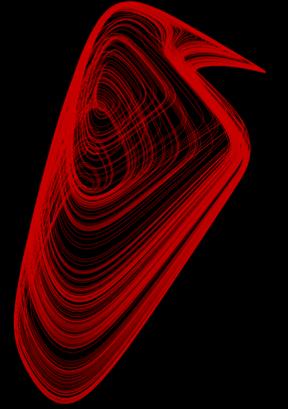
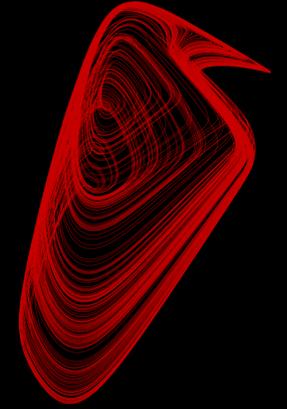


Mas sobre acoples fuente-filtro



Mas sobre acoples fuente-filtro

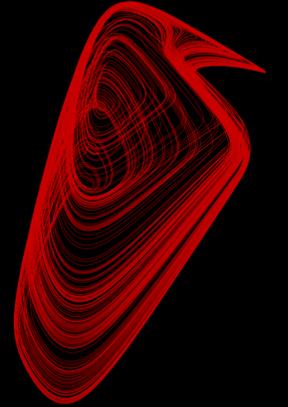


Aproximadamente 50,000 años

Desarrollada por Neanderthales

Las 4 notas generadas coinciden
con cuatro de las notas de la escala
diatonica

Mas sobre acoples fuente-filtro



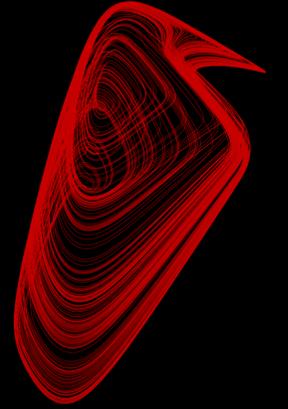
Aproximadamente 50,000 años

Desarrollada por Neanderthales

Las 4 notas generadas coinciden con cuatro de las notas de la escala diatonica

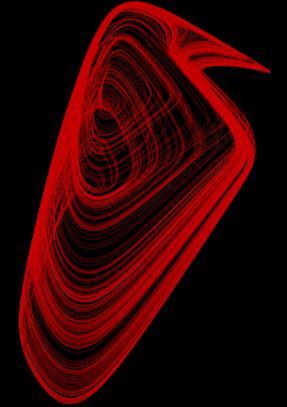


Mas sobre acoples fuente-filtro



Bob Fink added that the notes of the flute “are inescapably diatonic and will sound like a near-perfect fit within ANY kind of standard diatonic scale, modern or antique.”

Mas sobre acoples fuente-filtro



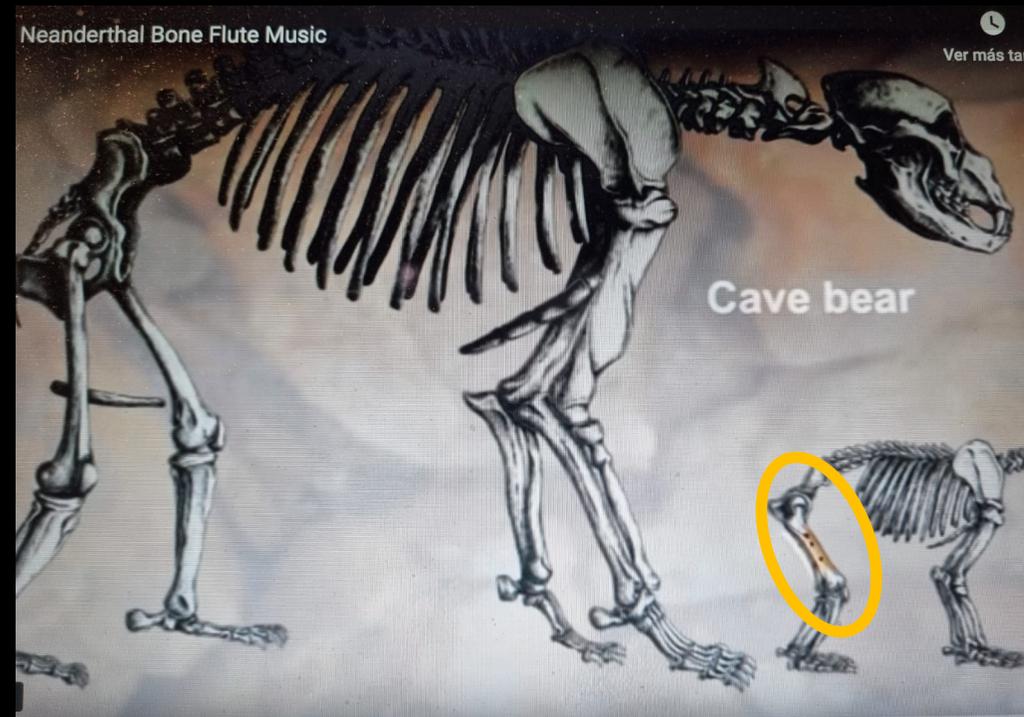
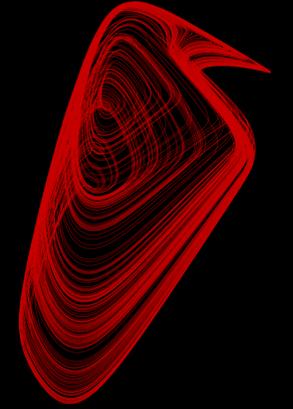
Bob Fink added that the notes of the flute “are inescapably diatonic and will sound like a near-perfect fit within ANY kind of standard diatonic scale, modern or antique.”



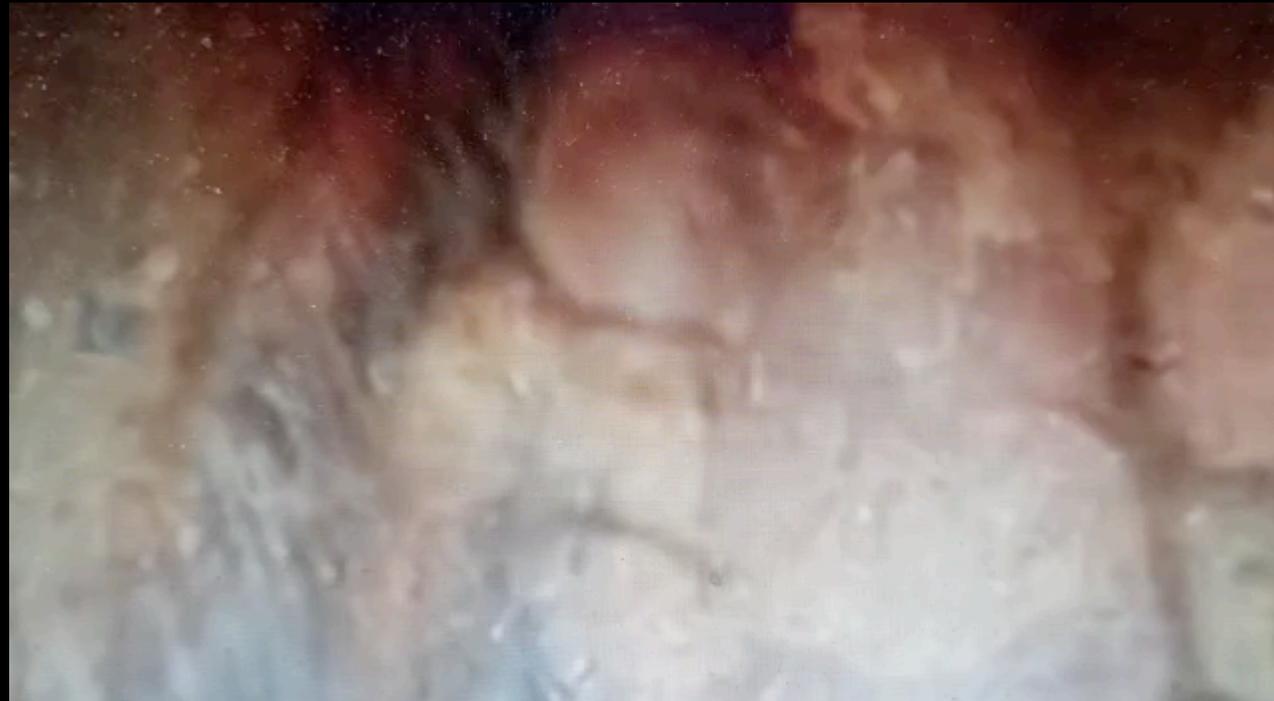
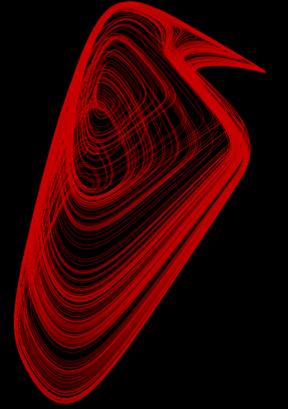
Teclado moderno de piano basado en la escala diatónica. La nota Do se encuentra más a la izquierda de la imagen y siete teclas blancas a la derecha, una octava más aguda.

La escala diatónica es una escala formada por intervalos de segunda consecutivos

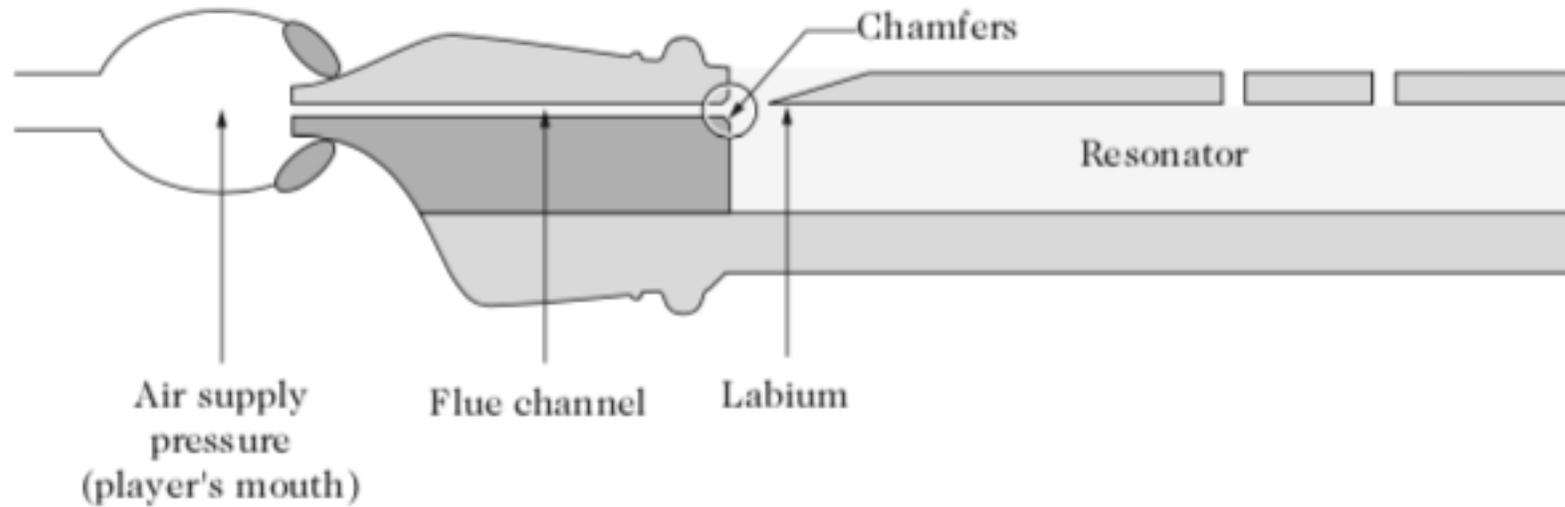
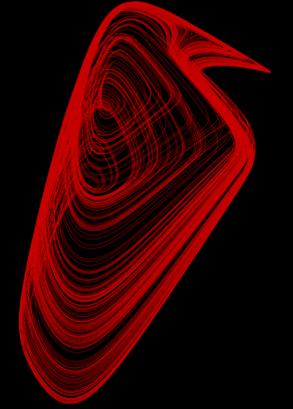
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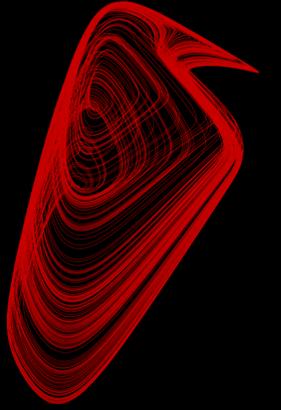


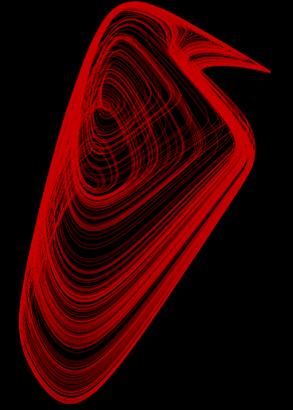
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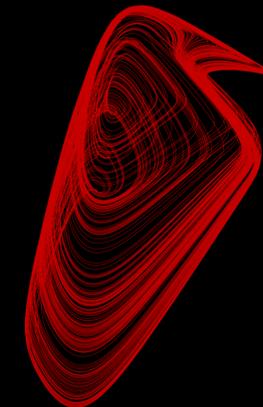
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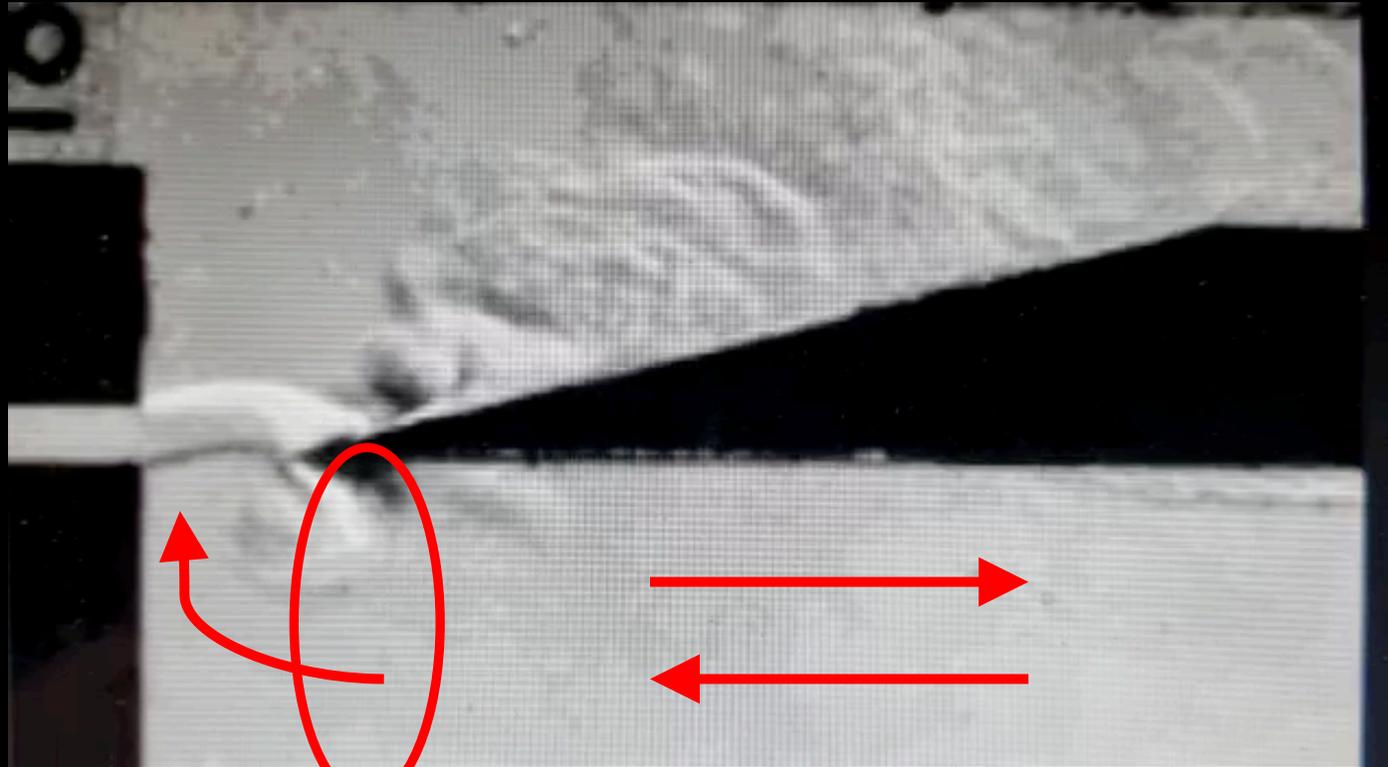




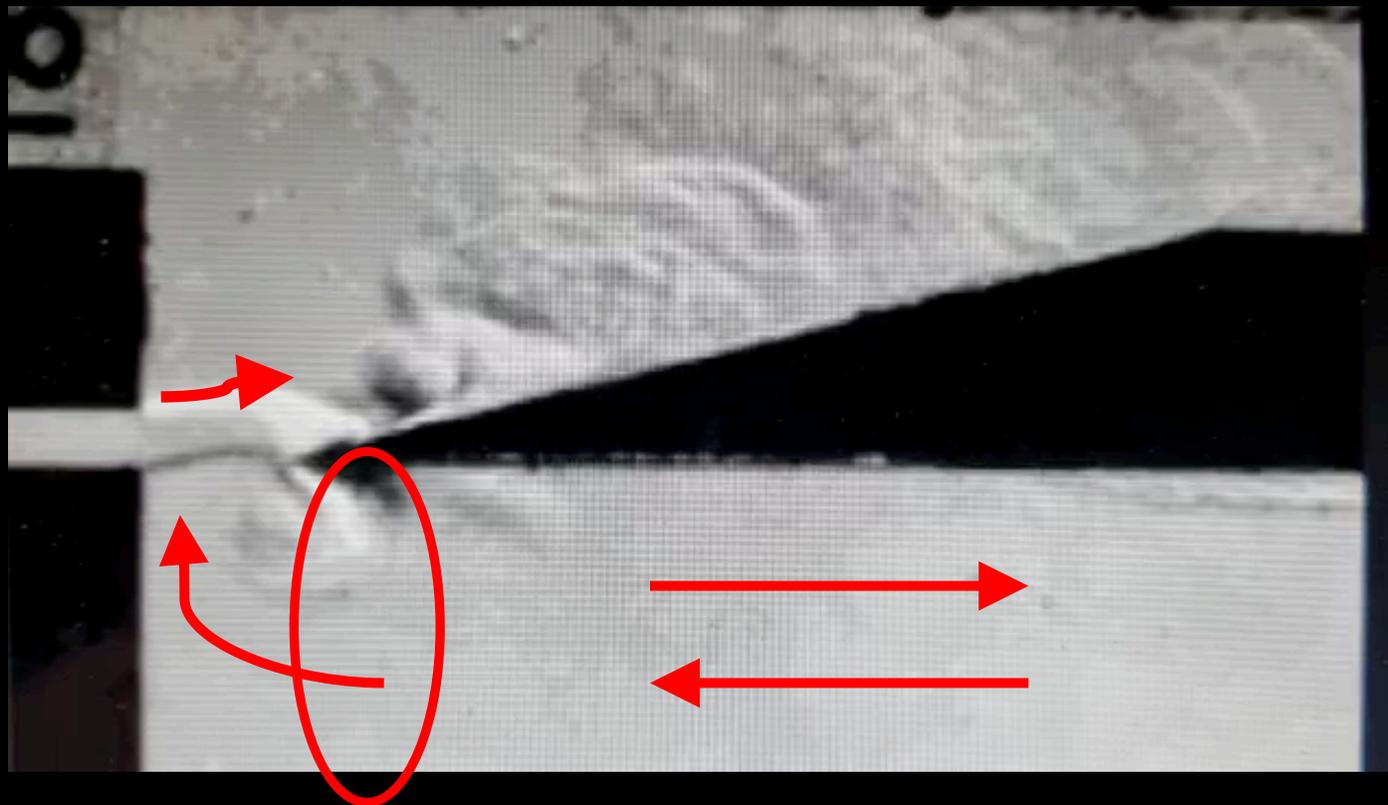
El proceso se inicia con la inyeccion de una perturbacion de la densidad, que genera una onda de presion



Esta perturbacion viaja por el resonador, y luego explora la correspondiente condicion de borde.



Cuando la onda regresa, afecta al jet, desestabilizandolo



La deformacion inducida en el jet, se propagara convectivamente hacia el filo

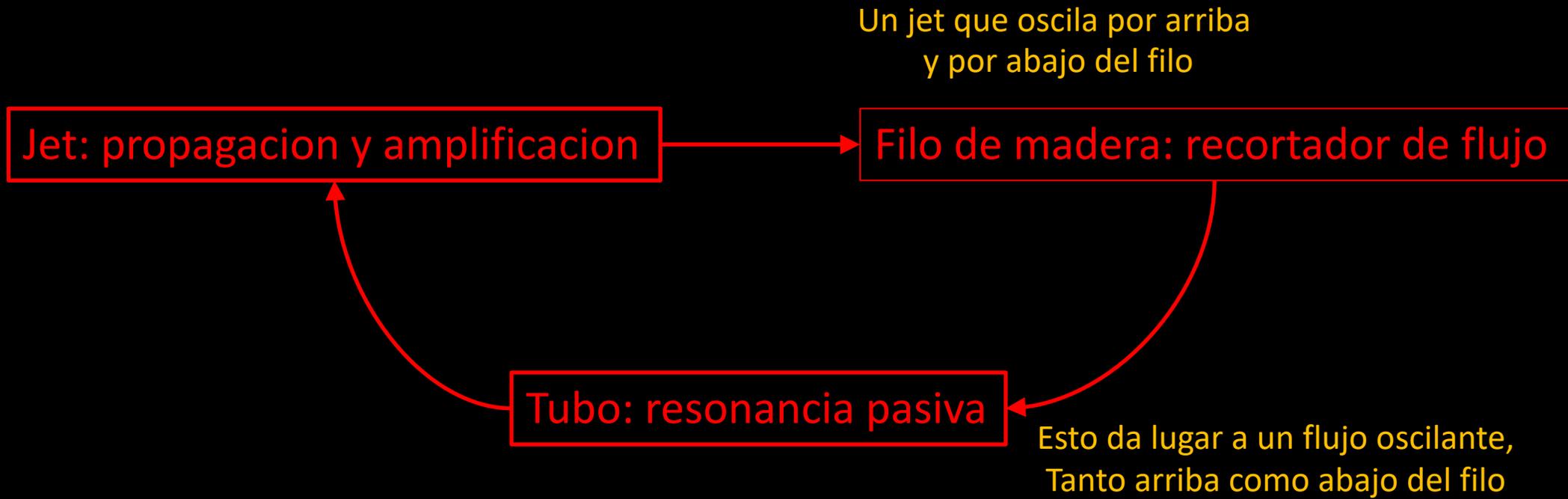
Jet: propagacion y amplificacion

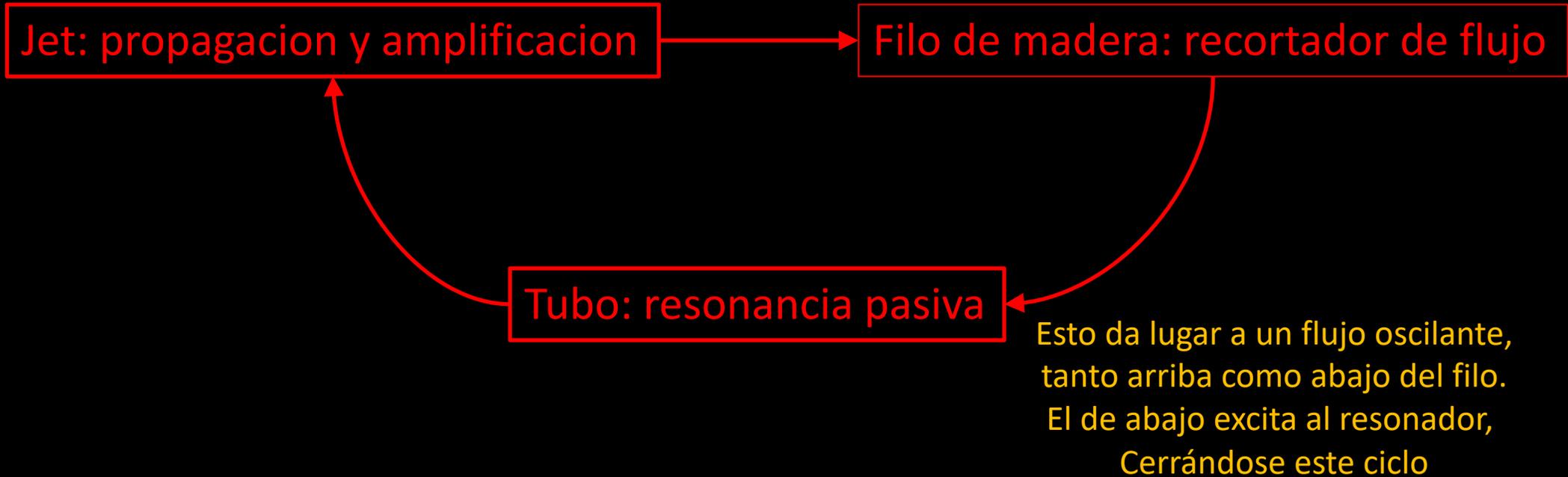
Filo de madera: recortador de flujo

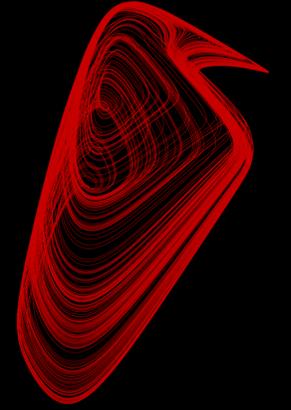
Fluctuacion periodica
en los tiempos del resonador

Tubo: resonancia pasiva



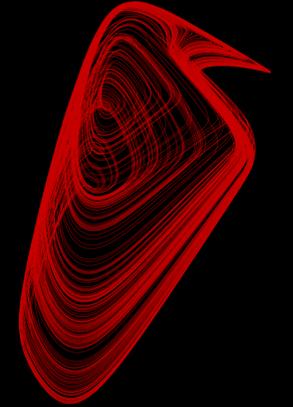






Empecemos por aca

Las mismas ecuaciones, linealizadas
alrededor de una presión y densidad
medias (p_0, ρ_0)



$$\frac{1}{\rho_0} \frac{\partial \rho'}{\partial t} + \nabla \cdot (\mathbf{v}) = q$$

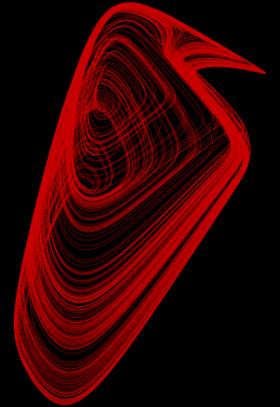
$$\rho_0 \left(\frac{\partial}{\partial t} \right) \mathbf{v} = -\nabla p' + \mathbf{F}$$

$$\rho' = p' / c_0^2$$

Que llevan a las famosas

$$\left(\frac{1}{c_0^2} \frac{\partial^2}{\partial t^2} - \nabla^2 \right) p = \rho_0 \frac{\partial q}{\partial t} - \nabla \cdot \mathbf{F}$$

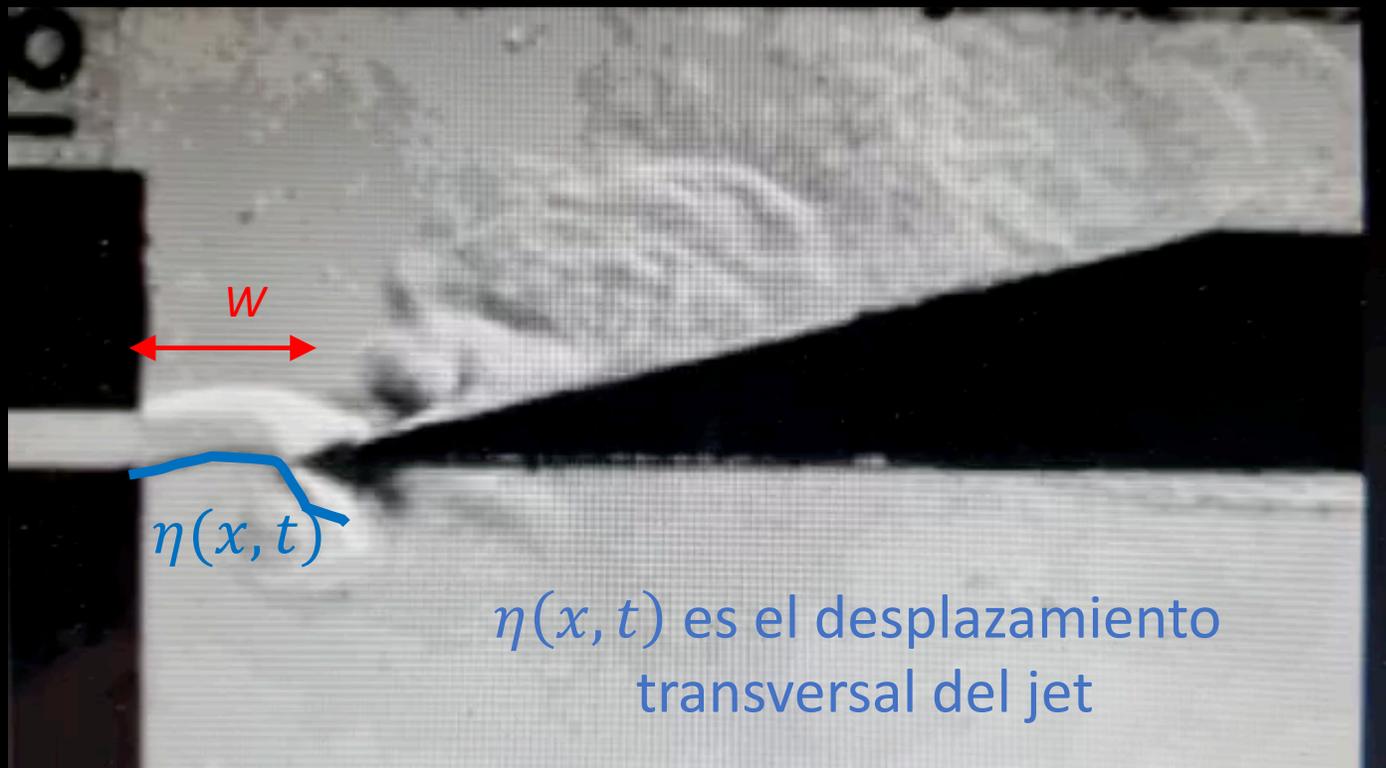
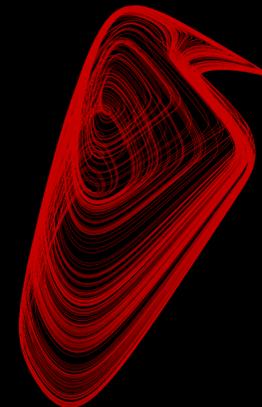
Con q un flujo de entrada, por
unidad de volumen



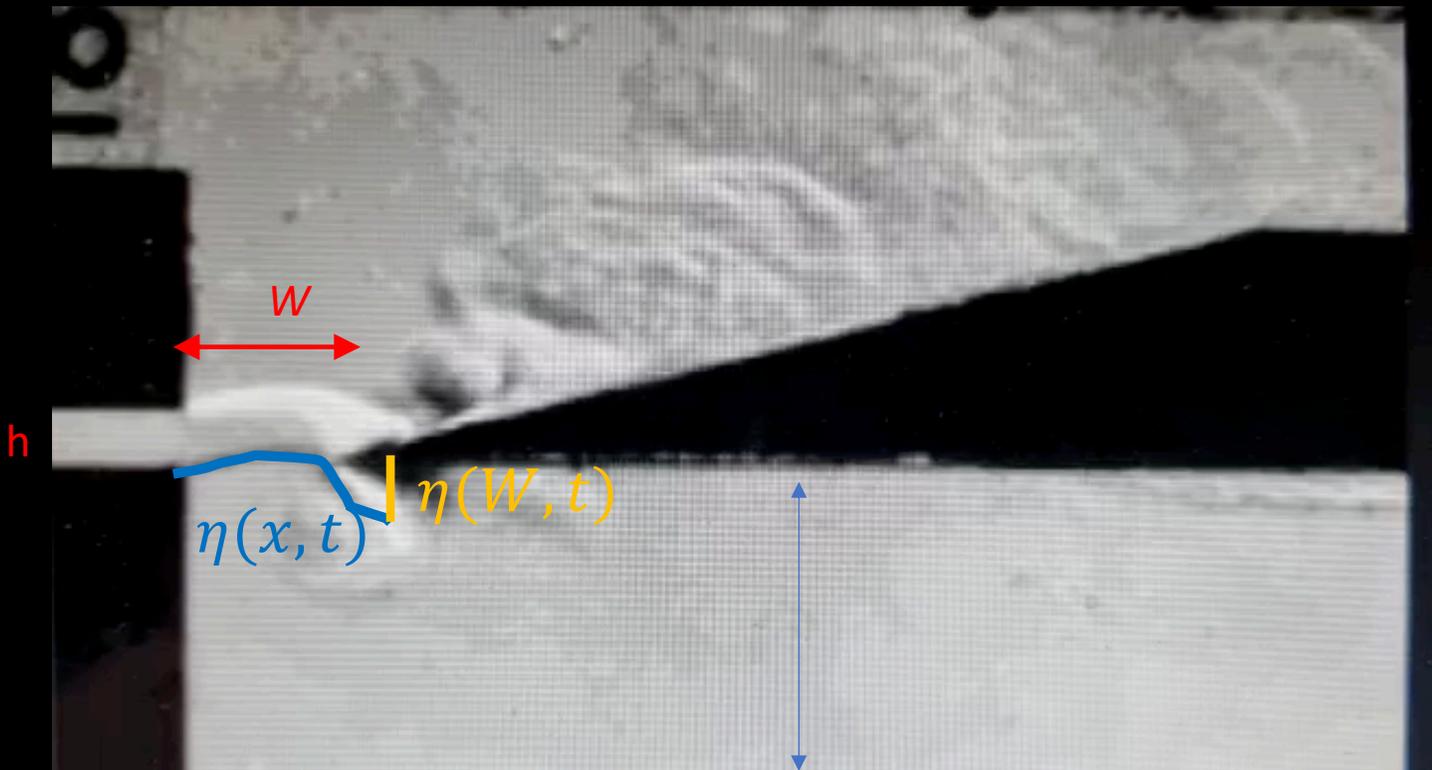
Esta ecuacion nos dice que son las fluctuaciones del flujo las que originaran el sonido

Empecemos por aca

$$\left(\frac{1}{c_0^2} \frac{\partial^2}{\partial t^2} - \nabla^2 \right) p = \rho_0 \frac{\partial q}{\partial t} - \nabla \cdot \mathbf{F}$$



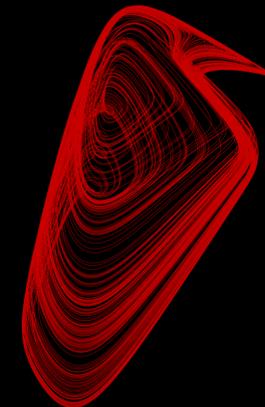
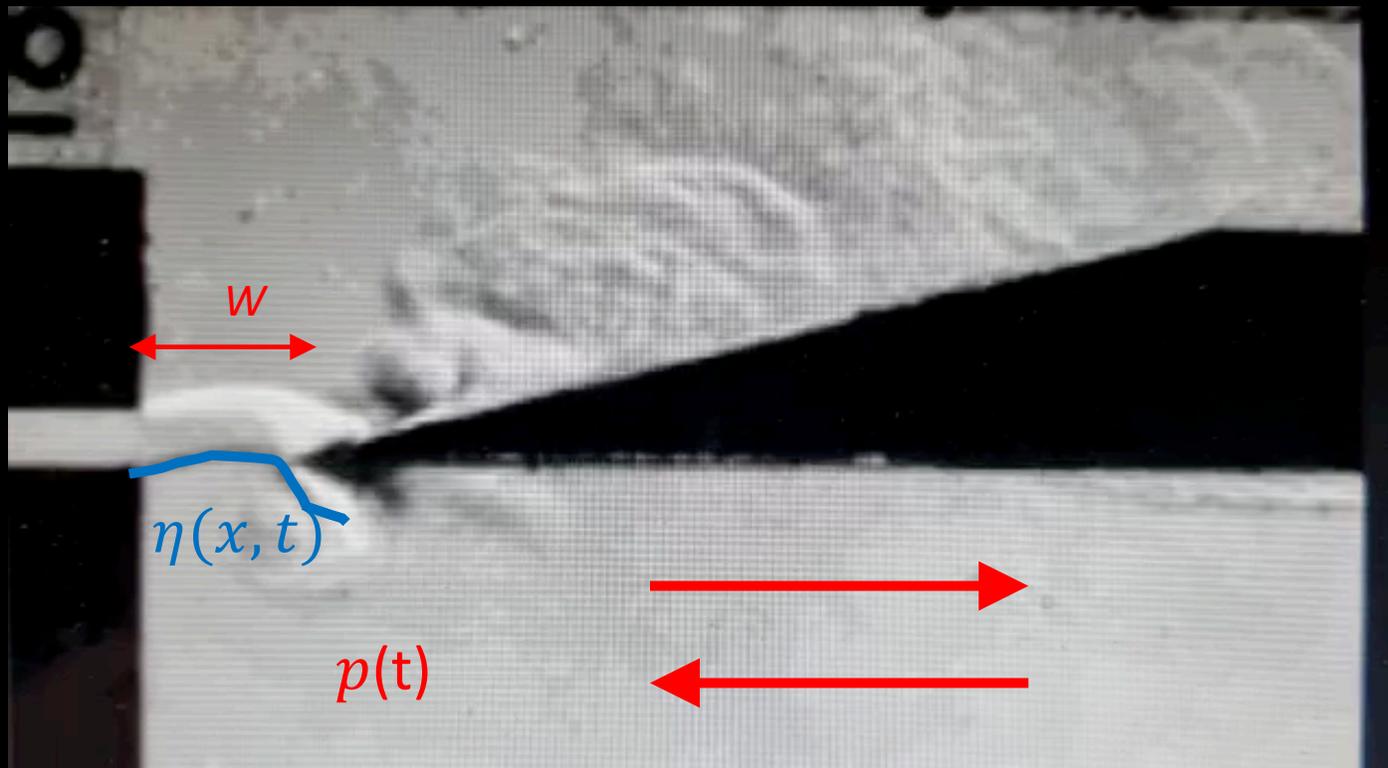
¿Y como calculamos ese flujo “q”?
Si sabemos como se deforma el jet
no es muy dificil:



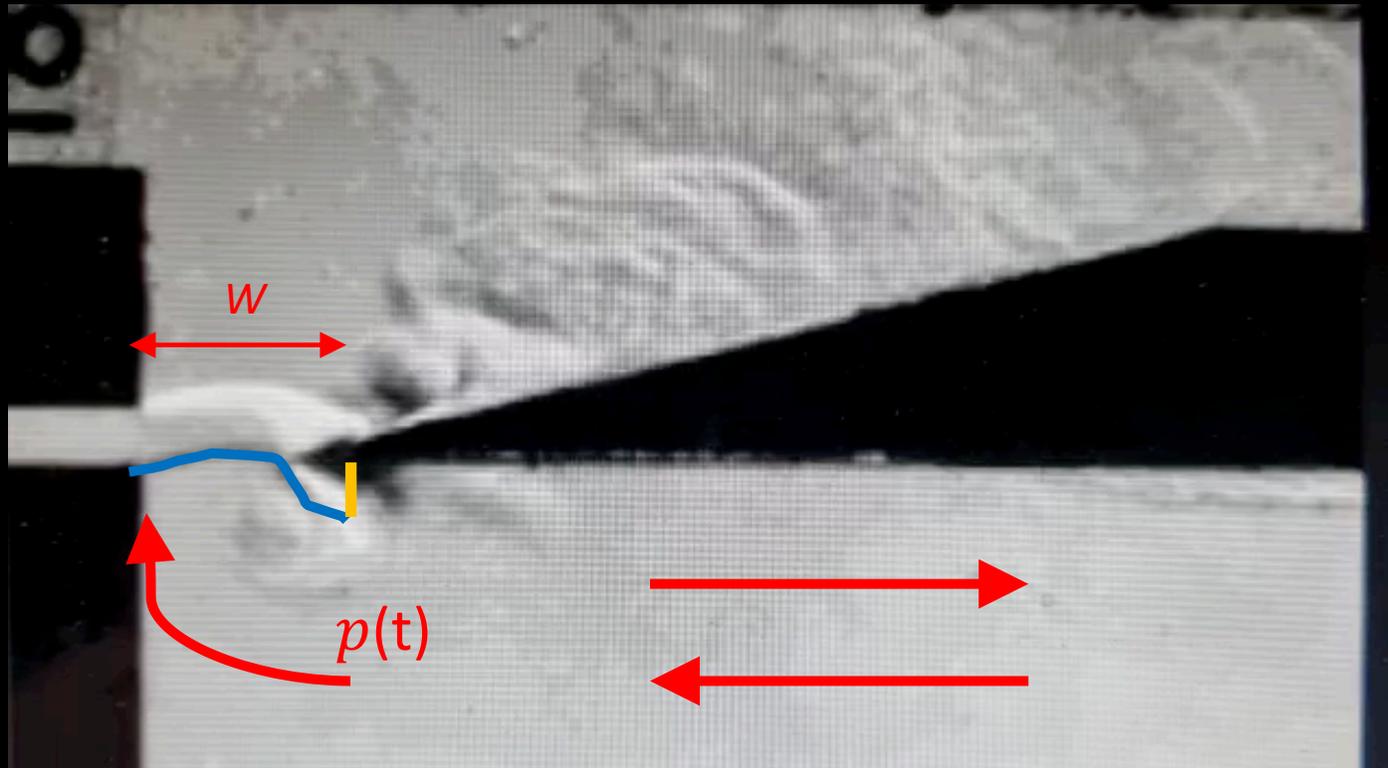
Con U el perfil de
velocidad del jet

$$q = \int_0^{L2} U(y - \eta(W, t)) dy$$

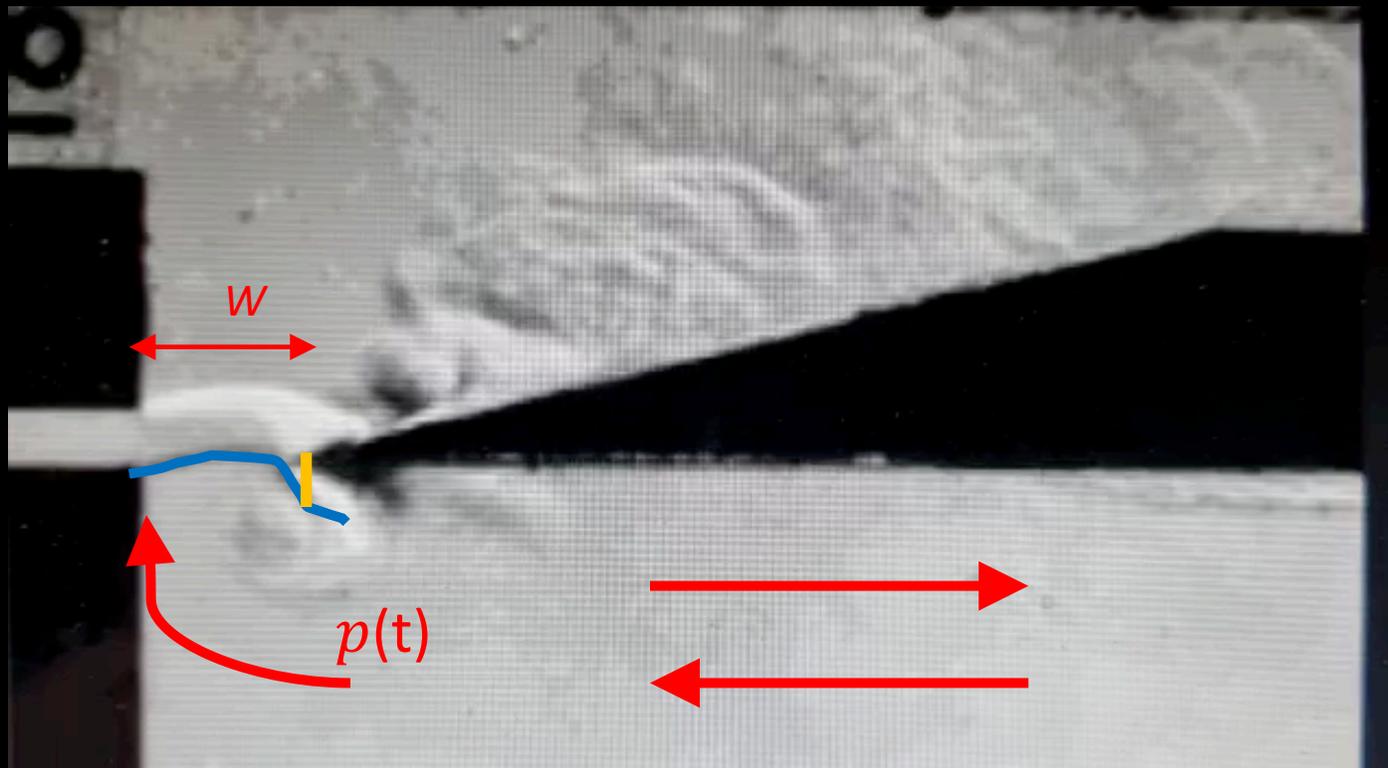
$$U(\alpha) = \begin{cases} 0, & \alpha > L2 \\ 1, & \alpha \in [L2, L2 + h] \\ 0, & \alpha < L2 \end{cases}$$



$$p = \# \frac{\partial q}{\partial t} + r p(t - 2T)$$



Y así tenemos en cuenta que la deformación al llegar al filo, fue originada por una fluctuación de la velocidad acústica (o sea de la presión), un tiempo W/c_p antes (c_p velocidad convectiva de viaje de perturbaciones en el jet)...



$$\eta(W, t) \propto p(t - W/c_p)$$

$$\eta(W, t) \propto p(t - W/c_p)$$

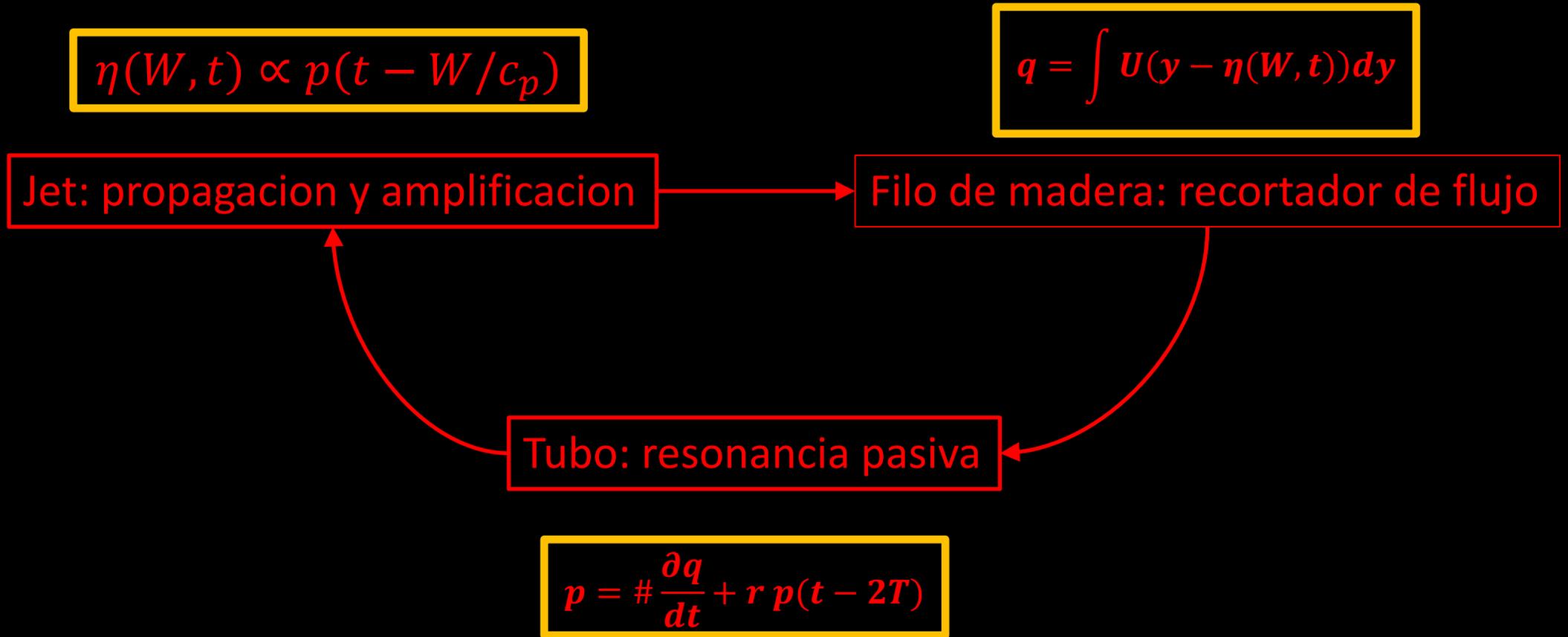
$$q = \int U(y - \eta(W, t)) dy$$

Jet: propagacion y amplificacion

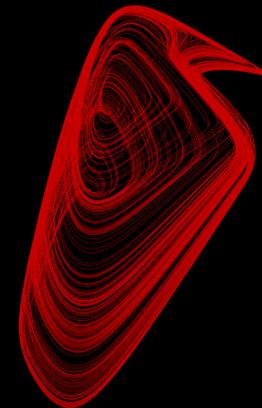
Filo de madera: recortador de flujo

Tubo: resonancia pasiva

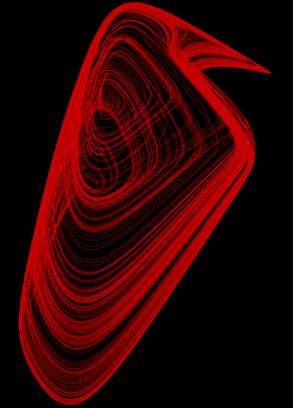
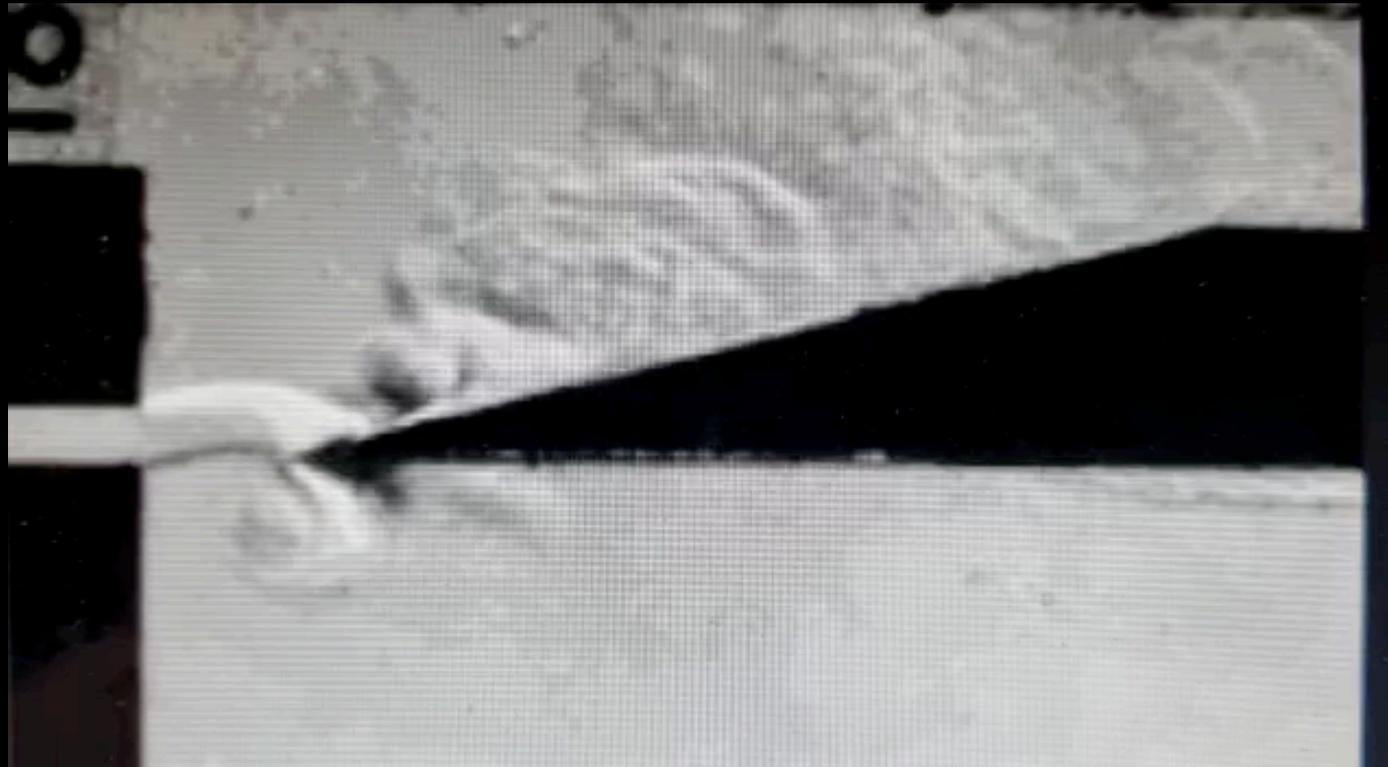
$$p = \# \frac{\partial q}{\partial t} + r p(t - 2T)$$



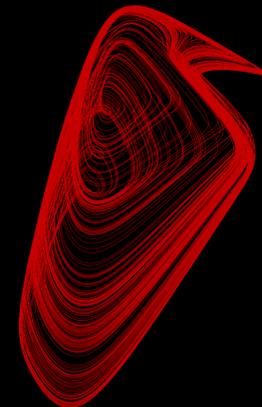
Mete energia por aca



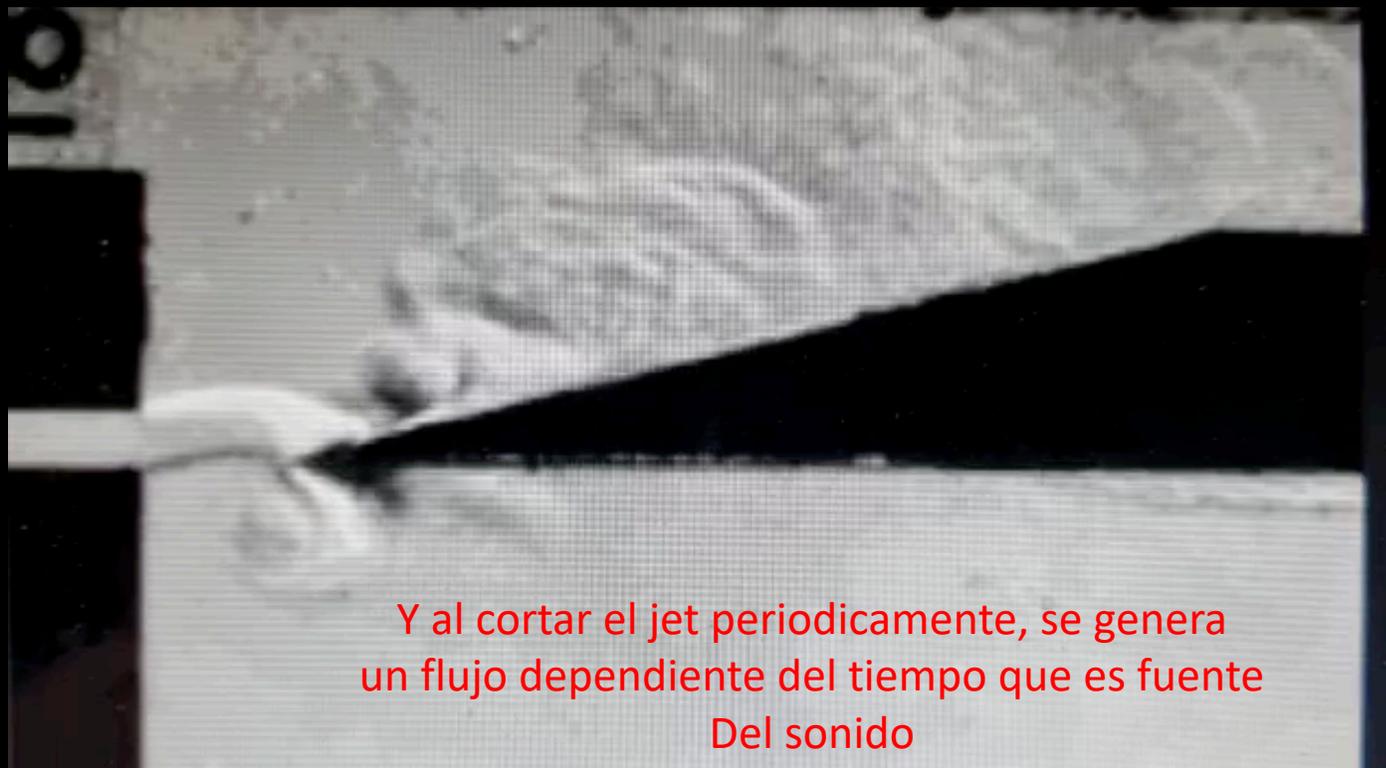
Mete energia por aca



Las resonancias del tubo seleccionan una frecuencia
Para desestabilizar al jet

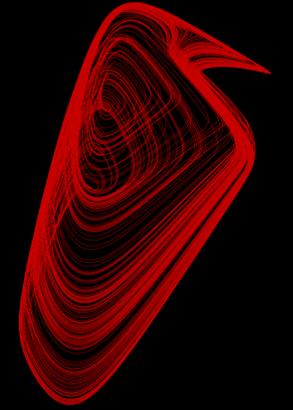
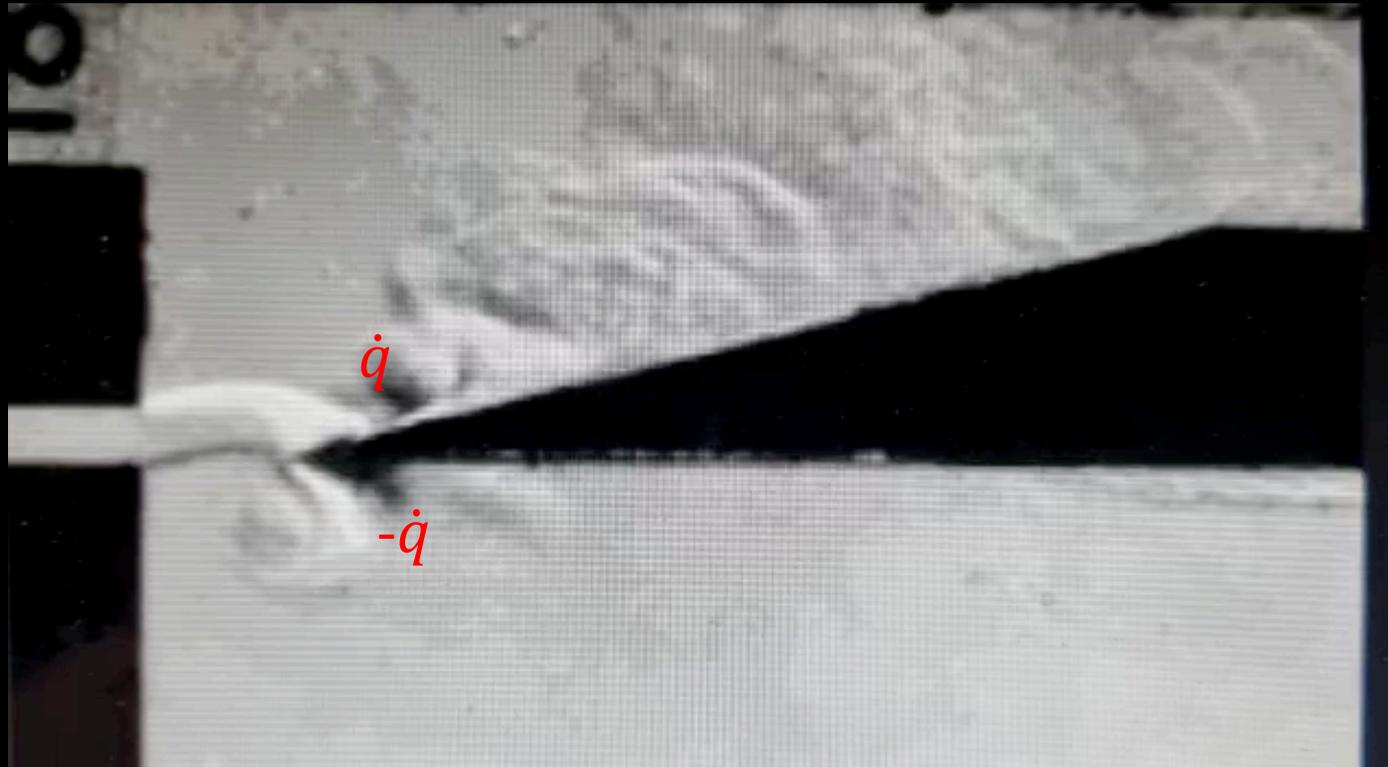


Mete energia por aca

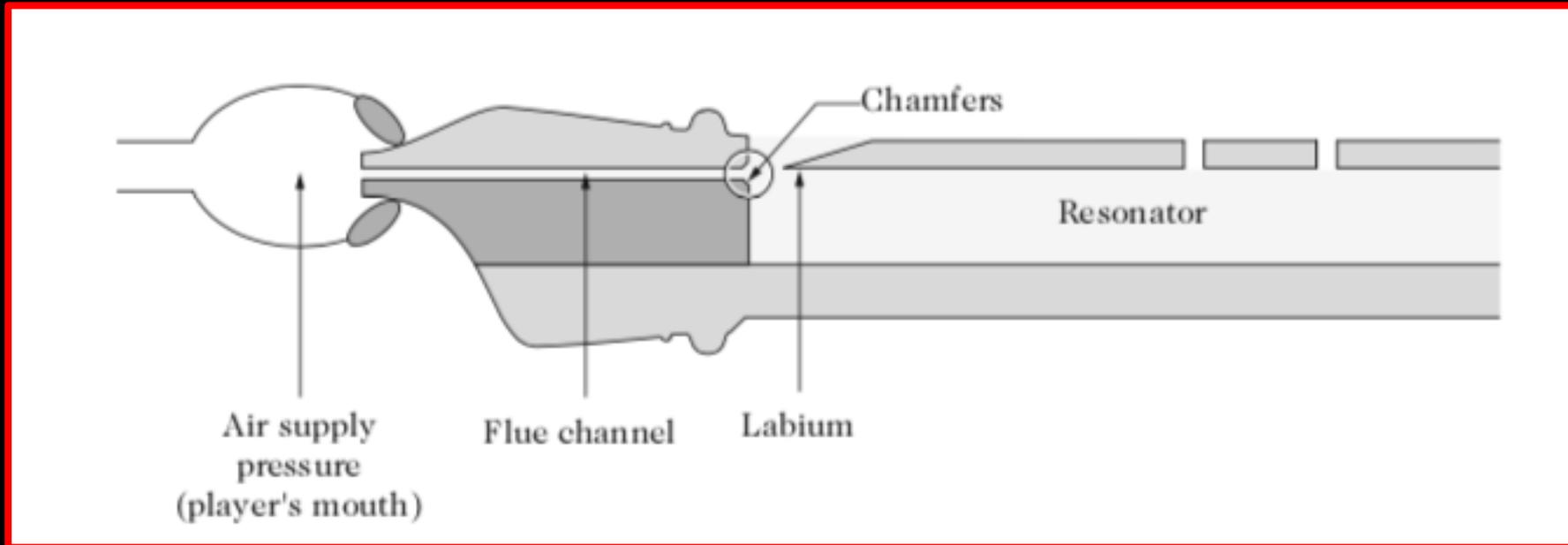


Y al cortar el jet periodicamente, se genera
un flujo dependiente del tiempo que es fuente
Del sonido

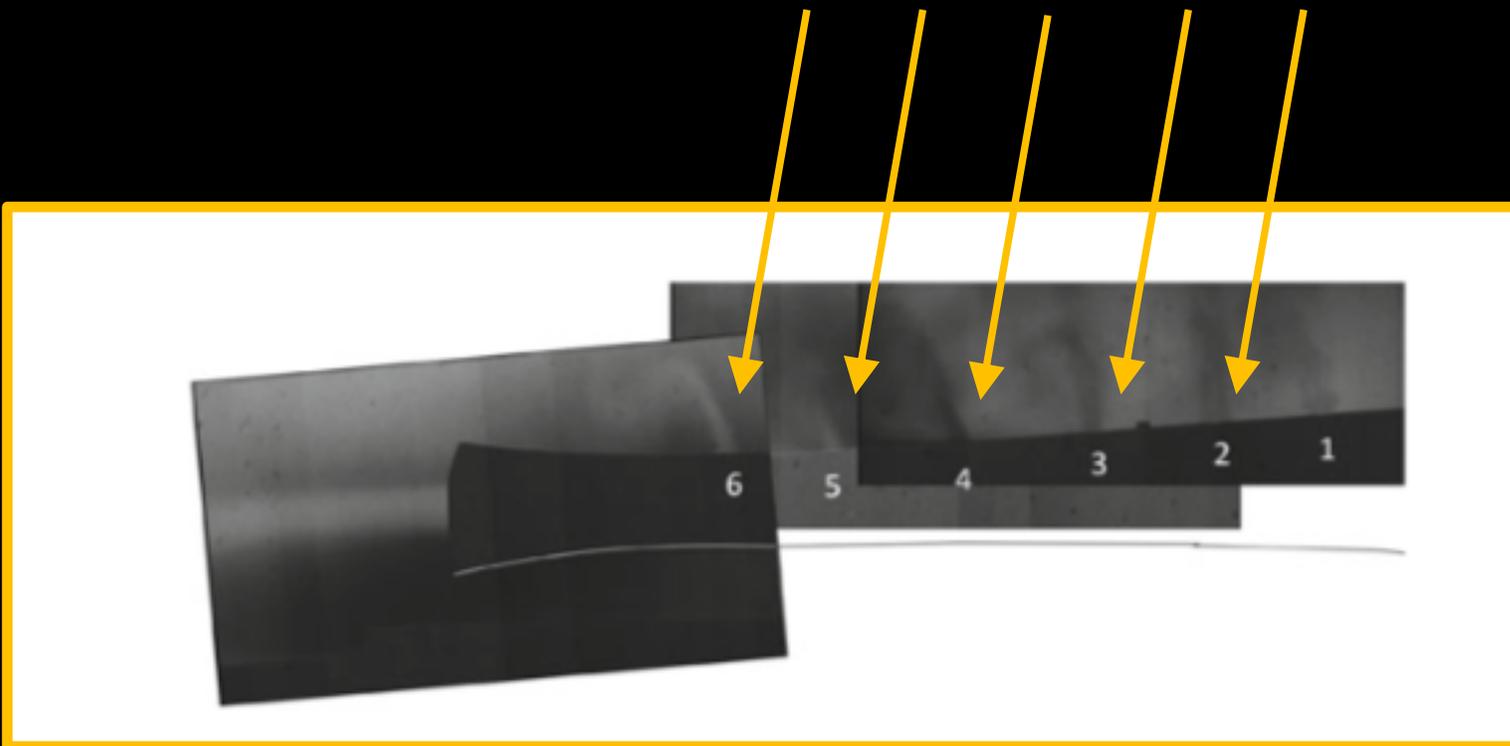
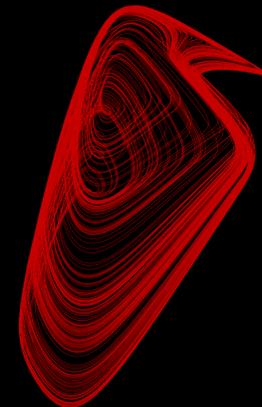
Las resonancias del tubo seleccionan una frecuencia
Para desestabilizar al jet



De hecho, se genera un dipolo
Podemos encontrar evidencia del mismo?

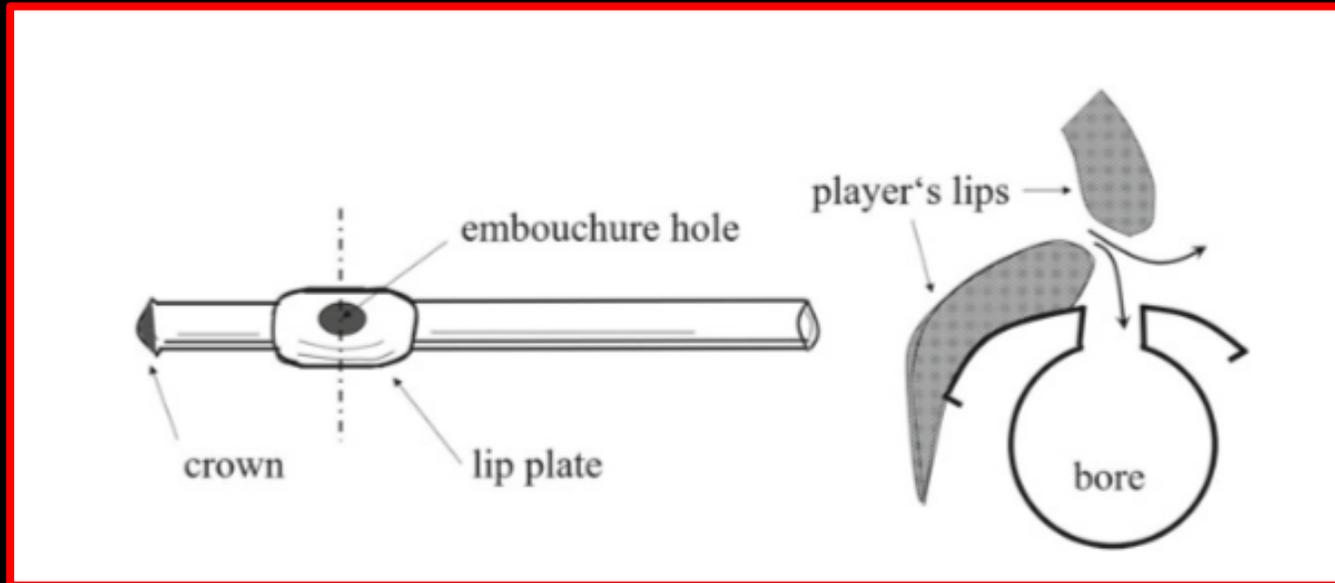
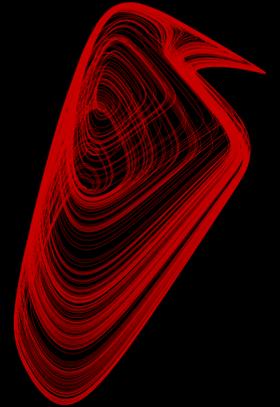


Una flauta dulce es básicamente un tubo abierto que, cuando se toca de forma normal, desarrolla una onda estacionaria entre el extremo abierto donde se sopla y el primer orificio abierto debajo de la boquilla.

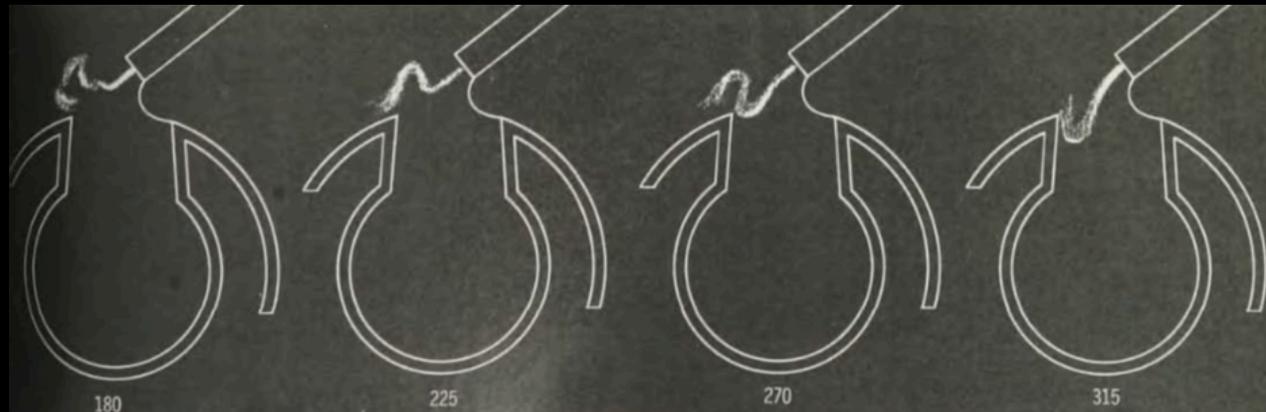
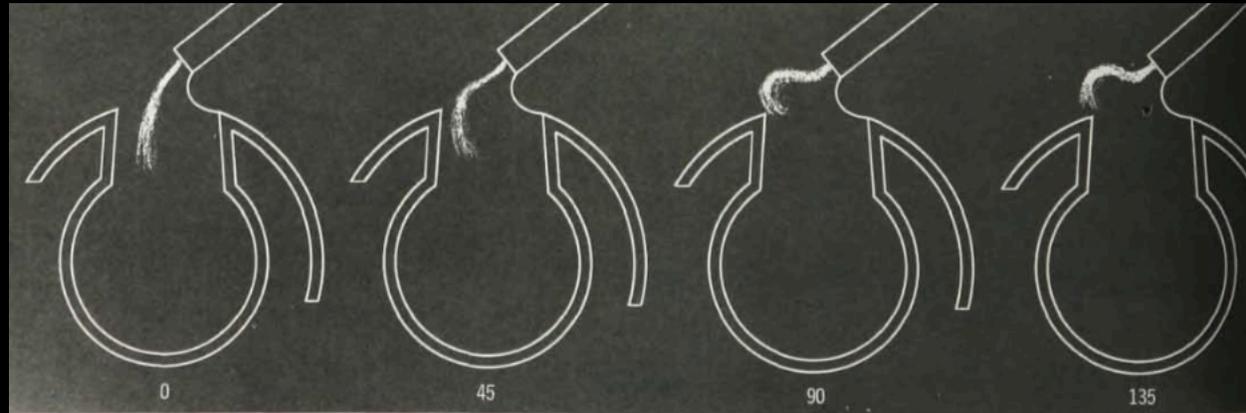


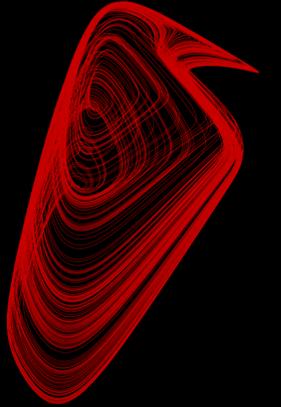
Nodos de presion, anti-nodos de desplazamiento

Una fisica parecida, en terminos de la **fuentes**

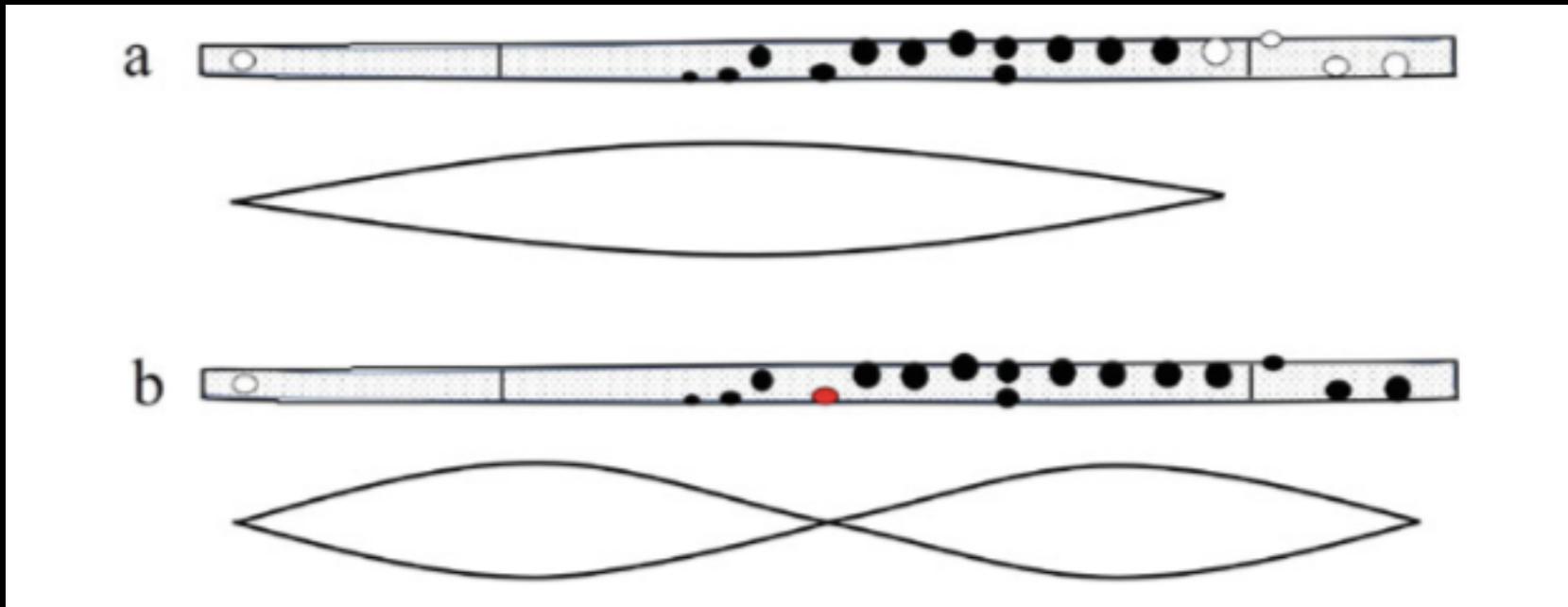


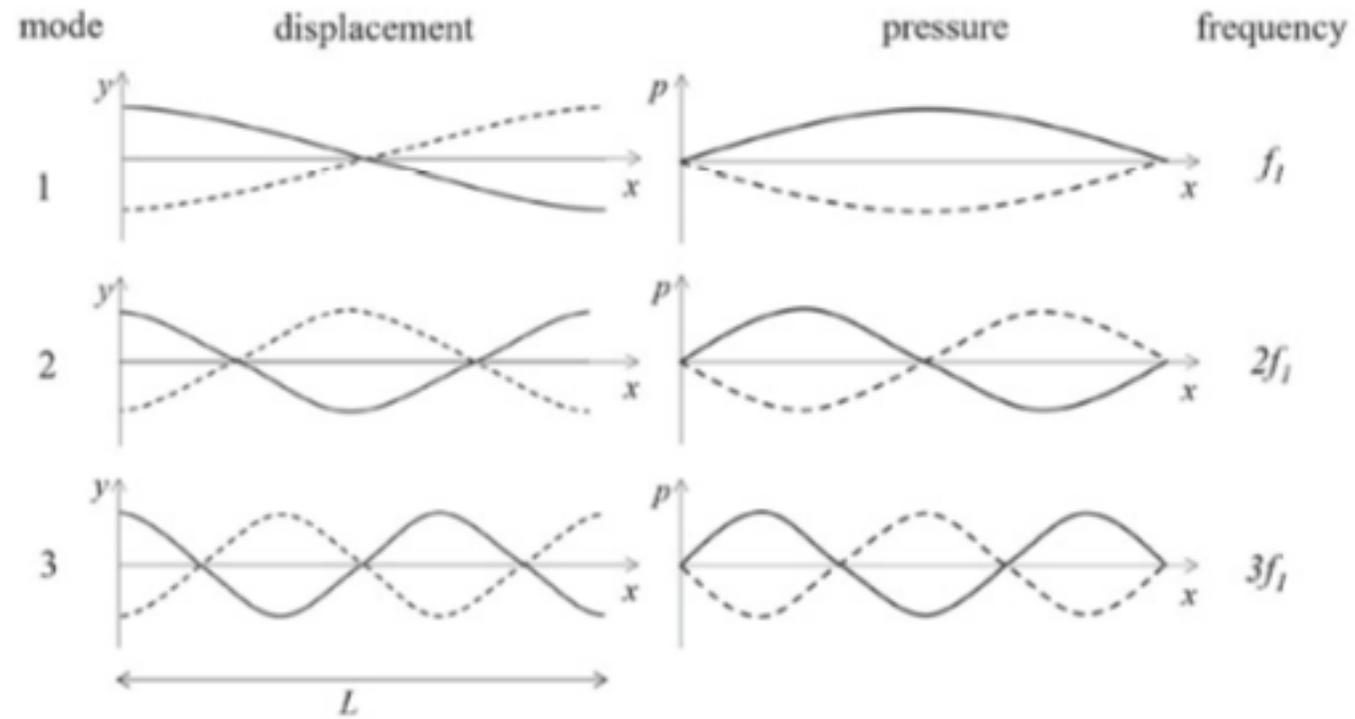
Oscilacion a 437 Hz, muestreo de cerca de 10 Hz



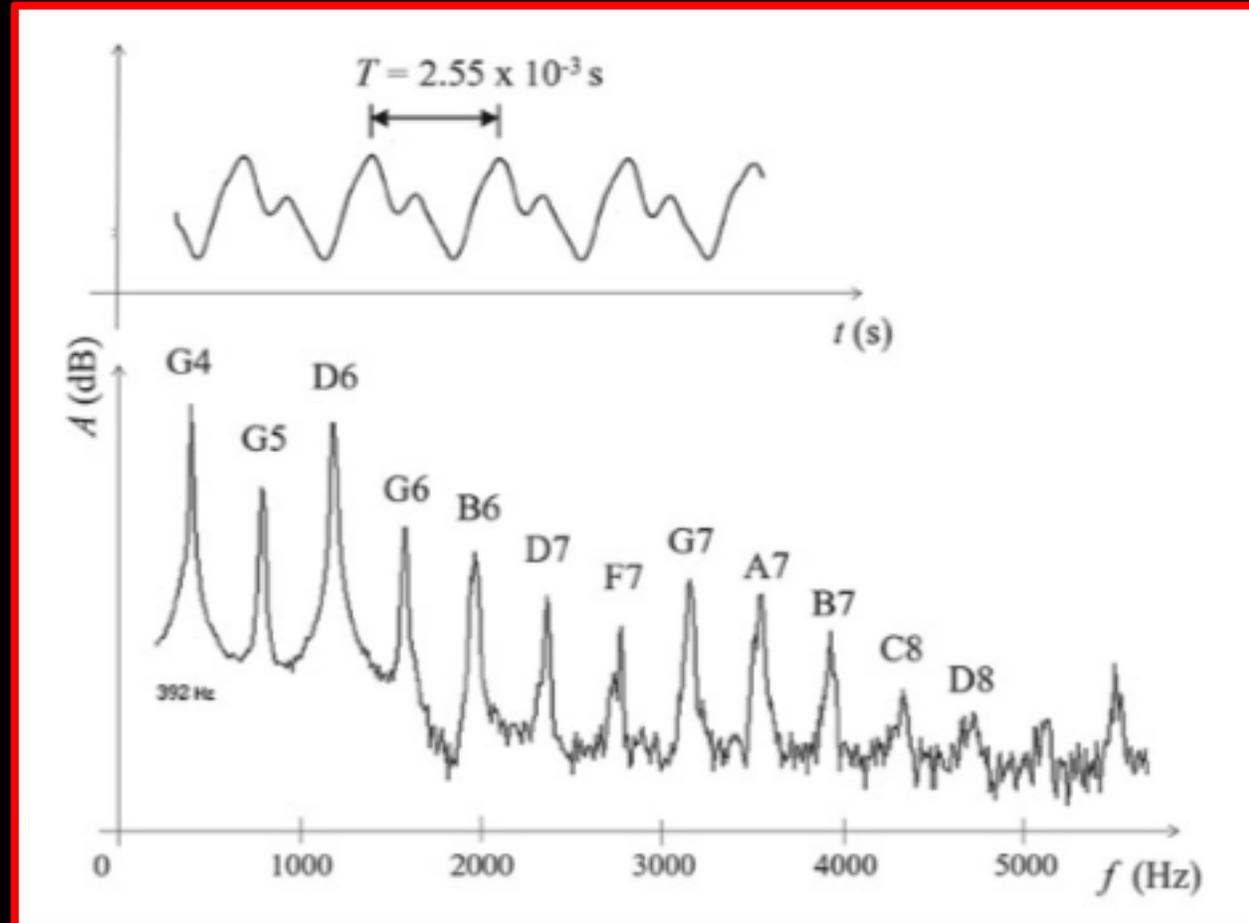


Pero el sistema resonador es abierto-abierto

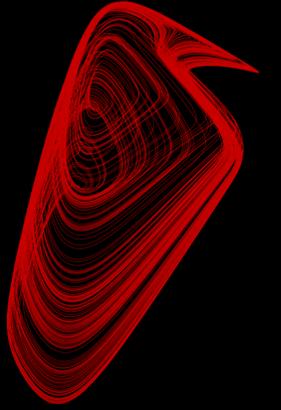


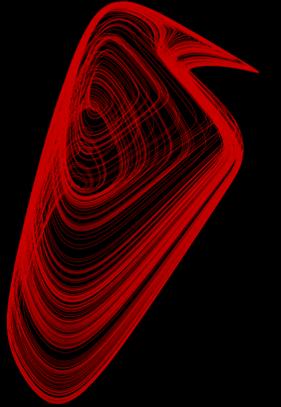


En la flauta traviesa
la fundamental es
marcadamente mayor
en todo el rango del
instrumento









DID NEANDERTHALS PLAY MUSIC? X-RAY COMPUTED MICRO-TOMOGRAPHY OF THE DIVJE BABE ‘FLUTE’*

C. TUNIZ,^{1,2} F. BERNARDINI,¹ I. TURK,³ L. DIMKAROSKI,⁴ L. MANCINI⁵
and D. DREOSI⁵

¹The ‘Abdus Salam’ International Centre for Theoretical Physics, Multidisciplinary Laboratory, II Strada Costiera, Trieste 34151, Italy

²Centre for Archaeological Science, University of Wollongong, NSW 2522, Australia

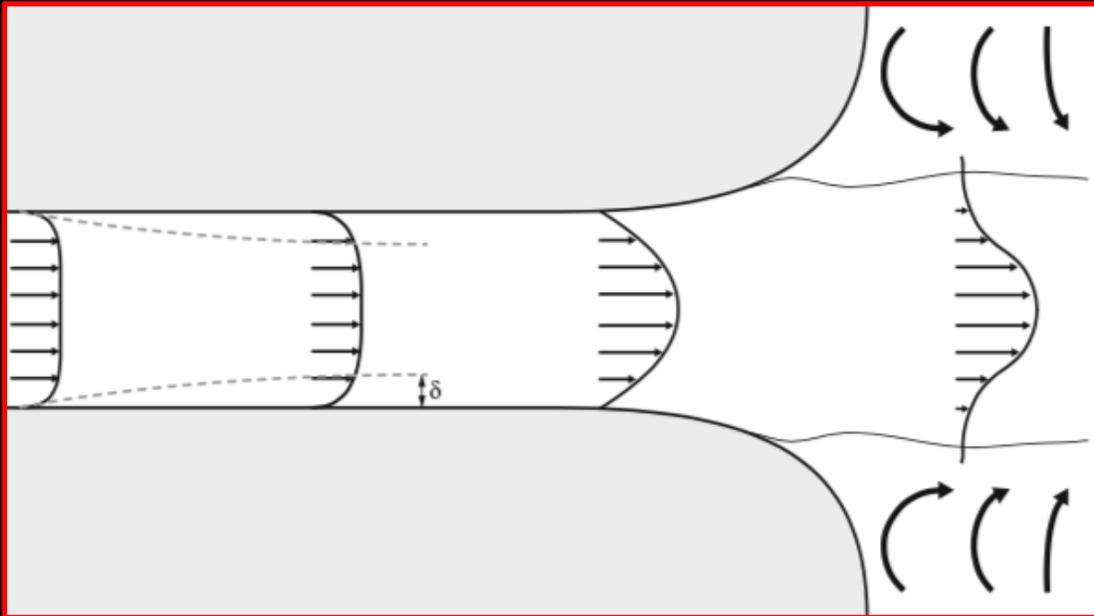
³Ex-research advisor of Institute of Archaeology SRC, Ljubljana 1000, Slovenia

⁴SNG Opera and Ballet, 5 Ljubejeva, Ljubljana 1000, Slovenia

⁵Elettra Sincrotrone Trieste, 14 Strada Statale, Trieste, Basovizza 34149, Italy

Archaeological evidence for wind musical instruments made by modern humans has been well established from the Upper Palaeolithic in Europe. Musical instruments evidently made by Neanderthals have not been found so far. The most controversial object is a juvenile cave bear femur with two complete holes, found in 1995 in the Middle Palaeolithic layers of the Cave Divje babe I, Slovenia. The bone was interpreted as a possible Neanderthal ‘flute’, but some scholars have firmly rejected this hypothesis on the basis of taphonomic observations, suggesting a carnivore origin for the holes. Here, we show the results of X-ray computed micro-tomography (mCT) performed on the Divje babe I ‘flute’. Our analyses demonstrate that there were originally four holes, possibly made with pointed stones and bone tools. Most surface modifications near the holes, previously interpreted as effects of carnivore gnawing, are post-depositional marks. Furthermore, a thin layer has been removed around one of the complete holes, producing a flat surface, possibly to facilitate perforation. The new data show that a Neanderthal manufacture of the object cannot be ruled out.

Temas adicionales



El calculo del perfil de velocidades,
tiene que tener en cuenta la viscosidad

$$\rho_0 \frac{d\mathbf{v}}{dt} = -\nabla p + \mu \nabla^2 \mathbf{v}$$

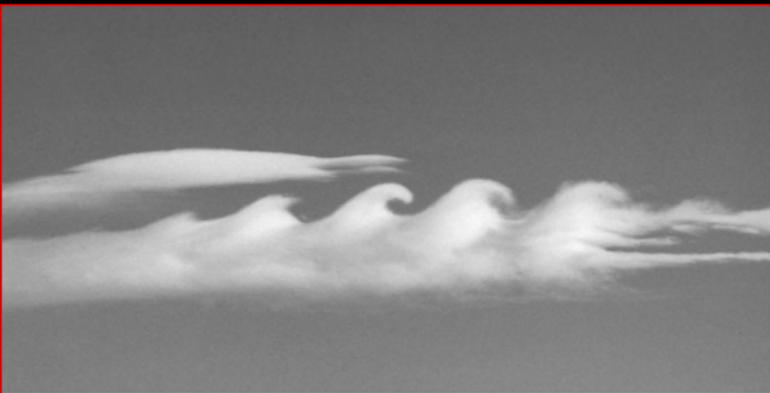
Temas adicionales



Inestabilidad de Rayleigh

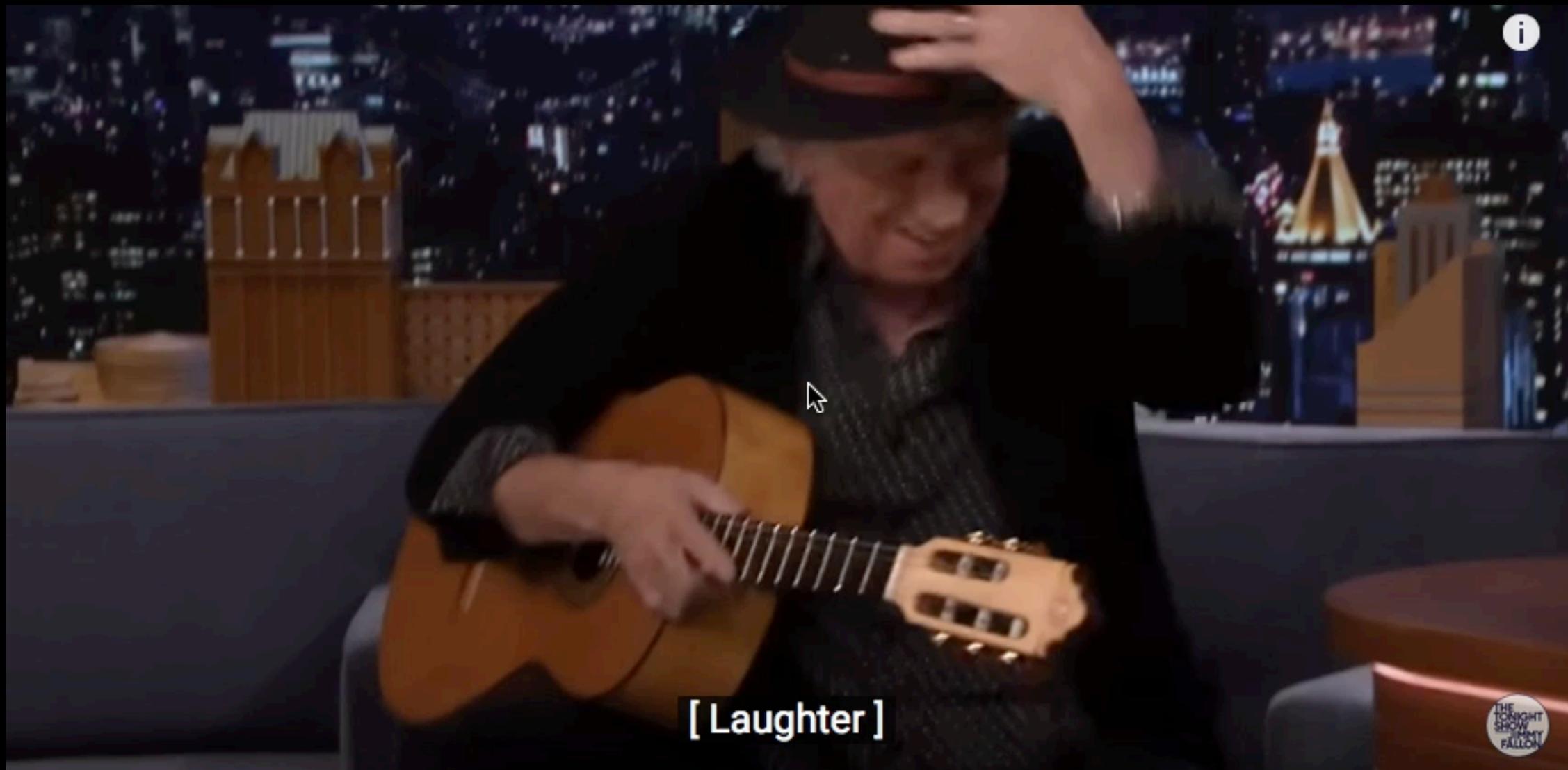
$$\frac{d\omega}{dt} = 0$$

Mas un desarrollo perturbativo



Chaigne y Kergomard

En esta clase solo mencionamos que las perturbaciones temporales a la entrada del Jet, se amplifican convectivamente



[Laughter]



¿Como le sacas a esa guitarra ese sonido?



Una buena pregunta es una que

1. nos hace colgar en el colectivo
2. nos deja pensando en la ducha
3. Se nos viene a la mente ante una conversacion aburrida

Las malas preguntas tambien llevan tiempo, asi que elijan una buena pregunta. Una que les interese.

Elegida la pregunta, hagan el duelo rapidamente:
generalmente uno no puede contestar rapidamente
una buena pregunta. Una buena pregunta, bien planteada,
puede llevar unos dos o tres años ser resuelta.

Formulense una pregunta que los acerque en la direccion
De responder la pregunta original. Por ejemplo, en este caso:

1. Si son “experimentales”. Grábense (si tocan la guitarra) tratando de Reproducir ese timbre, analicen los espectros, compárenlos con los que se obtienen al pulsar las cuerdas.
2. Si les gustan los modelos y el análisis. Vuelvan a las clases de timbre y cuerdas pulsadas y golpeadas, y comparen los espectros con los que Keith logra con su guitarra.
3. Si les gustan las ecuaciones. Busquen bibliografía. Como.



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[Hydromonochord: Visualizing String Vibration by Water Swirls](#)

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Pero no olviden LA pregunta.

