FACULTY UPDATE

The MIT Department of Physics is one of the largest physics departments in the United States. The Department currently has 75 faculty slots. One reason for this is that unlike most of MIT's peer institutions, MIT does not have a separate astronomy department. Instead, astrophysics is part of the Physics Department. The Physics faculty size is large also because of the Department's role teaching both General Institute Requirements (freshman physics) and supervising undergraduate majors and graduate students.

Since the last visiting committee meeting in 2010, seven new faculty members have joined Physics (Nevin Weinberg, Jeremy England, Anna Frebel, Liang Fu, Paolo Zuccon, Mike Williams and Will Detmold). Four faculty have been tenured (Marin Soljacic, Joe Formaggio, Josh Winn and Martin Zwierlein), four were denied tenure (Gabriella Sciolla, Bernd Surrow, Steve Nahn and Jan Egedal-Pedersen), and seven retired (George Benedek, Bruno Coppi, Tom Greytak, Ulrich Becker, Wit Busza, June Matthews and Roman Jackiw). Additionally, two more new junior faculty will join us in January, 2013 (Aram Harrow and Mike Evans) and two more will join us in September, 2013 (Tracy Slatyer and Yen-Jie Lee). All of this activity adds up to an extraordinary overturn of our faculty over a two year period.

Our current faculty roster of 69 (see Figure 2.1) consists of 50 tenured faculty members and 19 untenured. For a history of faculty distribution by tenure and rank see Figures 2.2 and 2.3. Their research interests span a wide range of physics research frontiers. Figure 2.4 shows that almost half of the faculty members study particle and nuclear physics, one fifth study astrophysics and astronomy and the rest study atomic, biological, condensed matter and plasma physics. Figure 2.5 shows the research volume of physics faculty principal investigators. Note that some of these funds support large facilities, such as Bates under Robert Redwine and AMS under Sam Ting.

Since 1989 the faculty size has decreased from 88 to 69, causing the freshman teaching load to grow significantly (see Figure 2.6) and raising the average number of students supervised per faculty member to 6.9 from 6.2. Given the style of research in our department it would be difficult for our faculty to supervise a significantly larger number of students.

After a precipitous drop in the number of physics majors and graduate students in the 1990s, our numbers have grown sharply, especially at the undergraduate level. The number of S.B. degrees awarded in 2012 is now back to the levels previously not seen since the late 1980s (see Figure 2.7), and a level that exceeds all of our peer institutions. At the graduate level, Figure 2.8 shows that MIT typically awards more Physics Ph.D. degrees than any other university, but this is somewhat misleading, because astronomy students do not get physics doctorates at most of our peer institutions. The number of Ph.D. degrees awarded went through a minimum in 2003 and has rebounded (Figure 2.9). Figures 2.7 and 2.9 also demonstrate the burden that these increases are placing on our faculty with the decline in faculty size over the years.

Figure 2.10 shows the arrivals and departures of faculty members by division since 1993. Figures 2.11 through 2.12 show the age distribution of the faculty over time and across divisions. Currently 18% of our faculty are over age 66. However, the last two years have seen a demographic shift to an overall younger average faculty with the influx of new junior faculty members and the retirements of seven individuals.

During the next five years we expect to hire more than 10 new faculty members. Hiring decisions must be made carefully so as to appoint the best faculty for the future in the most exciting fields by following our strategic plan while retaining some flexibility for unusual opportunities. Figures 2.13 through 2.15 show the history of our offers, acceptances and declines by division since 2000.

Physics Strategic Plan
September, 2012

Overview

This Physics Strategic Plan identifies several areas of interest to the Department whose renewal should enable us to maintain our core strengths while growing in areas identified as having high potential impact in research and education. The plan looks forward approximately five years, during which time we expect to make hires at a slower rate than the last two years when we hired 10 new faculty members. The plan has been developed by the Department Head and Physics Council and updates the version prepared two years ago.

This Strategic Plan helps guide our procurement and allocation of the resources (faculty slots, space and startup funds) needed to strengthen the Department's standing among its peers. This is always important but is critical during periods of diminished resources. During the last decade, only once have we been severely limited by faculty slots (FY2009), and during that time we held one faculty search (Astrophysics) compared with a typical level of four searches. At present, space is the limiting resource in most areas of the Department. Because physics faculty reside in more than a dozen buildings, with the majority of the space controlled by interdisciplinary institutes, labs and centers, space is not readily fungible and global solutions are rarely possible. When they are, as in the Green Center project that co-located high-energy and condensed matter theorists in 2007, the Department stands to make significant improvements.

During the next five years, the Department aims to strengthen its efforts in Biophysics and Astrophysics, the areas highlighted for the 2008 and 2010 Visiting Committees. Such efforts can take 5 to 10 years to mature, given the constraints mentioned above combined with the prudence of maintaining a broad age distribution. Both areas suffer from a deficit of mid-career scientific leadership compared with our peers, while having strong foundations that make further investment worthwhile. Astrophysics benefits from MIT's 10% share of the Magellan Telescopes combined with the resources of the Kavli Institute for Astrophysics and Space Research. Biophysics benefits from MIT's strong life sciences efforts and their convergence with engineering in many MIT departments and institutes.

Past Visiting Committees have noted the opportunities available in applied physics, an area that has traditionally had little representation in the Department because there is so much applied physics conducted in other departments, more than 10% of whose faculty members have physics degrees. However, we now have significant efforts in three applied areas: photonics and electromagnetics, biophysics, and quantum computing. Since the last Visiting Committee in 2010 we have hired one new faculty member in each of the latter two areas.

The 2010 Visiting Committee encouraged us to anticipate demographic trends in other areas that could affect scientific leadership. The Department has shrunk significantly in two areas owing to retirements and departures: plasma physics and experimental nuclear and particle physics. A series of recent new hires in nuclear and particle physics combined with strong mid-career leadership should enable us to maintain a strong program. Our experimental plasma physics

effort will soon be down to one senior faculty member and two senior research scientists, and the federal funding climate presents significant challenges should we wish to make new faculty hires in this area.

Many considerations influence faculty hiring but one trumps all others: our assessment of an individual's promise for achieving the high scientific impact required for tenure. We cannot predict in advance where candidates meeting this standard are to be found. They may be outside of subfields where we felt the need to focus, or among underrepresented groups who are reluctant to apply to MIT. For all these reasons, we adopt a broad, inclusive faculty search strategy that particularly seeks out highly qualified women and minority applicants.

For reasons of efficiency the Physics Department organizes faculty searches by research division; usually there is a separate search committee in each division. Given the large number of recent hires, this year only two of our divisions will conduct searches, in the areas of astrophysics, biophysics and experimental hard condensed matter physics. In FY2011 we added an extra "search" led by the Department Head to encourage and receive applications from anyone seeking a physics faculty position who feels their interests are not well matched to the areas defined by the other searches. We hoped that this innovation would attract more women and minority candidates as well as bring to our attention stars in emerging areas. It did not succeed in these goals, and starting last year we have instead explicitly encouraged applicants to contact the Department Head when an extant search did not appear to be a good match. Ad hoc review committees have been created to assess candidates in such areas, including gravitational wave physics.

Our strategic planning process is informed by reviews of the two labs closely aligned with Physics – the MIT Kavli Institute for Astrophysics and Space Research and the Laboratory for Nuclear Science. The lab directors serve on Physics Council and the Department Head participates in the lab reviews. Lab reviews performed in 2010 show that nuclear and particle physics at MIT is healthy while astrophysics has weaknesses requiring attention. The Department Head and Physics Council are aware of and attentive to such matters across the Department. Strategic plans for these two labs are included in an Appendix.

The sections following describe the strategic opportunities across the Department followed by a detailed biophysics space plan. Biophysics is given the most detail because this area is most severely limited by the lack of space and senior faculty leadership following the departure of Alexander van Oudenaarden. A separate Appendix gives research summaries for each of our current faculty members. Together these documents portray our assessment of the present and future prospects for research in the Department and they will guide our faculty hiring process.

Astrophysics

Despite having outstanding individual faculty in multiple research areas, MIT Astrophysics suffers from a lack of critical mass in many of these areas so that our faculty members are intellectually isolated from one another. MIT's leadership in high-energy astrophysics has been diluted through four faculty retirements and now relies heavily on the research staff of the Kavli Institute. The 2010 NRC Astronomy and Astrophysics Decadal Survey has identified national

priorities focused on cosmology, formation of the first cosmic structures, exoplanets, and gravitational waves. MIT has faculty members in all of these areas and is well positioned to strengthen in several of them.

Our first priority is in those areas (exoplanets, observational cosmology, and astrophysical transients) where optical and infrared observations have huge discovery potential. MIT has a major capital investment in optical and near-infrared astronomy through partnership in the Magellan telescope consortium. This investment has had a very positive impact on the strength and visibility of our astrophysics program, but recent junior faculty departures and the prospect of at least one senior retirement in the next few years leave us below critical mass to fully exploit this resource. The alignment of national priorities, our instrumentation development at Magellan (including the MagE optical-ultraviolet spectrograph and the FIRE infrared spectrograph) and the coming launch of the NASA James Webb Space Telescope present a compelling case for hiring in this area.

A particularly compelling scientific opportunity for us within observational optical/infrared astronomy is in the area of exoplanets. MIT has already established a strong cross-disciplinary program in this area with three faculty members: Winn (recently tenured in Physics), Seager (joint Physics/EAPS), and Schlichting (recently appointed in EAPS). The proposed TESS (Transiting Exoplanet Survey Satellite) mission, led by the Kavli Institute with significant faculty involvement, is a finalist vying for selection as the next NASA Astrophysics Explorer mission, with the final selection expected in early 2013. An additional Physics appointment in this very active are would firmly establish MIT as one of its world leaders.

Our second priority is in gravitational wave astrophysics. MIT and Caltech lead the development and operation of the ground-based LIGO gravitational wave interferometer. After several years of successful operation at sensitivities exceeding its initial design, LIGO is beginning significant upgrades this fall leading to the completion of Advanced LIGO in 2015. These improvements will transform LIGO from a physics experiment into an astrophysical observatory before the end of the decade. However, MIT is at risk of squandering its opportunity for scientific leadership of this experiment. We currently have one senior experimental faculty member in this area (Mavalvala) and a large research staff group on the project as well as a strong gravitational wave theory group (Hughes). We have also just appointed a junior experimentalist (Matthew Evans). However, we are notably lacking in faculty working on LIGO data analysis, which is where the astrophysical opportunities lie. While there is not yet a consensus on whether this role is best filled by a numerical analysis expert or an experimentalist with analytic skills, it is clear that at least one additional faculty appointment in this area will be necessary to fully exploit this transformative science opportunity and maintain our leadership on the project during its most impactful stages.

There are two other research areas of particular strategic interest, both of which involve science opportunities prioritized in the Decadal Survey. Radio astronomy is currently undergoing a significant renaissance, and there are attractive new opportunities in both 21-cm line cosmology and pulsar astronomy that would build on current faculty strengths. An additional appointment in theoretical cosmology and structure formation would better position MIT in this growing priority

area and help to build intellectual coherence by complementing our existing theory group and fostering stronger ties with the Center for Theoretical Physics.

Apart from issues of critical mass, MIT Astrophysics also suffers from a serious demographic problem: while there are several junior and newly tenured faculty and several very senior faculty nearing retirement, there is a dearth of mid-career senior faculty owing to a 24 year interval (1980-2004) during which only two astrophysics junior faculty members were tenured and remained at MIT. This gap has led to a shortage of scientific and administrative leadership that impedes our efforts to strengthen MIT Astrophysics relative to our peers and weakens our internal governance. We seek to make at least two outside senior appointments in the next five years in order reduce this demographic gap. Efforts to date have been unsuccessful but we will continue trying to attract a leading senior astrophysicist to MIT.

Atomic, Biological, Condensed Matter and Plasma Physics

Outside of biophysics (see the separate plan below), the most urgent need here is in the area of experimental condensed matter physics. Compared with our peer institutions, our group is very small. In hard condensed matter physics, the last several years have been particularly exciting, with major discoveries such as graphene, Fe-based superconductors and topological insulators, which have energized the community. An immediate new hire, followed in a few years by a second position, will be needed for us to build a thriving community in these areas. Much of the new development relies on the creation and perfection of new materials and this will be a particularly fruitful focus of our search. Another new direction is the study of oxide interfaces. Recent work has shown that novel electron states (including superconductivity) emerge at the interface between insulating oxides. The capability of controlled layer-by-layer growth of a variety of materials brings us closer to the dream of creating materials by design. New tools will also be needed to probe these new structures.

Soft condensed matter physics is now closely linked with biophysics and this is another area which is underrepresented in our department. This is also an area where the distinction between theorists and experimentalists is often blurred. Especially in biophysics, theorists often start up laboratories and many experimentalists also pursue theoretical work. We should conduct a broad search to fill two positions in the next five years.

The area of atomic and optical physics is increasingly overlapping with condensed matter physics. One direction is the creation of a strongly correlated system using optical lattices and MIT is in a leadership position here. A second emerging direction is the overlap with nanoscience and quantum information science. Examples include cooling of meso-scale mechanical oscillators to near the ground state and achieving quantum superposition, the coupling of single ions via superconducting wires, and the study of Bose-Einstein Condensation using ultra-sensitive cantilevers. These are attractive general directions where we can add one faculty member to our AMO group in the next five years. These areas are also related to experimental work done in connection with LIGO and theoretical work done in the CTP.

The condensed matter theory group has a tradition of maintaining close contacts with the experimental groups and has considerable strength. Last year we have hired two excellent young

theorists who will add further breadth to the group (Jeremy England in biophysics and Liang Fu in hard condensed matter physics). To maintain a productive balance between senior and younger faculty, we should plan on hiring another junior faculty member in condensed matter theory on a five-year time scale.

Experimental Nuclear and Particle Physics

This division has about twenty faculty members who participate in the Laboratory for Nuclear Science. LNS faculty lead research efforts at experimental sites all over the world and are leaders in development of new instrumentation, accelerators and analysis techniques. The division conducts an open search typically every other year. Our searches are driven primarily by excellence, but in coming cycles will emphasize the areas discussed below.

Several very important results have come out of MIT led experiments in the last two years:

- Measurement of the mixing angle between the heaviest and lightest neutrinos mass eignstates (Conrad).
- First observation of the Higgs boson at LHC (Klute, Nahn, Paus)
- A high precision measurement of parity violation in electron-proton scattering (Kowalski)

All of these results had major leadership from NUPAX and present strong vectors for the future.

Physics at the Highest Energies

The MIT Particle Physics Collaboration (PPC) high energy group (Klute, Paus, Nahn) works on the Compact Muon System (CMS) experiment at the Large Hadron Collider (LHC) that recently announced compelling evidence for observation of the Higgs boson with a mass of around 126 GeV. The MIT CMS group played a major role in the observation. We expect to continue to lead CMS in a major way in the coming years as the program moves into characterization of the new boson and the probing of higher masses through planned upgrades. We also have an effort on the ATLAS experiment (Frank Taylor) focused on the muon system.

Strong Interaction Physics

We enjoy a close connection with the CTP in strong interaction physics and we see many exciting opportunities in this area. At Jefferson Lab, a new faculty member (Michael Williams) will have a major role in the GlueX experiment in Hall D after the 12 GeV upgrade is completed. At the LHC, the MIT CMS Heavy Ion Group (Roland, Wyslouch) has always led the CMS heavy ion program and has made major advances in characterizing hot, dense nuclear matter with the data acquired so far. The MIT CMS heavy ion program will continue for the foreseeable future and with a strong recent faculty hire (Yen-Jie Lee). MIT faculty (Milner, Redwine) lead the OLYMPUS experiment at DESY searching for second order effects in electron-proton scattering. OLYMPUS is currently taking data. MIT collaborates with Brookhaven and Jefferson Lab in the Electron-Ion Collider that will in the future open a new regime in electron scattering.

Neutrinos

In the last year, the Double Chooz reactor experiment, with MIT leadership (Conrad), gave the first indications of large mixing between the lightest and heaviest neutrino mass states, a long sought after result. Double Chooz will continue to sharpen our understanding of this mixing as well as to search for evidence of sterile neutrinos. The MicroBooNe experiment (Conrad) at Fermilab will begin operation in the next year, undertaking a study of anomalous neutrino-nuclear interactions at low energies. In addition, MicroBooNe will demonstrate liquid argon detection in a large detector for the first time. The group has undertaken the development of high power cyclotrons to using as high intensity, mono-energetic neutrino sources to open a new window into neutrino interactions. A first step, IsoDAR, will study sterile neutrinos and a larger system, DAEdALUS, will search for CP violation in neutrino interactions. Neutrino masses may also be detected kinematically by precise measurements of the energies of electrons emitted in beta decay and MIT (Formaggio) is very active in the KATRIN experiment that will begin taking data in the next year. A new technique, called Project 8, with higher sensitivity based on measurement of the synchrotron radiation of the electrons orbiting in a magnetic field, has been instigated at MIT (Formaggio) and is under development.

Dark Matter

Laboratory evidence for dark matter will most likely come from the observation of nuclei recoiling after being struck by a heavy dark matter particle and MIT is very active in the CDMS (Figueroa) and MiniClean (Formaggio) nuclear recoil experiments. Both will undergo substantial upgrades in the coming years. Recently, the new idea of Dark Forces has emerged and MIT (Thaler) and Bates (Fisher, Milner) have instigated an experiment called DarkLight to this new theory. DarkLight was recently approved by Jefferson Lab. The AMS experiment, instigated and led by MIT (Ting) arrived at the International Space Station last year and has been taking data in a search for dark matter ever since; first results are expected in the new year. The analysis of the early AMS data is being carried out by a new hire (Paolo Zuccon).

Studies of fundamental symmetries

At the Spallation Neutron Source at Oak Right National Laboratory, MIT (Redwine) plays a major role in the search for an electron dipole moment of the neutron. Recently, we have begun an effort at LHCb (Williams) that will study heavy quark systems in a search for new physics.

NUPAX is fortunate that a number of senior faculty members who chose to retire from their tenured faculty position in the Physics Department remain active in research. They include Ulrich Becker (AMS), Aron Bernstein (electron scattering at Mainz), William Bertozzi (DarkLight and Hall A at JLab), June Matthews (neutron physics at Los Alamos) and Wit Busza (CMS Heavy Ions).

New Technologies in Particle Physics

LNS has always been a leader in developing new technology for particle detectors, accelerators, and, most recently, computing. In particular, the development of new accelerators for neutrino physics, new detectors for dark matter and electron scattering measurements and the development of new computing models for AMS-02 and LHC present excellent opportunities for hardware-oriented young people to attain leadership in major experiments.

The Future in Nuclear and Particle Physics

Accelerator physics is an important area of opportunity for the division. IsoDAR and DAEdALUS rely on the development of high power cyclotrons in the immediate future to give important physics results. The DarkLight experiment is very tightly coupled to the Jefferson Lab Free Electron Laser and has already made use of Bates expertise in beam studies. In the longer term, new acceleration techniques will be needed to open new avenues at the energy frontier. In the past several searches, we have paid close attention to talented people working in accelerator physics and we will continue to do so.

The continued health of the Bates Research and Engineering Center is essential to the well-being of our division. Bates allows us the launch new efforts and support existing ones, giving MIT a significant advantage. Recent examples are the development of DarkLight, DAEdALUS, computing for the LHC, OLYMPUS and Project 8.

Excellent students are our most valuable resource and expansion of the graduate student fellowship program is critical in this regard. Graduate fellowships have largely made up for the stagnation of federal support and kept our efforts healthy. We strongly urge expansion of the program, possibly by allowing two years of support for excellent students.

The last two years of Experimental Nuclear and Particle Physics have been boom years with many new results and good prospects for the future, despite considerable budget pressure. We have avoided extensive involvement in major projects that did not come to fruition or that we do not see as promising and put our efforts instead into those with high payoffs. While research directions are ultimately up to individual faculty, we do engage in strategic discussions in the LNS Research Group Leaders, Divisional meetings, particularly those meetings related to searches. Thus, continuing to renew our faculty through junior hires is the key to determining our strategic direction.

Center for Theoretical Physics

The Center for Theoretical Physics consists of just over a dozen faculty working in the broad areas of particle and nuclear theory, quantum field theory, string theory, the application of string theory techniques to other areas of physics, cosmology, as well as quantum computing and quantum information theory. In the spring of 2012, the group made three offers of assistant professorships to three outstanding scientists working in different areas of physics. All three accepted. Will Detmold joined the faculty in September 2012. His expertise is lattice QCD

which is a numerical approach to a strong interaction problem. In January 2013, Aram Harrow will come on board. He is an expert on quantum information and quantum computing. In September 2013, Tracy Slatyer will join our department. She works on beyond the standard model physics as well as the astro-particle connection. Given these three new hires the Center for Theoretical Physics will not conduct any formal searches for new faculty this academic year but will, of course, consider any excellent targets of opportunity should they arise.

Particle Phenomenology and Beyond the Standard Model Physics

The Large Hadron Collider is now functioning beautifully. The Higgs Boson, whose existence was predicted by the Standard Model of Elementary Particles, was found. The detailed properties of this particle will reveal information about the Standard Model or perhaps even indicate that there are things at work beyond the Standard Model. The LHC will continue to look for a variety of particles and phenomena predicted by theories that go beyond the Standard Model such as Supersymmetry. It may turn out that what is discovered was not foreseen. Clearly the Center for Theoretical Physics intends to have an active role in understanding this new energy frontier, both in examining candidate new signals and calculating Standard Model backgrounds. Complementing the LHC physics program is the hunt for dark matter particles by non-accelerator experiments. Tantalizing hints are being examined. Again MIT theorists intend to work in this exciting area hoping to understand the impact of any new discoveries on our view of the theory of elementary particles.

Early Universe Cosmology and Nuclear and Particle Astrophysics

LHC energies were achieved in the early universe by typical particles at roughly 10^{-13} seconds after the big bang, and at earlier times the energy was even higher. Thus the early universe provides a window to high energy particle physics that complements the research at particle accelerators. Our understanding of particle physics has been remarkably successful at describing the early universe in precise ways that make predictions for current observations. In particular the inflationary model makes contact with times less than 10^{-30} seconds after the big bang, and makes very successful predictions for the mass density of the universe and the spectrum of density fluctuations observed today. Closely related is the relationship between general astrophysics and particle physics, where for example the understanding of elementary particles is necessary to model neutron stars and supernovae explosions. The dark matter that permeates the universe is very likely composed of a new type of elementary particle, and the dark energy causing the acceleration of the universe may require new ideas in fundamental physics for its explanation. This whole area has been extremely fruitful, and the Center for Theoretical Physics hopes to continue to make contributions to it.

Strong Interaction Theory

Many problems in particle physics involve forces operating in regimes where the couplings are large and simple approximation techniques are not available. For example the force that binds quarks together to make a nucleon is strong and the best description of the properties of nucleons, viewed as composite objects, comes from intensive numerical simulations. This "Lattice Gauge Theory" approach to understanding nucleons has become a distinct branch of

particle/nuclear physics. But the general problem of strongly interacting quantum systems has applications in a much wider domain. For example there are many condensed matter systems which can be viewed as strongly interacting. The collision of relativistic heavy ions at accelerators produces a quark liquid that requires a strong interaction description. There is hope that ideas from string theory which have had some success in describing what is seen in relativistic heavy ion collisions may be further developed to gain insight into a wide variety of strongly interacting systems. Discovering general approaches to strongly interacting quantum systems would have far reaching consequences for theoretical physics. This cross disciplinary effort makes contact with condensed matter and cold atom physics and appears to be an area of growing importance.

Quantum Computing and Quantum Information

Chemistry, solid state physics, atomic physics and the current theory of elementary particles (not including gravity) are all described by quantum laws. However all computations done by conventional computers can be viewed as based on a logic system tied to binary arithmetic. Richard Feynman was an early advocate of the idea that we should think about designing computers whose logic base is quantum mechanical as opposed to based on the abacus. In the last twenty years the field of quantum computation has matured to the point where there are clear examples of the power of quantum computers over classical computers for certain tasks. It is also known that information sent in the form of quantum states can be secure against eavesdropping and other attacks in ways that classical information can not be. This general area of quantum computing and quantum information is very strong at MIT. However there are many more connections to be made between quantum computing/information and condensed matter physics. There is hope to grow even stronger in theoretical quantum computing with ties to computer science and other parts of the Physics Department.

Figure 2.1

MIT Department of Physics

Faculty Size by Division & Rank as of 9/1/12

Astrophysics	*Atomic, Biophysics Condensed Matter, Plasma*	*Experimental Nuclear & Particle Physics*	*Theoretical Nuclear & Particle Physics*
Head: D. Chakrabarty	Head: V. Vuletic	Head: P. Fisher	Head: E. Farhi
Full Professor Belcher, J. Bertschinger, E. Canizares, C. Chakrabarty, D. Hewitt, J. Joss, P. Mavalvala, N. Schechter, P. Tegmark, M.	*Full Professor* Ashoori, R Joannopoulos, J. Kardar, M. Kastner, M. Ketterle, W. Lee, P. Lee, Y. Levitov, L. Litster, D. Porkolab, M. Pritchard, D. Soljacic, M. Todadri, S. van Oudenaarden, A. Vuletic, V. Wen, X.-G.	*Full Professor* Chen, M. Conrad, J. Fisher, P. Kowalski, S. Milner, R. Paus, C. Redwine, R. Roland, G. Ting, S. Wyslouch, B.	*Full Professor* Farhi, E. Guth, A. Jaffe, R. Moniz, E. Negele, J. Rajagopal, K. Taylor, W. Wilczek, F. Zwiebach, B.
Assoc. Tenure Hughes, S. Winn, J.	*Assoc. Tenure* Zwierlein, M.	*Assoc. Tenure* Formaggio, J.	*Assoc. Tenure* Stewart, I. Liu, H.
Assoc. No Tenure Figueroa-Feliciano, E. Simcoe, R.	*Assoc. No Tenure* Egedal, J.	*Assoc. No. Tenure* Nahn, S.	*Assoc. No Tenure* McGreevy, J.
Assist. Prof. Frebel, A. Weinberg, N.	*Assist. Prof.* England, J. Fu, L. Gedik, N. Gore, J. Jarillo- Herrero, P.	*Assist. Prof.* Klute, M. Monroe, J. Williams, M. Zuccon, P.	*Assist. Prof.* Adams, A. Detmold, W. Thaler, J.
Adjunct/Joint Seager, S.	*Adjunct/Joint* Chuang, I. Mirny, L. Seung, S.	*Adjunct/Joint*	*Adjunct/Joint* Freedman, D.

Division	*Astro*	*A.P.&C.M.*	*Exp. N. & P.*	*Th. N. & P.*	*Total*
Full	9	16	10	9	**44**
Assoc. Ten.	2	1	1	2	**6**
Assoc.	2	1	1	1	**5**
Assist.	2	5	4	3	**14**
Subtotal	**15**	**23**	**16**	**15**	**69**
Open					**6**

Figure 2.2

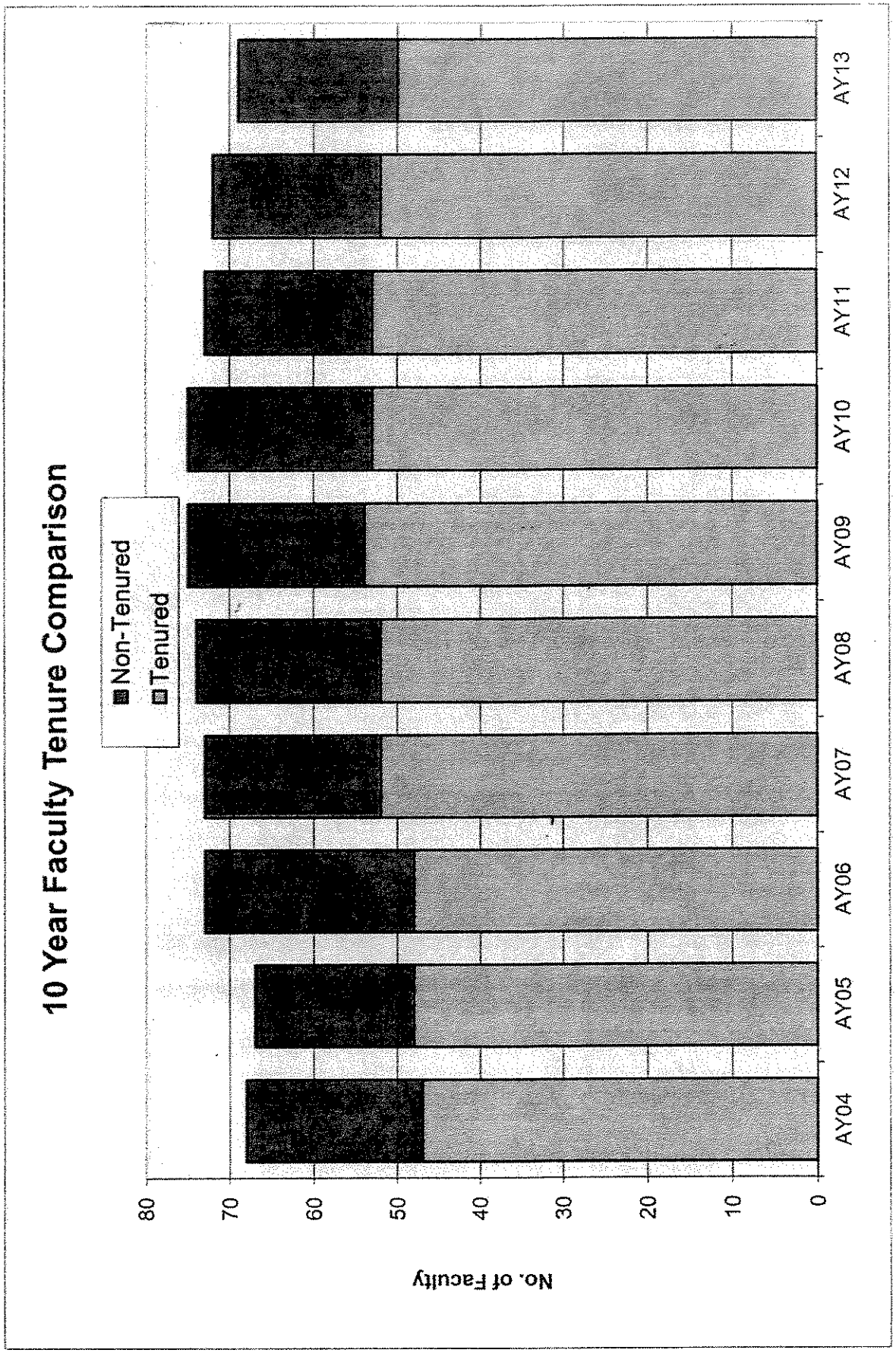
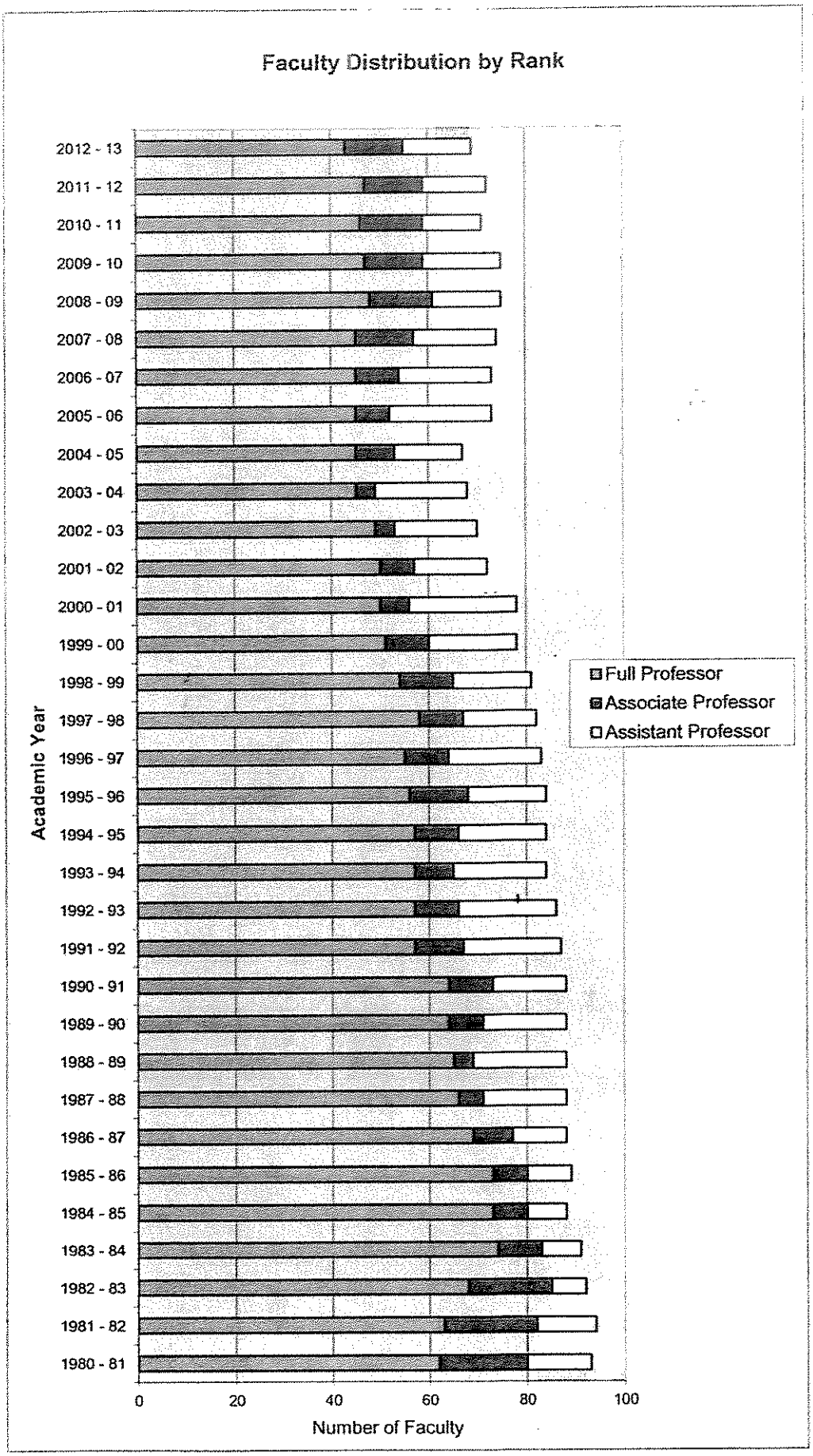

10 Year Faculty Tenure Comparison
Non-Tenured
Tenured
No. of Faculty
0
10
20
30
40
50
60
70
80
AY04
AY05
AY06
AY07
AY08
AY09
AY10
AY11
AY12
AY13

Figure 2.3


Faculty Distribution by Rank
2012 - 13
2011 - 12
2010 - 11
2009 - 10
2008 - 09
2007 - 08
2006 - 07
2005 - 06
2004 - 05
2003 - 04
2002 - 03
2001 - 02
2000 - 01
1999 - 00
1998 - 99
1997 - 98
1996 - 97
1995 - 96
1994 - 95
1993 - 94
1992 - 93
1991 - 92
1990 - 91
1989 - 90
1988 - 89
1987 - 88
1986 - 87
1985 - 86
1984 - 85
1983 - 84
1982 - 83
1981 - 82
1980 - 81
Academic Year
0
20
40
60
80
100
Number of Faculty
Full Professor
Associate Professor
Assistant Professor

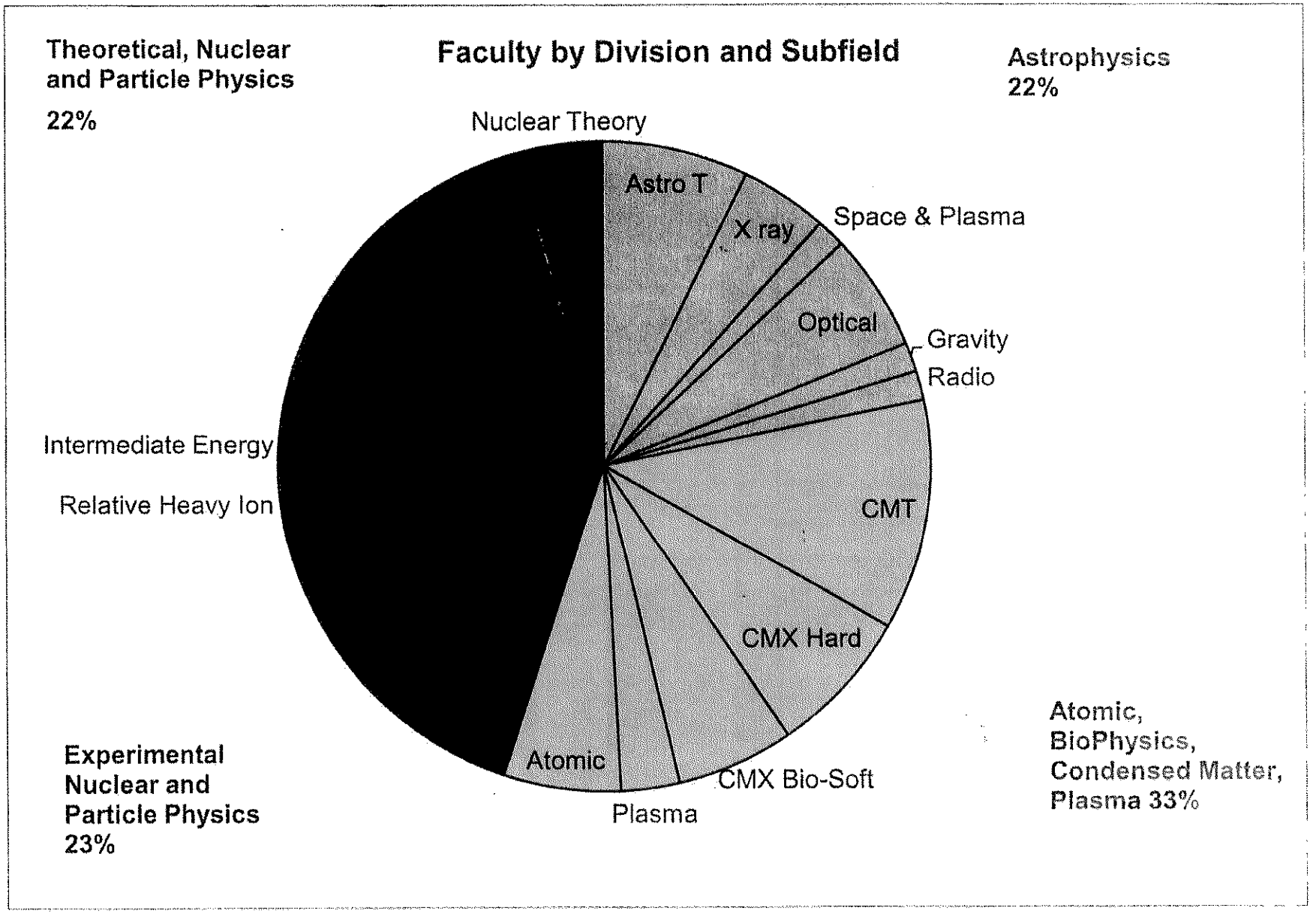
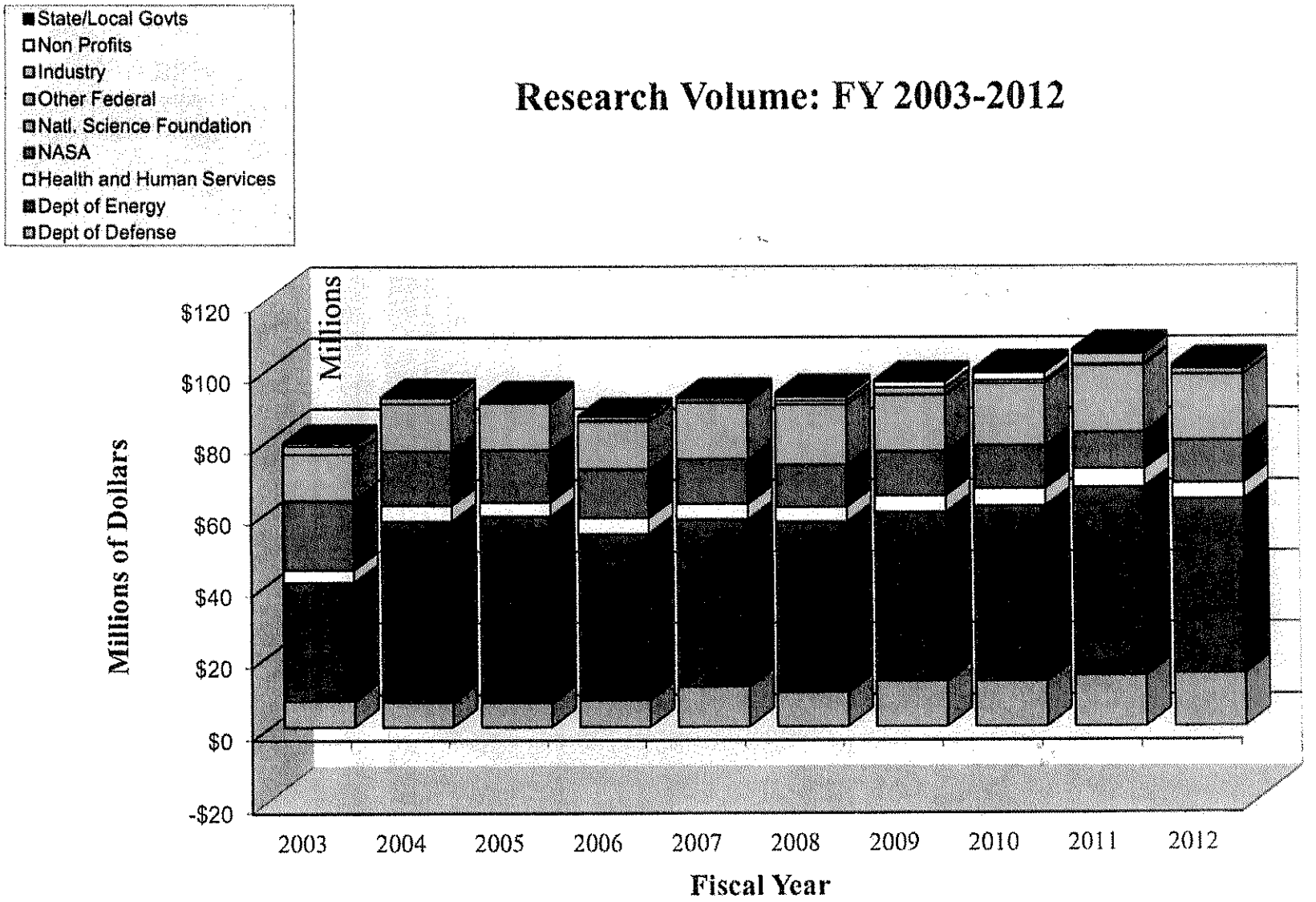
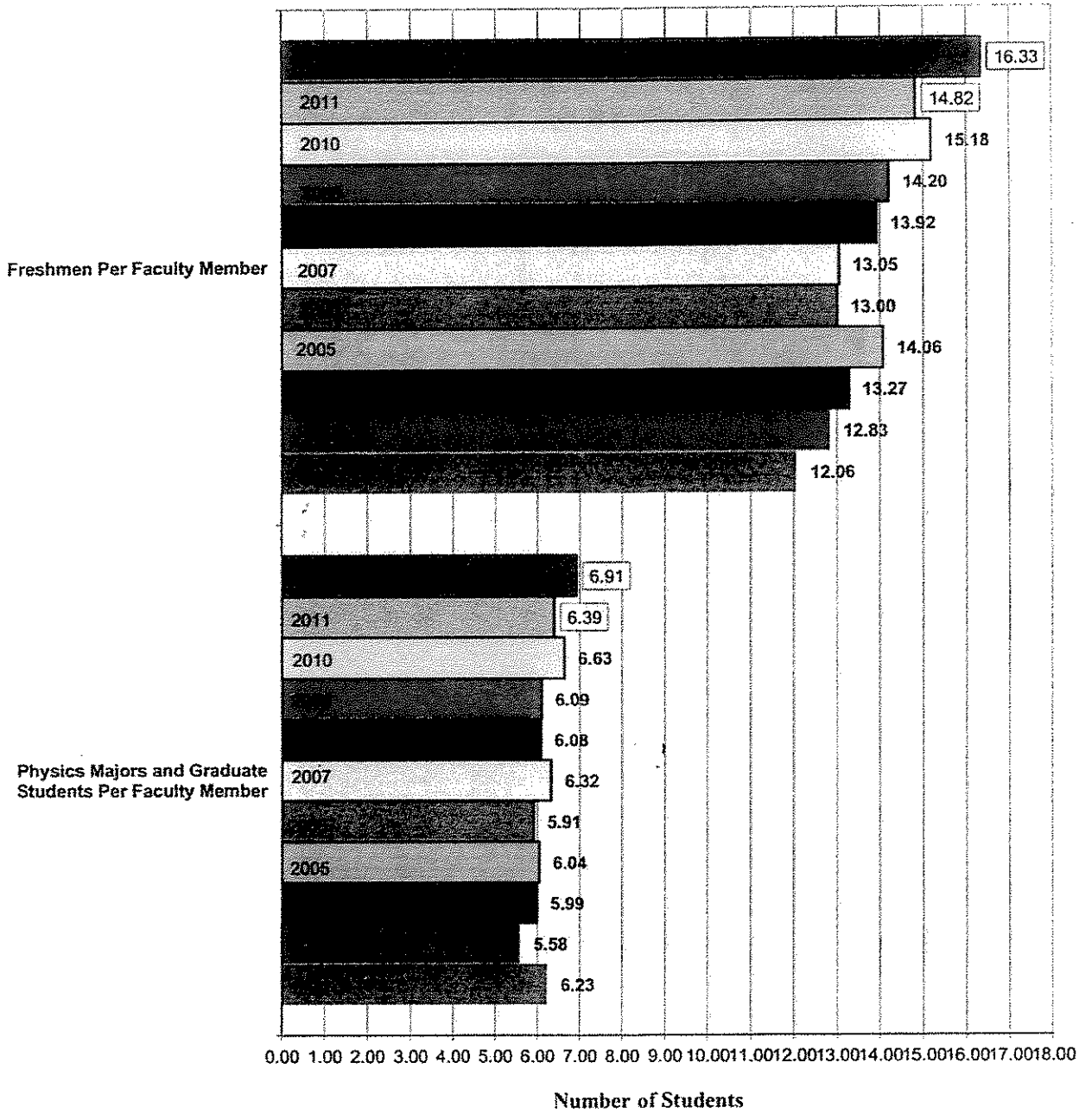
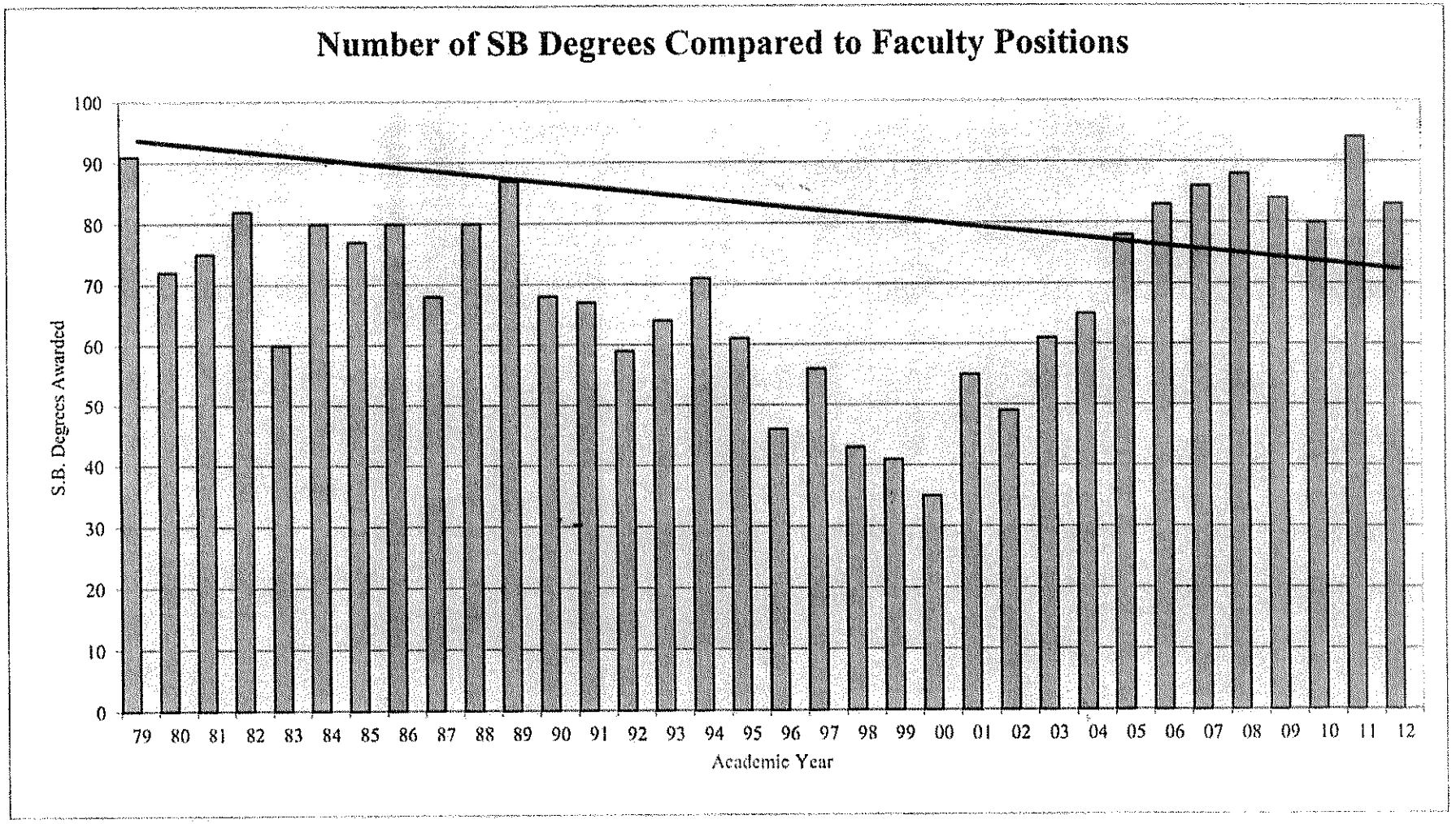

Faculty by Division and Subfield
Theoretical, Nuclear and Particle Physics 22%
Astrophysics 22%
Experimental Nuclear and Particle Physics 23%
Atomic, BioPhysics, Condensed Matter, Plasma 33%
Nuclear Theory
Astro T
X ray
Space & Plasma
Optical
Gravity
Radio
CMT
CMX Hard
CMX Bio-Soft
Plasma
Atomic
Intermediate Energy
Relative Heavy Ion

Figure 2.5


State/Local Govts
Non Profits
Industry
Other Federal
Natl. Science Foundation
NASA
Health and Human Services
Dept of Energy
Dept of Defense
Research Volume: FY 2003-2012
Millions
Millions of Dollars
$120
$100
$80
$60
$40
$20
$0
-$20
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Fiscal Year

RATIO OF FACULTY TO STUDENTS
FOR AY 1989, 2003 - 2012




Number of SB Degrees Compared to Faculty Positions
S.B. Degrees Awarded
100
90
80
70
60
50
40
30
20
10
0
79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12
Academic Year

Departments Averaging 15 or More Physics PhDs per Year, Classes of 2006, 2007 & 2008 Combined.

	Annual Average		Annual Average
MIT (MA)	37	Ohio State U	18
U of Illinois, Urbana-Champaign	36	Princeton U (NJ)	18
U of Texas, Austin	33	U of California, Los Angeles	18
U of Maryland, College Park	32	Michigan State U	17
U of California, Berkeley	28	U of Minnesota, Minneapolis	17
Cornell U (NY)	27	Georgia Inst of Tech	16
Stanford U (CA)	25	Pennsylvania State U	16
SUNY Stony Brook U (NY)	24	U of Washington	16
U of Colorado, Boulder	23	Columbia U (NY)	15
Caltech (CA)	22	Florida State U	15
U of Chicago (IL)	22	Purdue U, West Lafayette (IN)	15
U of Wisconsin, Madison	21	Texas A&M U, College Station	15
U of California, Santa Barbara	20	U of Rochester (NY)	15
U of Michigan, Ann Arbor	20	Washington U (MO)	15
Stanford U – Applied (CA)	19	Yale U (CT)	15
U of Florida	19		

Note: List includes only those departments who contributed degree data for all 3 years.

http://www.aip.org/statistics

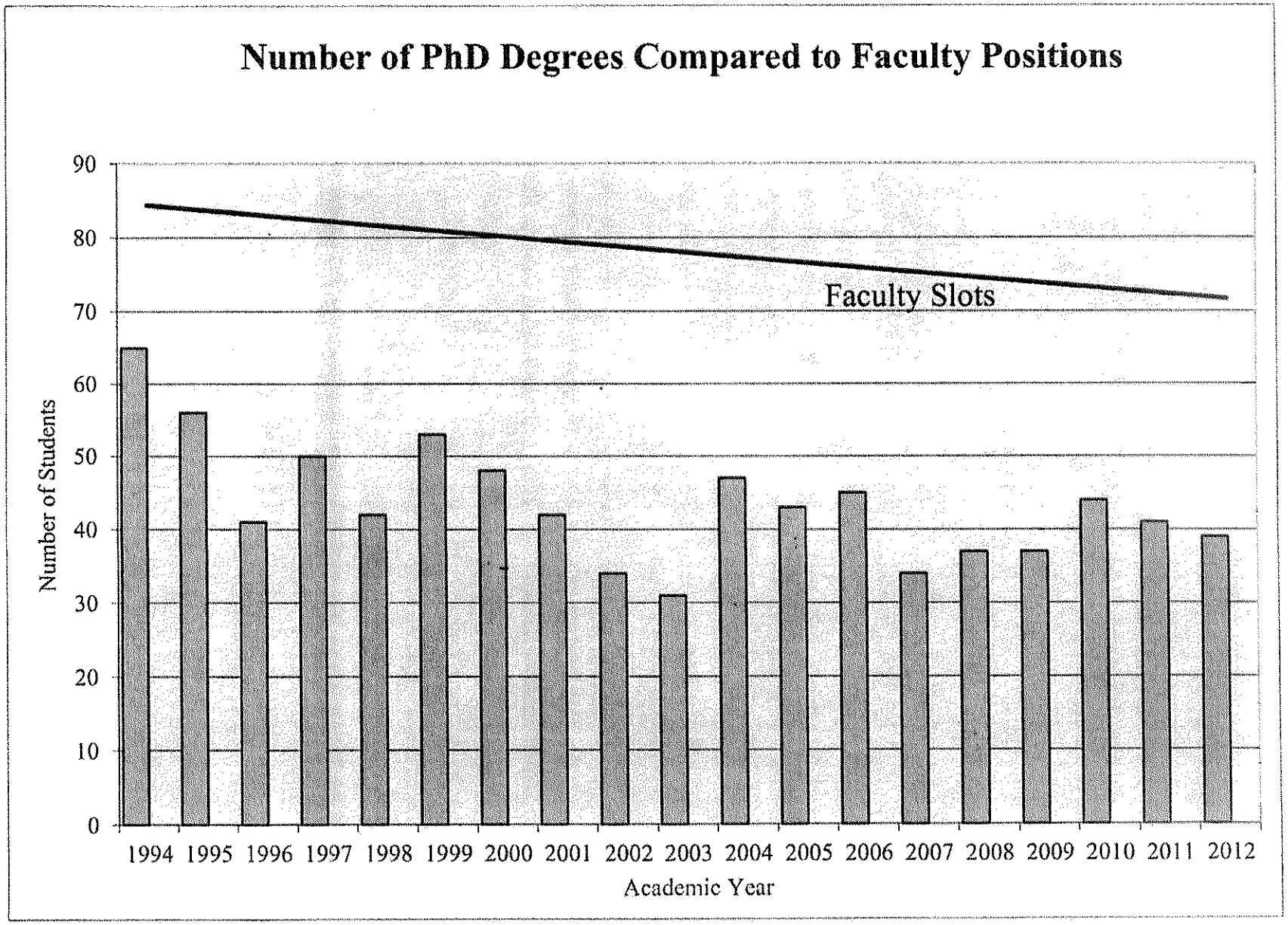

Number of PhD Degrees Compared to Faculty Positions
Faculty Slots
Number of Students
0
10
20
30
40
50
60
70
80
90
1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Academic Year

Figure 2.10

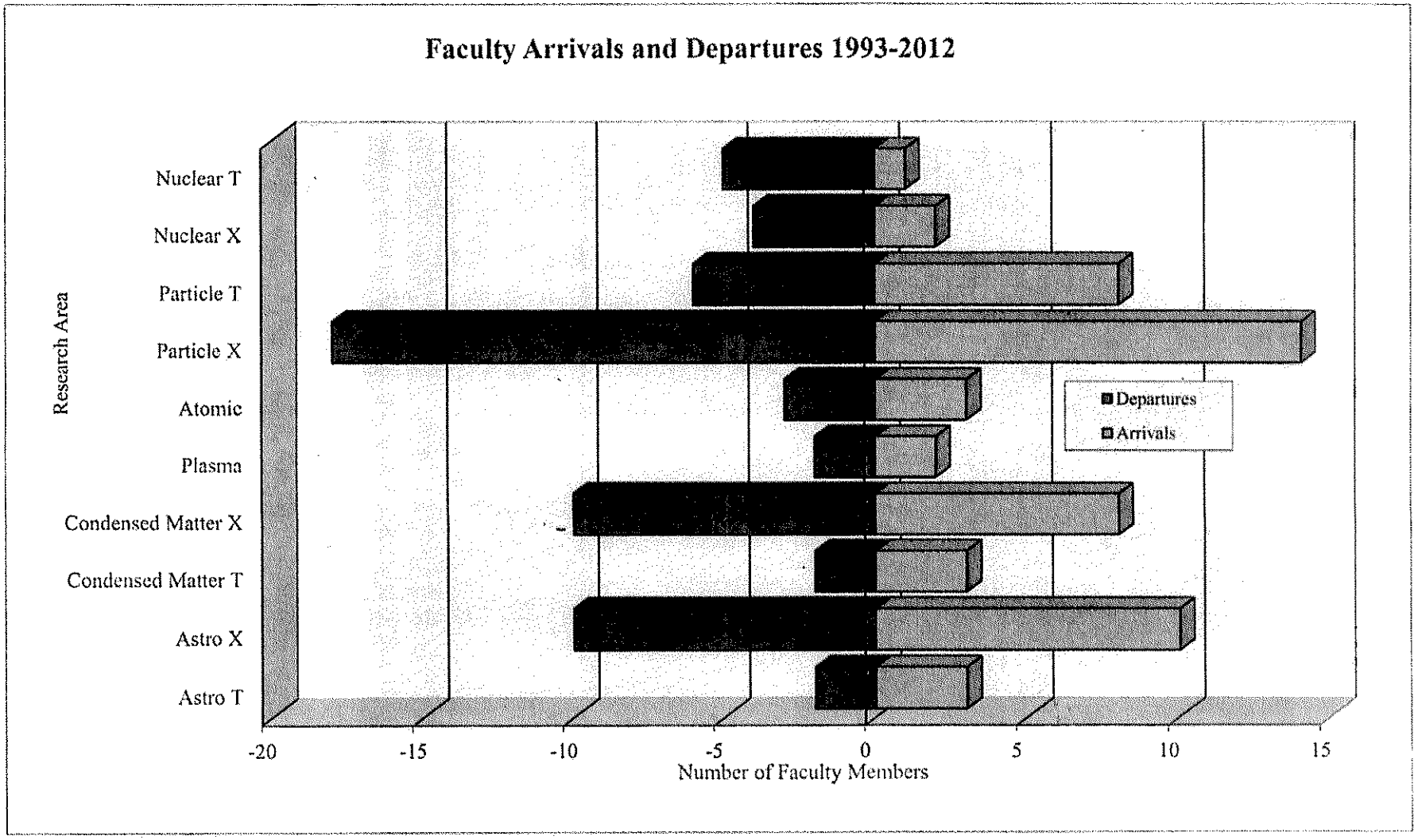

Faculty Arrivals and Departures 1993-2012
Research Area
Nuclear T
Nuclear X
Particle T
Particle X
Atomic
Plasma
Condensed Matter X
Condensed Matter T
Astro X
Astro T
Departures
Arrivals
-20
-15
-10
-5
0
5
10
15
Number of Faculty Members

Figure 2.11

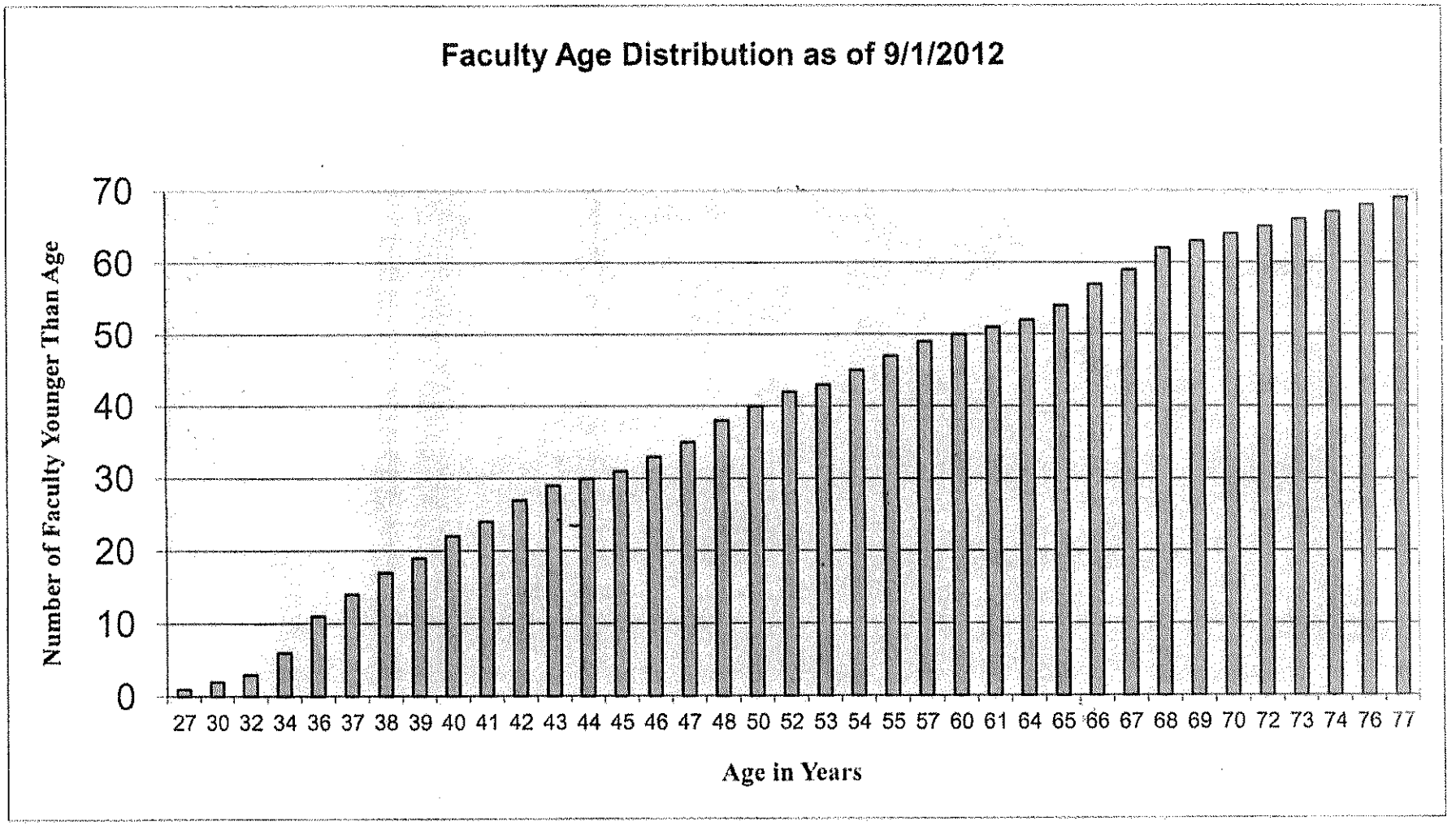

Faculty Age Distribution as of 9/1/2012
Number of Faculty Younger Than Age
0
10
20
30
40
50
60
70
27 30 32 34 36 37 38 39 40 41 42 43 44 45 46 47 48 50 52 53 54 55 57 60 61 64 65 66 67 68 69 70 72 73 74 76 77
Age in Years

Figure 2.12

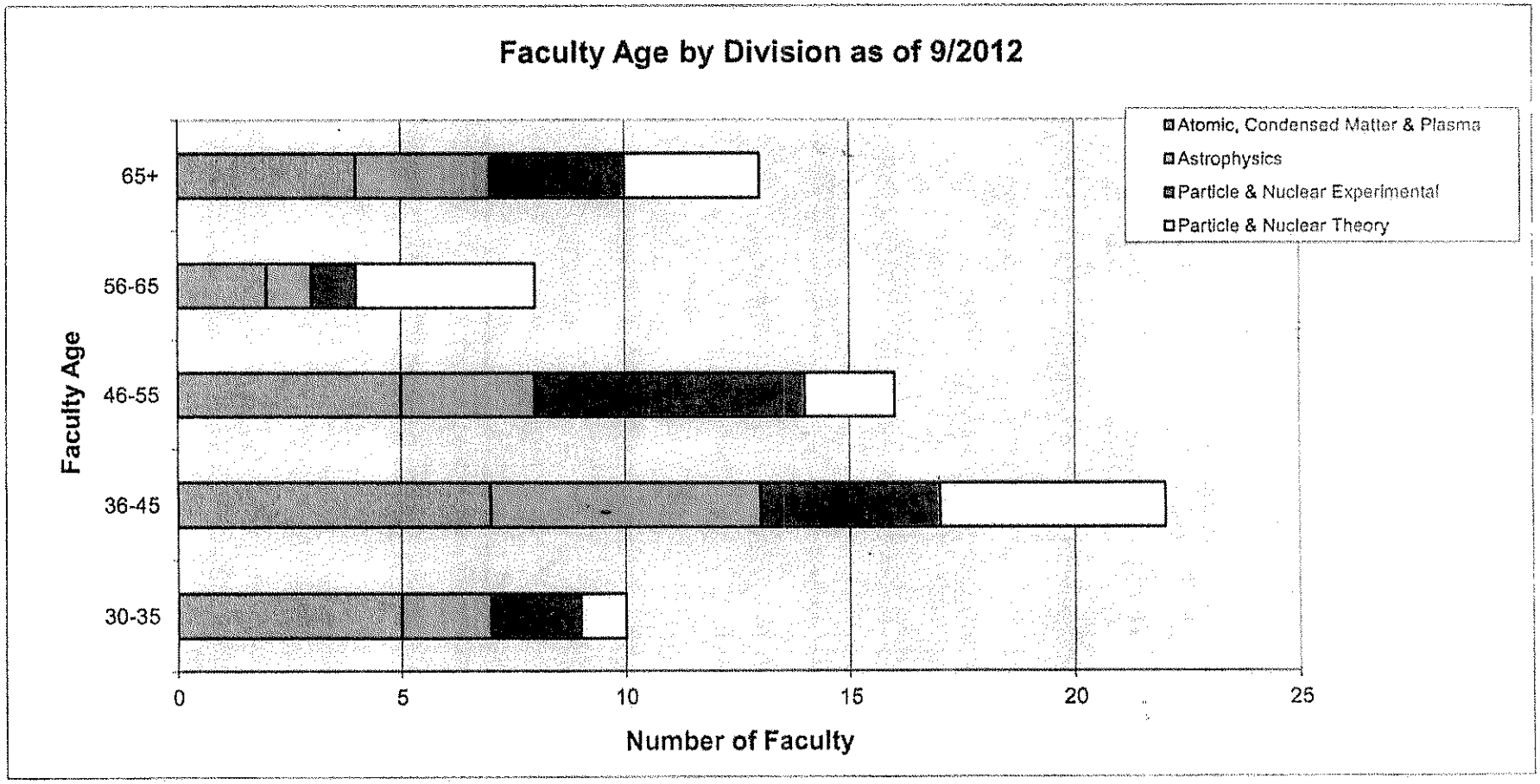

Faculty Age by Division as of 9/2012
Atomic, Condensed Matter & Plasma
Astrophysics
Particle & Nuclear Experimental
Particle & Nuclear Theory
Faculty Age
65+
56-65
46-55
36-45
30-35
0
5
10
15
20
25
Number of Faculty

Figure 2.13

Overview of Faculty Searches: 1996-2011

Year	Division	Area	RESULTS		Accept
			Accepted	Declined	/Offer
FY1996	Astro	Radio	*Kaspi, V.*		2/2
	Theor Nuc & Part	Nuclear	Rajagopal, K.		
FY1997	A, B, CM, P	Plasma		Forest, C.	4/7
	A, B, CM, P	Plasma	Fasoli, A.		
	A, B, CM, P	CMX-Hard		*Moler, K.*	
	Astro	Optical		Franx, M.	
	Exp Nuc Part	High Energy	McFarland, K.		
	Exp Nuc Part	Intermediate Energy	*Gao, H.*		
FY1998	Astro	Gravity		Cheng, H.	3/4
	Astro	X-Ray	Chakrabarty, D.		
	Exp Nuc Part	High Energy	Paus, C.		
	Theor Nuc & Part	String	Hanany, A.		
	Theor Nuc & Part	String	Taylor, W.		
FY1999	Astro	Astro Theory		Hu, W.	1/2
	A, B, CM, P	CMX Soft	van Oudenaarden, A.		
FY2000	A, B, CM, P	Atomic		Vuletic, V.	8/10
	A, B, CM, P	CMT	Todadri, S.		
	A, B, CM, P	CMX Hard	Lee, Y.		
	Astro	Optical	Burles, S.		
	Astro	Gravity	Katsavounidis, E.		
	Exp Nuc Part	High Energy X	Würthwein, F.		
	Exp Nuc Part	Relative Heavy Ion	Roland, G.		
	Exp Nuc Part	High Energy X	*Scholberg, K.*		
	Theor Nuc & Part	Particle	Wilczek, F.*		
FY2001	A, B, CM, P	CMX Soft		*Zhuang, X.*	2/8
	A, B, CM, P	CMX Hard	Hudson, E.		
	Astro	Radio		Gaensler, B.	
	Astro	Gravity	*Mavalvala, N.*		
	Theor Nuc & Part	Particle		*Nelson, A.**	
	Theor Nuc & Part	Particle		Kaplan, D.*	
	Theor Nuc & Part	Particle		Csaki, C.	
	Theor Nuc & Part	Particle		Son, D.	

Figure 2.13

Year	Division	Area	RESULTS		Accept /Offer
			Accepted	Declined	
FY2002	A, B, CM, P	Atomic	Vuletic, V.		3/7
	A, B, CM, P	CMX Hard/Soft		Lenhart, K.	
	Astro	Optical		Fan, X.	
	Astro	Astro Theory		Zaldariaga, M.*	
	Astro	Astro Theory	Hughes, S.		
	Theor Nuc Part	Nuclear	Stewart, I.		
	Theor Nuc Part	String		Bousso, R.	
FY2003	A, B, CM, P	CMX Hard/Soft		Nagel, S.*	4/9
	Exp Nuc Part	High Energy		*Kim, Y-K.*	
	Astro	Astro Theory		Sari, R.	
	Astro	Astro/Particle		Golwala, S.	
	Astro	Astro Theory	Tegmark, M.		
	The Nuc Part	Particle		Weiner, N.	
	The Nuc Part	String	Liu, H.		
	Exp Nuc Part	High Energy	Knuteson, B.		
	Exp Nuc Part	High Energy	*Sciolla, G.*		
FY2004	Astro	Radio		Halverson, N.	1/4
	Astro	Optical	Burgasser, A.		
	A, B, CM, P	CM Theory		Hastings, M.	
	A, B, CM, P	CMX Hard/Soft		*Moler, K.**	
FY2005	Astro	Optical	Winn, J.		7/10
	Astro	Optical	Simcoe, R.		
	Astro	X-ray	Figuero-Feliciano, E.		
	A, B, CM, P	CMT	Soljacic, M.		
	A, B, CM, P	Plasma	Egedal-Pedersen, J.		
	Exp Nuc Part	High Energy	Nahn, S.		
	Exp Nuc Part	High Energy	Formaggio, J.		
	The Nuc Part	Nuclear		Giusti, L.	
	The Nuc Part	Particle		Pierce, A.	
	The Nuc Part	Particle		Creminelli, P.	
FY2006	A, B, CM, P	CMT- Biophysics		Kussele, E.	2/6
	A, B, CM, P	CMT		Verstraete, F.	
	A, B, CM, P	Atomic	Zwierlein, M.		
	The Nuc Part	Particle		Wacker, J.	
	A, B, CM, P	CMX Hard		Keimer, B.	
	The Nuc Part	String	McGreevy, J.		

Figure 2.13

Year	Division	Area	RESULTS		Accept
			Accepted	Declined	/Offer
FY2007	A, B, CM, P	CMX Hard	Gedik, N.		2/4
	A, B, CM, P	CMX Hard	Jarillo-Herrero, P.		
	Exp Nuc Part	Interm. Energy		*Bai, M.*	
	Exp Nuc Part	High Energy		Furic, I.	
FY2008	A, B, CM, P	CMX- Biophysics		Yildiz, A.	3/4
	Exp Nuc Part	High Energy	*Conrad, J.**		
	Exp Nuc Part	High Energy	*Monroe, J.* (7/09 start)		
	The Nuc Part	String	Adams, A.		
FY2009	A, B, CM, P	Biophysics	Gore, J.		3/4
	Astro			*Soderberg, A.*	
	Exp Nuc Part	High Energy	Klute, M.		
	The Nuc Part	Particle	Thaler, J.		
FY2010	Astro	Extragalactic		*Greene, J.*	1/2
	Astro	Astro Theory	Weinberg, N.		
FY2011	A, B, CM, P	Bio, Soft	England, J.		5/8
	A, B, CM, P	Hard CMT	Fu, L.		
	Astro	Astrophysics	*Frebel, A.* (1/12)		
	Astro	Exp. Cosmo		Parsons, A.	
	Exp Nuc Part	High Energy	Zuccon, P.		
	Exp Nuc Part	Interm Energy	Williams, M. (7/12)		
	The Nuc Part	Beyond Standard Model		Cheung, C.	
	The Nuc Part	Theoretical Particle		Essig, R.	
FY2012	Astro	Gravity	Evans, M. (1/13 start)	Niemack, M.	5/6
	The Nuc Part	Quantum	Harrow, A. (1/13 start)		
	The Nuc Part	Theoretical Particle	*Slatyer, T.*(7/13 start)		
	The Nuc Part	Lattice QCD	Detmold, W.		
	Exp Nuc Part	Relative Heavy Ion	Lee, Y. (7/13 start)		

*Full tenured professor offers made.
Italics indicate women

Figure 2.14

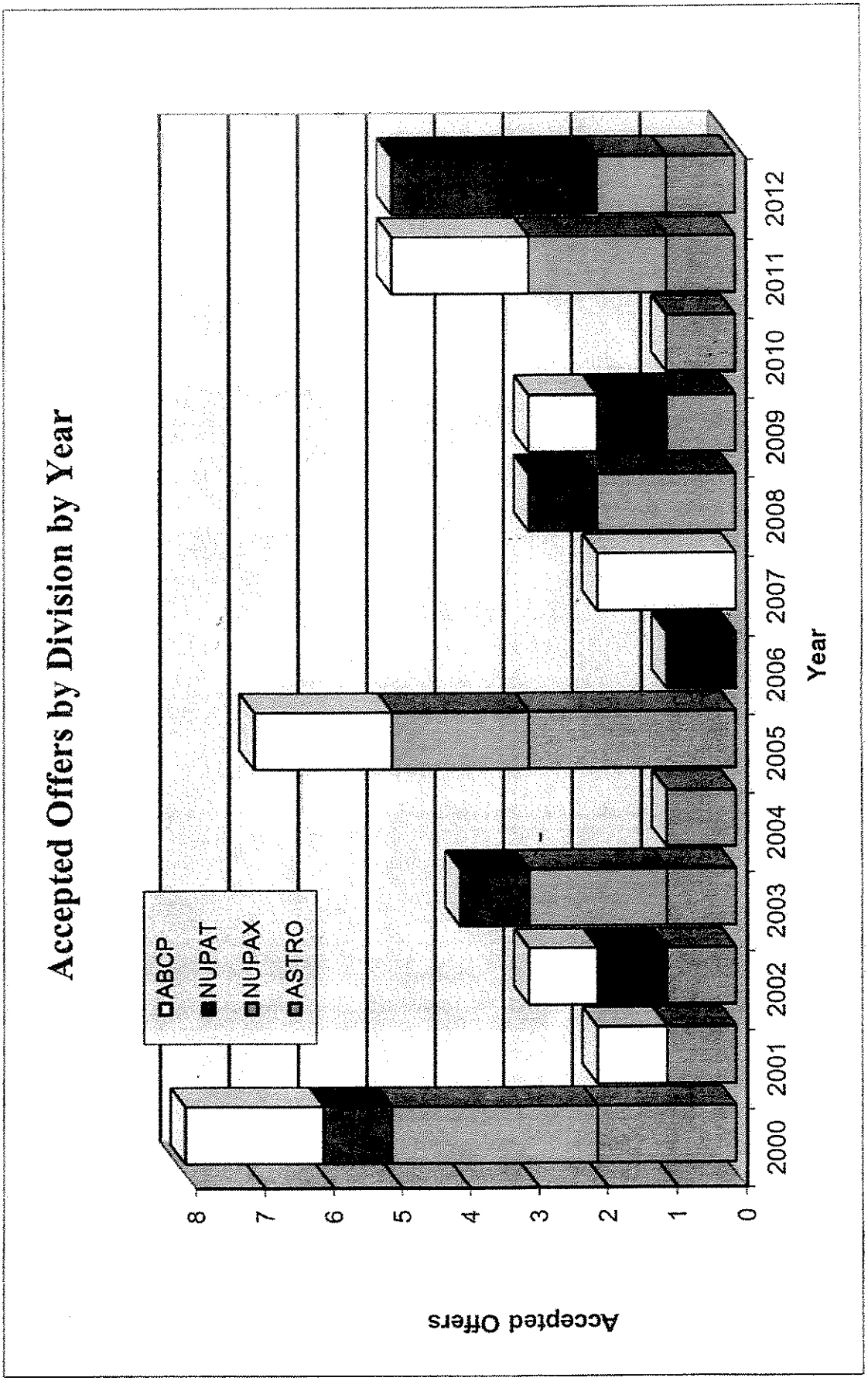
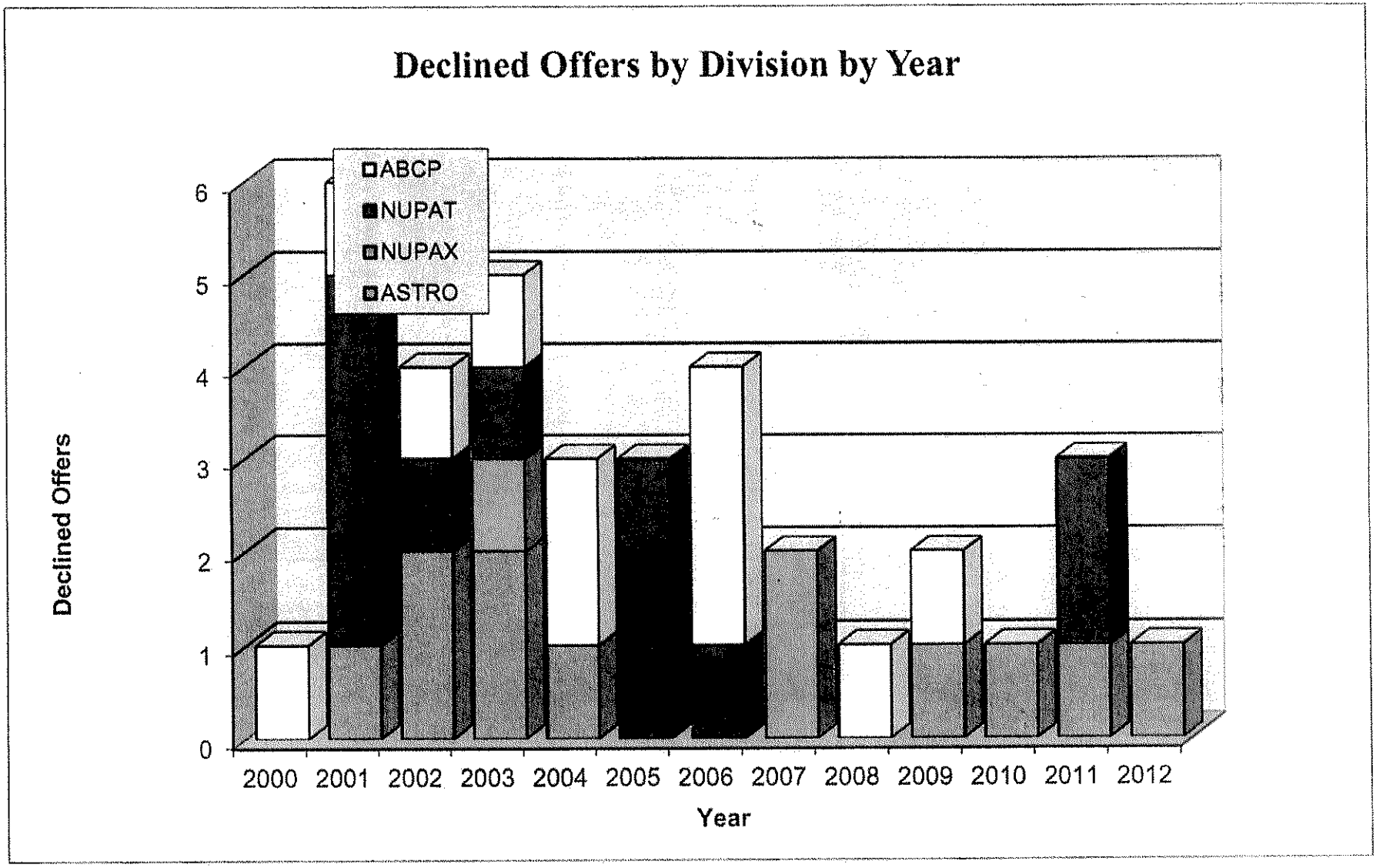

Accepted Offers by Division by Year
ABCP
NUPAT
NUPAX
ASTRO
Accepted Offers
0
1
2
3
4
5
6
7
8
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Year

Figure 2.15


Declined Offers by Division by Year
ABCP
NUPAT
NUPAX
ASTRO
Declined Offers
0
1
2
3
4
5
6
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Year