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Citation counts: trick or treat?

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The article by Kessler et al. was the introductory paper to a special issue of A&A letters dealing with first results obtained with ESA's Infrared Space Observatory (ISO). It describes the building of the telescope and the platform on which the telescope is mounted, as well as the operations, the data acquisition, and the lifetime of the mission. ISO was a major space observatory so the citation rate of 1011 is not surprising. It carried four instruments, a near-infrared camera (ISOCAM), a multiband photometer from the near infrared to 200 μm (ISOPHOT), and two spectrographs: the SWS for short wavelengths (up to 50 μm) and the LWS for long wavelengths (from 45 μm upward). Some 1600 papers have been published that carry one of these four acronyms in the title, and that number is about equal to the total number of articles and letters that appear in one year in A&A.

Let me first ask the question what citation numbers tell us. They certainly inform us of how often the article has been used for a continuing study. It measures impact: there have been at least 1600 studies based on ISO observations. This simple conclusion leads to at least two subsequent questions: How does this number of 1600 compare with those of other big instruments? And what has been the impact of these 1600 studies? To answer the second question, I derived the citation rates of the Letters in the same A&A issue of ISO letters, as presenting the scientifically important results obtained from the first observations with ISO. I then applied two numerical criteria: the first is the average citation number and the second the fraction of papers with a citation number higher than 50. This number 50 is somewhat arbitrary, but it helps to mark the very successful papers. Using these criteria, consider now the quality of the Letters in the special ISO issue and compare them with citation numbers of A&A Letters in earlier and in later issues. The average citation number of arbitrary A&A Letters is 21 and 10% have a rate higher than 50. After elimination of the first eight Letters in the ISO issue, technical descriptions of the instruments, one finds that the 83 remaining Letters have an average citation rate of 51, and 35% have a citation rate higher than 50. It clearly shows that these first ISO Letters have been well-received and they justify some a posteriori sense of success for this mission.

If one extracts all papers from the ADS data base that carry the word "ISO" in the title or "Infrared Space Observatory" one obtains 1724 papers with 9.6 as an average number of citations. There are 76 papers (or 4.4%) with a citation rate over 50. How do these numbers compare with those of other missions? First take NASA's SPITZER infrared satellite that is still operating at the time that these comments are being written. Extracting all papers from the ADS database that carry the word "Spitzer" in the title I found 1891 papers with a total number of citations of 15 013, thus on average 7.9. Sixty-eight of these 1891 papers (3.6%) had more than 50 citations. ISO and Spitzer rate equally highly, but Spitzer produces more papers. Let me now take the IRAS mission in the year 1983. There are 56 384 papers that carry the word IRAS in their titles, and the average number of citations is 15.4. In addition 9% of all these papers have a citation rate over 50. This is more than the rates of Spitzer and of ISO and that is not surprising. IRAS made the first large-scale survey in those infrared wavelength bands not previously accessible from the ground; IRAS was more than a timely mission, it was overdue. Already in the very first plans for IRAS, it had been decided that IRAS should make a whole-sky survey and should not be driven by any program chosen in advance. This clearly was the right decision.

Let me finally compare the ISO papers with those in other astronomical fields. First, take the X-ray observatories, starting with the oldest missions. There are 92 papers that carry UHURU in their title. The average paper has 38.8 citations and 24% of these papers have more than 50 citations – much higher values than for most other X-ray missions. ROSAT also has an impressive track record: 2368 papers with, on average, 15.7 citations and 9% papers with more than 50 citations. For XMM and for Chandra, the numbers are significantly lower. For XMM there are 3192 papers that have on average 6.9 citations per paper and 3% of the papers have a citation rate over 50. For Chandra these numbers are higher but roughly comparable: 3754 papers, 9.6 average number of citations, and 6% of the papers have more than 50 citations. UHURU and ROSAT were earlier missions than Chandra and XMM just as IRAS preceded ISO and Spitzer. Earlier missions produced more surprises, and that may explain why earlier missions produced more citations.

Secondly, I compared ISO with the Hubble Space Telescope. I selected papers from the ADS data base with either "HST" or 'Hubble Space Telescope' and found a total of 6461 papers with 12.9 citations on average; 7% of all papers have more than 50 citations. I also checked HIPPARCOS: 1010 publication with an average number of citations of 12.9 and 4% papers with more than 50 citations.

Finally, I was deeply impressed when I selected papers with either COBE or WMAP in their title. The 609 papers selected with COBE in their title had 26.7 citations on average and 13% of the papers had more than 50 citations. WMPA exceeds these

high numbers: the 493 papers had 28.0 citations on average and 18% of the papers have more than 50 citations.

Numbers of citations measure the popularity of any given paper. It also reflects the number of scientists working in this specific field. A well-known case is the following: compared to the size of the population there are more astronomy papers published by UK astronomers than by German astronomers. The difference is considerable. The same is true for the more highly cited papers. German astronomers have explained to me that, compared to the size of the population, there are fewer astronomers in Germany than in the UK. And this difference explains the difference in the production rate in the two countries. I think a similar effect explains the difference between the citation rates of infrared astronomy compared with those in X-ray astronomy. X-ray astronomy is almost completely dependent on satellite observations,which is not fully true for infrared astronomy. Similarly the very high citation rates of the COBE and WMAP papers reflect that these lead to rapid progress in our understanding of the cosmos. The community interested in cosmology is large, the satellites few: that explains the high citation rates.

Reference

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