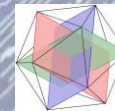


TOPOLOGIA È...

conferenza senza bordi

11 ottobre 2023



Associazione
BERGAMOSCIENZA

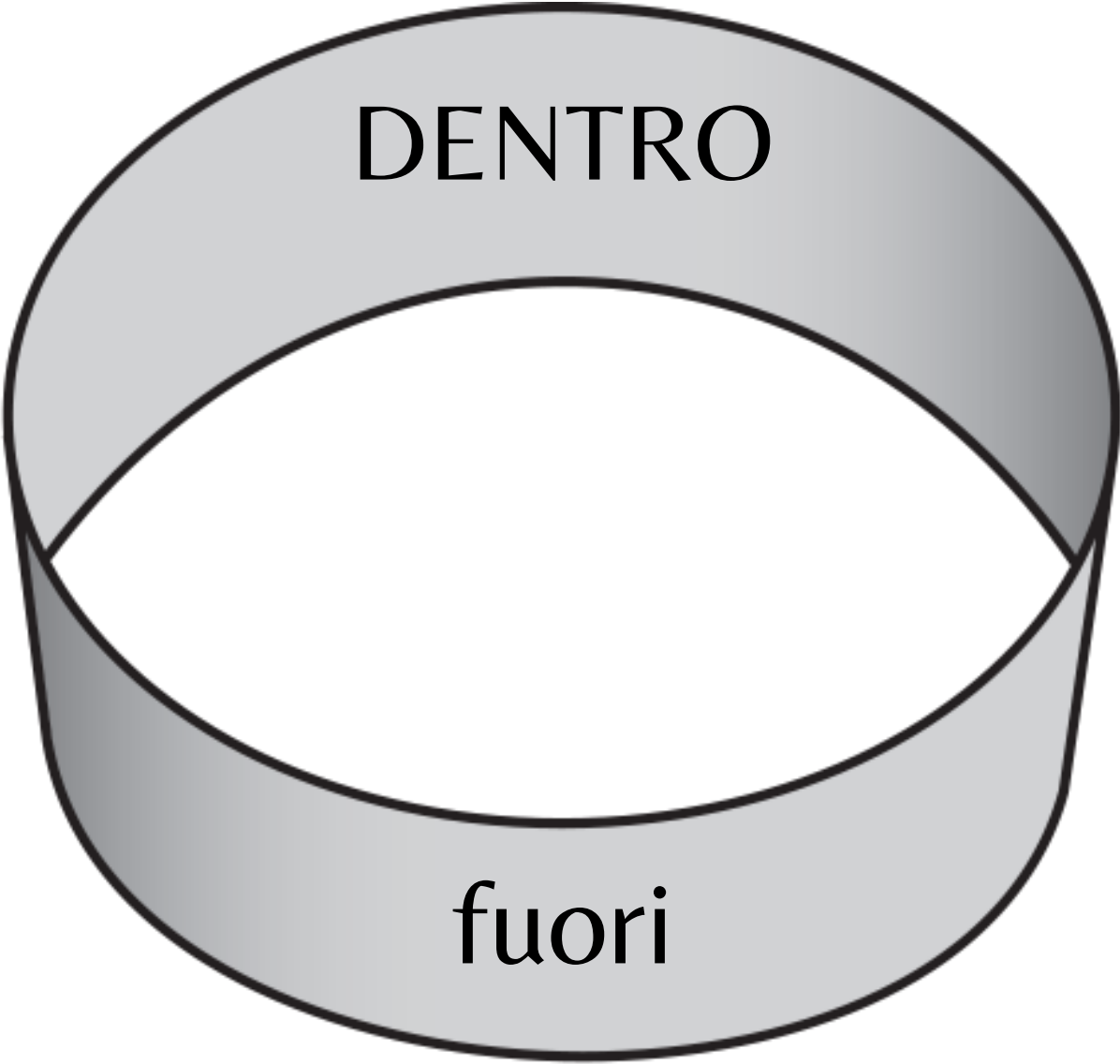


Grazie per l'attenzione!



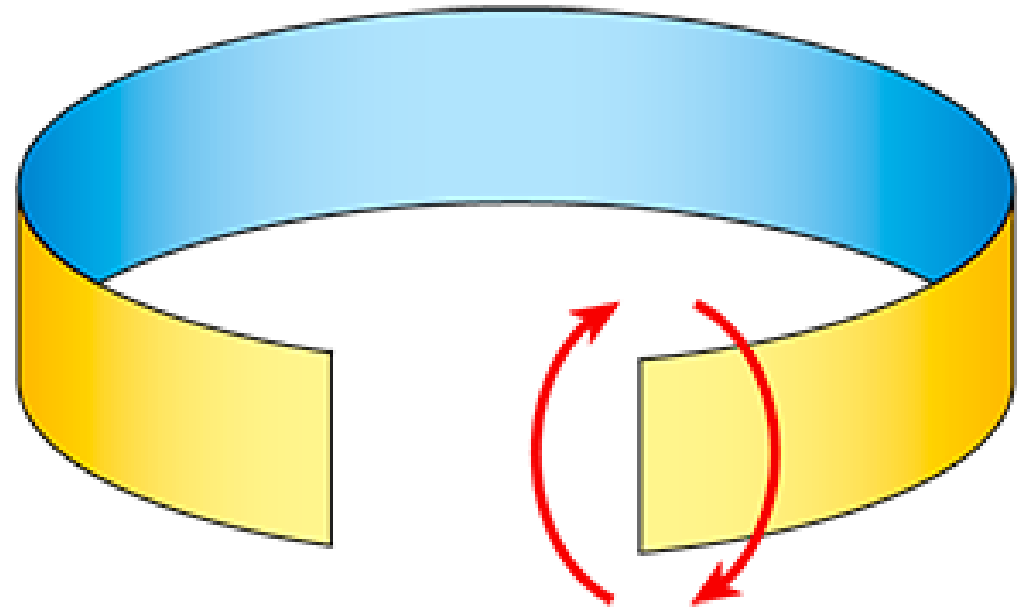
TOPO-SCIENZA

BergamoScienza al Liceo Celeri



DENTRO

fuori







Pantaloni topologici



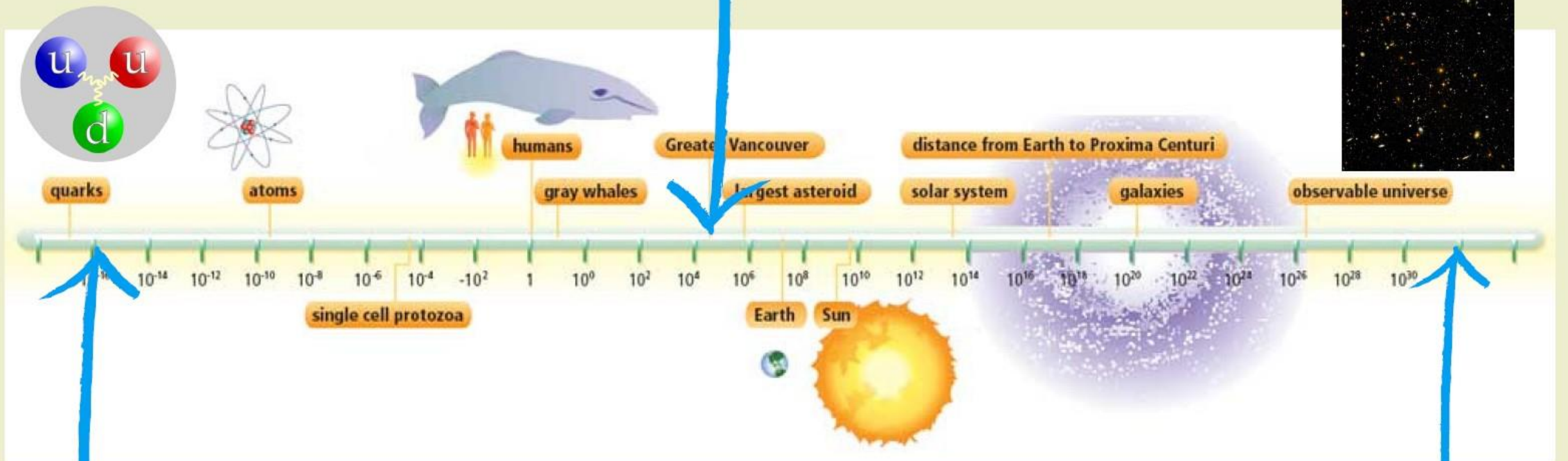
Topoutfit

The background is a chalkboard filled with various physics equations and diagrams. At the top left, there are wave diagrams. Next to them is the potential function $V(x) = \begin{cases} 0, & x < 0, \\ V_0, & x \geq 0. \end{cases}$ To the right, there's an uncertainty principle relation $\sigma_x \sigma_p \geq \frac{\hbar}{2}$, a diagram of a particle with momentum $\hbar k$ and energy $E = \hbar \omega$, and the energy formula $E = \frac{\hbar^2 k^2}{2m}$. On the left side, the Schrödinger equation $i\hbar \frac{\partial}{\partial t}$ is visible. Below it, there's a probability expression $P[a \leq X]$ and the energy term $-\frac{\hbar^2}{2m}$. On the right side, there are expressions like $\frac{\partial A(t)}{\partial t}$, $-m$, m_3 , (t) , and $(t)dt$. At the bottom, there are wave diagrams and a Gaussian function $\frac{1}{\sigma\sqrt{2\pi}} \exp[-\frac{1}{2\sigma^2}(x - \frac{pt}{\hbar})^2]$.

La topologia (fatta per bene!)

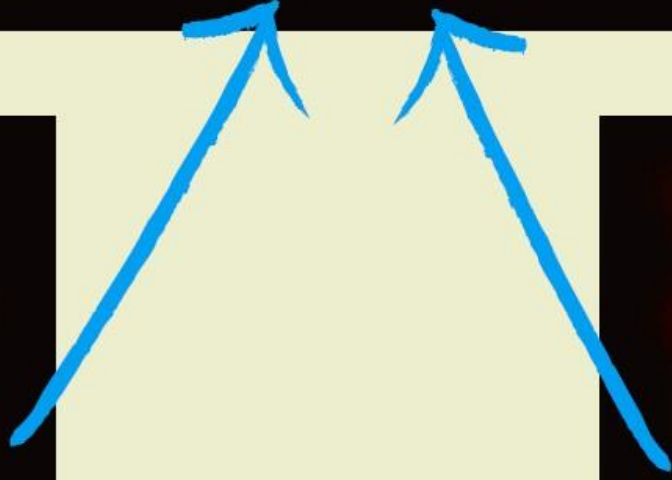
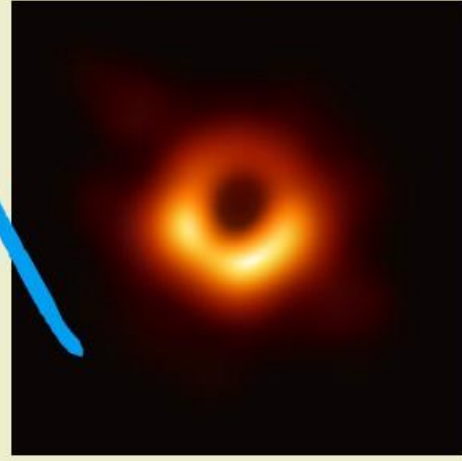
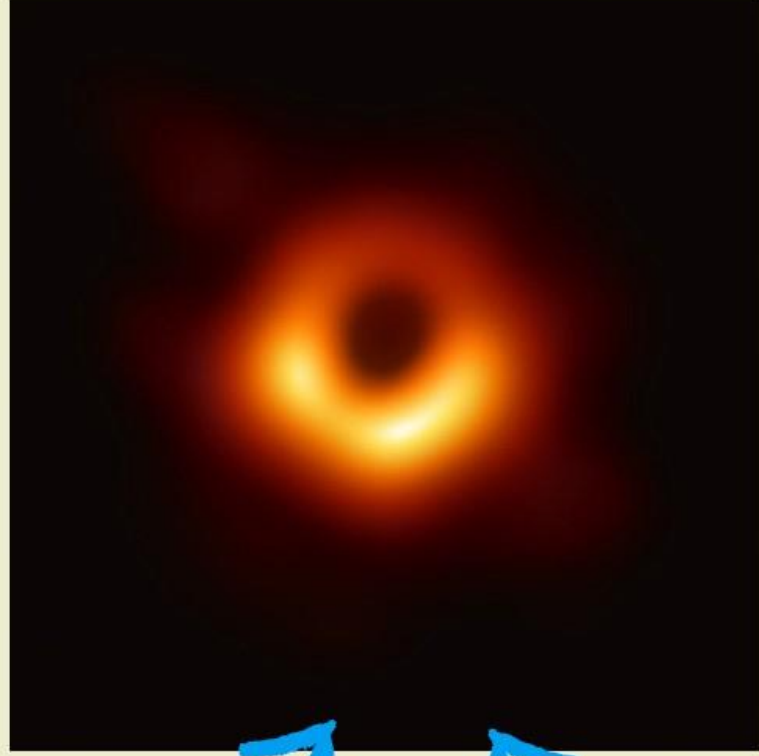
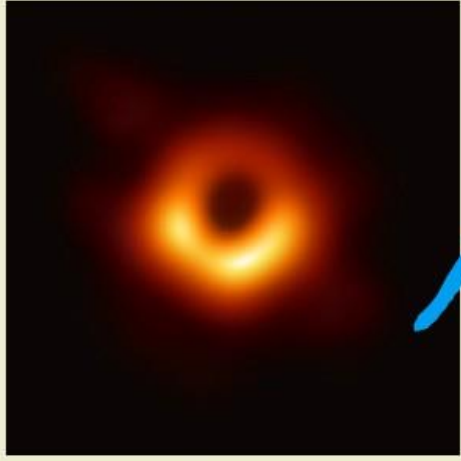
Dr. Luca Campagnoni

Altra topologia



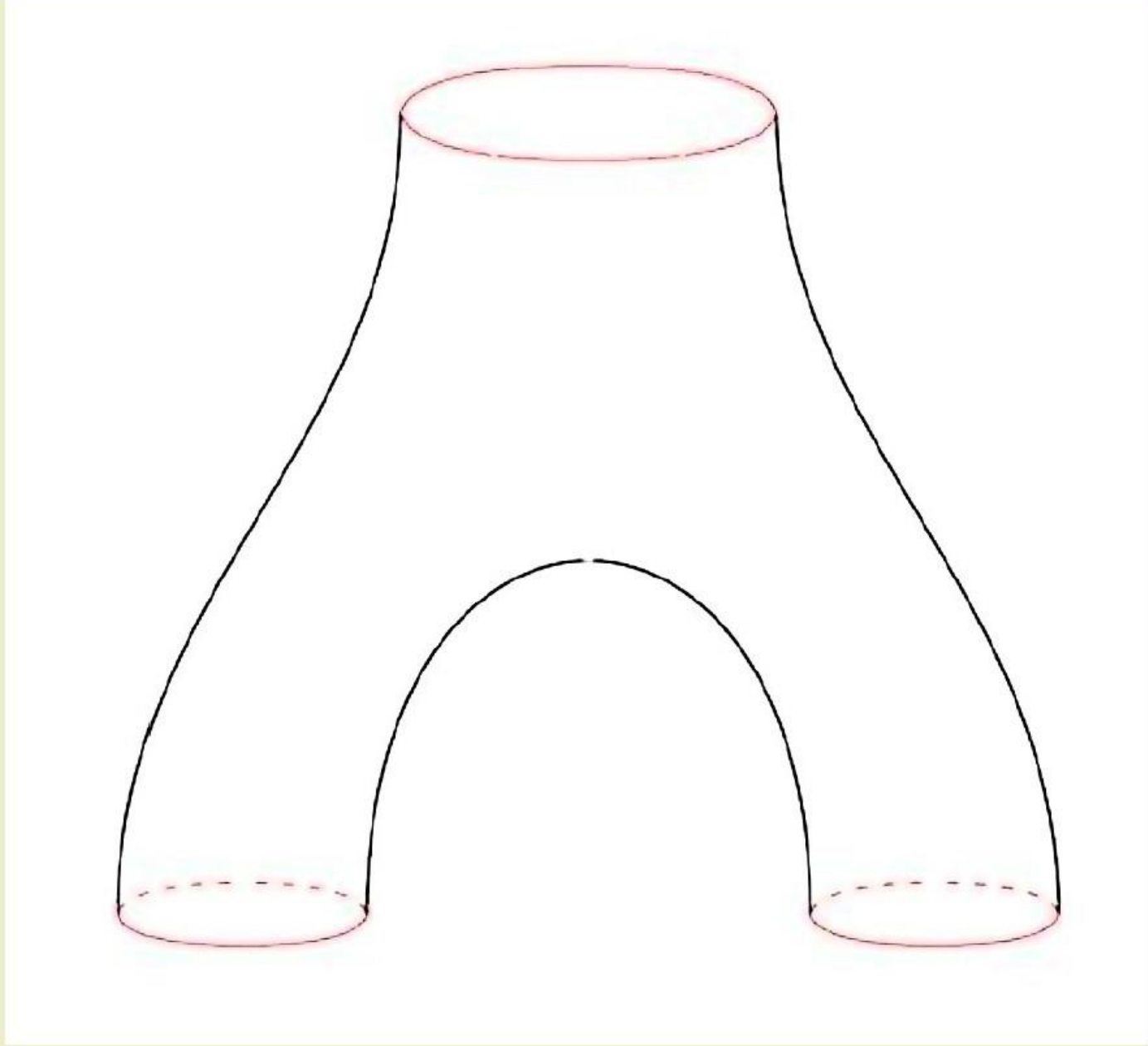
Topologia

Guarda un po'
ancora topologia



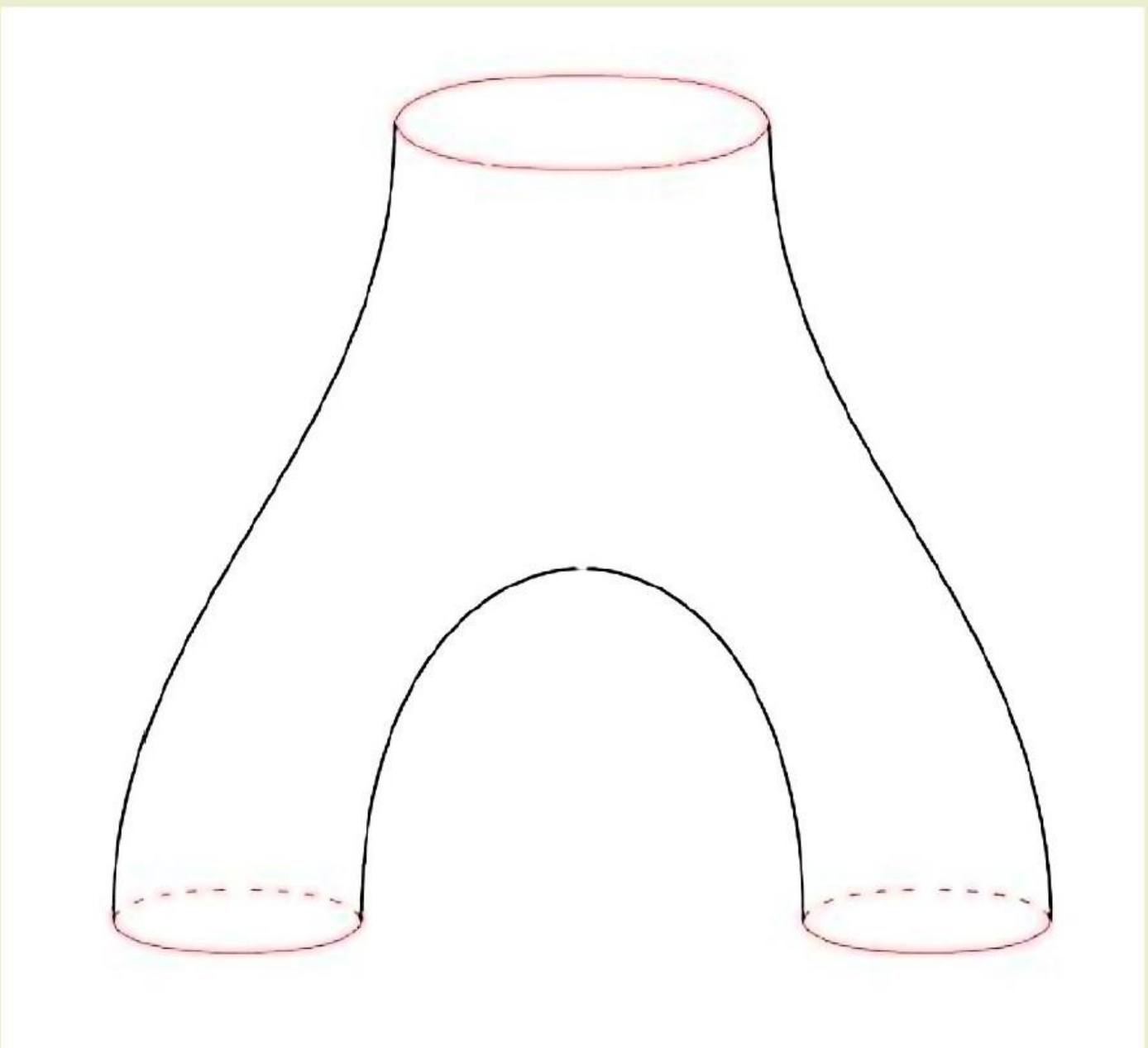
TEMPO



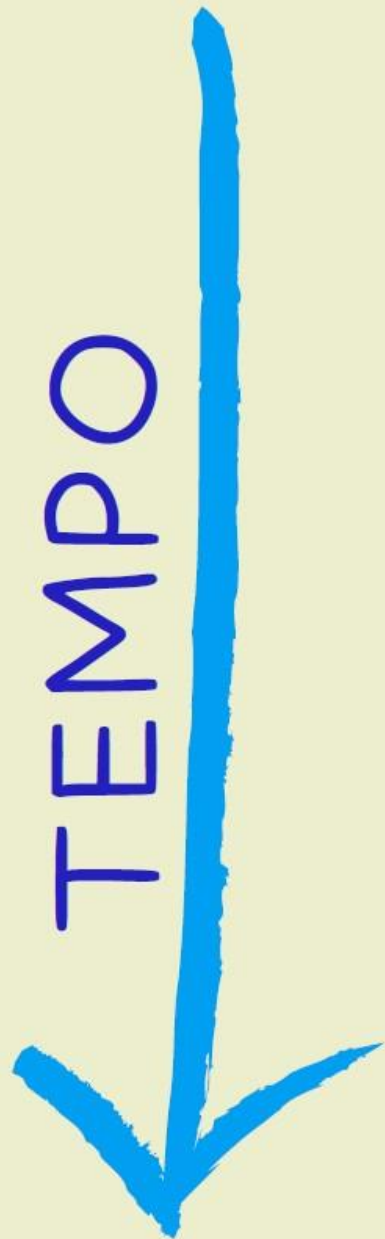
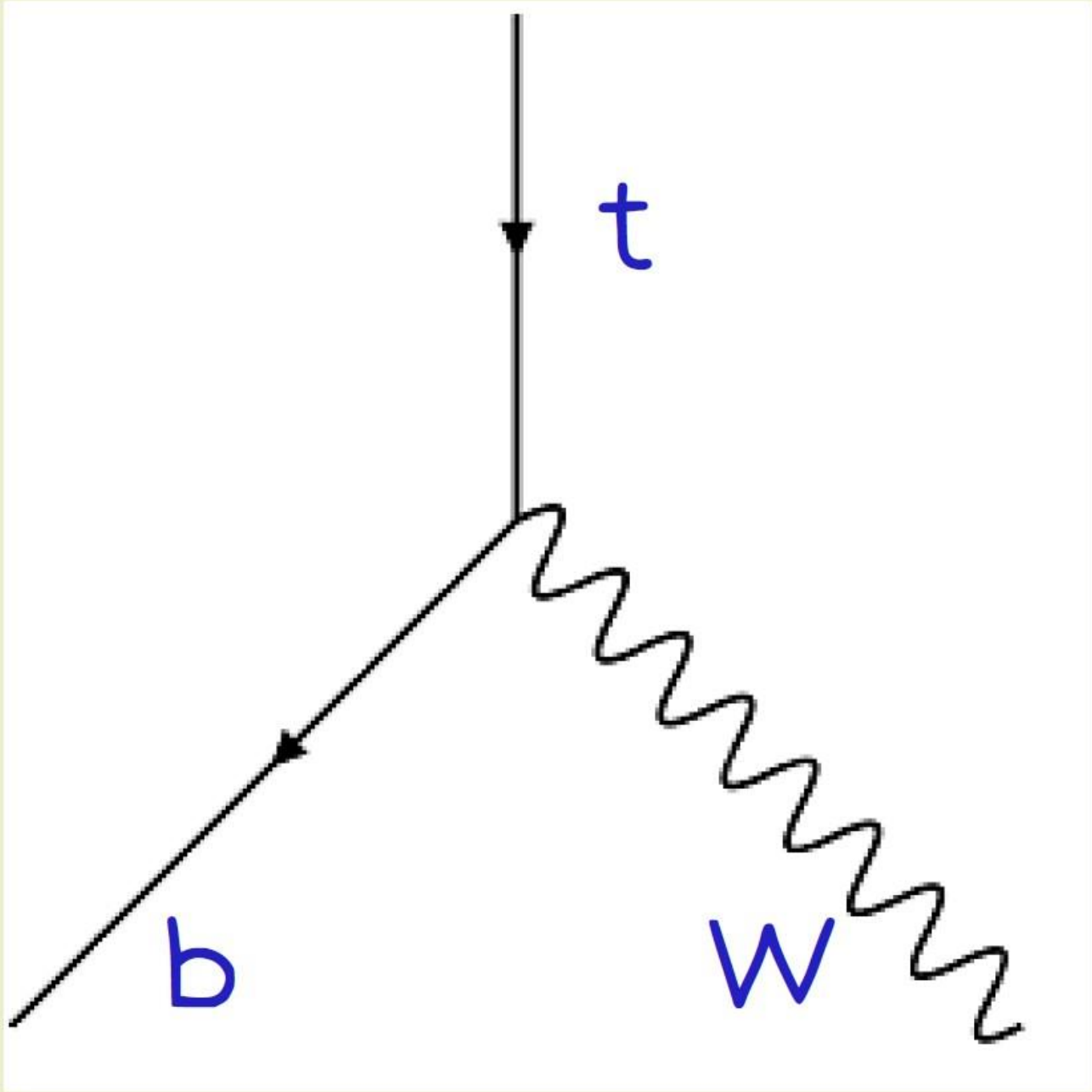


TEMPO

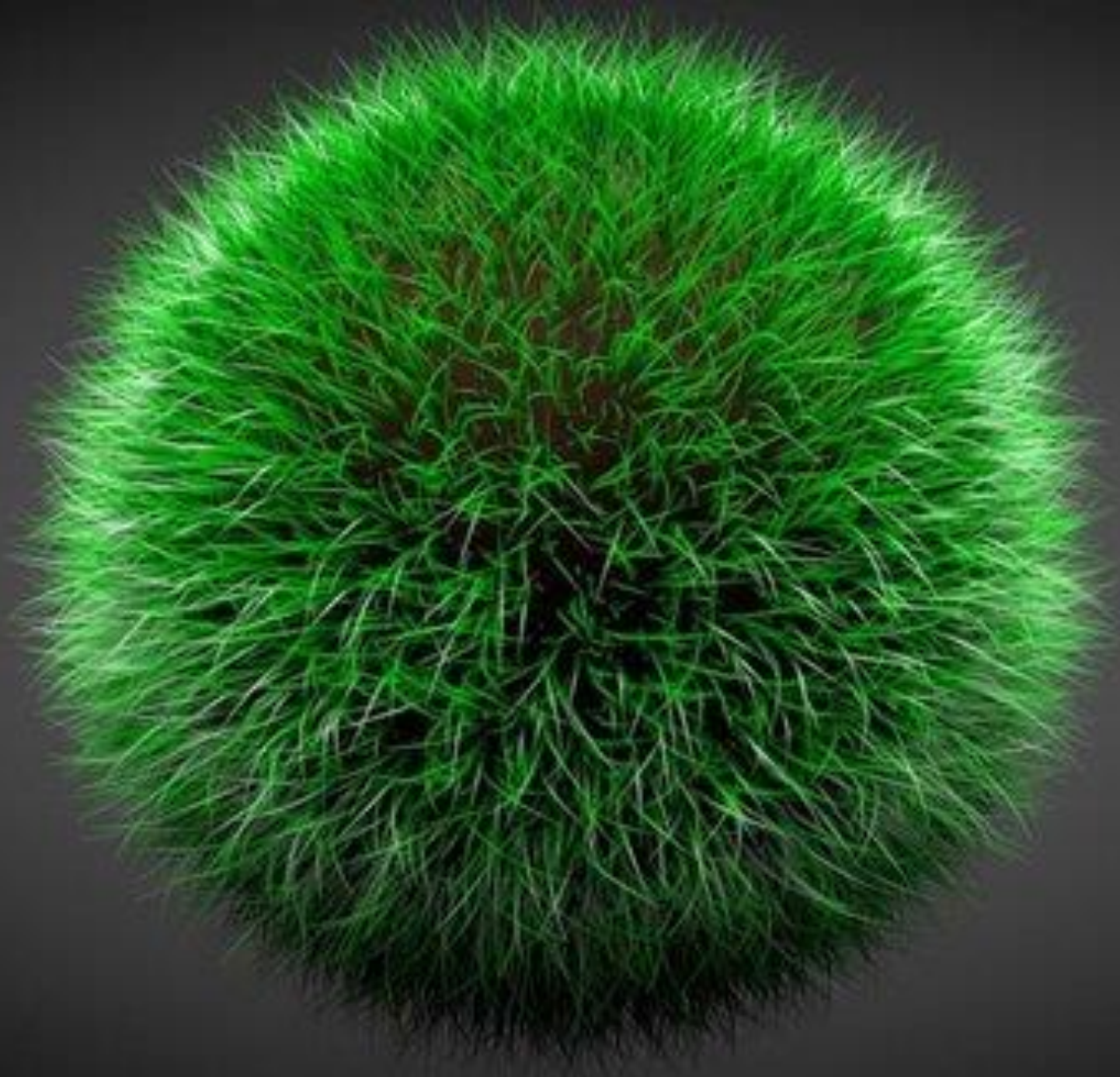




TEMPO

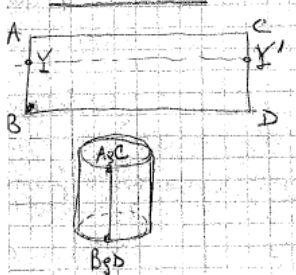








1. Cilindro

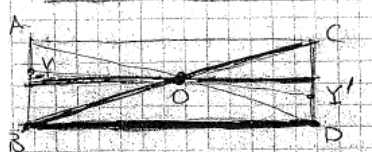


Rettang. $R = ABCD$ (chiuso) $\subseteq \mathbb{R}^2$
 (nottoz. dotato della top. indotta da \mathbb{R}^2)

$\forall Y \in AB \quad [Y] = \{Y, Y'\} = [Y']$
 $\forall Y' \in CD \quad \text{con } Y \leftrightarrow Y' \parallel BD$

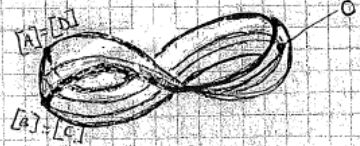
$R/\sim = S^1 \times I$ (con $I = [0, 1] \subseteq \mathbb{R}$)

2. Nastro di Möbius



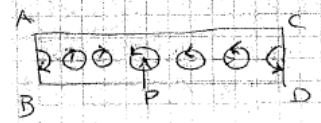
$R = ABCD \subseteq \mathbb{R}^2$
 $O = \text{centro di } R$

$\forall Y \in AB \quad [Y] = \{Y, Y'\} = [Y']$
 con $Y' = CD \cap YO \Rightarrow [A] = [D] \text{ e } [B] = [C]$

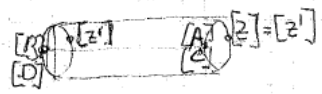


$R/\mu = \text{nastro di Möbius}$

- ha una sola faccia (passando con una matita colorata si può colorare tutto senza mai sollevare la matita)
- non è orientabile (fissato una cfr. orientate di centro P, posso muovere P lungo un cammino chiuso e quando arrivo al pto di partenza la cfr. ha cambiato orientaz.)



3. Toro



$R/\mu g'$ con μ' che identifica il lato AC col lato BD

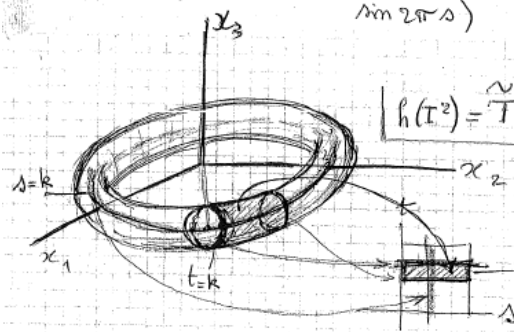


$[A] = [C] = [B] = [D]$

4) Toro T

$I^2, \sigma : [(0, t)]_{\sigma} = [(1, t)]_{\sigma} \text{ e}$
 $[(s, 0)]_{\sigma} = [(s, 1)]_{\sigma}$

$h : \begin{cases} I^2 \rightarrow \mathbb{R}^3 \\ (s, t) \rightarrow (2 + \cos 2\pi s) \cos 2\pi t, (2 + \cos 2\pi s) \sin 2\pi t, \sin 2\pi s \end{cases}$



Equas. cartes. di $h(I^2) = T : (x_1^2 + x_2^2 - 2)^2 + x_3^2 = 1$

Ricordiamo che $T \cong T^2 \subseteq \mathbb{R}^4$

questo rettangolo mi dà il cilindro se guardo tramite la sola identificaz. dei lati estremi verticali

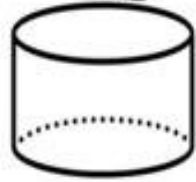
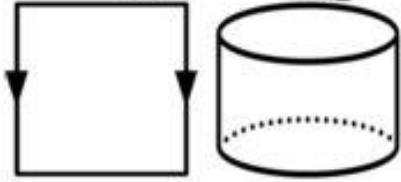
$s = k : \begin{cases} x_1 = (2 + \cos 2k\pi) \cos 2\pi t \\ x_2 = (2 + \cos 2k\pi) \sin 2\pi t \\ x_3 = \sin 2k\pi \end{cases} \rightarrow \text{cfr. nel piano orizz. } x_3 = \sin 2k\pi$

$t = k : \begin{cases} x_1 = (2 + \cos 2\pi s) \cos 2k\pi \\ x_2 = (2 + \cos 2\pi s) \sin 2k\pi \\ x_3 = \sin 2\pi s \end{cases}$

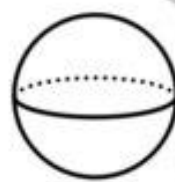
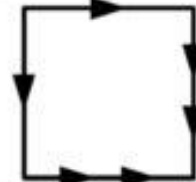
↓
 sfera di raggio 1 e centro $(2 \cos 2k\pi, 2 \sin 2k\pi, 0)$
 $(x_1 - 2 \cos 2k\pi)^2 + (x_2 - 2 \sin 2k\pi)^2 + x_3^2 = 1$
 $x_2 = \tan 2k\pi x_1$ — piano verticale contenente l'asse x_3

cfr. nel piano verticale $x_2 = \tan 2k\pi x_1$
 (è la cfr. ottenuta da quella fondamentale $(x_2 - 2)^2 + x_3^2 = 1$, corrispondente al valore $k = 1/4$, con la rotazione attorno all'asse x_3 di angolo $2k\pi$)

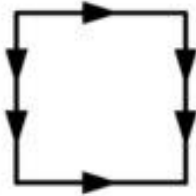
Topological Surfaces



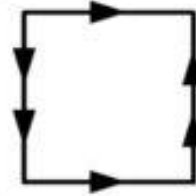
Cylinder



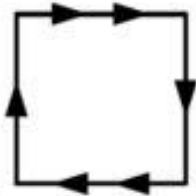
Sphere



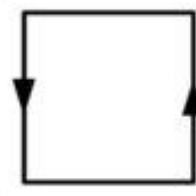
Torus



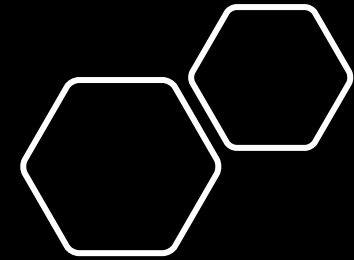
Klein Bottle

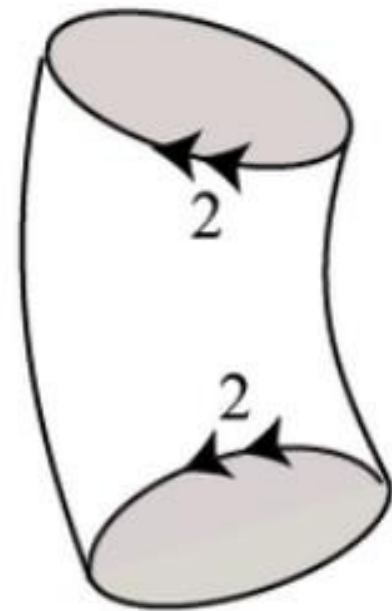
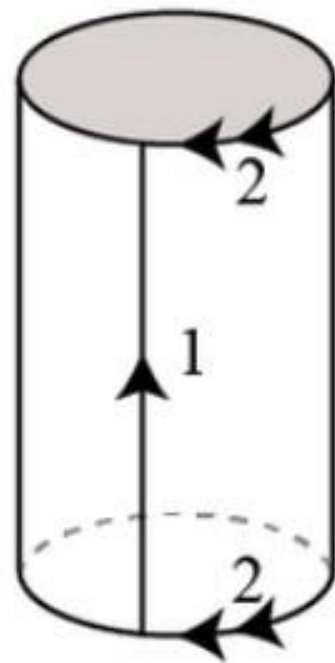
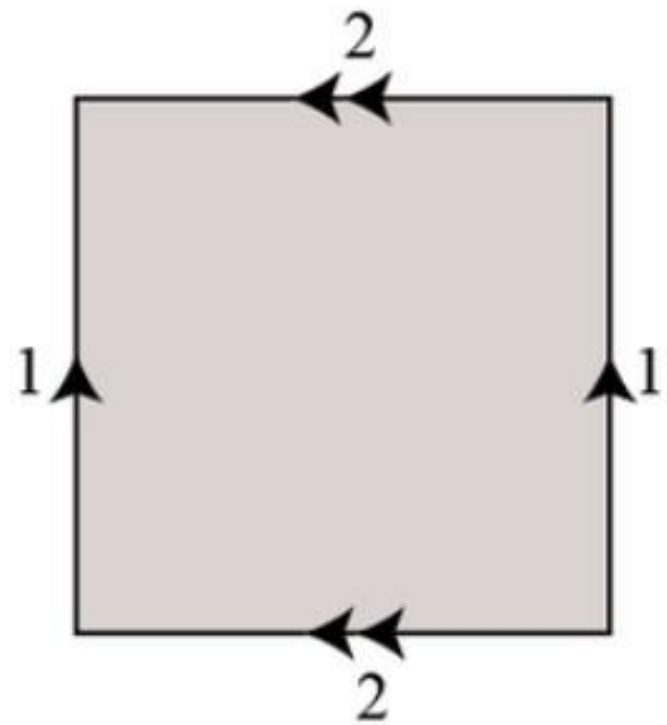


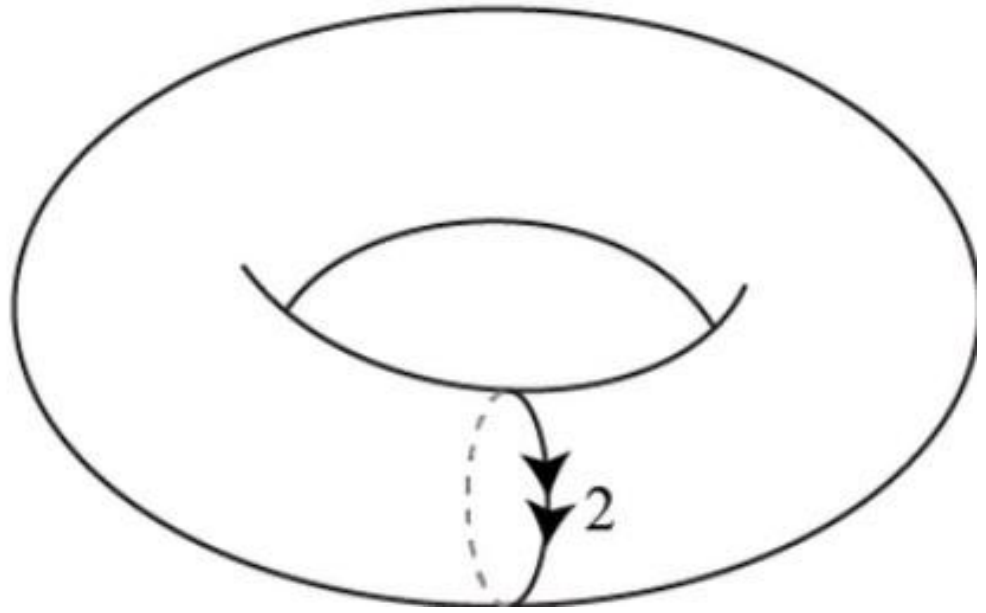
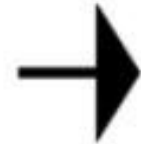
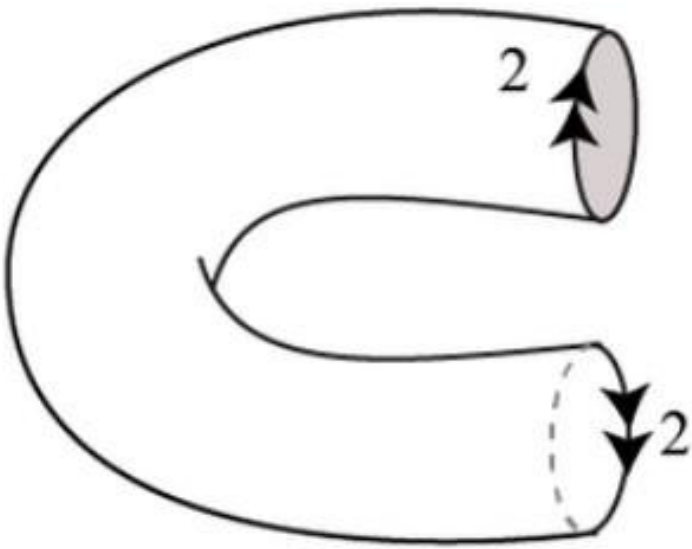
Real Projective Plane

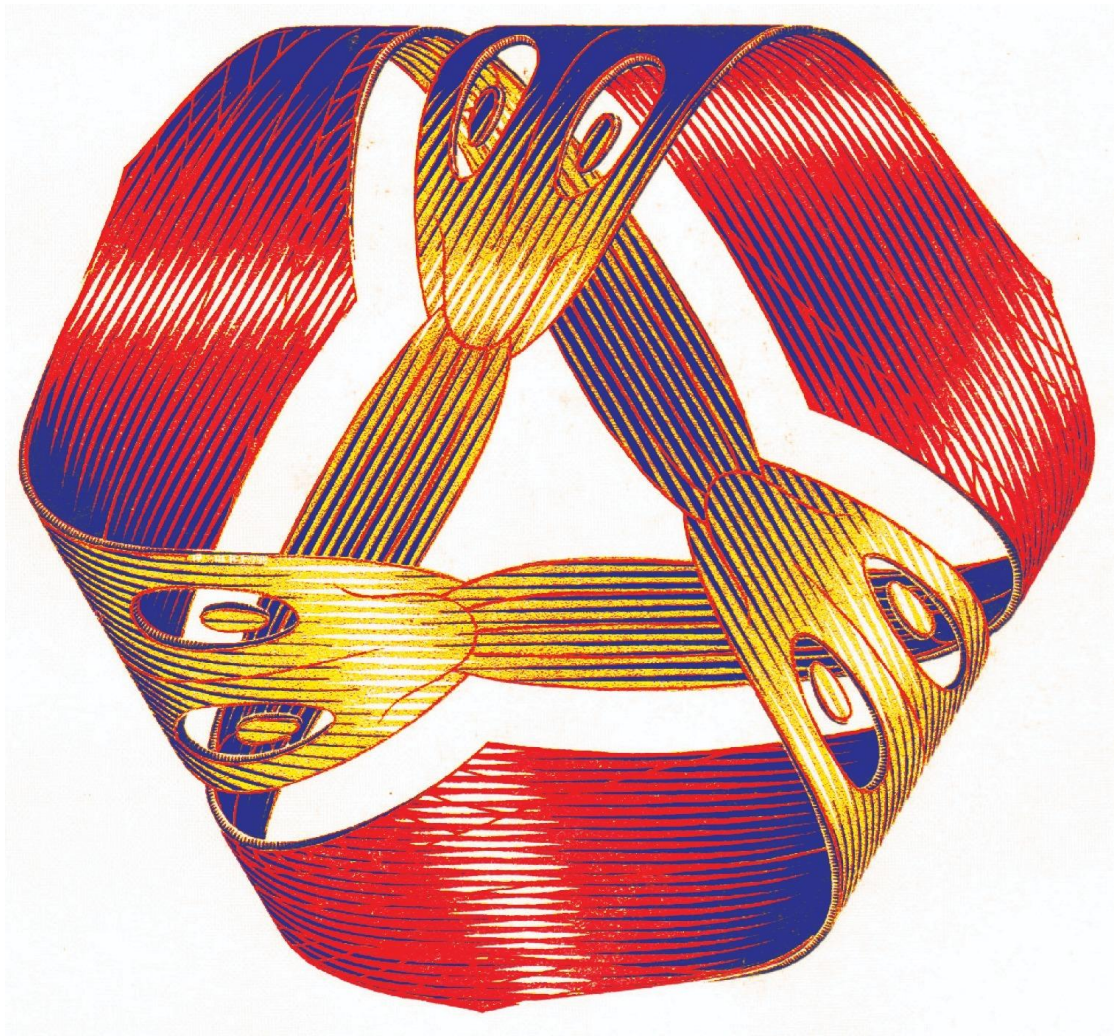


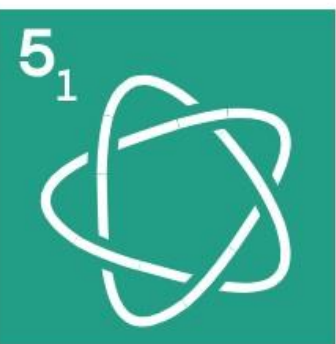
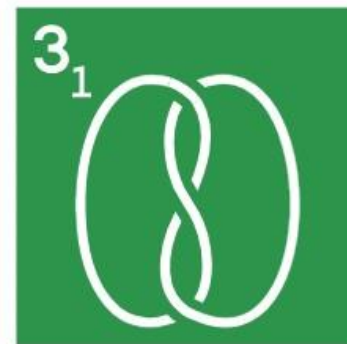
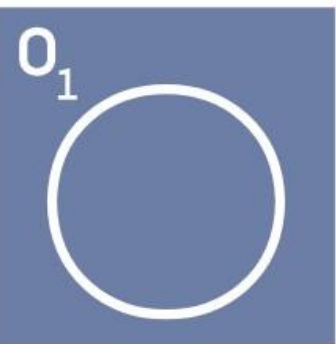
Möbius Band







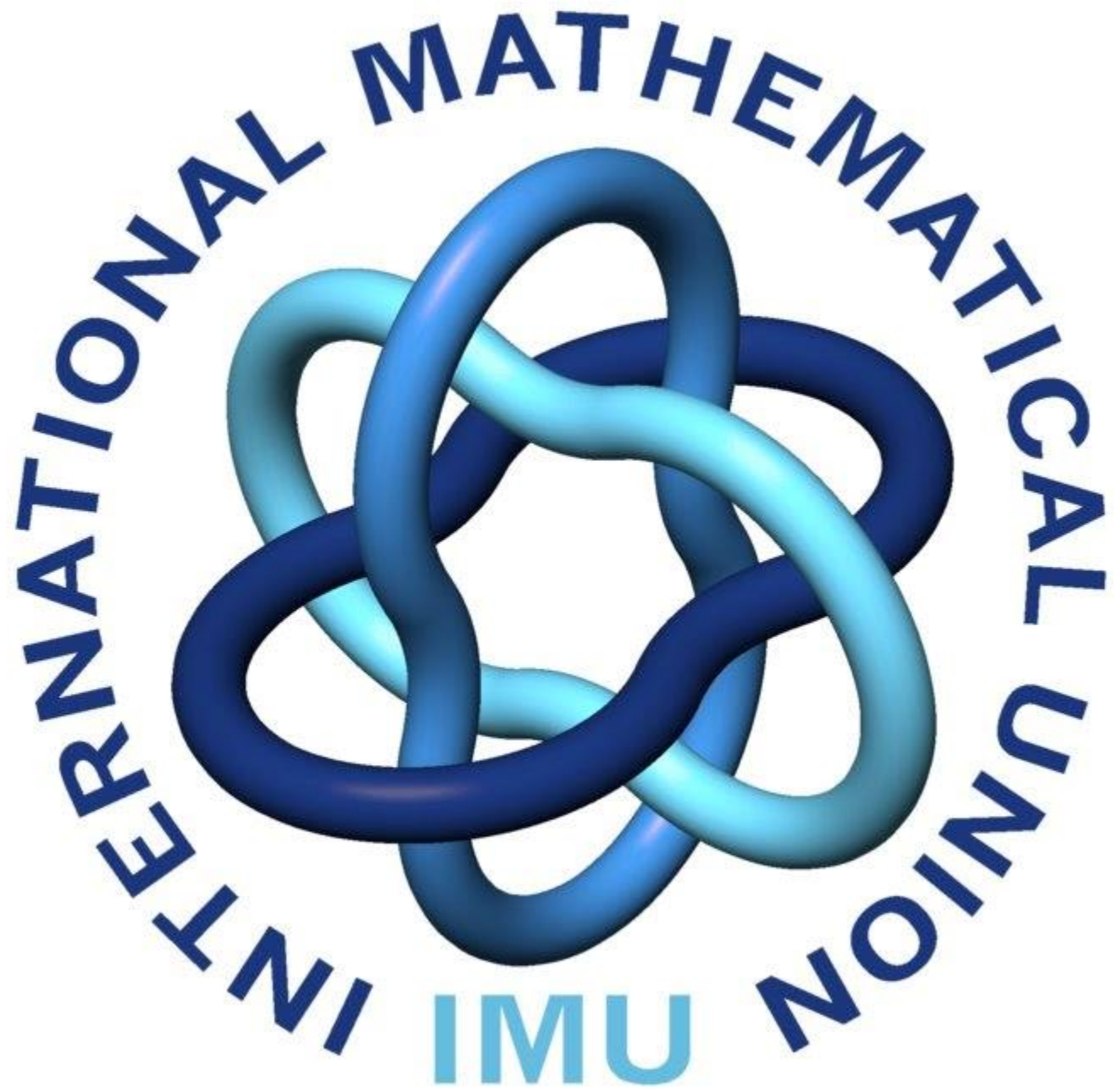




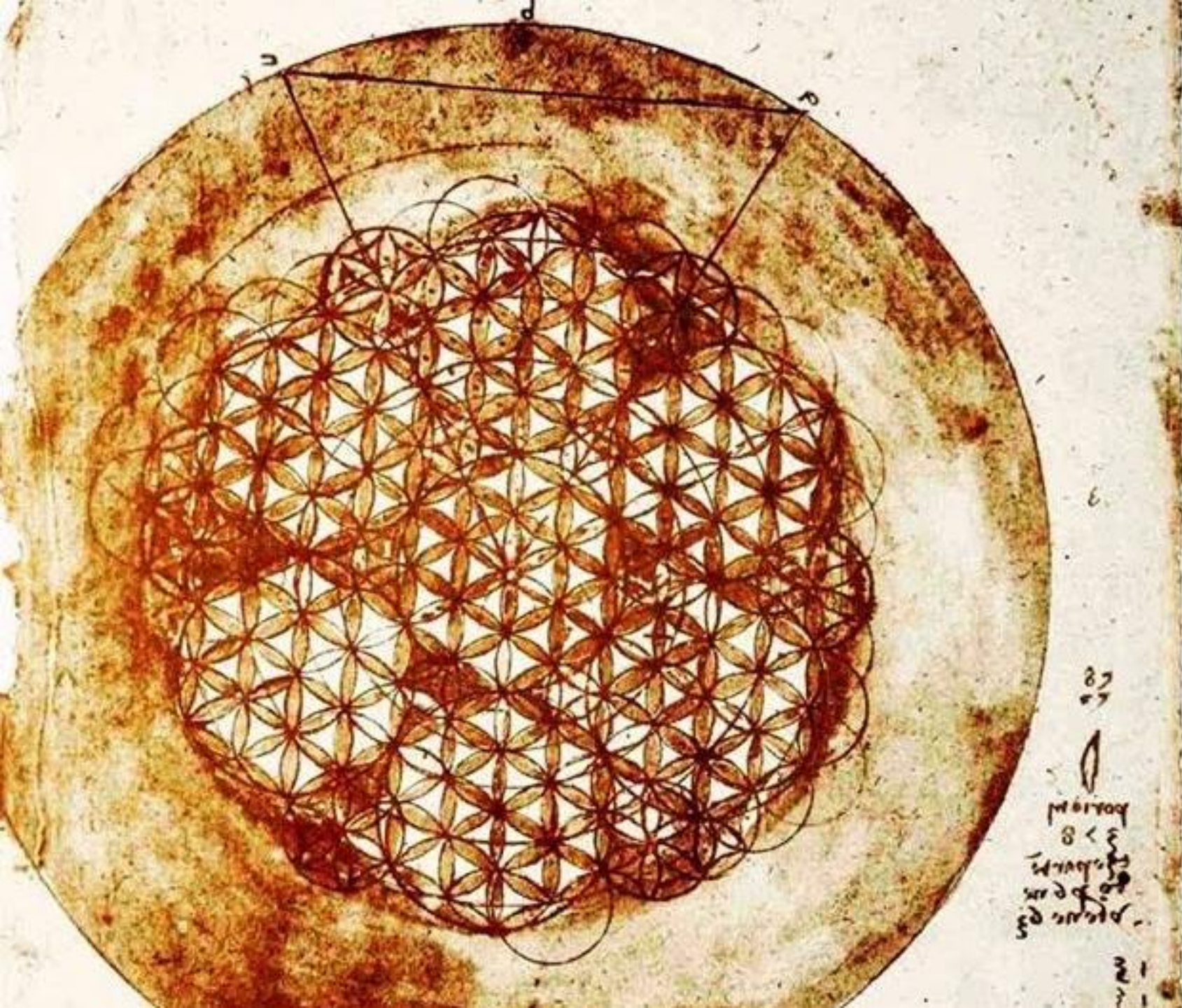






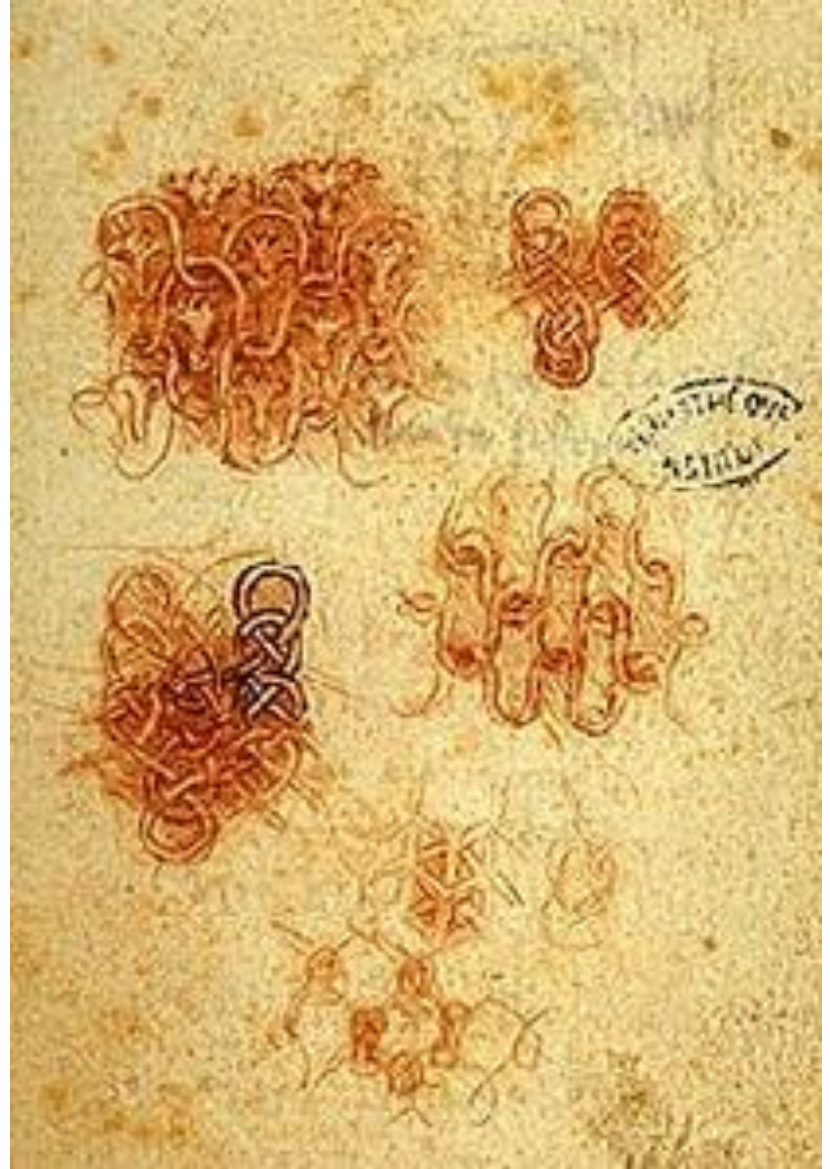






Handwritten text in a cursive script, likely a historical or religious text, located below the large circular diagram. The text is partially obscured and difficult to decipher, but appears to be a list or a set of instructions.













TOPO-SCIENZA

BergamoScienza al Liceo Celeri

Mercoledì 11 Ottobre ore 20:30 presso la Sala Affreschi dell'Accademia Tadini di Lovere, conferenza senza bordi: "Topologia è..."

Laboratori per TUTTI presso la sede del Liceo Celeri:

- Domenica 8 ottobre dalle 14:00 alle 17:30;
- Domenica 15 ottobre dalle 14:00 alle 17:30.

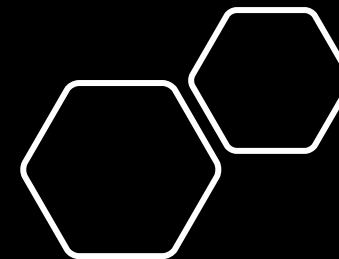
Prenotazioni per i laboratori su www.bergamoscienza.it

La partecipazione agli eventi è gratuita



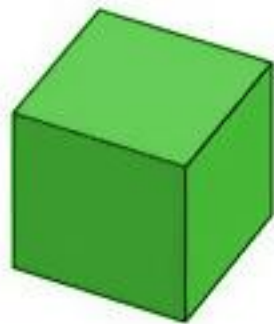
Associazione
BERGAMOSCIENZA

Tadini
Accademia Tadini Lovere





tetraedro



esaedro



ottaedro



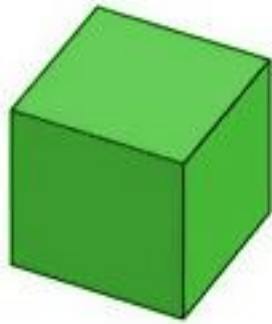
dodecaedro



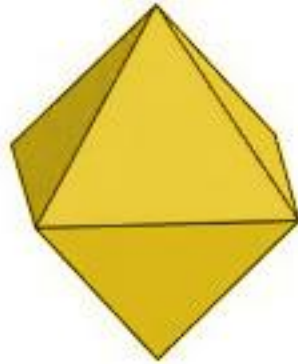
icosaedro



tetraedro



esaedro



ottaedro



dodecaedro



icosaedro

V

4

8

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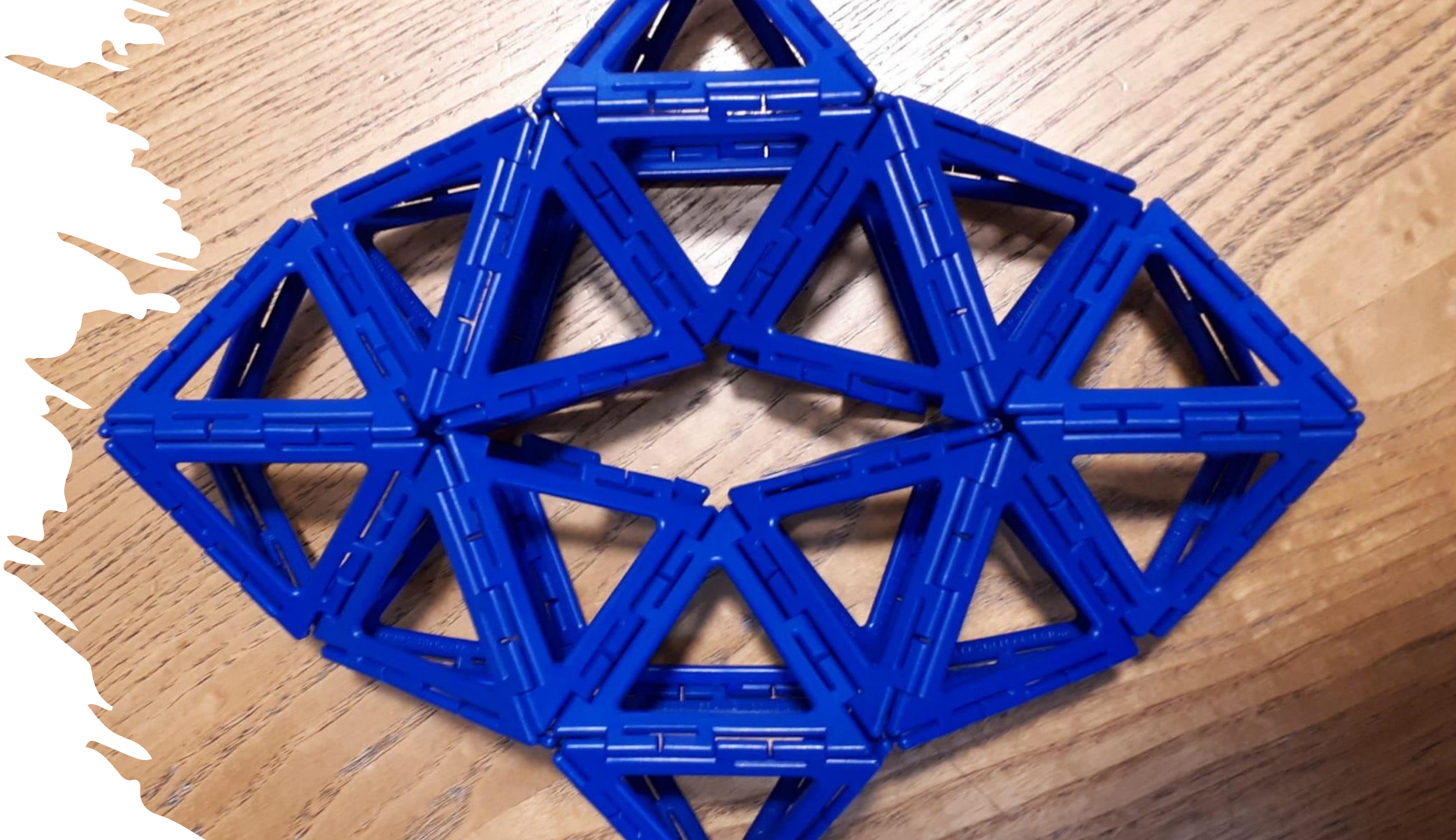
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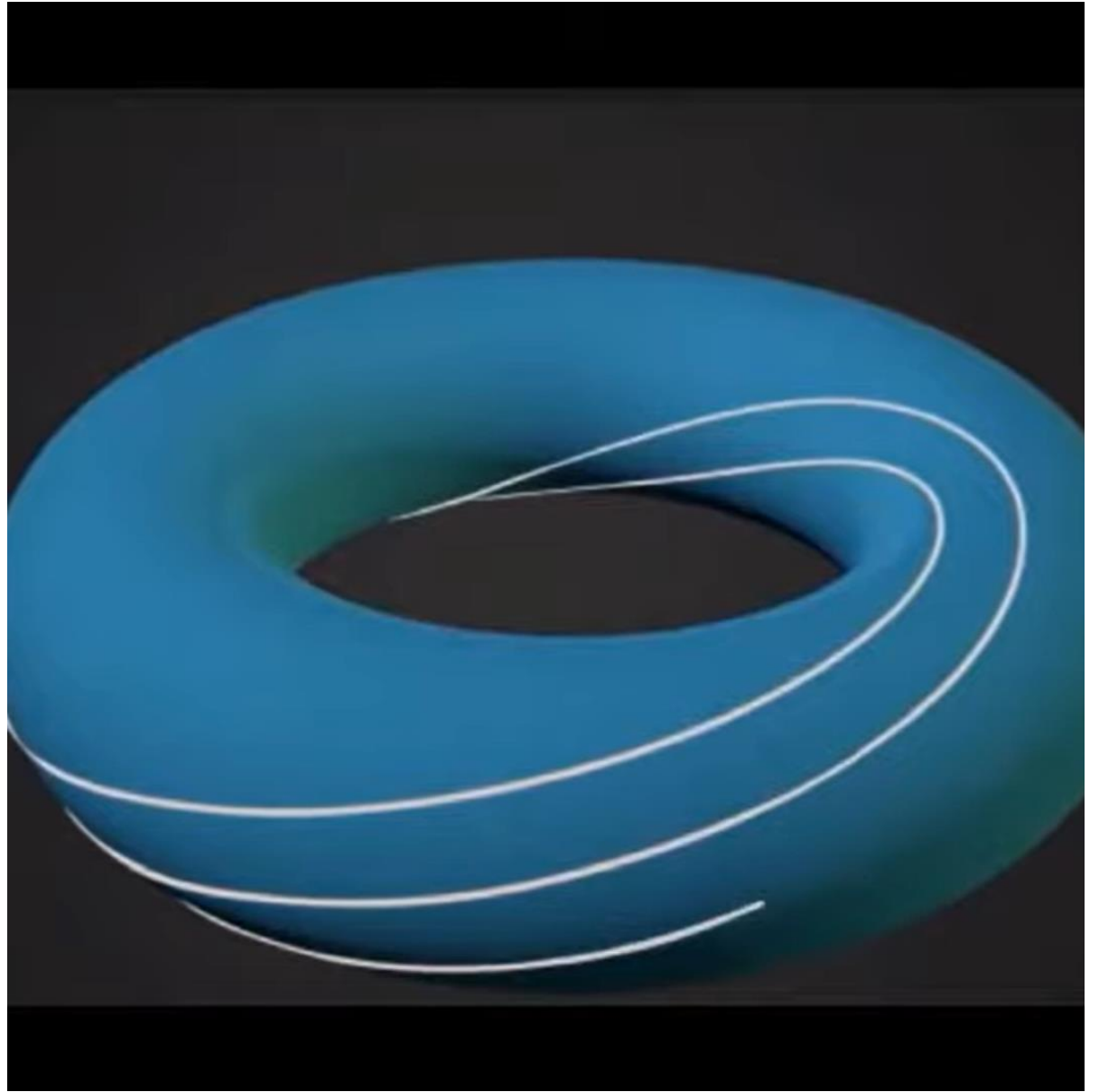
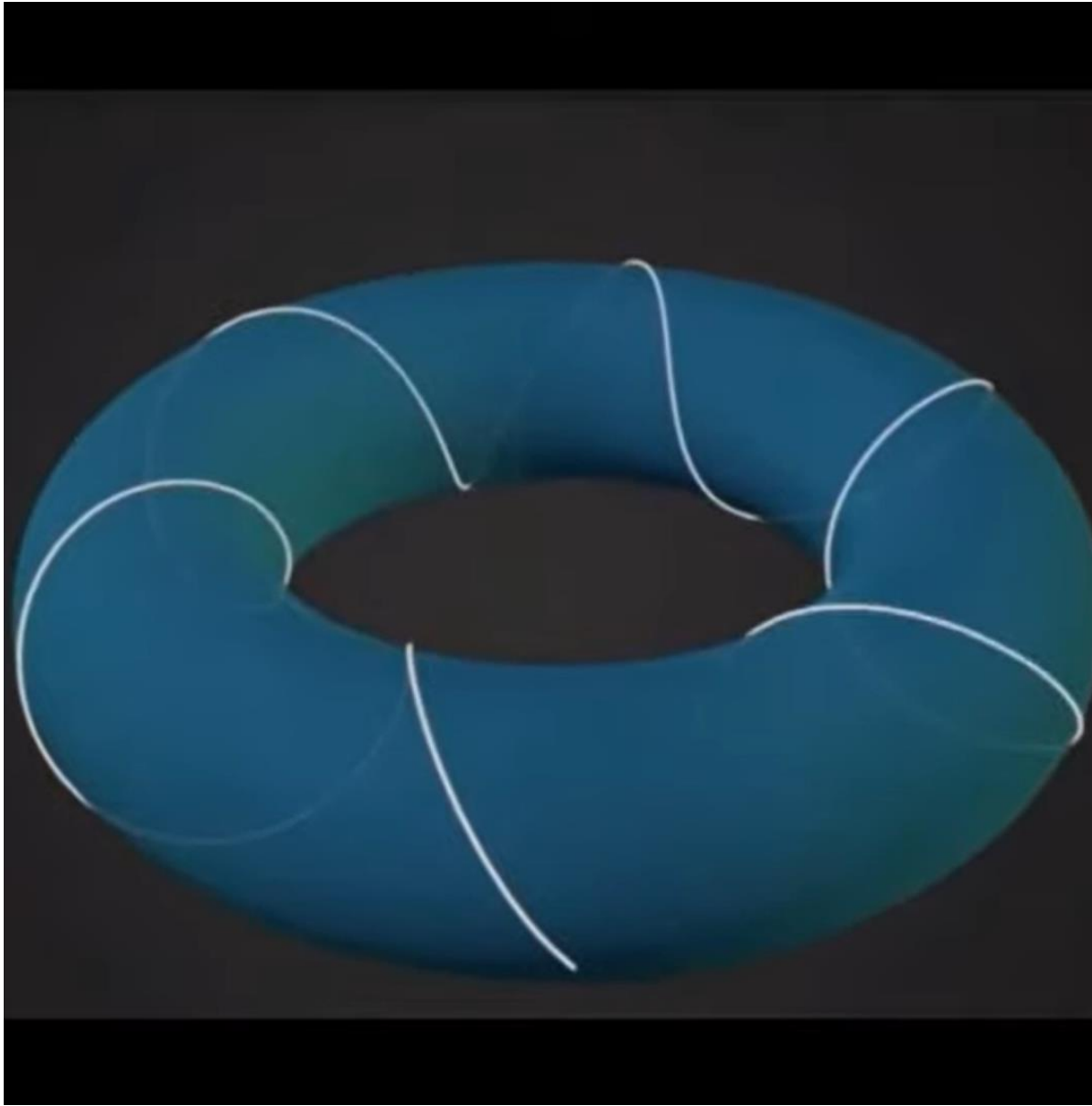




**35th International
Mathematical Olympiad**
HONG KONG July 8-20, 1994









Magic Wand Theorem. *The closure of any $\mathrm{GL}(2, \mathbb{R})$ -orbit is a complex suborbifold (possibly with self-intersections); in period coordinates $\vec{v}_1, \dots, \vec{v}_n$ in the corresponding space $\mathcal{H}(d_1, \dots, d_m)$ of translation surfaces it is locally represented by an affine subspace.*

Any ergodic $\mathrm{SL}(2, \mathbb{R})$ -invariant measure is supported on a suborbifold. In coordinates $\vec{v}_1, \dots, \vec{v}_n$ this suborbifold is represented by an affine subspace, and the invariant measure is just a usual affine measure on this affine subspace.









SEOUL ICM 2014

INTERNATIONAL CONGRESS OF MATHEMATICIANS



Grazie per
l'attenzione...
e la pazienza!

TOPO-SCIENZA
BergamoScienza al Liceo Celeri