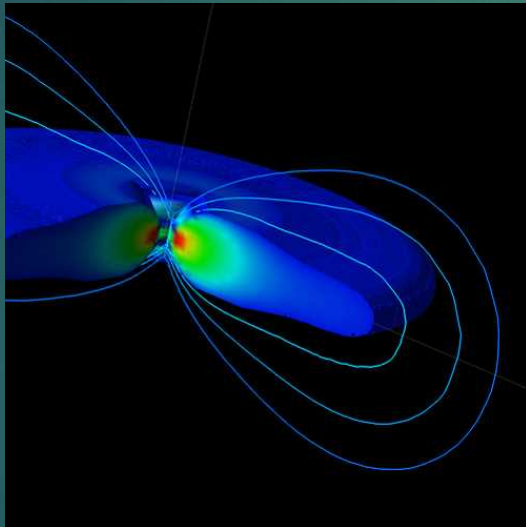


Zensho YOSHIDA

National Institute for Fusion Science

Plasma Physics, Nonlinear Science

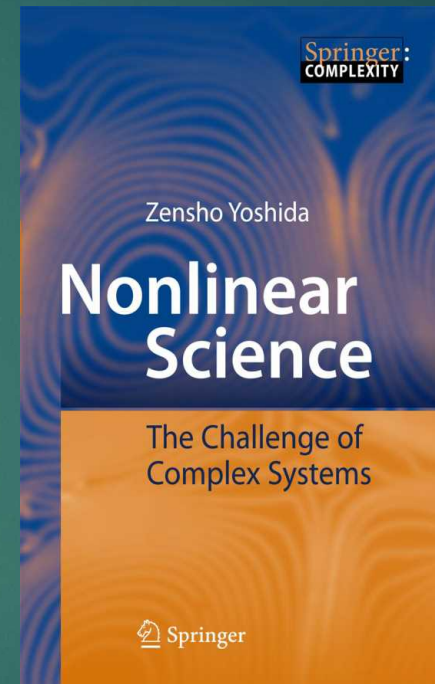


RT-1 project at the University of Tokyo: magnetospheric plasma confinement (till 2020)

Plasma physics in the context of nonlinear science



吉田善章；非線形とは何か
—複雑系への挑戦
(岩波書店, 2008)



Z. Yoshida, Nonlinear Science
---The Challenge of Complex Systems,
(Springer, 2010)

My interest:

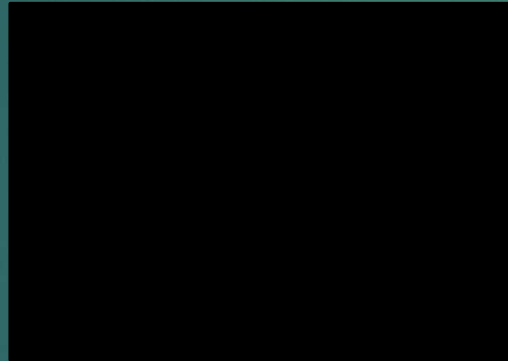
What is a vortex?

How does a vortex work?



M101

<https://universe.nasa.gov/galaxies/types/>



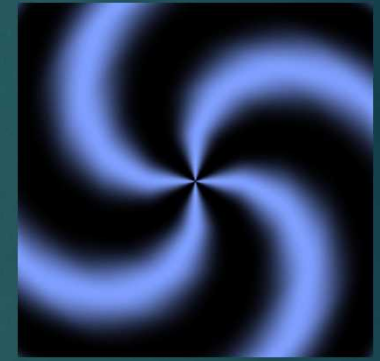
Solar flare

https://en.wikipedia.org/wiki/Solar_flare



Typhoon

<https://earthobservatory.nasa.gov/images/150290/typhoon-hinnamnor>



Quantum spiral

Z. Yoshida & S.M. Mahajan,
J. Phys. A: Math. Theor. 49 (2016) 055501

The universe is filled with various vortices.

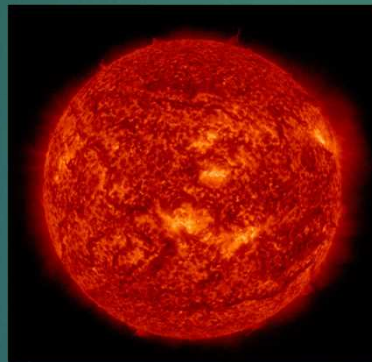
My interest

What is a vortex?

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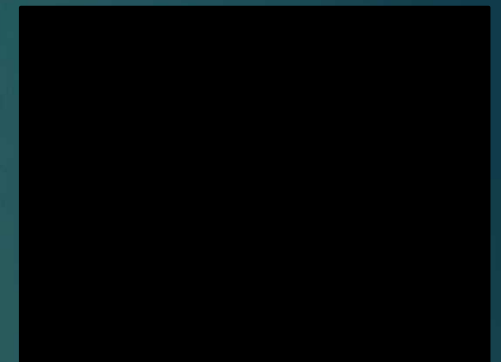
NGC6093(M80)
<https://ja.wikipedia.org/wiki/球状星団>



The sun
<https://ja.wikipedia.org/wiki/太陽>



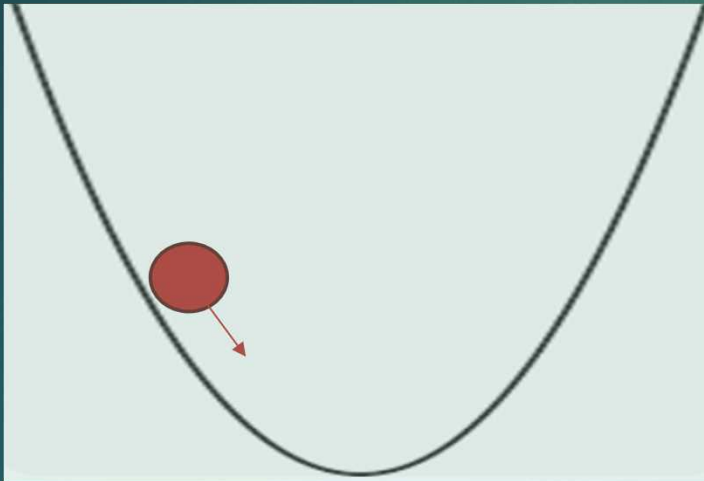
Marimo (*Aegagropila linnaei*)
<https://ja.kushiro-lakeakan.com/overview/295/>



Snow flake
<https://ja.wikipedia.org/wiki/雪片>

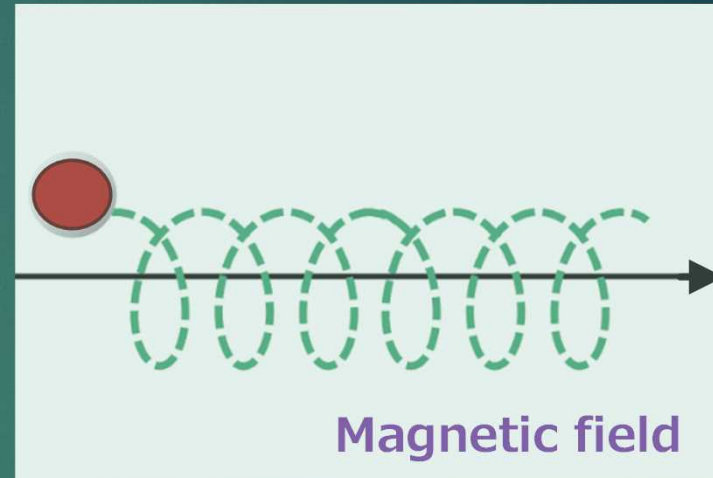
At the opposite pole are clusters generated by agglomeration effects.

Why do vortices matter for fusion energy ?



Trapping by
potential energy

$$H = \frac{1}{2}mv^2 + q\phi$$



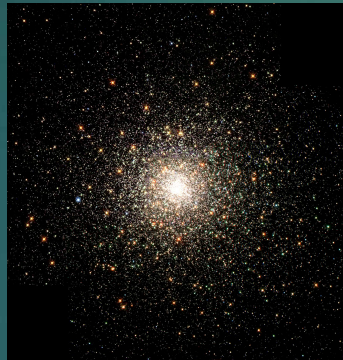
Trapping by
potential momentum

$$\mathbf{p} = m\mathbf{v} + q\mathbf{A}$$

magnetic field
 $\mathbf{B} = \nabla \times \mathbf{A}$
is the EM vorticity

Why do vortices matter for fusion energy ?

Self-organized
confinement

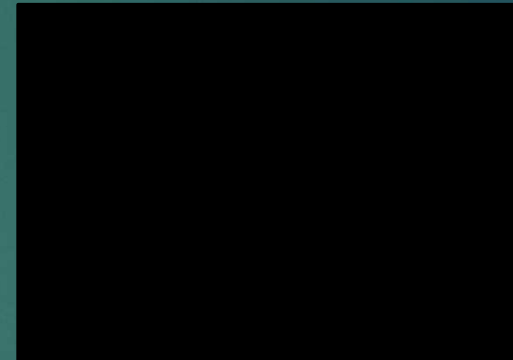


NGC6093(M80)
<https://ja.wikipedia.org/wiki/球状星団>

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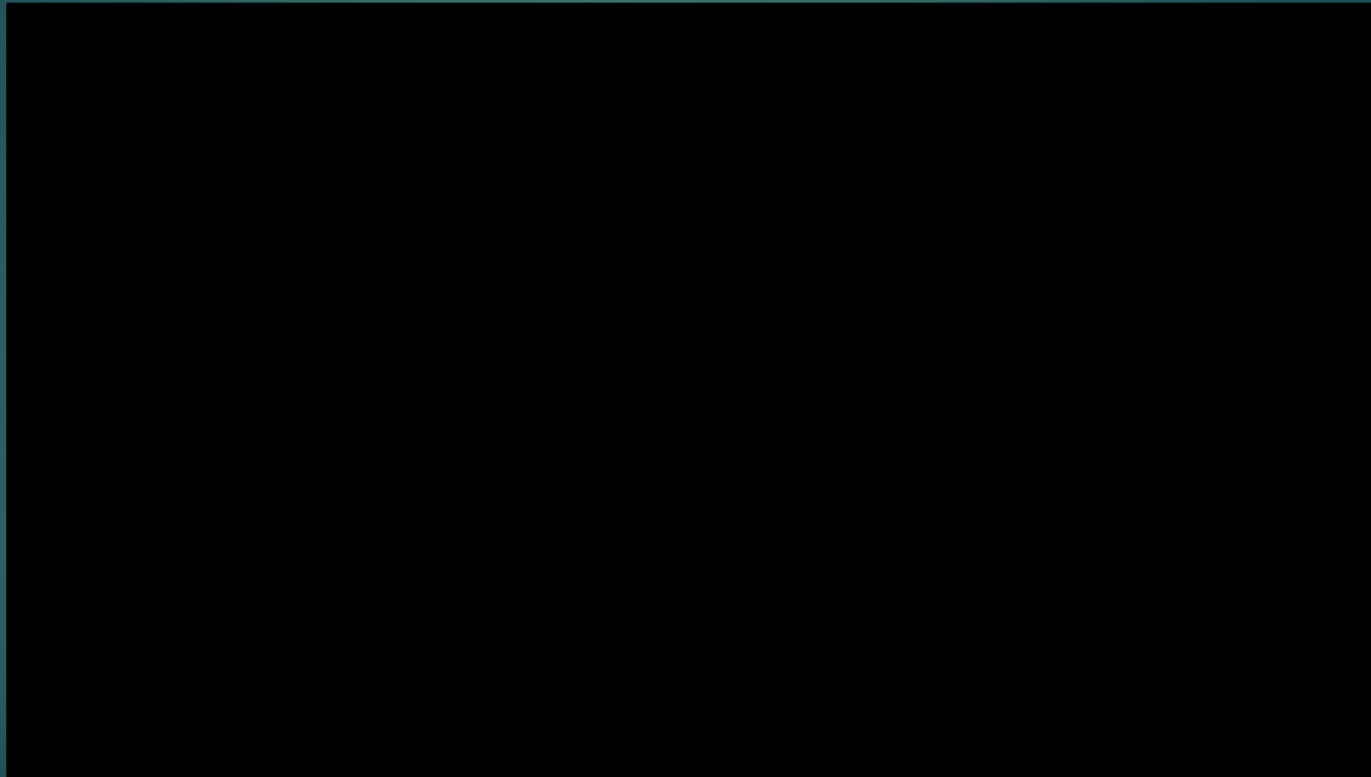
Solar flare
https://en.wikipedia.org/wiki/Solar_flare

Trapping by
potential momentum

$$\mathbf{p} = m\mathbf{v} + q\mathbf{A}$$

magnetic field
 $\mathbf{B} = \nabla \times \mathbf{A}$
is the EM vorticity

How a vortex emerges, and confines matter



<https://gigazine.net/news/20171128-art-of-flying/>

Ellipse model of aufheben → expand dimension

