



<https://www.nasa.gov/feature/goddard/2016/nsf-s-ligo-has-detected-gravitational-waves>

## NOTICE

The Coordinations of the Graduate Programs in Physics of the following institutions:

Instituto de Física - USP  
 Instituto de Física de São Carlos - USP  
 Instituto de Física “Gleb Wataghin” - UNICAMP  
 Instituto de Física Teórica - UNESP  
 Universidade Federal do ABC - UFABC  
 Universidade Federal de São Carlos - UFSCar  
 Universidade Federal do Rio Grande do Sul - UFRGS  
 Universidade Federal de Minas Gerais - UFMG  
 Universidade Federal de Pernambuco – UFPE  
 Universidade Federal do Rio Grande do Norte – UFRN

Make public the opening of registrations and establish norms for the:

### Unified Examination of Graduate Courses in Physics– EUF 2018-2

The individual results of the Unified Examination of Graduate Courses in Physics - EUF may be used as part of the selection process for admission to the Graduate Programs in Physics of the following universities and Brazilian institutions associated with the EUF:

IAG - Instituto de Astronomia e Geofísica da USP, São Paulo, SP	UFRGS - Universidade Federal do Rio Grande do Sul, RS
ITA - Instituto Tecnológico da Aeronáutica, São José dos Campos, SP	UFSC - Universidade Federal de Santa Catarina, SC
UEL - Universidade Estadual de Londrina, PR	UFSCar - Universidade Federal de São Carlos, São Carlos, SP
UEPG - Universidade Estadual de Ponta Grossa, Ponta Grossa, PR	UFU - Universidade Federal de Uberlândia, MG
UESC - Universidade Estadual de Santa Cruz, PROFISICA, Ilhéus, BA	UNB - Universidade de Brasília, DF
UFABC - Universidade Federal do ABC, Santo André, SP	UNESP - Universidade Estadual Paulista, IGCE, Rio Claro, SP
UFAM - Universidade Federal do Amazonas, AM	UNESP - Universidade Estadual Paulista, IFT, São Paulo, SP
UFG - Universidade Federal de Goiás, GO	UNICAMP - Universidade de Campinas, IFGW, Campinas, SP
UFMG - Universidade Federal de Minas Gerais, Belo Horizonte, MG	UNILA - Universidade Federal da Integração Latino-Americana, Foz do Iguaçu, PR
UFMT - Universidade Federal do Mato Grosso, Cuiabá, MT	UNICSUL - Universidade Cruzeiro do Sul, SP
UFPA - Universidade Federal do Pará, Belém, PA	UNIFEI - Universidade Federal de Itajubá, MG
UFPE - Universidade Federal de Pernambuco, Recife, PE	USP - Universidade de São Paulo, FFCLRP, Ribeirão Preto, SP
UFPR - Universidade Federal do Paraná, Curitiba, PR	USP - Universidade de São Paulo, IFSC, São Carlos, SP
UFRN – Universidade Federal do Rio Grande do Norte	USP - Universidade de São Paulo, IFUSP, São Paulo, SP

Detailed information on the Unified Postgraduate Examination in Physics relevant to the EUF 2018-2 edition will be exclusively available via the internet, through the

**PLATAFORM EUF** in [www.faurgs.ufrgs.br/EUF2018-2.htm](http://www.faurgs.ufrgs.br/EUF2018-2.htm).

Through the Platform the Candidates can, among other things, access this Notice, carry out their registration and place demands/requests that they deem pertinent. The candidate will also have access to their own portal (see instructions for access at the end of this announcement), which will include their personal data, proof of registration and results obtained in the exam, among others. All requests will be answered by Committee only by the EUF Platform and in line with the schedule of events of this announcement, detailed below.

## CONCERNING REGISTRATION

Registration will be open from **January 22 to February 16, 2018**, and must be made via the EUF Platform.

**ATTENTION:** registrations for those requesting TAX EXEMPTION, SPECIAL NEEDS assistance or request of an alternative PLACE for the EXAM APPLICATION can only be made AFTER request to the EUF Coordination. Therefore, applicants must wait for the response before doing registration.

The EUF registration fee, in the amount of R\$100.00, must be paid only by credit card or bank slip (it cannot be by appointment), according to the instructions on the registration page. Under no circumstances will this fee be refunded.

The candidate is self-responsible for knowing bank opening hours in order to proceed payment, either by visiting the bank (bank agencies, Brazilian lottery houses or any other payment places), or by online banking (internet or cashpoint). Registration fees paid on the last day and that are in disagreement with the bank operating hours, therefore resulting in the processing of the payment in days after February 16, 2018, will cause the non-homologation of the registration. Under no circumstances, will FAURGS process any payment record with a date subsequent to that provided in the Schedule of this Notice.

The candidate, whom was not granted with an exemption of the registration fee, will have their registration homologated only after FAURGS receives the confirmation from the Bank of the payment of Registration Fee.

**EXEMPTION FROM REGISTRATION FEE:** Candidates whose monthly family income is up to one and a half of Brazilian minimum salary per person can request exemption from the registration fee. Requests for exemption must be submitted through the EUF Platform from **January 22 to February 8, 2018**. Requests for exemption will only be accepted with supporting documentation. The results of the requests for exemption will be communicated to the applicants through the EUF Platform until **February 11, 2018**, and then, the candidate must proceed with registration, by the deadline of **February 16, 2018**.

**EXAM LOCATIONS:** The Exam will be held simultaneously at the locations indicated on the registration page. The candidate must choose only one of these locations at the time of their registration. Once the application has been homologated, the candidate cannot change the selected location to take the exam. **The establishment of new locations for application of the EUF Exam, in addition to the places available on the registration page, will not be allowed, except abroad in case there are demands that justify the requests.** Candidates who wish to request a new place of application of the tests abroad must submit this request via the EUF Platform between **January 22, 2018** and **February 5**. The organization will make efforts to make feasible the suggested location until **February 11, 2018**. By this deadline, the candidate must verify in the EUF Platform if the new requested location has been made available. If the requested location has not been made available by that date, this will be the official indication of the impossibility of applying the exam in the requested location. In that case, the candidate should select one of the available locations, if they still have interest.

**SPECIAL NEEDS:** Candidates with special needs (physically handicapped or with reduced mobility) must ask for the viability of the service, through the EUF Platform, between **January 22 and February 8, 2018**. The application should be done only after the positive response of the EUF Coordination, which must occur until **February 11, 2018**. In case of impossibility of attendance, the candidate will be notified by the organization, with justifications for that.

The application process has a deadline of **February 16, 2018**, for **all** applicants, including those who requested a fee waiver and/or a new location to take tests.

On **February 23, 2018** the preliminary list of candidates enrolled in the EUF 2018-2 will be announced. Candidates who have completed the registration and are not on the list must report it by **February 27, 2018**, through the EUF Contact - Coordination option available on the EUF Platform, in order to rectify their situation. The final and approved list of participants will be published on **February 28, 2018**.

## CONCERNING THE EXAMS

The selection exam will be carried out in two stages (exams), on **April 3 and 4, 2018**, from 2:00 p.m. to 6:00 p.m. (Brasilia time zone), in the locations published in the EUF Platform. The candidates can take the exams in an institution and register for selection in the Graduate Programs of other institutions.

The candidates must attend the place of the exams with identity document with photo and blue pen. **The exams will be scanned for correction, so the use of a blue pen is mandatory. Exams that do not allow clear, readable scanning will not be corrected. Draft sheets will be provided, but will NOT be considered for proofreading.** The use of a calculator and other electronic equipment such as cell phones, tablets, computers and calendars will not be allowed. The exams will consist only of discursive questions. A table with some formulas and physical constants will be provided for use during the exams. No other source of information is allowed.

## CONCERNING THE CONTENTS OF THE EXAMS

The exams will cover five general areas of the Undergraduate Programs in Physics, namely,

1. **Classical Mechanics;**
2. **Electromagnetism;**
3. **Modern Physics;**
4. **Quantum Mechanics;**
5. **Thermodynamics and Statistical Physics .**

The topics of each area to be evaluated and the recommended bibliography are as follows:

### 1. CLASSICAL MECHANICS

- Newton laws.
- One-dimensional motion.
- Linear oscillations.
- Movement in two and three dimensions.
- Newtonian gravitation.
- Variational calculus.
- Lagrange and Hamilton's equations.
- Central forces.
- Systems of particles.
- Non-inertial reference frames.
- Dynamics of rigid bodies.
- Coupled oscillations.

Bibliography: · J. B. Marion and S. T. Thornton, Classical Dynamics of Particles and Systems, 4th Edition, Harcourt, 1995.  
· K. R. Symon, Mechanics, 3rd Edition, Addison-Wesley, 1971.  
· D. Halliday, R. Resnick, e J. Walker, Fundamentos de Física, 8a. edição, Vols. 1&2, LTC/Wiley, 2008  
· H. Moysés Nussenzveig, Curso de Física Básica, 4a. edição, Vols. 1&2, Blucher, 2002.  
· T.W.B. Kibble, Classical Mechanics, Imperial College Press, 2004.

- A.P. French e M.G.Ebison, Introduction to Classical Mechanics, Chapman and Hall, 1987.
- R.A. Becker, Introduction to Theoretical Mechanics, McGraw-Hill, 1954.
- D. Halliday, R. Resnick, J. Walker, Fundamentos de Física, LTC, 2012.

## 2. ELECTROMAGNETISM

- Electrostatic fields in vacuum and dielectric materials.
- Resolution of equations of Poisson and Laplace.
- Magnetic fields, stationary currents and non-magnetic materials.
- Induced electromotive force and magnetic energy.
- Magnetic materials.
- Maxwell's equations.
- Propagations of electromagnetic waves.
- Reflection and refraction.
- Radiation.
- Electromagnetism and relativity.

- Bibliografia:**
- D. J. Griffiths, Introduction to Electrodynamics, 3rd Edition, Prentice-Hall, 1981.
  - D. Halliday, R. Resnick, e J. Walker, Fundamentos de Física, 8a. edição, Vols. 3&4, LTC/Wiley, 2008
  - H. Moysés Nussenzveig, Curso de Física Básica, 4a. edição, Vols. 3&4, Blucher, 2002.
  - J. R. Reitz, F. J. Milford, R. W. Christy, Fundamentos da Teoria Eletromagnética, 3ª. Edição, Editora Campus, 1982.
  - R.K. Wangsness, Electromagnetic Fields, Wiley, 1986.
  - E.M. Purcell, Curso de Física de Berkeley, Eletricidade e Magnetismo, Edgard Blücher,
  - J.B. Marion e M.A. Heald, Classical Electromagnetic Radiation, Brooks/Cole (1995).
  - D. Halliday, R. Resnick, J. Walker, Fundamentos de Física, LTC, 2012.

## 3. MODERN PHYSICS

- Foundations of special relativity.
- Relativistic mechanics of particles.
- Light propagation and Newtonian relativity.
- Experiment of Michelson and Morley.
- Postulates of the special theory of relativity.
- Lorentz's transformations.
- Causality and simultaneity.
- Relativistic energy and momentum.
- Thermal radiation, the black-body problem and Planck's postulate.
- Photons and corpuscular properties of radiation.
- Rutherford's model and the problem of atomic stability.
- Bohr's model.
- Boltzmann's energy distribution.
- Atoms, Molecules and Solids.

- Bibliography:**
- R. Eisberg and R. Resnick, Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles 2nd Edition, Wiley, 1985.
  - D. Halliday, R. Resnick, e J. Walker, Fundamentos de Física, 8a. edição, Vol. 4, LTC/Wiley, 2008
  - H. Moysés Nussenzveig, Curso de Física Básica, 4a. edição, Vol. 4, Blucher, 2002.
  - Tipler e R.A. Llewellyn, Física Moderna. 3ª. Edição, LTC, 2003.
  - W. Rindler, Introduction to Special Relativity, Oxford Univ. Press, 1991.
  - A.P. French, Special Relativity, W.W. Norton (1968).
  - S.T. Thornton e A. Rex, Modern Physics for scientists and engineers, Brooks Cole, 2005.
  - R.A. Serway, C.J. Moses e C.A. Moyer, Modern Physics, Brooks Cole, 2004.
  - J. Leite Lopes, Introdução à Teoria Atômica da Matéria, Ao Livro Técnico, 1959.
  - H.M. Nussenzveig, Curso de Física Básica IV, (capítulo 6), Edgard Blücher.
  - Halliday, R. Resnick, J. Walker, Fundamentos de Física, LTC, 2012.

#### 4. MECÂNICA QUÂNTICA

- Introdução às ideias fundamentais da teoria quântica.
- O aparato matemático da mecânica quântica de Schrödinger.
- Formalização da Mecânica Quântica. Postulados. Descrição de Heisenberg.
- O oscilador harmônico unidimensional.
- Potenciais Unidimensionais.
- A equação de Schrödinger em três dimensões. Momento angular.
- Forças centrais e o átomo de Hidrogênio.
- Spinores na teoria quântica não-relativística.
- Adição de momentos angulares.
- Teoria de perturbação independente do tempo.
- Partículas idênticas.

**Bibliografia:**

- D.J. Griffiths, Introduction to Quantum Mechanics, 2nd edition, Pearson, 2004.
- C. Cohen-Tannoudji, B. Diu, F. Laloë, Quantum Mechanics, Vols. I and II, 1st Edition, Wiley, 1977.
- S. Gasiorowicz, Física Quântica. Guanabara Dois, 1979.
- E. Merzbacher, Quantum Mechanics 3rd Edition, Wiley 1997.
- R.H. Dicke e J.P. Wittke, Introduction to Quantum Mechanics, Addison Wesley, 1961.
- Levin, Quantum Chemistry, Prentice-Hall, 1991.

#### 5. THERMODYNAMICS AND STATISTICAL PHYSICS

- Thermodynamic systems.
- Variables and equations of states, PVT diagrams.
- Work and the first law of thermodynamics.
- Mechanical equivalent of heat.
- Internal energy, enthalpy, Carnot's cycle.
- Changes of phase.
- Second law of thermodynamics and entropy.
- Thermodynamic functions.
- Practical applications of thermodynamics.
- Kinetic theory of gases.
- Statistical description of a physical system.
- Micro canonical ensemble.
- Canonical ensemble.
- Classical gas in the canonical formalism.
- Grand canonical ensemble.
- Quantum ideal gas.
- Fermi's ideal gas.
- Bose-Einstein's condensation.

**Bibliography:**

- S.R.A. Salinas - Introdução à Física Estatística . Edusp, 1998.
- F. Reif. Fundamentals of Statistical and Thermal Physics. 1st edition. Mc Graw Hill, 1965.
- D. Halliday, R. Resnick, e J. Walker, Fundamentos de Física, 8a. edição, Vol. 2, LTC/Wiley, 2008.
- H. Moysés Nussenzveig, Curso de Física Básica, 4a. edição, Vol. 2, Blucher, 2002.
- F. W. Sears and G. L. Salinger. Thermodynamics, Kinetic Theory, and Statistical Thermodynamics; 3rd Ed. Addison Wesley.1975.
- H.B. Callen, Thermodynamics ,Wiley, 1960
- R. Kubo, Statistical Mechanics, North-Holland, 1965
- M. W. Zemansky - Calor e Termodinâmica, Ed. Guanabara Dois, 1978.
- D. Halliday, R. Resnick, J. Walker, Fundamentos de Física, LTC, 2012.

## CONCERNING EXAM CORRECTION AND THE ANNOUNCEMENT OF THE RESULTS

The exams will be corrected in accordance with the Official List of Solutions and Correction Criteria, which will be made available on the EUF Platform. Each candidate will be awarded a final score of 0 to 10, to the second decimal place, reflecting their performance on the exam.

On **May 9, 2018** the final results of the exam will be posted at the candidates' portal on the EUF Platform through which the voucher of the scores obtained on the exam can be accessed.

Exams will be discarded **2 months** after disclosure of the results of appeals by candidates who have questioned their scores.

## CONCERNING THE IMPUGNATION OF THIS NOTICE

Any objection to any aspect of this NOTICE must be posted on the EUF Platform within 3 days of publication. Provided that it is duly supported and forwarded by an identified sender, the arguments will be analysed by the Organizing Committee. Applications for contestation will not be accepted:

- a) without clear and detailed explanation of the applicant's non-conformities;
- b) filed after deadline.

Once the deadline for submitting objections has been reached, the Organizing Committee will analyse them and send the applicants a response regarding their possible acceptance or rejection. In cases of rejection of the appeal, the response will include a substantiated opinion on the dismissal of the appeal. In the event of verification that the basis of the request for contesting the EUF Notice is pertinent, the Organizing Committee shall take the necessary measures to correct the Notice.

## CONCERNING THE IMPUGNATION OF QUESTIONS

Any objection to any EUF question should be posted on the EUF Platform within 3 days of the completion of each event. Provided that it is duly supported and forwarded by an identified sender, the arguments will be analysed by the Organizing Committee. In the event of cancellation of a EUF question, the corresponding score will simply be discarded and the scores will be normalized such that the maximum possible score is 10.00. No appeal will be allowed:

- a) without giving the applicant's reasons for non-conformism;
- b) filed after deadline.

After the deadline for submitting requests to contest issues, the Organizing Committee will analyse them, sending the applicants a response regarding their possible acceptance or their rejection. In cases of rejection of the appeal, the response will include a substantiated opinion on the dismissal of the appeal.

## CONCERNING REVISION OF THE SCORES

After correcting the exams and disseminating the results, the candidates can appeal by questioning the scores per question attributed to them, duly justified in writing. To do this, the candidates must proceed in two stages:

- 1) Within three days of the release of the results, the candidate can express their wish to see their test corrected by posting the application on the EUF Platform, in order to compare them with the Official List of Solutions. The organizing committee will post electronic copies of the corrected exams on the candidates' portal on the EUF Platform by **May 15, 2018**.
- 2) The candidate will then have until **May 18, 2018** to submit a review request of their score, upon request posted on the EUF Platform. The request must: a) be based on the Official List of Solutions and Correction Criteria of the

examination previously disclosed; B) present, for each item of each question whose correction is being questioned, clear and concise justifications that show the need to change the correction.

No request will be admitted:

- a) without the detailed and justified explanation, for each item of each question whose correction is being questioned, of the reasons for the nonconformity of the candidate. In particular, generic and vague review requests will not be considered;
- b) filed after deadline.

Upon completion of the period of appeal for revision of results, the Organizing Committee will analyse the appeals. Once this reviewing stage is over, the claimants will be informed of the result and the revised CHECK OF SCORES will be available at their portals, on the EUF Platform, on **May 30, 2018**.

**ATTENTION:** When choosing to review scores, the candidate's voucher, issued on **May 9, 2018**, will be automatically invalid. A new valid voucher, for use with the Graduate Programs Associated with the EUF, will be the one that can be accessed by the candidate (and Associated Programs) from **May 31, 2018**.

## **CONCERNING THE USE OF THE RESULTS**

Each Associate Graduate Program will use the results in the Exam for the selection and classification of the candidates according to its own criteria. Acceptance or non-acceptance in one Program does not imply acceptance in another Program. The Members must access the EUF Platform and extract an individualized and certified proof of the scores obtained by the candidate who is seeking entry into their Program.

## **CONCERNING THE APPLICATION OF THE EXAMS**

- The complete process will consist of two exams, applied on **April 03 and 04, 2018**.
- The candidate must appear at the place of the exams, each day, at least 30 minutes in advance for checking documents and signing the attendance list, with an ID with photo.
- The exams must be made mandatorily with blue ink pen, as they will be scanned for correction; Exams that do not allow clear and readable scanning will not be corrected.
- The answers to questions can be written in Portuguese, English or Spanish.
- Each exam will last four (4) hours starting at 2:00 p.m. (Brasília time).
- It will not be allowed to consult any material other than that contained in the exams sheets.
- The use of a calculator or any other electronic equipment such as cell phones and calendars will not be allowed.
- The candidate will not be allowed to enter the room after 60 minutes from the start time.
- The candidate will only be allowed to leave the room definitively after 90 minutes of the start time of the tests.
- The candidate can go to the bathroom only after 90 minutes of the start time of each test and with a room supervisor.
- Under no circumstances will draft sheets be considered in the correction of the exams.
- Each question should be solved solely and exclusively on the response sheet it has designated; Solutions outside the designated spaces will not be considered.

## CONCERNING THE SCHEDULE OF THIS NOTICE

STAGE/EVENT	BEGGINING	CLOSING
PERIOD OF INSCRIPTIONS	January 22, 2018	February 16, 2018
Last day for registration fee payment		February 16, 2018
Applications for FEE exemption	January 22, 2018	February 08, 2018
Requests for NEW PLACES FOR EXAMS <b>abroad</b>	January 22, 2018	February 05, 2018
Requests for SPECIAL NEEDS	January 22, 2018	February 08, 2018
Replies to requests for FEE EXEMPTION	January 22, 2018	February 11, 2018
Reply to requests for NEW PLACES FOR EXAMS <b>abroad</b>	January 22, 2018	February 11, 2018
Reply to requests for SPECIAL NEEDS	January 22, 2018	February 11, 2018
Publication of the list of exempt candidates and special needs services	February 18, 2018	
Publication of the PRELIMINARY LIST OF ENROLLED	February 23, 2018	
Deadline for APPROVAL OF INSCRIPTIONS	February 23, 2018	February 27, 2018
Publication of the FINAL LIST OF APPROVAL OF REGISTRATION	February 28, 2018	
<b>APPLICATION OF THE TEST - DAY 1</b>	<b>April 03, 2018</b>	
<b>APPLICATION OF THE TEST - DAY 2</b>	<b>April 04, 2018</b>	
IMPUGNATION OF QUESTIONS - DAY 1	April 04, 2018	April 07, 2018
IMPUGNATION OF QUESTIONS - DAY 2	April 05, 2018	April 08, 2018
Disclosure of SCORES	May 09, 2018	
Disclosure of OFICIAL LIST OF SOLUTIONS	May 09, 2018	
Disclosure of CORRECTION CRITERIA	May 09, 2018	
REQUEST FOR VIEWS OF THE SOLVED EXAMS, digitized	May 09, 2018	May 12, 2018
Post of SOLVED EXAMS on the candidate's portal, after registered application	May 09, 2018	May 15, 2018
SCORE REVISION: Candidate must request score revision	May 09, 2018	May 18, 2018
The Committee will analyse the request for REVISION OF SCORE, WILL communicate the decision to the candidate and issue a NEW VALID SCORE VOUCHER to be made available on their portal	May 09, 2018	May 30, 2018
DISCARDING of the exams in	July 30, 2018	

## CONCERNING THE ORIENTATIONS TO ACCESS THE CANDIDATE PORTAL IN THE EUF PLATFORM

Initially, the candidate must enrol at the website [www.faurgs.ufrgs.br/EUF2018-2.htm](http://www.faurgs.ufrgs.br/EUF2018-2.htm), entering all requested data. The candidate must register a password that will allow access to their Portal.

After completing the registration, access the EUF Platform again and click the **ACCESS** button, available in the upper right corner of the page, entering your LOGIN and PASSWORD data. When entering, the candidates will have access to the proof of registration and all other information that is generated during the course of EUF 2018-2 that concerns them.

If there are technical problems at the time of registration or a posteriori, users should try to use other internet browsers and always enable Pop-Ups.

All information relevant to EUF 2018-2 will be available on the portal and all communication between candidates and EUF Committee should only be done through the EUF PLATFORM.

## CONCERNING GENERAL PROVISIONS

Enrollment in the EUF does not imply that the applicant is automatically enrolled in any of the Graduate Programs associated with the examination. The candidate must register separately in the Postgraduate Programs of the Institutions of their interest. Applications to Programs must be made according to the specific rules of each Institution/Program and within the deadlines required by them. This information will be available on the pages of the Graduate Services of each Institution/Program.