



Advancing Women in Physics, Including YOU!



Third Conference for Undergraduate Women in Physics
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Beverly Karplus Hartline
University of the District of Columbia, USA
bhartline@udc.edu



Women in Physics: Few but Fantastic!



- **Marie Curie** (1867-1934): *Natural radioactivity*
- **Lise Meitner** (1878-1968): *Nuclear fission, beta decay*
- **Maria Goeppert Mayer** (1906-1972): *Nuclear shell model*
- **Bonnie Fleming**: *Neutrino physics*
- **Linda Godwin**: *Low temperature physics & astronaut*
- **Catherine Kallin**: *Theory of quantum materials*
- **Young-Kee Kim**: *Experimental particle physics*
- **Luz Martinez-Miranda**: *Materials science, liquid crystals*
- **Carol Scarlett**: *Axion physics*
- **Suzanne Staggs**: *Cosmic microwave background*
- **Yevgenia Zastavker**: *Physics of biological structures*
- **YOUR NAME HERE**



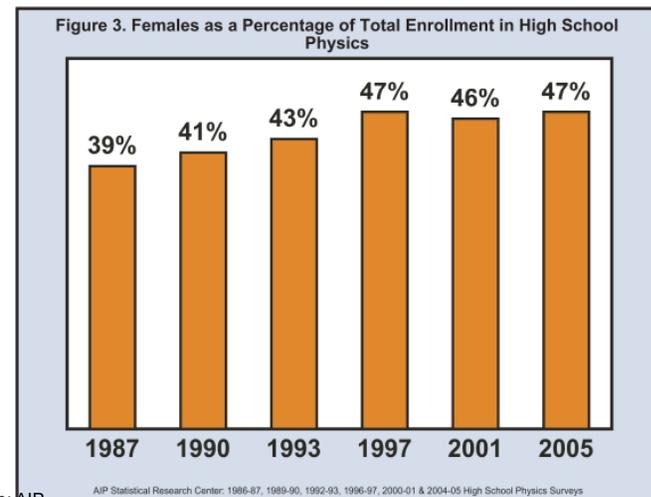
Women in Physics



First the numbers and trends



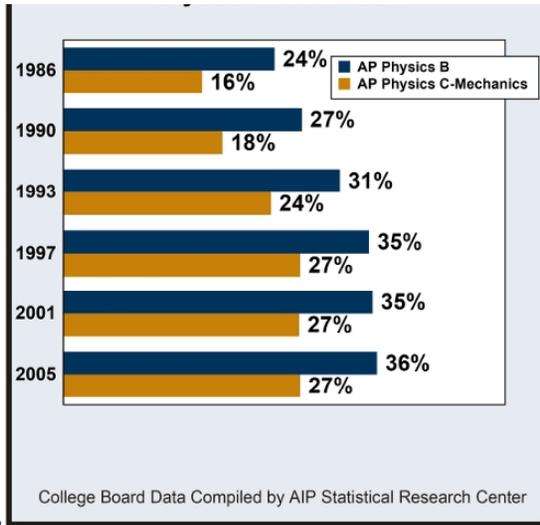
Girls Approaching Half of High School Physics Students



Source: AIP

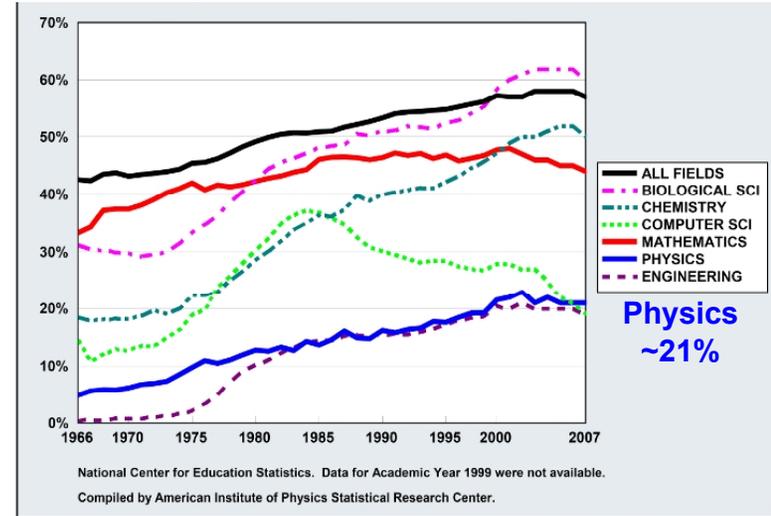


~50% Increase in Girls Taking AP Physics Tests Since 1986

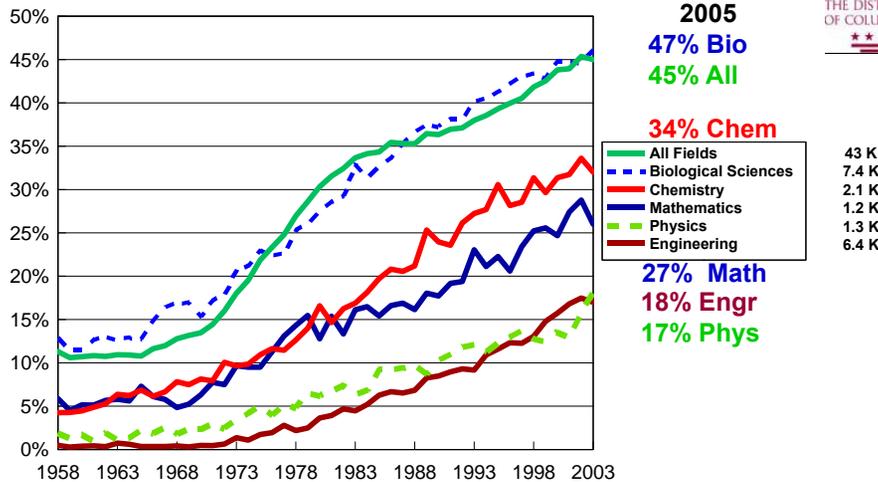


But much lower than their presence in HS physics classes

Slowly Rising Bachelor's Percentages to Women Since 1966



Rising Female Percentage of Ph.D.s in STEM: Physics is at the Low End (1958-2003)

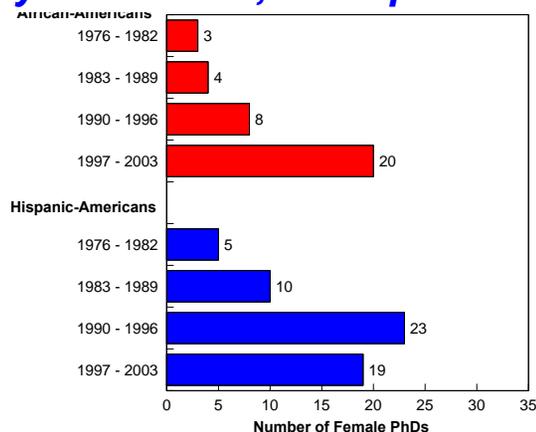


Statistics on Women in Physics (USA)



- 47% of high school students taking physics (2005)
- 21% of undergraduate degrees (class of '06)
- 17% of PhD recipients (class of '06)
- 6% of full professors (2006)
- 0% of faculty in 43% of physics departments (2006)
- < 20 departments graduating ≥ 5 female BS (1999-03)
- ~10 departments producing ≥ 5 female PhD (1999-03)
- **Minority women? Almost none!**

Almost No Minority Women Earn Physics Ph.D.s; But Up 600% from ~1980



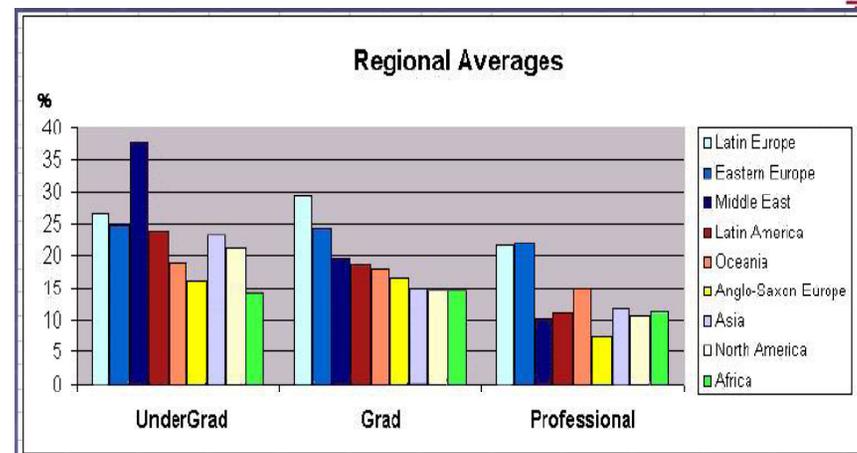
The problem for minorities, especially minority women, is **MUCH WORSE** than the problem for women:

Please help!

National Science Foundation. Data compiled by AIP Statistical Research Center.



Significant Global Differences, But Low Everywhere



A "Glass Ceiling" in All Countries



- Very few women in leadership positions
- Very few women full professors
- Some assistant and associate professors
- Several post-docs
- More graduate students
- Even more undergraduates
- Efforts by women & men are helping some women through the glass ceiling into leadership in some countries

Source: *Economist* 7/05



Physics Needs MORE Women



- Women bring talent, ideas and approaches that enrich and advance physics. Yet . . .
 - Women are **SCARCE**.
 - Senior women are **VERY SCARCE**.
- Some woman has to be the **FIRST ONE** in each department, subfield, program committee, directorship, etc
- **A classically forbidden state,**
- **Often meeting colossal resistance**

➤ **Physics needs YOU!**



WHY SO FEW?

What's going on and how the world works
Whether we like it or not



Barriers to Women in Physics



- Expectations of society
- Image of physicists (nerdy and geeky)
- Few visible female role models
- Parents, teachers, & neighbors
- Family responsibilities: children, home, & husband
- Limited physics career opportunities in developing countries
- Covert or overt discrimination or harassment



Bringing Up Girls & Boys

- | | |
|---|---|
| • Get dirty | • Stay clean |
| • Take things apart and put them together (or maybe not) | • Keep things whole, neat and pristine |
| • Work with tools | • Use paintbrushes artistically |
| • Explore and build | • Read and write |
| • Do sports and outdoor games | • Play quietly indoors |
| • In team projects: be the leader and innovator | • In team projects: be a follower and note-taker |
| • Be energetic & rambunctious | • Cook following recipes |
| • Think for himself | • Don't question |

Preparation for interest and success in
science and engineering?



Understanding the Challenges

- According to Dr. Virginia Valian (author of *Why So Slow?*) two key concepts help explain the difficulties girls and women face entering and advancing in science and engineering
 - ❖ "Gender schema"
 - ❖ Accumulation of advantage
- These hidden challenges are likely to be aggravated for under-represented minorities

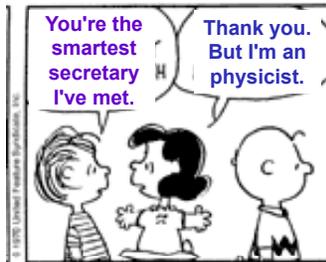


Gender "Schema"



- Gender and ethnic "schema" are widely held beliefs about men, women, and people from ethnic groups with respect to their competence, career roles, and leadership ability
 - Lead us to overrate white men
 - Lead us to underrate women and minorities

Overheard at the Physics conference:



Accumulation of Advantage



- "Accumulation of advantage" refers to the cumulative long-term effect of small differences in the way males and females from different ethnic groups are treated throughout their lives
 - At home and in school
 - On the sports field
 - In the workplace
 - In restaurants, stores, theatres,...
- If majority males experience "1.001" and others experience "0.999" the difference accumulates profoundly
 - White males' experience $\rightarrow \infty$ ("1400" after 20 years)
 - Others' experience $\rightarrow 0$ ("0.00067" after 20 years)



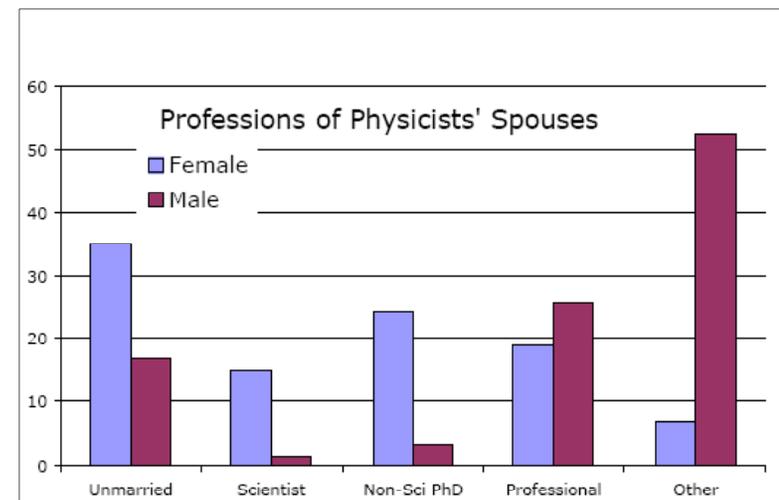
Balancing Family and Career



- Career/family conflicts are a serious challenge for women physicists around the world
 - Women have children at the age a physicist must start her career, working long hours in temporary positions, often abroad
- In most countries, women are responsible for children, home, cooking, laundry, . . .
 - It helps when men and women together share family and household duties and pleasures
 - Both boys and girls must be taught to expect this lifestyle
- In some countries and cultures the expectations of females CLASH sharply with the requirements to succeed in physics



Spouses of Women Physicists have High Professional Commitments



Other Tensions for Women in Science Or Business Leadership, Law, etc.



- **Being oneself versus** fitting into the science culture
- **Making connections:** political relationships *versus* meaningful relationships and performance
- **Controlling your destiny versus** conforming to others' expectations ("Agency")
 - Moreover, expectations about women conflict with expectations about scientists and engineers
- **Achieving wholeness:** freedom to align your ideas, personality, and passions while being and being perceived as professionally successful
- **Gaining self clarity:** knowing what you need to do and be

Adapted from M. Ruderman and P. Ohlott: Standing at the Crossroads

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ACTIONS

PROGRESS

OPPORTUNITIES

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Perspective



Every public action which is not customary,
either is wrong,
or if it is right,
is a dangerous precedent.

It follows that **nothing** should **ever** be done
for the **first time**.

--Francis M. Cornford (1908)
Classics Professor in UK

That hasn't stopped Women in Physics...

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23rd IUPAP General Assembly (1999)



- **Concerned about very low participation of women in physics in most countries**
- **Passed a resolution to form IUPAP Working Group on Women in Physics (WIP)**
 - Marcia Barbosa (Brazil), Chairperson
 - Judy Franz (USA) IUPAP Liaison
 - 13 members from 12 countries
- **WIP mandate to survey the situation, report to IUPAP, and suggest strategies to improve the situation**
 - Conducted international survey
 - Organized 3 Int'l Conferences: Paris 2002; Rio 2005; Seoul 2008

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IUPAP's Women in Physics Conferences: I: Paris, 2002 II: Rio, 2005



Paris 2002
~300 physicists from
65 countries; 15% men
(only ~45 countries were
IUPAP members at this time)

WYP 2005 Event
Rio de Janeiro 2005
~150 physicists from
~40 countries; 7% men
Limited by travel funding



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Women in Physics: The Third IUPAP International Conference



- Seoul, Korea: October 7-10
- Context: 57 IUPAP countries!
- Unanimous resolution approved by IUPAP General Assembly October 17, 2008
- *Proceedings* published



- **Diverse U.S. delegation of 27**
 - 6 grad students, 3 post-docs
 - 5 men, including APS president
 - 10 underrepresented minorities
 - 1 high school teacher
 - Many subfields & non-physicists
 - 14 states, including PR

International web site: icwip2008.org ; US web site: uswip.org

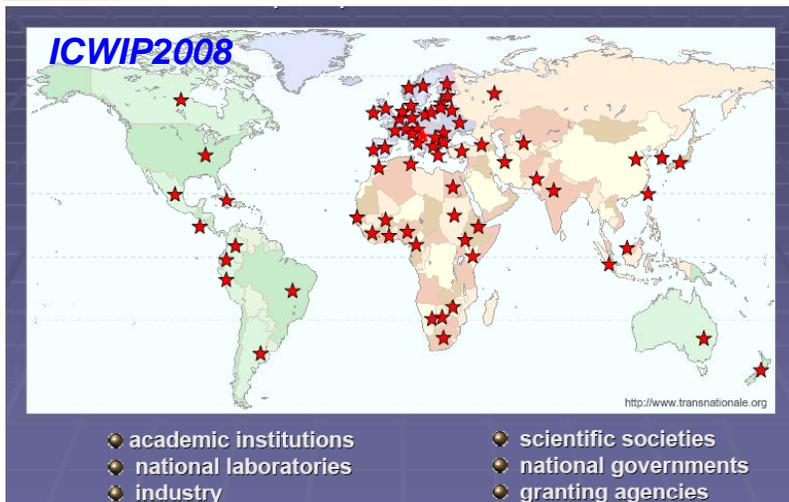
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Supported by NSF & others: THANKS

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~300 from 57 Countries; 15% men



From Y. Zastavker

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Results from ICWIP Conferences



- Unanimous resolutions later approved by IUPAP General Assembly
- Empowered participants returning home to take action
 - With surprisingly big results!
- Conference Proceedings published with reports from more countries than attended
- IUPAP created associate membership categories for developing countries

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IUPAP Actions After ICWIP 2002 & 2005



- Several women appointed to Liaison Committees
- Gender a consideration in nominations to Commissions and the Council
 - Judy Franz (USA) became Secretary General of IUPAP in 2005
 - Cecilia Jarlskog (Sweden) elected IUPAP President Designate in 2008
 - Marcia Barbosa (Brazil) elected IUPAP Vice President at large in 2008
- IUPAP-sponsored conferences required to have women on program committees and as invited speakers



National Actions after ICWIPs to Increase Women in Physics



- Women in Physics/Science groups: National and regional
- Science camps/clubs/networks for girls: In developed and developing countries
- Awards/fellowships: Germany, India, Ireland, South Africa, Tanzania, Senegal, Switzerland, UK, ...
- Child care at physics conferences: Japan
- Special conferences or Lecture Programs: Austria, Brazil, Egypt, Germany, India, Mexico, Spain, . . .
- Surveys to get the facts: Argentina, Japan, Korea, Nigeria, and more; New Global Survey underway now
- CUWP conferences: USA: USC, Yale, Ohio State, Duke



NEXT ICWIP



- Being organized now
- Stellenbosch, South Africa
- April 2011
- Mark your calendars and apply to be part of the US delegation!



YOU Make Physics' Future Bright



CUWPY2009



Women Elected Presidents of American Physical Society



« Chien-Shiung Wu (Columbia), 1975 (1912-1997)

Millie Dresselhaus (MIT), 1984 »



- Miriam Sarachik (CCNY-CUNY), 2003
- Helen Quinn (SLAC), 2004
- Cherry Murray (LLNL/Harvard), 2009



SOME “SECRETS” FROM MY GENERATION: HOW TO TAKE CONTROL TO MAKE YOUR PHYSICS FUTURE BRIGHT



“The minute you settle for less than you deserve, you get less than you settled for.”

– Maureen Dowd



Your ‘Physics’ Degree Opens Many Career Paths



- **B.S. or B.A.** (Reed College)
- **M.S.**
- **Ph.D. (University of Washington)**
- **Academia:** university level, school level; **teaching**, research, **administration**
- **Industry:** research, manufacturing, sales, management
- **Government:** **research**, **policy**, regulations, politics, **management**
- **Others:** **writing**, finance, medicine, law, movies, **consulting**...
- **Education:** **Doctorate**, Master's, Bachelor's

Me



Career Phases and Issues



- **Launching a physics career**
 - Choosing physics, a specialty, and career path
 - Setting near-term and long-range goals
 - Obtaining position/funding; surviving peer review
 - Starting a family & handling family responsibilities
- **Gaining reputation and visibility**
 - Finding/making the best mentors and opportunities
 - Getting and succeeding in important assignments
 - Assessing progress and adjusting goals
- **Winning the success and recognition you deserve**
 - Knowing/changing ‘the game;’ rewards and promotions
 - Joining the power structure
 - Mentoring others

Dimensions of success





Three Dimensions of Success

- Recognition: advancement, peer respect, publications, citations, job offers, invitations, funding success, ...
 - Impact on Society: improvement to world, country, society, science, engineering, ...
 - Individual/self: fulfilled passion, independence, life balance, balance between effort & rewards
- Importance of different dimensions depends on age, experience, & prior success
- **What does YOUR success look like?**



Career Goals: Near Term and Long Term

If you don't know where you want to go, you will likely end up somewhere else.

- What are your career goals?
- How do they relate to your personal or family goals?
- Who else has career goals for you?
- How well do they match?
- How often do you think about and adjust your career goals?



What Goals Will Define Your Success?



- What skills, experience, knowledge, and talents do you possess today?
- What do you REALLY ENJOY doing and do BETTER than nearly everyone else?
- What do you want to be known and recognized for?
- How do your goals take advantage of what you really enjoy and are great at?

❖ **What are your goals?**



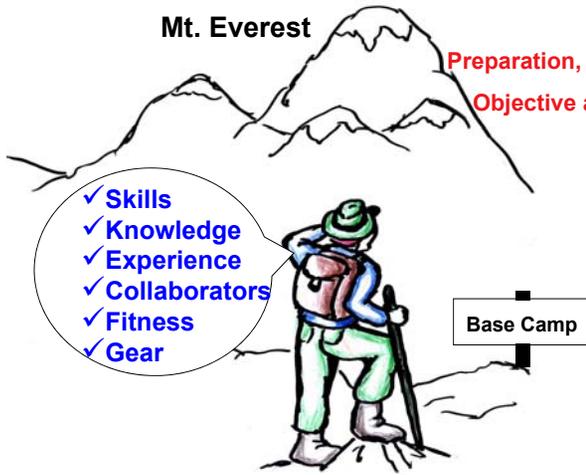
Example Goals



- Contribute to my group's success
 - Discover the origin of mass
 - Become a supervisor
 - Help society improve
 - Be promoted
 - Get a permanent position
 - Spend time in Spain
 - Have everybody like me
 - Become recognized as a leading researcher in nanomagnetism
- ❖ **Which would be helpful for career and life planning?**



What It Takes to Achieve Challenging Goals



- Preparation, planning & determination
- Objective and subjective conditions
- Good real-time decisions
- Weather (aka politics)
- Team rapport
- Opportunity
- Luck

Illustration by Larry Butler
11/2002

How to Plan Your Career



- ❖ Think of specific person(s) who are good at what you want to be doing in 2, 5, 15 years.
 - ❖ What skills, experiences, and talents do these people have?
 - ❖ Start thinking and acting like a person in the next position you aspire for
- ❖ What kinds of assignments and opportunities can help you develop and demonstrate the qualifications needed to achieve your career goals?
 - ❖ How can you get the needed assignments and opportunities?

How do you get from Washington, DC to Yale?



Implementing Your Strategy



Caution: The straight line isn't always fastest or even viable

Look how far we've come from Yale!
Everything is working great.
Next stop: South Africa



Be sure to match your approach to the current and next career step, not the last one

Larry Butler
11/2002

Lessons from the Wizard of Oz



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Align the Stars to Achieve Your Ambitions



- Have confidence in yourself and live by your high standards
- Decide your career goals and strategy
 - Be focused but flexible to exploit the best opportunities
 - Network to help yourself while helping others
 - It is a fact that "pedigrees" and "politics" count a lot
- Learn from people who are superb at what they do
- Find/make good mentor(s) who will help you advance
- Learn the "rules of the game" for funding and advancement
 - Play them or change them
- Get good assignments that allow you to contribute significantly, develop your skills, and "show your stuff"
- Regularly assess where you are and where you are going. Adjust as needed.
- Always deliver on commitments and ask for what you need

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Final Words....



Ask lots of questions
Have confidence in yourself,
Network to help yourself & others,
Always deliver more than you promise,
and
Be sure to have fun!

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ICWIP Proceedings Free On-Line



- B. K. Hartline & Dongqi Li, eds: Women in Physics, AIP Conf Proceedings 628 (2002). Available for free download at:
<http://proceedings.aip.org/proceedings/confproceed/628.jsp>
- B. K. Hartline & A. Michelman-Ribeiro, eds: Women in Physics 2, AIP Conf Proceedings 795 (2005). Available for free download at :
<http://proceedings.aip.org/proceedings/confproceed/795.jsp>
- B.K. Hartline, K. R. Horton, & C. Kaicher, eds: Women in Physics 3, AIP Conf. Proceedings 1119 (2009). Available for free download at:
<http://proceedings.aip.org/proceedings/confproceed>

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