

Decline in scientific publication in India: Is high energy physics an exception?

This is with reference to the correspondence by Arunachalam (*Curr. Sci.*, 2002, **83**, 107–108), showing that the total number of papers published from India has declined over the last few years, while China, Brazil and South Korea have increased their output quite rapidly and steadily. He has used data from 1980 to 2000 in his analysis. He pointed out that according to the *SCI* 2000, research share in all sciences was 1.55% for India as opposed to 2.83% for China. The *MathSci* 2000 and *CA* 2001 data also showed that China accounted for 10% of the world's output in mathematics and chemistry as opposed to 2% for India. He further stated that the number of research papers in China, Korea and Brazil had increased by factors 23, 68 and 4.3 respectively, whereas in India it had actually decreased. This indeed set quite a few bells ringing in India, including an Editorial in *Current Science* (2002, **83**, 193–194), a write-up in the *Economic Times*, a discussion in a piece in *Nature* (2002, **419**, 100, etc.). It further resulted in a special meeting of a group of scientists with Murali Manohar Joshi, the Minister for Science and Technology, to discuss what can be done. A response from Gangan Prathap on Arunachalam's article has already been published in *Current Science* (2002, **83**, 540), wherein he comments that even the quality of publication, as judged by citation, may be going down.

The correspondence by Arunachalam had not given any numbers for physics articles per se. In view of this I decided to look at the contributions in high energy physics (HEP), where data for a large number of years is easily available in the QSPIRES database (<http://www.slac.stanford.edu/spires/hep>). Here one can search through more than 500,000 high energy physics-related articles, including journal papers, preprints, e-prints, technical reports, conference papers and theses, comprehensively indexed since 1974. It was possible to study this using Spire search (country code, year and published as keys, results only as the output) for India, China, South Korea, Israel, Japan, France and Brazil. India, China, South Korea and

Brazil were among the countries mentioned by Arunachalam, India going down while the others going up for the period 1980–2000.

India's share of publications in HEP, as obtained from QSPIRES is 2.02% compared to 1.67, 1.46 and 0.7% for China, Brazil and South Korea respectively, and 2.54% for Canada, for example. In India, the total number of papers in HEP has increased from about 200 in 1980 to about 350 in 1996 to 587 in 2000. Corresponding numbers for China are 102, 362 and 512, and for South Korea 16, 192 and 329. The total number of papers published as a function of the year are shown in Figure 1. It can be seen here that while South Korea is clearly the boom country, the number of HEP papers from India has increased at a rate similar to all the other countries. A fit to the number of papers as a function of the year shows that the expected exponential growth fits well to all these (correlation coefficient about 0.90). India has a percentage growth rate of about 5, comparable to Israel as well as Japan and France (not shown in the plot). Brazil South Korea have about 11 and 17% respectively, whereas for China it is 7%, a value closer to that for the rest men-

tioned above. Further, it is striking that in HEP India had the highest number of papers published in 1980 among the five countries for which the data have been plotted and that remained true in 2000.

Looking at the citation summary option of Spire, it was possible to get data for India, South Korea and Israel, though for some years and for some countries, Spire did not provide any answer at all. The results for China, South Korea and India, the countries included in Table 1 in Arunachalam's correspondence as well as for Israel are summarized in Table 1. This shows that the citations for India have increased from about 4 per paper in 1981 to about 12 per paper in 1996. There is a lot of year-to-year fluctuation; so three-year running means have been calculated from the numbers in Table 1, while making any statements. Israel had about 22 citations per paper in 1981 and about 24 in 1996. Korea has increased from 12 to about 18 during the same period. For China, the numbers have remained around 6. So again, one sees that in HEP, it is the spectacular rise of South Korea that is remarkable. However, it does not necessarily mean a decline for India. The situation has, in fact, improved for India, as can be seen

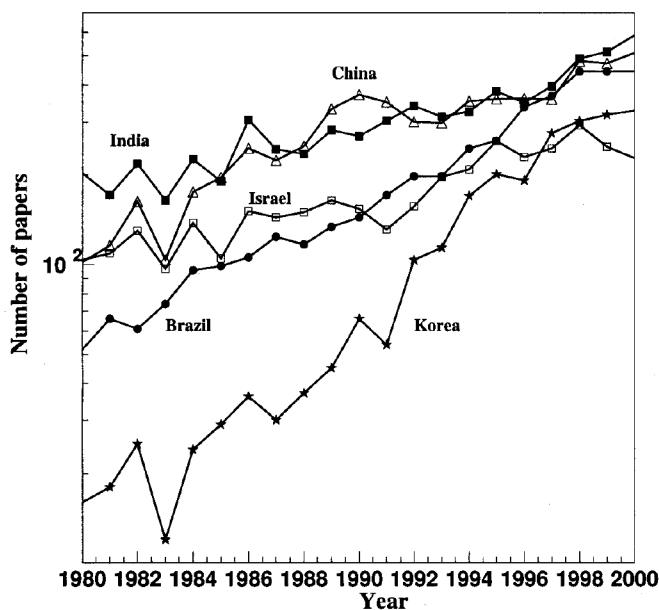


Figure 1. Number of papers published in high energy physics.

Table 1. Average citation per paper for Indian HEP papers from 1980 to 2000

Year	China	India	Israel	South Korea
1980	10	4	22	17
1981	4	4	24	9
1982	6	4	21	9
1983	9	6	22	3
1984	4	3	18	6
1985	3	7	18	8
1986	2	4	20	24
1987	2	5	26	8
1988	2	6	16	6
1989	7	6	20	15
1990	7	10	27	13
1991	7	10	26	22
1992	–	9	22	12
1993	8	10	30	22
1994	6	13	31	17
1995	6	13	28	23
1996	7	12	22	16
1997	6	10	25	16
1998	–	–	18	23
1999	5	8	14	13
2000	4	6	8	11

in the clear increasing trend in the number of citations per paper compared to the other developing countries like China. As a matter of fact, India's share of top-cited articles (more than 50 citations) has gone up from 1.16% for the period of 1980–90 to 3.35% for the period of 1991–95. For China and South Korea, the same numbers are 1.16, 1.85 and 0.32, 3% respectively. While the gains made by South Korea are remarkable, Indian HEP community has not done too badly either. Further, if one looks at the percent share of the top-cited articles by Indian authors for the periods 1980–2000, 1990–2000 and 1995–2000,

the numbers are 1.62, 2.50 and 2.75%, again indicating the better citation averages in more recent years.

It is to be noted that from 1996 to 2000, average citations have dropped for India, Israel, South Korea and China. But, this, I believe, is an artifact that the citation index is still rising for papers written after 1996. For example, in a search carried out on 15 September 1980 for India, the total number of citations was 800, and this increased to 806 when a search was made on the 26 October 1980, whereas for 2000 the number had increased much more substantially from 3707 to 4304, during the same period. This trend is shown by data for all the countries considered.

In summary, in stark contrast to the overall decline mentioned by Arunachalam, Indian HEP output has increased, and that too at about the same rate as other countries like Japan, France and Israel, though admittedly slower than boom country like South Korea. Further, the citation rate for this increased output has improved as well. These do not seem to be artifactual results – though a more thorough analysis may be much better.

While this does not mean that the HEP community in India can be complacent, it may in some sense be interpreted to imply that HEP is doing well in India. Further, one may be able to draw lessons from this to find a way so that there need not be a decline in other areas too. For that it may also be useful to consider the possible causes that have helped HEP to do well in India.

(a) HEP was already globalized due to the international nature of HEP experimentation.

(b) High energy physicists in general are net-savvy and the same is true of the Indian community. They also made best use of the open archives to stay on par with the others in the world. Thus they were on par on both fronts – technical and technological.

(c) Extensive collaborations within the country may have helped.

(d) Initiatives like the workshops on high energy physics phenomenology as well as yearly national or international conferences like the String Conference, where a large part of the active Indian HEP community regularly gets together, may have added significantly to foster the networking and hence (c) above. The series of SERC schools in HEP may also have played an important role.

Arunachalam's original article has been useful to draw the attention of the Indian Scientific Community to this important problem. In view of the above-mentioned strong dependence of the conclusions on the area of science that one considers, it may be worthwhile to carry out further discipline-wise analyses to get insights into the issue and possible solutions in areas where there is a problem.

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Winds of change

We write this in response to P. Balam's editorial 'Science in India: Signs of stagnation' (*Curr. Sci.*, 2002, **83**, 193–194). Balam cites the declining number of publications from Indian labs to conclude that science in India is stagnating. There is no denying this conclusion. What more could be expected from an environment where meritocracy is not encouraged, leadership of national labs and universities is politicized, institution-building is

not valued, and where the spirit of scientific inquiry is throttled by dogma and cultural chauvinism. Notwithstanding this grim scenario, there are positive stories to be told and one of them relates to the 'winds of change' that our national labs – the Council of Scientific and Industrial Research (CSIR), to be specific – have seen.

Balam, unfortunately, does not seem to agree and uses the publications crite-

ria, which is too narrow and exclusive a definition, to dismiss the scientific contributions of national labs. The editorial's comment that national labs are pursuing applied research for the 'carrot of large funding' ignores the fact that most national labs were founded with the objective of conducting applied research. Balam's dismissiveness of efforts to heighten awareness about patenting amongst Indian scientists as a ploy to