Scientometrics for Coauthorship of Big Science — A case study of LHC

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Introduction

Coauthorship is an important and extensive theme of scientometrics (Stokes, T. D. & Hartley, J. A., 1989; Glanzel, W., 2002; Rodriguez, M. A. & Pepe, A., 2008). Also, some selected science fields are studied by coauthorship analysis (Piette, M. J. & Ross, K. L., 1992; Tarnow, E., 2002; Yan, EJ, Ding, Y & Zhu, QH, 2010).

But some new technology such as cloud computing, grid computing, virtual organization, made the huge and large scientific project (big science) worldwide. And the big science begets the coauthorship of scientific literatures great transformation. We aim to characterize the transformation in the big science by a case study of the Large Hadron Collider project (LHC).

LHC was built by European Organization for Nuclear Research (CERN) with the intention of testing various predictions of high-energy physics. It's expected that address the most fundamental questions of physics, advancing our understanding of the deepest laws of nature.

LHC project was approved in 1996, completed and started up in Sept. 2008. Now the cost of LHC project is about 3,900 million Euro for the machine, experiments and computing supported by large collaborations of institutes worldwide.

LHC was funded by and built in collaboration with over 10,000 scientists and engineers from over 100 countries as well as hundreds of universities and laboratories.

Data Analysis and Results

Firstly, searching for the data in SCI-E by "TS=large hadron collider" from 1978 to 2010, we get 2898 documents. Where, the first document appeared in 1985.

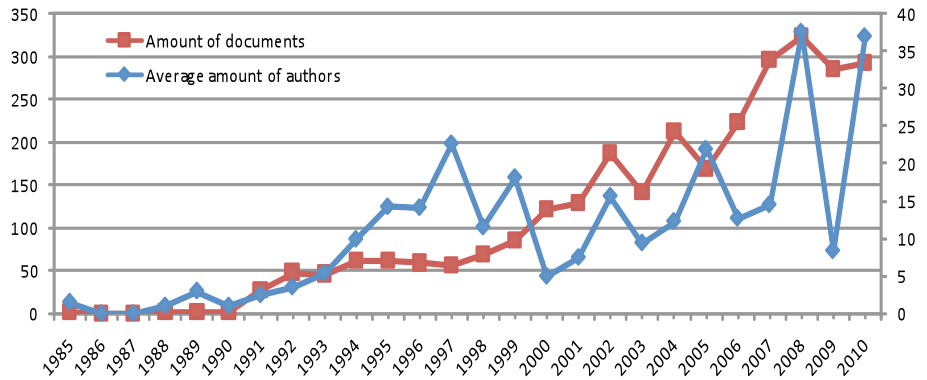

Figure 1. The amount of documents per year and the average amount of documents' authors per year from 1985 to 2010

Secondly, we study the scale of coauthorship in LHC. The average amount of authors of all papers is 17.6153, the maximal amount is 3100. That show the scale of coauthorship is large scale. And the figure 1 shows that the scale of

coauthorship is enhanced along with the increase of documents.

Thirdly, we study the coauthorship network of productive authors (amount of published papers more than 13). Figure 2 shows that the coauthorship network is very centralized.

Table 1. Details of the coauthorship network

Edges: M	**Average Degree:** $< k >$	**Average Distance:** L	**Average Cluster Coefficient:** C
16377	136.1857	1.6241	0.855

Details of the coauthorship network reveal more characterizes of the collaboration. Low amount of nodes and high amount of edges show that every author has many coauthors, and average amount of the coauthors per author is 136.1857. Also, because of the average distance being 1.6241, the average cluster coefficient being 0.855, the network is small-world.

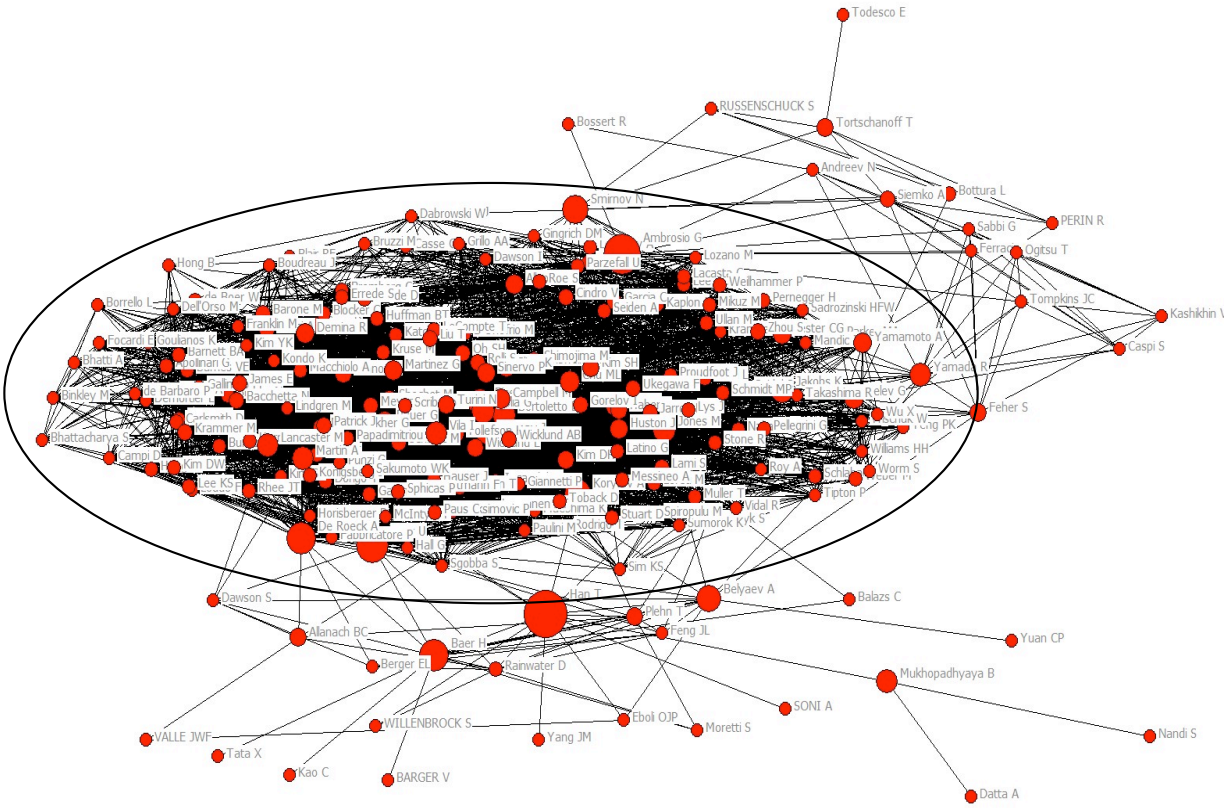

Figure 2. Coauthorship network composed of the authors whose amount of papers is more than 13, where the diameter of nodes is proportional to its value of betweenness centrality.

Conclusions

In conclusion, the coauthorship of big science has promising and encouraging results. The major finding is that

- The coauthorship of big science is large-scale: per paper have about 18 coauthors, and some papers have thousands of authors.
- The coauthorship of big science is centralized: every author has many coauthors. Especially, the average amount of the coauthors per productive author is about 136.
- The coauthorship network composed of productive authors is a small-world

network: average distance of the network is 1.6241, and its average cluster coefficient is 0.855.

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