

CONTRIBUTIONS FROM BALKAN COUNTRIES RECORDED IN MODERN DATABASES

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Abstract

The aim of this paper is to present data indicating the activity in publishing results of research in physics from the Balkan countries.

Already in the XVIII century there were publications [1] providing records of scientific papers classified according to their subject with information of interest to scientists and other readers. For most of XX century the main source of such information for physicists was the bimonthly publication of Physics Abstracts, a product of the Institution of Electrical Engineers in Great Britain with records of the order of hundred thousand papers annually. Other advanced countries had their own system of publishing records of scientific output. In the following we present some data concerning the publishing activity in the Balkan countries. We are unaware of any similar work concerning the area in question.

In 1960 a new form of indexing has been established by the appearance of Science Citation Index (SCI) created by Eugene Garfield [2]. It started as a publication of the Institute of Scientific Information in Philadelphia, and is now owned by the company Thomson-Reuters. The main feature of the database is to provide a possibility to a researcher to find out in which subsequent publications a given paper has been quoted. The index collects data from around 6500 most prominent journals published in the World, containing the most significant additions to scientific knowledge. The database includes papers published after 1900. It can be used to locate information, to observe evolution of ideas and to evaluate research. The quantitative analysis of research that can be done is not restricted to individuals, and can be applied to compare performance of particular institutions or any country. It is possible to observe how a given scientific field evolves and eventually becomes exhausted. The observations are useful for example, for planning of science, for making decisions on funding of projects and institutions, and for comparing the developments of scientific activities in our competing world [3]. Data presented [4] in Table 1 include different types of publications in all fields of sciences, excluding social sciences, arts and humanities, and have been registered in SCI for the period January 2006 – mid July 2010. The most active centres for science in general, within the Balkan countries, are the cities of Ankara, Athens and Istanbul.

Table 1 – Papers included in the Science Citation Index database for 2006 – mid-July 2010 with author's from 19 cities from the Balkan countries. Column 1 – total number of publications, 2 – full papers in peer review journals, 3 – abstracts, 4 – papers in conference proceedings, 5 – review papers, 6 – letters, 7 – countries of collaborating coauthors in decreasing order of number of papers (country codes: AL – Albania, BA – Bosnia and Herzegovina, DE – Germany, FR – France, GB – United Kingdom, HU – Hungary, IT – Italy, PL – Poland, RS – Serbia, RU – Russia, SI – Slovenia, US – United States).

City	1	2	3	4	5	6	7
Ankara	28581	21269	3309	1296	601	1432	US,DE,IT,GB,FR
Athens	26880	16700	4996	1751	1592	1032	US,DE,GB,FR,IT
Belgrade	10348	7287	1669	860	242	112	DE,US,IT,GB,FR
Bucharest	11413	8184	1312	1523	205	32	FR,DE,US,IT,GB
Istanbul	20627	15135	2772	1031	443	703	US,DE,GB,IT,FR
Izmir	8681	6587	1100	383	172	281	US,DE,IT,GB,FR
Kishinev	1044	768	123	120	23	6	US,DE,RU,PL,FR
Ljubljana	10482	7957	733	1129	358	87	US,DE,IT,GB,FR
Nicosia	1858	1354	162	175	71	25	GR,US,GB,DE,IT
Novi Sad	1890	1431	220	159	36	17	US,DE,HU,GB,SI
Podgorica	363	287	54	13	5	-	RS,DE,IT,FR,RU
Prishtina	147	81	58	4	1	2	RS,AL,BA,SI,FR
Sarajevo	824	565	192	48	9	3	DE,HR,US,RS,IT
Skopje	1257	628	520	58	22	15	DE,BG,US,RS,IT
Sofia	8964	6826	760	953	241	72	DE,US,FR,IT,GB
Split	1388	1083	98	79	46	42	US,DE,IT,SI,GB
Thessaloniki	11275	7481	1704	849	514	429	US,DE,GB,FR,IT
Tirana	348	162	147	22	7	7	IT,GR,DE,FR,US
Zagreb	9576	6590	1252	936	373	194	US,DE,IT,FR,SI

SciVerse SCOPUS is another database established more recently by Elsevier publishing company. It is less restrictive in the selection of journals included in the database which at present exceeds 19 thousand titles. The number of included primary sources in the database goes beyond 45 million, about 70% of the papers being accessible by their abstracts. The information provided in the following graphical illustrations and one additional table is obtained by use of SCOPUS database. All the papers included in the SCOPUS database

classified as papers in the fields of physical sciences are taken into account. The bulk comes from the four decades 1971-2010. A few papers that appeared before 1971 and have been registered in the database are also included. Papers published in the current year and registered in SCOPUS database before mid September 2011 are similarly taken into account. Some of the papers are counted more than once. This happens when the paper is a result of cooperation of coauthors affiliated to institutions from different countries. This is the case also when the authors have indicated the name of the constituent parts of former Yugoslavia, together with the name of the federal state at the time of its existence.

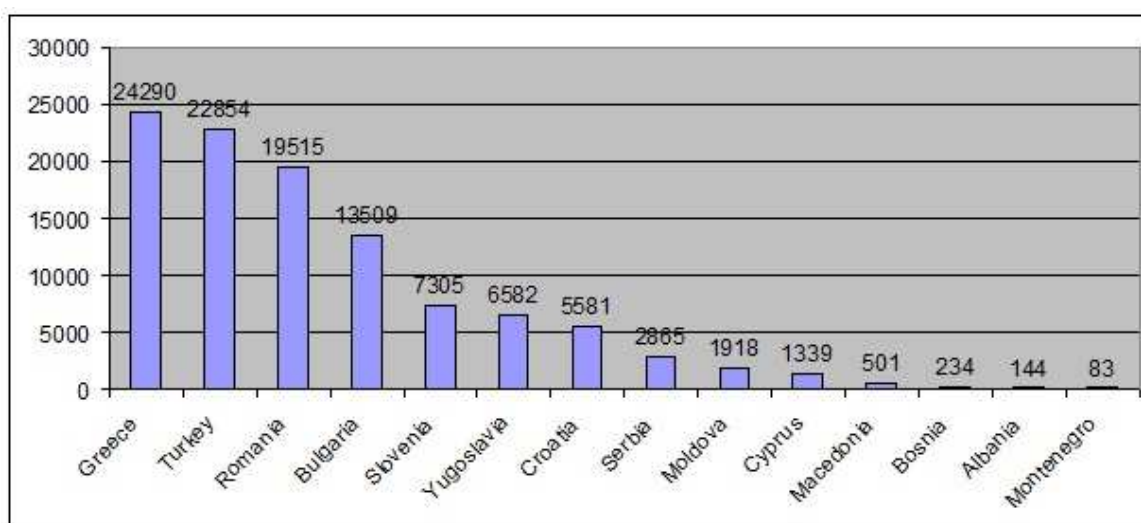


Figure 1. Total number of publications in the field of **physics** for Balkan countries according to the classification adopted by SCOPUS database. The acquisition of data took place in the first half of September 2011, when the recently created state of Kosovo was not present in the database as a separate entity.

As can be seen in Fig. 1, so far the largest number of papers in physics originates in Greece. It is closely followed by Turkey. Together with Romania and Bulgaria they form the group which separates itself from the other countries by higher number of publications. The next group consists of Slovenia, Croatia, Serbia and Yugoslavia. The remaining group of 6 Balkan countries has on average almost an order of magnitude smaller production.

The annual production in the years 1971-2010 of physics communities in Bulgaria, Greece, Romania and Turkey is shown in Fig. 2. Growth is observed for each of them, although with considerable difference in its magnitude. At present they span the interval between one thousand (Bulgaria) and three thousand (Turkey) publications in a year. Most remarkable is the growth of the number of papers originating from Turkey. Increased output from Romania is also strong with tendency to secure the second place for the country. Greece is experiencing steady growth at a slower pace. The growth in Bulgaria is considerably weaker and fluctuating. Looking at the figures 2-4, one should note the different scales on the ordinates of each figure.

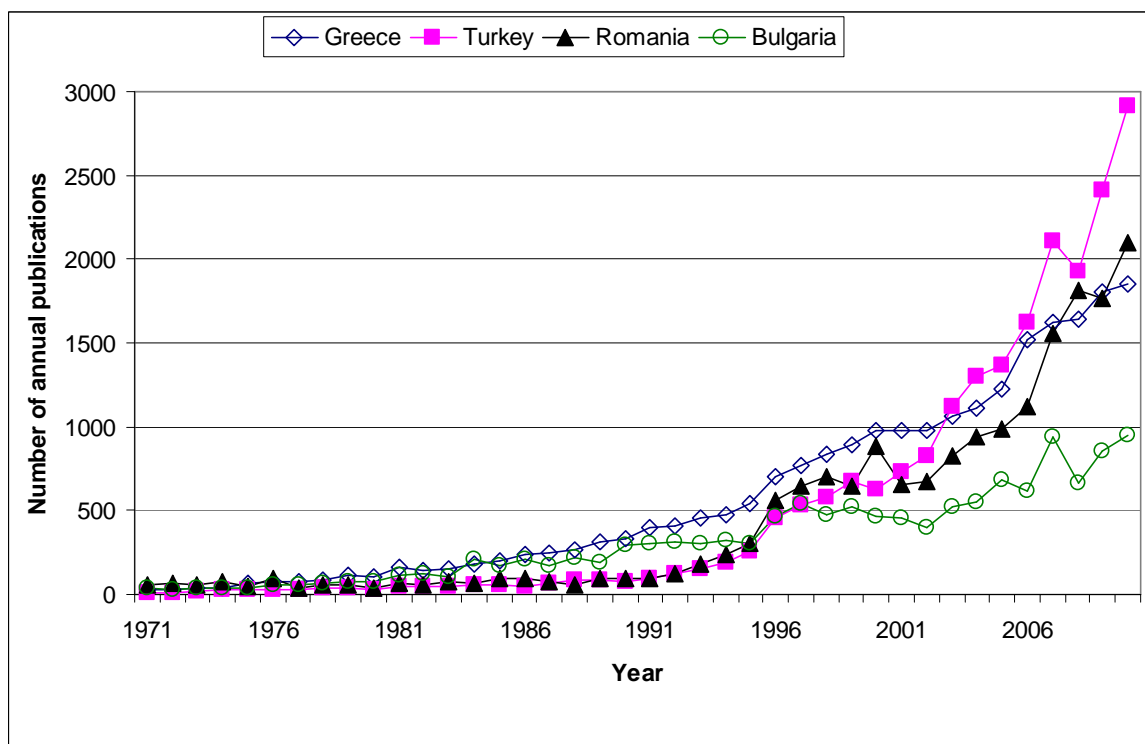


Figure 2. Changes in the number of annual physics related publications for the years 1971-2010 originating from Bulgaria, Greece, Romania and Turkey as registered by the SCOPUS database.

The current average production of Croatia, Serbia and Slovenia is about three times smaller in comparison with the previous group of countries. Again one observes (Fig. 3) growth for each of the countries. There is remarkable more than tenfold steady growth in the case of Serbia after 2006, rising from 63 publications in 2006, to 706 papers published in 2010. Between 1992 and 1996 the number of publications from Croatia and Slovenia is almost identical but afterward Slovenia continued to advance at a faster pace. As for Yugoslavia, the number of annually published papers clearly reflects the tragic events of the recent history of Balkan wars. The indicated affiliations of papers published before 1990 also speak about the tendencies that shaped the present organization of the Balkan peninsula.

The corresponding graphs for the last group of countries are shown in Fig. 4. They have between 27 and 208 published papers in 2010. The last year production of Cyprus is the highest and shows highest tendency for growth which is continuous for almost a decade. The next is Moldova, with growth of almost 100% since 1996, although it appears to be quite erratic. Macedonia reached a production of nearly 50 papers in 2010 with rather continuous

but slow growth. The number of publications from Albania and Montenegro has shown progress, but Bosnia and Herzegovina is clearly in a stage of stagnation.

With few exceptions, the leading scientific institution in the field of physics are the universities in the capitals of the Balkan countries. In recent years Aristotle University of Thessaloniki has more publications than its counterpart in the capital of the country. In Croatia and Moldova, the main contributors to physics publications are the Institute Ruđer Bošković in Zagreb and the Institute of Applied Physics of the Academy of Sciences in Kishinev.

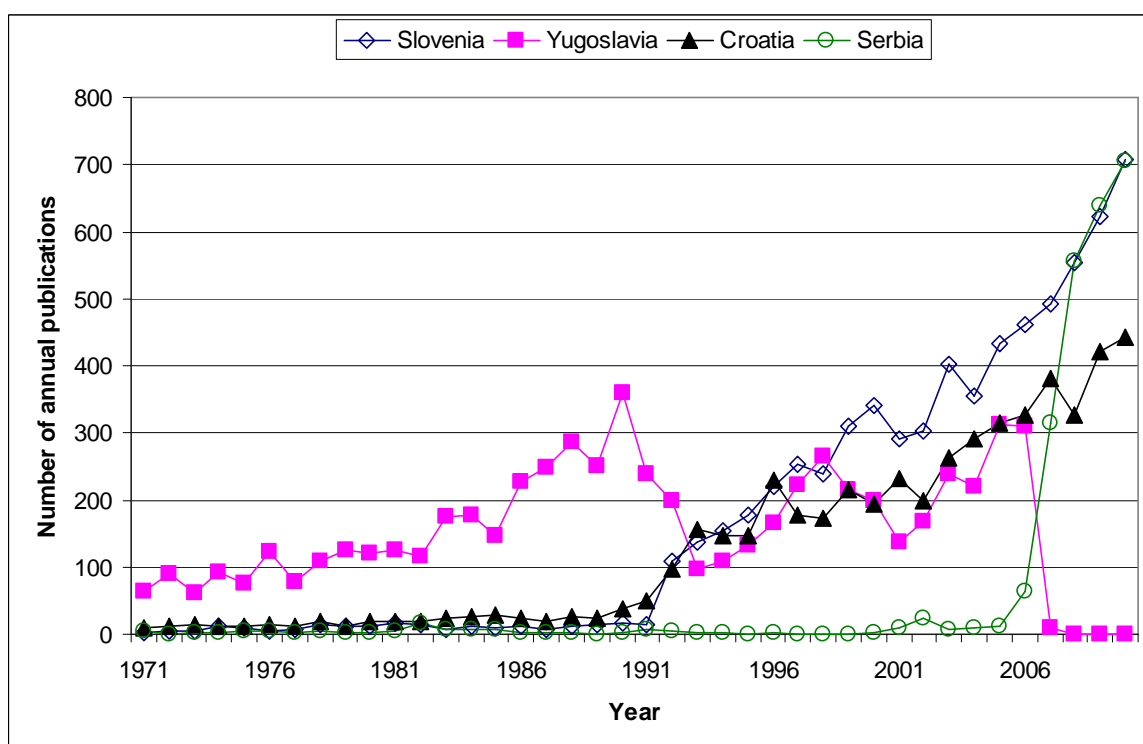


Figure 3. Changes in the number of annual physics related publications for the years 1971-2010 originating from Croatia, Serbia, Slovenia and Yugoslavia as registered by the SCOPUS database.

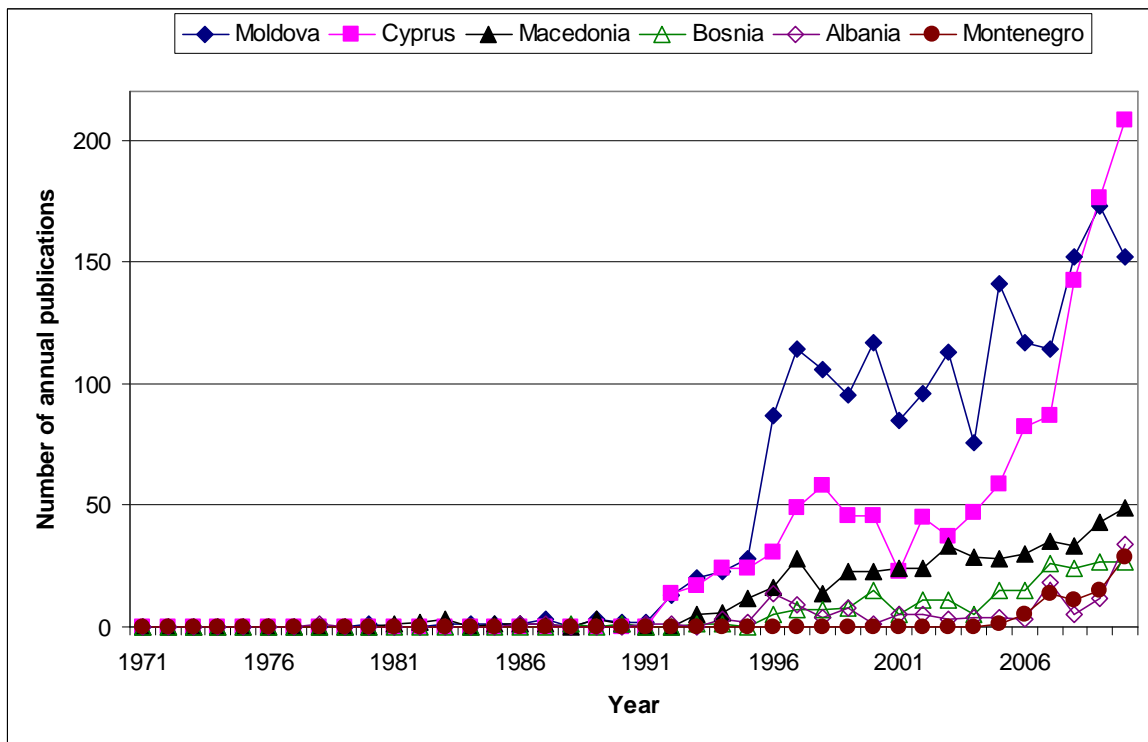


Figure 4. Changes in the number of annual physics related publications for the years 1971-2010 originating from Albania, Bosnia and Herzegovina, Cyprus, Macedonia, Moldova and Montenegro as registered by the SCOPUS database.

The number of publications coming from a particular country does not depend only on the activity and competences of its scientists. There are many other important factors, like established traditions for fostering research, existence of infrastructure, current support of scientific research, cooperation with other institutions, to mention just a few, influencing the amount and the quality of the published material. Data provided in Table 2 serve as an illustration of the background of the circumstances in the Balkan countries. The numbers are obtained using the information available at the web site of UNESCO [5]. Besides the data for the Balkan countries, at the end of the table, information is provided for the state of Singapore, as an example of a small highly developed country, in order to serve as a measure for comparisons in the current dispositions in the world.

The population of the Balkan countries is approximately 140 million, a little more than half being the citizens of Turkey. The highest per capita production of physics related papers has Slovenia. Slovenia, Cyprus, Greece, Bulgaria and Croatia, on average in 2009 and 2010 have published more than 100 papers per million of citizens. The number of researchers per million citizens is highest in Slovenia (3686). Seven countries, Slovenia, Greece, Bulgaria, Croatia, Serbia, Montenegro and Cyprus, have more than one thousand researchers per million

of its citizens. The corresponding number for Singapore is 6033. The percentage of female researchers is highest in Macedonia (54.4%) and lowest in Greece (32%). Singapore has even lower percentage of women employed as researchers (28%).

Funding of research in Balkan countries ranges between 0.02% (Bosnia and Herzegovina) of GDP and 1.88% for Slovenia. Only one more country, Montenegro, provides more than 1% of its GDP for support of research. The state of Singapore disburses 2.61% of its GDP for future developments, most of it coming from the business community.

Table 2 – Data on population of Balkan countries, average number of papers in the years 2009 and 2010 per million citizens, number of researchers and number of researchers in so called hard sciences, funding of science and percentage of female scientists. Data for the state of Singapore are provided for comparison with a highly developed small country. Country codes: AL – Albania, BA – Bosnia and Herzegovina, BG – Bulgaria, HR – Croatia, CY – Cyprus, GR – Greece, MK – Macedonia, MD – Moldova, ME – Montenegro, RO – Romania, RS – Serbia, SI – Slovenia, TR – Turkey, SG - Singapore.

Country	Population in millions	Papers per million citizens	Researchers per million citizens	Researchers in hard sciences per million citizens	Percentage of GDP for science	Percentage of women scientists
AL	3.195	7.2	149	24	0.15	44.3
BA	3.843	7.0	197	-	0.02	-
BG	7.365	122.2	1586	447	0.53	46.5
HR	4.291	100.7	1569	295	0.84	47.3
CY	0.804	238.8	1021	362	0.46	35.0
GR	10.788	169.6	1873	-	0.58	31.7
MK	2.057	22.4	474	-	0.23	54.4
MD	3.564	45.6	803	252	0.53	48.0
ME	0.625	35.2	1081	111	1.15	41.3
RO	21.414	90.4	906	187	0.48	46.2
RS	7.307	92.0	1429	303	0.86	47.7
SI	2.053	323.9	3686	1238	1.88	35.1
TR	73.723	36.1	772	97	0.85	33.4
SG	5.077	456.1	6033	845	2.61	28.0

In conclusion, judging from the number of publications registered in the SCOPUS database, we may say that advances are made in the physics related research in all Balkan

countries. Due to historic developments and current policies, the growth is quite uneven. The advances made by Turkey, Serbia, Slovenia and Cyprus are most significant, while others show increases which are more modest. Increasing the cooperation in the area on individual and institutional basis will be beneficial in many respects. Judging from the data in the last column of Table 1, the cooperation among the Balkan countries is not high, but this should be verified by more detailed information. The Balkan Physical Union General Conference (BPU8) which will be held next year in Constanta, could provide a forum for presentation of research and activities in individual Balkan countries and exchange of ideas with aim to stimulate joint efforts to increase the level of physics research in the area.

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