their use: inelastic or single crystal diffraction. When data for a publication has been taken by more than one technique, we chose the one where most time has been used (own judgement).

Category	Powder diffract.	Single crystal diffract.	Stress-strain diffract	SANS	Reflec-tometry	Inelastic scattering	Imaging	Review, book, old data	Instru-mentation	Theory	**SUM**
Denmark	58 (19)	50 (40)	2 (0)	94 (48)	23 (13)	120 (60)	16 (7)	36 (11)	61 (7)	85 (60)	**545 (265)**
Norway	116 (36)	9 (3)	5 (2)	57 (17)	6 (4)	18 (4)	1 (0)	23 (5)	5 (2)	21 (12)	**261 (85)**
Sweden	220 (69)	26 (11)	34 (5)	133(54)	114(47)	97 (44)	24 (8)	55 (17)	70 (9)	76 (56)	**849 (320)**
Finland	32 (10)	12 (4)	1 (1)	20 (8)	2 (0)	9 (4)	2 (1)	11 (3)	1 (1)	29 (13)	**119 (45)**
Iceland	2 (0)			1 (0)		1 (1)				6 (4)	**10 (5)**
Estonia	24 (14)	4 (3)		2 (0)		10 (4)		3 (2)		11 (5)	**54 (28)**
Latvia	7 (0)			3 (0)	1 (0)	4 (1)	3 (0)	5 (2)	6 (0)	1 (1)	**30 (4)**
Lithuania	5 (0)		1 (0)	3 (1)	10 (2)	1 (0)		1 (0)		2 (0)	**23 (3)**
double c.	43 (14)	12 (5)	1 (1)	30 (11)	18 (8)	36 (7)	13 (7)	9 (4)	32 (3)	16 (11)	**210 (72)**
SUM	**421 (134)**	**89 (56)**	**42 (7)**	**283 (117)**	**138 (58)**	**223 (111)**	**33 (9)**	**125 (36)**	**111 (16)**	**215 (140)**	**1681 (683)**

We see that Norway has a relatively very high activity in powder diffraction, and some in SANS, reflecting the instrumentation in Kjeller. Denmark has high publication volume in SANS and inelastics, reflecting the two Danish instruments at PSI. Furthermore, Denmark and Sweden have much work in instrumentation, related to ESS and the McStas software, and within theory. Sweden has significant activities within reflectometry, SANS, powder diffraction, and inelastics, and Sweden is only country to have a significant activity within stress/strain diffraction. Estonia has a relatively high activity within powder diffraction and theory, while the Finnish activities are rather evenly distributed.

The fraction of high profile publications is very high (50% to 60%) within single crystal diffraction, inelastic scattering, and theory. The overall volume of publications in powder diffraction and SANS is very high, but the fraction of high-profile publications is here lower (30% and 40%, respectively).

6. Neutron sources

We here analyse the actual neutron sources used for the 2006-2017 publications. We have included direct experimental work, as well as site-specific instrumentation work,. Some neutron publications use data from more than one source, in that case both/all sources are counted. Some publications do not use original data and are thus not counted here. Hence, the sums here are not consistent with the sums in the previous sections. Sources in parentheses were permanently closed by December 2017.

Source		DK	N	S	FI	IS	ES	LV	LI	Double count	**SUM**
ESS	S	25	2	30				2		18	**41**
Kjeller	N	8	96	5	2					15	**96**
ILL	F	132	27	207	22	1	11	3	3	49	**357**
ISIS	UK	45	27	162	9	2	3		4	29	**223**
PSI	CH	125	20	50	3		14	6	1	31	**188**
FRM2	D	24	7	34	4				3	8	**64**
HZB	D	26	6	28	2		4	9		9	**66**
LLB	F	4	4	16	9		2	4	1	2	**38**
BNC	H	5	2	2	3						**12**
Delft	NL	5		9						5	**9**
Rez	CZ	2	2	9	1					1	**13**
Dubna	RUS		5	3	2		5	6		2	**19**
Zarechnyi	RUS			3							**3**
PNPI	RUS				1						**1**
(GKSS)	(D)	8	7	17	1				1	6	**28**
(Studsvik)	(S)	3	5	67						7	**68**
(Jülich)	(D)	3	1	7	3						**14**
(DR3)	(DK)	3		1						1	**3**
SNS	US	20	4	22	2		1			6	**43**
NIST	US	20	6	30		1	2		7	1	**65**
HFIR	US	7		7							**14**
LANL	US	6	4	15	7					2	**30**
MURR	US	2									**2**
Chalk River	CAN	2	1	1							**4**
(IPNS)	(US)	5		2	2						**9**
J-PARC	JAP	1	1	3	1						**4**
KEK	JAP	2			1						**3**
ANSTO	AUS	10	3	24	1		1			3	**36**
Dhruva	IND			3							**3**
IRR-1	ISR			2							**2**
SUM	**-**	**493**	**230**	**759**	**76**	**4**	**43**	**30**	**20**	**195**	**1458**

The Nordic/Baltic countries have very different choice of sources. Danish activities are much focused on PSI with the Danish instruments, Norway has a strong focus on their own source in Kjeller, while Sweden has a strong activity at ISIS with the Swedish instrument there. All Nordic countries, as well as Estonia, benefit strongly from ILL, with Denmark and Sweden as clearly the largest users (and the only members).

The world leading sources SNS and (in particular) J-PARC show low numbers, even though they began user operation already around the beginning of the counting period. This is partly because the time from data taking to publication is typically 2-3 years, partly because both sources started with a limited selection of instruments, and partly because the distance to these sources will hardly allow them be first choice of source for any European experimental group, unless for unique experiments. On the other hand, the ILL-like reactor facility NIST, near Washington DC, has a large Nordic/Baltic use, which equals that of the geographically much closer sources HZB and FRM-2. The reason for this fact cannot be revealed by our data.

7. Present Nordic neutron initiatives

During 2016-2019, a number of programs to support the Nordic use of neutron scattering is launched or being launched. We here mention:

- The Nordic Neutron Science Program, NNSP. This Nordforsk program funds 17 graduate students (from 2017), 4 post docs abroad (from 2018; 1 at FRM-2, 1 at ILL, and 2 at ISIS), a collaboration of 6 scientific networks (from 2016), and the Nordic Neutron School (from 2017).
- The national Swedish program SwedNess. This program is funded by the Swedish Foundation for Strategic Research and supports (from 2017) 21 graduate students, with another 20 students likely to come in the near future.
- The national Danish program DANSCATT, supported by the DK Ministry of Science through the National Board for Research Infrastructure (NUFI), funds travels to neutron (and X-ray) facilities. In addition, the program funds 3 post docs abroad (from 2017; 2 at ILL and 1 at PSI).
- The national Danish “Lighthouse” projects funded by NUFI. This will from 2019 fund up to 6 topical communities with a total budget of at least 70 MDKK, each.

We have not yet seen any effect of these, recently initiated programs in the literature search. Neither could this be excepted, since the typical turn-around time from project start to publication in neutron scattering is around 3 years; in this case, an effect should be visible in 2019. We will in our future community reports carefully evaluate the effects of this targeted funding.

8. Conclusions

The Nordic/Baltic neutron scattering community counts 449 scientists, who have in total published 1681 neutron-related articles over the last 12 years. There is a clear increasing tendency in the annual publication rate over the period of investigation; this increase comes mainly from staff at ESS and from Swedish, Norwegian, and Danish universities. 12% of the publications are made in collaboration between two or more Nordic/Baltic countries, with an increasing tendency.

42% of the publications appear in the 20% highest ranked journals, and are spread over most of the “usual” scientific topics for neutrons. This shows that the research is broad and generally on a high international standard.

Notable potential for improvement is found within the topics Geology and Engineering, where the publication volume is low, except in Sweden. In addition, there is a potential for development within the Biological sciences, given the Nordic/Baltic countries' general high level in this these research areas.

The main neutron source used for obtaining the results is the ILL, which accounts for 25% of the (source-related) publications. In addition, Norway has a strong use of Kjeller, Sweden of ISIS, and Denmark of PSI. This reflects the different collaboration partners of each country, in particular investment in and operation of neutron instruments. These instrument operations are clearly linked to the scientific strong points of each country.

A number of programs for stimulating neutron scattering science in the Nordic and Baltic countries has recently been launched. It will be interesting to follow the impact of these programs on the publication records and community sizes, which is expected to be visible in 2019.