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# Smartphone e tablet per la simulazione e la visualizzazione dei fenomeni fisici

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# Smartphone e tablet per la simulazione e la visualizzazione dei fenomeni fisici (Indice)

- I. Simulazioni e visualizzazioni
- II. Scale di colori e daltonismo
- III. App utili
- IV. Esempio: Hydrogen!
- V. Sviluppare le proprie app



I.

# Simulazioni e visualizzazioni

# App – perché usarle?

Avete già visto il potenziale in laboratorio (sensoristica)

Aumenta l'attenzione e la motivazione

Tutti hanno sempre con sé uno smartphone (e sono contenti di imparare ad usarlo meglio)

Migliori dei video (interazione, non spettatori passivi)

# Simulazioni vs. Visualizzazioni

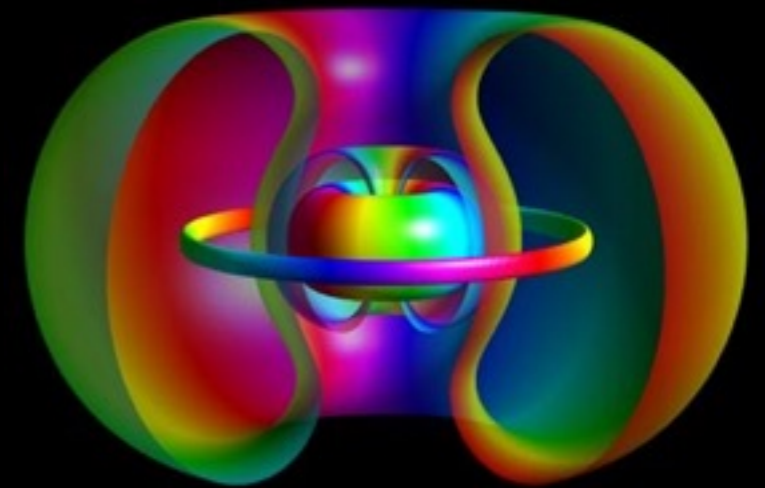
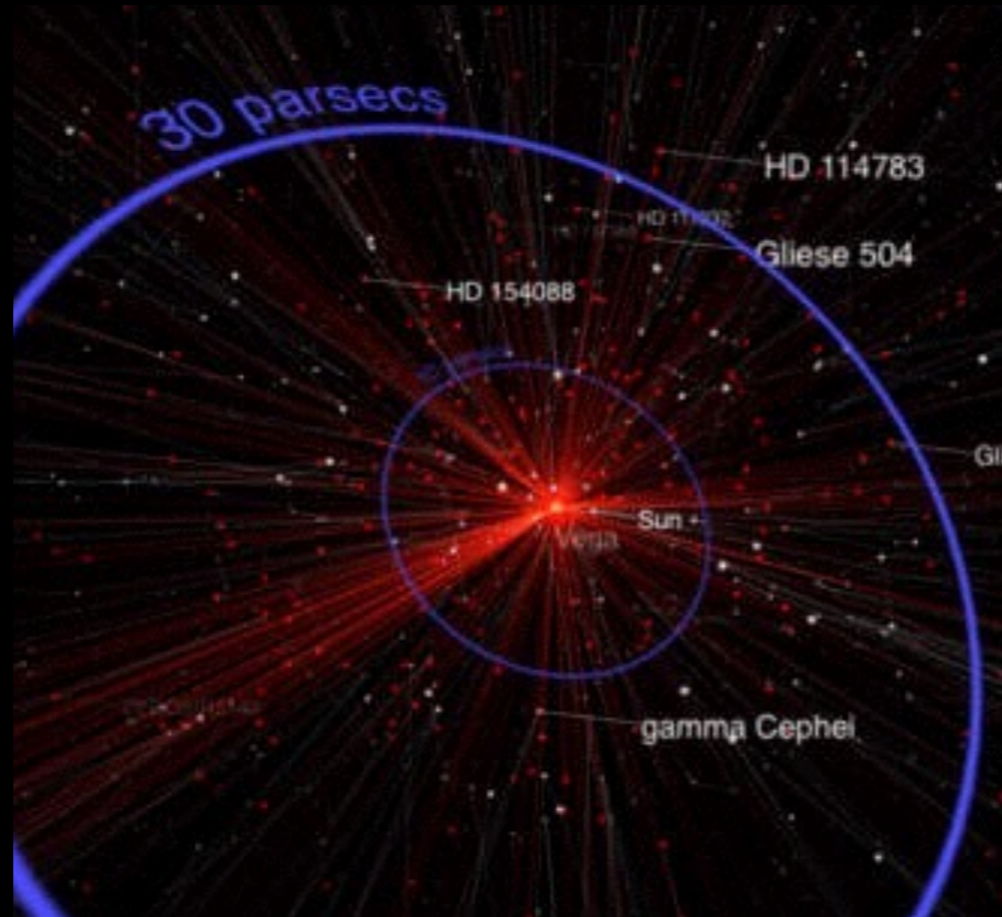
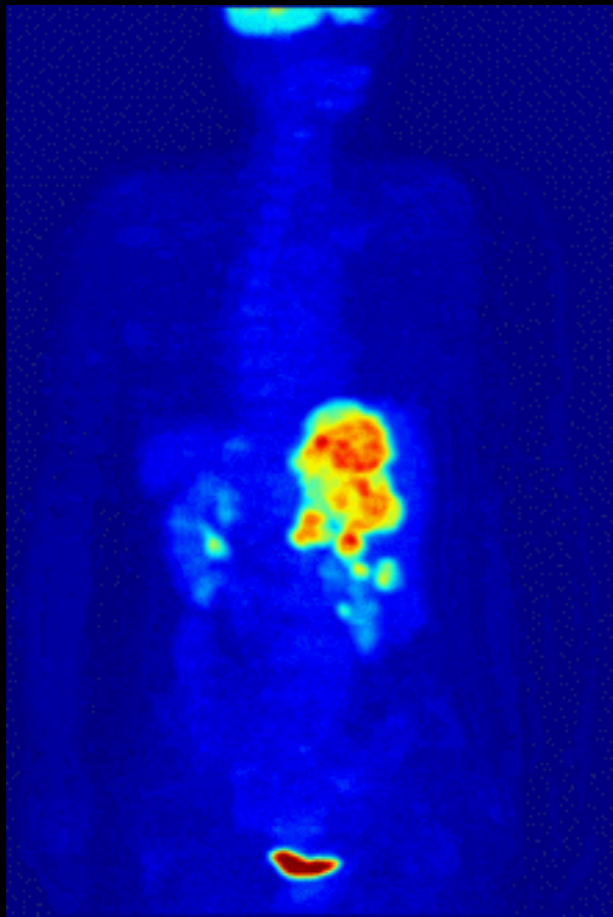
A volte si fa confusione tra i due termini, spesso si usa il termine “simulazione” riferendosi impropriamente ad una “visualizzazione”.

Una **simulazione** è l’imitazione di un certo processo o di un sistema del mondo reale.

Una **visualizzazione** può invece riferirsi non solo a dei dati simulati, ma anche misurati, o ad oggetti matematici etc...

**Non tutte le visualizzazioni derivano da simulazioni e non tutte le simulazioni sono visualizzate.**

# Queste non sono simulazioni!



# Condivisione dei dati & Database

# Condivisione dei dati

Un punto chiave della ricerca scientifica è la condivisione dei dati.

I dati devono essere salvati in formati che anche altri possono aprire e leggere (es: CSV, XML, JSON, ...).

Necessità di creare dei database per la conservazione e la condivisione dei dati.



# Database

Ci sono alcuni esempi bellissimi di **open database** disponibili online, che sono alla base di molte app di successo.

## Esempio 1: Astronomia

- I cataloghi *Hipparcos* e *Tycho* basati su lanci satellitari da parte della European Space Agency (ESA)
- “*The HYG database (v3.0)* is a compilation of interesting (...) stellar data from a variety of catalogs. It is useful for background information on all sorts of data: star names, positions, brightnesses, distances, and spectrum information”.

Da: <http://www.astronexus.com/hyg>



# Database

“**VizieR** provides access to the most complete library of published astronomical catalogues and data tables available on line organized in a self-documented database.”

<http://vizier.u-strasbg.fr>



**Find catalogs among 14436 available**

Clear  Find...

Expand search

? *Catalog, author's name, word(s) from title, description, etc. e.g.: AGN, Veron, I/239, or bibcodes...*

► **Search for catalogs by column descriptions (UCD)** ?

► **Search for catalogs containing additional data**

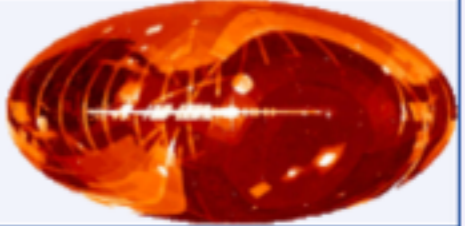
Wavelength	Mission	Astronomy
Radio	AKARI	Abundances
IR	ANS	Ages
optical	ASCA	AGN
UV	BeppoSAX	Associations
EUV	CGRO	Atomic_Data
X-ray	Chandra	Binaries:cataclysmic
Gamma-ray	COBE	Binaries:eclipsing

**Search by Position across 15587 tables**

Target Name (resolved by [Sesame](#)) or Position:

Clear  J2000  2 arcmin  Go!

Radius  Box size

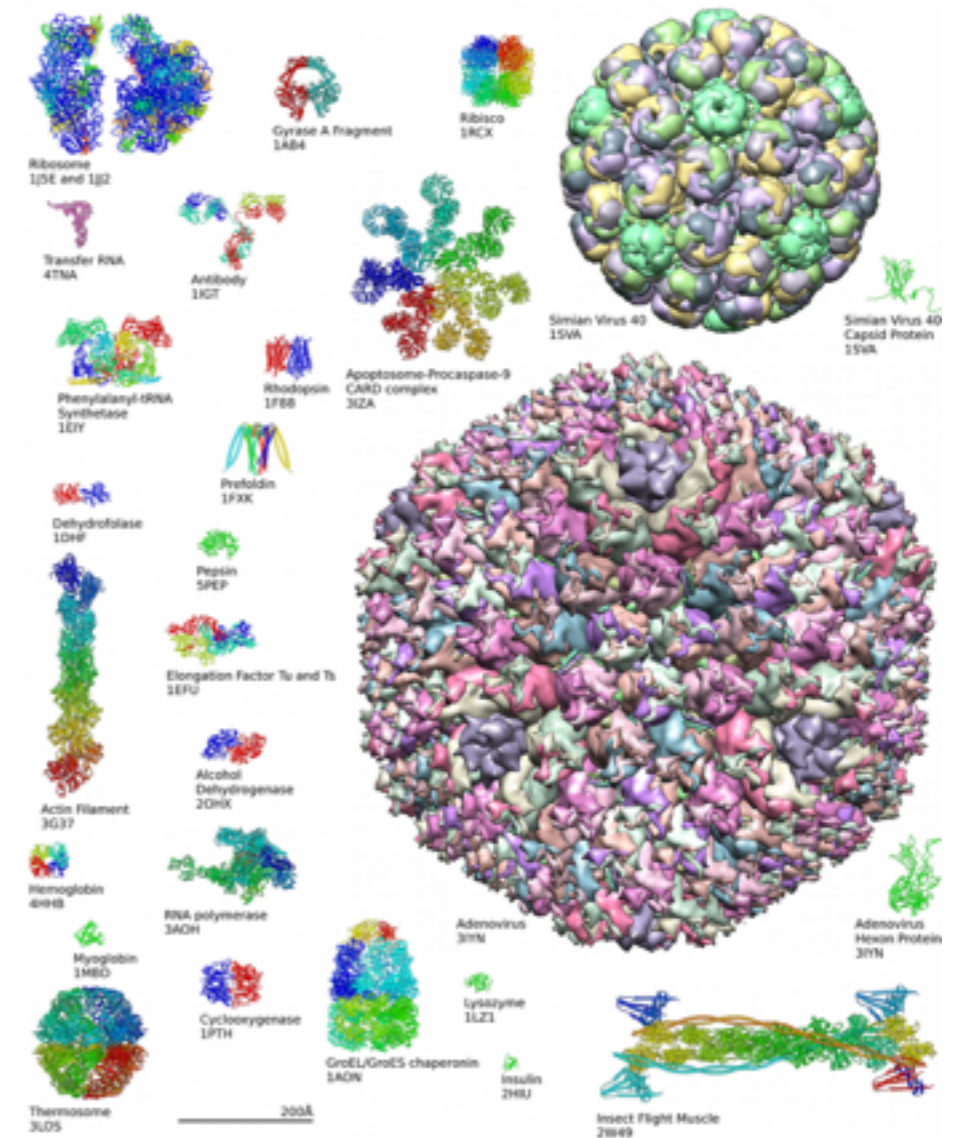


[More about VizieR](#)

# Database

## Esempio 2: Molecole

- Protein Data Bank: “crystallographic database for the three-dimensional structural data of large biological molecules, such as proteins and nucleic acids.”
- PubChem: “provides information on the biological activities of small molecules”



# PubChem



BioAssay ?



Compound ?



Substance ?

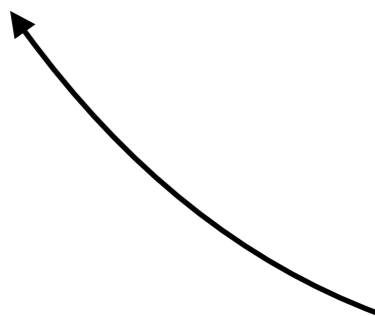
water



Go

Limits  
Advanced

**water**



Inserire nome della molecola, composto, ...

# 3D Conformer

Tutti i dati riguardanti la struttura 3D della molecola cercata sono scaricabili in un semplice file.

## 2 3D Conformer

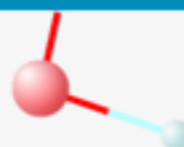


Search

Download

Get Image

SDF	Save	Display
JSON	Save	Display
XML	Save	Display
ASN.1	Save	Display



Magnify

# XML DATA

```
<?xml version="1.0"?>
<PC-Compounds
  xmlns="http://www.ncbi.nlm.nih.gov"
  xmlns:xs="http://www.w3.org/2001/XMLSchema-instance"
  xs:schemaLocation="http://www.ncbi.nlm.nih.gov ftp://ftp.ncbi.nlm.nih.gov/pubchem/specifications/pubchem.xsd"
>
  <PC-Compound>
    <PC-Compound_id>
      <PC-CompoundType>
        <PC-CompoundType_id>
          <PC-CompoundType_id_cid>962</PC-CompoundType_id_cid>
        </PC-CompoundType_id>
      </PC-CompoundType>
    </PC-Compound_id>
    <PC-Compound_atoms>
      <PC-Atoms>
        <PC-Atoms_aid>
          <PC-Atoms_aid_E>1</PC-Atoms_aid_E>
          <PC-Atoms_aid_E>2</PC-Atoms_aid_E>
          <PC-Atoms_aid_E>3</PC-Atoms_aid_E>
        </PC-Atoms_aid>
        <PC-Atoms_element>
          <PC-Element value="o">8</PC-Element>
          <PC-Element value="h">1</PC-Element>
          <PC-Element value="h">1</PC-Element>
        </PC-Atoms_element>
      </PC-Atoms>
    </PC-Compound_atoms>
  </PC-Compound>
</PC-Compounds>
```

3 atomi:  
Oxigen ("o"), Hydrogen ("h"), Hydrogen

↑  
↓  
8

↑  
↓  
1

↑  
↓  
1



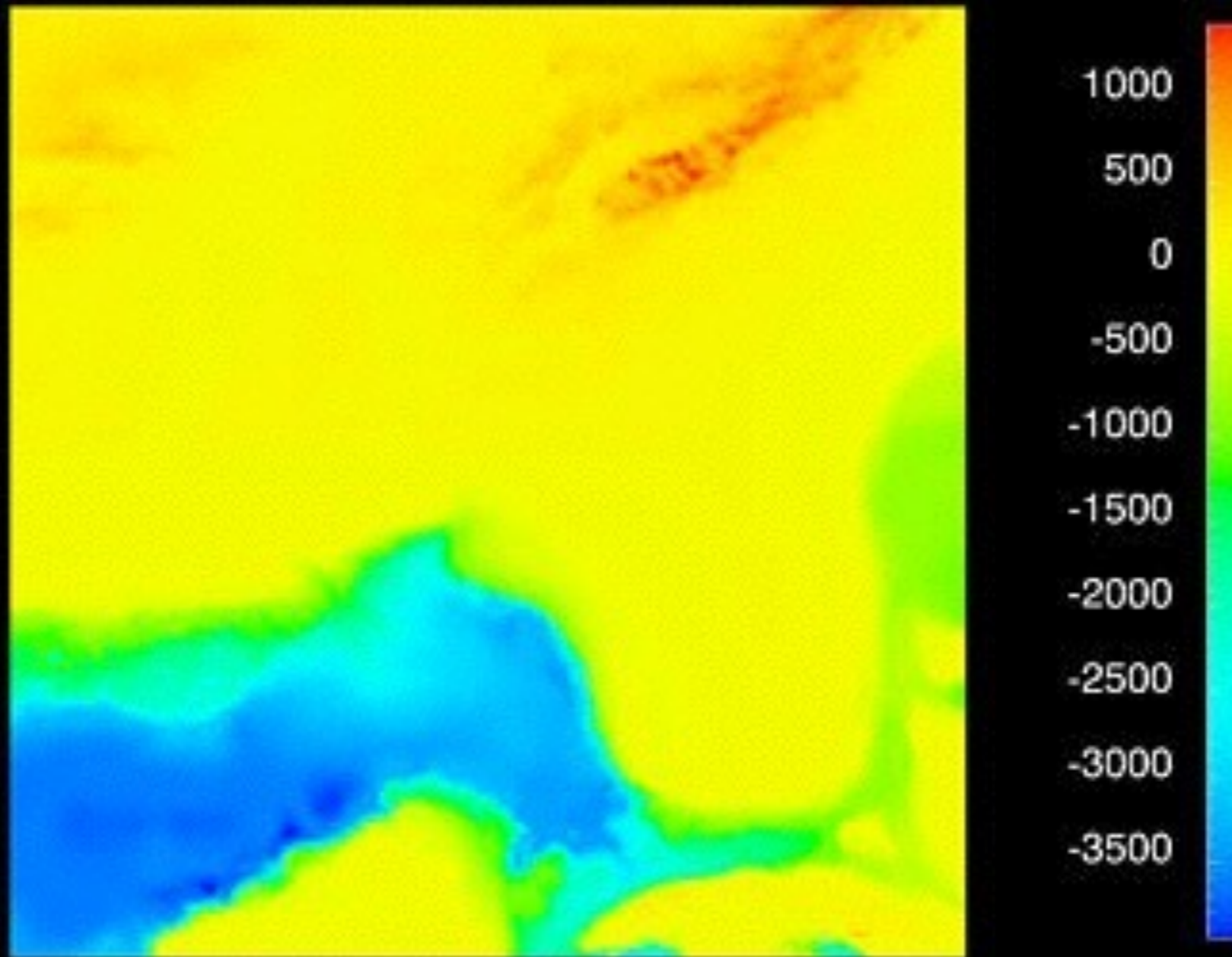
II.

Scale di colore e  
daltonismo

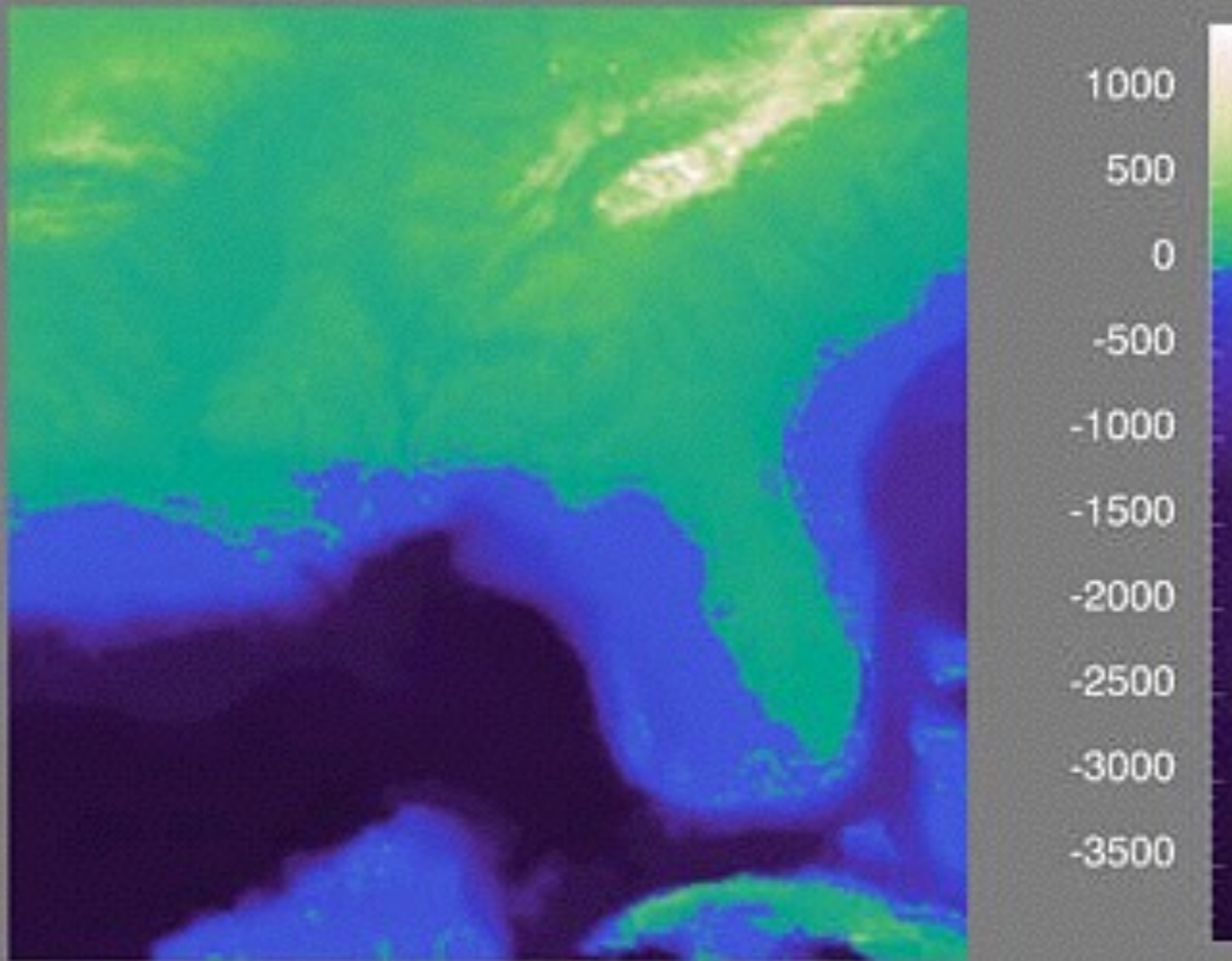
Scale di colore



# Cosa vedete?

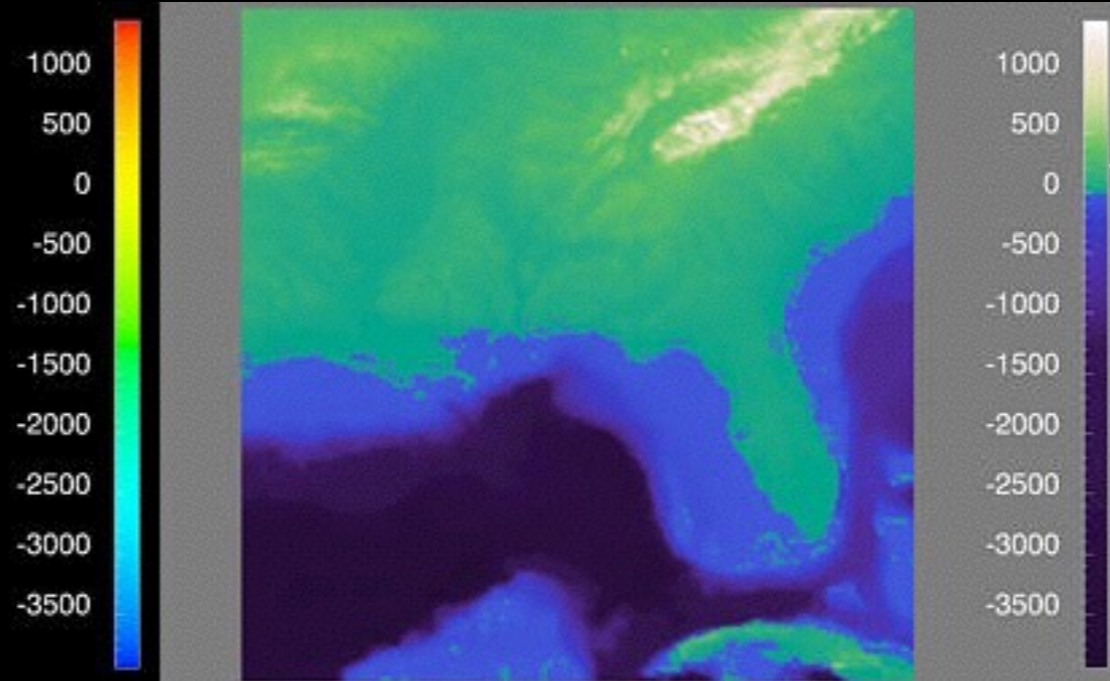
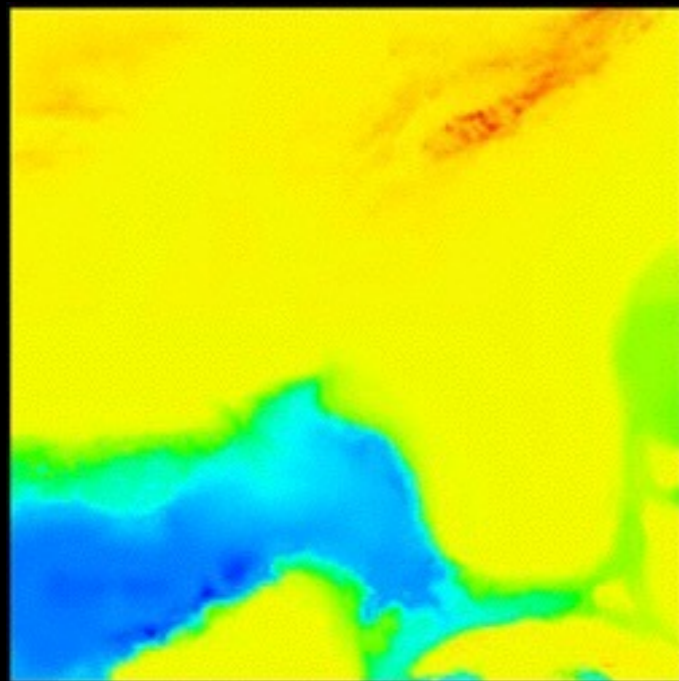


# Cosa vedete?



# Cosa vedete?

Nasconde importanti informazioni anziché metterle in risalto



0 è un valore chiave:  
alto contrasto  
in questo punto

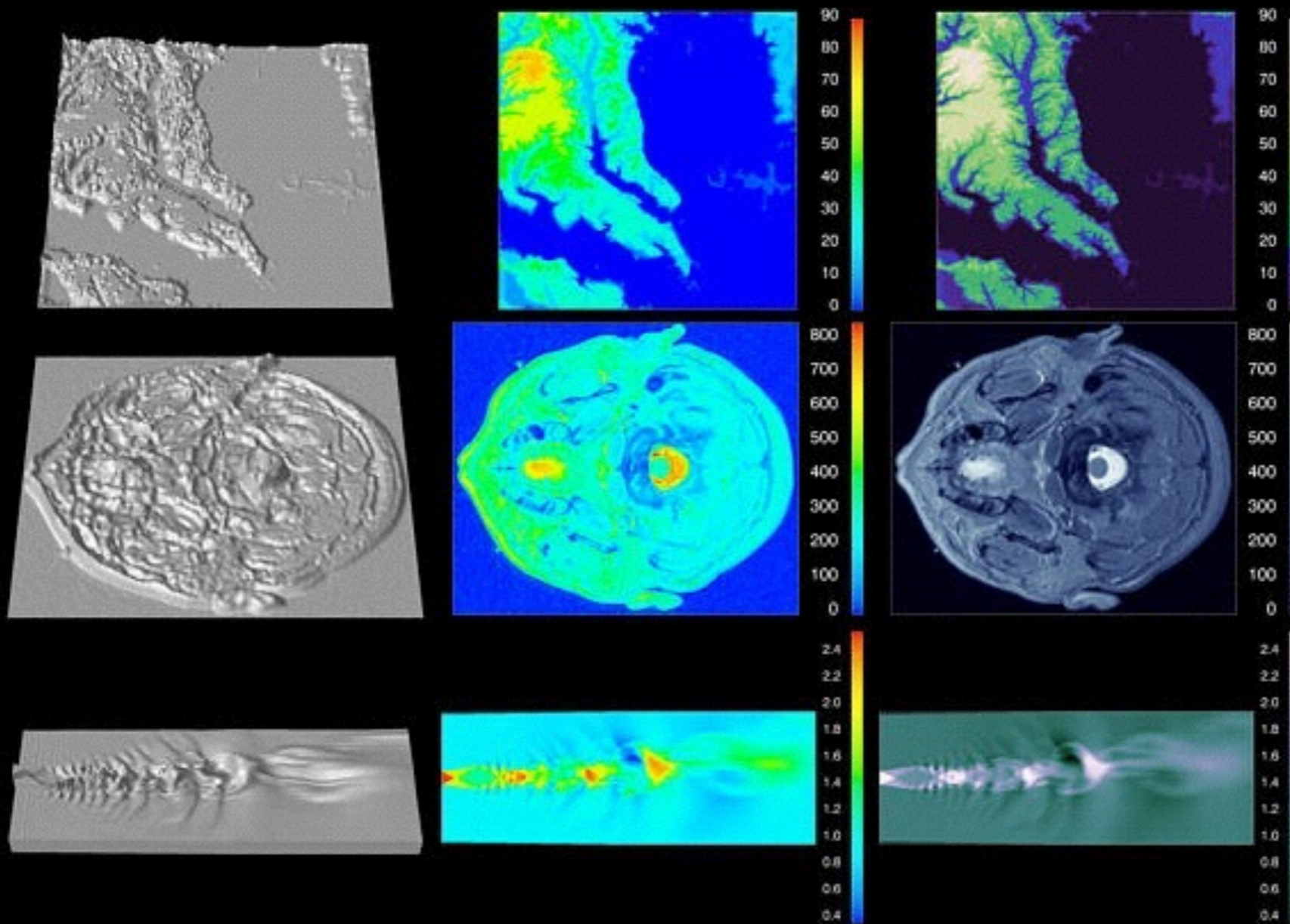
Due scale di colore distinte tra valori  
positivi e negativi

# Scale di colore

Pseudo-3D

Rainbow

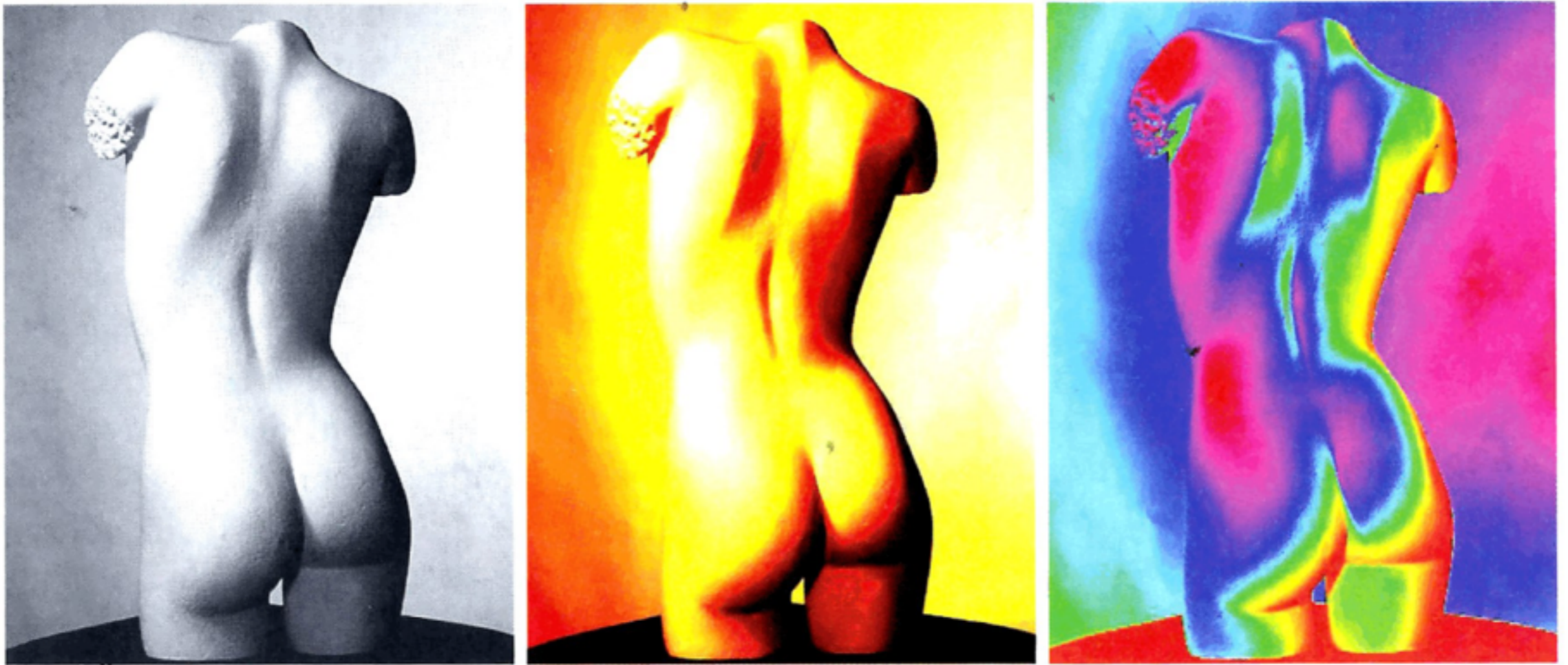
Custom



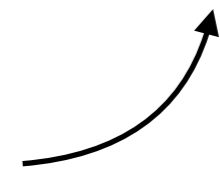
# Termocamera (scala di colore *Rainbow*)



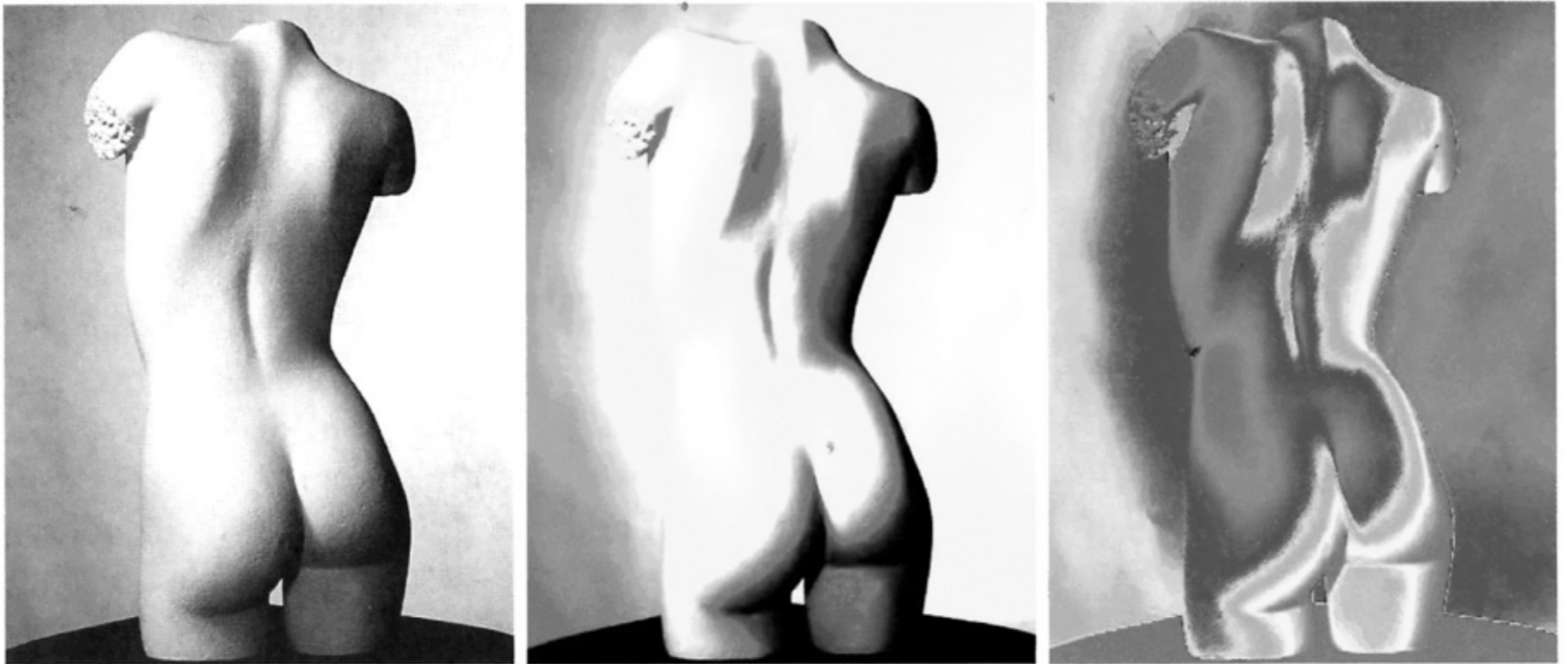
# Rainbow



Innaturale, contro-intuitiva



# Versione desaturata

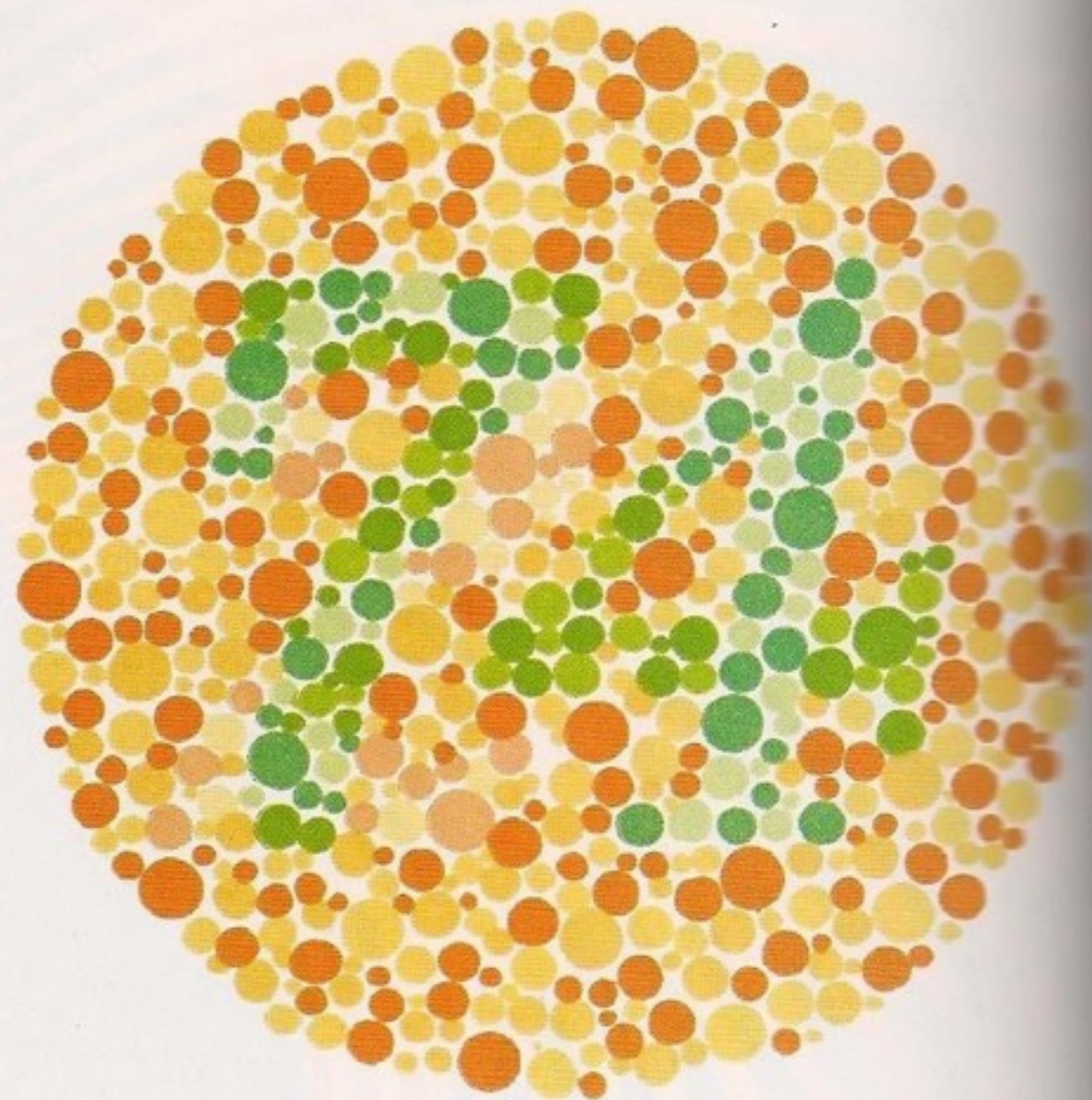
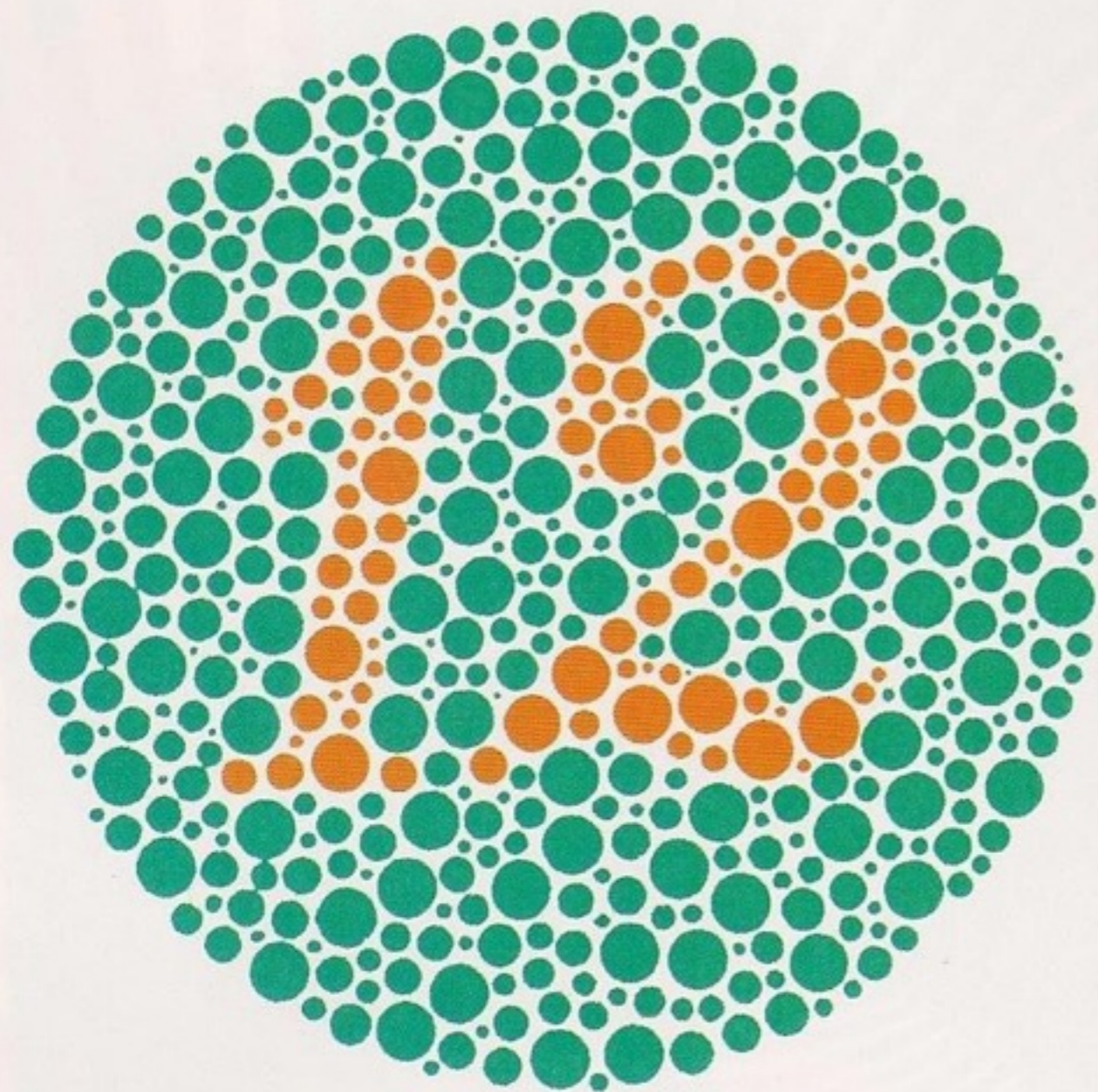


Luminosità che cambia quasi casualmente:  
male perché intuitivamente associata a  
modulo e rilevanza di un dato

# Daltonismo



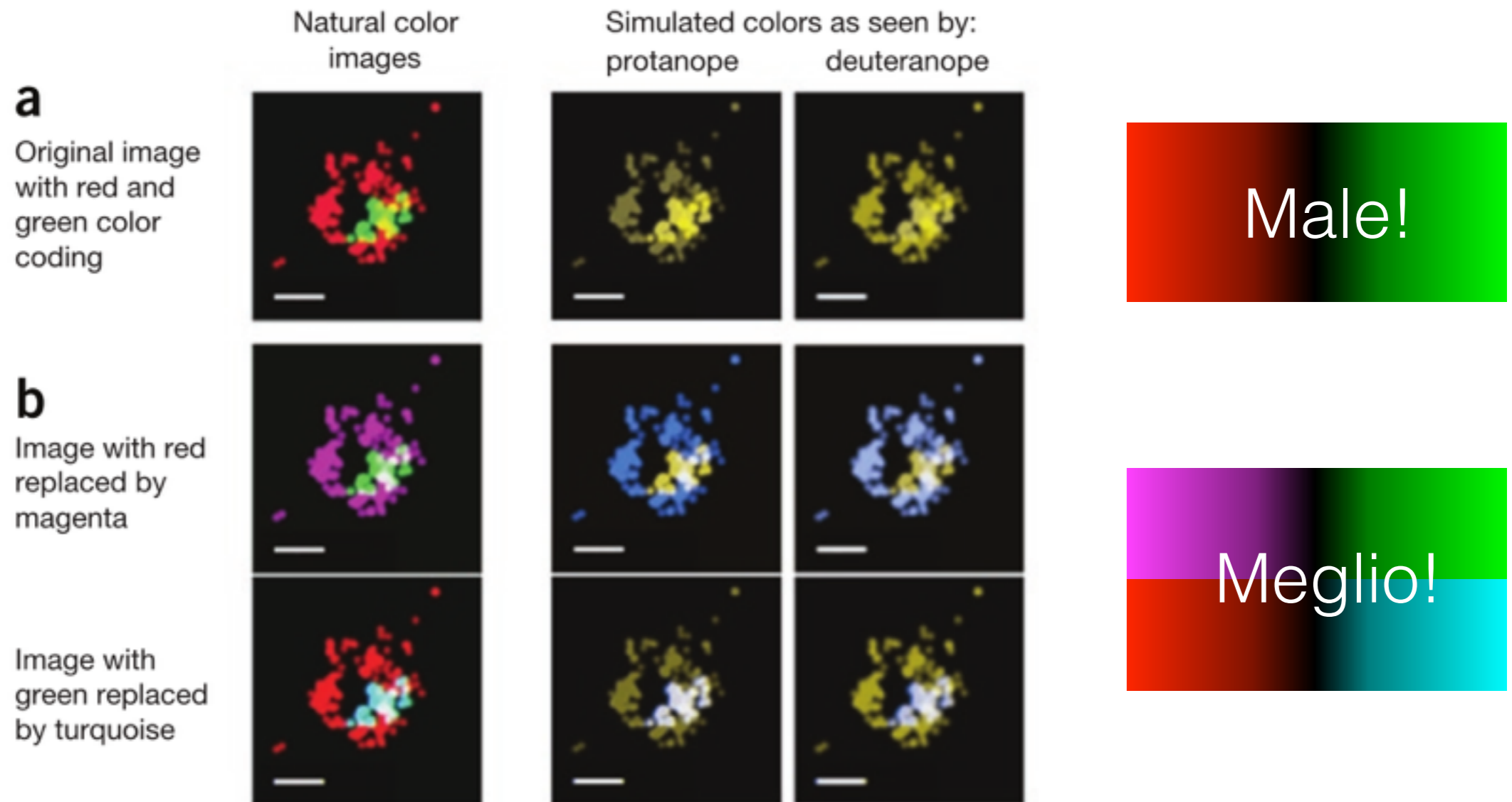
# Daltonismo



# Daltonismo

- Vari tipi: le forme più comuni sono la *protanopia* e la *deuteranopia* (l'assenza di fotorecettori del rosso e del verde, rispettivamente)
- 8% tra uomini e 0.5% tra donne (per individui con antenati nord europei)
- La scala di colori Rosso–Verde è molto comune: è una buona scelta rispetto alle persone daltoniche?

# Daltonismo



Sia la scala di colore **Magenta–Verde** che quella **Rosso–Ciano** sono molto migliori della comune scala **Rosso–Verde**

# Simulatore di Daltonismo

<http://www.color-blindness.com/>

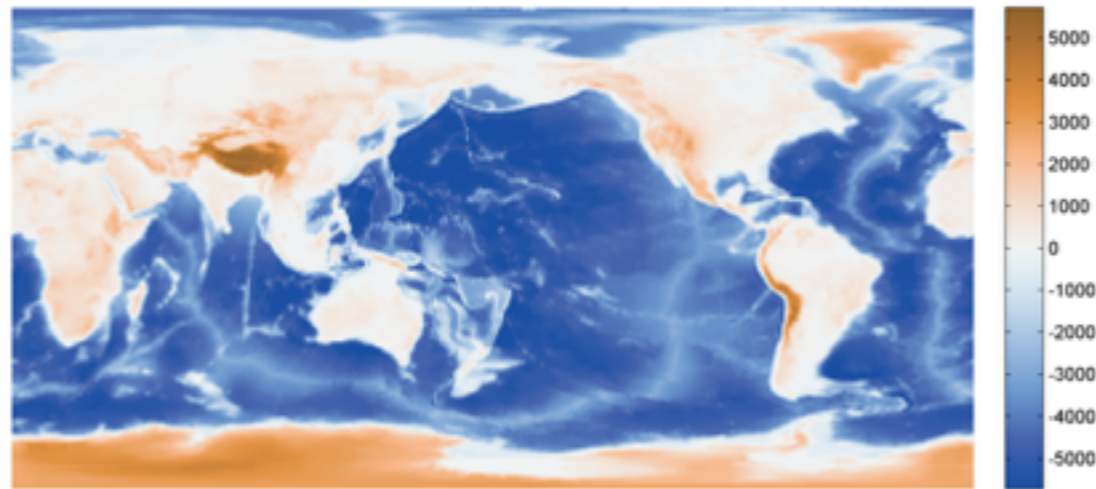


The screenshot shows the Colblindor website interface. At the top, there is a navigation menu with links for Home, CVD Essentials, Color Blindness Tests, Color Tools, and Contact. The 'Color Tools' dropdown menu is open, showing 'CVD Simulator' and 'Color Name & Hue'. The main heading is 'Coblis — Color Blindness Simulator'. Below the heading, there is a search bar and a 'Subscribe to News by Email' form. The simulator interface includes an image upload section with a 'select' button and an 'Upload Image' button. The image being simulated is 'symmetric.png', which is a world map. A color palette is visible on the right side of the simulator. Below the simulator, there is a list of color vision deficiency options: Normal Color Vision, Red-Blind/Protanopia, Green-Blind/Deuteranopia, Blue-Blind/Tritanopia (selected), Red-Weak/Protanomaly, Green-Weak/Deuteranomaly, Blue-Weak/Tritanomaly, Monochromacy/Achromatopsia, and Blue Cone Monochromacy. There is also a 'FREE Color Blind Check' section with a 'New kind of color blindness test! Try Color Blind Check and test type and severity of your color...' text and a small image of a color test.

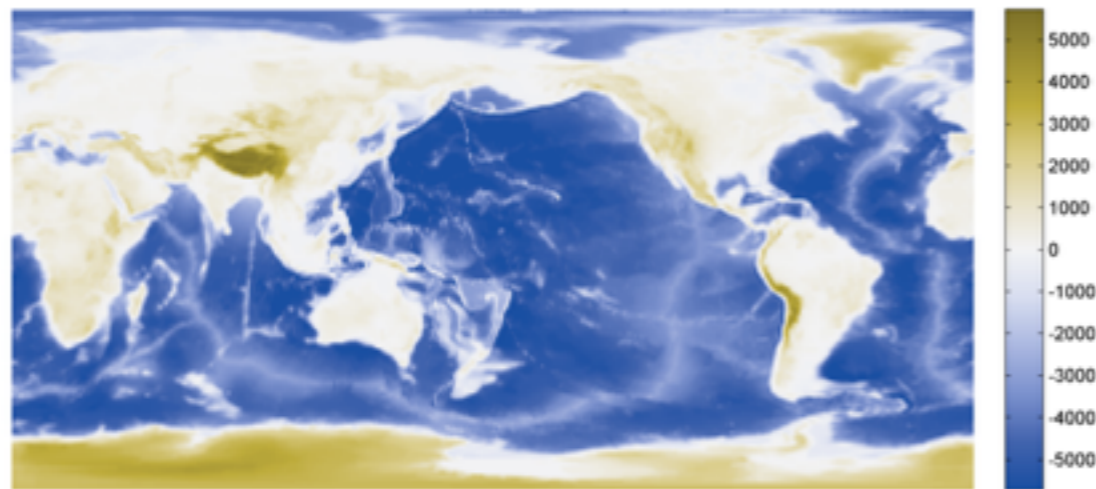
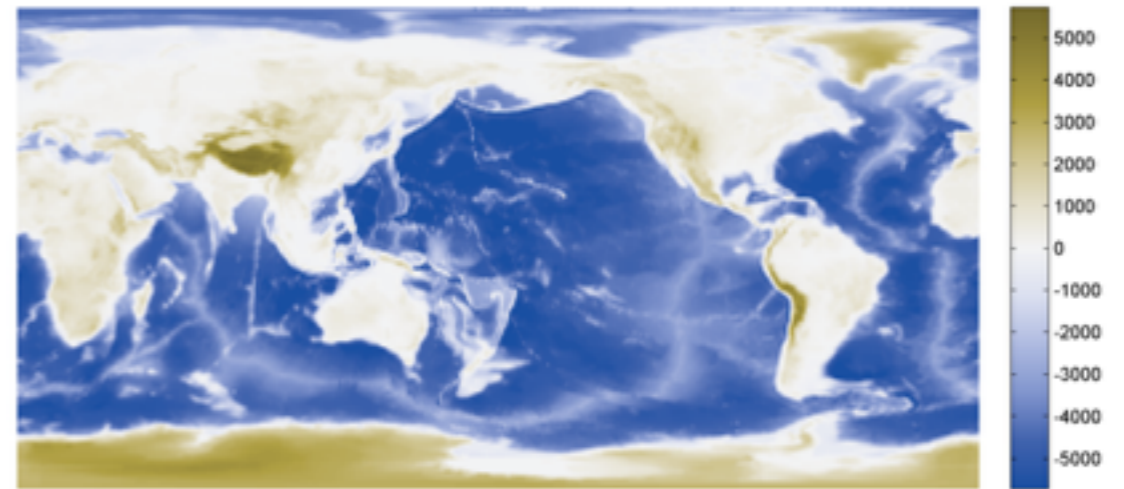
Ulteriori risorse: [www.vischeck.com](http://www.vischeck.com)

# Simulazioni di Daltonismo

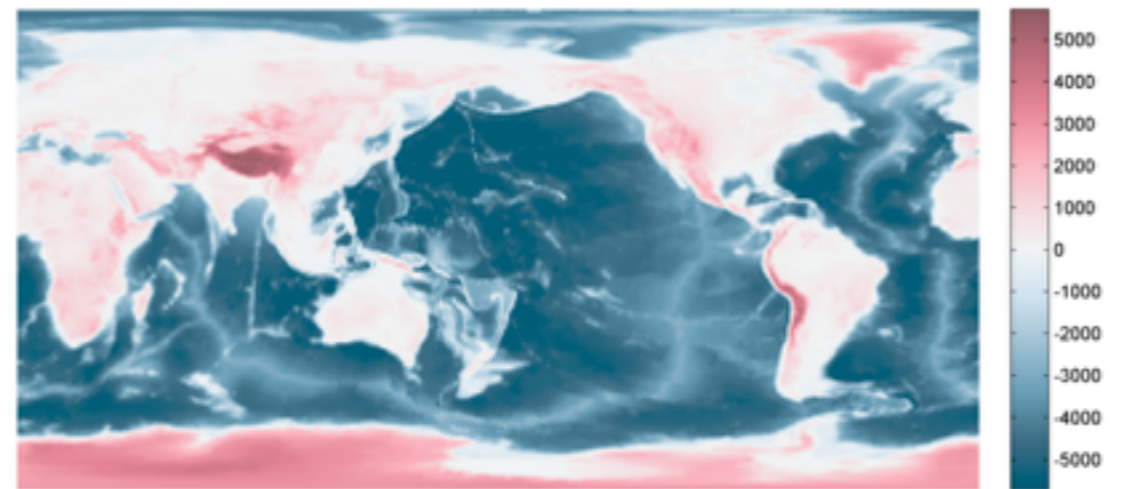
Scala di colore ben scelta



Protanope simulation



Deuteranope simulation



Tritanope simulation

# Cosa posso fare se non posso scegliere la scala di colori dei dati?

Potrebbe comunque essere possibile risolvere il problema con dei semplici passaggi di modifica delle immagini

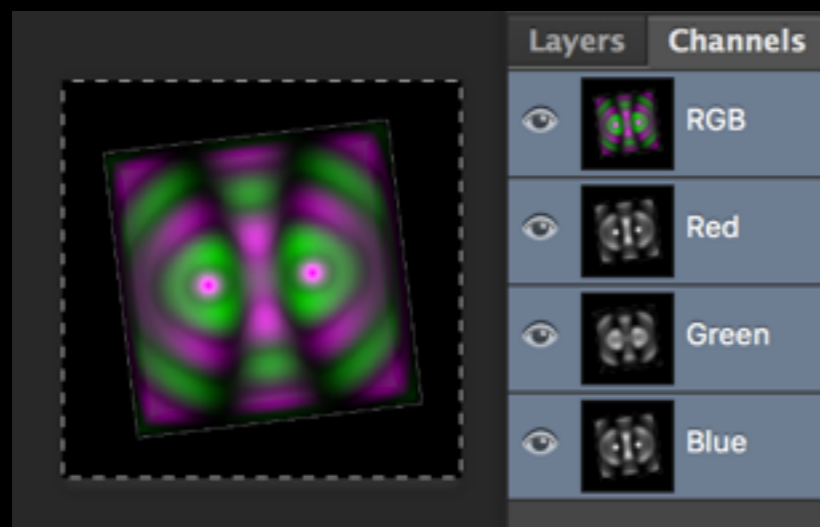
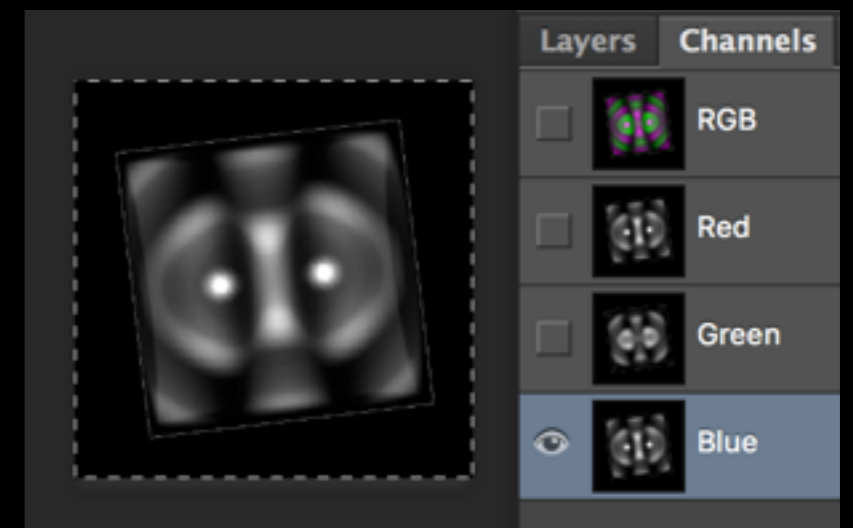
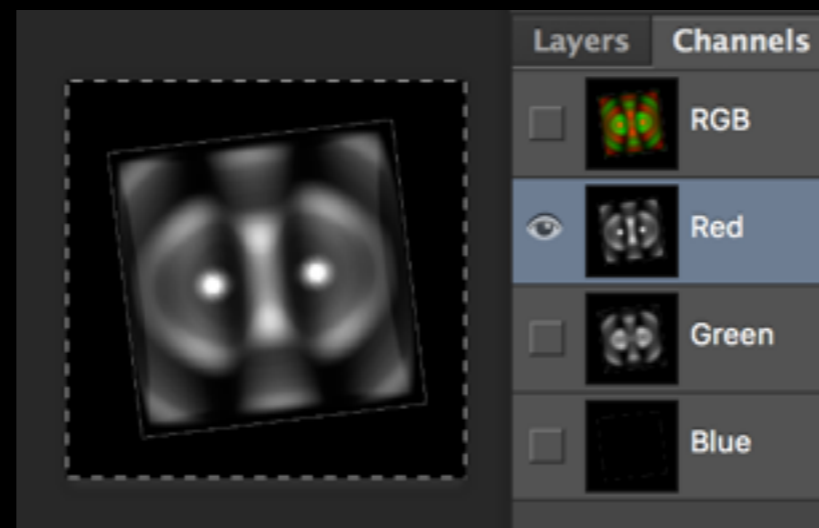
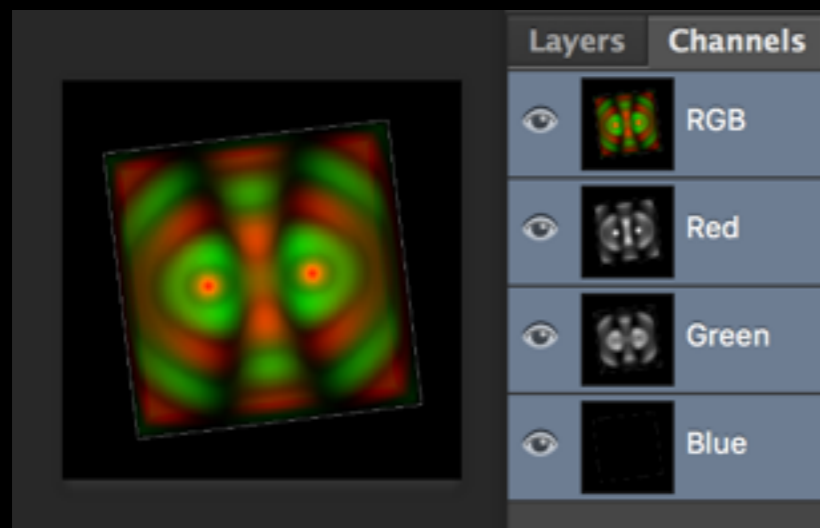


# Esempio in Photoshop

Cliccare “Channels”, Seleziona > Tutto,  
poi “Red”

Copia

Cliccare “Blue”,  
Incolla



Cliccare “RGB” per vedere l’immagine  
Magenta–Verde risultante  
(Copiare il canale verde per ottenere  
invece un’immagine Rosso–Ciano)

Fatto!

# Farlo in MatLab

Editor - /Users/micron/MATLAB/Scientific Visualization/Color Blindness/ChannelMixer.m

Dipole.m ChannelMixer.m +

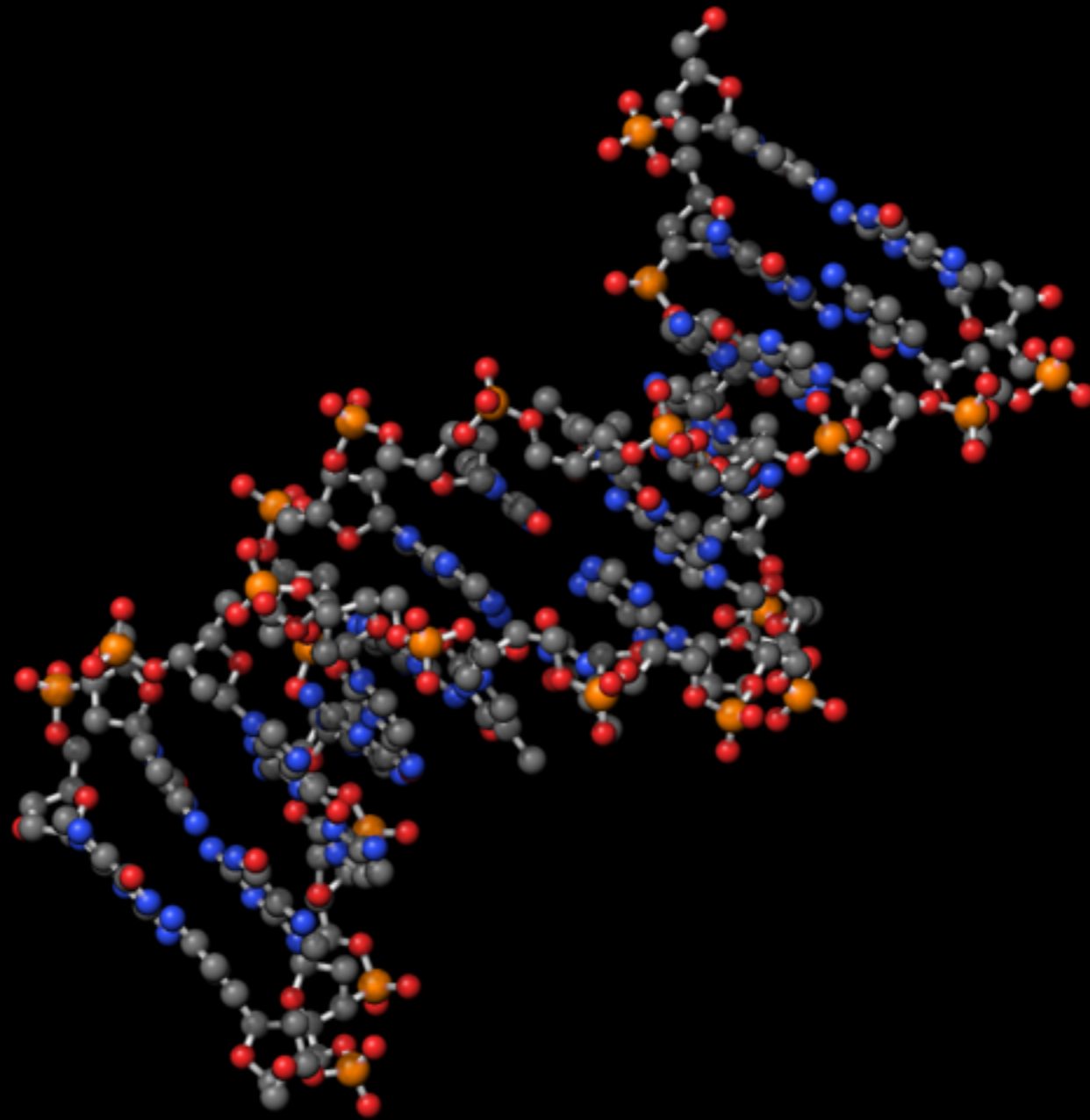
```
1 - I = imread('Falstad RG.png');
2
3 - R = I(:,:,1);% Red-Channel Matrix
4 - G = I(:,:,2);% Green-Channel Matrix
5 - B = I(:,:,3);% Blue-Channel Matrix
6
7 % Create image with Blue-Channel equal the Red-Channel...
8 % (result: Magenta-Green image)
9 - img = cat(3, R, G, R);
10
11 % ...or: create image with Blue-Channel equal the Red-Channel (uncomment)
12 % (result: Red-Cyan image)
13 % img = cat(3, R, G, G);
14
15 - image(img);
```



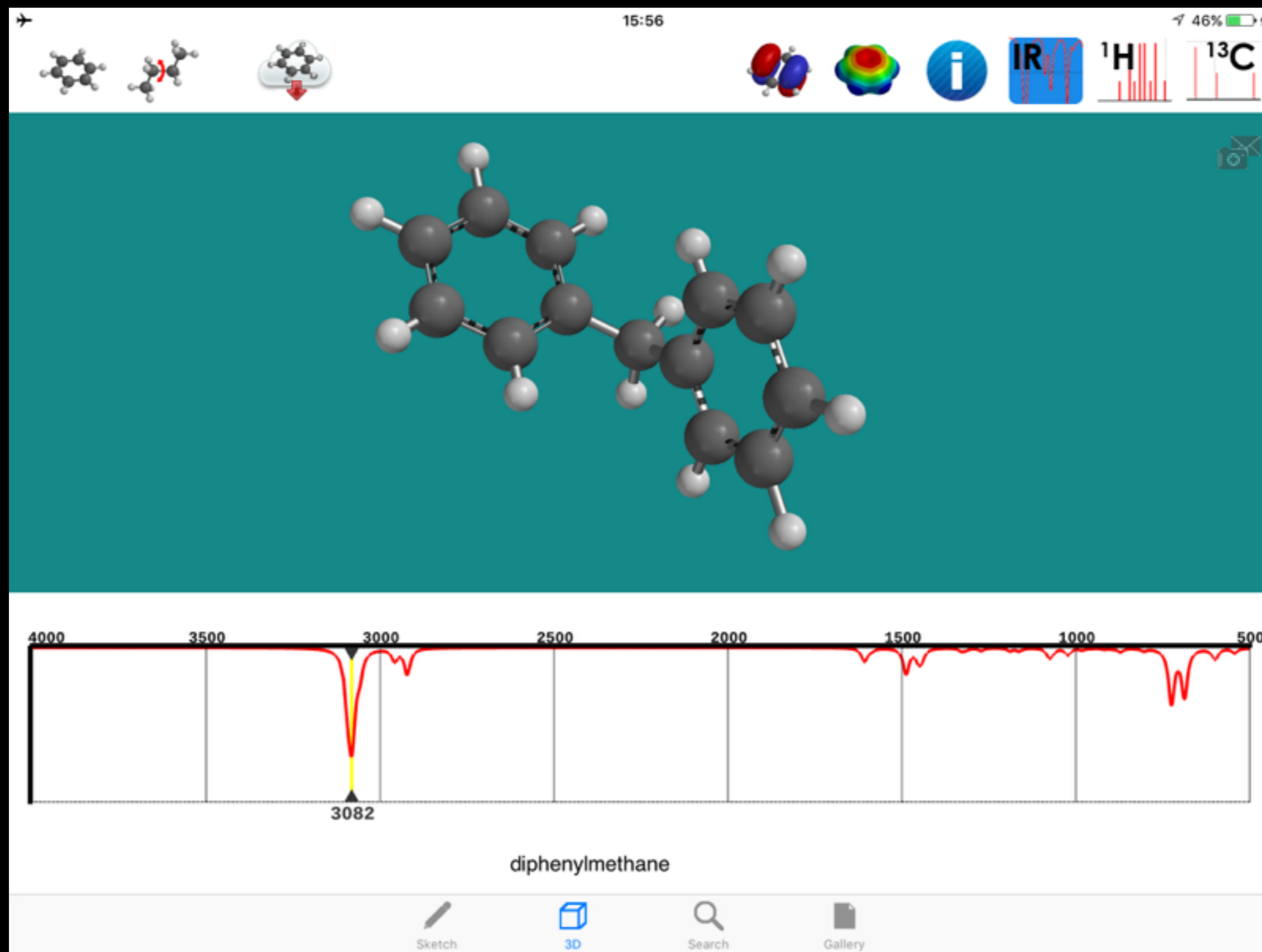
III.

App utili

# Molecules (free)

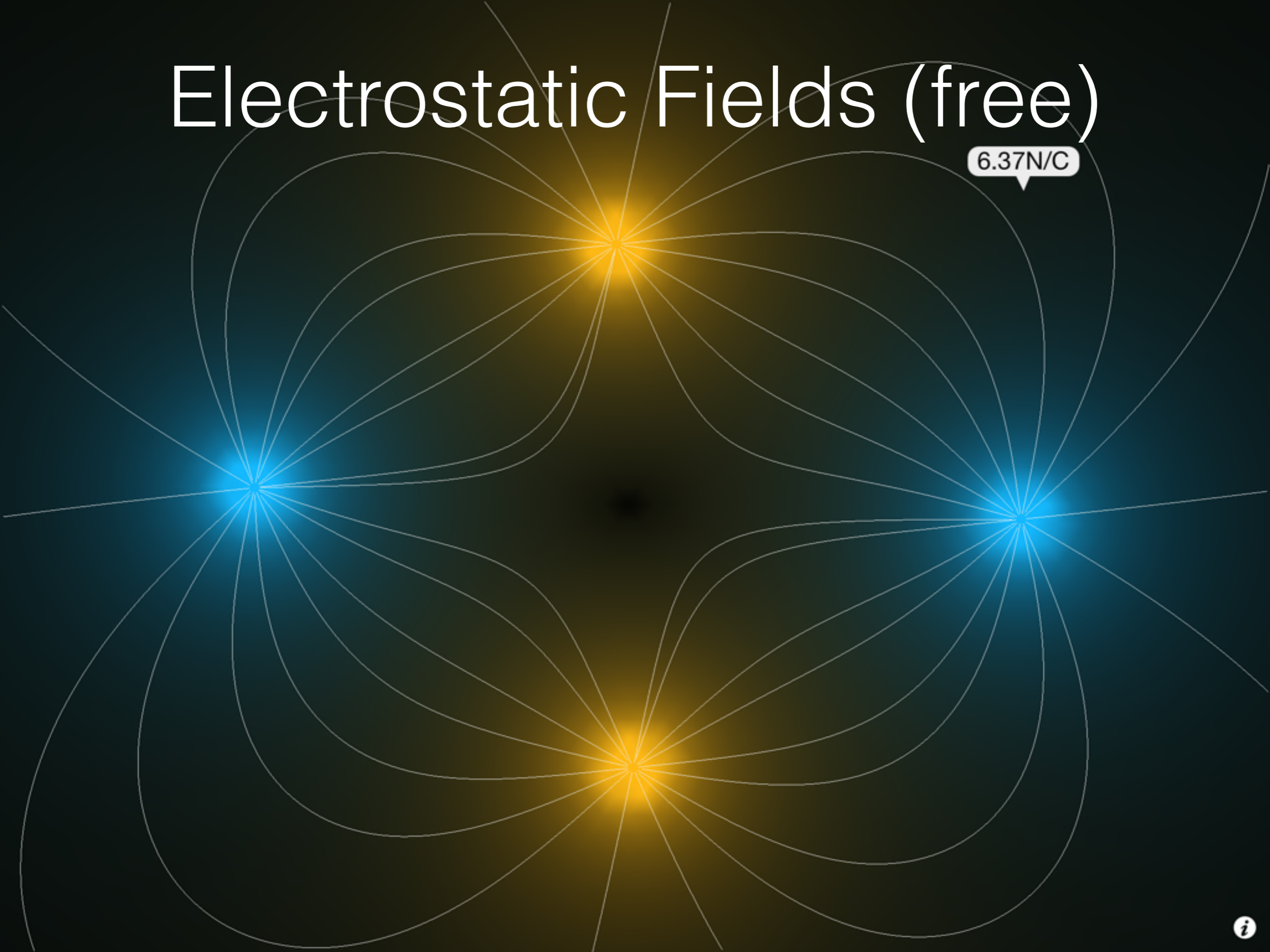


# iSpartan (19.99€)



# Electrostatic Fields (free)

6.37N/C

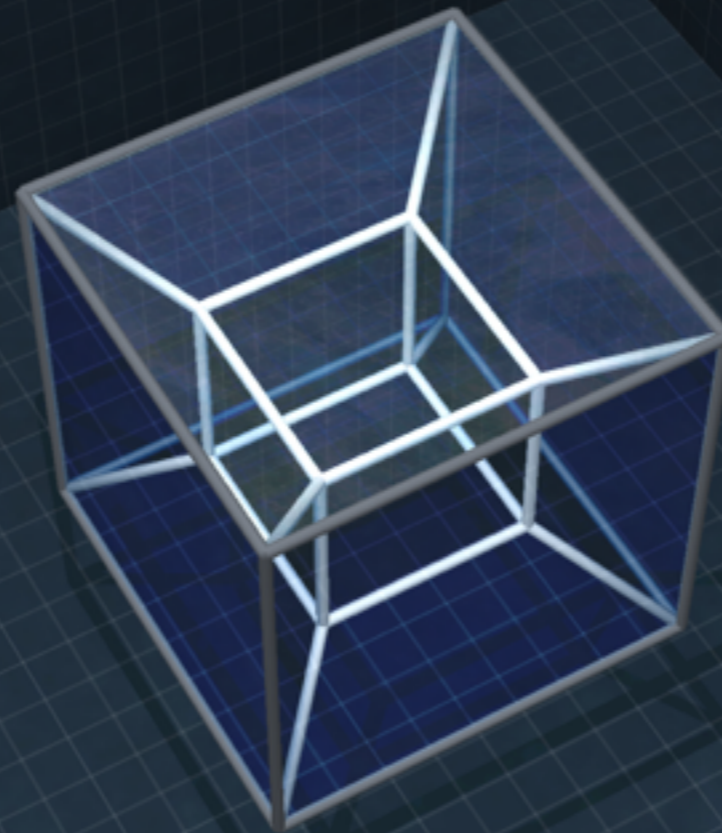


# La quarta dimensione (2,99€)

Ora fai ruotare il tesseratto nella *quarta dimensione*. Usa i pulsanti 3D/4D per passare dalla rotazione nella terza a quella nella quarta dimensione. La misteriosa sensazione di vertigine pluridimensionale che sentirai è la stessa che provano i matematici dopo una nottata intera di festeggiamenti.

3D

4D

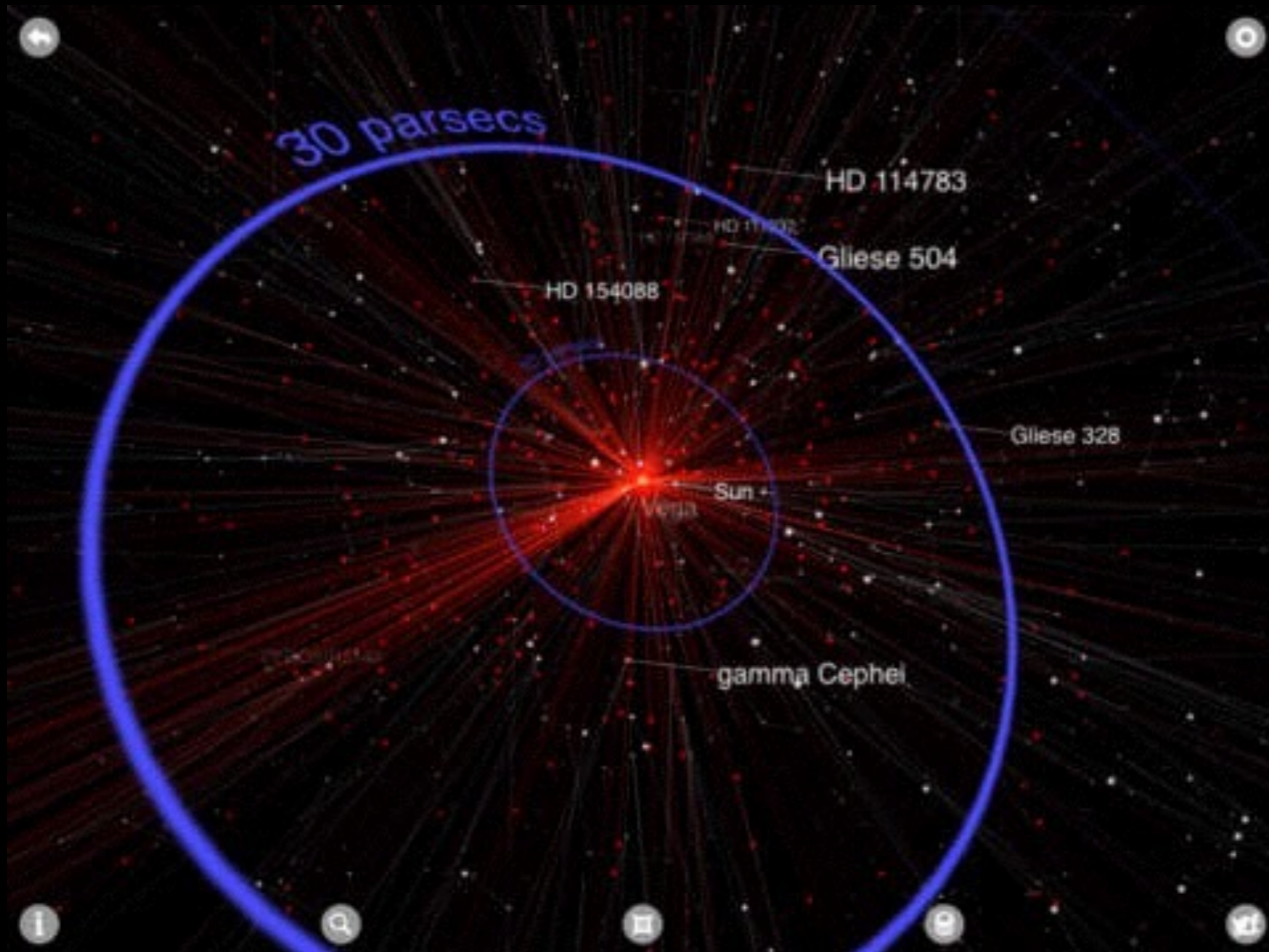


3D

4D



# Exoplanet (free)



# Solar Walk (free)

< Extra Ripristina

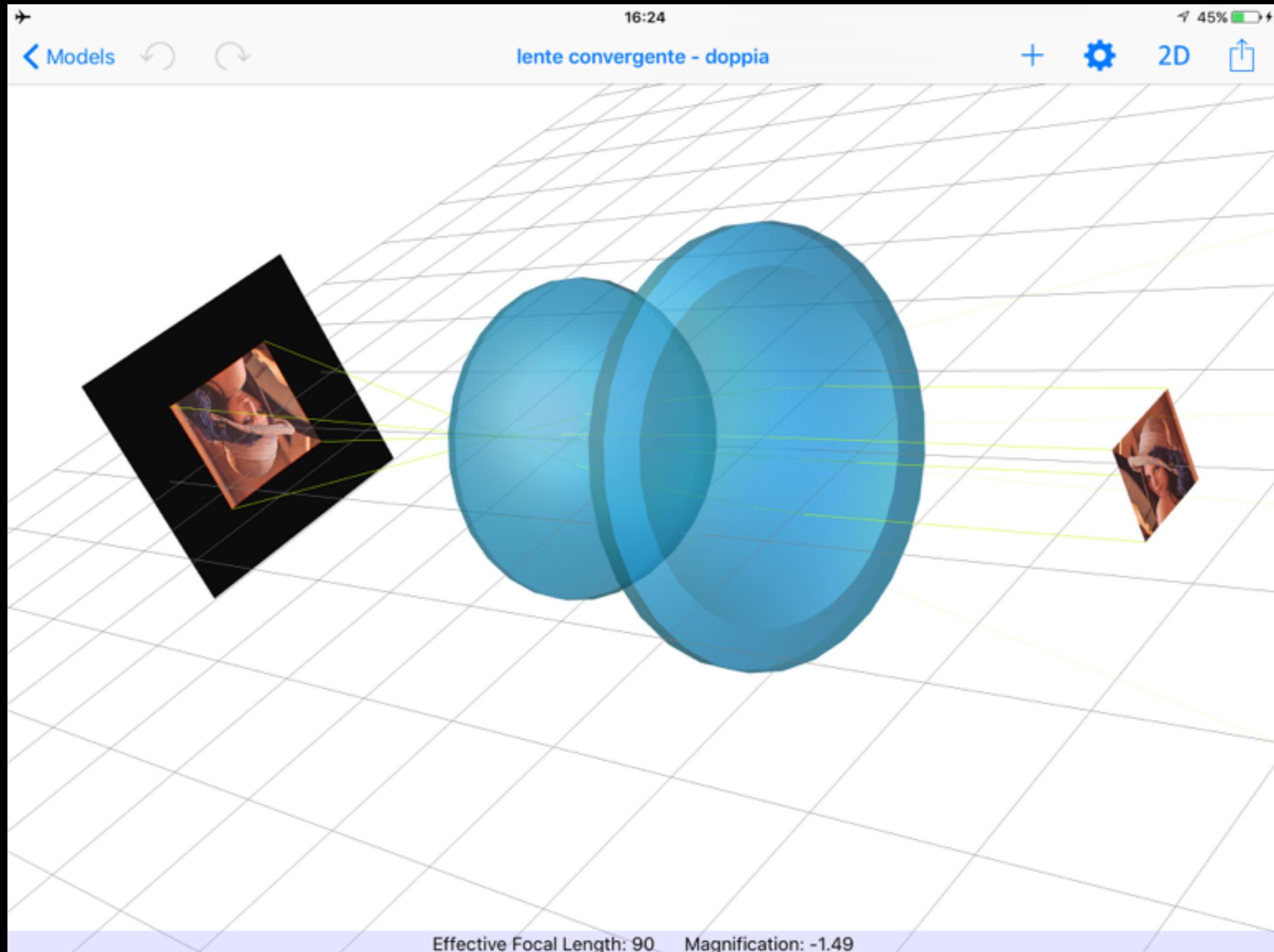
Missioni Film Pianeti alta risoluz.

Pacchetto tutto in uno -70%

\$0.99 [Sblocca](#)

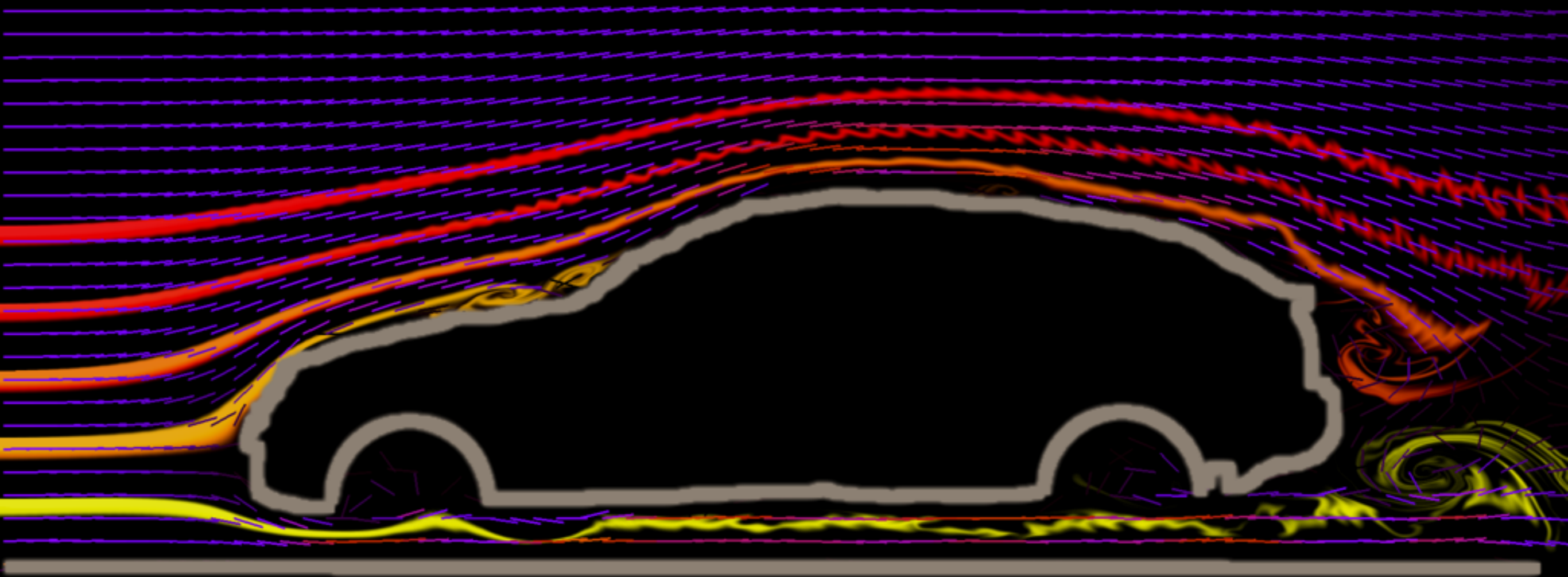
	<b>Confronto dimensioni</b> 1 min. 40 sec.		<b>Cicli della terra</b> 1 min. 57 sec.
	<b>Eclissi solare</b> 2 min. 22 sec.		<b>Le fasi lunari</b> 2 min. 45 sec.
	<b>Fenomeno delle maree</b> 1 min. 57 sec.		<b>Principali paralleli</b> 2 min. 11 sec.

# RayLab (free)





# Wind Tunnel (free)



# Ripple Tank (free)



Back

Play

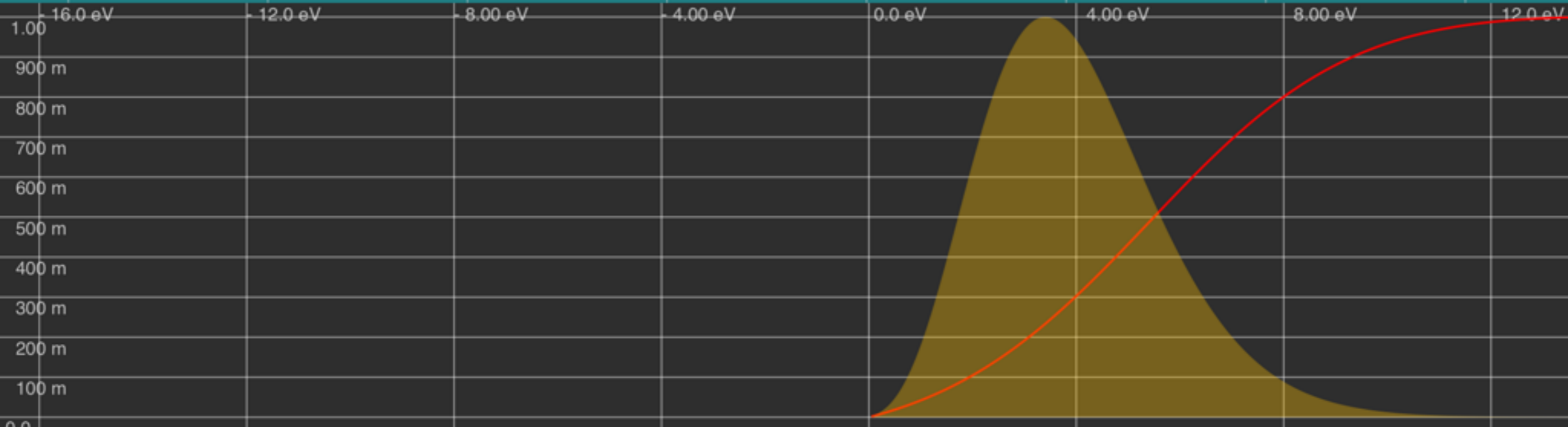
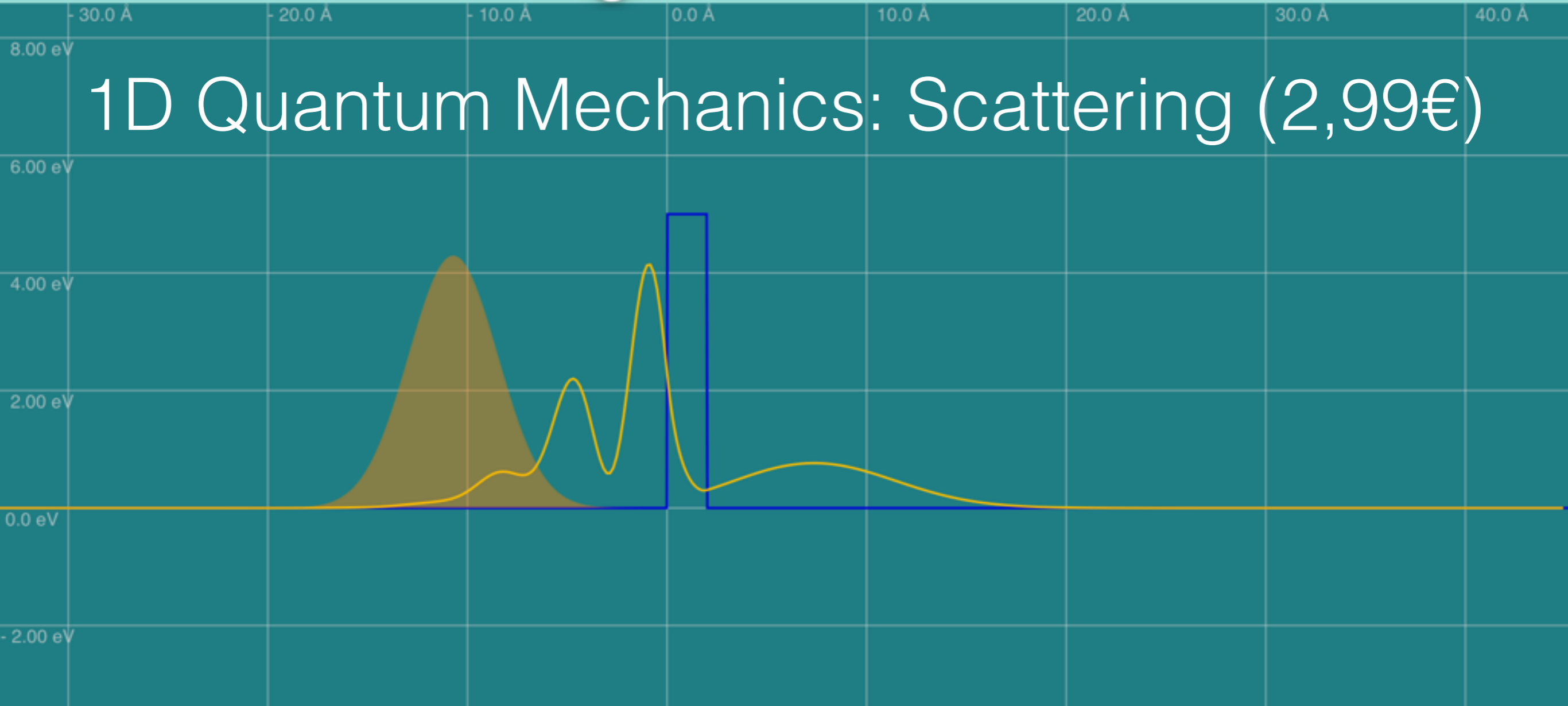
Resume

Speed

Info

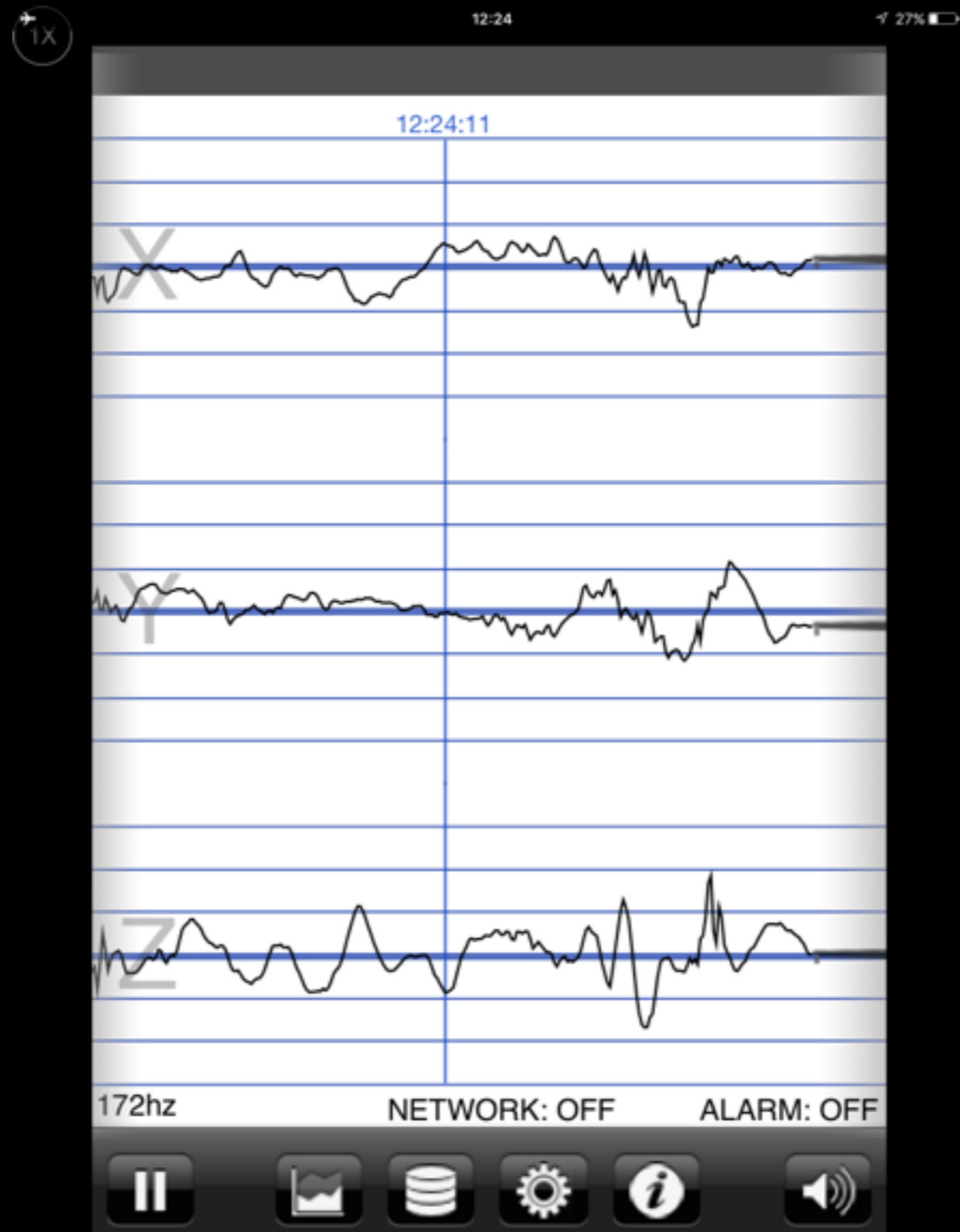
t= 1.44 fs

# 1D Quantum Mechanics: Scattering (2,99€)

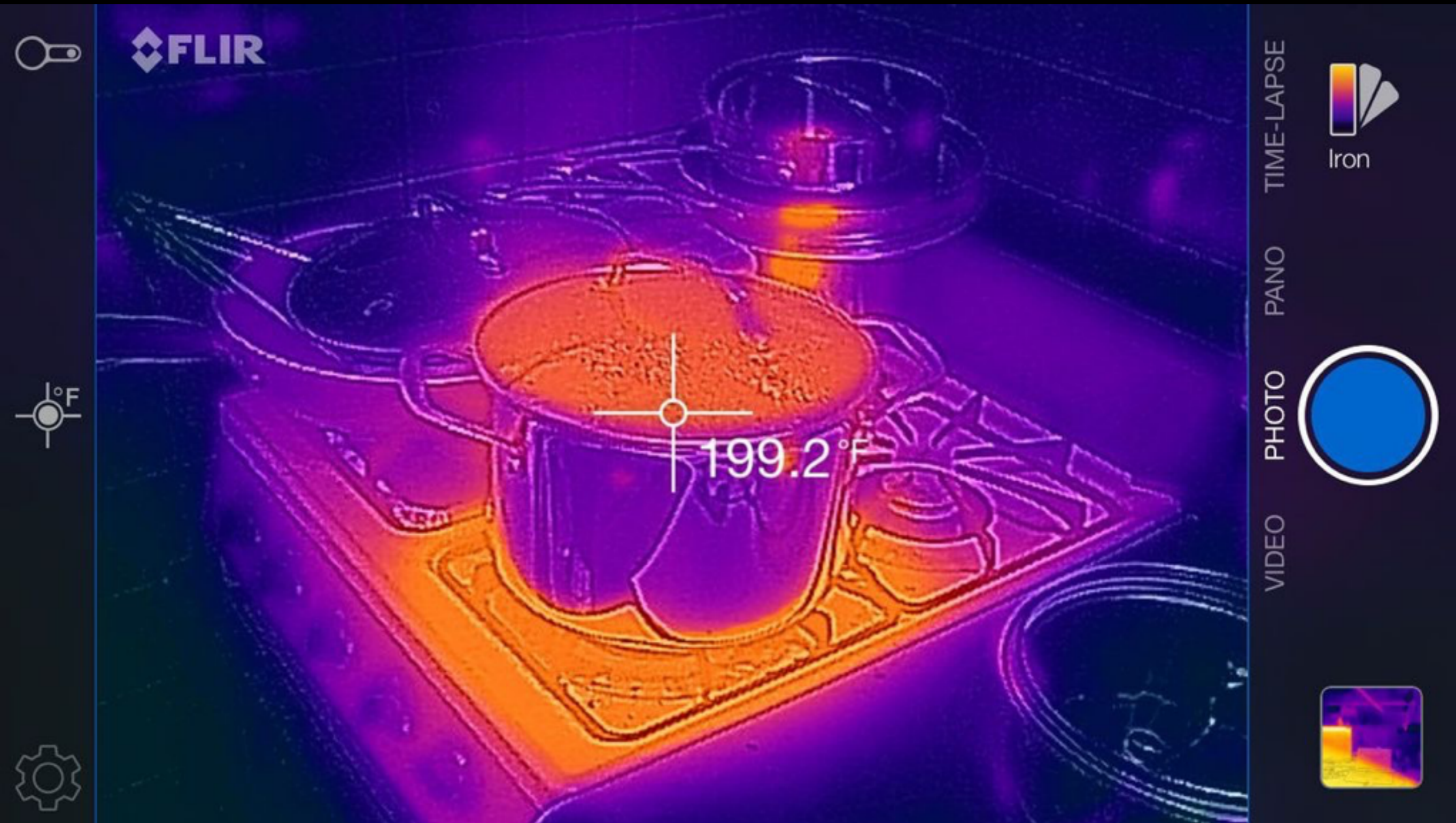


Visualizzazioni  
basate su sensoristica  
interna o esterna

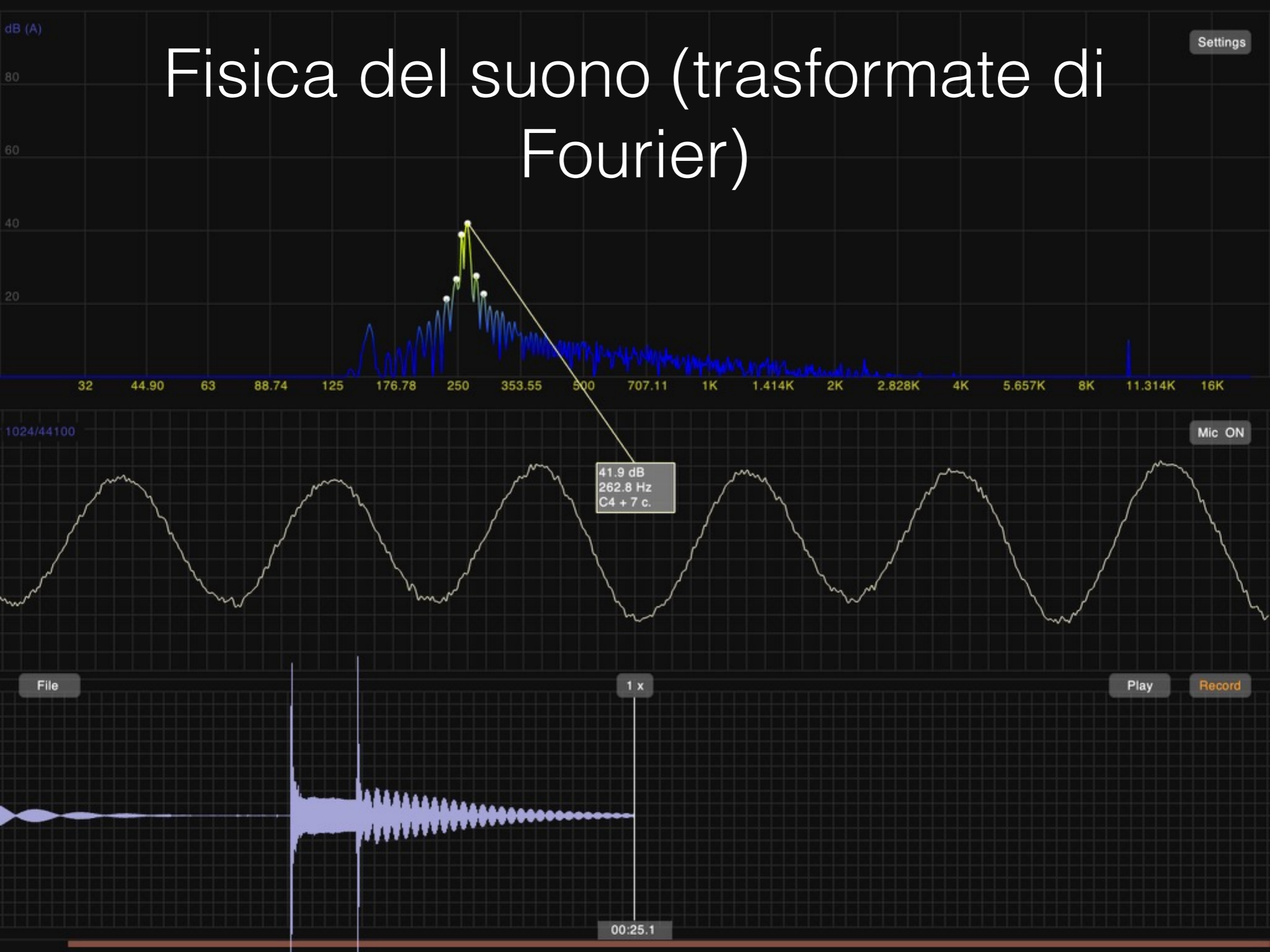
# Accelerometri



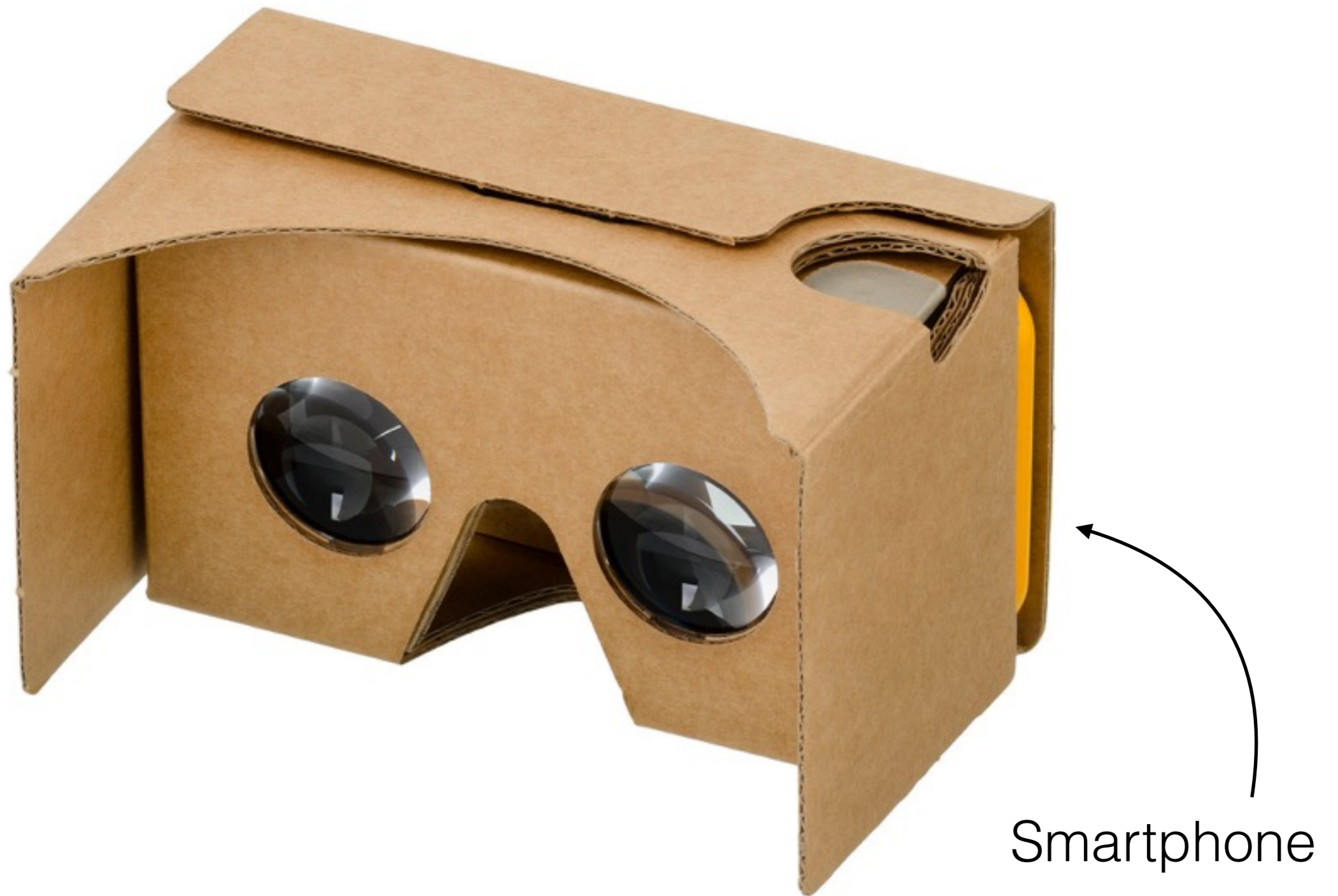
# Termocamera (FLIR ONE)



# Fisica del suono (trasformate di Fourier)



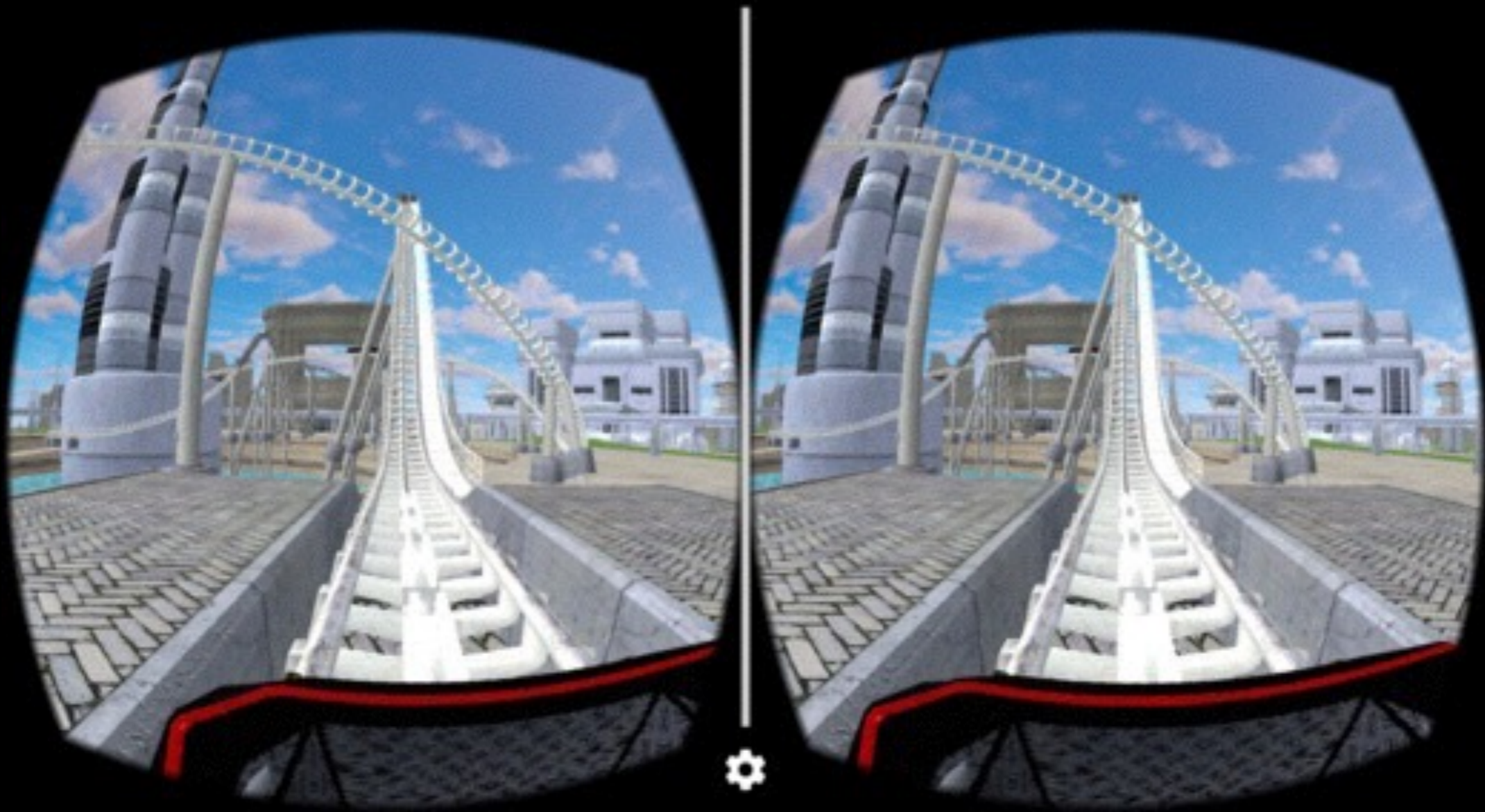
# Google Cardboard



Smartphone



# Realtà virtuale – Roller Coaster (free)



# Realtà virtuale – Within (free)



IV.

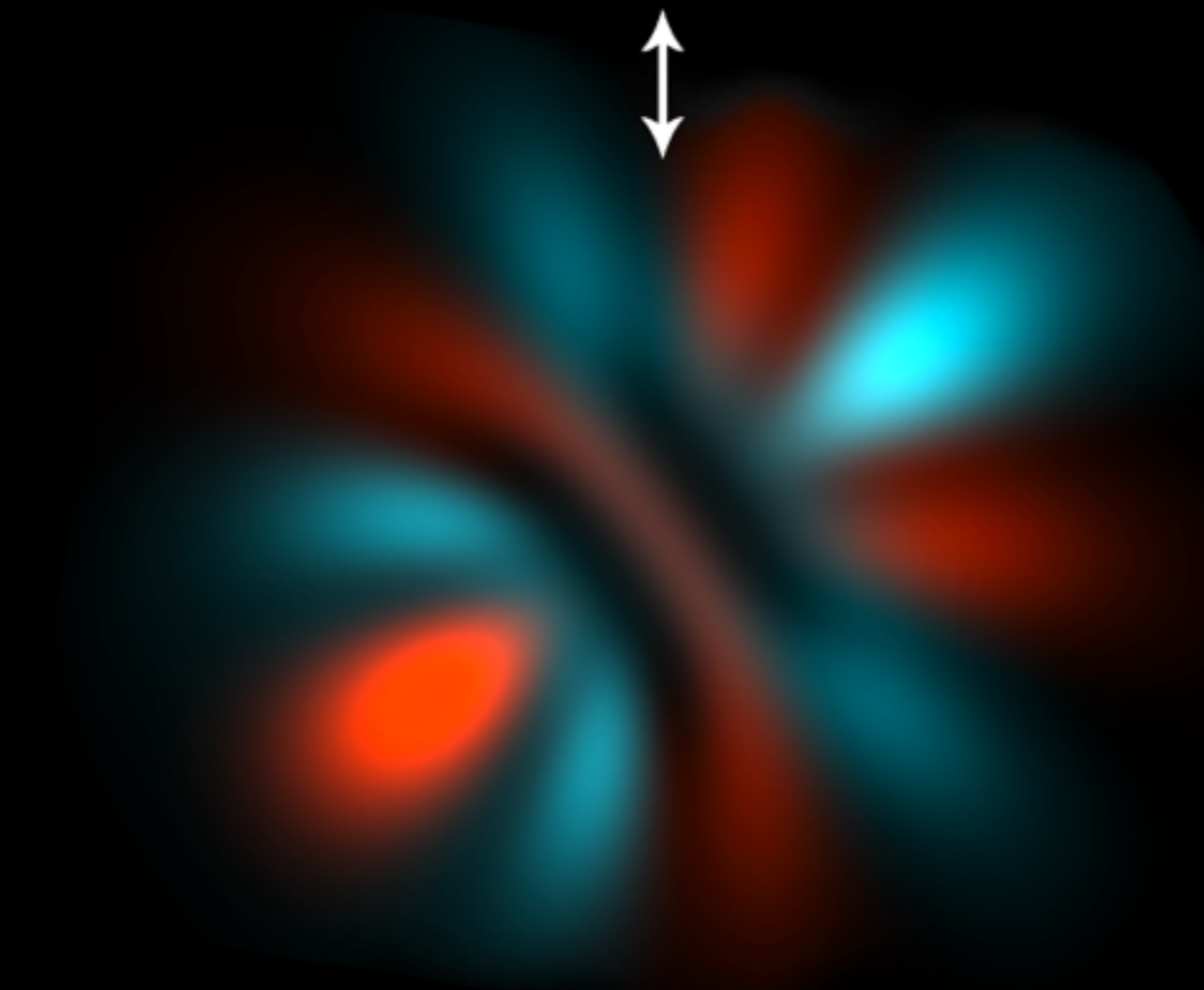
Esempio: Hydrogen!

# Hydrogen!

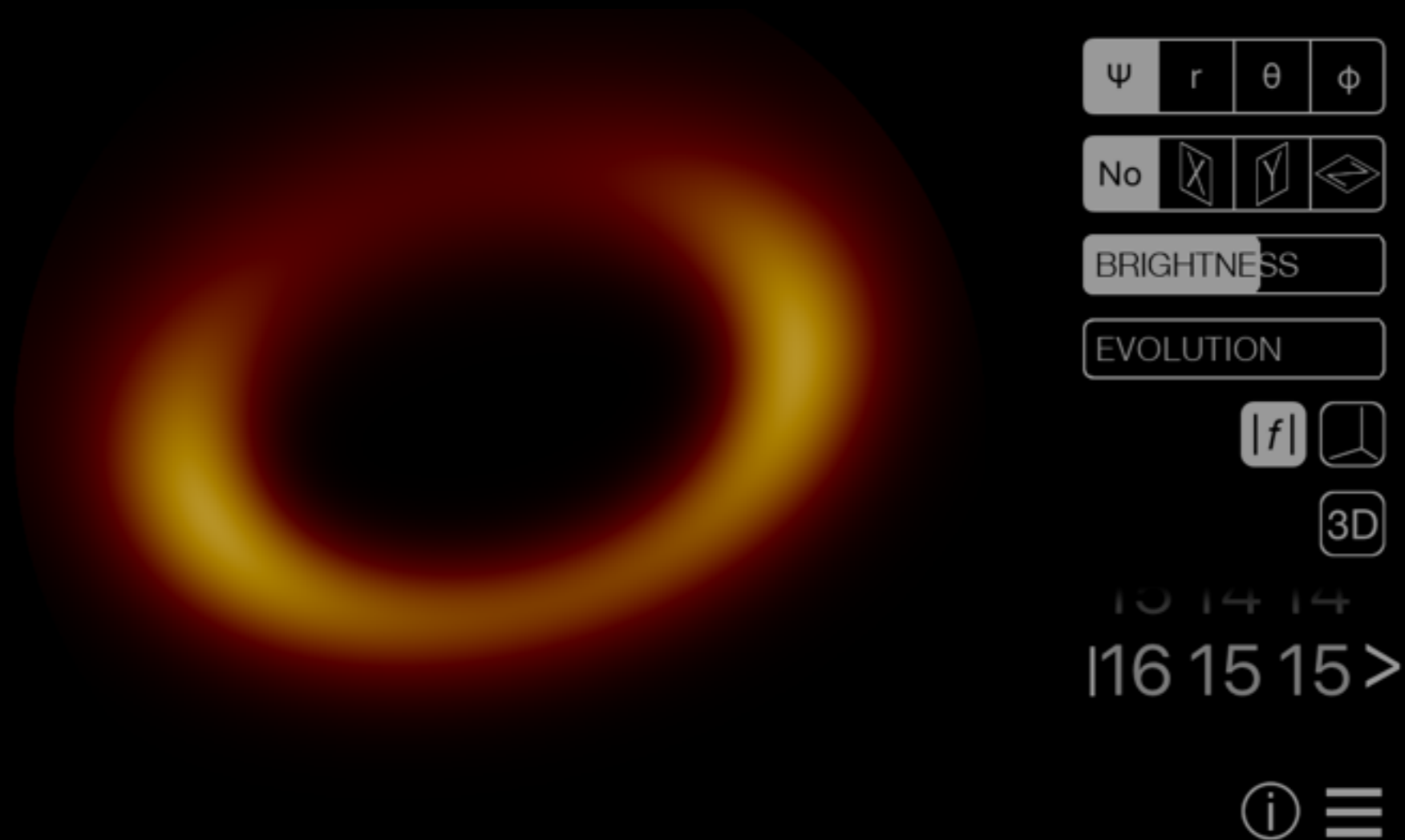


# Vedere attraverso la matematica

$$\psi_{nlm} = a_0^{-\frac{3}{2}} N_{nl} F_{nl} \left( \frac{2r}{na_0} \right) Y_l^m(\theta, \phi)$$

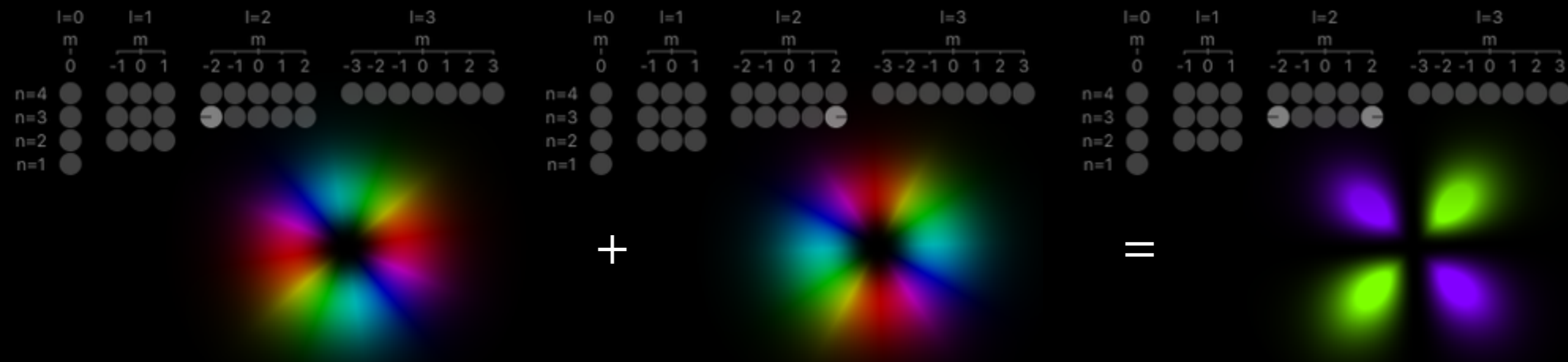


# Principio di corrispondenza



Per alti numeri quantici i risultati quantistici tendono a quelli classici

# Interferenza



Differenza tra probabilità classica e quantistica  
(analogo dell'esperimento della doppia fenditura)

# Spettroscopia



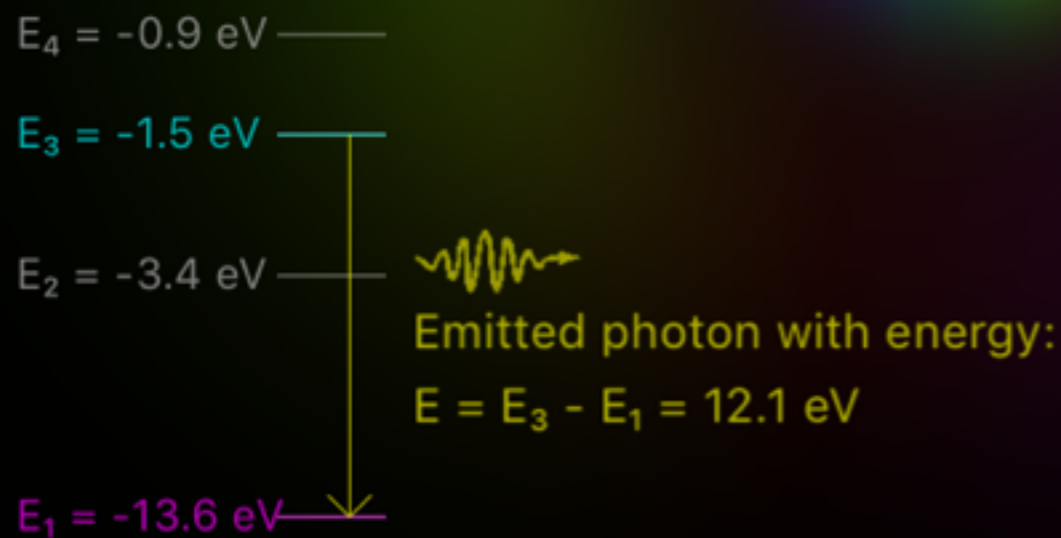


# Transizioni e spettroscopia

Choose a transition permitted by selection rules:



Starting orbital



V.

Sviluppare le proprie  
app

# Android



# Android Studio

← Back to Developers

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FEATURES

USER GUIDE

## Android Studio

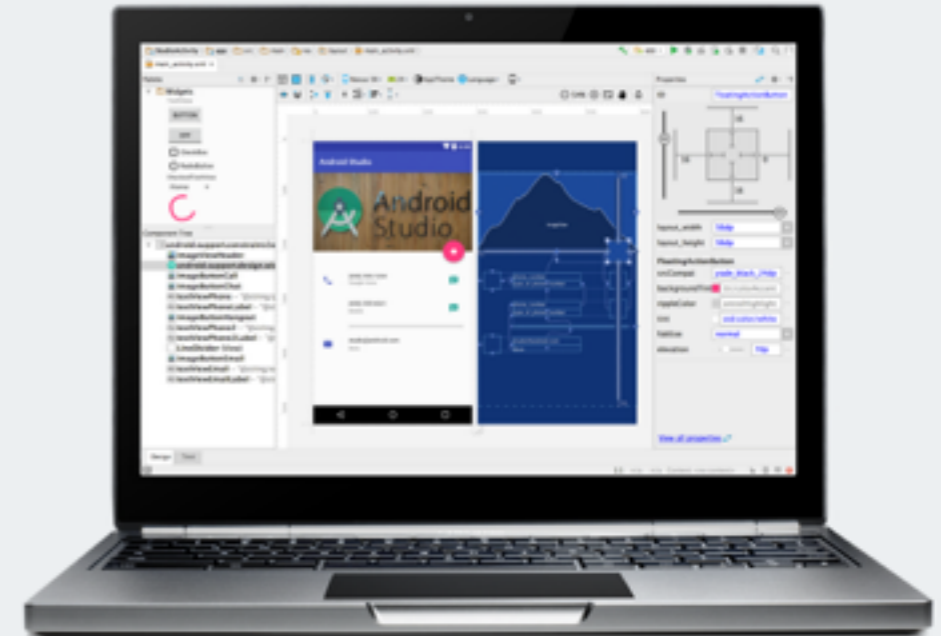
### The Official IDE for Android

Android Studio provides the fastest tools for building apps on every type of Android device.

World-class code editing, debugging, performance tooling, a flexible build system, and an instant build/deploy system all allow you to focus on building unique and high quality apps.

**DOWNLOAD ANDROID STUDIO**  
2.2.2.0 FOR MAC (440 MB)

> Read the docs    > See the release notes



> Features    > Latest    > Resources    > Videos    > Download Options



# Processing

Processing

p5.js

Processing.py

Processing for Android

Processing Foundation

# Processing



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Welcome to Processing 3! Dan explains the new features and changes; the links Dan mentions are on the [Vimeo page](#).

» [Download Processing](#)

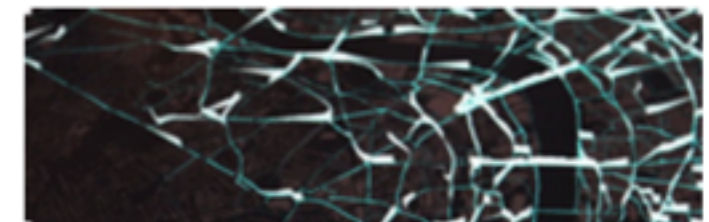
» [Browse Tutorials](#)

» [Visit the Reference](#)

» [Exhibition](#)



[Fluid Leaves](#)  
by Reinoud van Laar

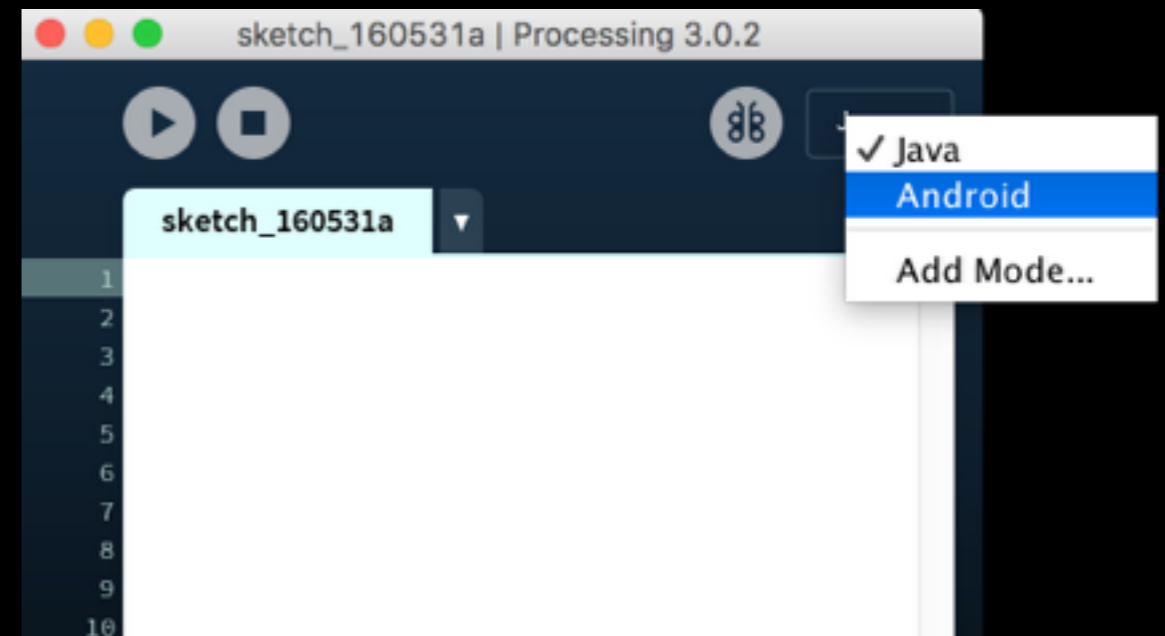


[cf.city flows](#)  
by Till Nagel and Christopher Pietsch

# Processing

Ottimo software / linguaggio per cominciare a sviluppare:

- semplice e potente
- compatibile con: computer (cross-platform), Android, Arduino
- open-source e gratuito
- forte comunità, ottima documentazione e supporto
- tutorial, esempi



# Processing “Android mode”

[Processing](#) [p5.js](#) [Processing.py](#) [Processing for Android](#)

## Processing for Android



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[Forum](#)

[GitHub](#)

Processing for Android allows you to create Android apps using Processing. You can run your Processing sketches on Android devices (phones, tablets, smartwatches) with little or no changes in the code, and without having to take care of tasks such as installing SDK files, creating project folders, or editing layout files. You can also access the Android SDK to get sensor data and other advanced features, and export your sketch as a signed package to upload to the Google Play Store.

The current 3.0 version of the mode lets you to develop regular Android apps. The upcoming 4.0 version will add support for live wallpapers, watch faces, and Cardboard. Stay tuned for updates from the Contribution Manager in the Processing environment, or Processing's [twitter channel](#)!

# Processing: esempi

The screenshot displays the Processing IDE interface. The main window is titled 'IsoContourExample | Processing 3.1.1'. The code editor shows the following code:

```
1 /k-----
2 Library: ComputationalGeometry
3 By: Mark Collins & Toru Hasegawa
4 Example: IsoContour
5
6 Creates a 2D isometric contour,
7 based on a series of random points.
8 -----*/
9
10 import ComputationalGeometry.*;
11 IsoContour iso;
12
13 void setup(){
14     size(250,250,P3D);
15
16     // Creating the Isocontour
17     iso = new IsoContour(this, new PVector(0,0), new PVector(width,height));
18
19     // Adding Meta-blobs to the Isocontour
20     randomSeed(1);
21     for(int i=0; i<20; i++){
22         PVector pt = new PVector( random(width), random(height), random(255));
23         iso.addPoint(pt);
24     }
25 }
26
27 void draw(){
28     background(220);
29
30 }
```

Overlaid on the right is a 'Java Examples' panel with an 'Add Examples...' button. It lists various example folders, with 'Computational Geometry' expanded to show sub-examples: 'IsoContourExample', 'IsoSkeletonExample', 'IsoSurfaceExample', and 'IsoWrapExample'. The 'IsoContourExample' folder is highlighted in blue. At the bottom of the IDE, there are tabs for 'Console' and 'Errors', and an 'Updates' button with a notification icon.



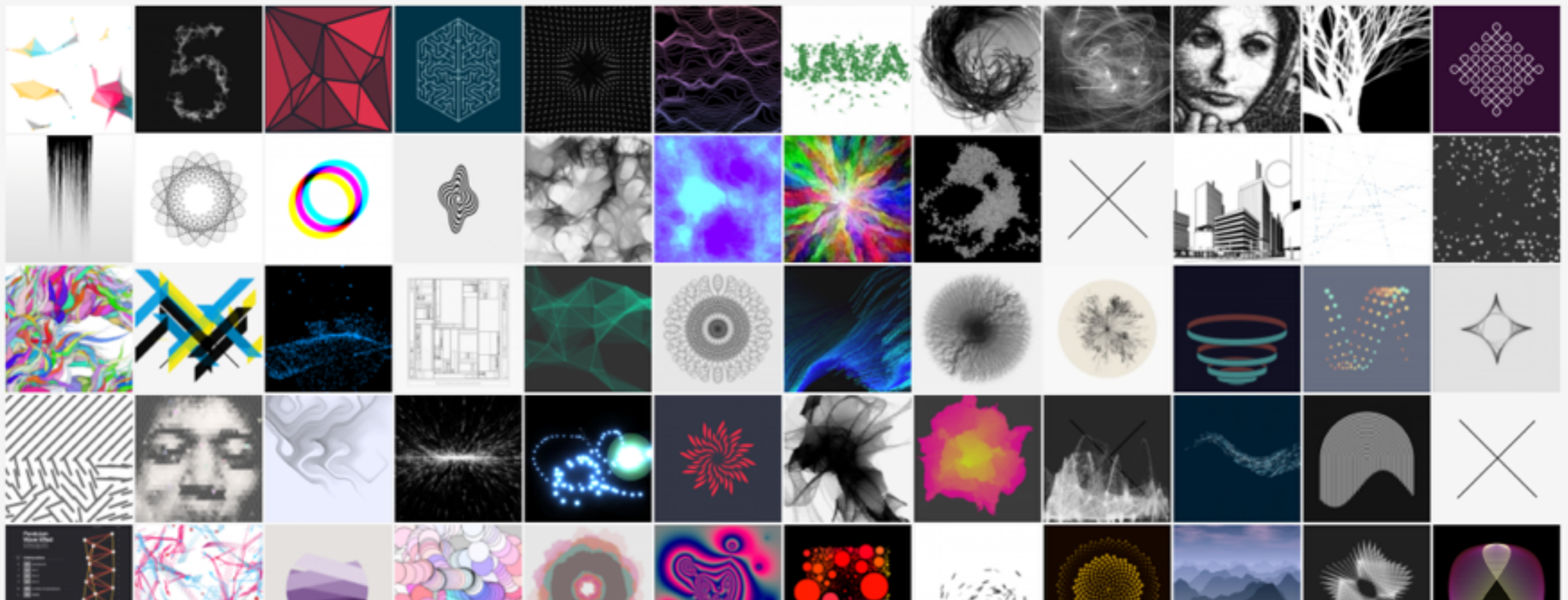
# Open Processing

Esempio di comunità su Processing: [www.openprocessing.org](http://www.openprocessing.org)

Esempi di codici visualizzabili online e scaricabili.



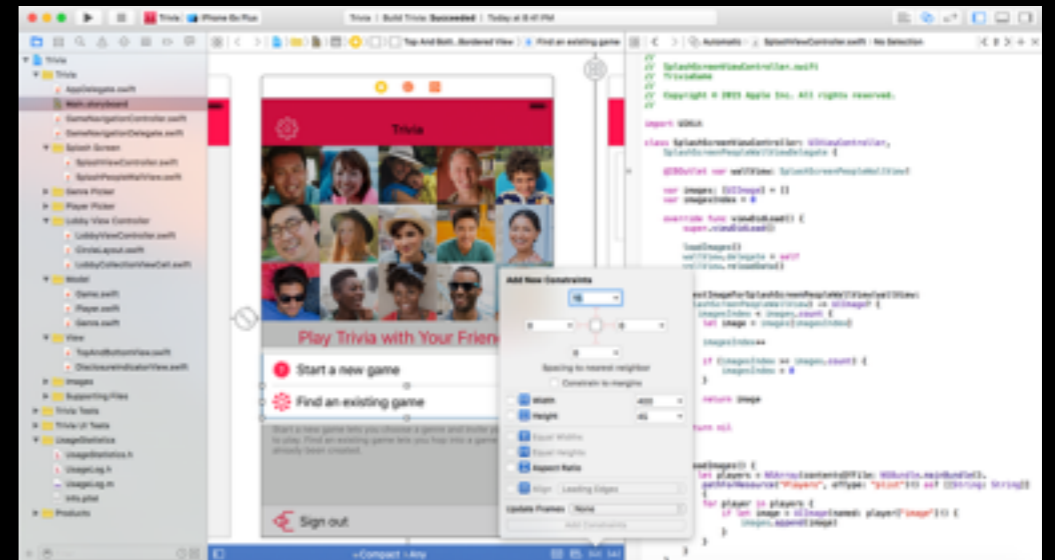
are created  
Sketches that received s during this month with keywords    
are tagged this year anytime



# iOS & WINDOWS

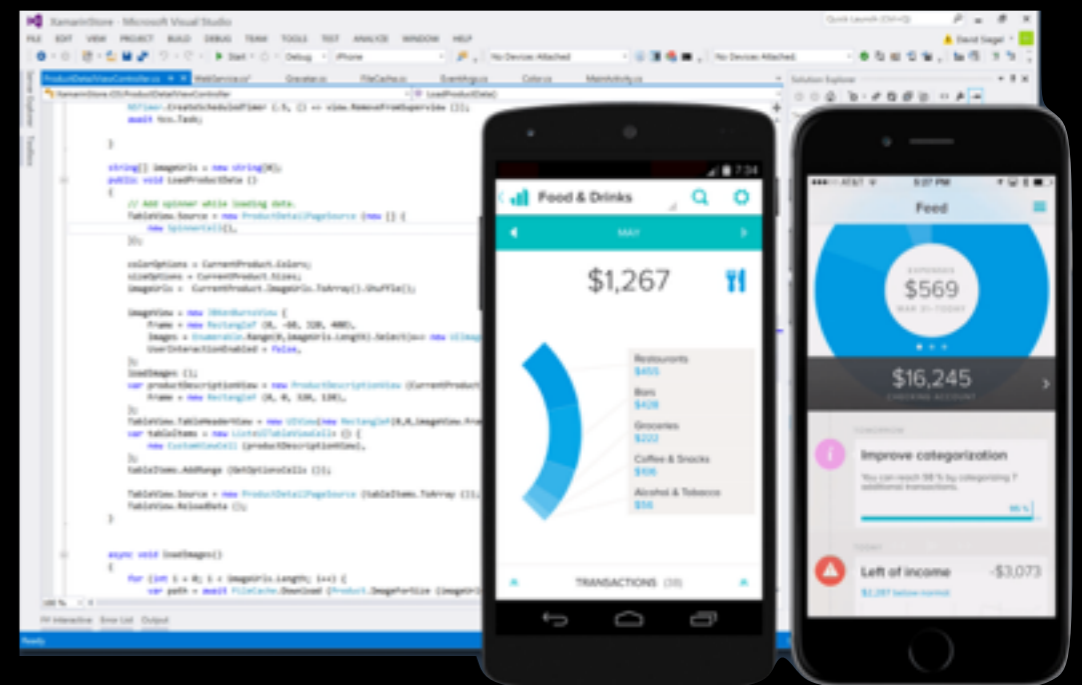
iOS: Xcode

<https://developer.apple.com/xcode/>



Windows: Visual Studio

<https://www.visualstudio.com>



# Esempi Xcode



## AccelerometerGraph

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## AccelerometerGraph

---

**Last Revision:** Version 2.6, 2013-07-15  
Upgraded for iOS 6.0, now using Automatic Reference Counting (ARC), updated to adopt current best practices for Objective-C.  
[\(Full Revision History\)](#)

---

**Build Requirements:** iOS 6.0 SDK

---

**Runtime Requirements:** iOS 5.0 or later

---

AccelerometerGraph sample application graphs the motion of the device. It demonstrates how to use the `UIAccelerometer` class and how to use Quartz2D and Core Animation to provide a high performance graph view. It also demonstrates a low-pass filter that you can use to isolate the effects of gravity, and a high-pass filter that you can use to remove the effects of gravity.

Next

# Librerie Open di chi vende l'hardware

FLIR ONE is lightweight,  
easy to connect and easy  
to use.

Explore the world around you in ways you never thought possible, with no additional cords, cases, devices or screens necessary. Connect your FLIR ONE to your smartphone or tablet to transform it into a thermal camera. What will you do with your new super power?



# Librerie Open di chi vende l'hardware



The image shows a screenshot of the OpenKinect project's main page. At the top right, there are links for 'create account' and 'log in'. Below these are navigation tabs for 'page', 'discussion', 'view source', and 'history'. A notice states: 'Notice: Now on HTTPS. Report any rough edges to [marcan@marcan.st](mailto:marcan@marcan.st)'. The main heading is 'Main Page'. The central logo features the word 'OPEN' in white on a black background, followed by a stylized green 'K' with a white outline, and the word 'INECT' in white on a black background. Below the logo, it says 'Welcome to the OpenKinect project'. There is a language selection box with 'Language:' followed by links for 'English', 'español', 'suomi', 'français', 'italiano', 'português do Brasil', and '中文 (简体)'. The 'About' section contains three paragraphs: the first describes the project as an open community using Xbox Kinect hardware; the second states the community has over 2000 members; the third focuses on the 'libfreenect' software. A bulleted list provides links to the source code on GitHub and instructions on how to get started. The 'Communications' section encourages users to subscribe to a mailing list and follow the project on Twitter and Meetup Groups.

create account  log in

[page](#) [discussion](#) [view source](#) [history](#)

Notice: Now on HTTPS. Report any rough edges to [marcan@marcan.st](mailto:marcan@marcan.st)

## Main Page



Welcome to the OpenKinect project

Language: [English](#) • [español](#) • [suomi](#) • [français](#) • [italiano](#) • [português do Brasil](#) • [中文 \(简体\)](#)

### About

**OpenKinect** is an open community of people interested in making use of the amazing Xbox Kinect hardware with our PCs and other devices. We are working on free, open source libraries that will enable the Kinect to be used with Windows, Linux, and Mac.

The OpenKinect community consists of over 2000 members contributing their time and code to the Project. Our members have joined this Project with the mission of creating the best possible suite of applications for the Kinect. OpenKinect is a true "open source" community!

Our primary focus is currently the **libfreenect** software. Code contributed to OpenKinect where possible is made available under an Apache20 or optional GPL2 license.

- Source code is available here: <https://github.com/OpenKinect/libfreenect> 
- Get started right away by [installing](#) the software to your platform.

### Communications

If you want to participate or just watch the progress of the OpenKinect effort, subscribe to the OpenKinect [mailing list](#) . In the application form, please tell us something about yourself and you'll be approved automatically. You could also subscribe to the low-traffic announcement-only [mailing list](#) .

- You can follow us on *Twitter* [@openkinect](#) . Please use the #tag #openkinect when tweeting your work.
- You can meet people in your area working on OpenKinect through [Meetup Groups](#):
  - [NYC](#) 

Grazie  
dell'attenzione!

Tommaso Rosi

email: [tommaso.rosi@unitn.it](mailto:tommaso.rosi@unitn.it)