UNIVERSIDADE ESTADUAL DE FEIRA DE SANTANA
Departamento de Física/Observatório Astronômico Antares

PROGRAMA DE PÓS-GRADUAÇÃO EM ASTRONOMIA
MESTRADO PROFISSIONAL

AVALIAÇÃO ESCRITA DE LÍNGUA INGLESA - SELEÇÃO 2016

Nome:____Feira de Santana,___/___/2016

Prezado(a) Candidato(a),

Após a leitura silenciosa do texto, responda em português, com base na sua compreensão, as perguntas apresentadas. É permitida a consulta apenas ao dicionário. Celular, computador, tablete e eletrônicos similares, não serão permitidos e deverão permanecer desligados.

Escreva as respostas apenas nas folhas fornecidas (carimbadas e assinadas pela Comissão da Seleção 2016 do MPAstro). Preencha as mesmas com o seu nome e RG. Use caneta preta ou azul (não use lápis).

Esta avaliação é individual e sem consulta física ou virtual.

Atenciosamente,

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Comissão da Seleção 2016 do MPAstro

LIGO detects gravitational waves
Sung Chang, Physics Today 69(4), 14 (2016)

On 11 February of this year, David Reitze, executive director of the Laser Interferometer Gravitational-Wave Observatory (LIGO) Laboratory stood before a crowd of reporters at the National Press Club in Washington, DC, and declared, “Ladies and gentlemen, we have detected gravitational waves. We did it!” That announcement was the crowning moment in a story that spans more than four decades.

The story opens as the 1960s are winding down. Rainer Weiss, then a young physics professor at MIT, was teaching a course in general relativity. As a classroom exercise, he gave his students a simple thought experiment: Imagine three test masses at the vertices of a right triangle—how would gravitational waves affect light beams that travel along the triangle’s perpendicular sides? A spacetime-distorting gravitational wave would produce a phase difference between the beams. Realizing that advances in lasers could turn his thought experiment into a real one, Weiss wrote up in 1972, in an internal MIT report, his idea for a kilometer scale interferometer and a list of all the possible noise sources he could think of. By 1983 he had teamed up with Ronald Drever and Kip Thorne, both at Caltech, to propose the pair of interferometers that ultimately became LIGO. NSF approved construction of LIGO in 1990, and it took nearly another decade to build the two 4 km instruments, one in Livingston, Louisiana, and the other in Hanford, Washington. (The original Hanford instrument had a second 2 km interferometer.) Along the way, the three-person team of Weiss, Thorne, and Drever evolved into LIGO Laboratory, the joint Caltech–MIT venture that operates the LIGO instruments. In 1997, Barry Barish, the second executive director of LIGO Laboratory, established the LIGO Scientific Collaboration, which today includes more than 1000 scientists from 83 institutions worldwide.

An alternate telling might start 1.3 billion years ago in a far-off region of space roughly in the direction of the Large Magellanic Cloud. A 29 solar mass ($M_\odot$) black hole merged with a 36 $M_\odot$ black hole to form a single 62 $M_\odot$ black hole. The violent union radiated away 3 $M_\odot c^2$ worth of energy as gravitational waves. The waves reached the Livingston detector on 14 September 2015 at 5:51am local time; 7 ms later, they reached the Hanford detector.1 Labeled GW150914, the 0.2-second-long event, confirmed in spectacular fashion Albert Einstein’s prediction that gravitational waves exist.

1ª Questão – De acordo com o texto apresentado, qual foi a atividade de classe proposta por Rainer Wass que evidenciaria os efeitos de uma onda gravitacional?

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2º) Quando foi aprovada, e quando ficou pronta a construção do LIGO?

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3º) A detecção das ondas gravitacionais a partir da coalescência de dois buracos negros foi percebida nos dois interferômetros. Quais eram as massas desses dois buracos negros? Qual foi a energia liberada nessa coalescência em forma de radiação gravitacional?

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2ª Questão – Traduza o texto abaixo extraído da Physics Today 69(4), 14 (2016):

General Relativity

The detection of Gravitational Wave (GW)150914 by LIGO was not the first time gravitational waves have been observed or at least inferred. In 1974 Joseph Taylor Jr and Russell Hulse discovered the first binary pulsar, for which they were awarded the 1993 Nobel Prize in Physics. Measurements of the pulsar's orbital decay gave convincing quantitative evidence that binary neutron stars lose energy to radiated gravitational waves. However, GW150914 was the first direct measurement of gravitational waves. Until then, all tests of general relativity have been in the limit of weak gravitational fields. Gravitational-wave observations enable researchers to test general relativity in the limit of strong gravitational fields and rapidly changing spacetime curvature.