Remarks by Dr. Donald C. Winter
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Dr. Williams, ladies and gentlemen, thank you for inviting me to speak to you today.

It is always a pleasure to spend time with fellow physicists, both because it is a reminder of my younger days, and because, at last, I can tell physics jokes that will be sincerely appreciated.

Back when I was a graduate student in physics at the University of Michigan, we did use to joke about how quickly science advanced, and how that could pose potential problems.

For example, we used to say that if you are a graduate student working on quantum optics, then the field would be dead by the time you got your Ph.D.

Even worse, if you were to start over with a new thesis topic, the new field would also be dead by the time you get your Ph.D. . . .

There is some truth to that anecdote, and from the Navy's perspective, rapid changes in technology can have a huge impact on the capabilities of our ships, which take up to a decade to build and design, and which are expected to remain in service for several decades.

So physics, in that sense, was an excellent preparation for this job, as I am frequently reminded that technological obsolescence is a danger that can afflict not only graduate students in physics, but Navy programs as well.

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Today, I would like to talk to you about the physics-trained mind, and how much the physics-trained mind is needed in the Navy and Marine Corps.

Now, I understand that many of you here today are still graduate students of physics, with varying degrees of ambition to obtain the PhD.

Your status as students reminds me of the predicament that Nobel Prize-winning

physicist Murray Gell-Mann once found himself in.

Faced with a choice between going to MIT or committing suicide, Gell-Mann pondered these divergent paths.

In his words, “A little reflection convinced me that I could try MIT and then commit suicide later if I wanted to, but not the other way around.”

The process, a student of mathematics or physics might say, is not commutative.

Now here is the physics-trained mind at work.

As a card-carrying physicist, I know that physicists have a particular way—an approach—of dealing with society’s problems.

It is often said of a lawyer that he “thinks like a lawyer.”

The same can be said of an engineer, a businessman, or an economist.

It is worth noting that economics is known—perhaps unfairly—as the “dismal science.”

After all, human wants are unlimited, whereas resources are characterized by scarcity.

The physics-trained mind, on the other hand, is driven by the urge to solve seemingly impossible problems.

It also gives one a keen appreciation for the role—and value—of failure.

As Freeman Dyson, one of the more celebrated physicists of the 20th century, observed:

“You can’t possibly get a good technology going without an enormous number of failures. It’s a universal rule. If you look at bicycles, there were thousands of weird models built and tried before they found one that really worked. You could never design a bicycle theoretically. Even now, after we’ve been building them for 100 years, it’s very difficult to understand why a bicycle works—it’s even difficult to formulate it as a mathematical problem. But just by trial and error, we found out how to do it, and error was essential.”

Physics provides a person with a mechanism of thinking, and physics training provides one with an ability to adapt.

Once you have mastered the fundamentals of physics, you have a better perspective on the technology of the moment, which may be critical today, but of little

value in the future.

This lesson has been applied to my own career, which has taken me into a wide range of areas.

My doctoral dissertation was in the field of coherent optics.

But my professional focus since then has shifted into areas as disparate as analyzing re-entry vehicles for ICBM's, to developing sonar processors for sonobuoys, to building satellites for surveillance and reconnaissance missions.

Needs and technologies change.

But the fundamentals of the discipline do not.

Well, most of the time.

Notwithstanding the discoveries of an Einstein, a Neils Bohr, or a Murray Gell-Man that fundamentally change our understanding of physics from time to time, the fundamentals of the science will always serve you well in tackling complex problems.

I have not done physics, per se, in a long time.

But I have been able to use the thought processes and perspective of physics training in the jobs I have held.

One of the most valuable, I have found, is that it gives you the ability to immediately raise the—this is a family venue so I will use the G-rated euphemism—"BS flag" in meetings when someone is not making scientific sense.

This can come in quite handy, and save a lot of time as well.

The physics-trained mind also provides you with an appreciation for the difficulty of various technological challenges, such as the anti-satellite test that the Chinese conducted in January 2007.

The layman may not fully realize the significance of such events, how to evaluate that technology relative to other technological breakthroughs, or what the success of such a test portends.

Deep scientific understanding is acquired by relatively few people, and intellectual rigor is a valuable commodity.

The Navy is a science and technology-intensive organization, and physics is central to almost everything we do.

The challenge is to find great minds that are captivated by the beauty and power

of physics, and lure them into careers that benefit the Navy, either in government service or in the private sector.

As you all know, it takes great discipline and a long time to earn a PhD in physics.

The opportunity cost of another year in graduate school—living on student loans and living a spartan, and perhaps solitary existence—rises with each passing year, as the siren song of well-paying jobs in industry beckons.

The temptation to abandon one's studies and earning one's keep is difficult to resist.

The statistics compiled by the National Science Foundation bear that out.

In 2004, the number of doctoral degrees in physics in the United States was only 1,186.

Less than half of those were earned by U.S. citizens—559.

This is significant, as non-U.S. citizens are generally not eligible for security clearances, and are thus not part of the talent pool that the Navy can recruit from for the physicists we need.

We are finding a greater and greater percentage of seats taken by foreign students, particularly in the technical fields.

Not long ago I had an opportunity to visit the Indian Institute of Technology in Mumbai, which has since become somewhat famous in the U.S. as a result of the "60 Minutes" story on IIT that recently aired.

I was extremely impressed by not only the quality of the faculty at IIT, but the intensely competitive and serious environment at the school.

The average entering student there had two years of calculus which is more than most high schools in the U.S. even offer.

Many IIT graduates then move to the U.S., recruited by some of our top corporations and universities.

We encounter the same phenomenon with other foreign-trained students—from China, South Korea, and elsewhere across the globe, who then become extremely marketable in the competition for top talent in the U.S. economy.

The field of physics—and our nation—have benefited enormously from foreign

students, as anyone familiar with the work of Einstein, Enrico Fermi, and Robert Oppenheimer and so many others can attest.

But we must cultivate homegrown talent as well, give American students the superb preparation that IIT and other foreign students receive, and produce our own generation of physicists who can advance the frontiers of science.

Doing so is vital to the security of the United States.

Whether in space, at sea, or in cyber-space, potential enemies and rising powers are investing heavily in technology that will challenge us in the years ahead.

If we expect to remain the preeminent military power, and if we expect to be equal to the challenge that engineers and scientists in China, India, and other rising powers will present, we will have to do a better job of finding students with the talent and the drive to become physicists.

Thomas Friedman, in "The World Is Flat," writes at length about the extent of our decline in science and engineering relative to other nations that have made investment in the sciences a national priority.

With high tech skills increasingly transportable, and our economy increasingly knowledge-based, we would do well to heed the warnings that he and others have sounded.

One way we must do that is by expanding the pool of applicants, and reaching out to communities that have been overlooked too often in the past.

We cannot afford to ignore the potential contributions of African-Americans and Hispanics in the United States, and it is imperative that we do a better job in recruiting and nurturing top talent throughout our society.

With U.S. Census Bureau projections that the United States may be a majority minority country by 2050, it is clear that we will need to make inroads in communities under-represented in the field.

The current situation is a significant problem—to our disadvantage.

Consider again the figure 559, which is the number of American citizens who earned a PhD in physics last year.

Of those, exactly 13 were earned by black students, and 13 by Hispanic students.

We must do better.

We need you.

And you are the ones who can help.

All of you can leave here today with three ideas about how you can do your part in helping us find the people we need.

Recruit; mentor; lead by example.

As physicists you have already shown admirable commitment and courage in pursuing a challenging career path.

Go out and recruit others to join the fraternity of physicists to which all of you belong.

Engage with young students by encouraging them to go into teaching math and science, participate in science fairs in your local community, and volunteer your time to tutor students who have a thirst to learn science.

Tell your friends, your colleagues, and those whom you meet in your professional capacity about the rewards of physics, and about the opportunities that a physics background can provide.

But recruiting someone to pursue a graduate degree in physics is not enough.

You can recruit numbers, but—as you all know—that cannot get someone through.

For every proud graduate with a diploma in physics in hand, probably nine others who started the program with him did not stay with it until the end.

Those you recruit should be told that it must be driven by them.

If they do not want it, they will not get it.

But there is something that you can do to help prospective candidates that you recruit—mentor.

Sometimes encouragement can make all the difference.

Go out and recruit—and then mentor those whom you have an opportunity to help during their long journey to graduation.

Mentorship helps, and it can be one of the most personally rewarding time investments you will ever make.

Finally, after recruiting and mentoring, lead by example.

You are already serving as role models for others, particularly in minority

communities in which a life in science may be far from what most students would ever imagine.

The trailblazers that have come before you—Edward Alexander Bouchet, Willie Hobbs Moore, Harry L. Morrison, Arthur BC Walker, Frances Cordova, and many others—have led the way, showing what is possible with hard work and determination.

Now it is your turn to let your personal example lead others to reach their potential in the field of physics.

Seeing your success, and knowing that others have faced the struggles that they now face, will inspire them to choose—and stick with—a similar path.

Recruit, mentor, and lead by example.

We need you—and we need others whose lives can be touched by your example.

By reaching out to those who are now in your shoes, weighing the decision to continue their studies in physics, you can make a great contribution to minority communities, to the Navy, and to the Nation.

From sonar to missile defense to nuclear power, the Department of the Navy is an organization that leverages technology and physics for its success.

In today's world of terrorist challenges, and great uncertainty regarding future threats, we need you more than ever.

Best of luck to all of you as you pursue lives in an exciting field, and may all of you have the courage to dare greatly with your physics-trained minds.

Thank you.