14th International Spring Seminar on Nuclear Physics
Ischia 19 - 23 May 2025

Gender equality in STEM careers

Sara Pirrone – INFN Catania
CPO - SIF

QUESTIONS:

- **Really is the Gender Equality a problem in the STEM field?**
- **What are the reasons?**
- **What are the consequences of that for society and for science?**
- **What solutions can we find ?"**

- The context and the data

- The causes

- The consequences

- The positive actions

The context and the data

United Nations

Science and Equal Opportunity is one of the 17 goals in the UN 2030 Agenda for Sustainable Development

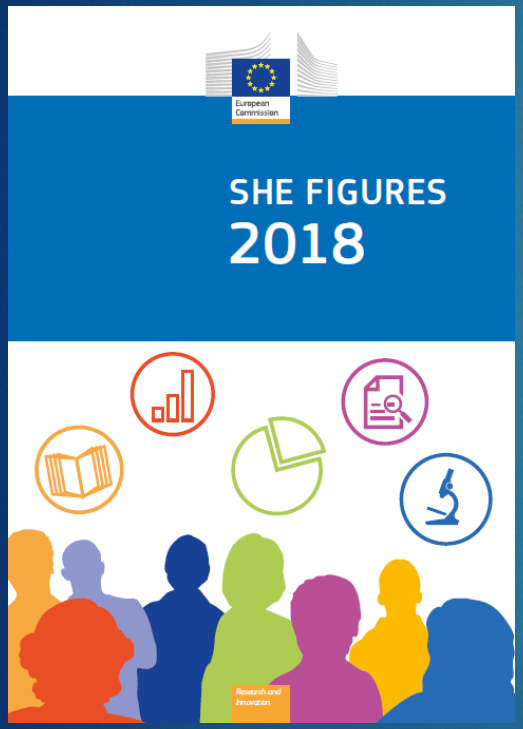
Research and Gender Equality in Europe

The issue of gender equality is central to the European research strategy, with the development of concrete programs since 2000.
Currently, the Gender Equality Strategy 2025, Horizon Europe (2021-2027) and European Research Area (ERA) (2020-2025) have being implemented

- **equal opportunities in scientific careers**
- **parity in decision-making committees**
- **fighting stereotypes and gender violence**
- **elimination of gender inequalities, both economic and in caregiving responsibilities**
- **cross-cutting integration of gender and diversity dimensions (ethnic, sexual, disability, ….)**

The She Figures publication (every three Years since 2003) is the European Commission's flagship report monitoring gender equality in R&I across Europe and beyond (Member States-Countries associated with HE and G20 Nations).

March 2025



European Commission: Directorate-General for Research and Innovation, *She figures 2024 – Gender in research and innovation – Statistics and indicators*, Publications Office, 2024, https://data.europa.eu/doi/10.2777/592260

Women in EU Academia

Diagrams show the percentage of women and men, as a function of the levels of career, from Students to Full Professor.

In the top diagram all kind of university courses are considered (humanistic and scientific).

In the bottom diagram only STEM courses are reported

- in both cases, in the highest career level women are less than men (vertical segregation, glass ceiling, leaky pipeline)
- women that choose STEM courses are less than men (orizontal segregation)

Figure 6.1 Proportion (%) of women and men in a typical academic career, students and academic staff in the EU, 2019 and 2022

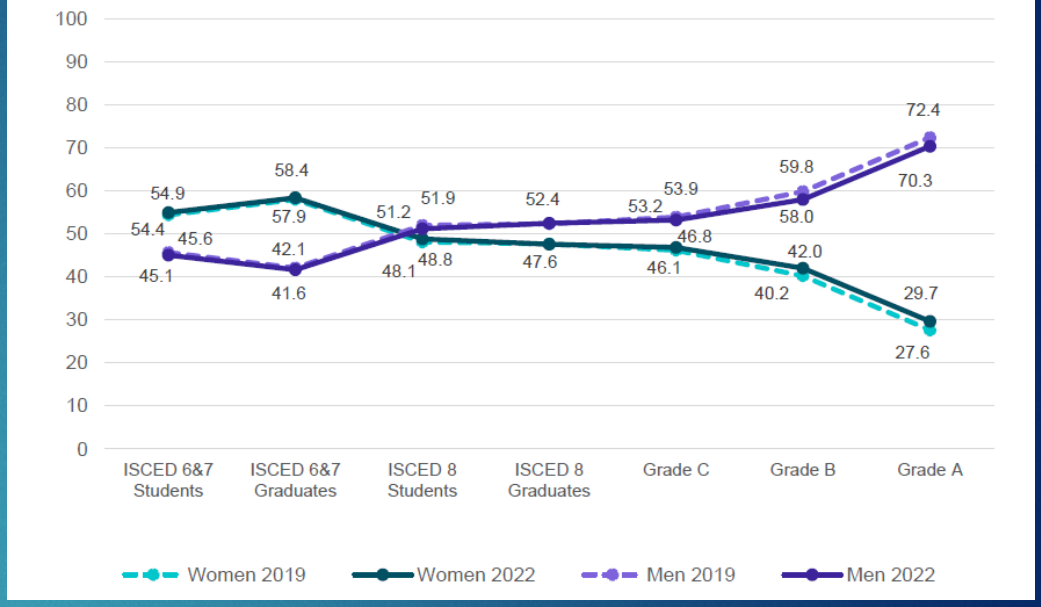
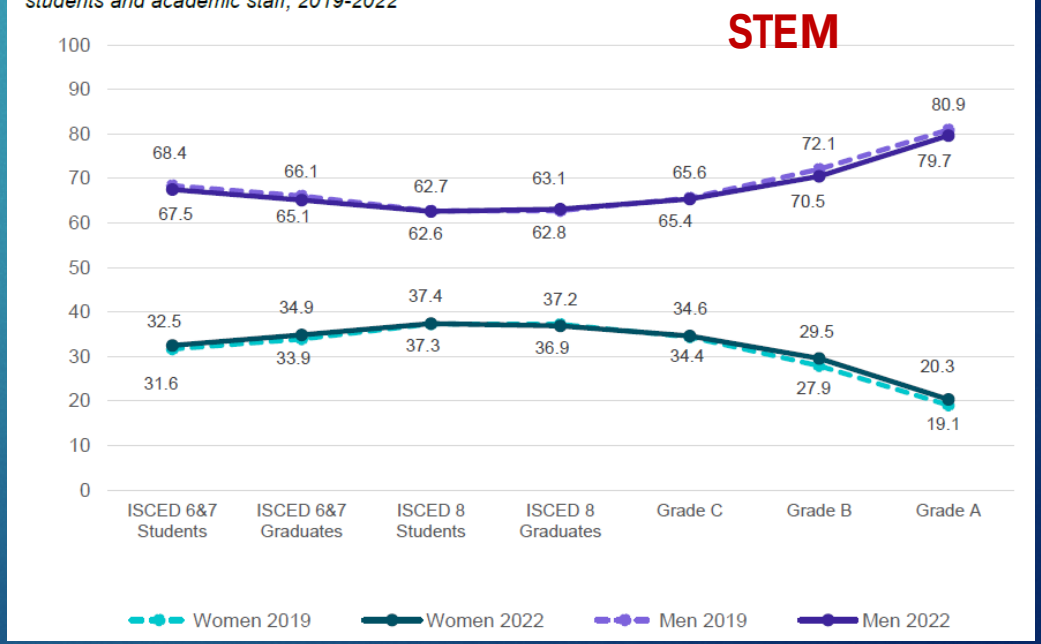


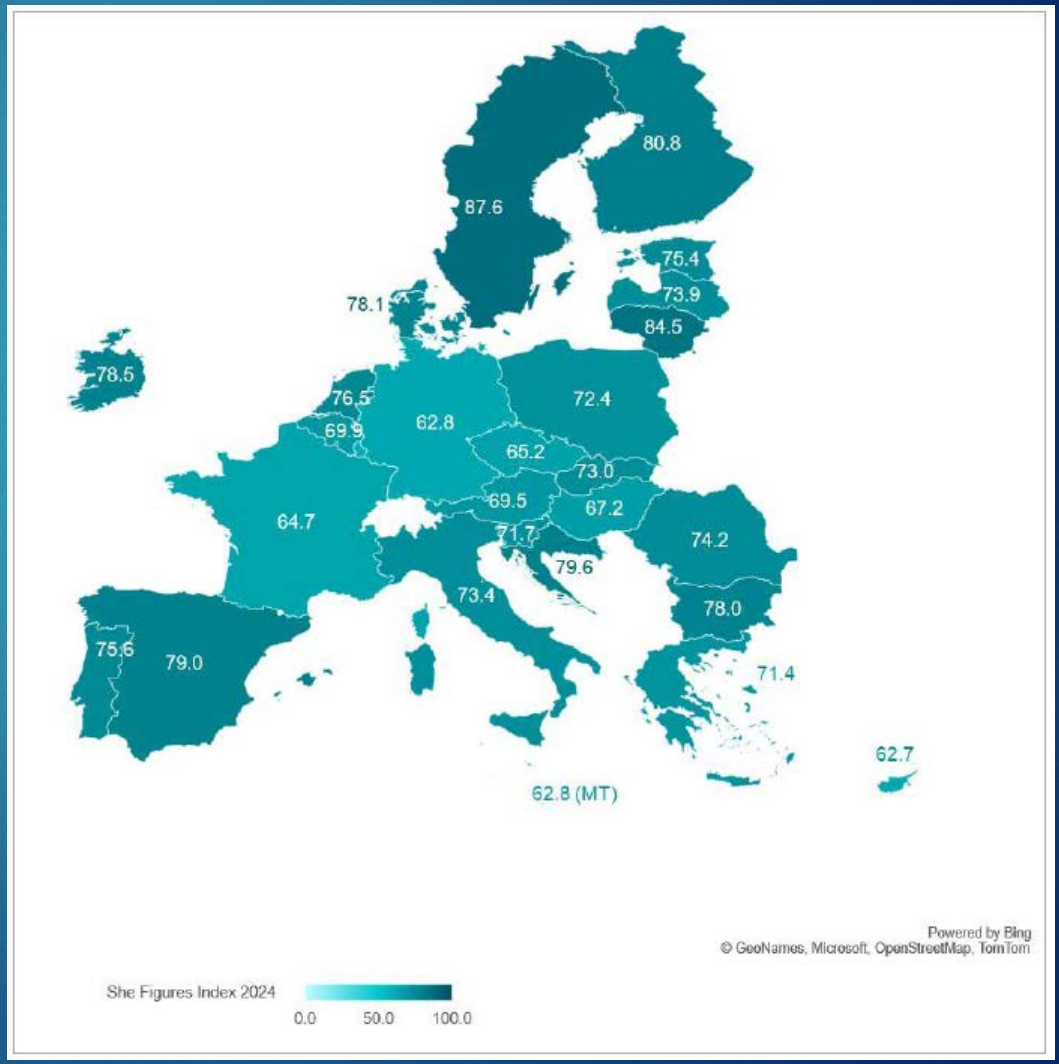
Figure 6.2 Proportion (%) of women and men in a typical academic career in science and engineering, students and academic staff, 2019-2022



NEW TOOL 2024- She Figures "Index",
that is a composite indicator (0-100) built from 6 selected indicators* and that measures Member States' progress towards gender equality in R&I.
Score 100 indicates that the gender equality is fully achieved

in **She Figures 2024**, overall Index scores range between **60 and 88**

that means an enough good "gender balance"



* segregation in the talent pipeline;
research careers and sectors;
career progression;
representation in decision-making positions;
research participation;
gender dimension in R&I content

European Commission

Research and Innovation

SHE FIGURES 2024

She Figures monitors the state of Gender Equality in R&I. The 2024 edition highlights improvements and persisting gaps in comparison with the 2021 edition. In more detail...

Education

Women continue to account for around half of Doctoral graduates

48% = 0 pp* (Eurostat, 2021)

Women remain underrepresented among Doctoral graduates in science and engineering

37% ↓1 pp (Eurostat, 2021)

Employment

Four in 10 scientists and engineers at EU level are women

41% = 0 pp (Eurostat, 2021)

However, women are still underrepresented as researchers, where they constitute just over one-third

34% ↑1 pp (Eurostat, 2021)

Women are better represented in lower grades of academic positions, but representation reduces as seniority increases...

47% = 0 pp of grade C staff (entry-level postdoctoral position e.g. researcher) (WiS Database, 2022)

42% ↑2 pp of grade B staff (mid-senior level position e.g. associate professor (WiS Database, 2022)

Research outputs

Women make up just over one-third of authors on publications across all fields of research and development

34% ↑3 pp (Scopus, 2018 - 2021)

Women continue to be significantly underrepresented among patent applicants, accounting for fewer than 1 in 10 applicants

9% ↑1 pp (PATSTAT, 2018 - 2021)

Funding success rates are lower for women than for men

29% ↑2 pp success rate for women (WiS Database, 2022)

32% = 0 pp success rate for men (WiS Database, 2022)

... with the lowest representation among the highest academic positions, where women comprise one-third of grade A staff (most senior position e.g. full professor)

30% ↑4 pp (WiS Database, 2022)

Decision making

Women are still underrepresented among board members and leaders, but their representation is growing

38% ↑7 pp (WiS Database, 2022)

This underrepresentation is more pronounced in science and engineering than across all fields, where women make up

20% ↑1 pp of grade A staff. (WiS Database, 2022)

*Number indicates percentage point (pp) difference compared to values reported in She Figures 2021, rounded to the nearest integer.

Gender Equality in Research and Innovation

Let's connect

@RTDScienceInnov

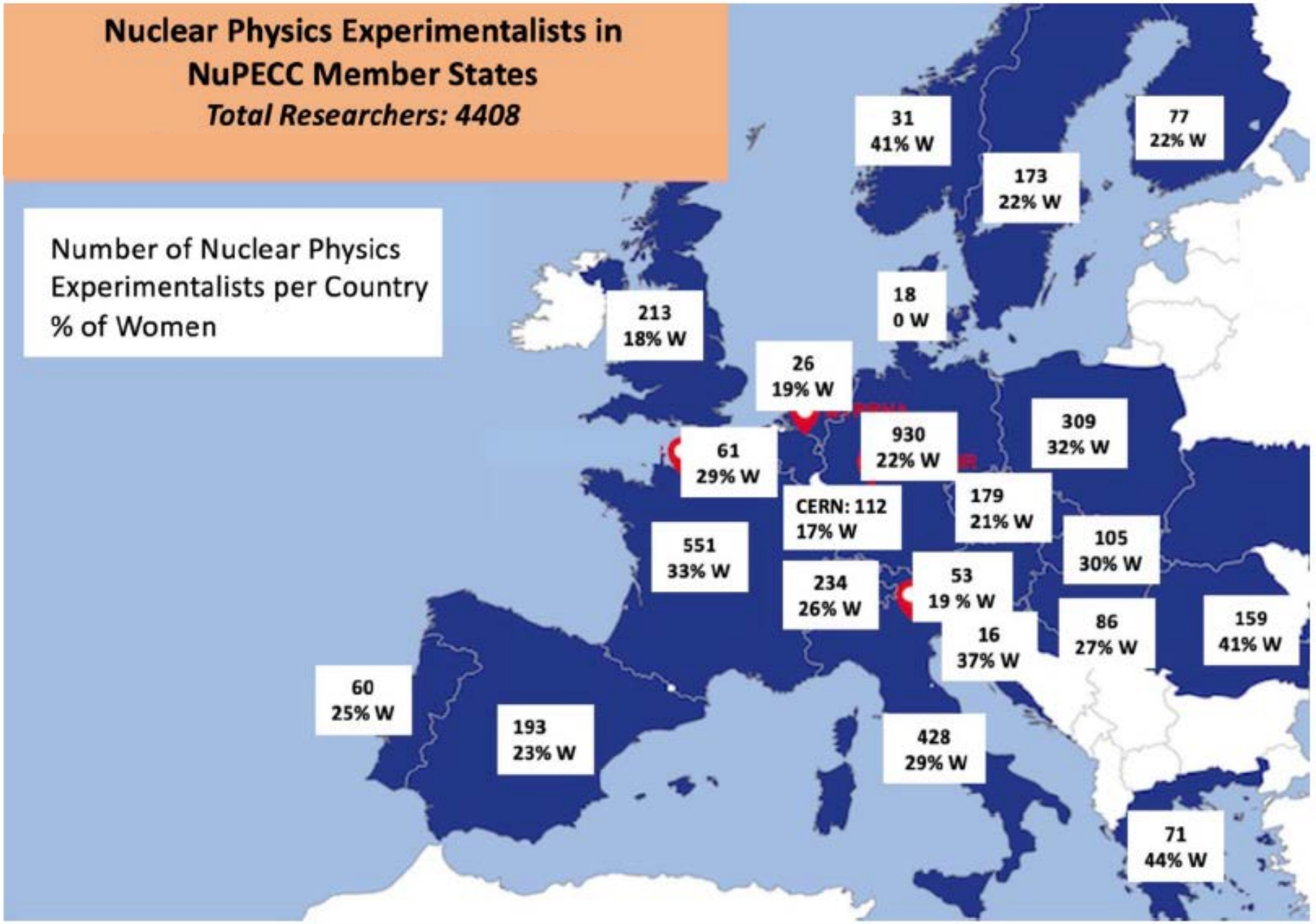
EU Science, Research and Innovation

EU Science & Innovation

2024

The NuPECC Long Range Plan 2024 for European Nuclear Physics

NuPECC



Average women in experimental physics 26%

The European Physical Society

42 Member Societies

Over 130,000 physicists

To promote physics in Europe

Equal Opportunities Committee (EOC) (Chair Pedra Rudolf)

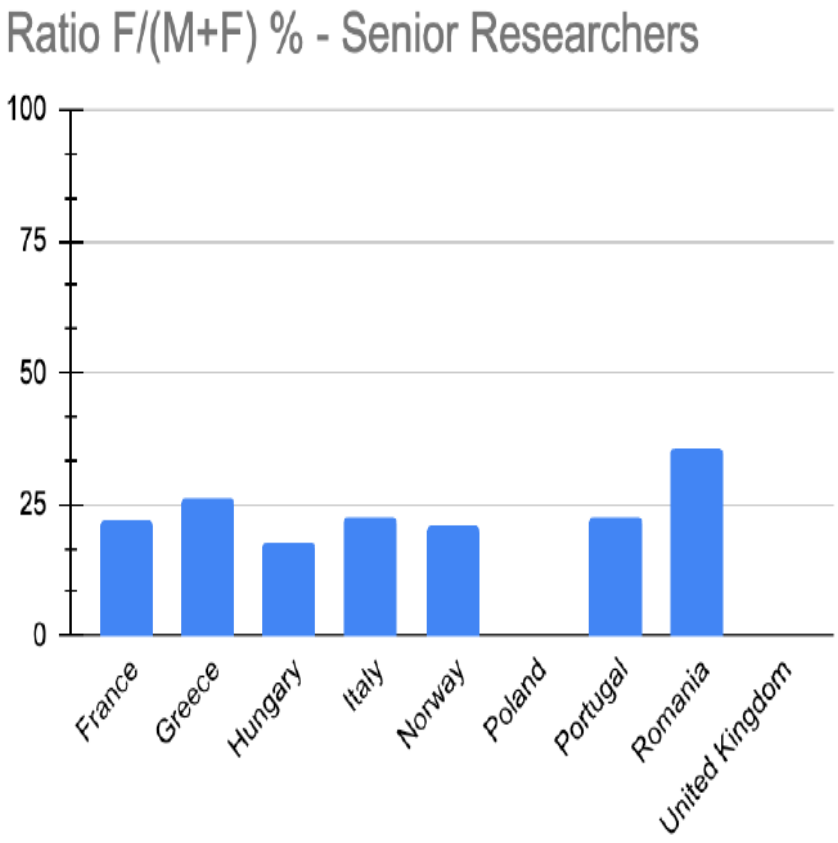
Activities within EPS

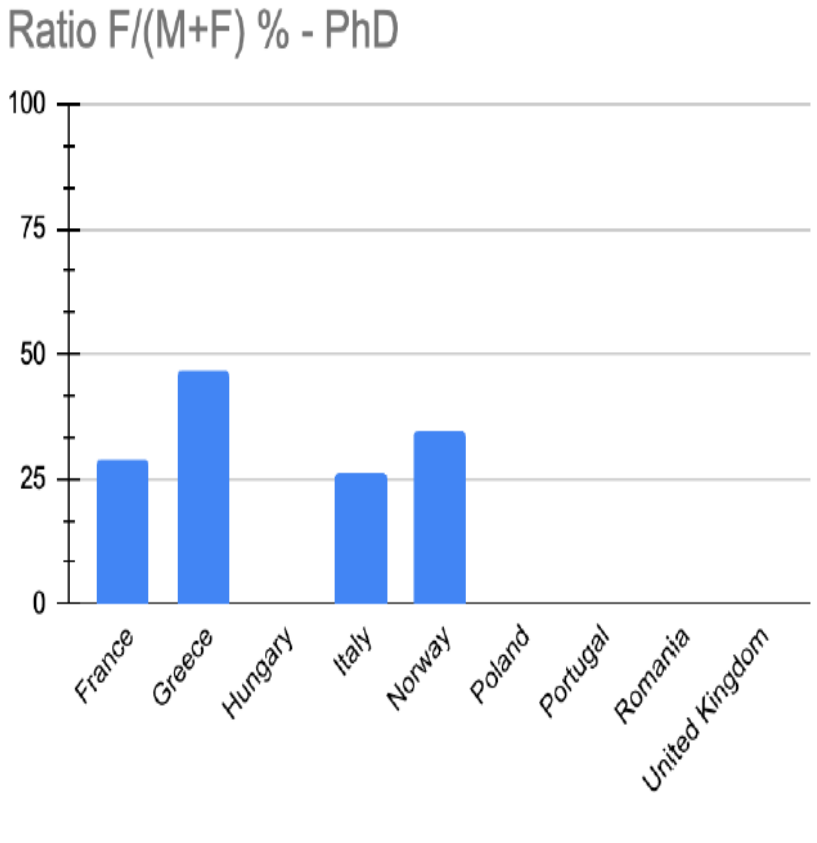
- **DIVISIONS**
- **Atomic, Molecular and Optical Physics Division**
- **Condensed Matter Division**
- **Environmental Physics Division**
- **Gravitational Physics Division**
- **High Energy Particle Physics Division**
- **Nuclear Physics Division**
- **Division of Physics in Life Sciences**
- **Physics Education Division**
- **Plasma Physics Division**
- **Quantum Electronics and Optics Division**
- **Solar Physics Division**
- **Statistical & Nonlinear Physics Division**

GRouPS

- **Accelerator Group**
- **Computational Physics Group**
- **Energy Group**
- **History of Physics Group**
- **Physics for Development Group**
- **Technology and Innovation Group**

Nuclear Physics Division @ EPS





Data from EPS Nuclear Physics Division
board members countries at 31/12/2023

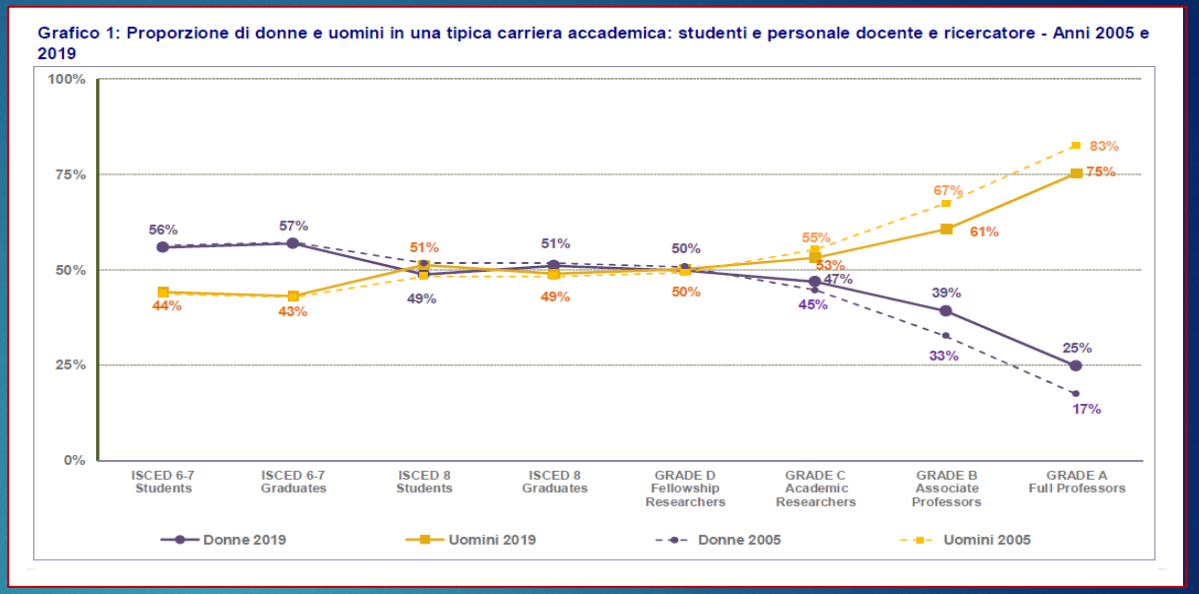
Women in italian Academia

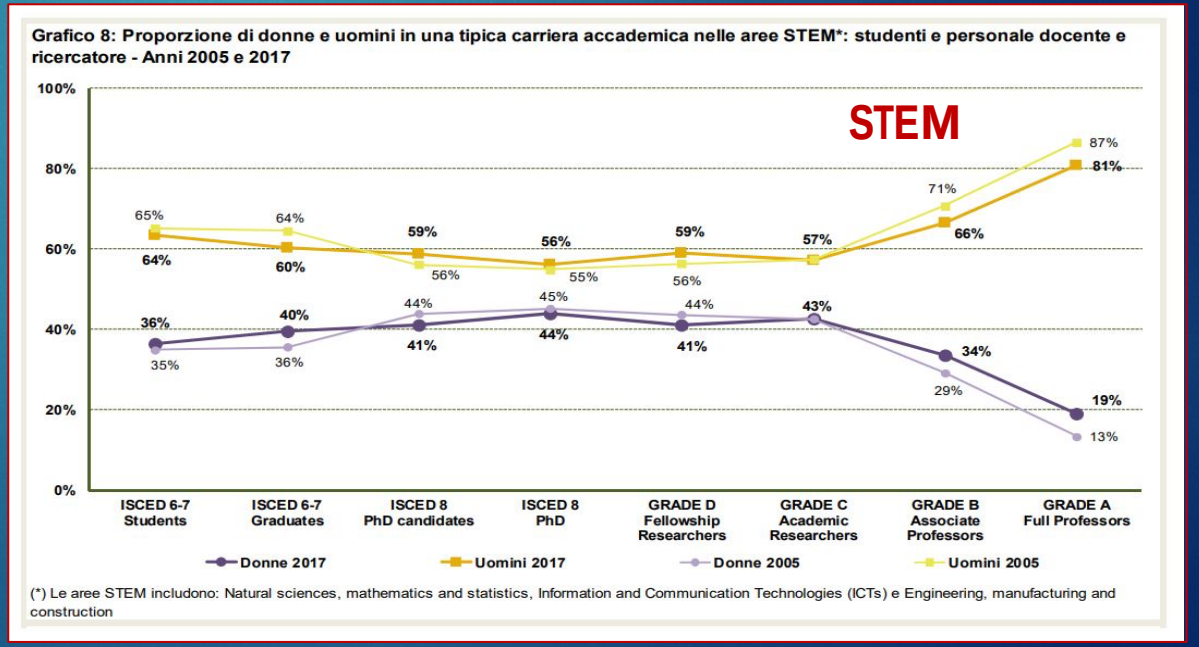
Ministero dell'Università e della Ricerca

In the top diagram all kind of university courses are considered (humanistic and scientific).

In the bottom diagram only STEM courses are reported

- women that choose STEM courses are less than men **(orizontal segregation)**
- in both cases, in the highest career level women are less than men **(vertical segregation, glass ceiling, leaky pipeline)**





Elaboration by MIUR-DGSIS databank — March 2021

L'Istituto Nazionale di Fisica Nucleare

Ettore Majorana

It was founded in 1951 to consolidate the tradition of Italian nuclear and subnuclear physics. Today, it is one of the largest research organizations in the world, with about 2700 employees, including researchers, technologists, technicians, and administrative staff.

Enrico Fermi

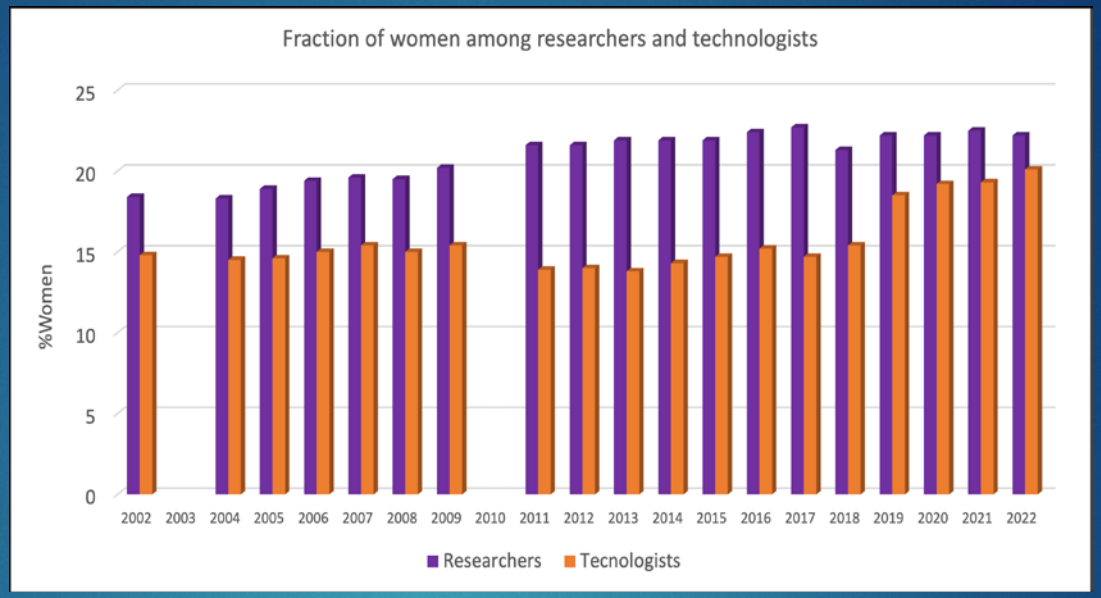
Women @INFN

FULL TIME STAFF December 2022	TOT	M	F	F/TOT (%)
RESEARCHERS	699	544	155	22
TECHNOLOGISTS	447	357	90	20
TECHNICIANS	606	571	35	6
TOTALE	**1752**	**1472**	**280**	**16**

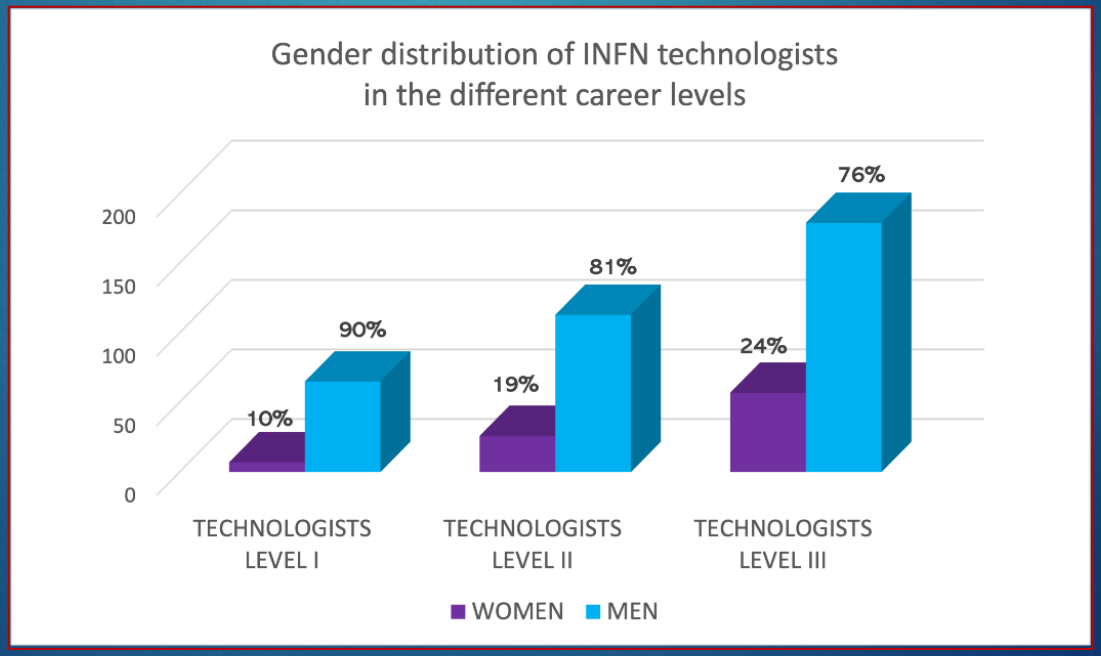
Women are 16% of total if administrative roles are excluded

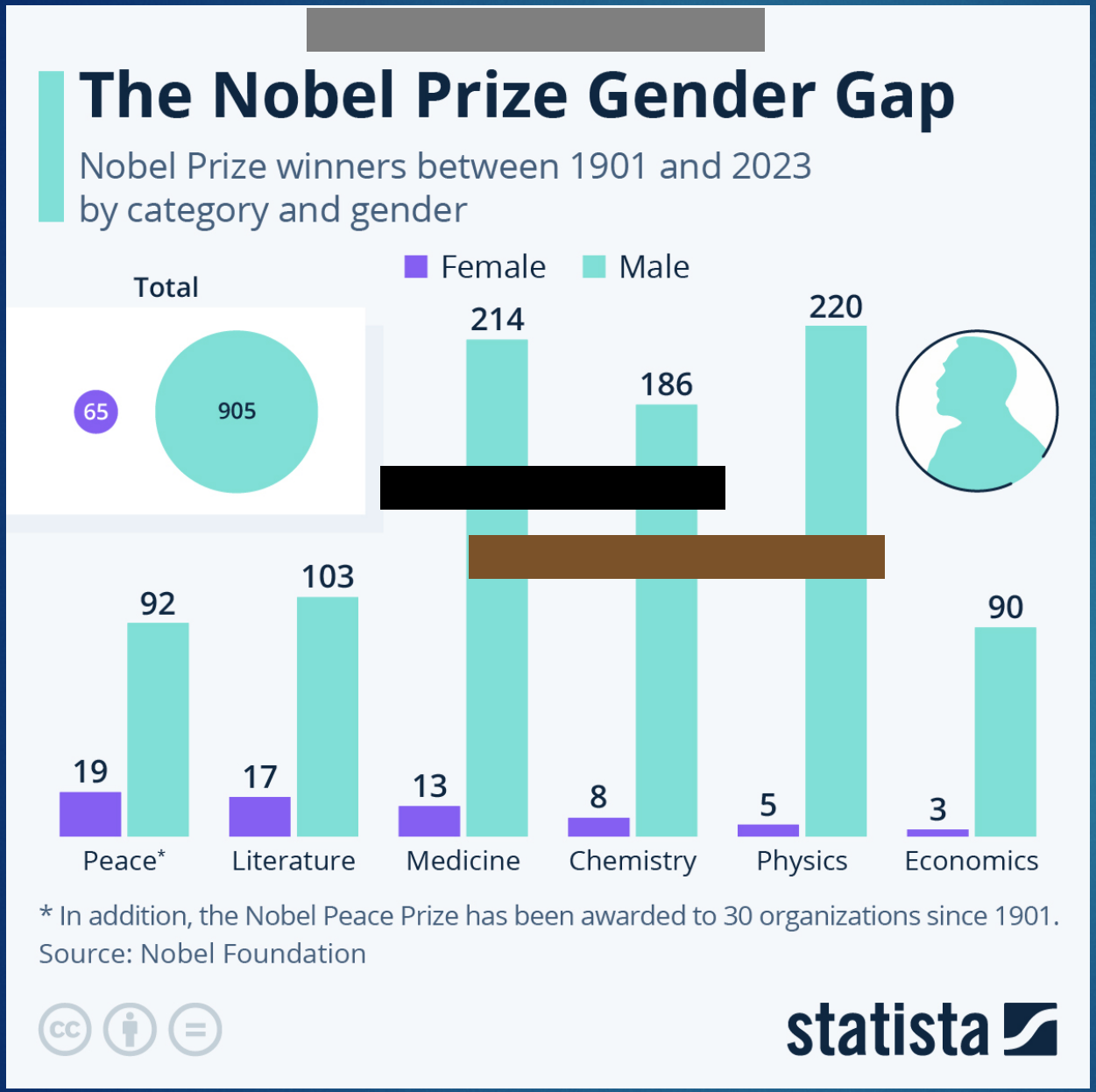
Women @INFN

Orizontal segregation



Vertical segregation





Nobel per la Fisica

Marie Sklowdowska – Curie 1903

Maria Goeppert - Mayer 1963

Donna Strickland 2018

Andrea Ghez 2020

Anne L'Huillier 2023

The data clearly show a gender inequality in the STEM career, and in particular in Physics.

It is urgent to understand the causes and find remedies!

The causes of gender inequalities in STEM (Science, Technology, Engineering, Mathematics) mainly arise from **cultural and social** factors:

- the presence of gender stereotypes, which are sometimes unconscious bias reinforced by schools, families, and media;
- a lack of female role models in certain disciplines;
- an atmosphere of dominant masculinity in scientific and technological workplaces;
- phenomena of self-exclusion (impostor syndrome);
- discrimination and harassment;
- difficulties in reconciling research time with 'family care' responsibilities.

These factors influenced both orizontal and vertical segregation

We can work on these items deploying “positive actions”

Consequences

Negative effects and consequences of gender inequality:

- **exclusion of skills**
- **distortion of results**
- **limitation of topics**
- **fairness issues**

Gender inequality is a waste of human talent, with negative effects on productivity and economic growth. It creates socio-economic disparities that undermine solidarity and social cohesion, and it acts as a barrier to poverty reduction.

STUDIO EIGE (European Institute for gender equality)

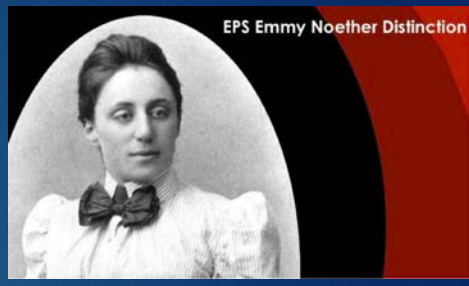
on the contrary….

- **Promoting equity and inclusion,** creates a work environment conducive to collaboration and scientific organization.
- **Gender diversity,** introduces a variety of perspectives, ideas, and approaches that enrich innovation and scientific understanding.
- **The presence of women** brings relevant approaches, including the ability to manage time and work modes, and to promote open and collaborative work environments.

Positive Actions

EU – National GEP

EPS - Positive Actions



- **EPS Prizes- Emmy Noether Distinction (Senior & Junior)**
  to promote women in Physics since February 2013

- **The Code of Conduct for EPS Confereces**
  To be followed by events organizers and participants, to avoid any form of discrimination, harassment or retaliation. Adhering to this Code is mandatory for EPS-sponsored conferences

- **Monitor Project "Gender fairness in Physics"**
  Charter on Gender Fairness in Conferences , to count, monitor and promote the gender equality in Committees, Speakers, Chairpersons,…..

- **Events (workshops, seminars, round tables, …) on Mentoring & Bias awareness**
  organized supporting member societies & informing young researchers

INFN – Positive Actions (CUG)

- **Annual Prize «Milla Baldo Ceolin» for theoretical graduating women**
- **25 scholarships for graduating women "Più donne per la Fisica" («More women for Physics»)**
- ***Mentoring program (mentor = senior woman research & mentee= early career woman)***
- **Staff training courses on Equal Opportunity and against discrimination and harasment**
- **Financial Support for babysitting cost**
- **Parenting Guide**
- **Monitor of the gender «success rate» in competitive examinations**
- **Partecipation to European Network (ex GENERA)**

IL PROGETTO GENERA

GENDER EQUALITY NETWORK IN THE EUROPEAN RESEARCH AREA

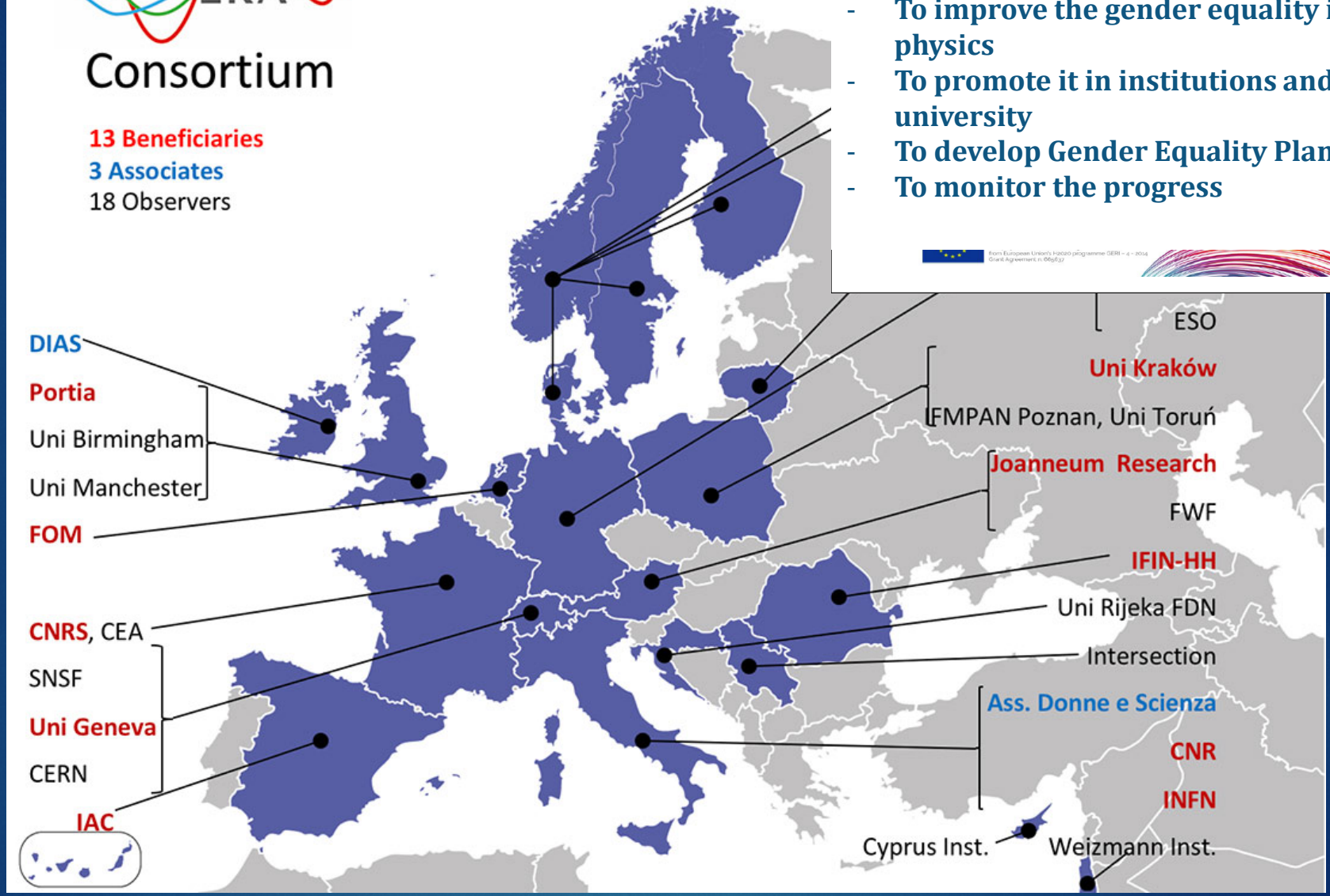
- To improve the gender equality in physics
- To promote it in institutions and university
- To develop Gender Equality Plan
- To monitor the progress

from European Union's H2020 programme GERI – 4 – 2014
Grant Agreement n. 665637

GEN ERA

Consortium

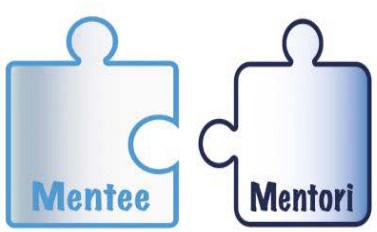
13 Beneficiaries
3 Associates
18 Observers

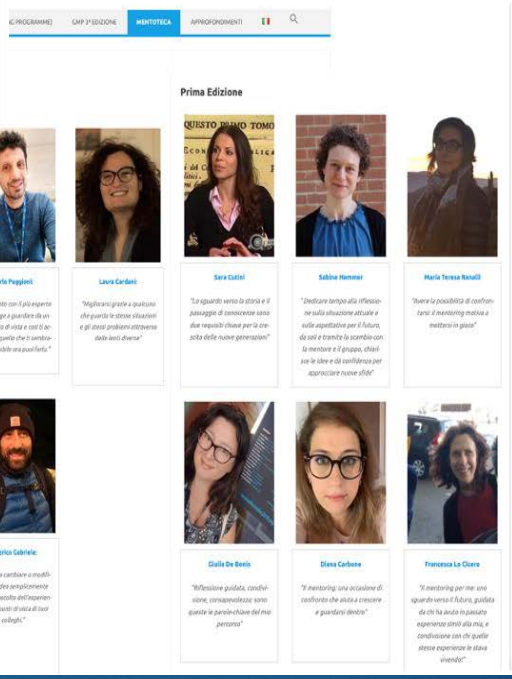


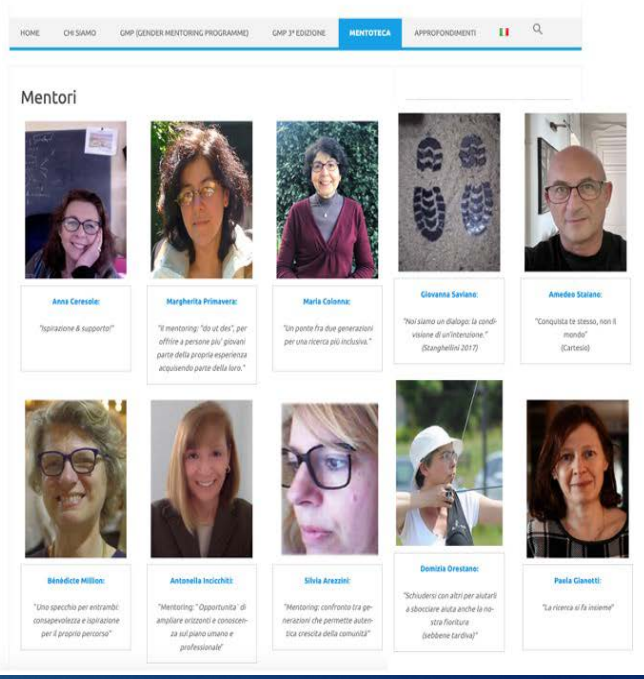
GENERA - Gender Equality Network in the European Research Area – dal 2015 a tutt'oggi

Gender mentoring programme (GMP)
INFN – First Institution in Italy to do it since 2018

Promote skills development and personal growth of young Mentee with the support of a Mentor







INFN Coord. Group

Giulia De Bonis
Angela Gargano
Maria Rosaria Masullo
Sabina Pellizzoni

https://mentoring.infn.it/

Società Italiana di Fisica – Positive Actions

The Italian Physical Society, established as an Institution by a Royal Decree of September 5, 1935, has the aim to promote, favour and protect the progress of Physics in Italy.

All those who carry out researches, cultural and didactic activities in the field of physics, acknowledge the aim of the Society and wish to take part in it, may thus subscribe.

www.sif.it

President:
Angela Bracco

Council Members:
Alessandro Bettini, Padova
Eugenio Coccia, GSSI L'Aquila
Salvatore De Pasquale, Salerno
Giuseppe Grosso, Pisa
Antigone Marino, Napoli
Sara Pirrone, Catania
Bernardo Spagnolo, Palermo

CPO-SIF since 2017
President: Sara Pirrone, Catania
Members:
Anna Di Ciaccio, Roma
Silvia Soria, Firenze
Paolo Rossi , Pisa
Nadia Martucciello, Salerno
Maria Rosaria Masullo, Napoli

Gender equality positive actions by CPO - SIF

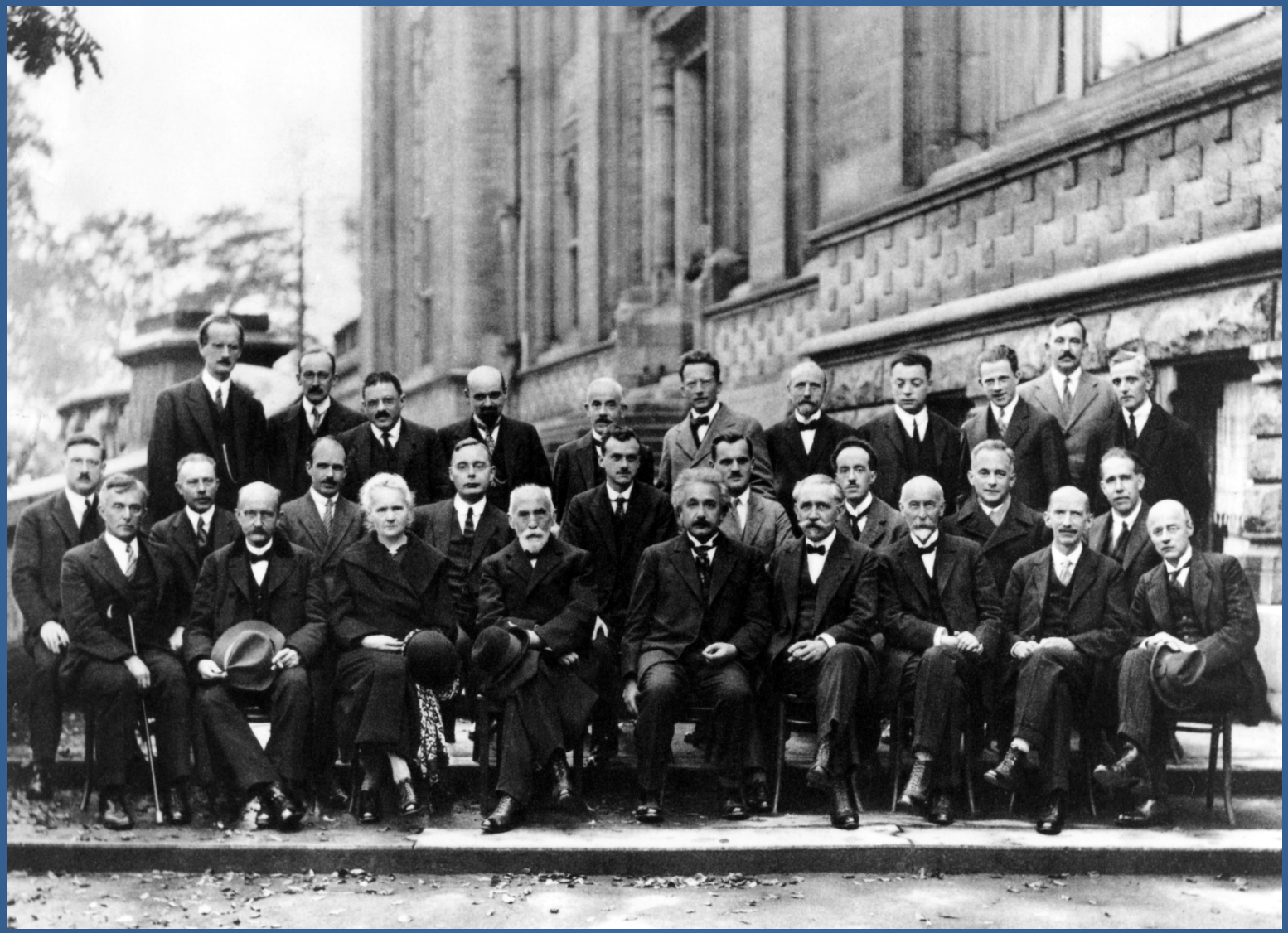
Since 2017, the CPO – SIF works to promote the gender equality in physics and to increase the female presence in science.

The CPO –SIF has always worked to very concrete actions.

<u>Most relevant actions by SIF:</u>

- **Propose women scientists as role model**
- **Estabilish awards for women in Physics**
- **Realized gender balance report of SIF**
- **Organization of Round Table to promote equal opportunities in physics**
- **Collaboration with scholar projects (ex. GENERA)**
- **Collaboration with actions of EPS**

2017 Congresso SIF, Trento - 1927 Congresso Solvay, Bruxelles



I fila - I. Langmuir, M. Planck, M. Curie, H.A. Lorentz, A. Einstein, P. Langevin, Ch.-E. Guye, C.T.R. Wilson, O.W.Richardson
II fila - P. Debye, M. Knudsen, W.L. Bragg, H.A. Kramers, P.A.M. Dirac, A.H. Compton, L. de Broglie, M. Born, N. Bohr;
III fila - A. Piccard, E. Henriot, P. Ehrenfest, E. Herzen, Th. de Donder, E. Schrödinger, J.E. Verschaffelt, W. Pauli, W. Heisenberg, R.H. Fowler, L. Brillouin;

Congresso Società Italiana di Fisica – Trento 2017

I FILA: Cinzia Giannini, Anna Di Ciaccio, Guido Tonelli, Monica Colpi, Antigone Marino, Chiara La Tessa, Patrizia Cenci, Luisa Cifarelli, Beatrice Fraboni
IIFILA: Simonetta Croci, Daniela Calvo, Lidia Strigari, Silvia Picozzi, Alessandra Gugliemetti, Alessandra Rotundi, Angela Bracco, Olivia Levrini, Speranza Falciano
III FILA: Elisa Molinari, Marina Cobal, Roberta Ramponi, Francesca Vidotto, Silvana Di Sabatino, Silvia Tavazzi, Nadia Robotti, Clementina Agodi, Edwige Pezzulli, Sara Pirrone, Marta Greselin

“Le Scienziate delle Sezioni” since 2020

During the annual Congress, each of the seven physics Sections is named to a woman scientist (*role models*)

106° Congresso SIF, 2020


1-Lise Meitner


2-Rita Brunetti


3-Vera Rubin


4-Laura Bassi


5- Giuseppina Aliverti


6- Daria Bocciarelli


7- Hedy Lamarr

110° Congresso SIF, 2024


1-Milla Baldo Ceolin


2-Mildred Dresselhous


3-Lucia Padrielli


4-Moira Dunbar


5 - Elizabeth Fleischman


6-Katherine Johnson


7-Emilie du Chatelet

Premi Laura Bassi

Since 2021
Two Prizes "Laura Bassi" Awards for women in Physics

EARLY CAREER

MID TO FULL CAREER

“Talent has no gender, but opportunity too often does.

Women are driving progress in education, but still face too many barriers in research, innovation, and leadership.

We need to change that—not just because it’s fair, but because Europe’s future depends on it.

A truly competitive and innovative Europe is one where every mind, regardless of gender, gets the chance to thrive.”

Katerina Zaharieva, EU Commissioner for Startups, Research and Innovation