Pubblicata su *Global Junior Challenge* (http://2017.gjc.it)



## Paese, Città/Regione

**Paese:**
Italy
**Città:**
Monselice, Pd, veneto

## Organizzazione

**Nome dell'ente o associazione:**
IIS J.F. KENNEDY MONSELICE
**Contesto dell'ente o dell'associazione che presenta il progetto:**
School
**Specify:**
Progetto laboratorio di Fisica a scuola, lezioni in classe

## Sito Web

http://www.inspiring-science-education.net/showcases/alfonso-dambrosio

## Legge sulla privacy

Consenso al trattamento dei dati personali
**Acconsenti al trattamento dei dati personali?:**
**Autorizzo la FMD al trattamento dei miei dati personali.**

## Tipo di progetto

Educazione fino ai 18 anni

## Descrizione del progetto

**Description Frase (max. 500 characters):**

In order to introduce how the movement of an object requires a net force to be acting on it and

objects can affect other objects at a distance, we decided to investigate mathematically or experimentally undergoing to Kepler laws. We can explain our data in a Newtonian Gravitational model, but on a curved space we have new astronomical phenomena (as light deflection, gravitational waves)and we have introduce a new Gravitation Model, General Relativity. we used ambiental sensor gyroscope smartphone to map curved space and video analysis software to edit frame by frame the trajectory bodies using Tracker software and vidanalys and videoediting on Android and Iosdevices

**Project Summary (max. 2000 characters):**

Students engaged gravity force exploring the planet movements managing Apps [Ref.1] on own Smartphone/Tablet . We woked with mixed class of from 16 to 18 years old. We encourage to use daily own device to search informations, collect data, explore science. Using the simulation software Celestia, we calculated the orbit radius and the orbital period of 7 Jupiter satellites . ?How can we sure that really the planet motions are due to a force?? ?we can see the elastic force, the magnetic force, but how can we ?feel? gravitational force? ?. Newtonian gravity model doesn?t explain what is the cause of this force. So we decided to investigate the third Kepler law in another way. General Relativity gives us a great effort to have a new vision of mechanics. In this model gravity is NOT a force, but it can be described as a curvature of space and time (a whole 4 dimensional space-time). A new engagement starts now! We founded many amazing videos of particle motions on a warped space [Ref.4]. We realized a Spandex Universe, which is used in many educational settings to demonstrate various astronomical effects. We created a Spandex universe on a circular structure of 170cm diameter. A webcam recorded particle trajectories , the video analysis was made using the software Tracker [Ref.5]. When we put an heavy mass on Spandex, a coin falls down in quasi circular orbit , because of curvature caused by heavy mass and not as an attraction by the heavy mass. We experimented tidal forces (fig.11 ), double star, satellites formation (fig.12), gravitational waves. When we put an heavy mass on Spandex, using gyroscope App in our Smartphone, we can register on our smartphone, a curvature ?vibration?, due to mechanical elasticity texture force, this perturbation is like a gravitational (mechanical) wave. It was exciting to see how this simple model can explain many complex physical phenomena. They are a qualitatively devices, but in the future we want to elaborate it with new data set. In our Spandex model the gravity is caused by space curvature . If we live in a Spandex Universe, a straight line for us may be a curved line for another observer A zero mass trajectory deflection (like light) is caused by an intrinsic curvature Planet motion may be explained as geometry curvature of space, the space distortion is caused by masses and influenced particles motions; gravity is described as the warping of space due to the presence of matter and energy. Our data match with third Kepler law, introducing a covariant space measurement. Our results are satisfactory because we can explain a great variety of phenomena such as light deflection, tidal force, satellites formation, gravitational waves. Bibliography [1] https://play.google.com/store/apps/details?id=com.tss.android [1] https://play.google.com/store/apps/details?id=jp.danball.planet [2] https://play.google.com/store/apps/details?id=com.rts.android.spacesim [3] [2] http://imagej.nih.gov/ij/ [4] [3] http://en.wikipedia.org/wiki/Jupiter_mass [5] [4] https://www.youtube.com/watch?v=RqVKIxqIorg [6] https://www.youtube.com/watch?v=ZkURrrACG0g [7] https://www.youtube.com/watch?v=CvN13ZE544M&list=PL2nSpVcaaKQT_qiNgEuUxD... [8] [5] http://www.cabrillo.edu/~dbrown/tracker [9] [6] Middleton, C., Langston,M., Circular orbits on a warped spandex fabric, Am. J. Phys. 82, 287 , 2014 [7] http://www.einstein-online.info/spotlights/light_deflection [10]

## Da quando è funzionante il vostro progetto?

2014-09-29 22:00:00

## Obiettivi ed elementi di innovazione

Share and collect data on own mobile device Realize an experimental setup Work in group Analyze experimental data Build a reasonable physical model Introduce the Big Idea in Science of Gravity Use smartphone and tablet in our daily experimental activity

The link on newspapers

http://dida.orizzontescuola.it/news/il-successo-della-didattica-della-fi... [11]

http://www.professionistiscuola.it/didattic/1526-metodologia-ibse-un-app... [12]

http://ilgazzettino.it/PAY/PADOVA_PAY/200_professore_di_fisica_all_istit... [13]

## Risultati

**Describe the results achieved by your project How do you measure (parameters) these. (max. 2000 characters):**
We chose a project in accordance with the physics curriculum in our country. Specific knowledge has been required during the project. It covered celestial orbits, Kepler’s and Newton’s laws, time and space relativity, gravitational forces, elasticity force, General Relativity, tidal force, gravitational waves and gravitational lensing. At fist the approach intimidated the students, but after the objective to build an own real experiment , they became more enthusiastic and even took initiatives, such as the Facebook Group “Fisica laboratorio povero Kennedy” or virtual classroom in Edmodo, Skype talking, video analysis. The data analysis was the main difficulty (we have 4 hours of particle trajectories), but it was fantastic to explore , with our model, many new phenomena, also mathematically. Our project is quite original, because we haven’t seen an experimental and quantitative approach to General Relativity. By our Spandex Universe we can study the measure problem in Physics and have a new vision of Gravitation. We won the nation second Place year light in Italy
http://scienzapertutti.lnf.infn.it/index.php?option=com_content&view=article&id=891&Item
teacher was one of the top finalist for didactical methodology in European project Science on Stage in June 2015, london The video of the whole project is on
https://www.youtube.com/watch?v=I_uYYEADt-w
**How many users interact with your project monthly and what are the preferred forms of interaction? (max. 500 characters):**

Students were 20. The project was shown in Congress and a School in Tourin In May and June

## Sostenibilità

**What is the full duration of your project (from beginning to end)?:**
Meno di 1 anno
**What is the approximate total budget for your project (in Euro)?:**
Meno di 10.000 Euro
**What is the source of funding for your project?:**
Finanziamenti pubblici o privati
**Note eventuali:**
www.iiskennedy.it

**Il progetto è economicamente autosufficiente?:**
No
**Since when?:**
2015-06-29 22:00:00
**When is it expected to become self-sufficient?:**
2015-12-30 23:00:00

## Trasferibilità

**Has your project been replicated/adapted elsewhere?:**
Sì
**Where? By whom?:**
Using Skype in a School in Tortona
**What lessons can others learn from your project? (max. 1500 characters):**

TO realize a whole physical model of gravity (general relativity) Using guroscope sensor smartphone to map a curved space To improve ideas on spacetime To collect, share and analyze data using videoediting an own device software

**Are you available to help others to start or work on similar projects?:**
Sì

## Informazioni aggiuntive

**Future plans and wish list (max. 750 characters):**
To realize a School kit of our Spandex Universe
video editing [14] physics [15] light deflection [16] gyroscope smartphone sensor [17] gravitational waves [18] General Relativity [19]



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**URL di origine:** http://2017.gjc.it/it/progetti/ibse-inquiry-based-science-education-approach-general-relativity

**Collegamenti**
[1] https://play.google.com/store/apps/details?id=com.tss.android
[2] https://play.google.com/store/apps/details?id=jp.danball.planet
[3] https://play.google.com/store/apps/details?id=com.rts.android.spacesim
[4] http://imagej.nih.gov/ij/
[5] http://en.wikipedia.org/wiki/Jupiter_mass
[6] https://www.youtube.com/watch?v=RqVKIxqIorg
[7] https://www.youtube.com/watch?v=ZkURrrACG0g
[8] https://www.youtube.com/watch?v=CvN13ZE544M&list=PL2nSpVcaaKQT_qiNgEuUxDzIKroDGQOU0
[9] http://www.cabrillo.edu/~dbrown/tracker
[10] http://www.einstein-online.info/spotlights/light_deflection

[11] http://dida.orizzontescuola.it/news/il-successo-della-didattica-della-fisica-mediante-l%E2%80%99approccio-ibse
[12] http://www.professionistiscuola.it/didattic/1526-metodologia-ibse-un-approccio-vincente-per-appassionare-gli-studenti-alla-scienza.html
[13] http://ilgazzettino.it/PAY/PADOVA_PAY/200_professore_di_fisica_all_istituto_kennedy_di_monselice_l_unico_docer
[14] http://2017.gjc.it/it/category/keywords-separate-with-commas/video-editing
[15] http://2017.gjc.it/it/category/keywords-separate-with-commas/physics
[16] http://2017.gjc.it/it/category/keywords-separate-with-commas/light-deflection
[17] http://2017.gjc.it/it/category/keywords-separate-with-commas/gyroscope-smartphone-sensor
[18] http://2017.gjc.it/it/category/keywords-separate-with-commas/gravitational-waves
[19] http://2017.gjc.it/it/category/keywords-separate-with-commas/general-relativity