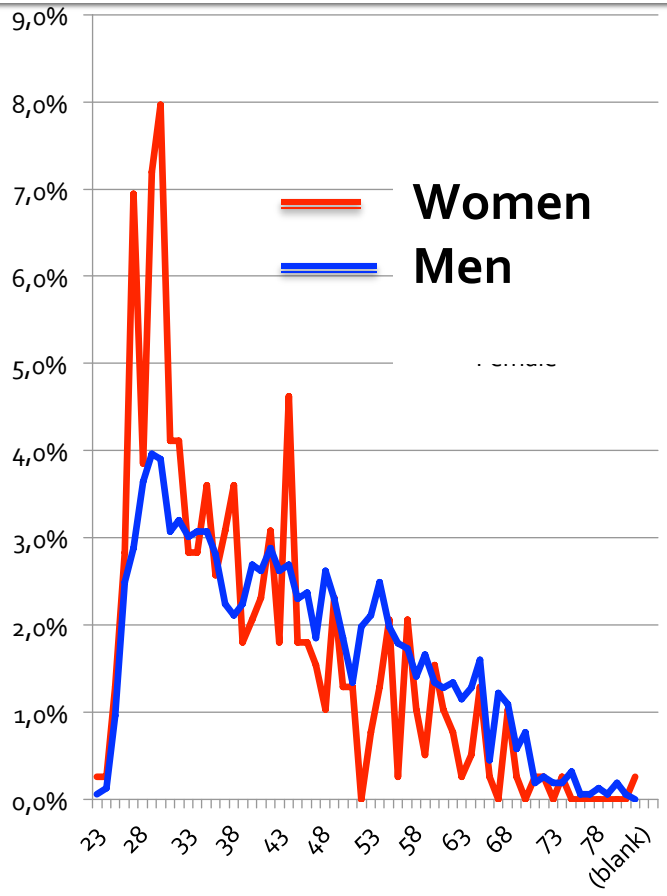
Women in physics : Are we there yet?

Pauline Gagnon, Indiana University/CERN

Outline

- Statistics from ATLAS and CERN
- Are women physicists treated equally?
- Easy things to improve the situation

Fraction of women in ATLAS as on October 2012



Based on qualified authors
(after 1 year of service work)
1952 scientific authors:

- 389 women
- 19.9% women (was 15.6% in May 2008)

- below the age of 36:
  - 50% of all women; 33% of all men
- of all ATLAS authors:
  - above the age of 50: 12% are women
  - above the age of 36: 16% are women
  - below the age of 30: 30% are women

Many young women are joining ATLAS

% of women by affiliation and nationality

country of affiliation	% in ATLAS by affiliation	% of women by affiliation	% of women by nationality
USA	18,2%	16,1%	11,3%
Germany	13,9%	20,7%	15,2%
UK	10,1%	23,2%	18,1%
Italy	7,7%	25,8%	31,9%
France	7,0%	29,2%	23,6%
Russia	5,1%	5,1%	6,1%
Japan	4,1%	4,9%	7,5%
Canada	3,8%	20,0%	22,2%
Spain	2,9%	35,7%	35,6%
Czech	2,5%	6,3%	8,9%
Netherland	1,9%	27,0%	11,1%
Sweden	1,8%	25,7%	26,7%

country of affiliation	% in ATLAS by affiliation	% of women by affiliation	% of women by nationality
China	1,7%	5,9%	12,0%
Israel	1,6%	18,8%	19,2%
Switzerland	1,4%	25,9%	16,0%
Greece	1,3%	34,6%	40,5%
Poland	1,2%	30,4%	31,3%
Norway	0,9%	27,8%	28,6%
Portugal	0,9%	22,2%	20,8%
Romania	0,8%	46,7%	42,9%
Australia	0,7%	7,1%	0,0%
Turkey	0,7%	21,4%	26,3%
Denmark	0,6%	16,7%	9,1%
Brazil	0,5%	30,0%	23,1%

Women on ATLAS per country of affiliation above ATLAS average in 2012

Country of affiliation	# women	% women
Romania	7	46,7%
Spain	20	35,7%
Greece	9	34,6%
Poland	7	30,4%
France	40	29,2%
Norway	5	27,8%
Netherland	10	27,0%
Switzerland	7	25,9%
Italy	39	25,8%
Sweden	9	25,7%
UK	46	23,2%
Portugal	4	22,2%
Germany	56	20,7%
Canada	15	20,0%

Using only countries with > 14 people; these countries = 54% of ATLAS

Women on ATLAS per affiliation below ATLAS average in 2012

Country of affiliation	# women	% women
Japan	4	4,9%
Russia	5	5,1%
China	2	5,9%
Czech	3	6,3%
USA	57	16,1%
Israel	6	18,8%
CERN	14	14.4%

Using only countries with > 14 people; these countries = 38% of ATLAS

What is behind these statistics?

High % of women

Romania, Greece, Turkey, UK, Spain, Poland, France, Italy

- **Historically low or modest salaries**
- **Are women there less seen as "stealing good jobs" from men?**
- **Better recruitment efforts both with young girls and at hiring?**

Very low % of women

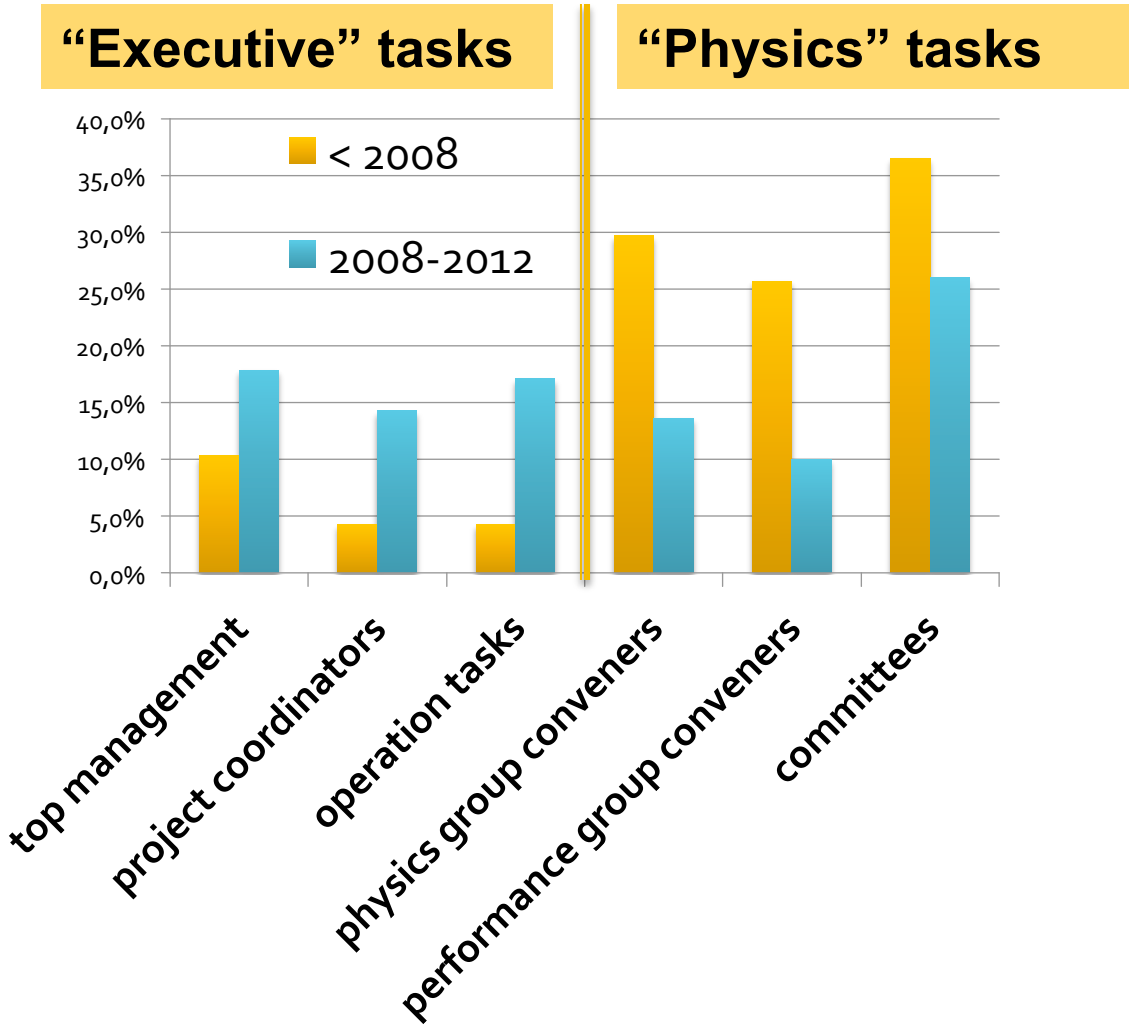
- In Japan, Austria, CERN
- Was also the case for Germany and Switzerland in 2008
- **salaries are higher**

Also very low % of women

in Russia or Czech Republic but salaries are not high there

- other factors are contributing

Responsibilities by gender in ATLAS (2000-12)
% of women per cumulative person year



Women used to be appointed mostly as group conveners and on committees (administrative tasks)

Now women are also found in top management and project leaders positions

How is CERN doing?

% of women physicists at CERN by end of 2012

physicists	men	women	% women
CERN staff	71	8	10.1%
Users	9217	1602	17.4%

Low fraction for CERN partly explained by the lack of graduate students

Summer Student Program	lecturers			Member states program		Non-member states program	
	women	men	% women	applied	admitted	applied	admitted
2009	4	22	15.4%				
2010	2	22	8.3%	21%	27%	23%	30%
2011	4	28	12.5%	22%	31%	21%	23%
2012	6	29	17.1%	24%	29%	21%	26%
2013	4	28	12.5%	25%	28%	23%	31%

CERN Summer School

- Very few female lecturers – 15.5% on average since 2009
- Reason given to us when we questioned the situation: the scheduling committee could not think of any women…
- Early 2012, we provided a list of 218 qualified women on 33 different topics after asking women for input
- Only 2 women among the 12 new appointments in 2013
- This gives the wrong image to all participants

How about career opportunities?

- Representation (i.e. fraction of women in the field) is only one aspect
- Are women physicists treated equally?

This is really where we still have a lot to gain

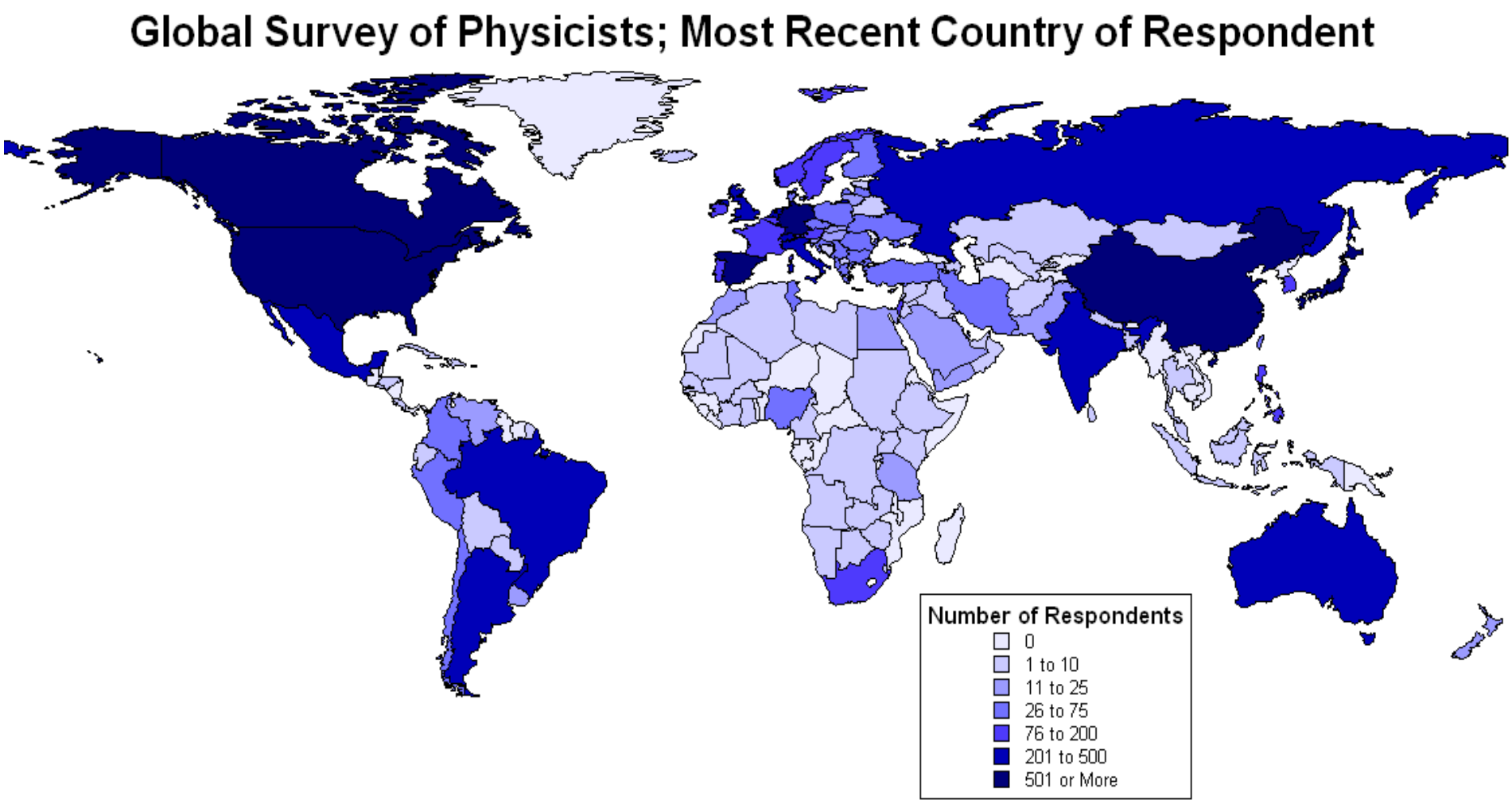
The following information was taken from a talk given by **Rachel Ivie** from the American Institute of Physics at IUPAP Women in Physics 4th meeting held in April 2011 in South Africa

www.aip.org/statistics/trends/highlite/women/global.pdf

Survey was widely distributed
1000 participants were women

- 130 countries
- 14,932 respondents
- Language of responses
  - 60% English
  - 11% German
  - 11% Spanish
  - 7% Japanese
  - 5% Chinese
  - 3% French
  - 2% Russian
  - 1% Arabic

Respondents distribution



Participation in various activities

(binomial error: ±1.5% for women; ± 0.4% for men)

% Yes	Less Developed		Very Highly Developed	
	Women	Men	Women	Men
Given a talk at a conference as an invited speaker	51	67	58	73
Attended a conference abroad	75	81	83	87
Conducted research abroad	54	71	61	69
Acted as a boss or manager	38	53	46	61
Served as editor of a journal	16	24	11	19
Served on committees for grant agencies	22	37	26	36
Served on important committees at your institute or company	50	62	48	60
Served on an organizing committee for a conference in your field	48	59	48	55
Advised undergraduate students	82	84	69	74
Advised graduate students	63	77	58	70
Served on thesis or dissertation committees (not as an advisor)	52	66	37	52

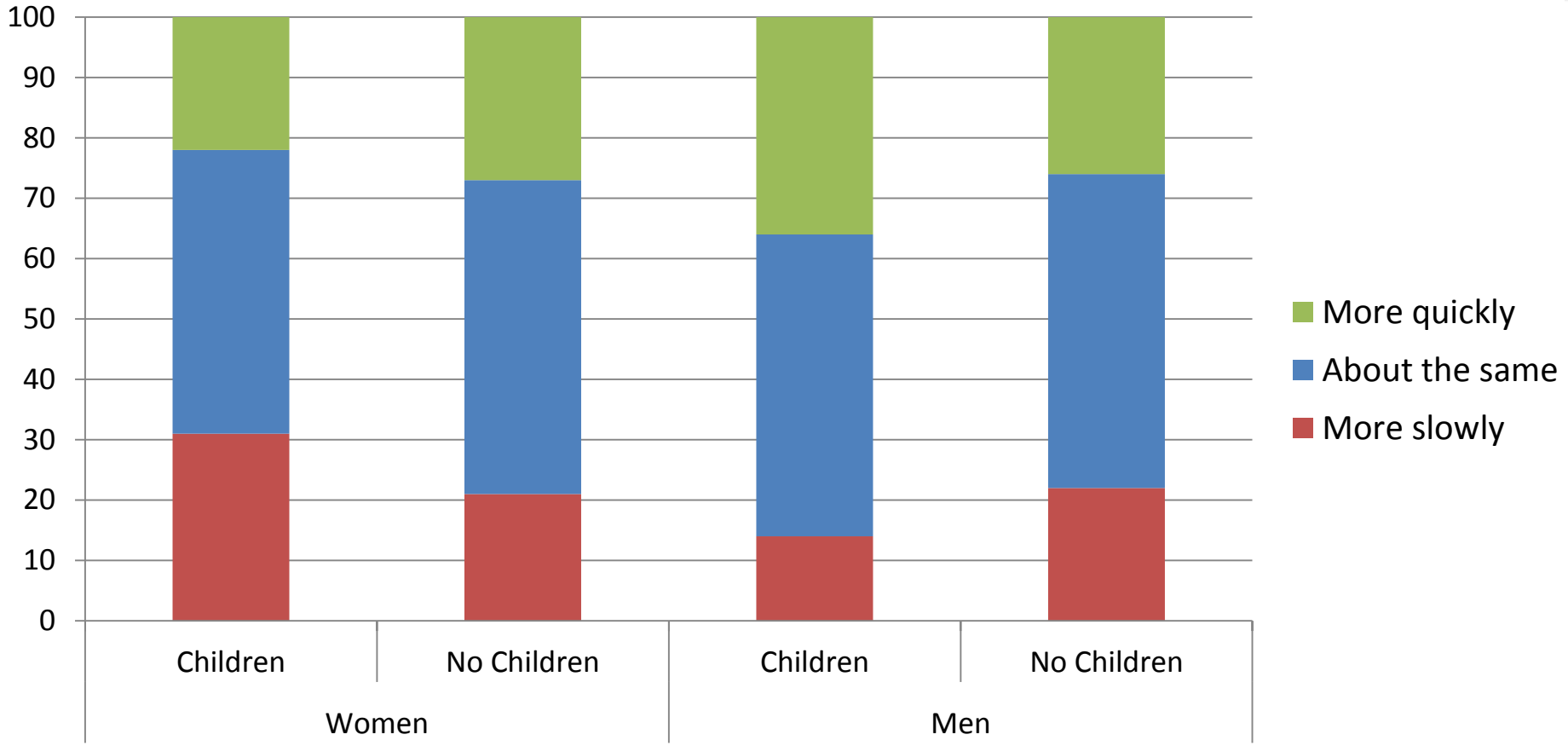
Women are disfavored statistically significantly

Do you have enough resources?

% Yes	Less Developed		Very Highly Developed	
	Women	Men	Women	Men
Funding	34	51	52	60
Office space	64	74	72	77
Lab space	42	47	46	52
Equipment	42	49	58	64
Travel money	31	47	57	64
Clerical support	22	38	30	43
Employees or students	42	53	33	43

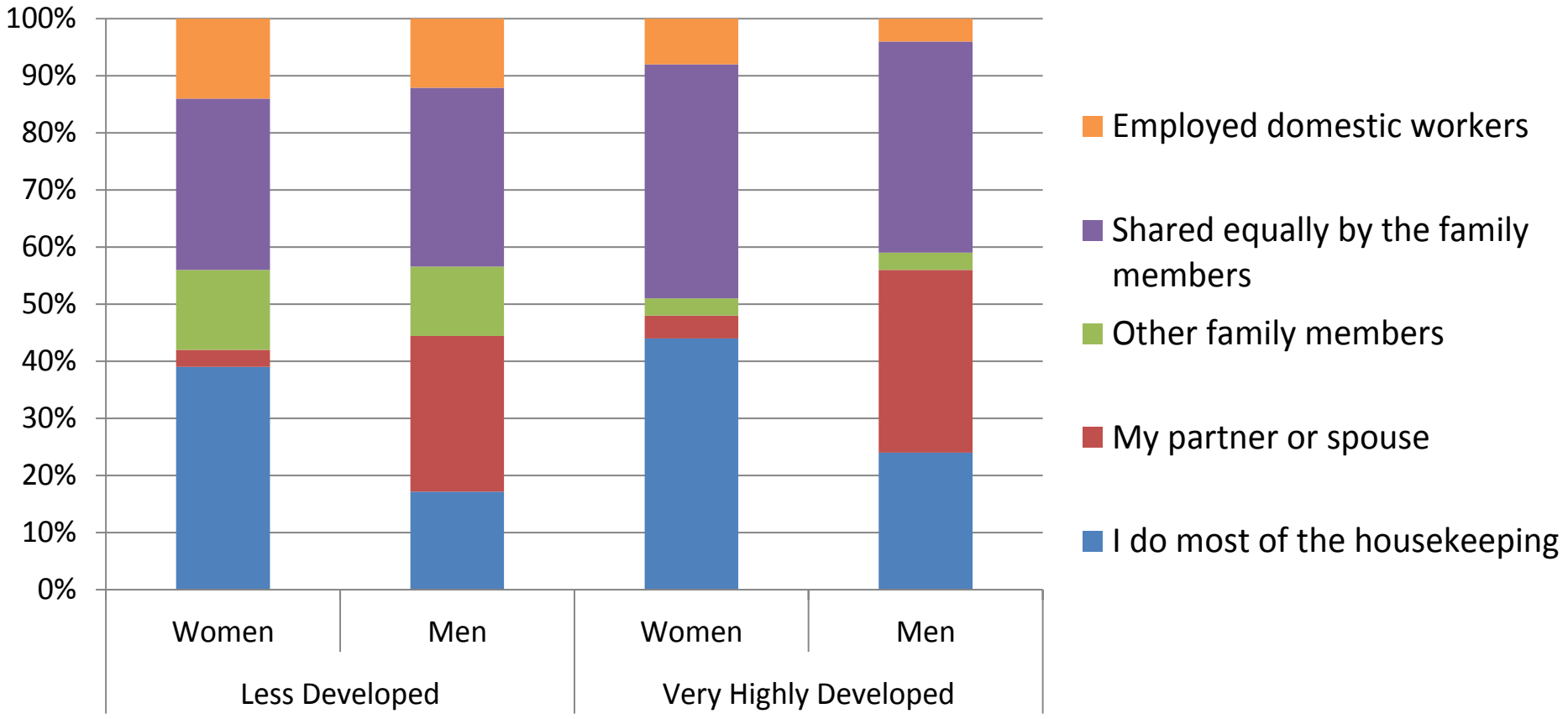
On all accounts, women are significantly disadvantaged

Compared to your colleagues, how quickly have you progressed in your career?



Fathers are advantaged while mothers answered "slower" twice as often

Who is responsible for the majority of housework?



Women answered "me" twice as often

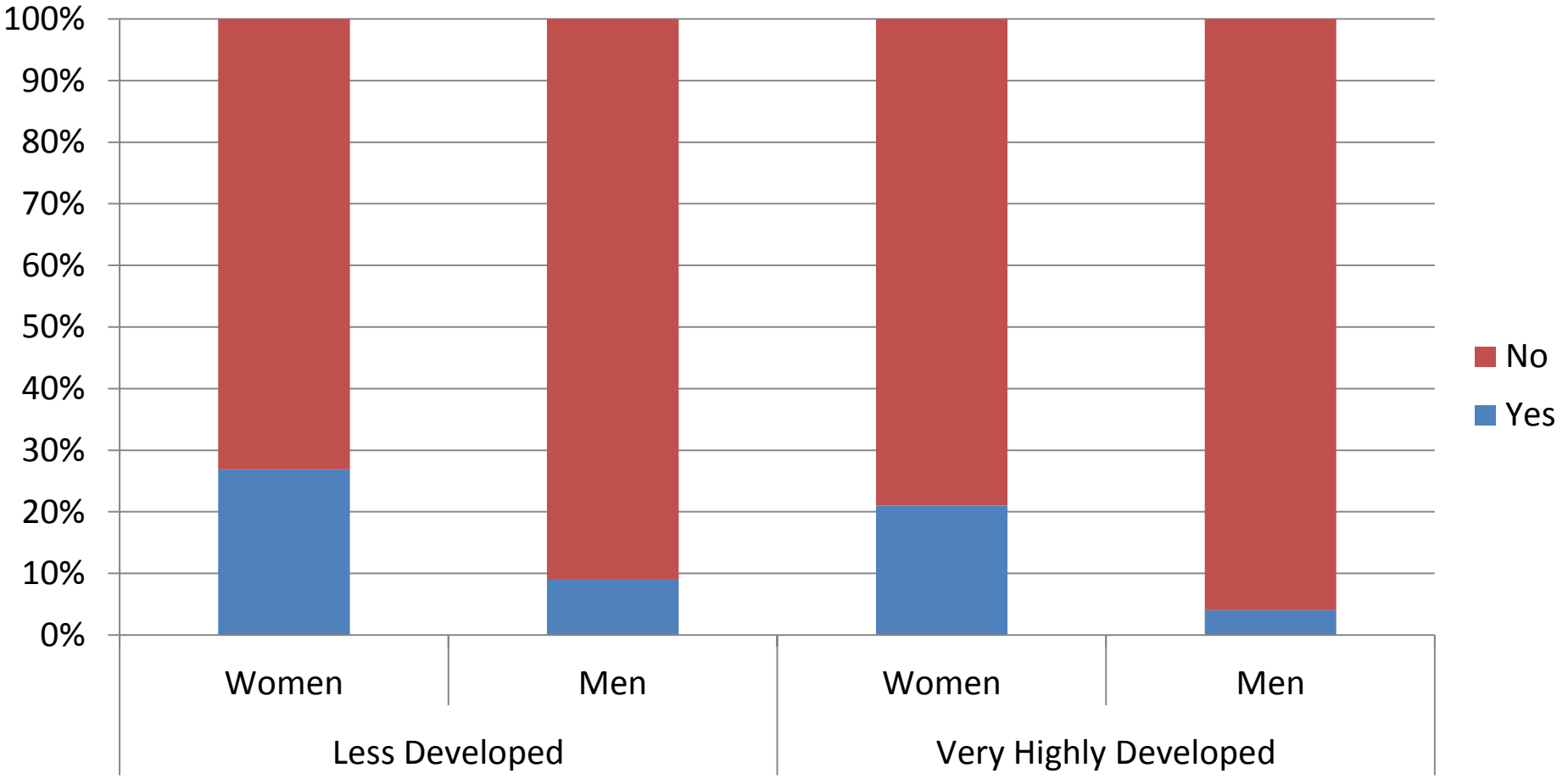
Men answered "my spouse" 10 times more

How did your work or career change when you became a parent?

	Women	Men
I chose a less demanding or more flexible work schedule	39	20
I changed my employer or field of employment	7	4
I spent significantly less time at work	35	18
I was more productive and efficient at work	29	15
My career or rate of promotion slowed significantly	34	9
I became a stay at home parent	6	1
My work or career did not change significantly	**32**	**65**

Women are affected 2-4 times more often

Did your employer assign to you less challenging work when you became a parent?



3 times more women said yes than men

Should we just conclude:
More women but same old deal?

What can be done?

What's the best way to attract more women in physics?

Great study from Harvard (PRiSE study)
http://blogs.scientificamerican.com/guest-blog/2011/03/29/can-we-declare-victory-for-women-in-their-participation-in-science-not-yet/

- Students who pursue studies in physics need a strong "physics identity":
  - Student must feel good at it
  - It is extremely important for students to believe in their own abilities
  - Students need reinforcement from peers, teachers, family etc.

- This is true for both male and female students, but female students tend to believe in themselves less, contributing to the difficulties they can encounter in physics.

What helps build a strong "physics identity"

- Students liked
  - Having opportunities for peer teaching
  - Receiving encouragement from teachers
  - Discussing in class about the benefits of being a scientist
- Teachers should:
  - Discuss current and cutting-edge physics topics
  - Encourage student questions
  - Set up labs addressing students' beliefs about the world

One classroom experience makes a huge difference

The explicit discussion of under-representation of women in science.

- Talking about the fact that there are few women in physics helps young women see the problem comes from society, not from them
- Female students who had these discussions in high school had significantly stronger physics identities
- These discussions had no adverse impact on young men

Recommendations from young women physicists

http://www.quantumdiaries.org/2013/04/03/how-to-attract-hire-and-retain-more-women-in-science/

To attract more women:

1. Fight gender stereotypes at all levels
2. Help young people build a strong "physics identity"
3. Provide role models and mentors for young women

To hire more women:

1. Implement anonymous job application processes
2. Implement equitable parental leaves
3. Add spousal considerations to hiring processes

To retain more women:

1. Provide mentors for young women starting their careers
2. Have broad discussions about gender issues at large scientific meetings
3. Hold scientific meetings for women

Remember: everything that is good for women is good for everyone

What could the Diversity office do?

- Establish a policy stating that all CERN produced documents must be gender-neutral or inclusive
- Implement anonymous job application process
- Implement equal parental leaves
- Encourage collaborations to hold discussions on gender equality and diversity in large scientific meetings
- Organize a scientific meeting for women (like in Germany or Nederland)

Conclusion

- The number of women in physics and HEP is increasing
- But there is still a clear gender-based difference in opportunities worldwide
- Reinforcing “physics identity” helps recruiting more young women but also more young men.
- Discussing the poor representation of women in physics helps strengthening “physics identity”
- There are many ways to improve the situation: talking about it is already a good step