Evaluation of Italian Astronomy 2016-2018

Raffaele Gratton, INAF – Osservatorio Astronomico di Padova

Summary

In this document, I give a quantitative evaluation of the contribution of Italy (as well as of other nations) to astronomy over the period 2016-2018, for different areas of astronomy. I compare this data with a similar analysis for previous epochs, so that I can obtain trends with time. Italian astronomers may consider this data in a discussion of trends in the production, though I do not give any explicit comment.

Global production

Method

I use in the following statistics the NASA ADS (hereafter ADS) and the SCIMAGO INSTITUTIONS RANKING[1] (hereafter SJR, based on SCOPUS[2]) databases. I use citations rather than simply number of papers to evaluate the impact of research. A basic issue here is because most papers include authors from many different countries, a circumstance that we call "internationalization" of research. The queries possible on these databases attributes the total citations of each paper to all countries with at least one author. This fact gives too much weight the contribution by small countries. As done also in my former review (Gratton, 2014, ArXiv:1402.4080; hereinafter Paper I), I considered the "internationalization" factor:

$int = \Sigma\, cit_i / cit$,

where cit_i and cit are the number of citations for country i and for world, respectively. As noticed in that paper, int increased rapidly with time (see Figure 1). The annual rate of increase has been about 5%, over the period 2002-2017, ant it has been fairly constant over this period.

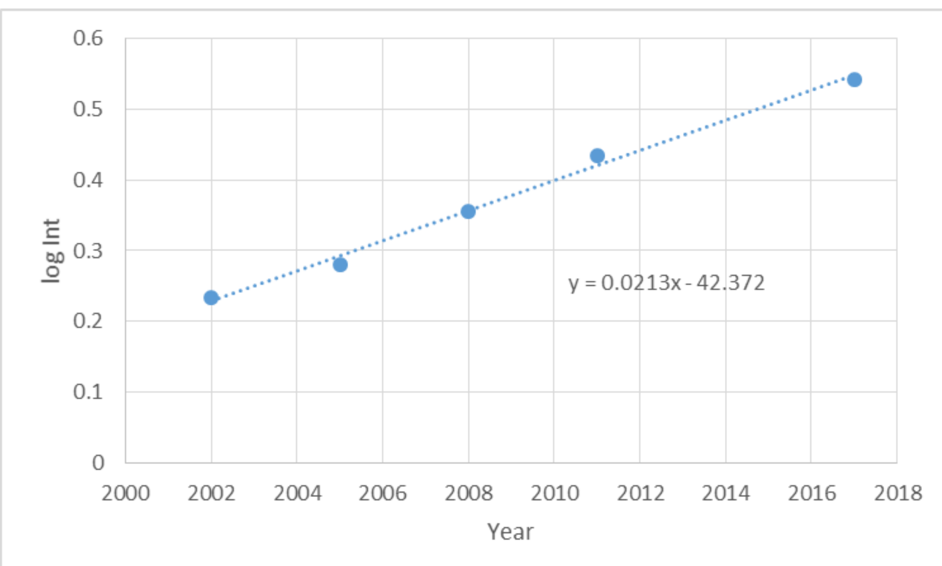

Figure 1. Run of the internationalization factor as a function of time

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[1] https://www.scimagojr.com/

[2] https://www.elsevier.com/solutions/scopus

I applied a correction that is based on an exponential law related to a power of int, and I considered a constant increase factor of int over time (that implies an exponential increase of int). To determine the correct power of int, in this report I considered the presence of each country among the 200 papers most cited of each year (this is different from what done in Paper I). I attributed each paper to a country by the affiliation of the first author[3]. Table 1 lists the top ten countries according to this parameter; in order to reduce the uncertainties due to small number statistics, I considered the 4-year range 2014-2017 (that is a total of 800 papers); in the same Table we also give similar data for the period 2008-2010 (that is a total of 600 papers) from Paper I.

Table 1. Nations ranked by first authors of papers among the 200 most cited of each year in the period 2014-17. For comparison, also values over the period 2008-10 are also isted (from Paper I)

Rank	Country	2008-2010		2014-2017	
1	USA	297	0.495	357.0	0.446
2	Germany	69	0.115	76.4	0.096
3	United Kingdom	61	0.102	72.3	0.090
4	France	34	0.057	50.4	0.063
5	**Italy**	**39**	**0.065**	**31.0**	**0.039**
6	Australia	9	0.015	27.0	0.034
7	China			23.0	0.029
8	Netherlands	15	0.025	22.7	0.028
9	Spain	6	0.010	21.0	0.026
10	Canada	17	0.028	19.0	0.024

I then adjusted the functional form of int in order to reproduce the fractions for these countries for both epochs. Figure 2 shows the extremely good correlation I obtained with this method between the fractions of papers among the 200 most cited that I attribute to each country and the corrected fraction of citations according to SJR. I repeated a similar procedure for the citations according to ADS. Figure 1 compares the corrected fractions of citations for different countries obtained using the ADS and the SJR database. Again I found a very good correlation, supporting my approach.

[3] When preparing this table, Planck and Gaia papers were subdivided into contributing countries according to their contribution to ESA

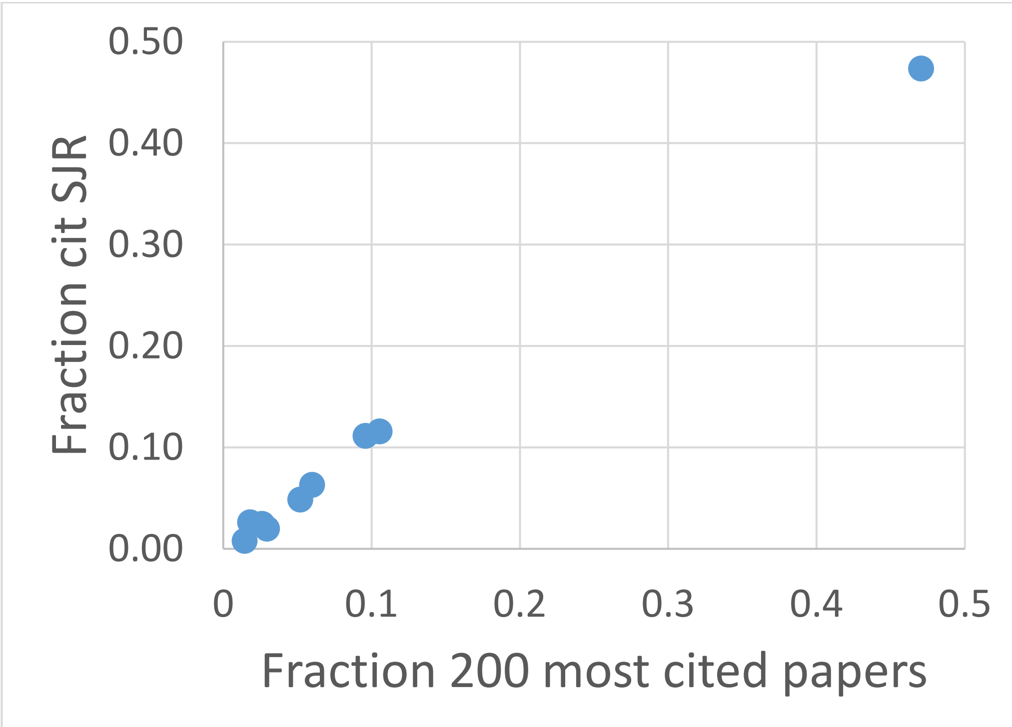


Figure 2. Correlation between the fractions of papers among the 200 most cited that I attribute to each country and the corrected fraction of citations according to SJR. Note the extremely good correlation

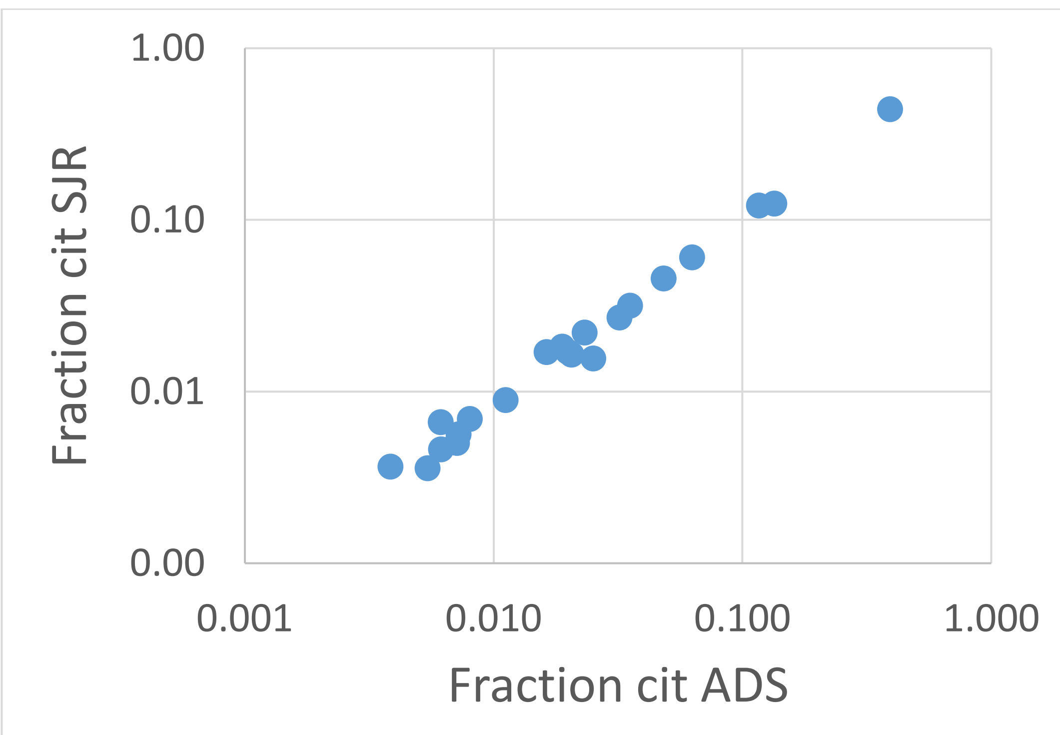


Figure 3 Correlation between the corrected fractions of citations for different countries obtained using the ADS and the SJR database. Note the extremely good correlation

Trends with time

Once properly normalized, I can then obtain reliable time series for the contribution of different countries to research in astronomy. Table 2 and Table 3 gives the data obtained using the ADS and SCI databases. Figure 4and Figure 5 gives the same in graphical form for selected countries.

Table 2 Time series of the contributions of different countries to research in astronomy obtained using the ADS database

Rank	Country	2001-2003	2004-2006	2007-2009	2010-2012	2013-2015	2016-2018	Average 2013-2018
1	USA	0.442	0.450	0.459	0.455	0.469	0.461	0.465
2	Germany	0.113	0.125	0.121	0.123	0.113	0.110	0.112
3	UK	0.094	0.094	0.090	0.077	0.111	0.110	0.110
4	France	0.064	0.067	0.067	0.073	0.069	0.057	0.063
5	**Italy**	**0.064**	**0.061**	**0.060**	**0.056**	**0.044**	**0.042**	**0.043**
6	Canada	0.037	0.030	0.044	0.046	0.036	0.029	0.032
7	Spain	0.028	0.030	0.033	0.041	0.031	0.032	0.032
8	Netherlands	0.033	0.027	0.022	0.026	0.025	0.027	0.026
9	Australia	0.025	0.020	0.019	0.020	0.022	0.022	0.022
10	Japan	0.035	0.033	0.031	0.031	0.025	0.018	0.022

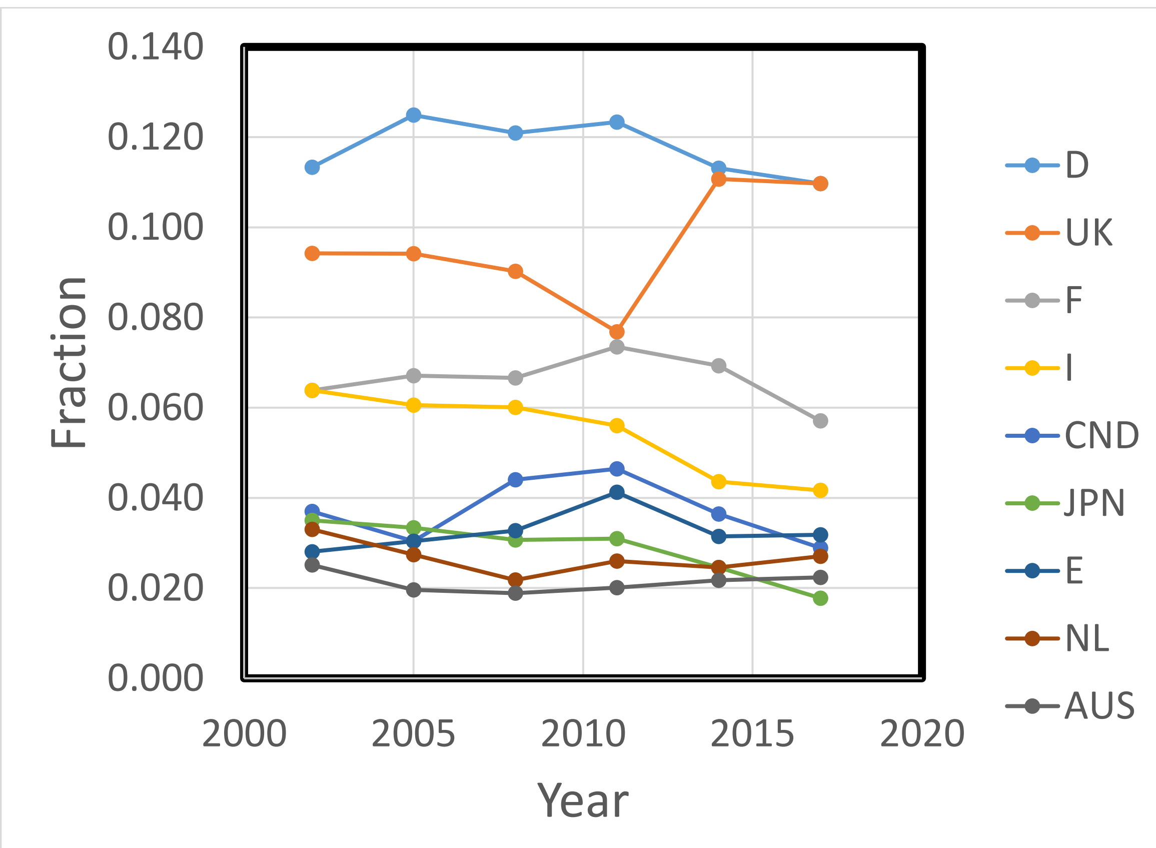


Figure 4. Run with time of the contributions of selected countries to research in astronomy obtained using the ADS database

Table 3 Time series of the contributions of different countries to research in astronomy obtained using the SCI database

Year	USA	D	UK	F	I	CND	JPN	E	NL	AUS
1997	0.452	0.111	0.098	0.060	**0.045**	0.030	0.031	0.025	0.030	0.028
1998	0.442	0.108	0.108	0.064	**0.050**	0.024	0.025	0.026	0.029	0.032
1999	0.460	0.101	0.105	0.063	**0.052**	0.027	0.028	0.024	0.027	0.030
2000	0.466	0.098	0.106	0.062	**0.056**	0.027	0.029	0.025	0.032	0.024
2001	0.489	0.097	0.108	0.054	**0.057**	0.026	0.034	0.019	0.031	0.020
2002	0.494	0.103	0.105	0.058	**0.053**	0.026	0.031	0.019	0.029	0.019
2003	0.495	0.107	0.103	0.062	**0.052**	0.025	0.030	0.020	0.025	0.017
2004	0.489	0.116	0.103	0.067	**0.049**	0.025	0.025	0.023	0.024	0.016
2005	0.490	0.115	0.112	0.062	**0.049**	0.023	0.025	0.022	0.023	0.016
2006	0.494	0.117	0.113	0.063	**0.047**	0.026	0.023	0.022	0.020	0.015
2007	0.496	0.116	0.116	0.061	**0.046**	0.028	0.024	0.021	0.019	0.016
2008	0.498	0.121	0.110	0.064	**0.048**	0.026	0.023	0.023	0.018	0.015
2009	0.485	0.125	0.108	0.066	**0.051**	0.026	0.022	0.029	0.019	0.014
2010	0.475	0.126	0.110	0.070	**0.052**	0.029	0.020	0.033	0.020	0.014
2011	0.472	0.128	0.111	0.070	**0.049**	0.028	0.018	0.035	0.020	0.016
2012	0.488	0.130	0.114	0.066	**0.042**	0.027	0.017	0.029	0.019	0.019
2013	0.474	0.127	0.114	0.064	**0.042**	0.024	0.018	0.030	0.022	0.020
2014	0.471	0.124	0.124	0.062	**0.042**	0.021	0.017	0.029	0.022	0.020
2015	0.431	0.120	0.125	0.063	**0.047**	0.020	0.016	0.034	0.027	0.023
2016	0.446	0.122	0.125	0.062	**0.045**	0.017	0.016	0.031	0.026	0.022
2017	0.440	0.124	0.121	0.060	**0.045**	0.016	0.017	0.032	0.027	0.022

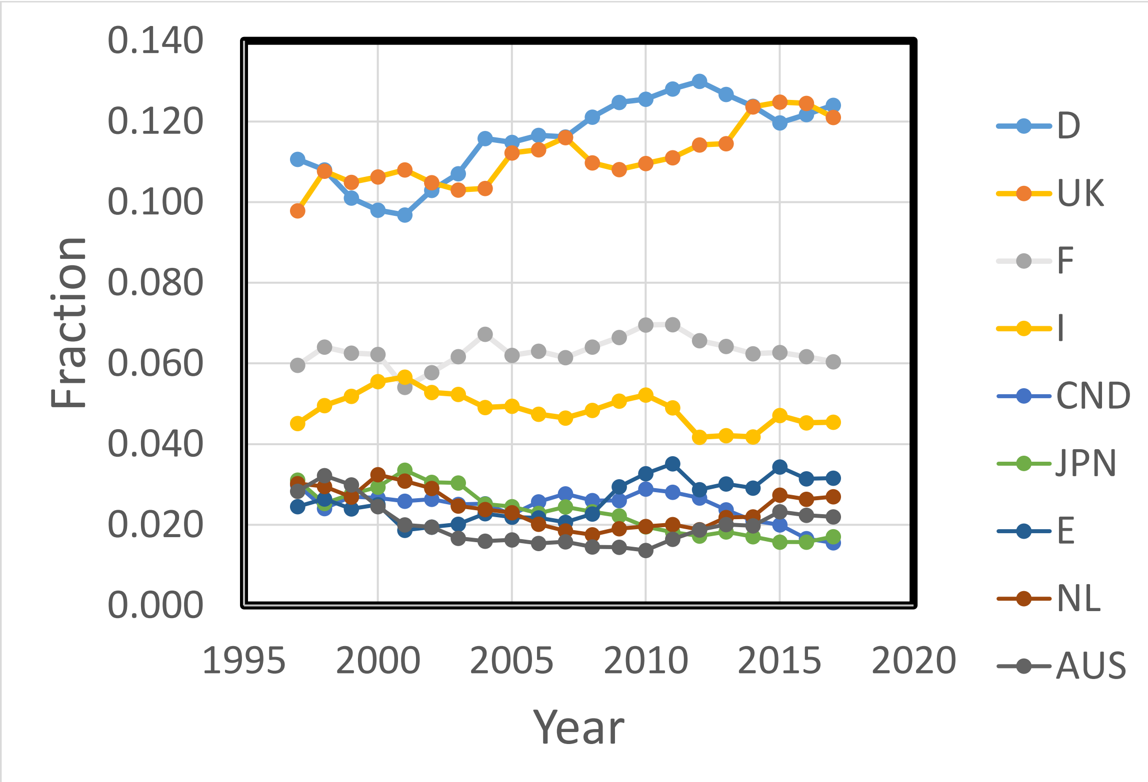


Figure 5. Run with time of the contributions of selected countries to research in astronomy obtained using the SCI database

Production in different fields of astronomy

I collected data about citations for papers with different keywords from the NASA ADS. This was done for each country. I then used the same approach for handling internationalization considered above, using values of int appropriate for each keyword.. I give results for different groups of keywords (corresponding to the INAF Macroareas) in Table 4-9.

Table 4. Role of Italian astronomy in different areas according to selected keywords – General keywords

Keyword	Papers	Int	Rank 10-12	Italy/World 10-12	Rank 16-18	Italy/World 16-18	Rank diff	Italy/World diff
Surveys	1023	6.9	5	0.056	6	0.031	-1	-0.025
Catalogs	701	7.5	5	0.058	5	0.039	=	-0.019
Gravitation	3839	4.0	6	0.038	4	0.049	+2	+0.011
Hydrodynamics	1128	1.9	6	0.033	8	0.033	-2	0.000
Gravitational lensing	935	4.7	7	0.034	5	0.032	+2	-0.002
Radiative Transfer	887	2.4	7	0.038	10	0.026	-3	-0.012
Radio	2106	3.4	4	0.057	6	0.043	-2	-0.014
Infrared	1437	3.7	7	0.046	5	0.051	+2	+0.005
Average			5.9	0.045	6.1	0.039	-0.2	-0.006

Macroarea 1: Galaxies and Cosmology

Table 5. Role of Italian astronomy in different areas according to selected keywords – Macroarea 1 Galaxies and cosmology

Keyword	Papers	Int	Rank 10-12	Italy/World 10-12	Rank 16-18	Italy/World 16-18	Rank diff	Italy/World diff
Galaxies - starbursts	936	3.7	6	0.053	7	0.021	-1	-0.032
Galaxies – active	4458	3.5	3	0.070	4	0.061	-1	-0.009
Galaxies – clusters	4637	5.1	3	0.061	5	0.047	-2	-0.014
Galaxies – formation	9013	3.3	6	0.044	5	0.042	+1	-0.002
Galaxies – high redshift	3685	4.8	5	0.045	5	0.044	=	-0.001
Galaxies – evolution	7061	3.5	5	0.050	5	0.050	=	0.000
Galaxies - nucleus	3246	3.1	4	0.059	4	0.060	=	+0.001
Galaxies - individual	4499	3.8	5	0.048	5	0.050	=	+0.002
Galaxies – structure	6059	3.6	6	0.041	6	0.040	=	-0.001
Galaxies – kinematics	2825	3.1	4	0.039	6	0.043	-2	+0.004
Galaxies – halo	3198	2.7	3	0.048	5	0.035	-2	-0.013
Cosmology	17493	3.8	5	0.046	5	0.056	=	+0.010
Large scale structure	1234	4.4	5	0.042	6	0.018	-1	-0.024
Cosmological parameters	5293	4.7	5	0.038	6	0.052	-1	+0.014
Dark matter	1575	2.5	5	0.045	6	0.045	-1	0.000
Dark energy	1092	3.2	8	0.030	6	0.048	+2	+0.018
Average			4.6	0.047	5.3	0.044	-0.7	-0.003

Macroarea 2: Stars and Interstellar Matter

Table 6. Role of Italian astronomy in different areas according to selected keywords – Macroarea 2 Stars and Interstellar Matter

Keyword	Papers	Int	Rank 10-12	Italy/World 10-12	Rank 16-18	Italy/World 16-18	Rank diff	Italy/World Diff
Planetary systems	3197	3.4	10	0.018	7	0.030	+2.4	+0.012
Planetary atmospheres	1589	2.5			9	0.022		
Protoplanetary disks	980	3.0			7	0.034		
Planet formation	2278	3.6			8	0.028		
Planet individual	1673	3.3			7	0.037		
Stars – evolution	6215	3.2	5	0.048	5	0.048	=	0.000
Stars – formation	6567	3.4	6	0.041	5	0.044	+1	+0.003
Stars - populations	2541	3.2	3	0.065	4	0.072	-1	+0.007
Stars - abundances	3253	3.4	3	0.076	4	0.060	-1	-0.016
Stars - clusters	2413	3.2	3	0.077	4	0.082	-1	+0.005
Stars - atmosphere	2122	2.6	6	0.047	7	0.032	-1	-0.015
Supernovae	1631	2.9	4	0.059	6	0.030	-2	-0.029
Interstellar Matter	4663	3.5	6	0.046	5	0.036	+1	-0.008
Average			5.1	0.053	5.3	0.049	-0.2	-0.004

Macroarea 3: Sun and Solar System

Table 7. Role of Italian astronomy in different areas according to selected keywords – Macroarea 3: Sun and Solar System

Keyword	Papers	Int	Rank 10-12	Italy/World 10-12	Rank 16-18	Italy/World 16-18	Rank diff	Italy/World diff
Sun - atmosphere	1317	1.6	8	0.016	11	0.028	-3	+0.012
Sun – planet interactions	2102	2.0	7	0.030	8	0.037	-1	+0.007
Solar system planets	1156	2.8	8	0.026	6	0.038	+2	+0.012
Comets	715	4.4	9	0.025	5	0.053	+4	+0.028
Minor bodies	694	2.4	8	0.062	6	0.050	+2	-0.012
Average			8.0	0.032	7.6	0.041	+0.4	+0.009

Macroarea 4: High Energy and Relativity

Table 8. Role of Italian astronomy in different areas according to selected keywords – Macroarea 4: High Energy and Relativity

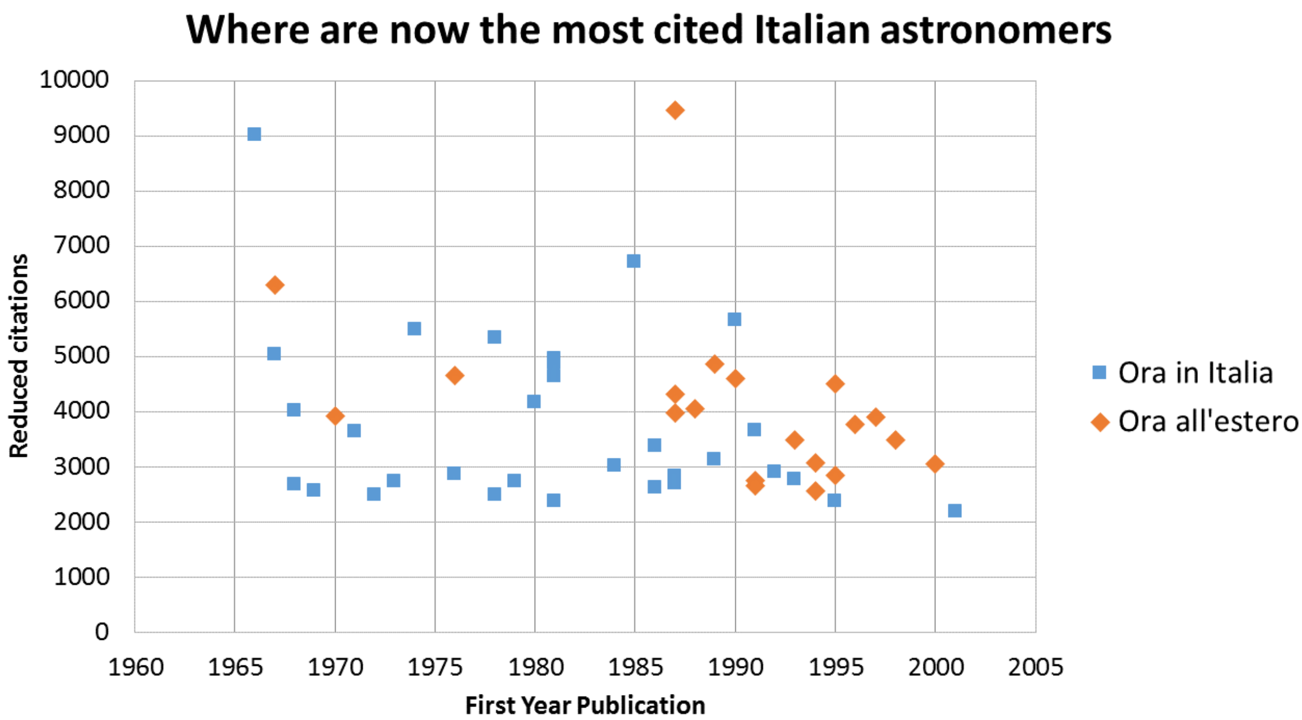
Keyword	Papers	Int	Rank 10-12	Italy/World 10-12	Rank 16-18	Italy/World 16-18	Rank diff	Italy/World diff
High energy	16973	3.1	3	0.075	3	0.065	=	-0.010
X-ray	3039	3.2	4	0.061	4	0.080	=	+0.019
gamma-ray	5127	3.5	4	0.066	4	0.092	=	+0.026
pulsar	1005	3.2	4	0.061	8	0.042	-4	-0.019
GRB	818	4.2	2	0.074	3	0.100	-1	+0.026
AGN	1583	3.2	4	0.067	4	0.075	=	+0.008
X-ray binaries	1265	2.8	5	0.061	5	0.069	=	+0.008
Cosmic rays	901	3.3	3	0.071	3	0.086	=	+0.015
Relativity	11046	3.2	4	0.047	5	0.067	-1	+0.020
Astroparticles	7836	3.6	4	0.051	4	0.053	=	+0.002
Gravity waves	1096	5.3	6	0.041	4	0.052	+2	+0.011
Average			3.9	0.061	4.3	0.073	-0.4	+0.012

Top ten

Keyword	Rank 2010-12	Italy/World 2010-12	Rank 2016-18	Italy/World 2016-18	Rank diff	Italy/World diff
GRB	2	0.074	3	0.100	-1	+0.026
gamma-ray	4	0.066	4	0.092	=	+0.026
Cosmic rays	3	0.071	3	0.086	=	+0.015
Stars - clusters	3	0.077	4	0.082	-1	+0.005
AGN	4	0.067	4	0.075	=	+0.008
Stars - populations	3	0.065	4	0.072	-1	+0.007
X-ray binaries	5	0.061	5	0.069	=	+0.008
Galaxies – active	3	0.070	4	0.069	-1	-0.001
Relativity	4	0.047	5	0.067	-1	+0.020
High Energy	3	0.075	3	0.065	=	-0.010

Where are now the most cited Italian astronomers?

As a final piece of information, I show in Figure 6 the relation between the number of reduced citations for NASA ADS and year of first publication for a number of Italian astronomers. They were selected among the most cited; note however that the list might be incomplete. Different symbols are used do mark astronomers that are currently in Italy and those that are now abroad.



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