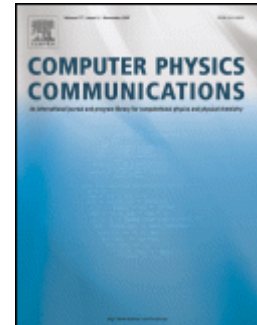


```
<!-- parameters for the shaping amp -->
<parameter name="StarFEEAmpRiseTime" type="double"> 42 </parameter>
<parameter name="StarFEEAmpFallTime" type="double"> 42.3 </parameter>
<parameter name="StarFEEAmpGain" type="double"> 3.3 </parameter>
```

```
<!-- parameters for the ADC -->
<parameter name="FlashADCGain" type="double"> 1.0 </parameter>
<parameter name="FlashADCBitsPerSample" type="int"> 10 </parameter>
```

```
<!-- parameters of the geometry of the readout pads -->
<PadRowLayout2D type="FixedPadSizeDiskLayout"
  rMin="320.0" rMax="1600.0"
  padHeight="6.0" padWidth="2.0"
  maxRow="200" padGap="0.0" />
```



WRITING SOFTWARE OR WRITING SCIENTIFIC ARTICLES?

Maria Grazia Pia
INFN Genova, Italy

T. Basaglia (CERN), Z. Bell (ORNL),
P. Dressendorfer (IEEE), A. Larkin (IEEE)

IEEE Nuclear Science Symposium 2007
Honolulu, HI, USA

Thanks to A. Howard, J. Knobloch, S. Mele, J. Yeomans (CERN)



```
Program Mesh
use fgl
implicit None

integer i, j, N
real z(30,30)

c Create data for plotting
do 100 i = 1, 30
  do 200 j = 1, 30
    z(i,j)=3.0*sin((i+1)/
      + 4.0)*cos((j+1)/4.0)+2.0
      + *sin((i+j)/4.0)
  200 continue
  100 continue

c Convert Fortran variable z
c to mfArray using mf(z), and
c call msMesh for Mesh plot
call msMesh(mf(z))

c Pause to display the graph
call msViewPause()
End Program Mesh
```

Physics Today, March 2004, 61-62

Publish or Perish—An Ailing Enterprise?

Mohamed Gad-el-Hak

Three recent events, taking place in rapid succession, incited me to write this Opinion. The first was an annual report from a major school of engineering whose dean proudly listed 52 pa-

significant to write about.

Unfortunately, today we witness a different environment from that of a generation ago. The publish-or-perish emphasis for some, but not all, institutions has deteriorated into bean-

criticized by some (including this writer³) as somewhat biased against unorthodox ideas, is essential to weed out the charlatans, the misguided, and the fools. Peer review must be preserved if not strengthened. However, more papers published means that on



"Surely you were aware when you accepted the position, Professor, that it was publish or perish."

Do **software-oriented** physicists follow similar publication patterns as their **hardware-oriented** colleagues?

Are there any different habits between software-oriented publication in **HEP** and other "radiation physics" disciplines?

No scientometric study on this topic yet

Background

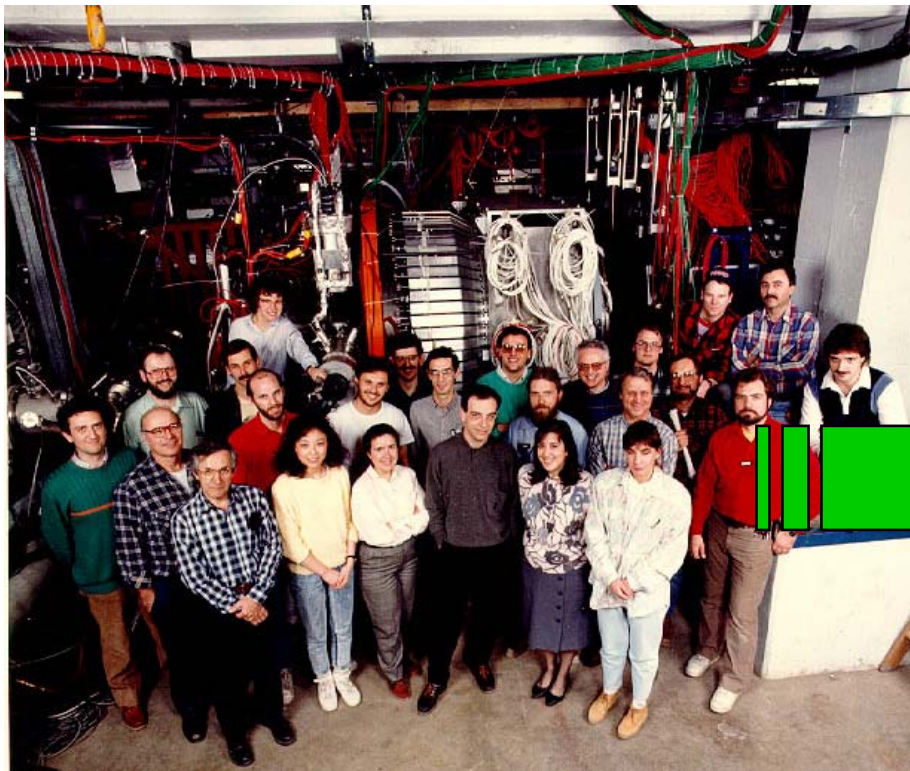
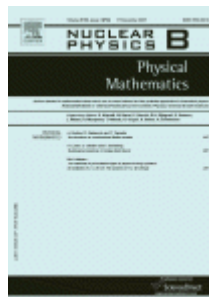
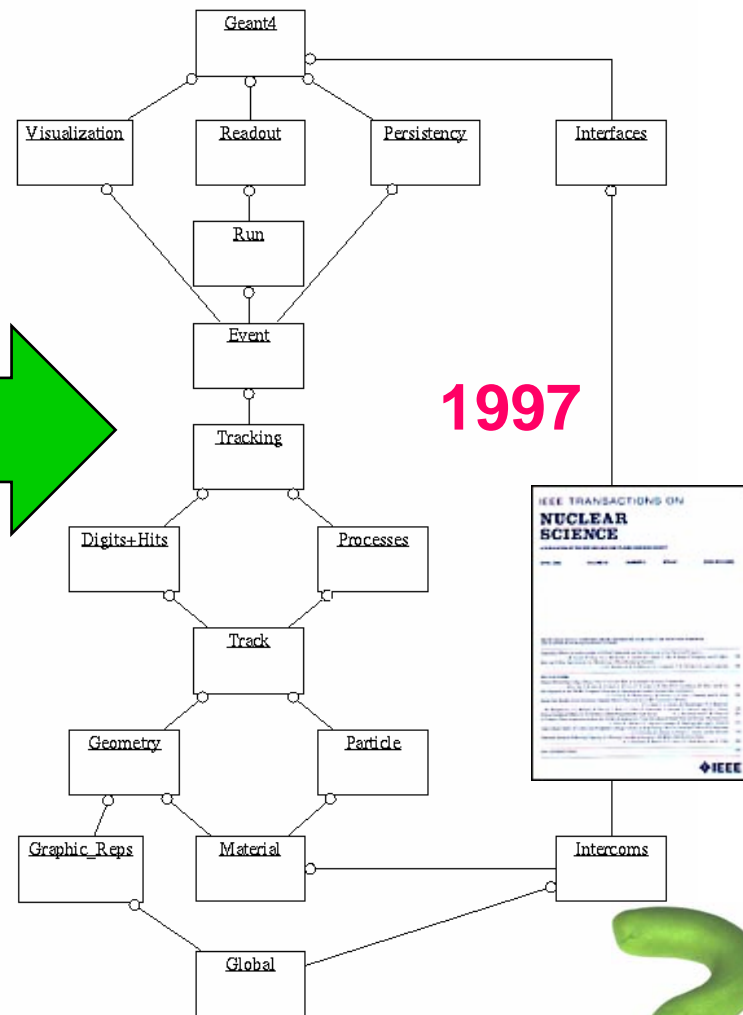


Photo courtesy of Fermilab archive

1987



Geant 4



1997

2007

Data analysis

● Main source of data

- **ISI Web of Science** (covers year >1990)
- Google Scholar (HEP experiments year < 1990)
- Publisher web site and search engines (Elsevier Science Direct, IEEExplore etc.)
- Internal IEEE TNS editorial data (*thank you!*)

● Coverage

- Detailed analyses: years 2002-2006
- Citation searches: 1990-today (*ISI Web of Science coverage*)

● Automated searches

- But manual inspection of partial sample: avoid blind analysis!
- Introduction of **noise**: background evaluation to be refined

● Manual scan for paper classification

- In many cases no other way to evaluate the pertinence of papers
- Some degree of **subjective evaluation** (1-10%)
- Conservative bias: assign to software in case of sw/hw ambiguity

● Cross checks with other databases (INSPEC, CDS etc.)

- For a few samples

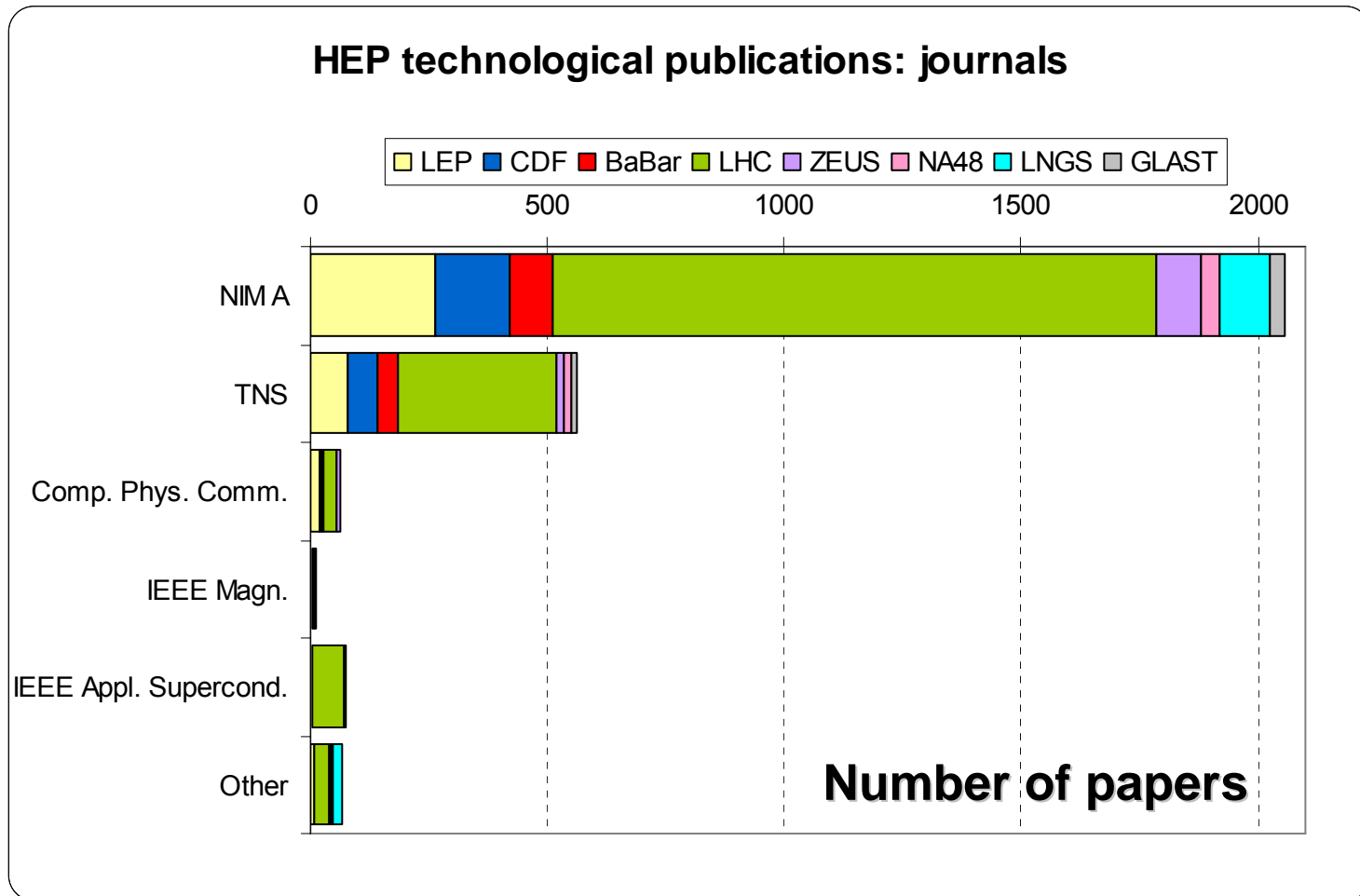
HEP experiments

How does software-oriented HEP literature production compare to a hardware-oriented one?

- A set of reference HEP experiments
 - LEP, LHC, Tevatron, PEP-II, HERA, fixed target, astroparticle
 - Apologies to those not included in the statistics: no judgment of merit!
- Publications in technological journals only
 - Exclude papers on physics results
- Hardware
- Software
- Trigger/DAQ
 - More hardware-oriented in the early days (*LEP era*)
 - More software-oriented nowadays (*LHC era*)
- Manual scan (a few hundreds papers/experiment at most)

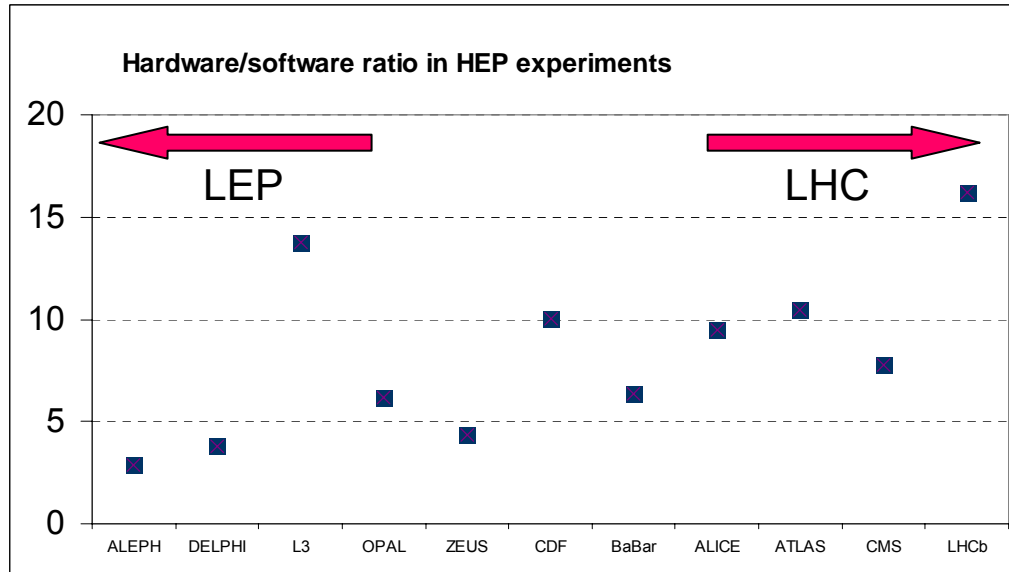
HEP technological publications

Most popular journals



Hardware vs software papers in HEP

1980-today



LEP: full life-cycle
ALEPH, DELPHI, L3, OPAL

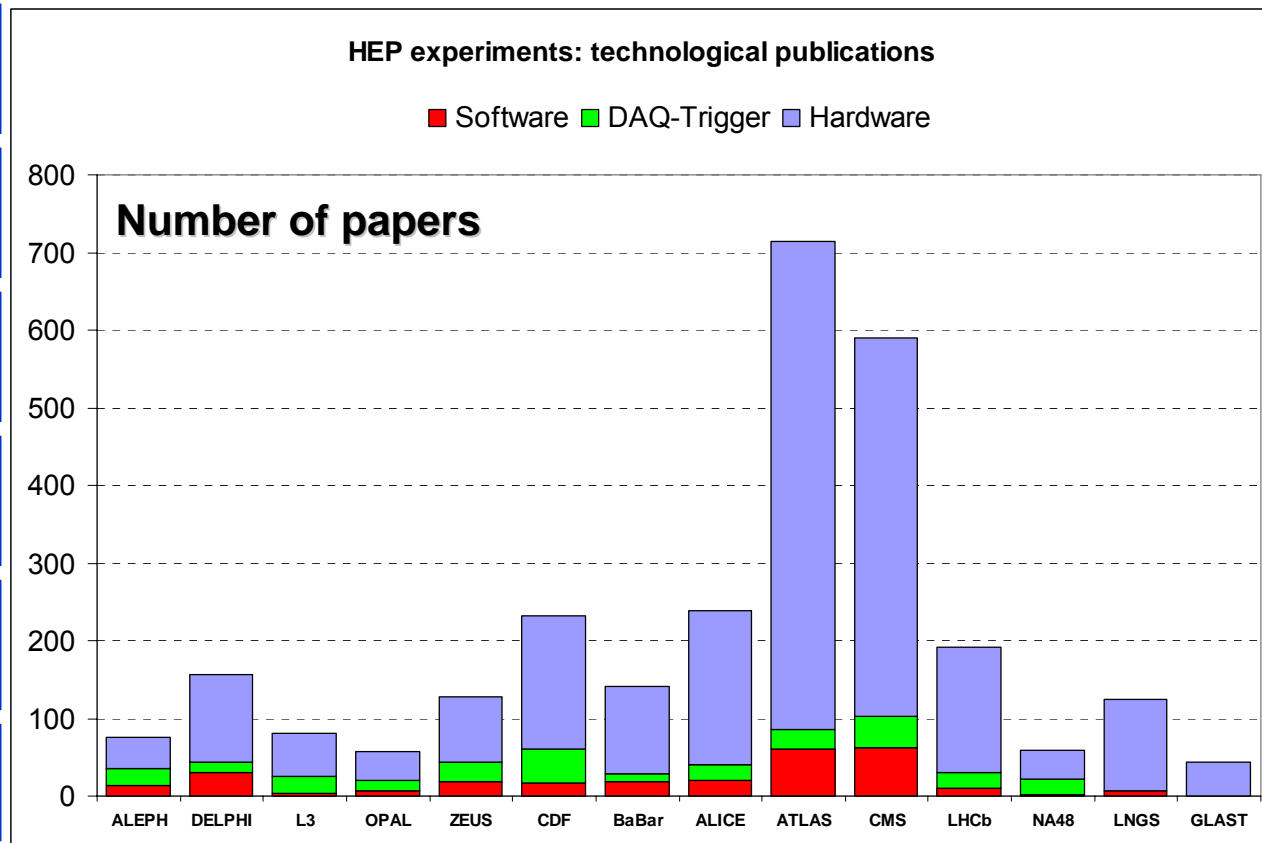
In between:
CDF, ZEUS, BaBar

LHC: the new generation
ALICE, ATLAS, CMS, LHCb

Fixed target
NA48

Astroparticle:
LNGS, GLAST

Labs
CERN, DESY, FNAL, LNGS, SLAC



Grid computing

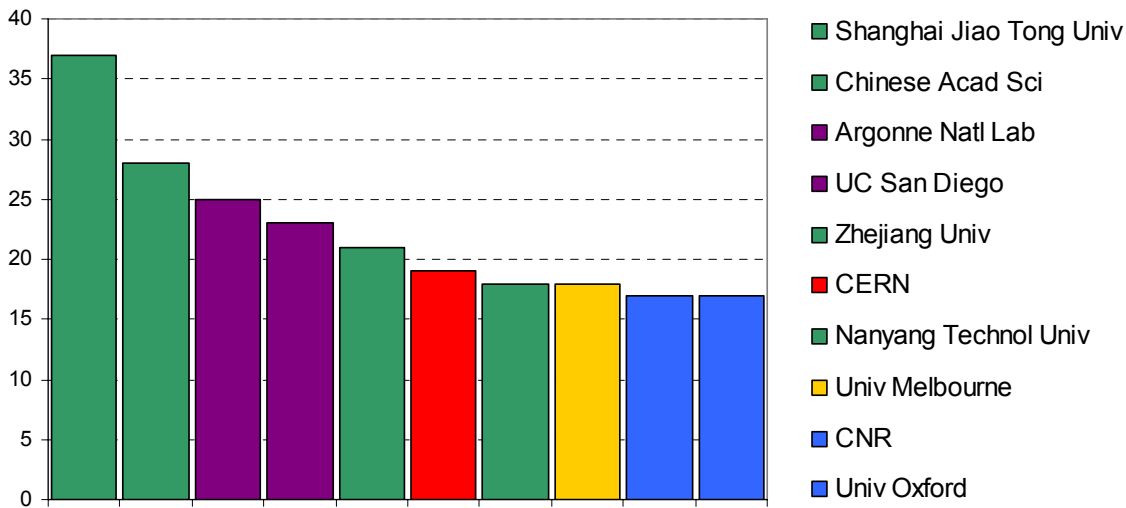
- The big hype in HEP nowadays
 - Not only in HEP...
 - Large investments (funds, manpower)
- Large literary production (2002-2006)
 - Grid/distributed computing journals: **4572** papers
 - NIM A + IEEE TNS: **10386** papers

What are the publication trends in this active computing domain?

Where does HEP stand?

Grid computing: top 10 institutes

Grid computing: top 10 institutes

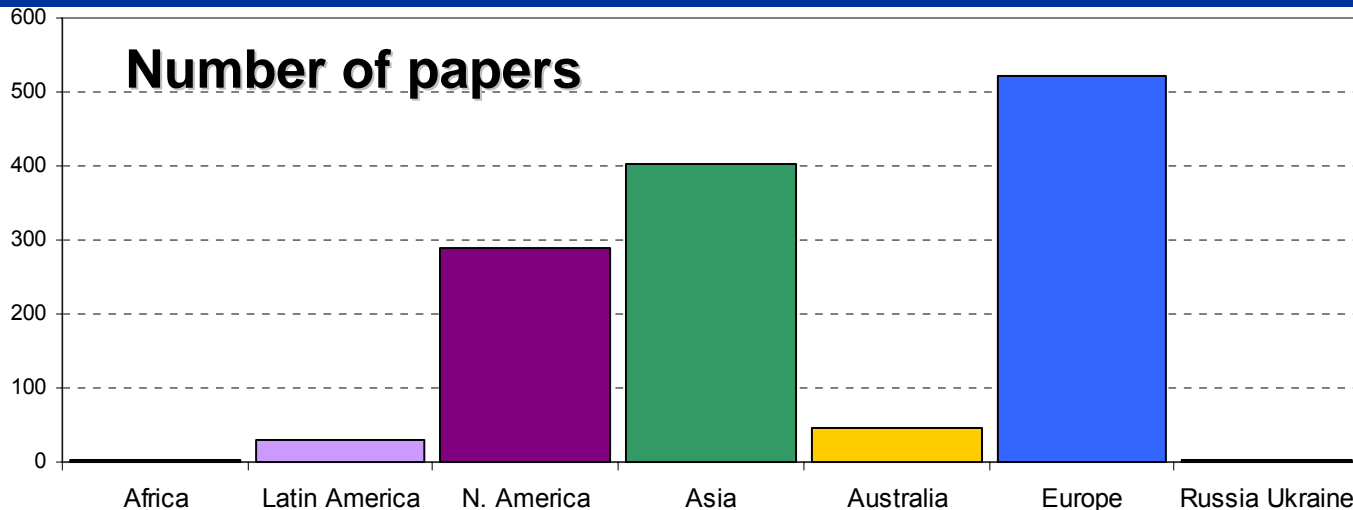


Number of papers

Source:
ISI

Web of Science
2002-2006

Geographical distribution of publications

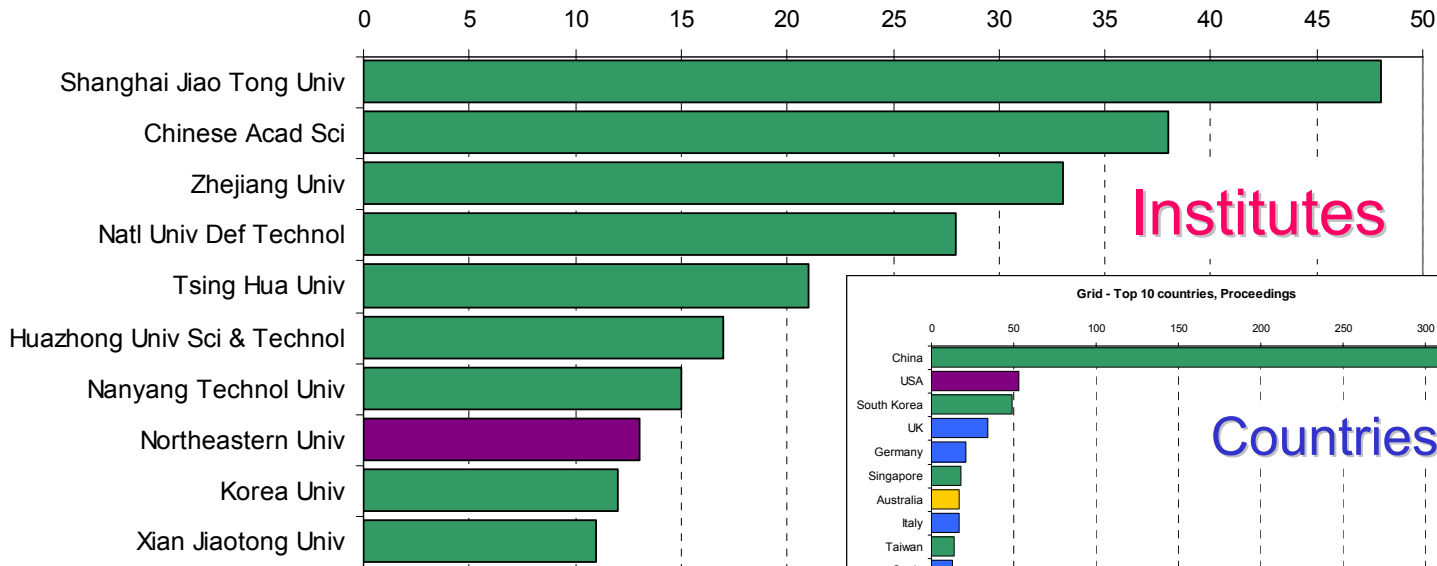


% of all papers

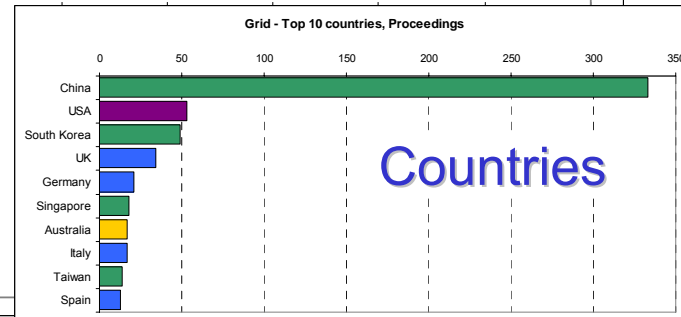
All types of
publications:
**journals,
proceedings**

Number of papers Grid - Top 10 institutes,

Conference proceedings

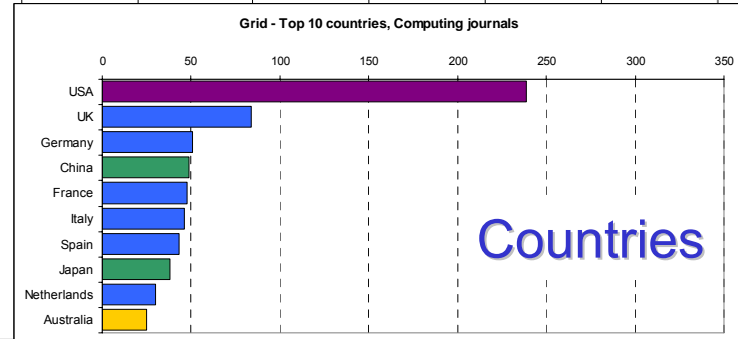
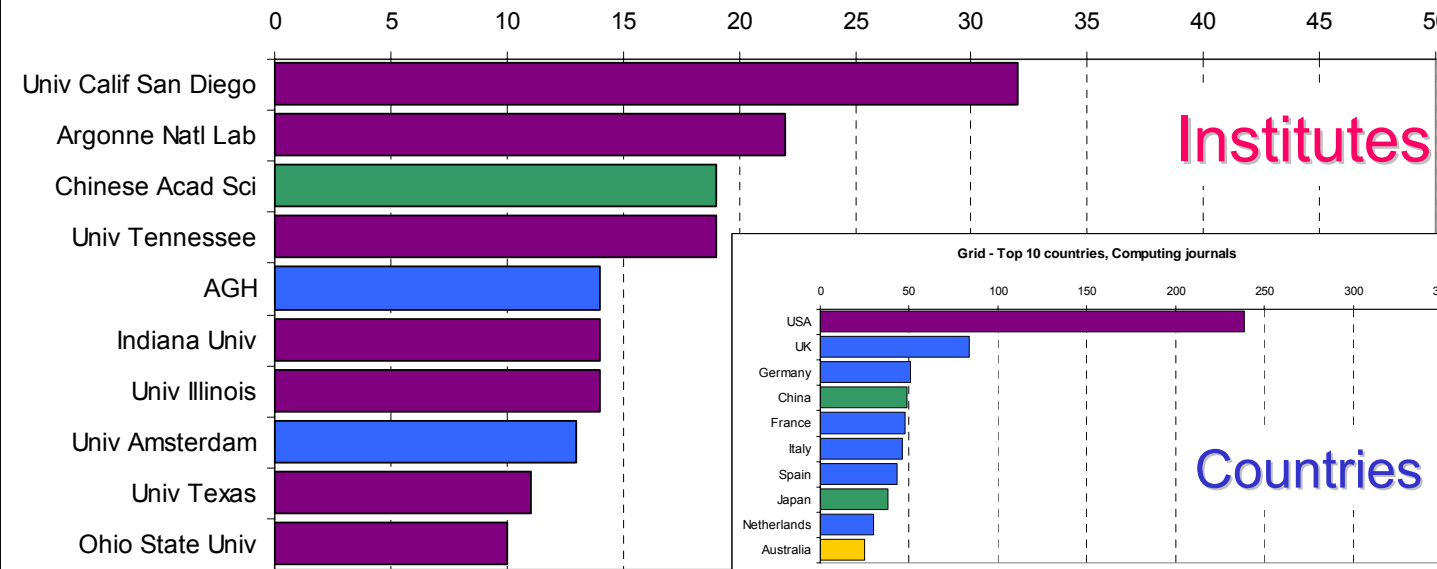


Source:
ISI Web of Science
2002-2006



Number of papers Grid - Top 10 institutes,

Computing journals



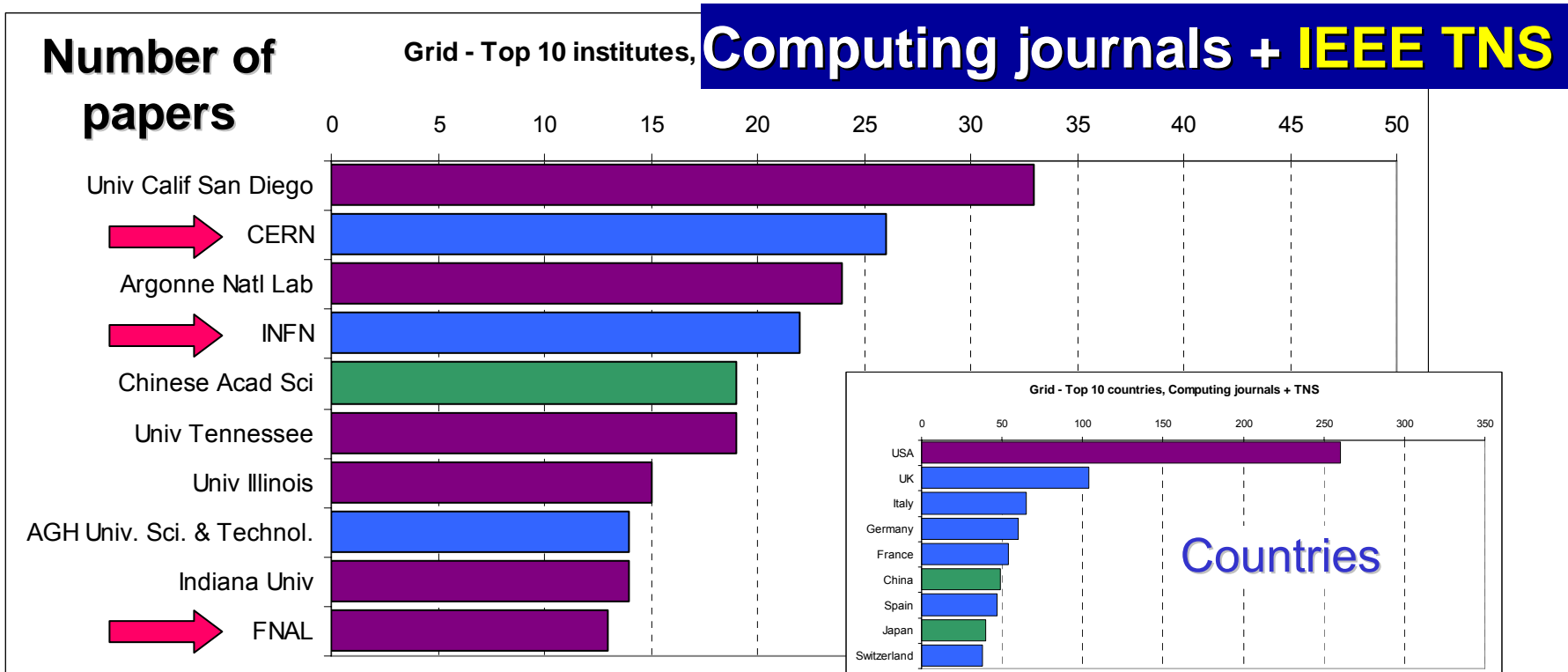
Different
publication
habits

US/EU
academic
environment

Asian univ.

Where is HEP?

Grid computing plays a major role in LHC experiments
HEP labs/institutes play leading roles in grid development



No regular paper on grid-computing in NIM (only in NIM-proceedings)

Simulation - Monte Carlo

One of the main areas of software contribution to experimental physics research

Event generators
Particle transport

Detector
Physics

Software



Core system
developers

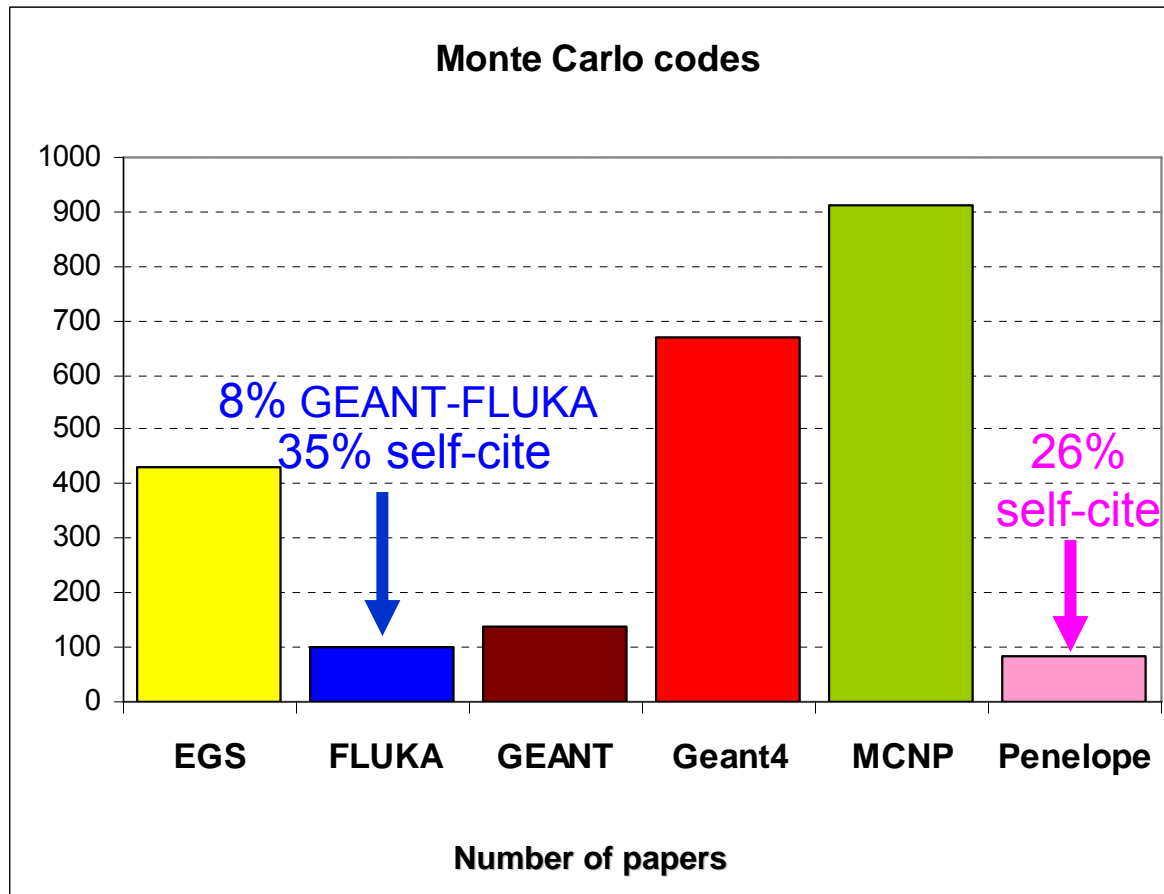
Application
developers

Application
users

Which domains for simulation papers ?

Monte Carlo codes

Statistics in ISI Web of Science, 2002-2006

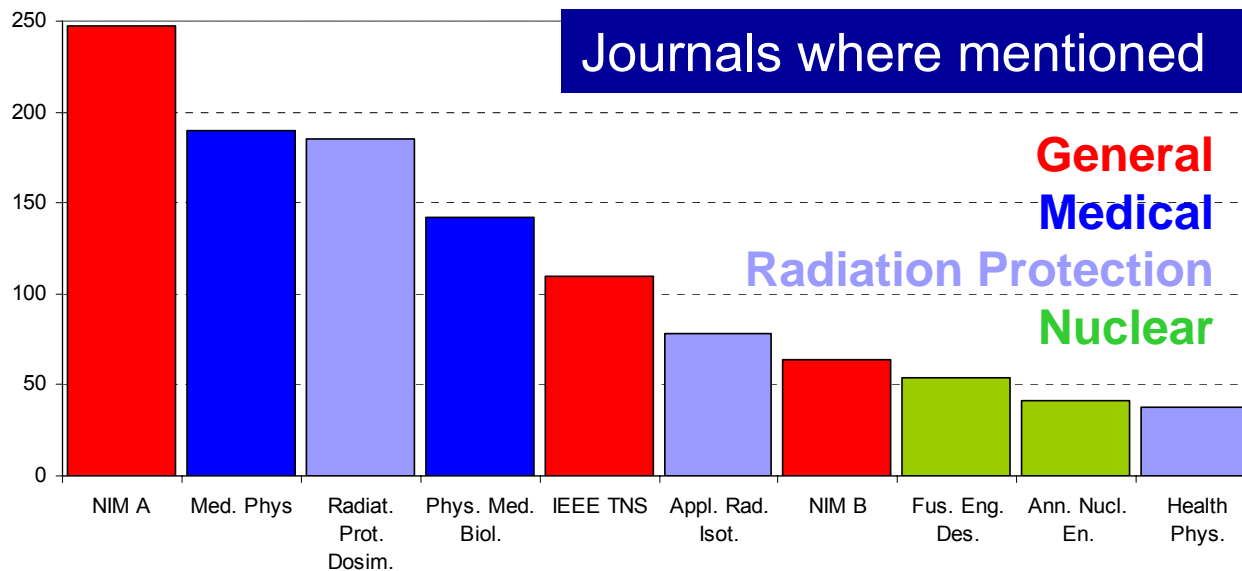


Mixed sample

Geant4: citations
Others: word search

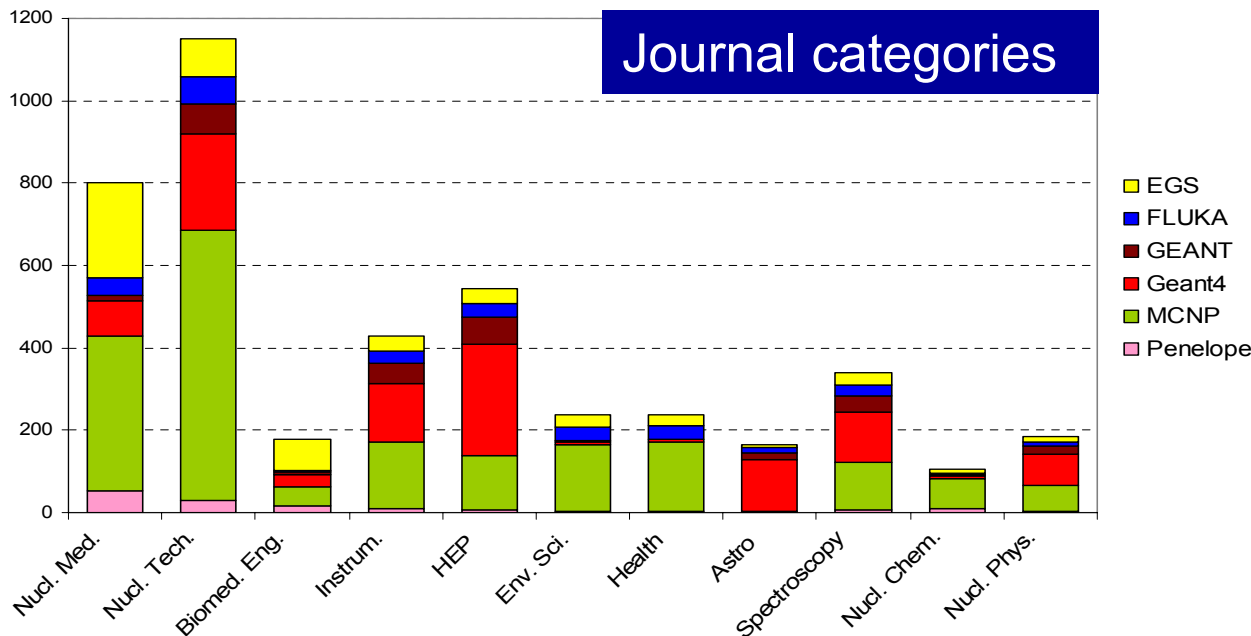
Note: often Geant4 is mentioned as GEANT in published papers

EGS FLUKA GEANT Geant4 MCNP Penelope



A large fraction of Monte Carlo literature is published in journal for **medical physics** and **radiation protection**

Top 5 Monte Carlo categories (defined by journal category)

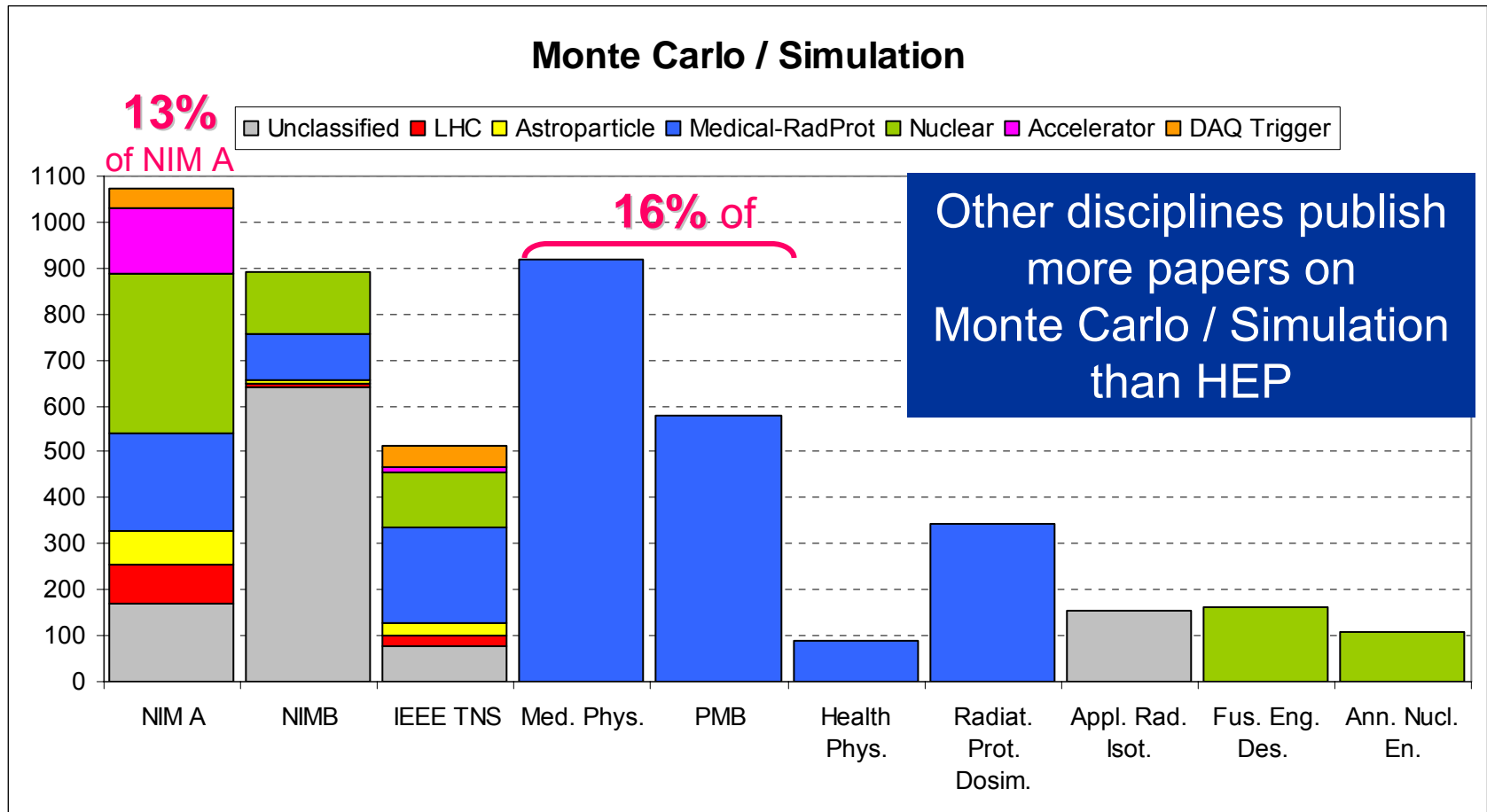


Multiple entries

e.g. NIM A classified by ISI in HEP, Nuclear Technology and Spectroscopy

Monte Carlo / Simulation

Distribution of articles across experimental topics
ISI Web of Science, 2002-2006



HEP Cinderella?

- **Vertex detector** of a collider experiment
 - 79 papers on Si vertex detector hardware
 - 11 papers on Si vertex detector trigger and DAQ
 - 1 paper on vertex reconstruction software
 - 0 papers on vertex detector **simulation**...
- **LEP experiments**
 - 5 papers on **simulation** in total (2 on specific topics)
 - over ~20 years of construction, running, data analysis...
 - J. Allison et al.
The detector simulation program for the OPAL experiment at LEP
NIM A 317 (1-2): 47-74 Jun 15 1992
Times Cited: [324](#)
- **Medical physics**
 - ~1500 simulation papers in *Med. Phys.* and *Phys. Med. Biol.* (2002-2006)

Computing - Software

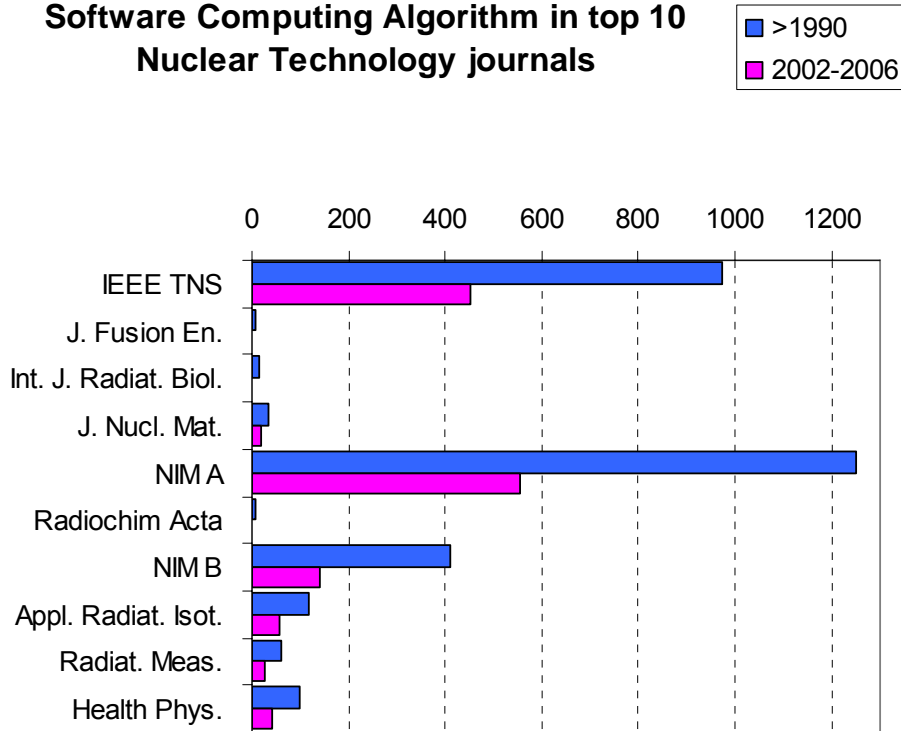
- Generic keyword search: too many
 - Restrict search to a subset of technological journals
- Computing + software + algorithm + Monte Carlo + simulation
 - Still some noise introduced in the sample
 - Some “software” papers not retained by the selection
 - Comp. Phys. Comm.: 62% sample retained
 - Fraction of CPC missed includes mostly theoretical, non-radiation-physics papers
 - Tests with other keyword searches do not modify the conclusions substantially
 - Better check needed for TNS papers due to noise introduced
- Sample selected: mostly detector application papers

Software - Computing

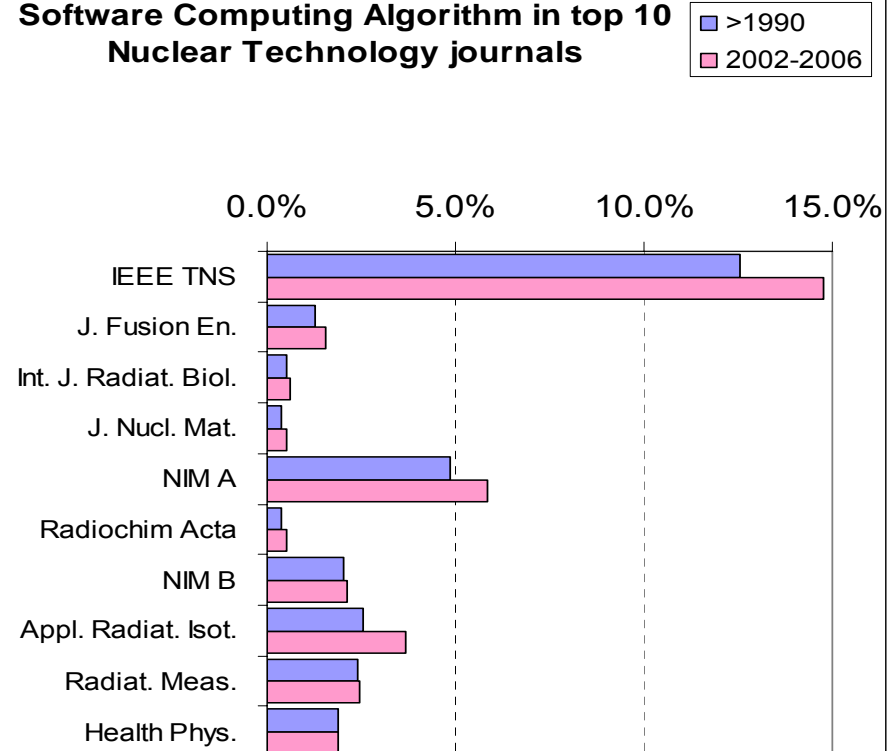
- Keyword search in ISI Web: software + computing + algorithm
- Top 10 Nuclear Technology journals
 - Periods: > 1990 and 2002-2006

Dominated by TNS and NIM A/B

Software Computing Algorithm in top 10 Nuclear Technology journals



Software Computing Algorithm in top 10 Nuclear Technology journals



Citation statistics

- Not necessarily the best metric of scientific relevance
 - but widely used (*journal impact factor*)
- Most cited papers in **HEP labs/institutes**
 - CERN, INFN, other labs
- Most cited papers in **selected technology journals**
 - NIM A, TNS, Med. Phys., Phys. Med. Biol., Rad. Prot. Dos.
- Most cited papers in all **Nuclear Science and Technology journals**

1. IEEE Trans. Nucl. Sci.
2. J. Fusion En.
3. Int. J. Radiat. Biol.
4. J. Nucl. Mat.
5. NIM A

6. Radiochim Acta
7. NIM B
8. Appl. Radiat. Isot.
9. Radiat. Meas.
10. Health Phys.

32 journals,
top 10

132367
papers
in total

Where do software papers stand?

Most cited papers - CERN

1. Sjostrand T
[High-energy-physics event generation with Pythia-5.7 and Jetset-7.4](#)
Comp. Phys. Comm. 82 (1): 74-89 Aug 1994
Times cited: 1835
93% citations: HEP
7% technol., astropart.
2. Antoniadis I
[A possible new dimension at a few TeV](#)
Phys. Lett. B 246 (3-4): 377-384 Aug 30 1990
Times Cited: 981
99.7% citations: HEP
3. Amaldi U, Deboer W, Furstenau H
[Comparison of grand unified theories with electroweak and strong coupling-constants measured at LEP](#)
Phys. Lett. B 260 (3-4): 447-455 May 16 1991
Times cited: 801
97% citations: HEP
4. Agostinelli S, et al.
[GEANT4 - a simulation toolkit](#)
NIM A 506 (3): 250-303 Jul 1 2003
Times cited: 657

Most cited papers - INFN

1. Gammaitoni L et al.
Stochastic resonance
Rev. Mod. Phys. 70 (1): 223-287 Jan 1998
Times cited: [1574](#)
2. Marchesini G et al.
HERWIG 5.1 - A Monte-Carlo event generator for simulating hadron emission reactions with interfering gluons
Comp. Phys. Comm. 67 (3): 465-508 Jan 1992
Times cited: [999](#)
3. Abe F et al.
Observation Of top-quark production in (p)over-bar-p collisions with the Collider Detector at Fermilab
Phys. Rev. Lett. 74 (14): 2626-2631 Apr 3 1995
Times cited: [739](#)
4. Agostinelli S et al.
GEANT4-a simulation toolkit
NIM A 506 (3): 250-303 Jul 1 2003
Times cited: [657](#)

HEP paradox?

Few software publications
but

software articles are most cited
(much more than hardware ones!)

How does it compare to other labs?

● FNAL

- No software papers among the 100 most cited ones

● DESY

- Software paper in 4th rank of DESY most cited ones

- Lonnblad L

[ARIADNE Version 4 - a program for simulation of QCD cascades implementing the color dipole model](#)

Comp. Phys. Comm. 71 (1-2): 15-31 AUG 1992

Times Cited: [427](#)

● LLNL

- Most cited software paper: 88th

- Prestridge DS

[Signal scan - a computer-program that scans DNA-sequences for eukaryotic transcriptional elements](#)

Computer Applications in the Biosciences 7 (2): 203-206 APR 1991

Times Cited: [325](#)

Most cited papers: NIM A

1. Agostinelli S et al.
[GEANT4-a simulation toolkit](#)
NIM A 506 (3): 250-303 Jul 1 2003
Times Cited: 663

Top two: software!

2. Radford DC
[ESCL8R and LEVIT8R - Software for interactive graphical analysis of HPGe coincidence data sets](#)
NIM A 361 (1-2): 297-305 Jul 1 1995
Times Cited: 491

3. Kubota Y et al.
[The CLEO-II detector](#)
NIM A 320 (1-2): 66-113 Aug 15 1992
Times Cited: 453 ▶ *88% self-cite*

4. Adeva B, et al.
[The construction of the L3 experiment](#)
NIM A 289 (1-2): 35-102 Apr 1 1990
Times Cited: 450

5. Ahmet K
[The OPAL detector at LEP](#)
NIM A 305 (2): 275-319 Jul 20 1991
Times Cited: 442

7. Sauli F *1st hardware paper*
[GEM: A new concept for electron amplification in gas detectors](#)
NIM 386 (2-3): 531-534 Feb 21 1997
Times Cited: 367

Large-scale HEP detectors

High self-cite fraction from physics papers

Most cited papers: IEEE TNS

1. Cherry SR et al.
[MicroPET: A high resolution PET scanner for imaging small animals](#)
IEEE Trans. Nucl. Sci. 44 (3): 1161-1166 Part 2 Jun 1997
Times Cited: [234](#)
2. Melcher CL, Schweitzer JS
[Cerium-doped lutetium oxyorthosilicate - a fast, efficient new scintillator](#)
IEEE Trans. Nucl. Sci. 39 (4): 502-505 Aug 1992
Times Cited: [189](#)
3. Strother SC, Casey ME, Hoffman EJ
[Measuring pet scanner sensitivity - relating countrates to image signal-to-noise ratios using noise equivalent counts](#)
IEEE Trans. Nucl. Sci. 37 (2): 783-788 Part 1 Apr 1990
Times Cited: [167](#)
4. Summers GP et al.
[Damage correlations in semiconductors exposed to gamma-radiation, electron-radiation and proton-radiation](#)
IEEE Trans. Nucl. Sci. 40 (6): 1372-1379 Part 1 Dec 1993
Times Cited: [160](#)
5. Hoffman EJ et al.
[3-D phantom to simulate cerebral blood-flow and metabolic images for PET](#)
IEEE Trans. Nucl. Sci. 37 (2): 616-620 Part 1 Apr 1990
Times Cited: [134](#)

Most cited papers: Med. Phys. + Phys. Med. Biol.

1. Nath R, et al.
[Dosimetry Of Interstitial Brachytherapy Sources - Recommendations Of The AAPM Radiation-Therapy Committee Task Group No 43](#)
Med. Phys. 22 (2): 209-234 Feb 1995
Times Cited: [610](#)
2. Rogers DWO et al.
[BEAM - A Monte-Carlo Code To Simulate Radiotherapy Treatment Units](#)
Med. Phys. 22 (5): 503-524 May 1995
Times Cited: [391](#)
3. Studholme C, Hill DLG, Hawkes DJ
[Automated Three-Dimensional Registration Of Magnetic Resonance And Positron Emission Tomography Brain Images By Multiresolution Optimization Of Voxel Similarity Measures](#)
Med. Phys. 24 (1): 25-35 Jan 1997
Times Cited: [305](#)
4. Farrell Tj, Patterson MS, Wilson B
[A Diffusion-Theory Model Of Spatially Resolved, Steady-State Diffuse Reflectance For The Noninvasive Determination Of Tissue Optical-Properties In Vivo](#)
Med. Phys. 19 (4): 879-888 Jul-Aug 1992
Times Cited: [300](#)
5. Gabriel S, Lau RW, Gabriel C
[The dielectric properties of biological tissues .2. Measurements in the frequency range 10 Hz to 20 GHz](#)
Phys. Med. Biol. 41 (11): 2251-2269 Nov 1996
Times Cited: [263](#)

Most cited papers: Radiation protection journals

1. Ahlbom A et al.
[Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields \(up to 300 GHz\)](#)
HEALTH PHYSICS 74 (4): 494-522 APR 1998
Times Cited: [547](#)
2. Olive PL, Banath JP, Durand RE
[Heterogeneity in radiation-induced DNA damage and repair in tumor and normal-cells measured using the Comet assay](#)
RADIATION RESEARCH 122 (1): 86-94 APR 1990
Times Cited: [479](#)
3. Ron E et al.
[Thyroid-cancer after exposure to external radiation - a pooled analysis of 7 studies](#)
RADIATION RESEARCH 141 (3): 259-277 MAR 1995
Times Cited: [363](#)
4. Pierce DA et al.
[Studies of the mortality of atomic bomb survivors. Report 12 .1. Cancer: 1950-1990](#)
RADIATION RESEARCH 146 (1): 1-27 JUL 1996
Times Cited: [355](#)
5. Thompson DE et al.
[Cancer incidence in atomic-bomb survivors .2. Solid tumors, 1958-1987](#)
RADIATION RESEARCH 137 (2): S17-S67 Suppl. S FEB 1994
Times Cited: 258

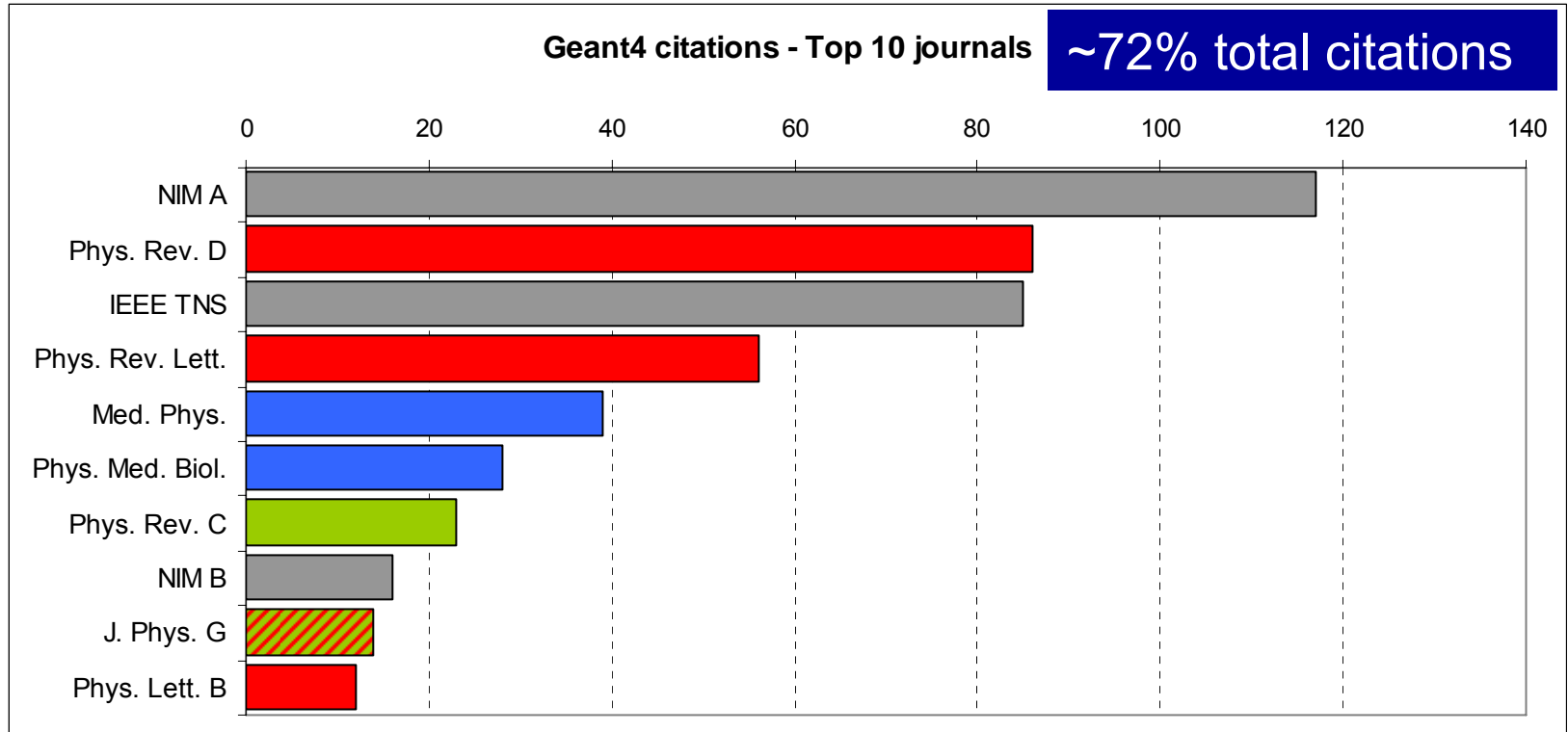
All Nuclear Technology journals

1. Agostinelli S et al.
[GEANT4-a simulation toolkit](#)
NIM A 506 (3): 250-303 Jul 1 2003
Times Cited: [663](#)
2. Ahlbom A et al.
[Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields \(up to 300 GHz\)](#)
Health Phys 74 (4): 494-522 Apr 1998
Times Cited: [547](#)
3. Murray AS, Wintle AG
[Luminescence dating of quartz using an improved single-aliquot regenerative-dose protocol](#)
Radiat. Meas. 32 (1): 57-73 Feb 2000
Times Cited: [499](#)
4. Radford DC
[ESCL8R and LEVIT8R - Software for interactive graphical analysis of HPGe coincidence data sets](#)
NIM A 361 (1-2): 297-305 Jul 1 1995
Times Cited: [491](#)
5. Kubota Y et al.
[The CLEO-II detector](#)
NIM A 320 (1-2): 66-113 Aug 15 1992
Times Cited: [453](#)

657 → 663

Increased while preparing the slides

Who cites Geant4?



Technology journals
46% of top 10

HEP physics
33% of top 10

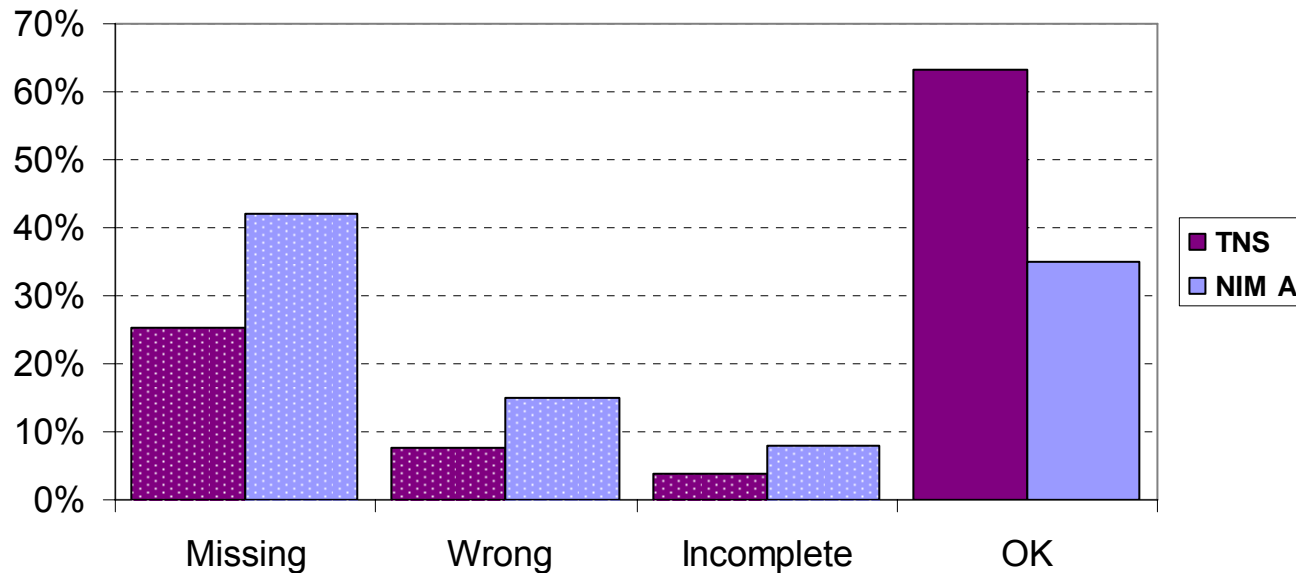
Medical physics
14% of top 10

Nuclear physics
5% of top 10

Who does **not** cite Geant4? (...but mentions it in the paper)



Geant4 references 2005-2006



Only 2 journals analysed
The same pattern may appear in other journals too!

Hardware reference

GEM

~8% missing citation in NIM A

Scientific software is not appropriately cited in many instances

Warning: the message is in the picture rather than in absolute numbers
(noise, manual scans, subjective category assignments, limited search tools etc.)

Meditations...

- HEP
 - Low number of software publications in scholarly journals in relation to hardware publications
 - But high number of citations in the field and in absolute terms
- Other “radiation” disciplines
 - Significant number of papers in some software areas (e.g. simulation)
 - Use software originating from HEP
- Software research (and HEP results) would likely benefit from a higher publication rate
 - What is the cause of the low publication rate?
 - How can this publication rate be improved?

...and action

IEEE TRANSACTIONS ON
**NUCLEAR
SCIENCE**

A PUBLICATION OF THE IEEE NUCLEAR AND PLASMA SCIENCES SOCIETY

JUNE 2007 VOLUME 54 NUMBER 3 IETNAE (ISSN 0018-9499)

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S. Guatelli, A. Mantero, B. Mascialino, P. Nieminen, and M. G. Pia

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 IEEE

- **Computing & Software** is the largest track (# abstracts) at this conference
 - It was the largest last year too, but few software papers presented at the conference were followed by journal submission
 - Proceedings do not carry the same academic weight as publications in a refereed journal!
- **IEEE TNS**
 - No software papers in top cited list (yet)
 - HEP-grid papers
- ... our hardware-oriented colleagues give us a good example!

Manuscript type for software papers: **Instrumentation**