16 Novembre 2016

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

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!
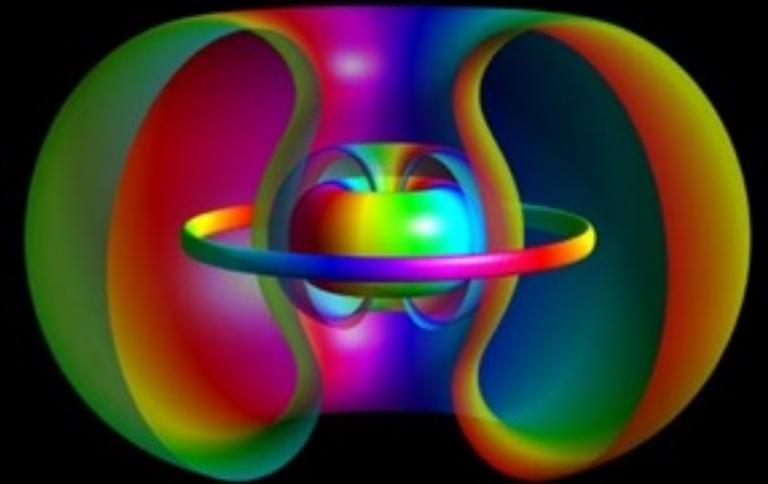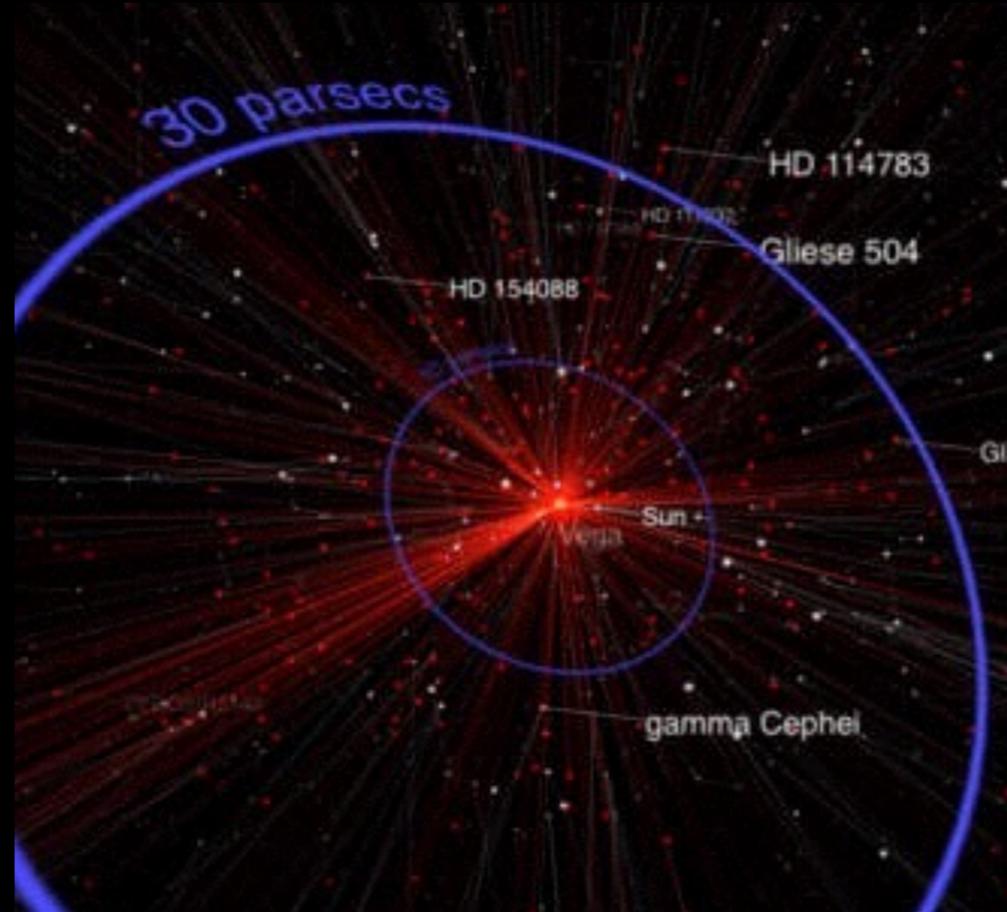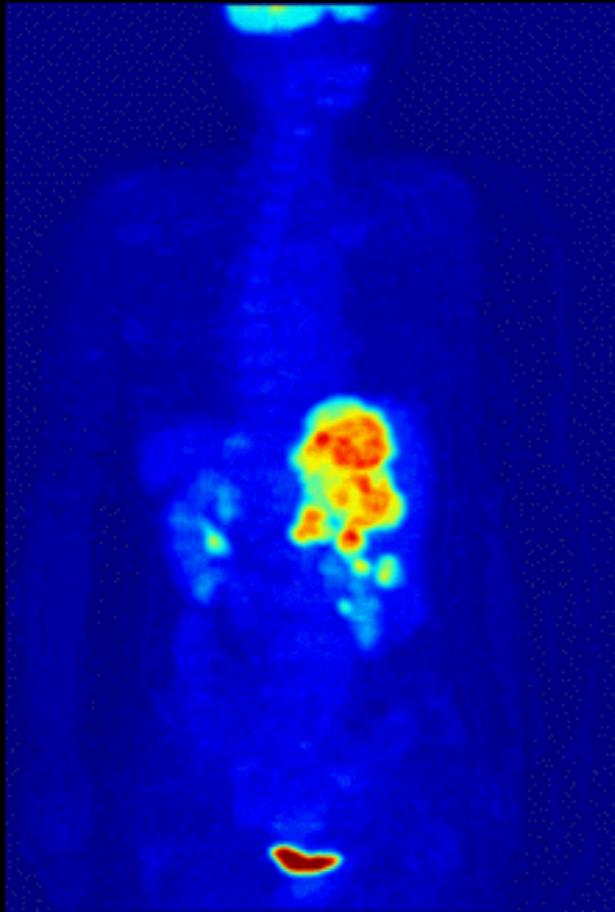
Condivisione dei dati

&

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
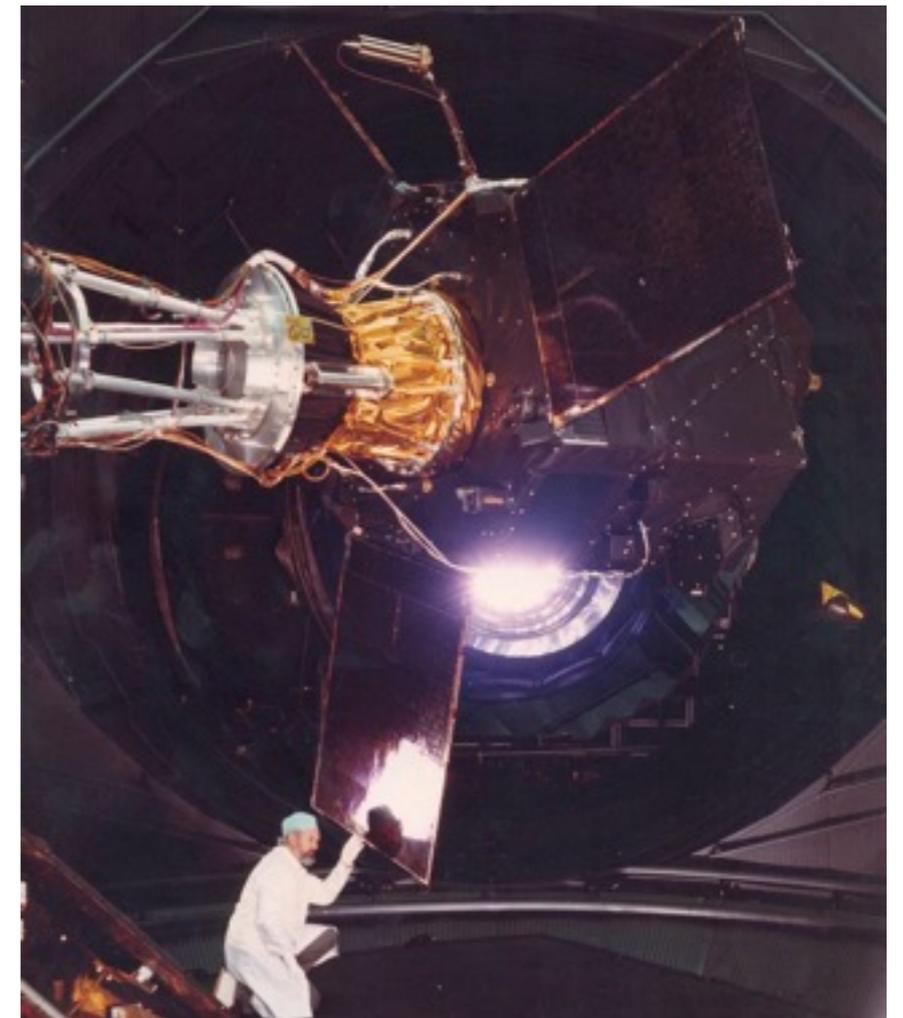
Database

"**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

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"
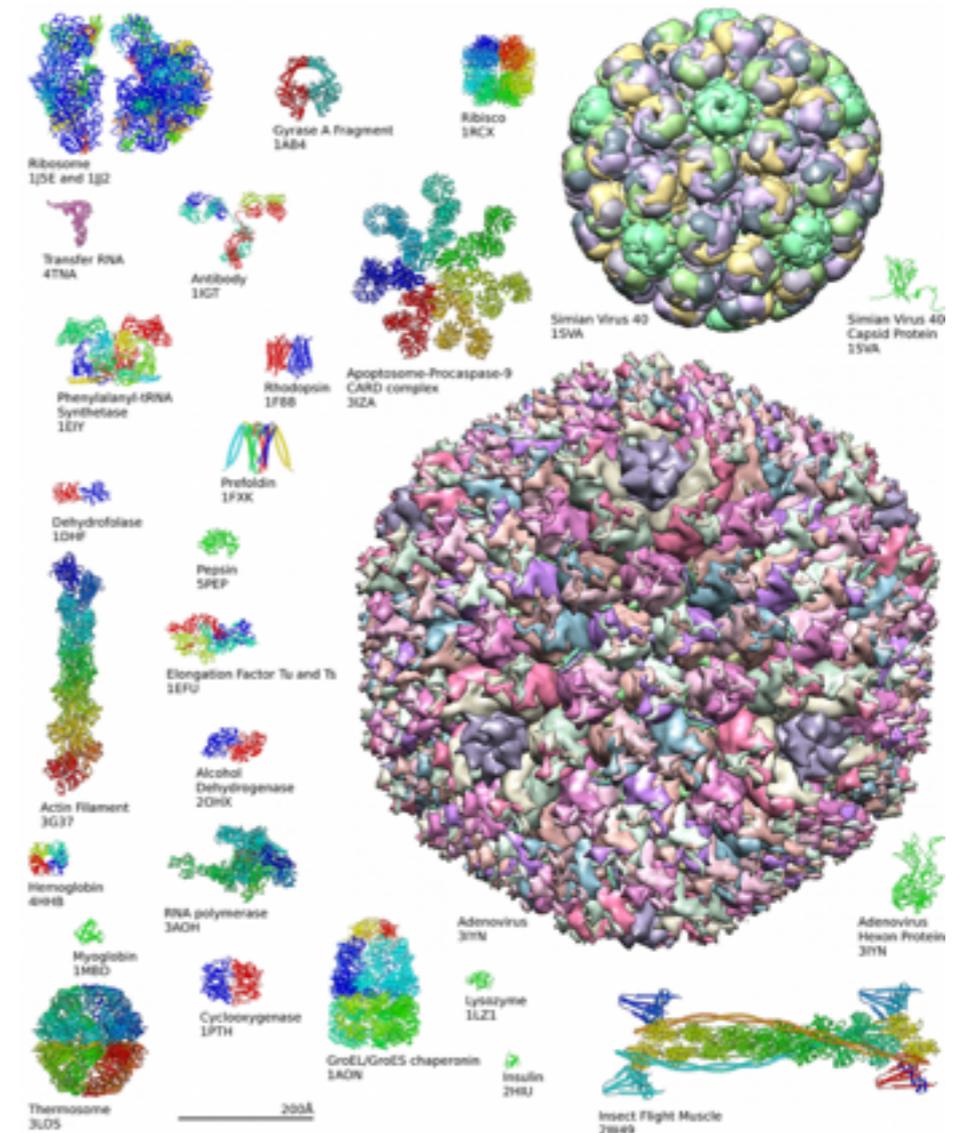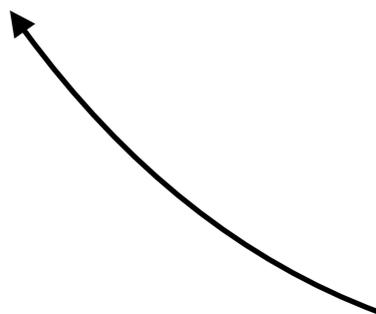
Inserire nome della molecola, composto, …

3D Conformer

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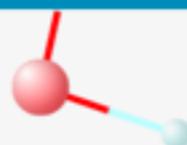
XML DATA

```
<?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>
```

3 atomi:

Oxigen ("o"), Hydrogen ("h"), Hydrogen

8   1   1
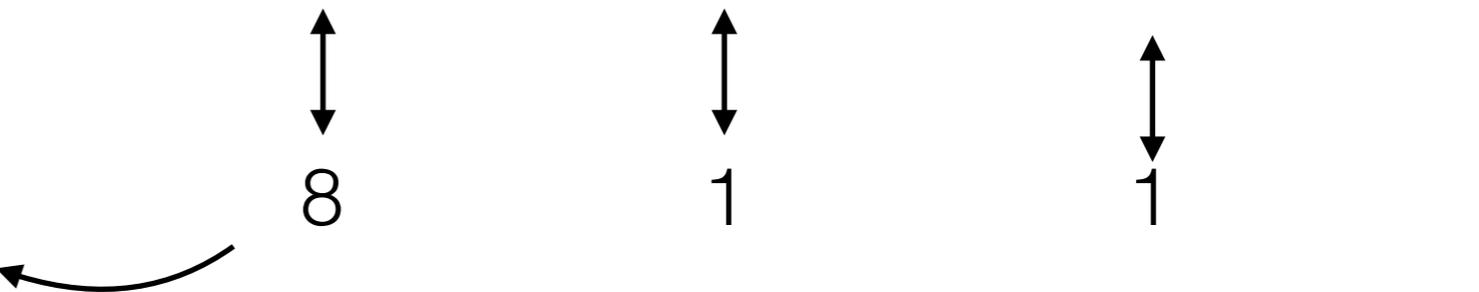
II.
Scale di colore e daltonismo

Scale di colore

Cosa vedete?
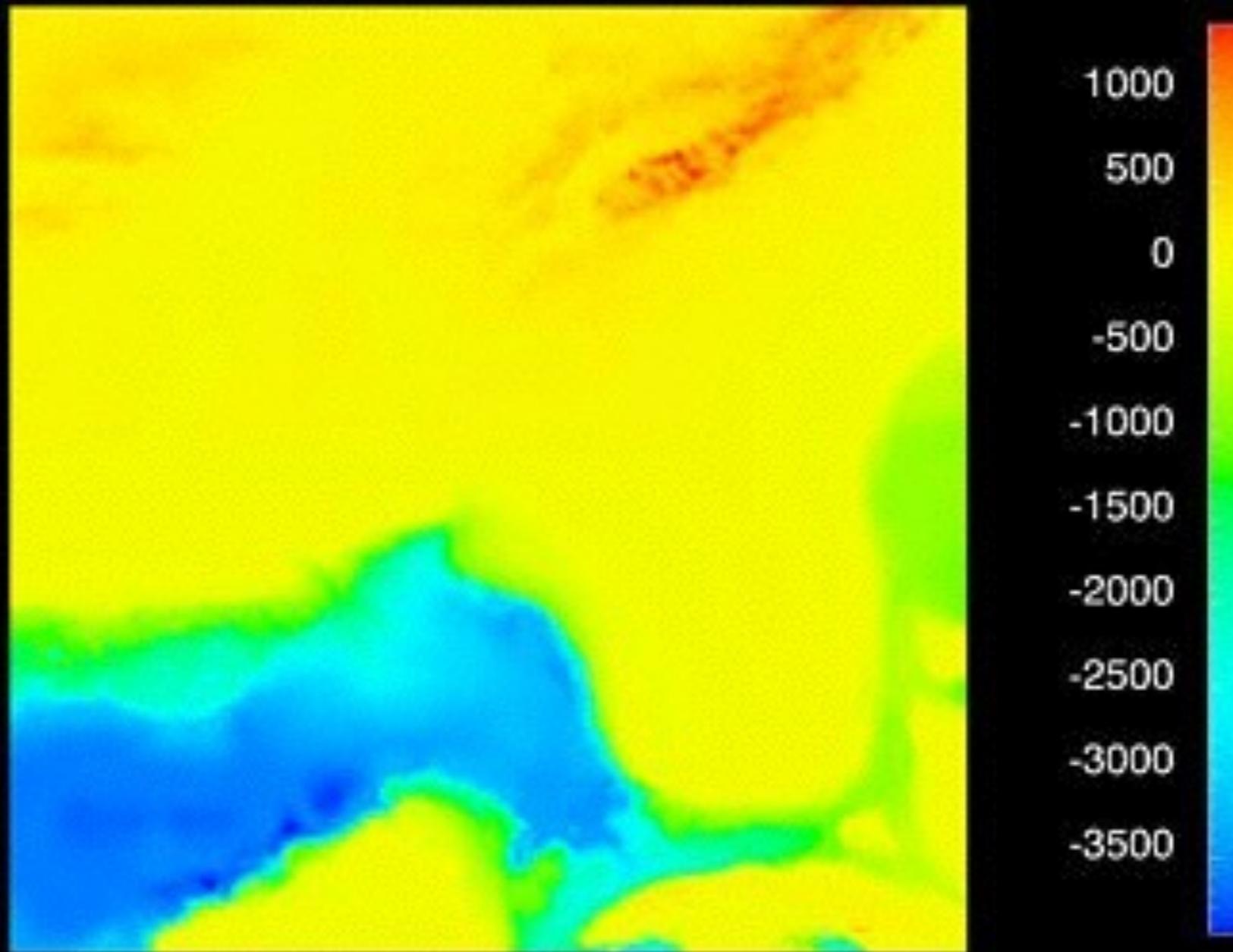
Cosa vedete?
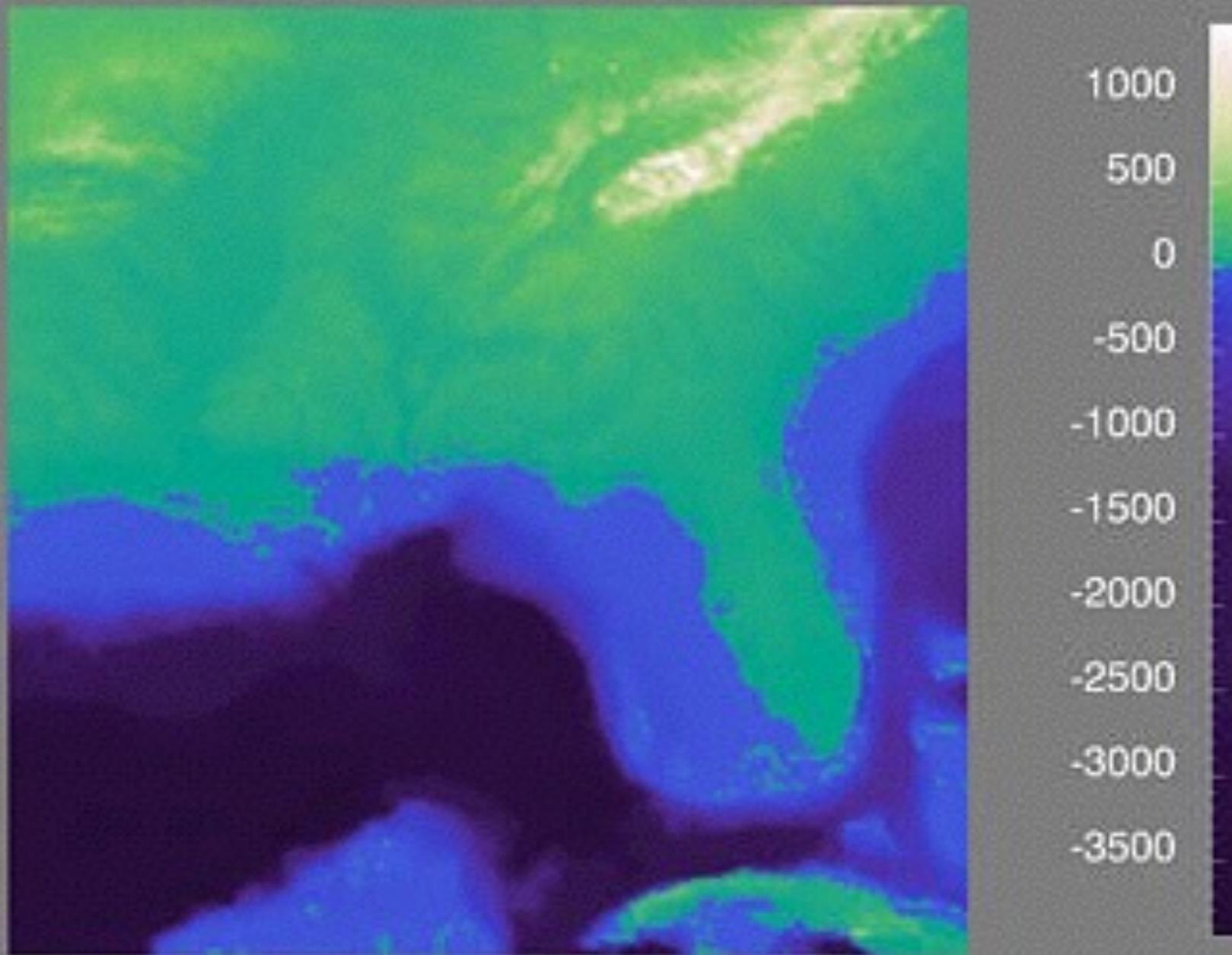
Cosa vedete?

Nasconde importanti informazioni anziché metterle in risalto
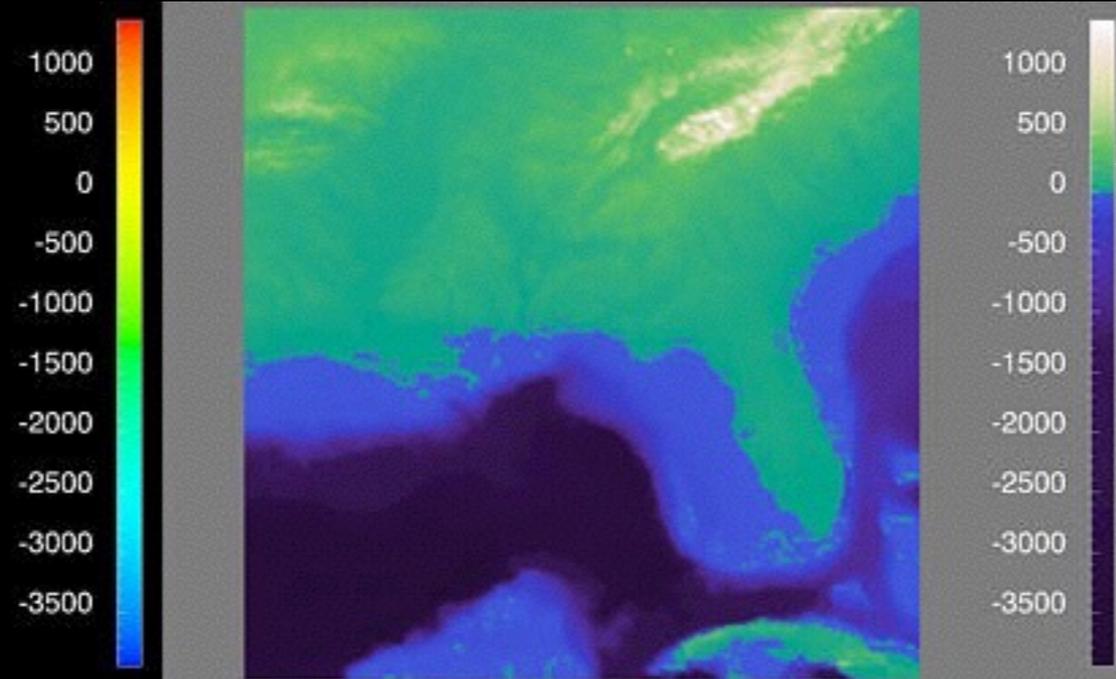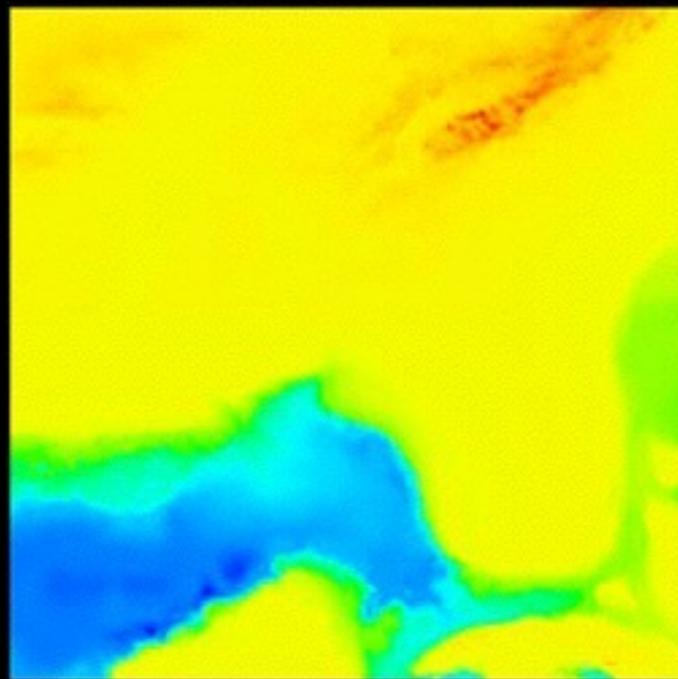


0 è un valore chiave:
alto contrasto
in questo punto

Due scale di colore distinte tra valori positivi e negativi

# Scale di colore

Pseudo-3D   Rainbow   Custom
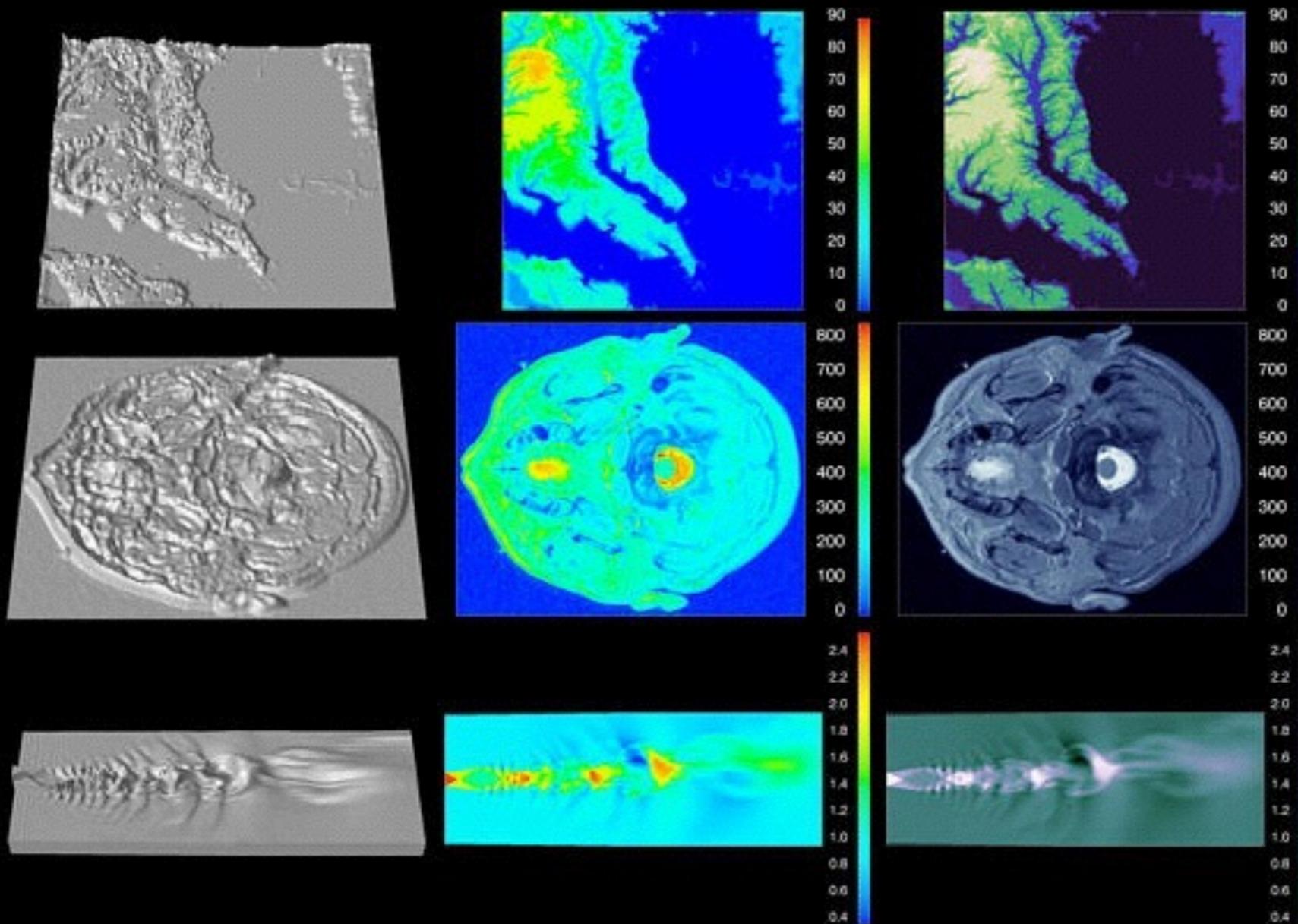
Termocamera
(scala di colore *Rainbow*)

Rainbow

Innaturale, contro-intuitiva
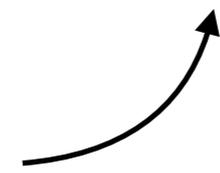
Versione desaturata
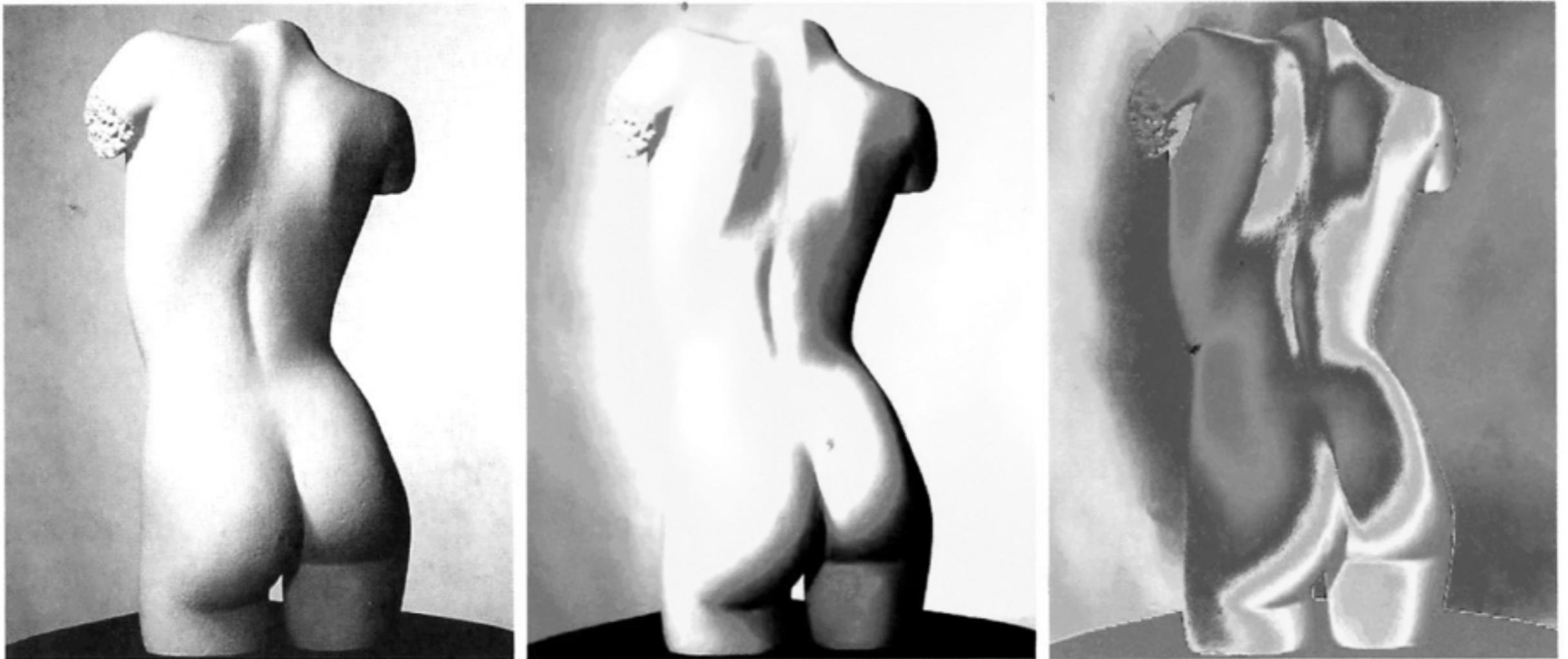
Luminosità che cambia quasi casualmente:
male perché intuitivamente associata a
modulo e rilevanza di un dato

Daltonismo

Daltonismo
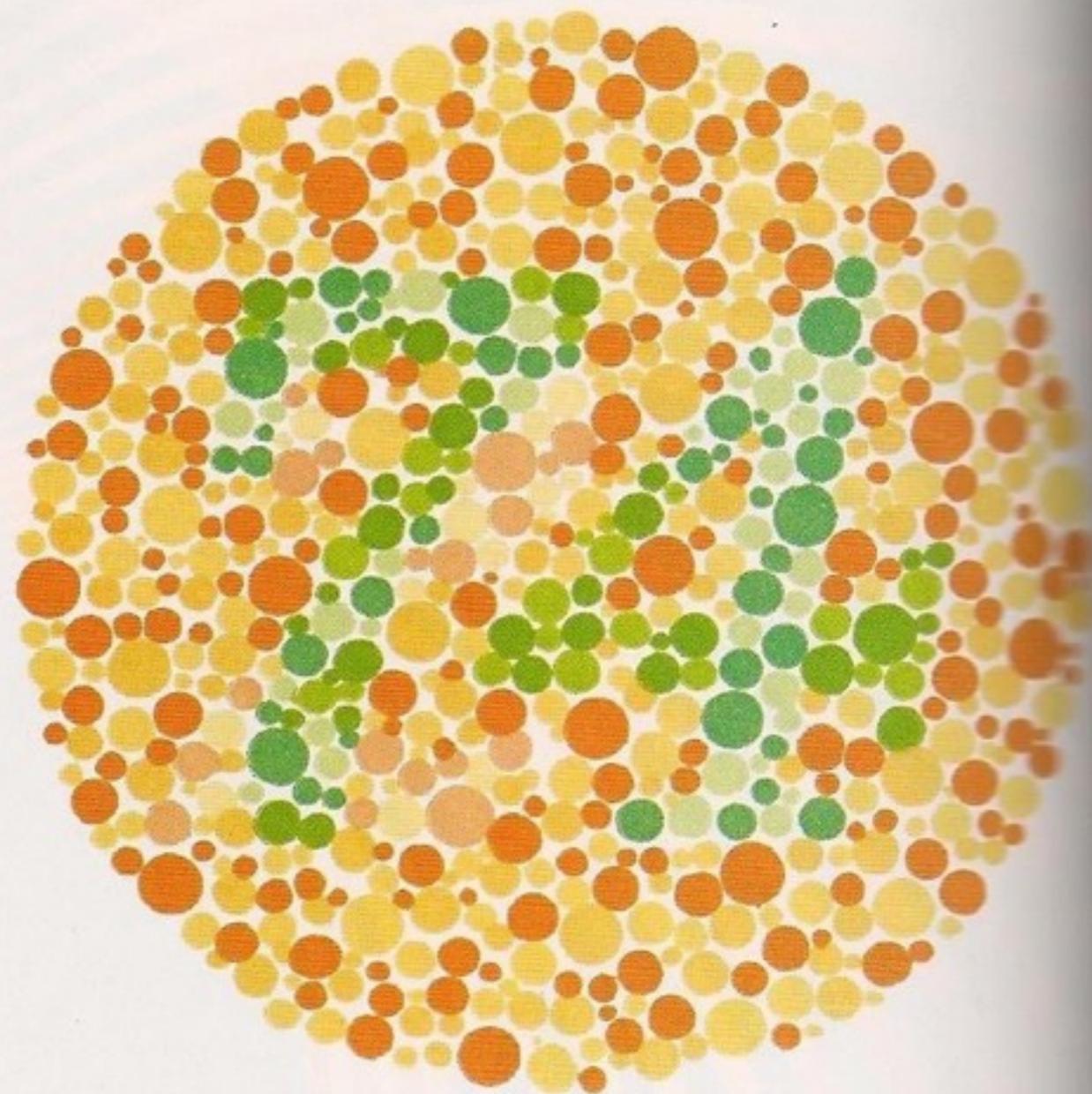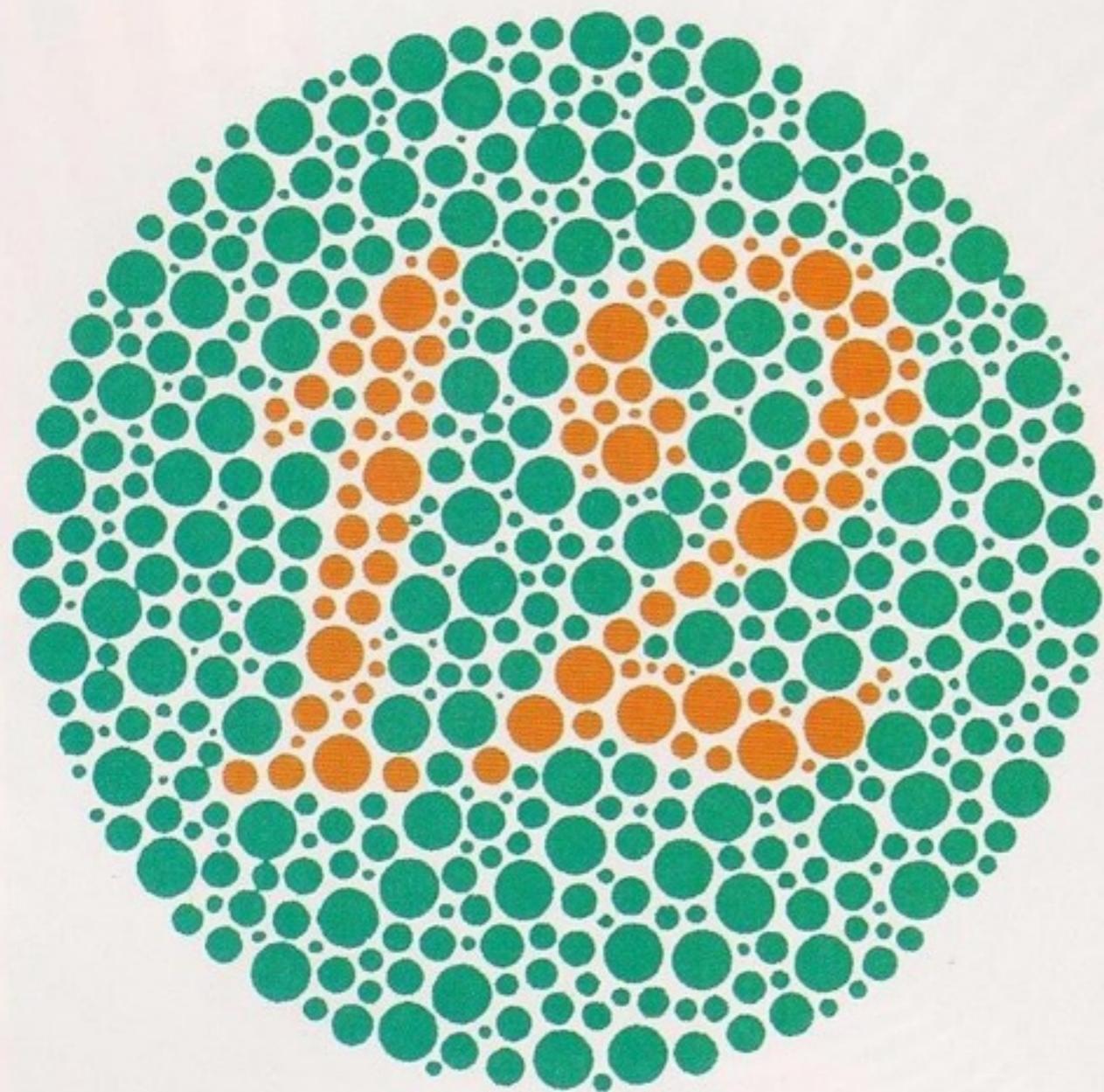
Daltonismo

- 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

Natural color images

Simulated colors as seen by: protanope · deuteranope

a Original image with red and green color coding

b Image with red replaced by magenta

Image with green replaced by turquoise

Male!

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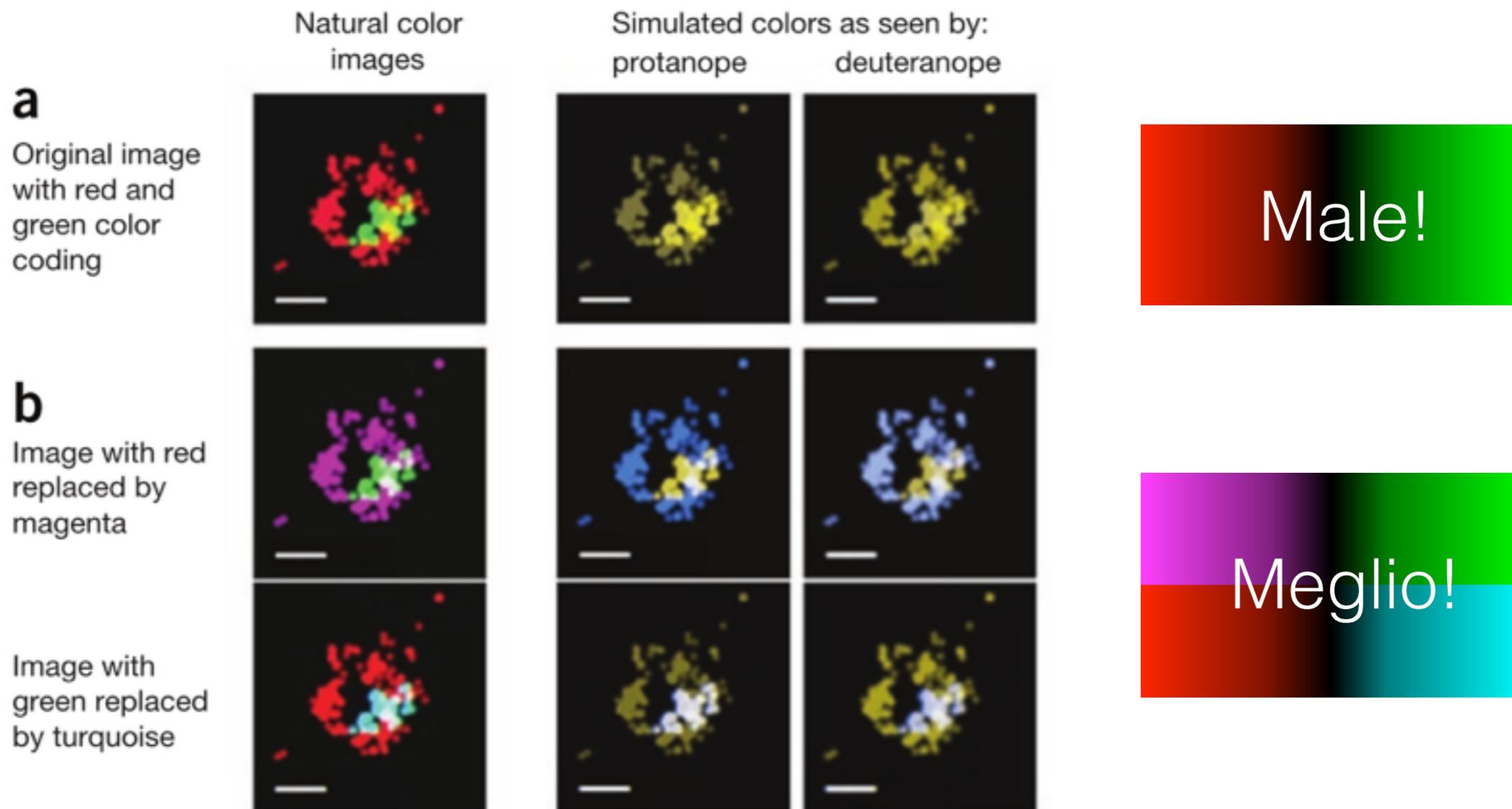
Sia la scala di colore Magenta–Verde che quella Rosso–Ciano sono molto migliori della comune scala Rosso–Verde

Simulatore di Daltonismo

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

Ulteriori risorse: www.vischeck.com

Simulazioni di Daltonismo

Scala di colore ben scelta
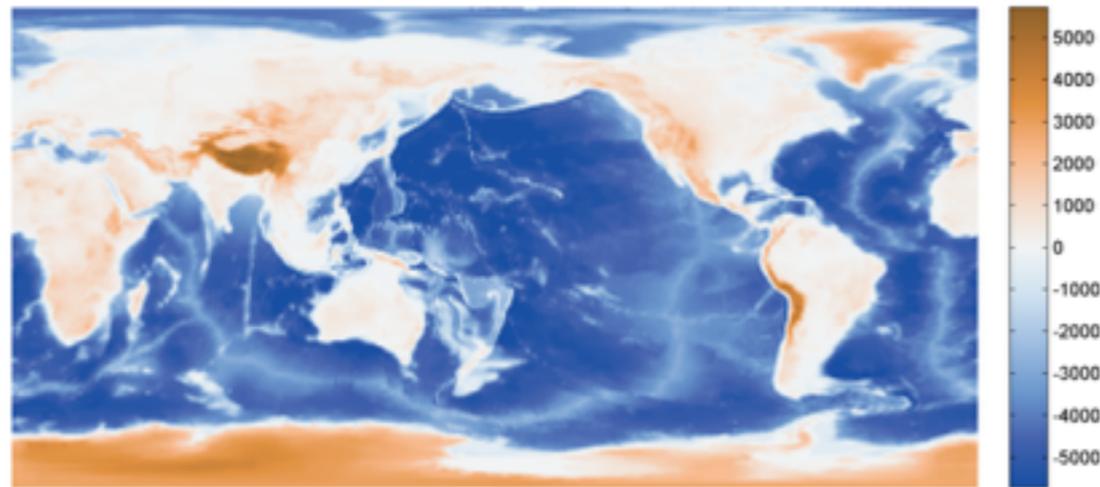
Protanope simulation
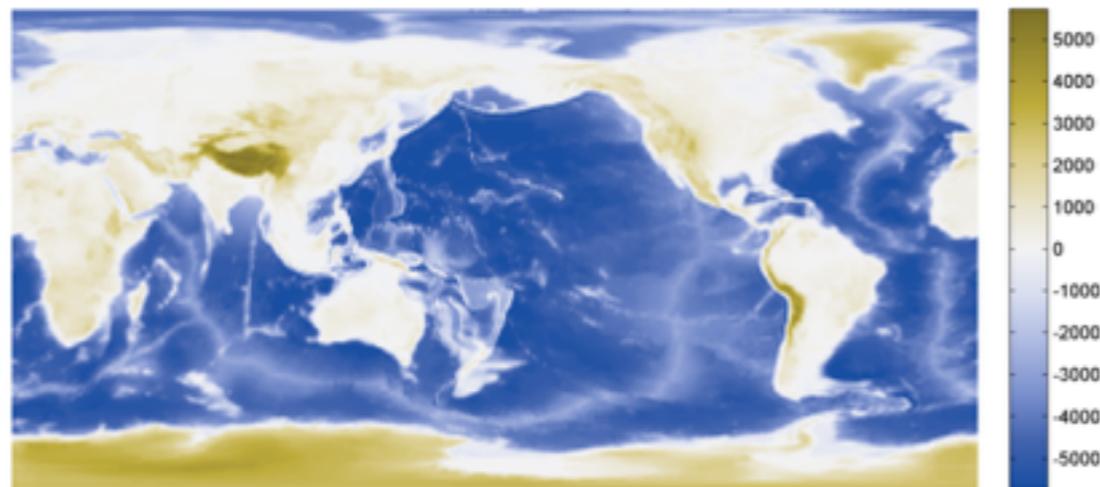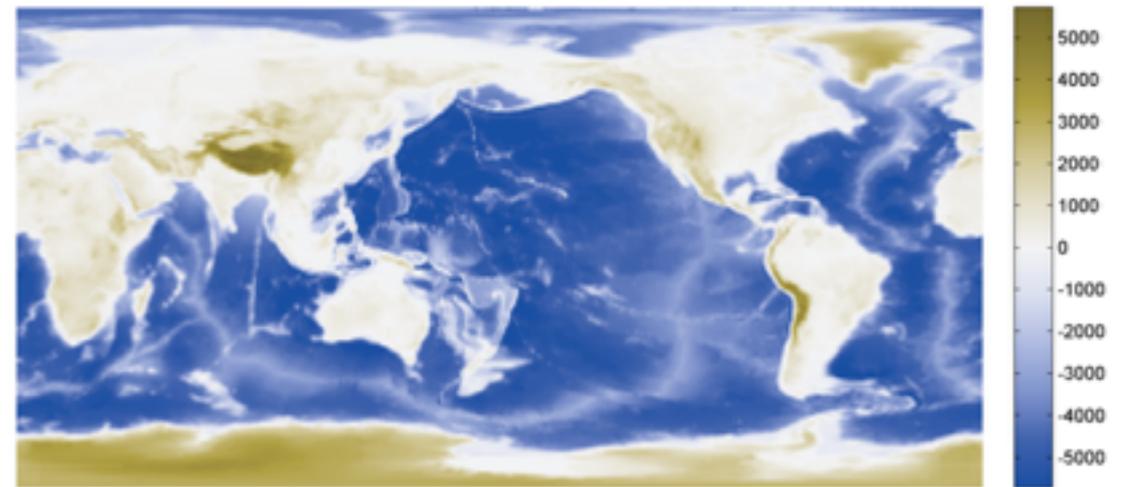
Deuteranope simulation
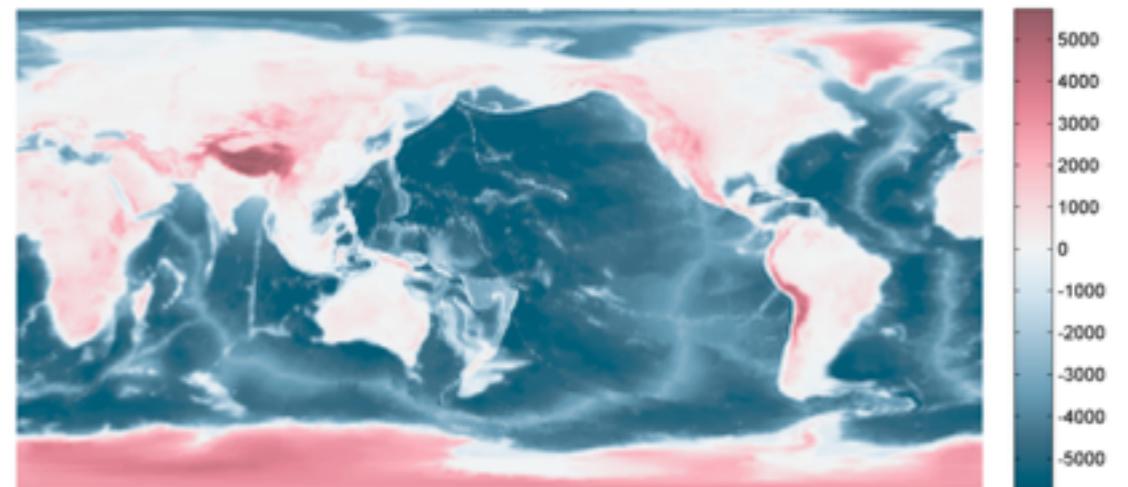
Tritanope simulation

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
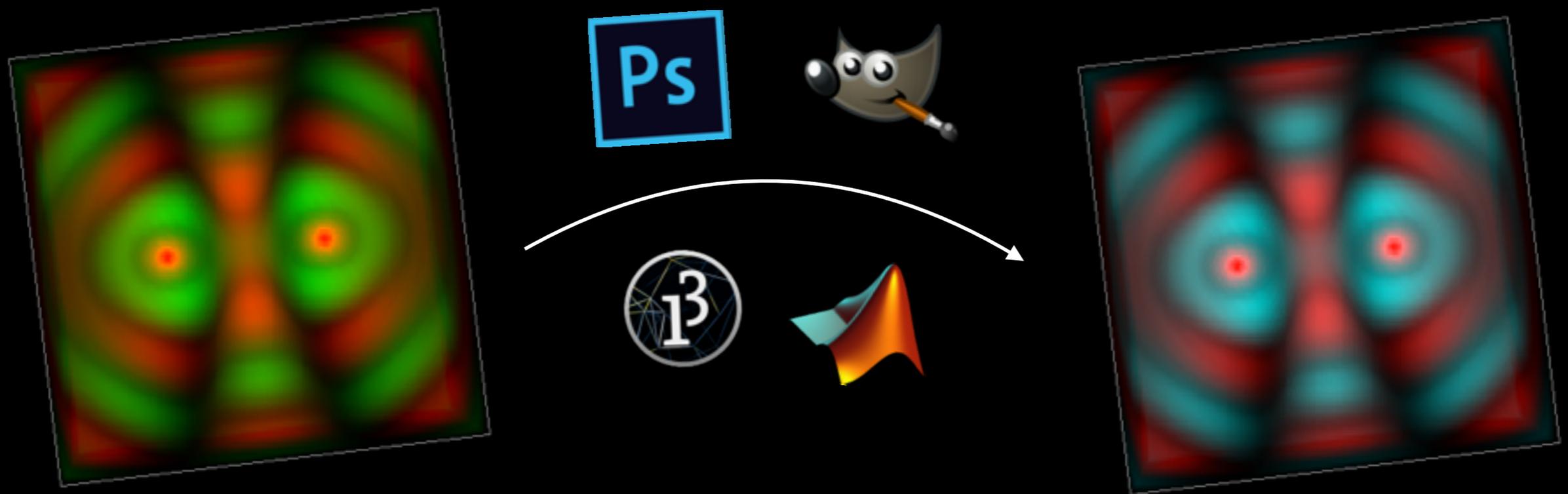
Esempio in Photoshop

Cliccare "Channels", poi "Red"

Seleziona > Tutto, Copia

Cliccare "Blue", Incolla
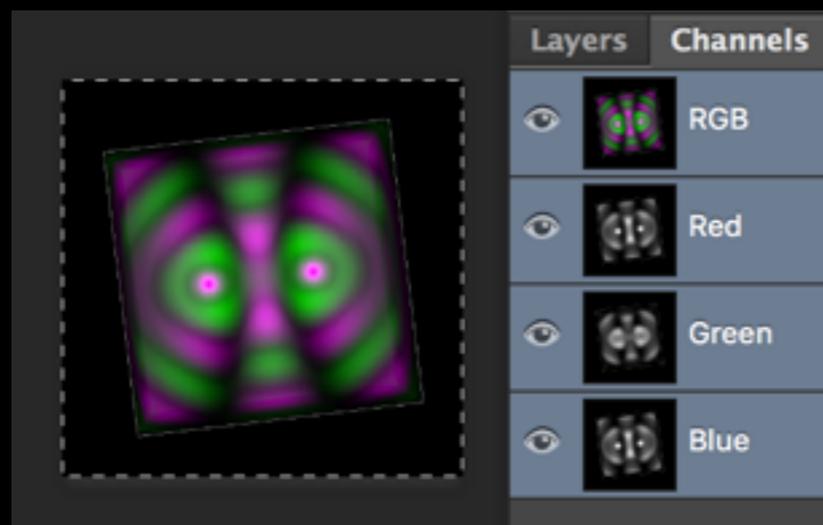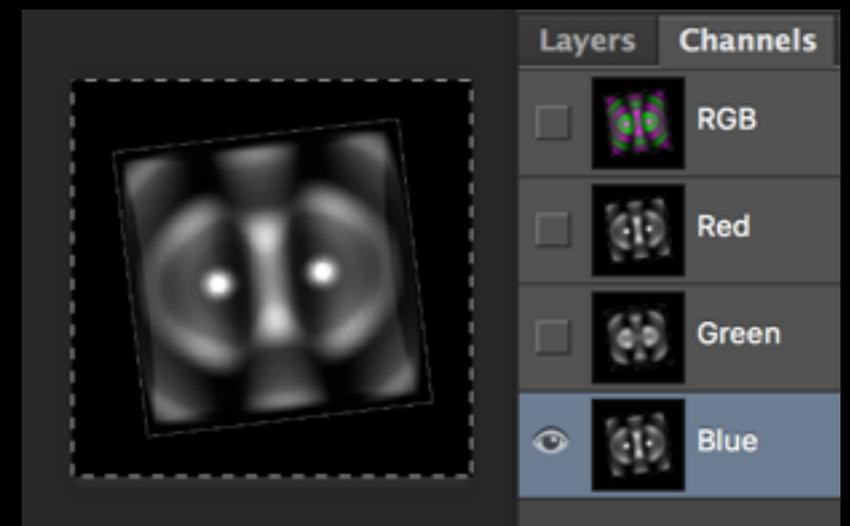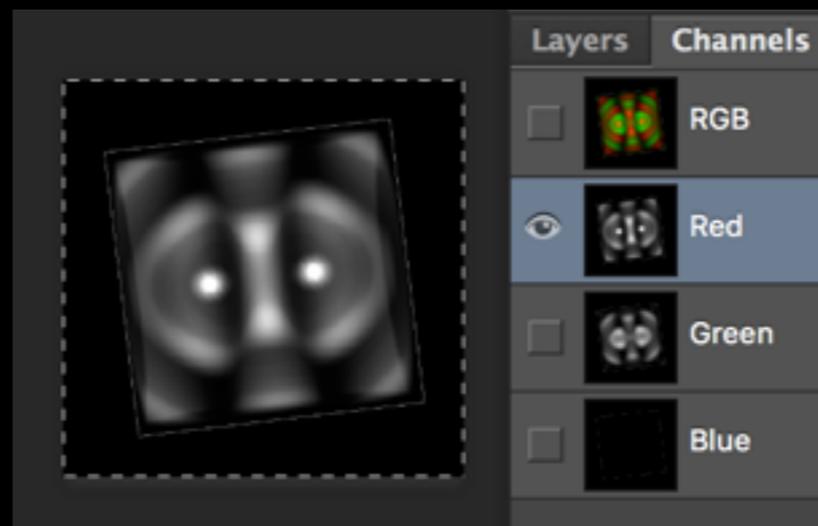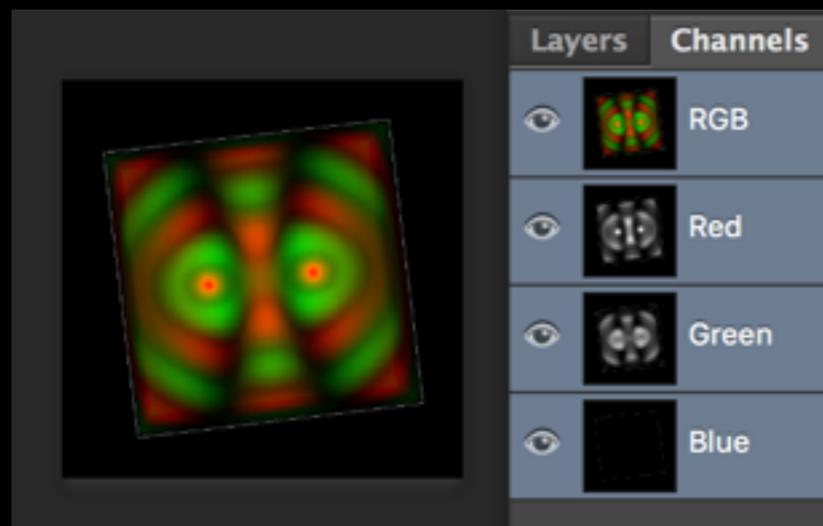
Cliccare "RGB" per vedere l'immagine Magenta–Verde risultante
(Copiare il canale verde per ottenere invece un'immagine Rosso–Ciano)

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)
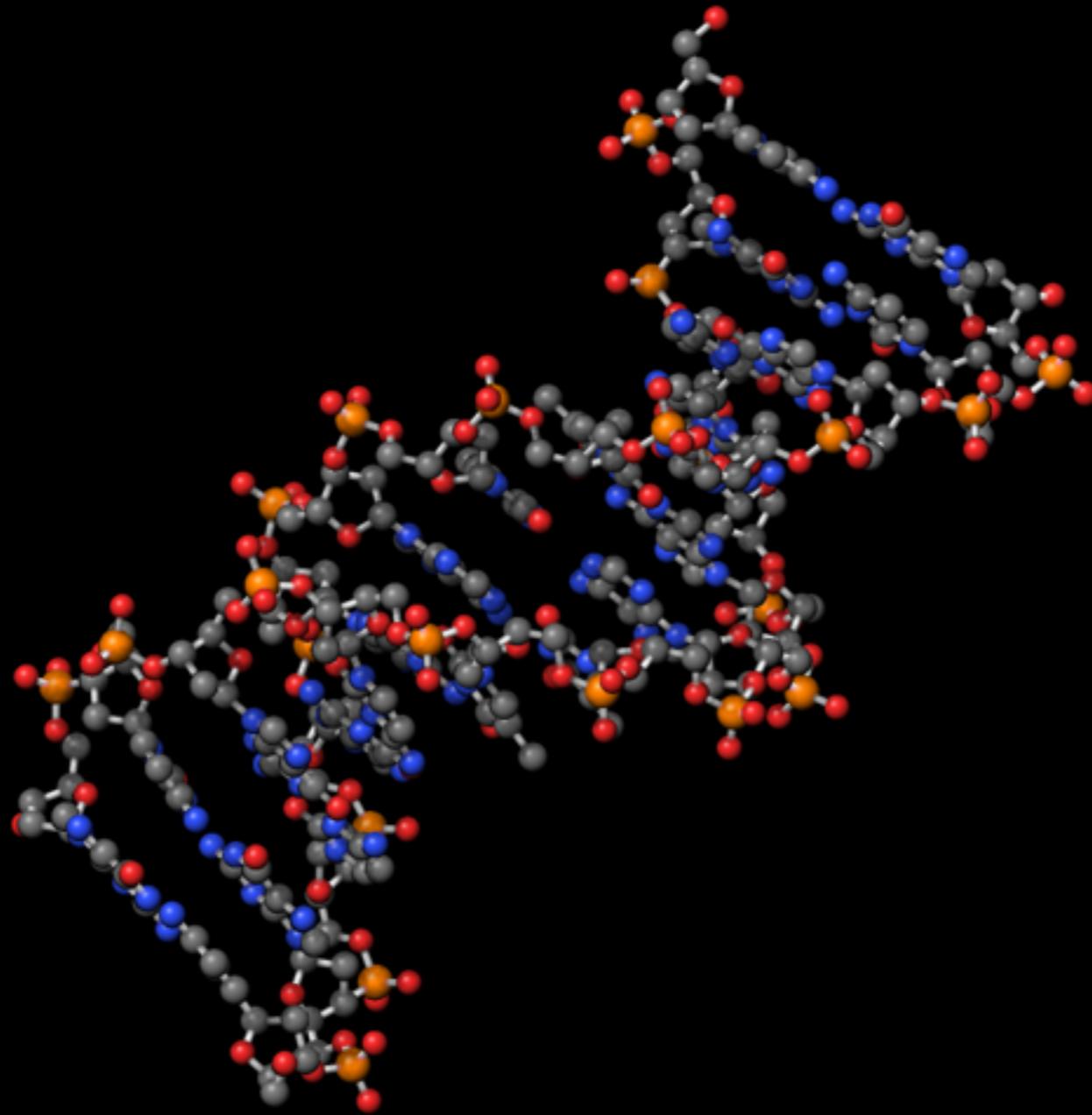
iSpartan (19.99€)
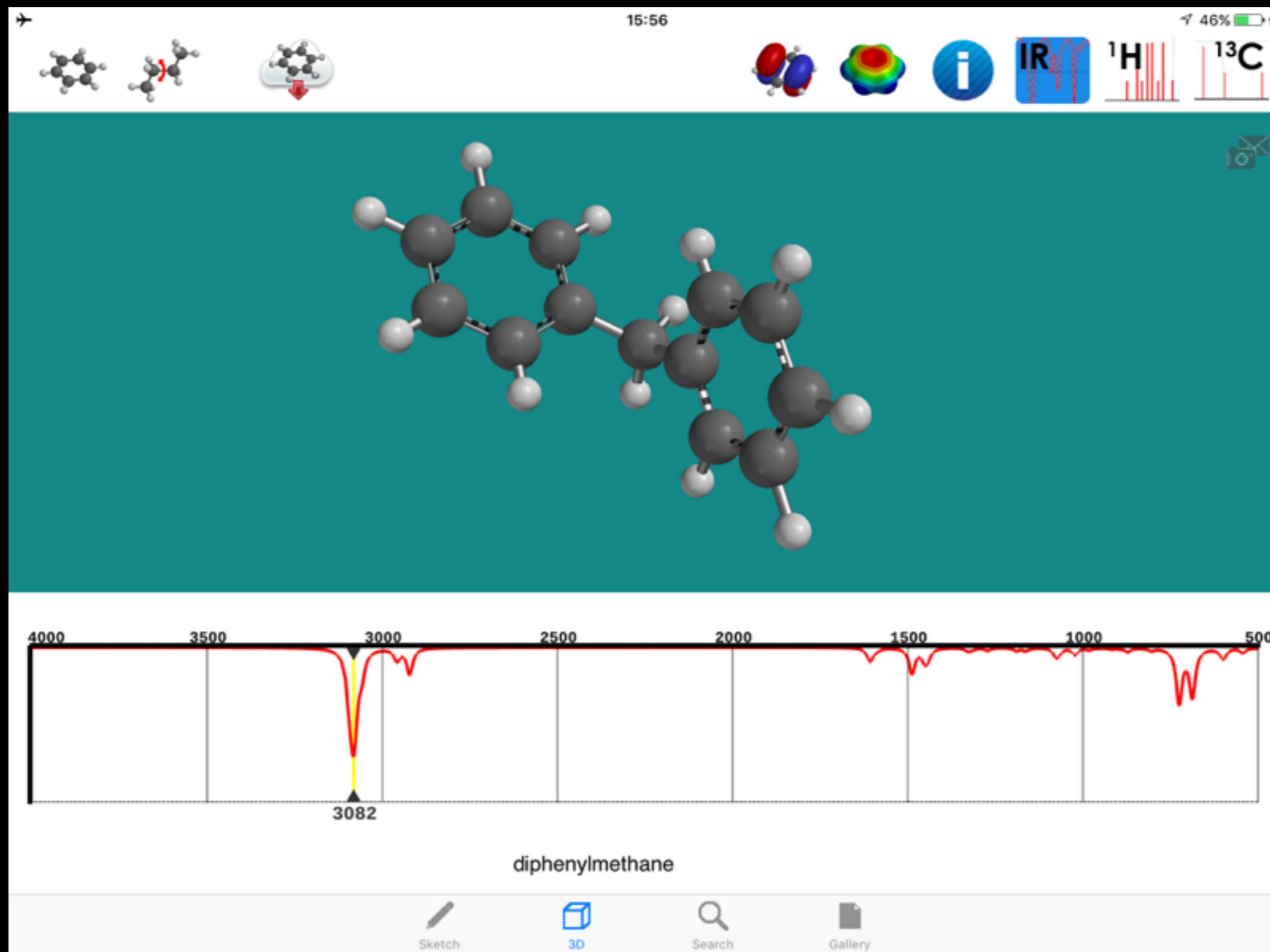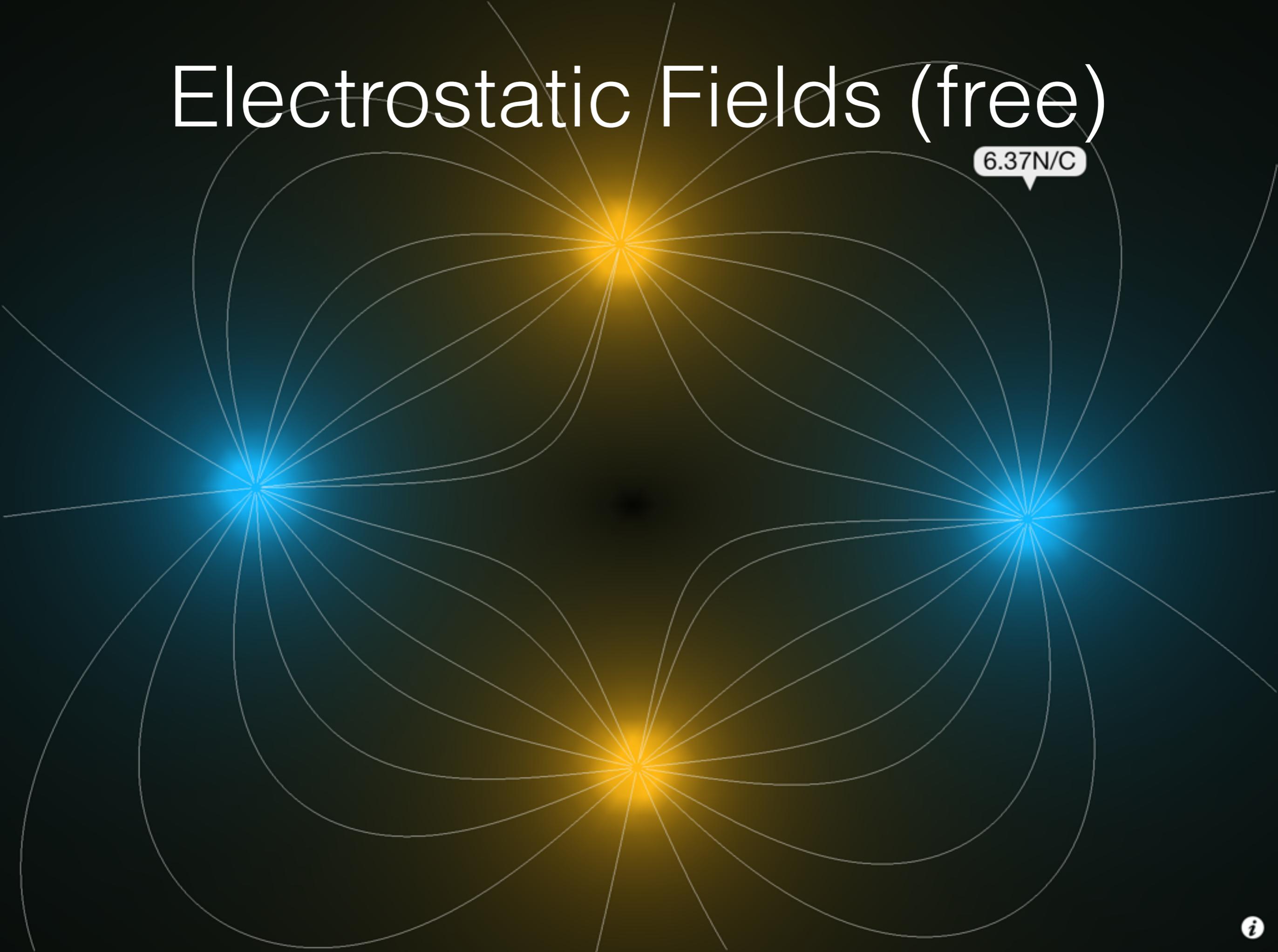
La quarta dimensione (2,99€)

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
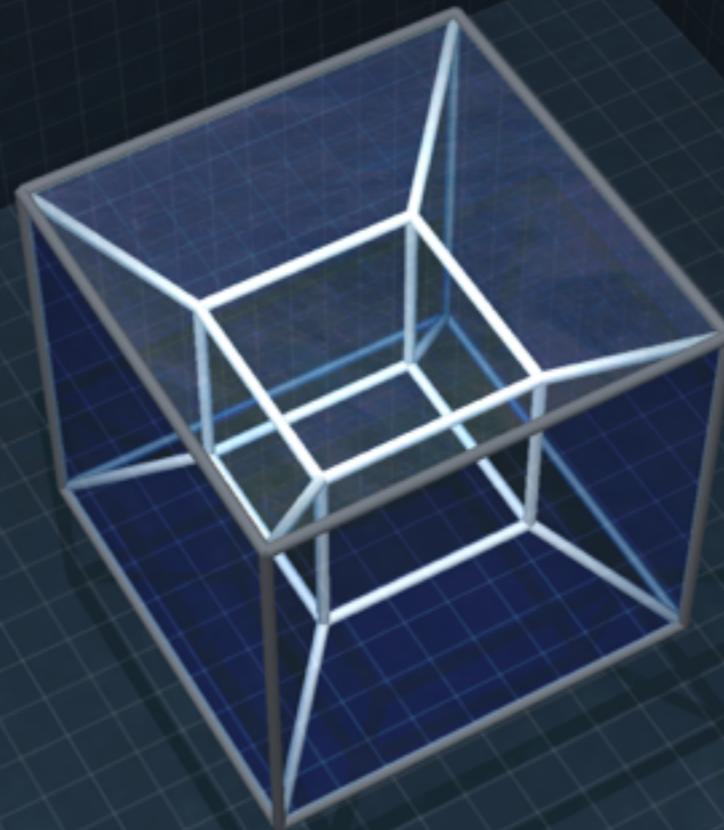
3D

4D

Exoplanet (free)
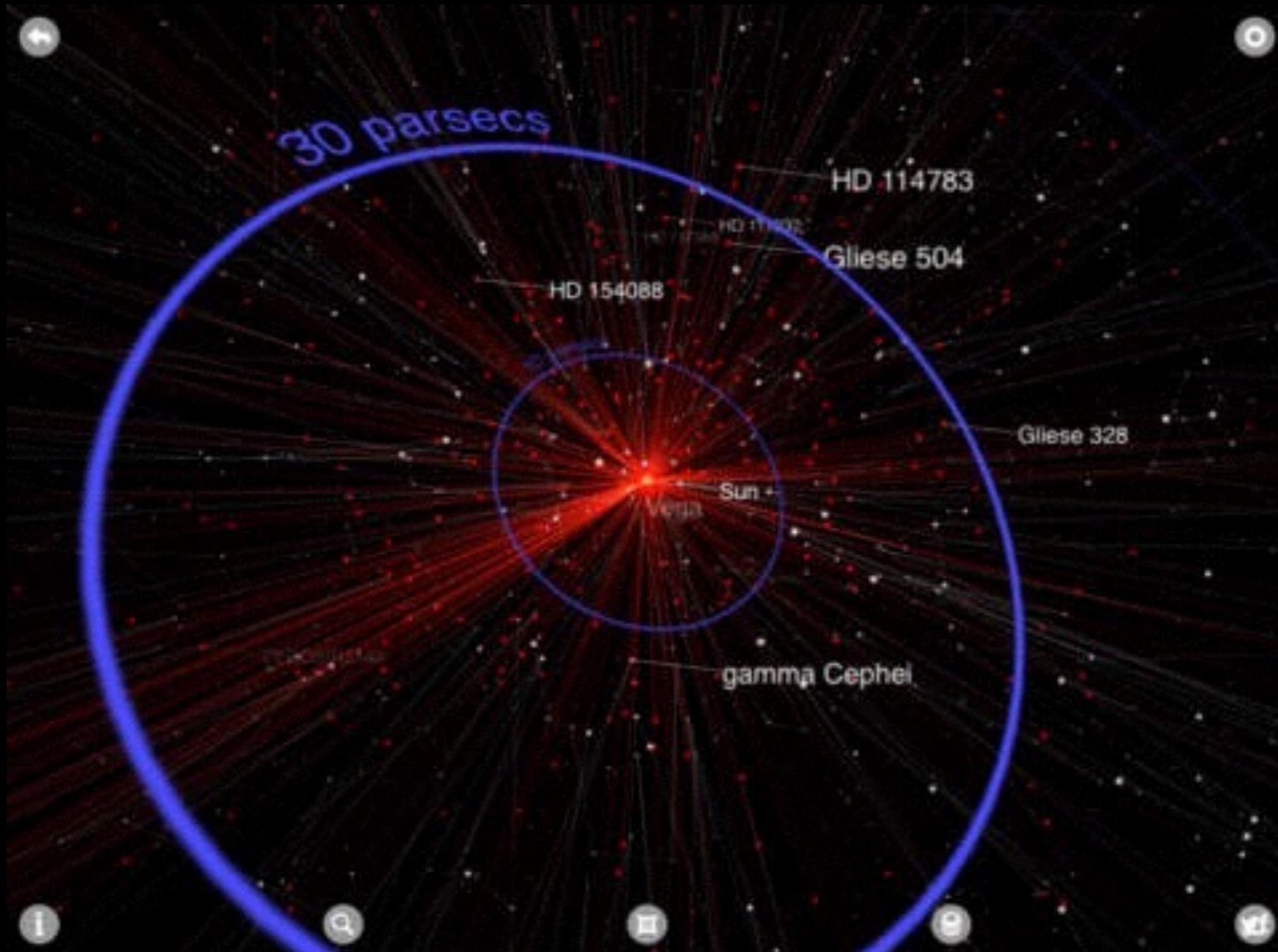
Solar Walk (free)

Missioni   Film   Pianeti alta risoluz.

Pacchetto tutto in uno

-70%

$0.99   Sblocca

	Confronto dimensioni 1 min. 40 sec. Apri		Cicli della terra 1 min. 57 sec. Apri
	Eclissi solare 2 min. 22 sec. Apri		Le fasi lunari 2 min. 45 sec. Apri
	Fenomeno delle maree 1 min. 57 sec.		Principali paralleli 2 min. 11 sec.
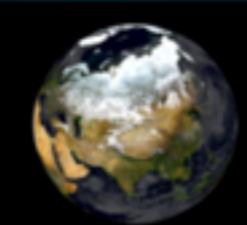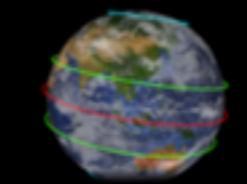
RayLab (free)
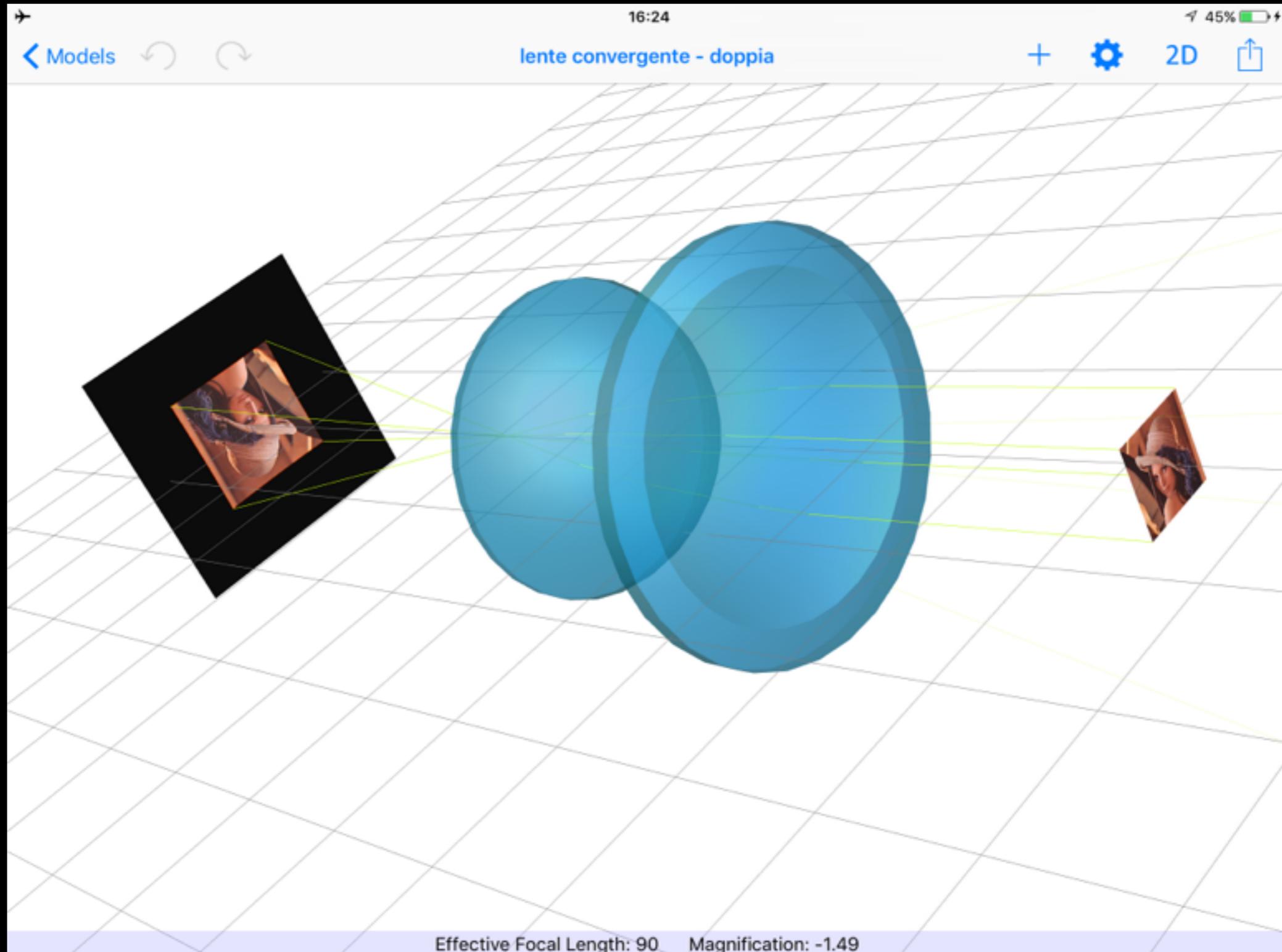
Wind Tunnel (free)
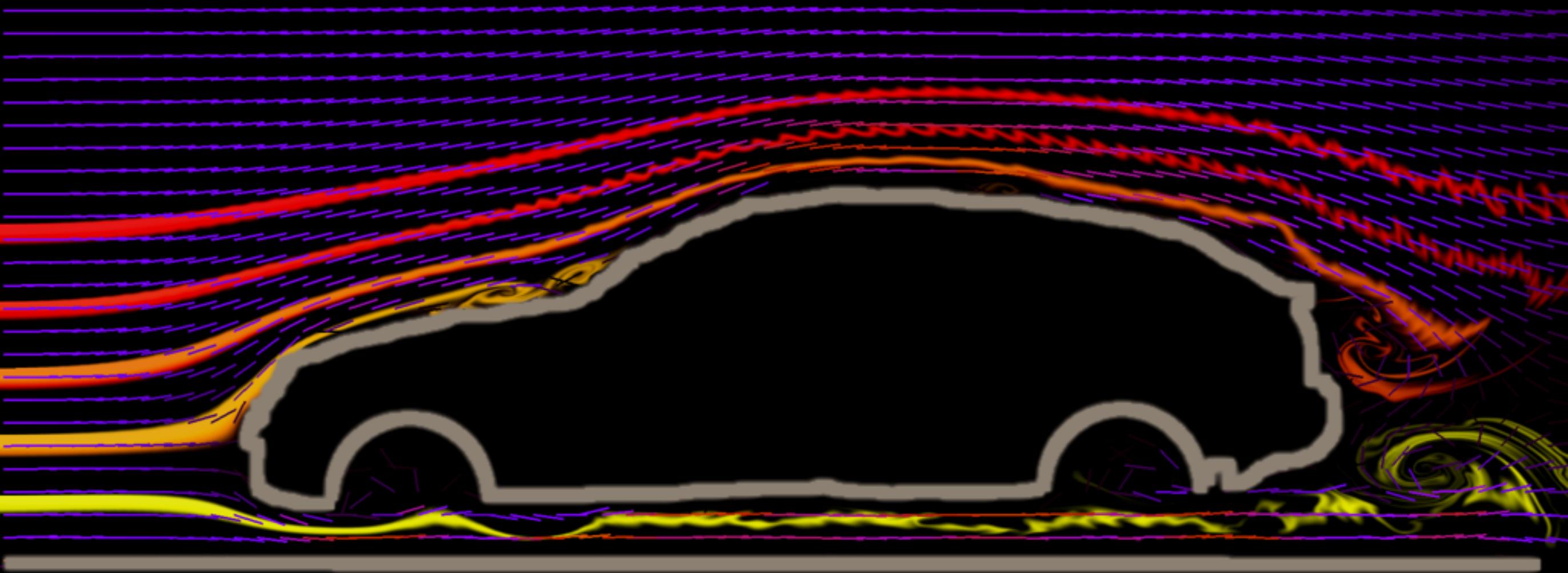
Ripple Tank (free)
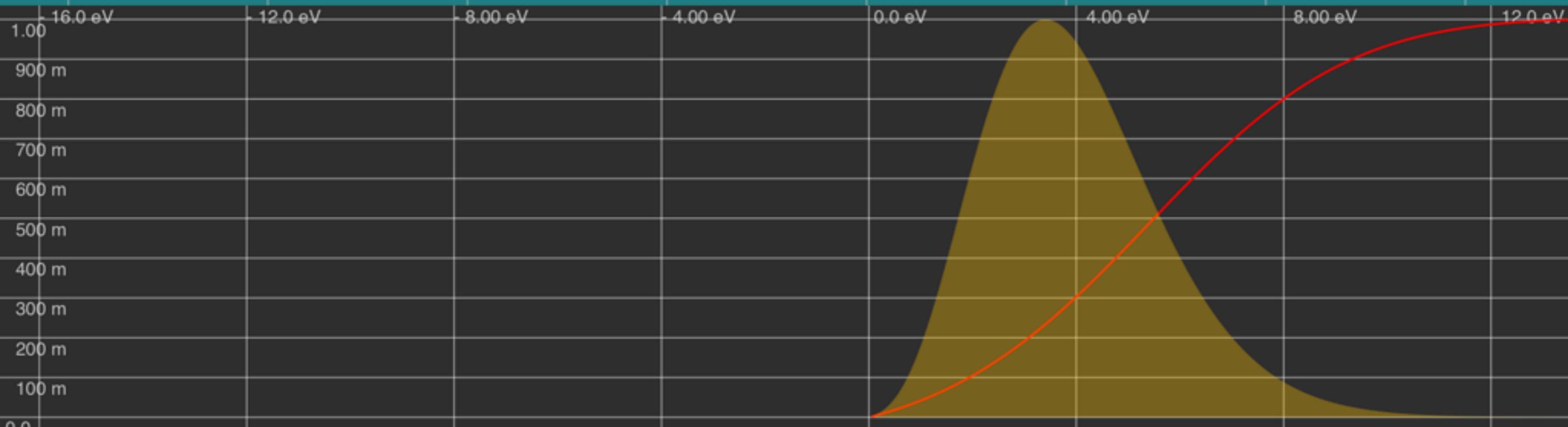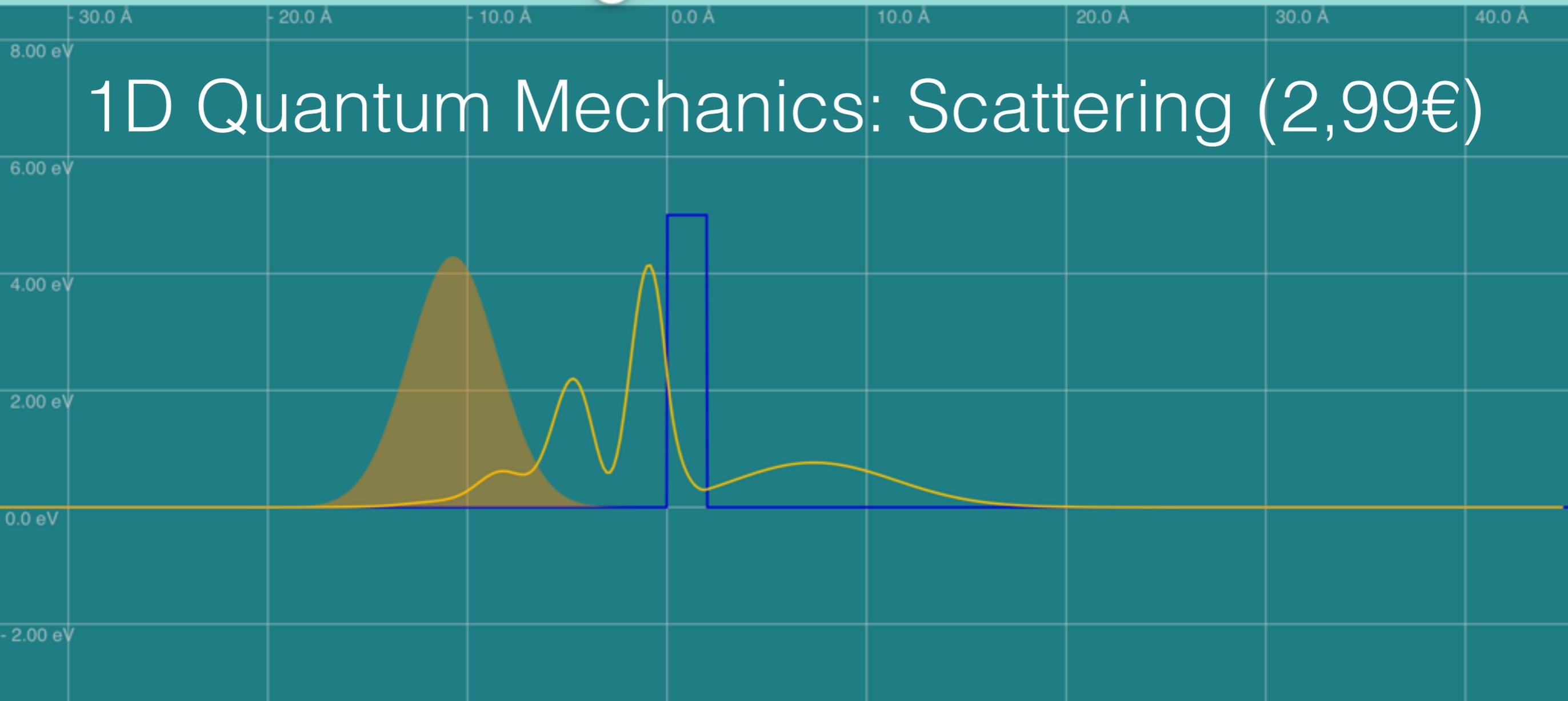
Visualizzazioni basate su sensoristica interna o esterna

Accelerometri
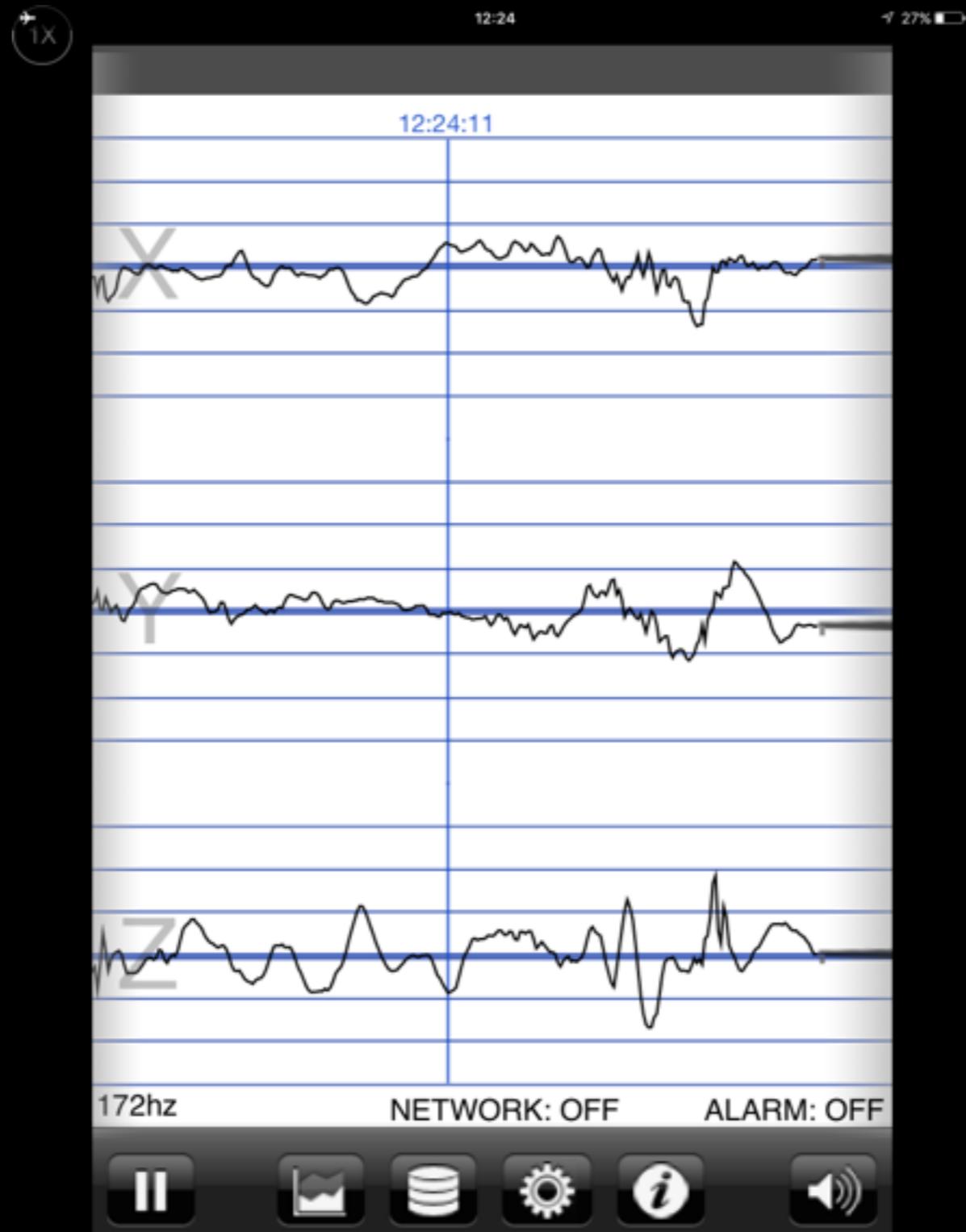
Termocamera (FLIR ONE)
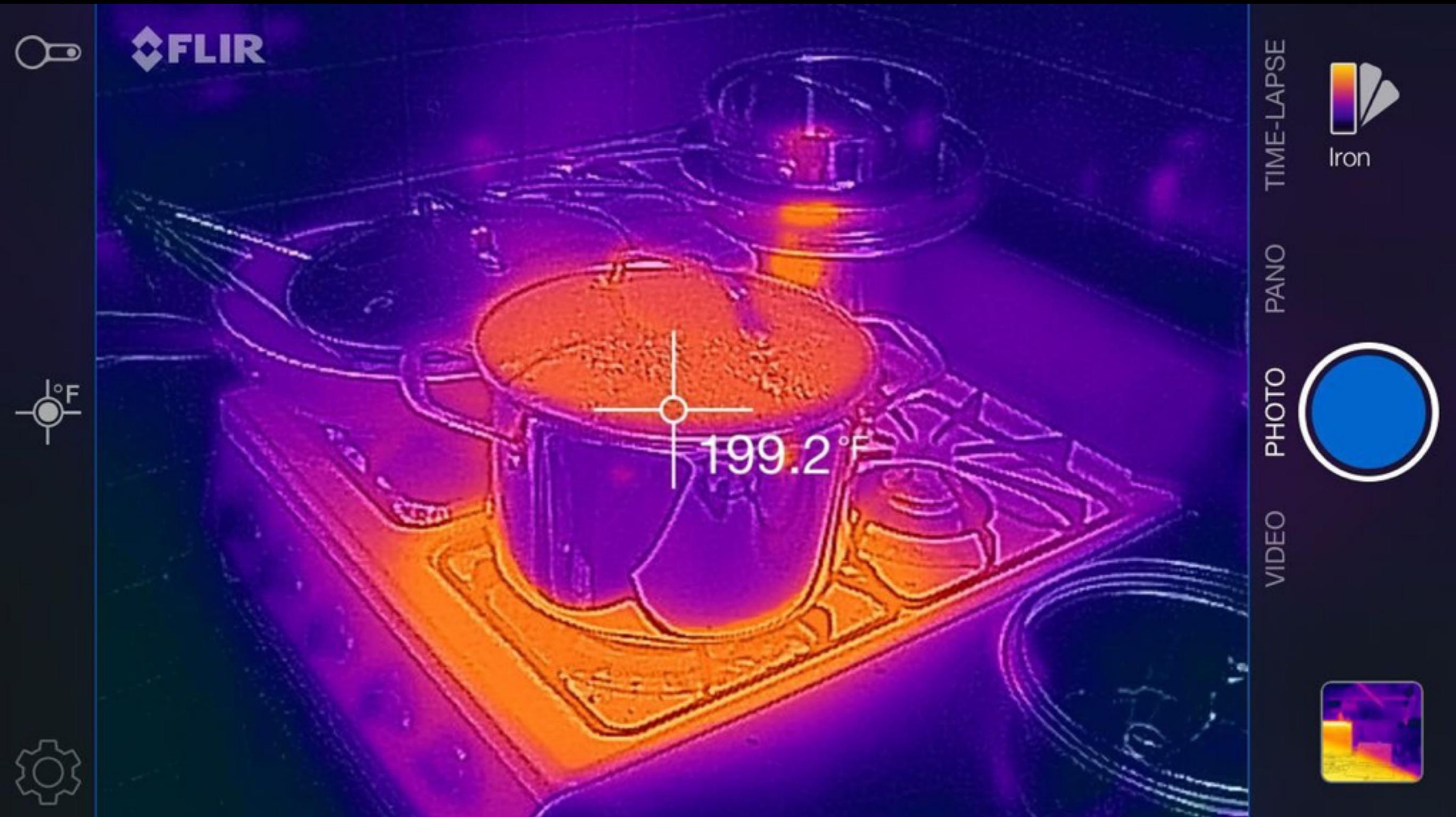
Fisica del suono (trasformate di Fourier)
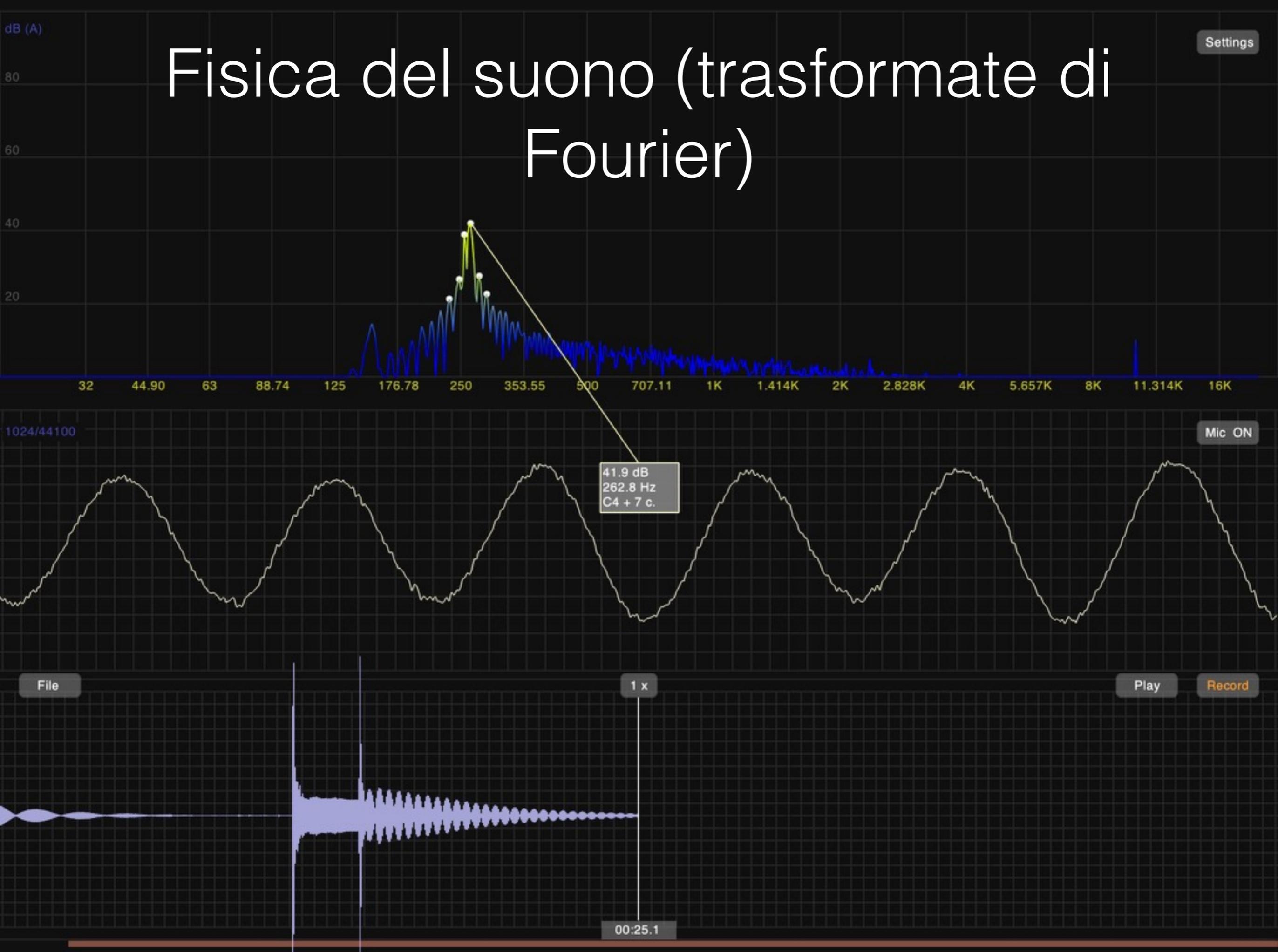
Google Cardboard
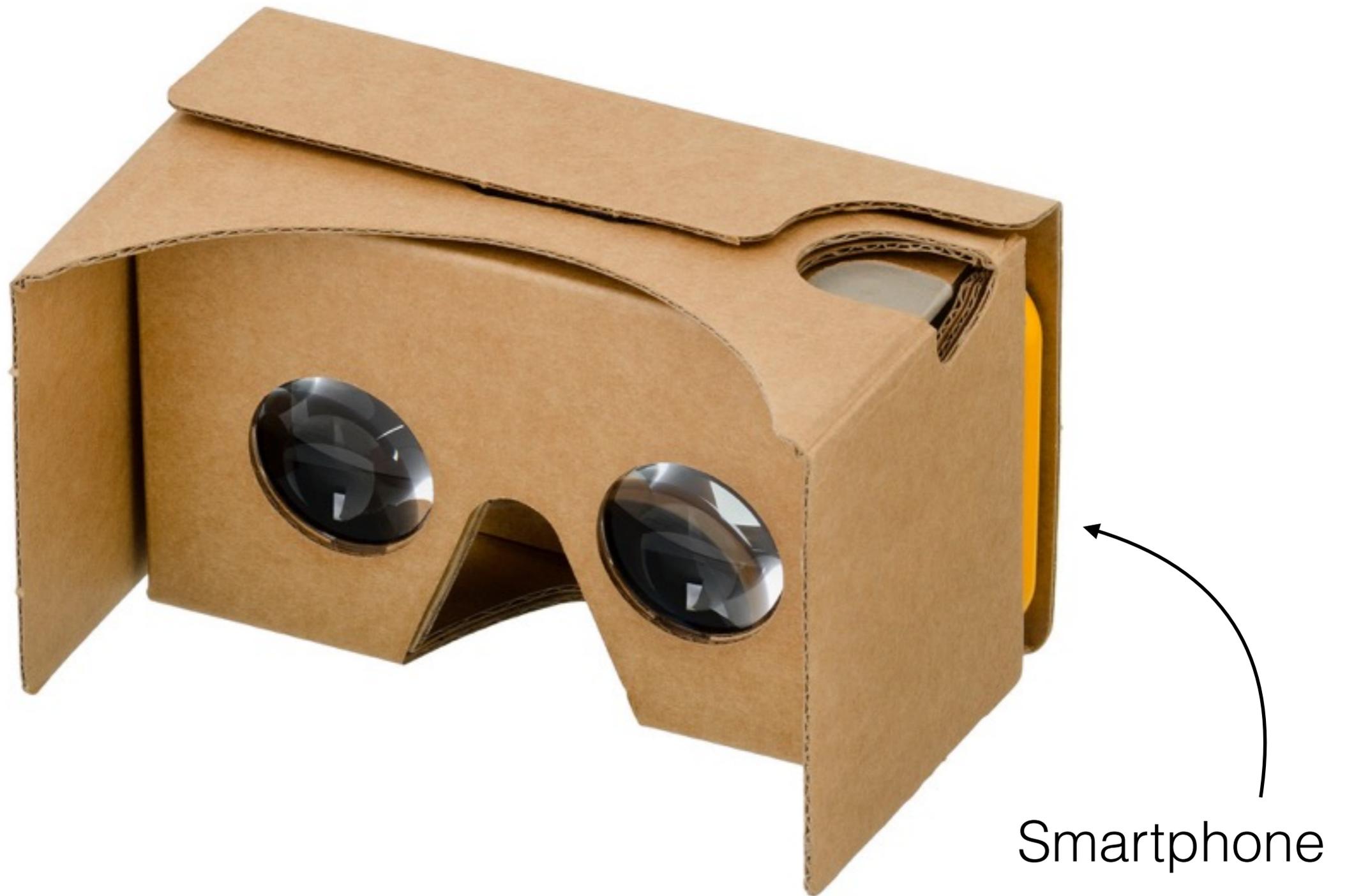
Smartphone

Realtà virtuale – Roller Coaster (free)
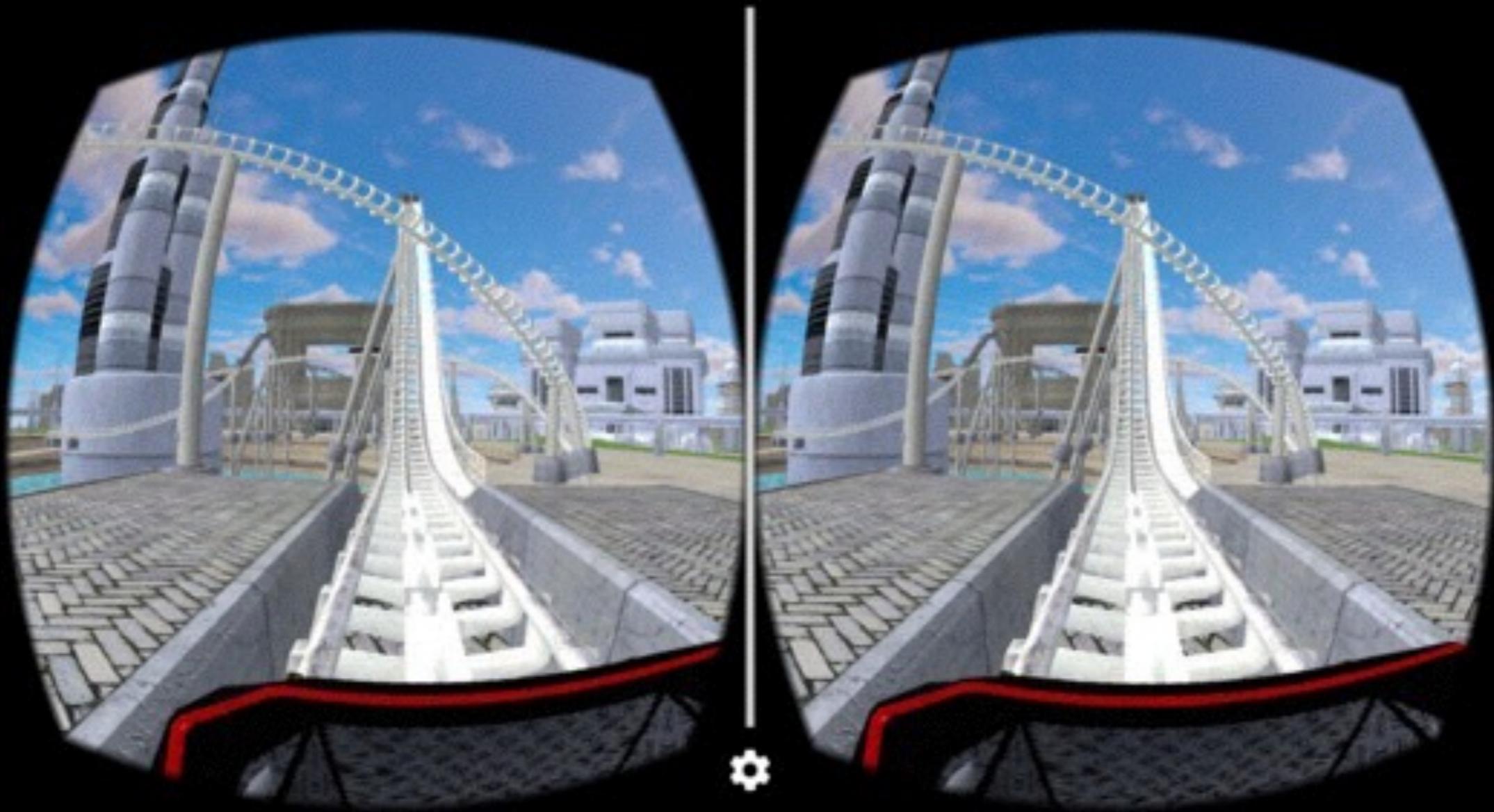
Realtà virtuale – Within (free)

IV.
Esempio: Hydrogen!

Vedere attraverso la matematica

$$\psi_{nlm} = a_0^{-\frac{3}{2}} N_{nl} F_{nl}\left(\frac{2r}{n a_0}\right) Y_l^m(\theta, \phi)$$
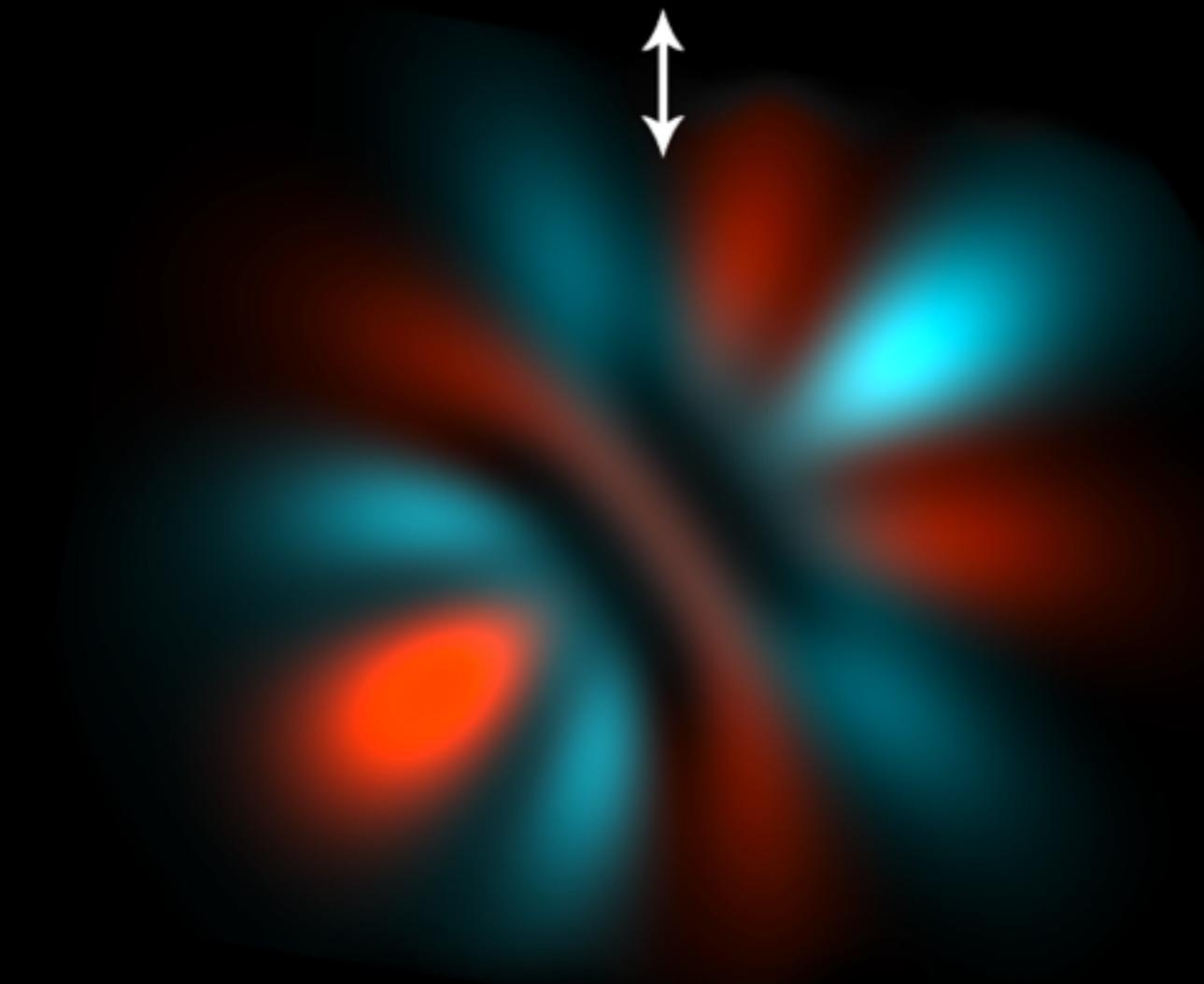
Principio di corrispondenza
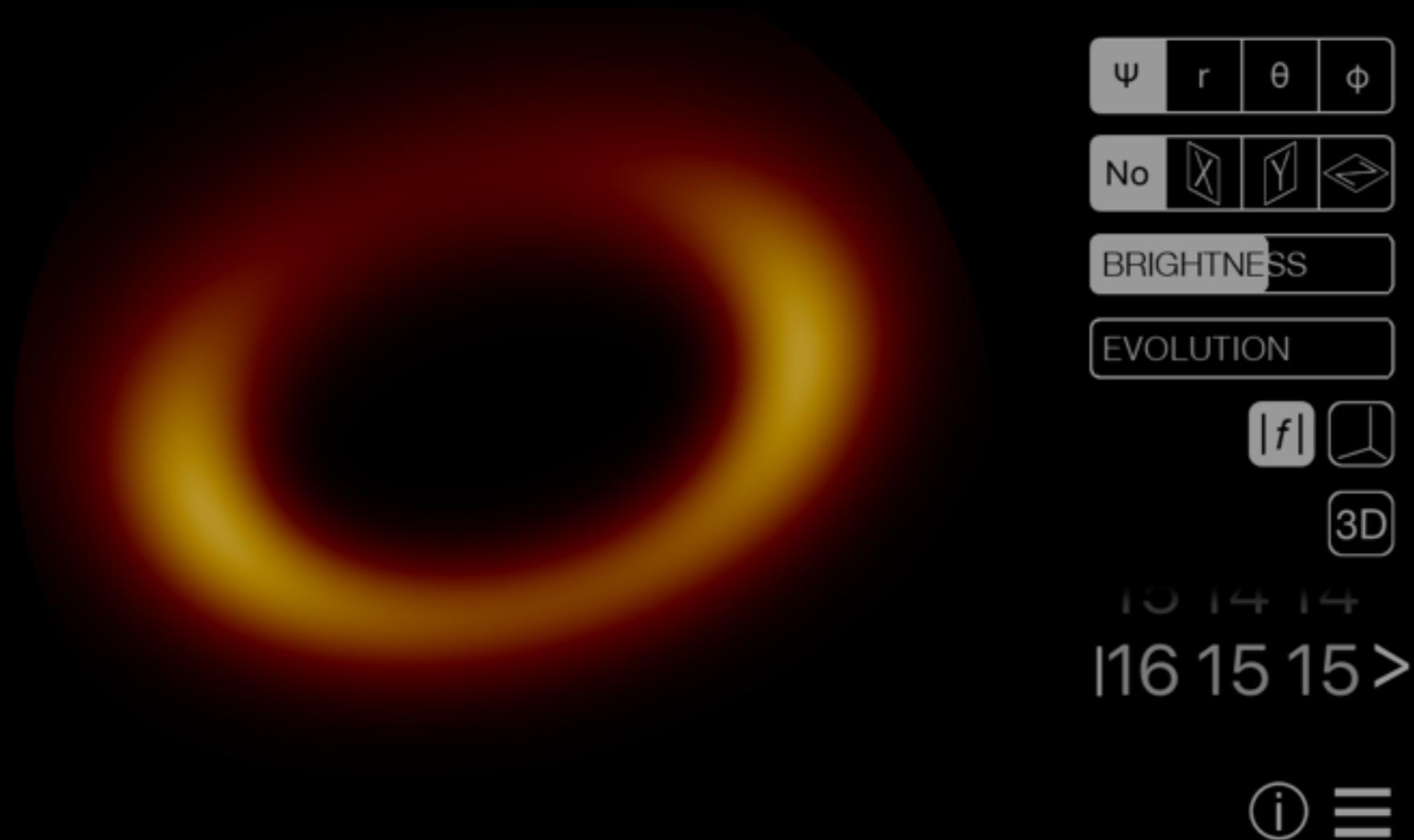
Per alti numeri quantici i risultati quantistici tendono a quelli classici

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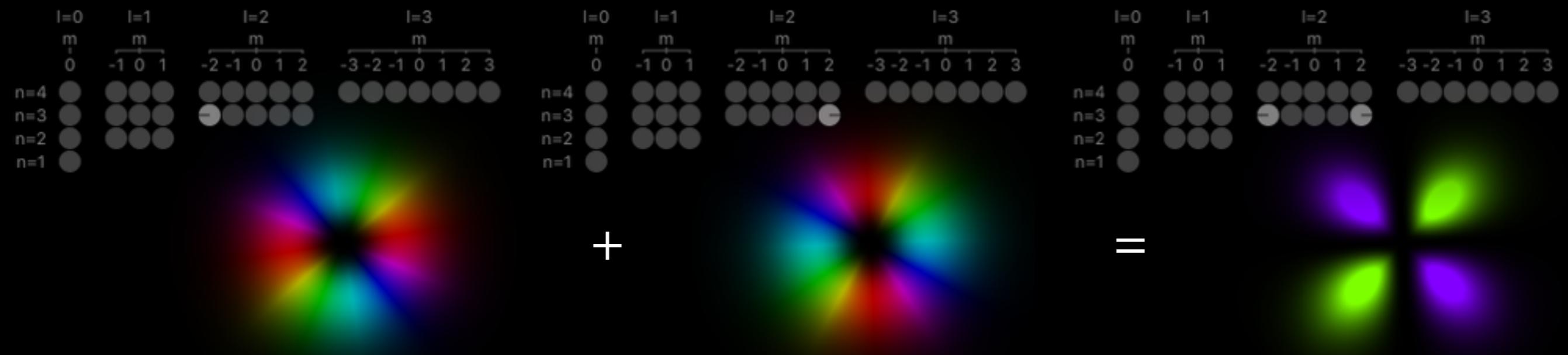
Differenza tra probabilità classica e quantistica
(analogo dell'esperimento della doppia fenditura)

Transizioni e spettroscopia

Choose a transition permitted by selection rules:

Starting orbital

$|3 \ 1 \ 1 >$

l=0   l=1   l=2   l=3

m   m   m   m

0   -1 0 1   -2 -1 0 1 2   -3 -2 -1 0 1 2 3

n=4
n=3
n=2
n=1

$E_4 = -0.9 \text{ eV}$

$E_3 = -1.5 \text{ eV}$

$E_2 = -3.4 \text{ eV}$

Emitted photon with energy:

$E = E_3 - E_1 = 12.1 \text{ eV}$

$E_1 = -13.6 \text{ eV}$
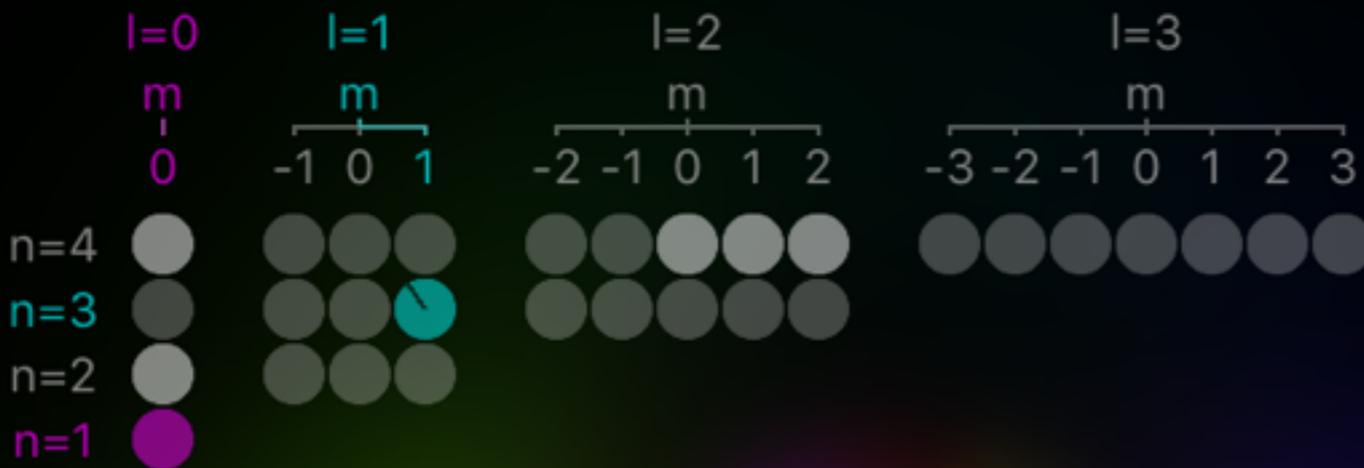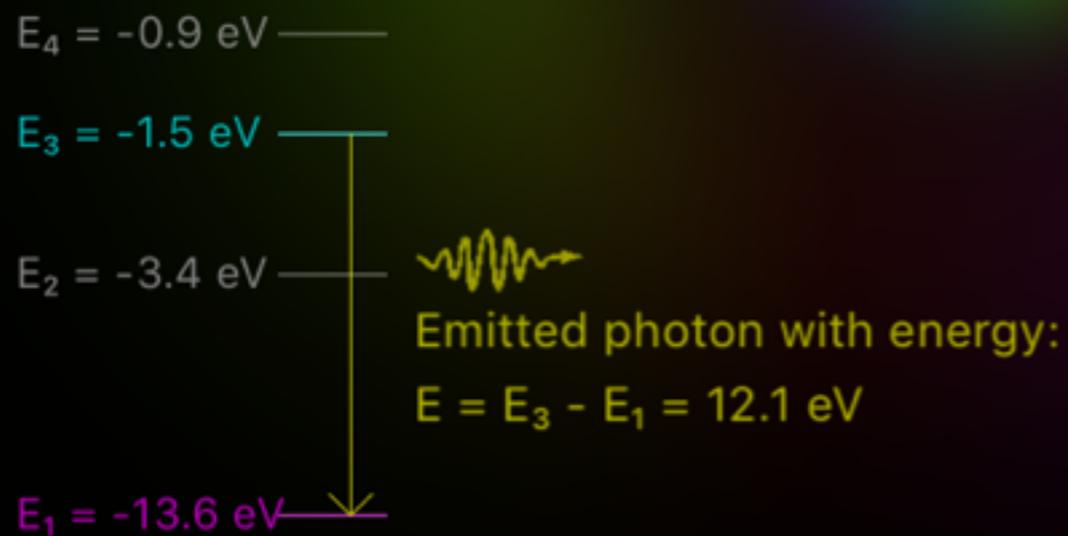
V.
Sviluppare le proprie app

Android

Android Studio

Processing

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
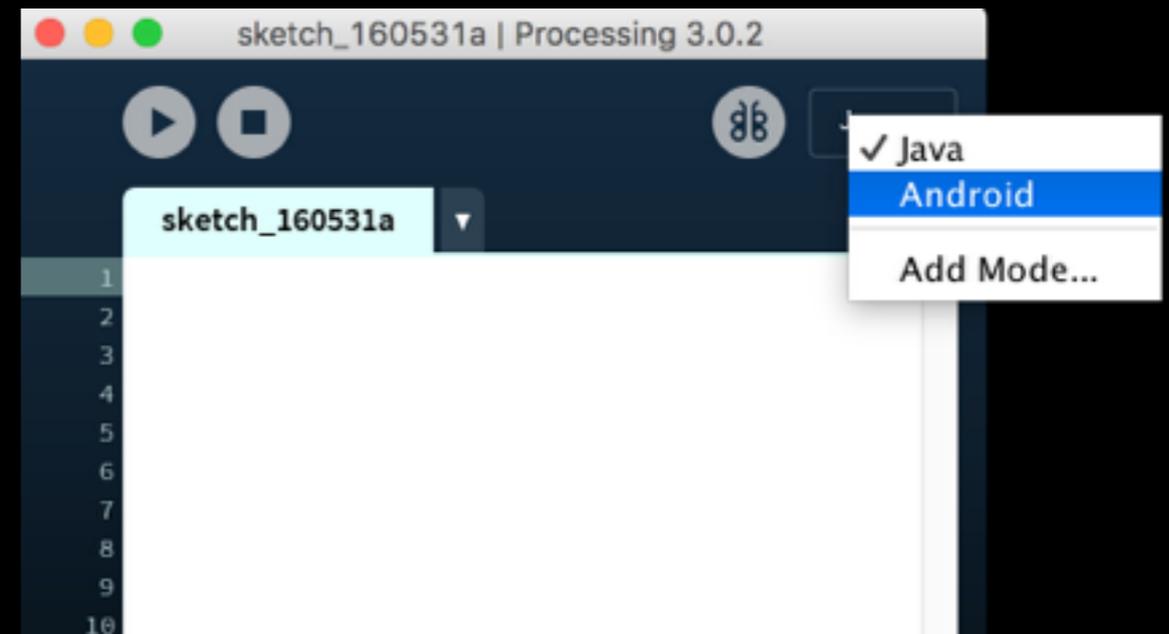
Processing "Android mode"

Processing for Android

Home
Install
Reference
Tutorials
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

Open Processing

Esempio di comunità su Processing: www.openprocessing.org

Esempi di codici visualizzabili online e scaricabili.

iOS & WINDOWS

iOS: Xcode
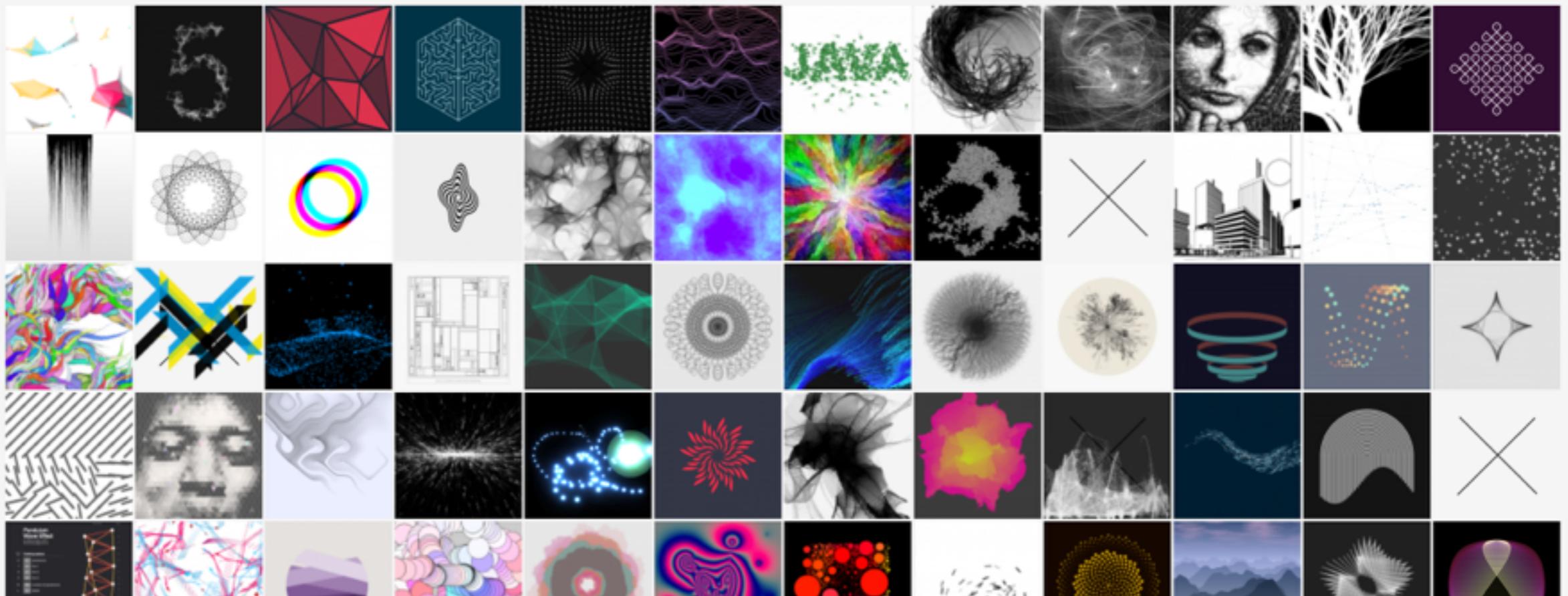
https://developer.apple.com/xcode/
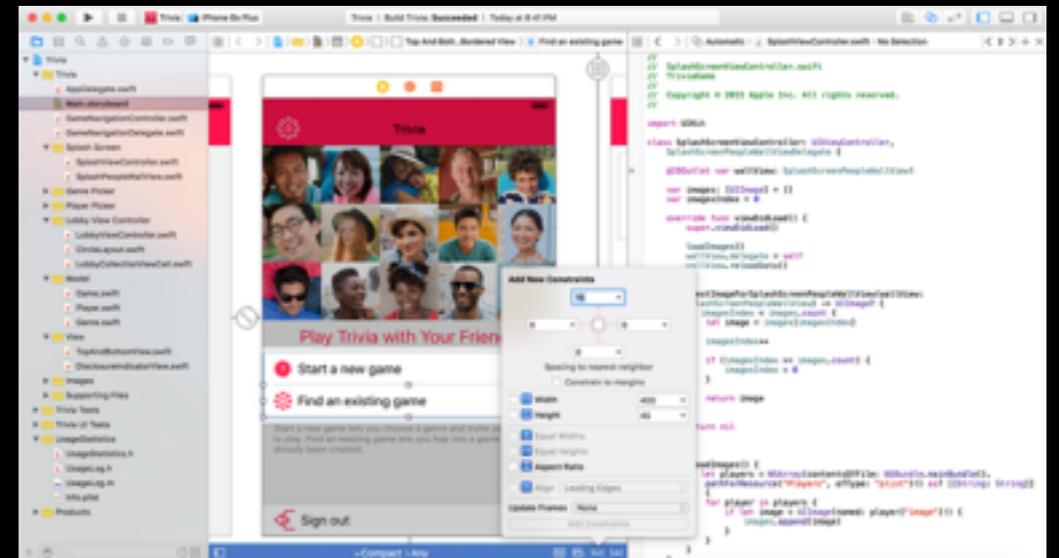
Windows: Visual Studio

https://www.visualstudio.com
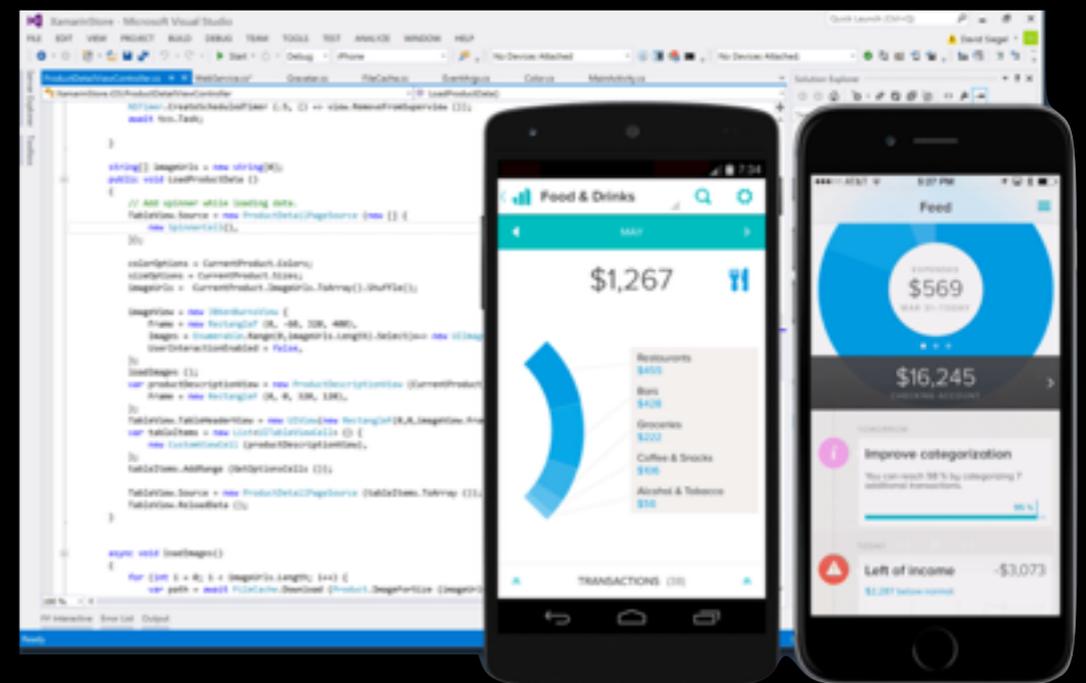
Esempi Xcode

AccelerometerGraph

▼ Table of Contents

Download Sample Code

Next

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

Librerie Open di chi vende l'hardware

Grazie dell'attenzione!

Tommaso Rosi

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