The Implementation of the Bologna Process into Physics Studies in Europe

Draft Project Report

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1. Introduction: Description of Project

In 2007 the European Physical Society received funding from the European Commission to carry out a study of the implementation of the two-cycle (Bachelor/Master) study and degree structure into Physics studies in European Universities. It was envisaged to cooperate with the National Physical Societies of at least 15 European countries to collect relevant Physics curricula for in-depth analysis and conduct an online survey addressed to coordinators of Physics programmes in a representative sample of universities in each of the countries involved in the study. The International Centre for Higher Education Research (INCHER-Kassel) at Kassel University was subcontracted as a partner in this project to analyse the curricula and administer the survey. Representatives of the European Physical Society acted as members of the steering group of the project as a whole and as contact persons to the national Physical Societies.
Originally it was envisaged to include both classical physics studies and engineering physics programmes into the analysis, however, during a first meeting of project partners and steering group it was decided to concentrate in the first year of the project on Bachelor programmes only and exclude engineering physics and teacher training programmes in physics in order to arrive at a relatively homogeneous sample of programmes for the analysis. It is envisaged to focus on Master programmes in Physics in the second year of the project.
The aims of the project can be summarised as follows:

- to provide an overview of the state of implementation of Bachelor and Master structures in Physics Studies in Europe;
- to analyse possible regional differences in the structures;
- to determine to what extent common standards and well-timed examinations have been introduced as an element of quality assurance;
- to provide information about the extent of modularisation that can be found in the new structures;
- to assess whether professional qualifications can be obtained within the framework of Bachelor studies in Physics; and
- to determine whether Bachelor curricula have a more standardised structure while Master programmes offer a higher degree of specialisation and, thus, diversity.

Due to the specific character of Physics studies in most European countries which have introduced the Bachelor/Master structure only in recent years, there will also be a special focus on the interfaces and transitions, i.e. the transition from school into university physics studies and the transition either into the labour market or into Master studies in Physics after successful completion of a Bachelor degree.
Overall, the study aims to provide a profile of the implementation of the Bachelor/Master structure in European Physics programmes and arrive at conclusions pertaining to the following issues:

- an assessment whether major goals of the Bologna Process have been addressed and whether the aims of the European Commission's "Education and Training 2010" Work Programme will be met;
- enabling Physics Departments involved in the study to recognise potential partners for exchange and cooperation;
- yielding the basis for advice to students interested in changing university;
- providing a basis for modifications and amendments which might become necessary to achieve the overall reform goals.

2. Design of the Study

The study is divided into two parts which will complement each other and linked together in the concluding chapter.
After having determined the sample size – approximately 60 percent of all universities offering Physics programmes in each country involved in the study – contact persons in the respective National Physical Societies were asked to select the respective number of universities and ask the local programme coordinators to send their Bachelor and Master Physics curricula to INCHER-Kassel. Where necessary they were also asked to help with translations into English. The curricular material was analysed according to a list of criteria (cf. chapter 4) which had been derived from the main structural dimensions of the Bologna reform process.
In a second step an online questionnaire was designed focusing primarily on Bachelor programmes and covering altogether nine areas (cf. chapter 5):

- personal details of the respondent(status and function),
- institutional details (type, size),
- implementation of the tiered (two-cycle) structure (accreditation status, duration, number of programmes on offer),
- implementation of complementary measures (ECTS, workload, modularisation, mobility opportunities),
- characteristics of the curriculum (generalised/specialised, use of foreign languages in teaching and learning, extent of interdisciplinarity),
- forms of student assessment and examinations,
- mechanisms of quality assurance,
- employability and acquisition of transferable skills,
- number of international students, completion rates and transition into Master studies or into the labour market.

For the United Kingdom a separate online questionnaire was constructed due to the fact that the Bachelor and Master structure is the rule in British universities and many questions did not apply. Thus, results of the UK online questionnaire will be presented separate from the other countries involved and – where possible – integrated at a later point in time.
Together with a cover letter explaining the project and including the link to the online questionnaire a sufficient number of PINs (generated by chance) were then sent again to the contact persons in the National Physical Societies with the request to forward the letter and one PIN to the programme coordinators in the selected universities. Due to reasons of data protection all universities having submitted curricular material as well as all persons filling in the online questionnaire were assured of complete anonymity.

3. Bologna Reforms and Physics Studies

3.1 The Bologna Process: Structures and Elements of Bachelor and Master Programmes

The overall goal of the Bologna Declaration and the resulting reform process (for short: Bologna Process), namely to create a European Higher Education Area

(EHEA) by the year 2010 has been described as a “target on the move” (cf. Maassen/Olsen 2007, Kehm/Huisman/Stensaker 2008). And indeed, with every ministerial meeting after the one in Bologna in 1999 when the original Declaration was signed by 26 European countries goals were added to the agenda and targets refined increasingly moving from a mostly structural level to also include content related goals. Thus, for example, the “social dimension” was added at the 2001 ministerial meeting in Prague, doctoral education as the third cycle of studies was added at the 2003 ministerial meeting in Berlin, further details on specific targets, in particular on quality and a European qualifications framework were added at the 2005 ministerial meeting in Bergen. All the while more and more countries joined the process by signing the Declaration and committing to the achievements of the goals by 2010. By now altogether 46 countries have signed and the Bologna Process is regarded as the biggest and most far reaching reform of curricula and study structures since possibly the period after World War II.

In addition to ever more countries joining the reform, stakeholder inclusion was extended as well. Starting as an intergovernmental initiative of ministers responsible for (higher) education, deliberations, follow-up and stocktakings now include the European Commission, the European Association of Universities (EUA), the European Student Union (ESIB), and a number of other actors (e.g. ENQUA, EURASHE, the Council of Europe). In fact, the process of coordinating this massive reform project has become so complex that a Bologna Follow-up Group has been established with its own Secretariat, a Stocktaking Group, and a number of other European organisations and consortia have become involved studying particular issues and working on the formulation of recommendations.

In addition to periodic national reports about the implementation of the Bologna reforms to be submitted by all signatory countries, the European Commission is currently funding an independent consortium (in which INCHER-Kassel is one of altogether three partners) analysing the state of implementation and the achievement of the Bologna goals for the ‘finale furioso’ which can be expected in 2010. Finally, the responsible ministers are currently in the process of designing and discussing a strategy for the future and sustainability of the Bologna Process 2010 to 2020 which will be decided at the upcoming ministerial meeting in Leuven in April 2009 (cf. Kehm/Huisman/Stensaker 2008).

Despite the growing complexity of the reform agenda, there are a few core issues which can be said to constitute the main targets for 2010:

- the adoption of a system of easily readable and comparable degrees, also through the implementation of the Diploma Supplement (Bologna Declaration 1999);
- the adoption of a system essentially based on two main cycles, undergraduate and graduate, the first cycle lasting a minimum of three years and being relevant to the European labour market as an appropriate level of qualification (Bologna Declaration 1999);
- the establishment of a system of credits (such as in the ECTS system) to promote student mobility (Bologna Declaration (1999);
- the promotion of mobility of students, teachers, researchers and administrative staff including recognition and valorisation of periods abroad (Bologna Declaration (1999);
- the promotion of European cooperation in quality assurance to develop comparable criteria and methodologies (Bologna Declaration 1999) further refined in the Berlin Communiqué 2003);

- the promotion of the necessary European dimensions in higher education with regard to curriculum development, inter-institutional cooperation, mobility schemes, and integrated programmes of study, training and research (Bologna Declaration 1999);
- to promote lifelong learning as an essential element of the European Higher Education Area (Prague Communiqué 2001);
- involvement of higher education institutions and students as competent, active and constructive partners in the reform process (Prague Communiqué 2001);
- to promote the attractiveness of the European Higher Education Area to students from Europe and other parts of the world (Prague Communiqué 2001);
- the establishment of a link between the Bologna reforms and the Lisbon Strategy to create a European Research Area (Berlin Communiqué 2003);
- the adoption of an overall framework for qualifications comprising three cycles (Bergen Communiqué 2005);
- the inclusion of a social dimension in the Bologna Process (Bergen Communiqué 2005);
- the establishment of a European Register of Quality Assurance Agencies (London Communiqué 2007);
- to promote the attractiveness and competitiveness of the European Higher Education Area in a global context (London Communiqué 2007).

In order to be able to analyse the structures and elements of Bachelor and Master programmes (for the time being the third cycle, i.e. doctoral education, is not included in this study) we have concentrated on those Bologna reform goals that are targeting to study programmes and have to be implemented at the institutional level and have not dealt in detail with goals that have to be implemented at the national level and through policy. This basically leaves the two-cycle structure and their duration, the diploma supplement, the introduction of a credit point system, the issue of employability after successfully completing the first cycle, the promotion of mobility and a European dimension in the curricula, widening access or enabling equality of access (social dimension), and quality assurance. These are the items on which we have concentrated our analysis of Bachelor (and Master) curricula in Physics studies in Europe.

3.2 Previous Analyses

More policy and nationally or European level oriented; hardly any curriculum analyses and not in Physics at all; few exceptions: Witte (but not Physics), Tuning/STEPS/EUPEN etc.
Most analyses show, however, that there is a certain amount of convergence on the level of macro structures while the is a clear trends towards diversity and divergence at the level of the micro structures. In addition, policy makers of many Bologna signatory countries have attached national reform agendas to the Bologna reform process so that not everything subsumed under the “Bologna label” actually is prescribed by the Bologna reform agenda.
(…)

3.3 Sample Size, Responses, Specificities

Basically through word of mouth and promotion of the project by the European Physical Society the number of countries involved in the project could be extended from the envisaged 15 to 26 by now. In particular a number National Physical Societies from smaller, often Central and Eastern European countries were keen to join, while some of the larger and more central countries have been lagging behind a bit.
Through a desk research we first tried to determine the total number of universities in each of the countries and assumed that these would be offering Physics Studies. We then decided in cooperation with the steering group to have a sample of about 50 to 60 percent of these universities in the big countries and 100 percent in the small countries and ask the contact persons in the respective National Physical Societies to provide us with the Bachelor and Master Physics curricula of a given number of universities or approach a university contact person to submit them either in paper or in electronic form. This did not quite work out as expected. The following factors prevented us from having our ideal type sample:

(a) the implementation of the Bachelor and Master structure in some countries had not yet started at all or was in its preparatory stages (e.g. Spain);
(b) some countries had opted to implement Bachelor programmes first and Master programmes at a later stage (or vice versa);
(c) implementation of the new structure does not happen at the same time in every university across some countries so that some universities have changed to the new structure already while others have not yet (e.g. France, Germany);
(d) in two very centralised countries the Bologna reforms are being implemented by designing one national template for a curriculum which has to be implemented by all universities (Belarus, Ukraine);
(e) in a few cases physics studies are not offered at all universities but are centralised in one or two institutions (e.g. Czech Republic);
(f) some countries are late in submitting their curricula or never reacted to our requests, despite the fact that the president of the National Physics Society had committed to participate in the project (but that phenomenon can be observed in the overall Bologna Process itself) (Poland, Denmark,);
(g) from quite a number of countries we received links to the relevant websites of the universities and had to go through the website page by page and click by click in order to fish out the information relevant for our project (e.g. UK, Netherlands);
(h) finally, there was and still is the problem that some of the curricula and related material have not been translated but were sent to us in the language of the country; and while we can deal with quite a number of languages, at least sufficiently to get an idea about the curriculum, other languages are simply beyond our capacity (e.g. Finnish, Albanian).
(i) In a few cases there was a change of contact person so that the curricula arrived late.

In order to produce this draft report we also had to base our equally preliminary data and conclusions on a low response rate for the questionnaire. Due to the fact that collecting and analysing the curricula took considerably longer than anticipated, the online questionnaire was administered later than envisaged. No reminder activities

have been done so far and responses are still coming in. For the final report these will be taken into consideration.
So here is a table contrasting what we ideally had hoped for and what we have actually received so far in terms of curricula submitted for analysis:

Table 1: Countries involved in the study, number of universities, curricula received (status: 2 December 2008)

Country	Total number of universities	Number of universities with Physics Departments	Number of universities to be included in project	Number of universities having submitted curricula	Comments
Albania	15	4	4	2	
Austria	31	6	6	6	
Belarus	28	6	6	2	One curriculum for a one year Master; one curriculum for a (traditional) 5 year specialist education.
Belgium (fl.)	6	3	3	3	
Belgium (fr)	10	3	3	3	
Croatia	5	4	4	4	
Czech Republic	24	12	7	3	80 to 90% of Physics education concentrated in 3 universities.
Denmark	12	4	4	0	
Finland	13	11	8	8	
France	94	43	25	5	Collection of curricula ongoing.
Germany	97	59	35	35	
Greece	23	5	5	3	
Hungary	25	5	5	5	
Irish Republic	21*	9	3	3	* 7 Universities; 14 Institutes Of Technology with equivalent programmes.
Italy	89	36	20	11	
Lithuania	15*	4	0	1	* 7 private Universities.
Macedonia	5	2	2	2	
Netherlands	15	15	5	5	
Poland	18	12	8	0	
Portugal	34	15	10	10	
Slovenia	4	3	3	3	
Slovakia	13	6	4	2	80 to 90% of Physics education concentrated in two universities.
Spain	73	18	10	6	Implementation of Master progr. just starting, further delivery promised as soon as available.
Sweden	20	20	12	2	
Switzerland	12	10	8	7	
Ukraine	81	10	3	2	One national curriculum for a 4-year Ba (Ma envisaged at a later stage.)
United Kingdom	212	48	30	30	
Total	**995**	**373**	**233**	**163**	
In Percent		**37.5 % of the universities**	**62.5 % included in project**	**70.0 % of departments/ faculties submitted one or more curricula**	

The table shows that there are altogether roughly 1,000 universities in the 26 countries involved in the study of which 373 (37.5 %) offer physics studies according to an information of the European Physical Society. From among these we selected (as described above) a sample of about 60 percent. The response rate until 1 December 2008 has been 70 percent, however we also should note the inherent bias in the sample. About two fifths (39.9%) of the curricula in the sample are from Germany and the UK. No curricula so far have been received from Poland and Denmark. Lithuania joined the project additionally. Two of the larger countries submitted only one curriculum due to the fact that a national curriculum template had been designed which must be implemented by all universities in the country offering Physics studies. In Slovakia and in the Czech Republic classical Physics studies are concentrated in just a few institutions while the others offer teacher training or applied Physics which we excluded from our analysis. Finally, the collection and translation of curricula in France, Sweden and Spain is still ongoing.
Altogether the analysis of Bachelor Programmes in Physics is based on 148 universities having submitted one or more Bachelor curricula by the beginning of December 2008. Some curricula which were submitted only very recently have not yet been included in the analysis but will be included in the final report. To establish the exact number of Bachelor curricula in Physics included in this study presents a problem. The majority of institutions offer only one Bachelor Programme in Physics, however there is a sizable number of universities (esp. in the UK) – 29 out of 31, i.e. 93.6 percent – offering more than one and up 10 or 12 different programmes at this level. In addition there are also a few universities offering different Physics degree programmes at the Bachelor level which are distinguished into one general Physics programme with a given number of variants in form of specialisations which are also named as part of the degree. These variations in the combination of general Physics education plus a chosen specialisation do not count as individual programmes everywhere. In order to deal with this potential bias we have chosen Physics departments/faculties as our aggregate level for overall tables and only total number of curricula submitted for statements about individual countries. For the time being we have established a number of 148 faculties/departments with Bachelor Physics curricula as a basis for our analysis. In two countries we have examples from more than one university but there is only one unified national curriculum. Finally, three departments submitted a Master curriculum only. This explains the difference between the number of universities (n=163) having submitted curricula (be it Bachelor curricula or be it Master curricula or both) provided in table 1 and the number of departments/faculties having submitted Bachelor curricula in Physics (n=148) used as the basis for our analysis. Due to lack of time the 6 Spanish universities from which we have received curricula are included in table 1 but not in the analysis yet.

3.4 Bachelor Studies in Physics

(this chapter will contain some general observations about the character of Bachelor Physics studies in Europe)

4. Results of the Curriculum Analysis

4.1 Duration of Studies

The majority of Bachelor programmes in Physics which have been submitted for analysis have a duration of three years. Exceptions are found in Greek and Irish universities as well as in Lithuania and Macedonia where they have a duration of four years. The one curriculum we received from Belarus which is the same for all universities in the country is a traditional five year programme.
What has to be kept in mind when talking about duration of studies are two things:

- The Bologna Declaration only talks about a first cycle which should have a duration of at least three years, thus longer programmes are possible as well as long as the combined duration of first and second cycle studies is not longer than fives years.
- The transition phase from school into Physics studies at universities increasingly tends to be extended through preparatory courses which may last up to one year. In addition, some programmes (esp. in the UK) offer a year of study abroad which might also extend the duration until completion of the degree.

Table 2 provides an overview of the regular duration of Bachelor studies in Physics as established in the curricula. It does not inform about the actual duration until successful completion of the degree.

Table 2: Duration of Bachelor studies in years

Duration in years	3 years	3 or 4 years	4 years	5 years	No information	Total
Number of curricula	135	1	11	1	1	148
In percent	91.2	0.7	7.3	0.7	0.7	100

4.2 Use of Credit Points Systems and Student Workload Calculations

A number of European countries had introduced credit point systems long before the beginning of the Bologna Process, some even before the advent of the European Credit Transfer Scheme (ECTS) as a pilot scheme (in 5 subjects and 145 universities) in the academic year 1989/90.
While ECTS gradually became more popular in the course of the 1990s as a formal instrument of recognition, it experienced it final breakthrough at the beginning of the Bologna Process. The Bologna Declaration and subsequent Communiqués of the responsible Ministers do not prescribe the use of ECTS but accept other credit point systems as well as long as they are compatible with ECTS. Those countries operating their own credit point systems (in particular UK, Ireland, some of the Central and Eastern European countries within our sample, but also some of the Scandinavian countries and France outside of our current sample) have by now found means and ways to make them compatible with ECTS (here information will be added which countries use national credit point systems and which countries use ECTS).

The idea of basing credit points on a calculation of student workload crept into the reform agenda during the 2003 ministerial meeting in Berlin at which the establishment of an overarching framework of qualifications for the European Higher Education Area was introduced. Establishing such a framework of comparable and compatible qualifications (at first implemented by the Dublin Descriptors which were then further developed into a European Qualifications Framework) entailed the description of "qualifications in terms of workload, level, learning outcomes, competences and profile" (cf. Berlin Communiqué 2003, p. 4) and marked the shift from a teacher centred to a learner centred organisation of studies. The student workload is calculated on the basis of the number of hours a student has to spend for earning one credit and consists of self-study, participation in classroom teaching and doing the homework or prepare for and participate in an examination. The general idea that one ECTS credit point equals approximately 25 to 30 hours of student workload is based on an estimate of how long an average student might need to fulfil certain tasks, acquire certain competences, or successfully acquire knowledge, skills and competences of a certain type. The latter is defined as learning outcome. According to these parameters students acquire 60 ECTS credit points in a given academic year and accumulate altogether about 180 ECTS credit points in the framework of a 3 year Bachelor programme (between 4,500 and 5,400 hours of student workload).
The vast majority of Physics bachelor curricula in our sample indicated the number of national or ECTS credit points that have to be earned for a Bachelor degree, however it frequently remains unclear how many hours of student workload are necessary to earn one credit point or whether credit point calculations are based on student workload at all.
Table 3 provides an overview of the number of curricula based on national and ECTS credit points.

Table 3: Number of credit points to be earned for a Bachelor degree and student workload

	ECTS	National Credit Point System	Student Workload/Hours*	No Information	Total
Curricula	100	30	1	16	148
In percent	68.0	20.4	0.7	10.9	100

* One university submitted a five year curriculum requiring 9,744 hours of studies but does not use a credit point system.

(here more concrete information will be added about student workload, modularisation and learning outcomes.)

4.3 Diploma Supplement

Despite the fact that the Diploma Supplement is becoming increasingly more widespread, the majority of curricula included in our analysis does not provide information about its implementation. Not finding any mention of it does, however, not necessarily imply it is not issued or available. It might also be that the issue of the Diploma Supplement is stated in different documents which we did not collect. We

therefore created three categories (automatically issued, issued upon request and no information available).
Of the 148 curricula which we have analysed so far 118 (79.7%) did not provide any information concerning the Diploma Supplement, 25 (16.9%) stated that it was issued automatically, and 5 (3.4%) stated that the Diploma Supplement was issued upon request.

4.4 Time Windows for Mobility

It is well known that easing and increasing mobility of students (and staff) is an important goal in the Bologna reform process. When the actual process of implementing the tiered structure of study programmes and degrees had taken off, there was first a widespread concern that the way of implementing the reform would create a problem for mobility because curricula showed a high level of density of subject matter and the more formalised structure of studies in many programmes seemed to close rather than open up time windows for mobility. In addition, figures tended to support this concern. Intra-European, ERASMUS-type mobility was stagnating or even decreasing. However, gradually another picture is emerging. Temporary periods of study abroad (à la ERASMUS), now being termed "credit mobility" are beginning to be complemented by what has been called "degree mobility", i.e. more and more students opt to study abroad for a whole degree programme. In addition, there is an increasing number of students from outside Europe seeking to get a degree at a European university. The latter is also related to the fact that the number of English taught degree programmes has increased in the non-English speaking countries. Finally, there also seems to be a slight increase in the number of double or joint degree programmes which – together with the ERASMUS Mundus programme – offer further opportunities for study abroad which are integrated into the curricular structure of a given programme and thus, constitute the rule rather than an exception.
Only a minority of our Bachelor Physics curricula which are included in the study include an obligatory phase of study abroad. In a number of programmes study abroad is possible – most likely within the framework of ERASMUS agreements – and the majority of curricula does not provide information on this issue. Here the same arguments are valid as provided for the "no information" category for the issue of the Diploma Supplement. An overview is provided in the following table (Table 4).

Table 4: Mobility within the Physics Bachelor curricula

	Mobility possible	Mobility obligatory	No Information	Total
Curricula	48	3	97	148
In percent	32.4	2.0	65.5	100

4.5 Employability: Key Skills and Competences

The shift towards a student centred organisation of studies and the related assessment of learning outcomes together with the emphasis on labour market relevance of the first cycle degrees (employability) more attention has been paid to the acquisition of key skills and competences by students.

On the one hand a considerable number of key skills and competences for important Physics graduates have been identified, first and foremost – in the non-English speaking Bologna signatory countries – a good command of the English language. On the other hand it is still unclear in many of those countries having newly introduced the tiered structure of study programmes and degrees what a Bachelor graduate in Physics can actually do on the labour market. There continues to be a widespread view that a proper Physicist can not be produced within three years of study. This of course is different in those countries (namely UK and Ireland) which have always had the tiered structure of study programmes and degrees.
In the Bachelor Physics curricula which have been analysed for this study the following key skills and competences have been identified most frequently:

- (…)
- (…)
- (…)

4.6 Transitions

Two factors tend to increase the actual duration of studies for a Bachelor degree: mobility and access regulation.
An example for the first factor are UK universities. UK Bachelor programmes in Physics normally have a duration of 3 years. However, a number of Bachelor degree programmes are offered with an obligatory (and integrated) year of study abroad which often increases the number of years until completion to four. Typically students would spend their third year of studies in another country and return to their home university for the final year. These arrangements are not necessarily in the framework of an ERASMUS partnership or a joint or double degree programme. They can also exist within the framework of institutional or departmental arrangements and then do not necessarily include an exchange.
The second factor is only indirectly related to the Bologna reform goals. Due to shifts towards formula or performance based funding of universities in many countries, a frequently used indicator is “number of students successfully completing their studies within the regular period of time”. This indicator puts pressure on universities to take over responsibility for getting as many students as possible through the programme in the prescribed period of time in order to secure their funding. This in turn has led to the fact that universities become increasingly selective in their admission to Physics studies. This is further re-enforced by the growing competitiveness of European universities among each other for the best talent.
Many curricula which have been analysed in the framework of this study do no longer accept the upper secondary school leaving certificate at face value but have established further conditions which have to be met by students who are seeking access into Physics studies. In some countries (e.g. Germany, Italy and Croatia) universities have established entrance examinations, in other countries additional requirements are defined, like outstanding marks in particular school subjects like mathematics, physics or chemistry), or participation in longer preparatory courses is recommended before enrolment (this is the case in some universities in Croatia, Switzerland, Germany, and Italy).
The following list of key skills and competences could be found in the curricula submitted for analysis:

- (…)
- (…)

Another issue to be mentioned here is that previous studies about learning outcomes came to the conclusion that key skills and competences are more easily acquired if they are integrated with the subject matter. However, we do see a certain trend to "outsource" at least parts of them to other departments or service centres for the support of teaching and learning. This practice can be found in subjects other than Physics as well and is most probably related to either lack of competences among the regular teaching staff in Physics or capacity problems in terms of teaching load. Bachelor Physics curricula (as other Bachelor curricula as well) are also shaped by the transition phase starting after completion of the degree. Here the issue is whether transition onto the labour market or transition into a Master programme is sought. In many countries, persons responsible for the curriculum of a given Bachelor programme continue to find it difficult to prepare students for both options within three years. In addition, universities which are competing for best talent tend to be more interested in preparing their students for transition into a Master programme or possibly turn them into early career researchers than preparing them for the labour market. The Bachelor degree then tends to become an 'honourable way out' for those students who are deemed to have insufficient potential fur getting a higher level degree, i.e. the Bachelor award becomes an implicit 'weeding out' procedure. Again, the cases of UK and Ireland are different in this respect because the labour market is used to absorb Bachelor graduates while this is not the case for those countries in which the Bachelor degree is new and potential employers are used to recruit Physics graduates after five or more years of studies.

(concluding sentences here)

5. Results of the Questionnaire

5.1 Description of Sample and Respondents

In mid-November 2008 a cover letter with a link to the online questionnaire and a number of PINs (generated by chance) were sent to the contact persons in the National Physical Societies with the request to send the cover letter and one PIN to each of the programme coordinators of study programmes in Physics in the universities selected for inclusion in the project. Also countries were included from which no curricula had been received for analysis. For the UK and Ireland a special questionnaire had been designed which went online a few days later. The results of the online questionnaire from UK and Ireland are not included in this draft report due to time reasons and insufficient response rate at this stage. The deadline for submitting the filled in questionnaires was set for 28 November 2008. A week after that a reminder email was sent to all contact persons in the National Physical Society with the request to forward it to the programme coordinators in the universities. Altogether 242 PINs were provided to programme coordinators at universities offering Physics studies in 26 European countries (among them 34 to UK and Irish universities which are not yet included here). Before the first reminder was sent out the response rate was 33 percent (n=68). From altogether 10 countries no filled in questionnaires had been sent and from only two countries all universities selected for inclusion in the project had responded. Again this creates a serious bias because almost half of the returned questionnaires (30) were from German universities. This is the reason for only presenting aggregate data at this stage and no data by country. It

is also necessary to keep in mind that information from German Physics studies make up a large part of the sample.
The highest proportion (47%) of local contact persons or programme coordinators in the universities who filled in the questionnaire were senior teachers (professors, readers, lecturers) followed by deans, directors or heads of studies (32%). But there were also some junior academic (3%) and administrative staff (7%) dealing with the questionnaire as well as a number of persons in other functions ranging from vice dean and faculty manager to head of the examination board. In relation to the Physics Bachelor Programme or Programmes, the respondents had different functions, most of them being senior teachers (69%), followed by programme coordinators (62%), and administrative staff (18%). Other functions were indicated by 10 percent of the respondents.
Regarding the higher education institutions Physics Departments of which have participated in the survey the sample has a slight bias towards older universities, more than half are 100 years old or older, the oldest being 700 years old, the youngest 15 years. Among the Physics departments responding to our questionnaire 89 percent were part of a university and 11 percent part of a technical university. We also asked about the range of subjects offered by the institution as a whole and it tends to be rather broad. All of the institutions offer programmes in natural sciences, more than three fourth offer humanities and social sciences, almost one third offers law, and more than half of them offer engineering and medicine. Arts (including Design and Architecture) are offered by almost half of the institutions (47%) and agriculture by only 20 percent. We can conclude that a clear majority of universities in which participating Physics Departments are located offer the full or at least a very broad spectrum of subjects.
This is supported by the overall number of students studying at the respective universities as table 5 shows.

Table 5: Size of institutions participating in the survey by number of students

Number of students	Absolute	In percent
Up to 5,000	5	7.6
5,001 – 10,000	9	13.6
10,001 – 15,000	9	13.6
15,001 – 20,000	9	13.6
20,001 – 25,000	7	10.6
25,001 – 30,000	9	13.6
More than 30,000	8	12.1
No information provided	10	15.2
Total	66	100

The smallest higher education institution in our sample has slightly less than 1,000 students and the biggest has 72,000 students.
Slightly more than one third of the universities participating in the survey (35) are less than 100 years old and slightly less than one third ranges in age between 100 and 700 years. Overall our sample of universities tends to have a slight dominance of large and older institutions offering a broad range of subjects and study programmes. The Physics departments or faculties which have filled in the online questionnaires also tend to be larger ones with 30 departments having up 420 undergraduate

students and 28 departments/faculties having between more than 450 and up to more than 3,000 undergraduate students.
The number of doctoral students/candidates in the departments/faculties having participated in the survey is shown in table 6.

Table 6: Size of Physics departments/faculties by number of doctoral students

Number of doctoral students/candidates	Absolute	In percent
Up to 10	4	6.1
11 – 50	24	36.4
51 – 100	15	27.7
More than 100	11	16.7
No information	12	18.2
Total	66	100

To be added: size of Physics departments/faculties in terms of students, academic staff, doctoral students/candidates according to country.

To be added: comparison of previous names of study programmes and new names of study programmes.

The types of Physics programmes currently offered by the departments/faculties responding to the questionnaire (n = 66) show a considerable range as well. About one fifths of the departments (21%) offer (degree) programmes other than Bachelor or Master or doctoral programmes indicating either that traditional programmes are still offered or that programmes other than degree programmes in Physics are also provided (cf. Table 7).

Table 7: Types of Physics programmes currently offered (multiple replies possible**)**

Type of programme(s)	**Absolute**	**In percent**
Bachelor progr.	56	97
Stand alone Master progr.	34	59
Consecutive/integrated Master progr.	38	66
Other (degree) progr.	12	21
Doctoral progr.	43	74

(To be added: more explanation on Ns and missing cases.)

5.2 Implementation of the Tiered Structure

Two thirds of the responding departments/faculties introduced first-cycle or Bachelor programmes in Physics in the years 2004 to 2007, about ten percent each said that Bachelor programmes are the traditional degree programmes or that Bachelor programmes were introduced before the year 2000. Two percent introduced the new programmes and degrees in 2008 and seven percent answered that the introduction

of new programmes and degrees is envisaged for a later point in time. This adds up to 90 percent of all undergraduate programmes in Physics which are included in the survey having changed to the new structure (including those departments/faculties in which the Bachelor degree is the traditional degree). The degree of change thus is considerable.
The vast majority of countries have national and/or institutional accreditation systems for new programmes in place. New study programmes are accredited by a national 68%) or institutional (17%) accreditation procedure, further 12 percent of respondents stated that new programmes are approved by the responsible Ministry. Altogether seven higher education institutions (12%) having submitted a Bachelor Physics curriculum are institutionally accredited and autonomous to establish their own programmes. Altogether 61 percent of the respondents stated that their Bachelor programmes in Physics are accredited while 39 percent said that it was not (yet) accredited.
In more than four fifths (84%) of departments participating in the survey the Bachelor programmes in Physics have a duration of three years, in 15 percent of the departments the duration is 3.5 years and in only two percent it is four years. The scheduled or prescribed duration of a study programme is, however, not identical with the time it takes students on average to successfully finish their programme. On average, only 13 percent of the students finish in the prescribed period of three years, 23 percent take 3.5 years, 15 percent need four years, two percent 4.5 years, and 84 percent of respondents stated that students need five years to finish their programme. In 47 percent of the cases information on this issue was not provided or not yet available.

(From here onwards only rough information)

5.3 Implementation of Complementary Measures (Credit points, workload, modularisation, mobility)

ECTS credit points are used by 87 percent of Physics departments/faculties while the rest either uses a national credit point system (as a rule ECTS compatible) or both. Furthermore, three quarters of the respondents (73%) state that their Bachelor Physics programmes are modularised.
A very high proportion of respondents (88%) state that their modules are calculated on the basis of student workload and about two thirds indicate that 25 to 30 hours of workload earn one credit point. Only 14 percent of the respondents indicate that there are fewer hours required to earn one credit point and seven percent state that the category of student workload does not apply. Furthermore, 88 percent of the respondents state that the module or course descriptions in their programme(s) include expected learning outcomes.
Compulsory phases of study abroad are rare (2%), however 98 percent of the respondents state that elective phases of international student mobility are part of their Bachelor curriculum in Physics. In almost half of the programmes (46%) students can go abroad for a temporary period of time at any point during their programme of studies but there is a clear trend (39%) that the third year of studies is the preferred point in time to go abroad. More than half of the respondents (55%) state that mobile students spend between three and 5 months abroad but 38 percent also spend more than five months abroad.

Joint or double degree programmes are rare at the Bachelor level in Physics. Only 2 percent of the respondents stated that their programme is a joint or double degree programme.

5.4 Character of Physics Bachelor Curricula (generalised/specialised, learning outcomes, foreign languages, interdisciplinary elements)

Two thirds (63%) of the respondents state that their Bachelor Physics programmes are more general, two percent characterise them as more specialised and one third (35%) state that there is a mix of general and more specialised content. Frequently teaching is offered in a foreign language (add here which languages). One third (36%) of the respondents state that foreign language teaching takes place in parts (85%) or even for the whole (15%) of the Bachelor Physics programme. Furthermore, the majority of Bachelor Physics programmes (87%) also include interdisciplinary components. The majority (74%) of these components is an integrated part of the curriculum. The subjects to which these components are related or linked show a broad range of fields (cf. table 8).

Table 8: Other subjects or subject groups being part of the Physics curriculum (multiple replies possible).

Subjects/subject groups	**In percent**
Other natural sciences	90
Engineering	46
Medical sciences	17
Humanities	23
Social sciences	38
Other subjects	17

5.5 Assessment and Examinations

Modularisation and continuous assessment of learning outcomes is linked to the reduction of the dominant weight of the final examination. 79 percent of the respondents stated that student performance in terms of learning outcomes is assessed after each module or unit of teaching and learning. Still, the final examination continues to have considerable weight is often composed of several aspects or parts. The written thesis plus defence was the most frequently stated forms of final examination (47%), followed by an oral examination (38%). 28 percent of the respondents stated that in their Bachelor examination for a Physics degree a written thesis is required, 20 percent each stated that there are written tests and project presentations, fiver percent required the demonstration of a project, a mathematical formula or similar, and eight percent named further forms of assessment in the final examination. Furthermore, 40 percent of the respondents indicated that only subject knowledge is assessed, while 60 percent also included transferable skills in the assessments.
During the course of study the following types of assessment are used:

- written tests (100%)
- oral examinations (75%)
- homework papers (68%)
- interviews by the teachers (29%)

- multiple choice teats (25%)
- other forms of assessment (22%).

The forms of marking which are used in Bachelor Physics programmes tend to be rather varied as well. Only 16 percent of the respondents stated that the final degree is not marked but stated as passed or failed only, though the pass degree might be additionally qualified, i.e. by 'with honours' or 'with distinction'. Markings in thee course of the programme and for the final examination show a clear preference for (74%) for absolute marking, assessing the degree of fulfilment of established criteria. 36 percent of the respondents stated that the marks refer to individually acquired knowledge during a module (or a class), in 17 percent of the cases a relative marking (i.e. the performance of an individual student in relation to the group) is used, and only two percent state that individually acquired competences and skills are marked. Practical parts (e.g. laboratory work, demonstrations etc.) are not marked in 42 percent of the cases. In these cases they are just assessed as pass or fail. However, in 58 percent of the cases the practical parts have a certain weight and count for the final mark. Mostly (38%) the weight accorded to the practical parts is between 11 and 20 percent, in 10 percent of the cases the weight is between 5 and 10 percent, in eight percent it is between 21 and 30 percent and in one case (2%) it is more than 30 percent.

5.6 Quality Assurance

Over the last 10 to 15 years quality assurance of teaching and learning has become more and more important. Regular evaluations of study or degree programmes have become the rule. Originally such evaluations mostly consisted of student satisfaction questionnaires. However, increasingly other mechanisms of quality assessment and assurance are being applied. We therefore provided a range of options with regard to quality assurance activities and asked what types of quality assurance activities were carried out with regard to the Physics Bachelor programmes in the institutions of the respondents (cf. table 9). Multiple replies were possible.

Table 9: Quality assurance activities in Physics Bachelor programmes

Quality assurance activity	**In percent of respondents**
Periodic accreditation/re-accreditation	78
Evaluation of courses/modules by student questionnaire	91
Evaluation of programme by external evaluators	29
Inclusion of external examiners	7
Monitoring of teacher preparation and teaching material	17
Obligatory participation of teaching staff in pedagogical courses	9
Other activities	14

Table 9 shows that the student satisfaction questionnaire is still the most frequently used form of quality assurance activity (91%), followed by accreditation and periodic re-accreditation (78%). An evaluation of programmes by external evaluators is also carried out relatively frequently (29%).

5.7 Employability and Transferable Skills

The majority of respondents stated that the acquisition of transferable skills is part of their Bachelor curriculum in Physics (75%). While 60 percent of the respondents stated that the acquisition of transferable skills is integrated into the Physics curriculum, slightly more than one third (36%) stated that there is a mix of integration and separation into special courses.
Not surprisingly 69 percent of the respondents said that in their Bachelor Physics programme students are dominantly prepared for transition into a Master programme. Only two percent stated that Bachelor Physics students are prepared for transition into the labour market and 29 percent said there was a mixture of both.
In the meantime higher education institutions have established a broad range of services and activities to support students in their transition onto the labour market. Still 25 percent of respondents stated that no such services are available at their institution. Where services exist they can also be used by Bachelor Physics students and graduates. Respondents listed the following services and activities available to students in this respect (cf. table 10):

Table 10: Services/activities to ease transition of students/graduates into the labour market (in percent; multiple replies possible)

Service/activity	**In percent of respondents**
Career service and advice	54
Interviews with potential employers	33
Internships	19
Lectures by alumni or potential employers	37
Training for job applications and job interviews	19
Informations brochures about potential job areas	39
Other activities/services	12
No particular activities/services on offer	25

5.8 Student Body, Completion, Transition

(to be added at a later point in time)

6. Conclusions: Physics Studies in Europe Today

(to be written after the meeting in Mulhouse)

7. Literature

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