Generation of collective states in Josephson heterostructures with large coupling and dissipation parameters.

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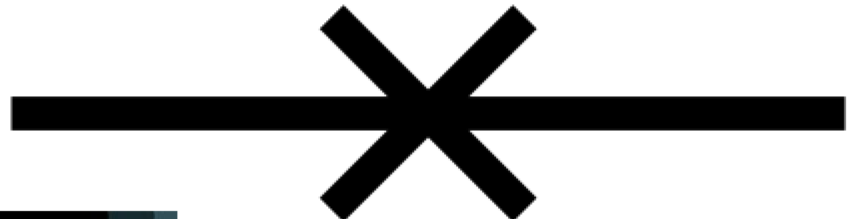
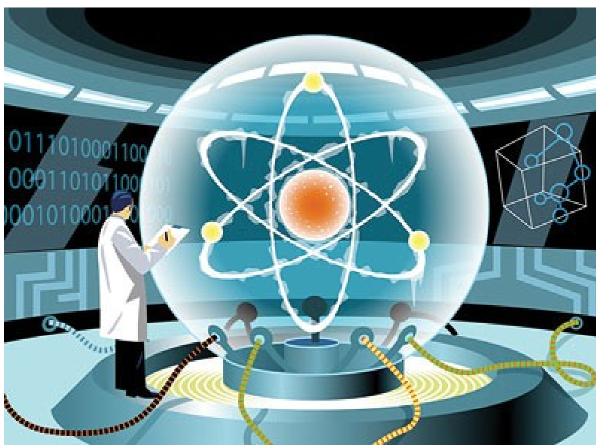
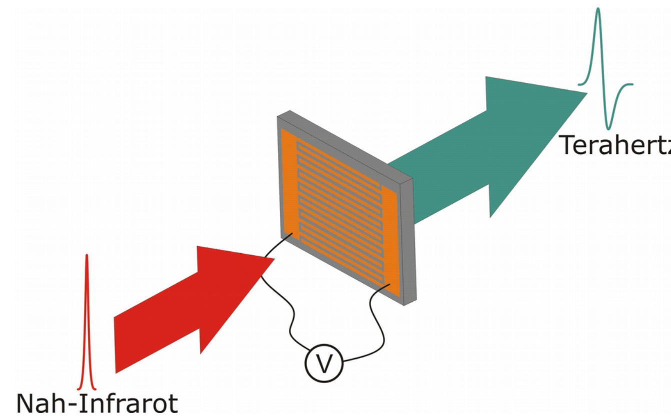
Why Josephson Junctions





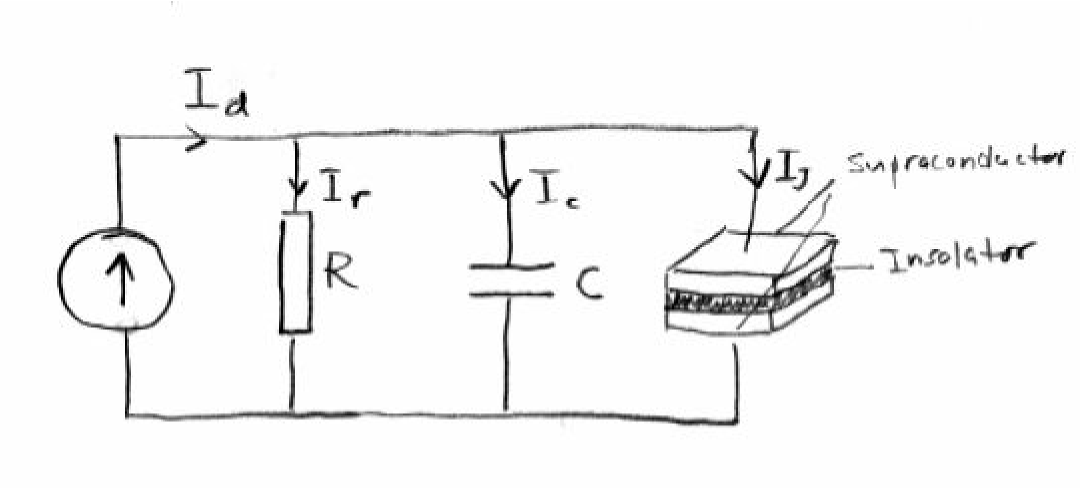
Quantum computing

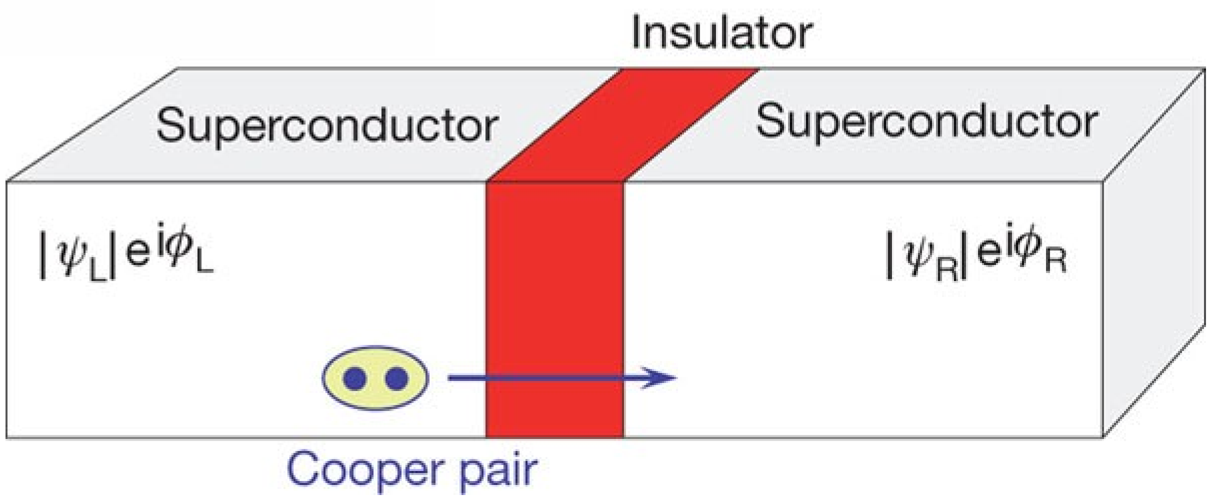
Space sensors



Thz emitters

What is Josepson Junctions





We will study a system of N serial conected Josephson junctions.

CCJJ+DC model

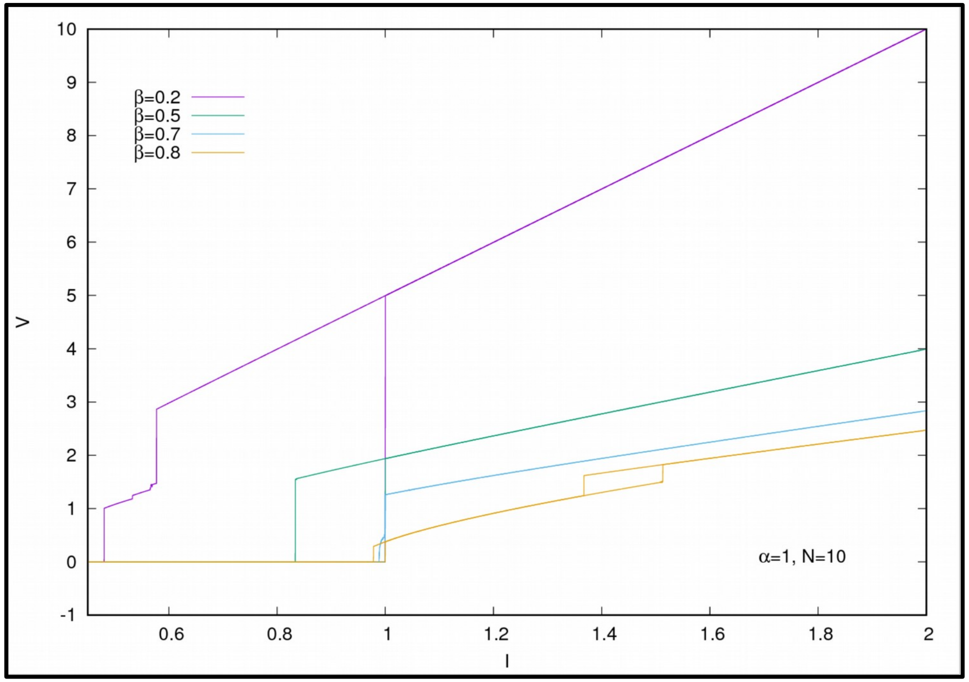
The system of nonlinear equations:

$$\frac{dV_l}{dt} = I + I_l^n - sin(\phi_l) - \beta \frac{d\phi_l}{dt}$$

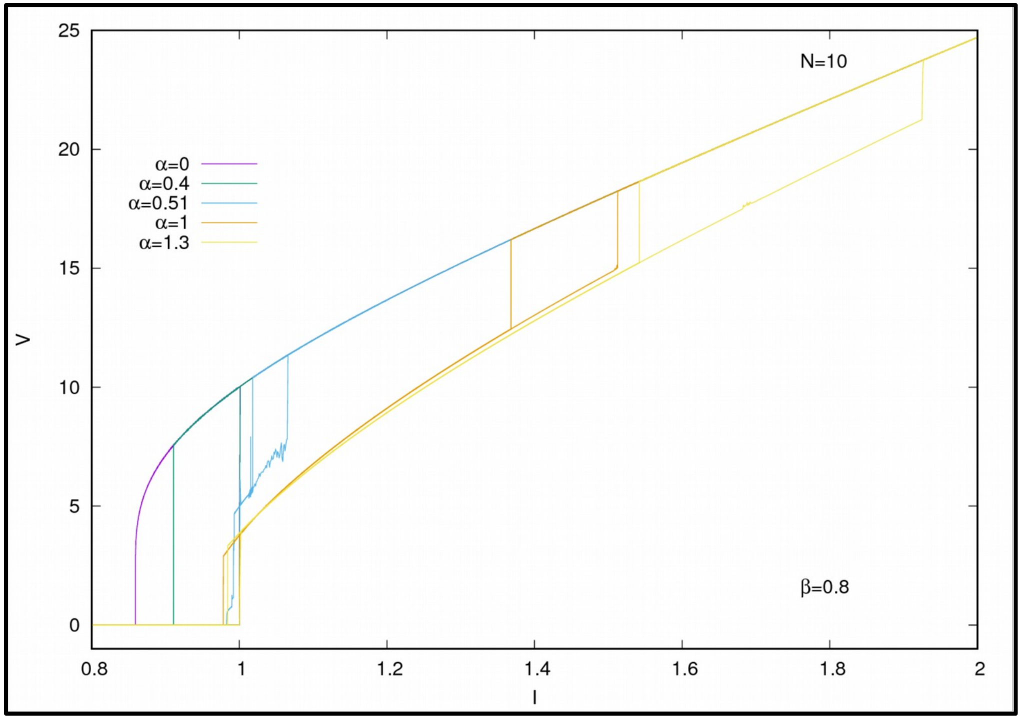
$$\frac{\phi_l}{dt} = V_l - \alpha(V_{l+1} + V_{l-1} - 2V_l)$$

Was solved numerically by using of 4-th
order Runge-Kutta method

I – V characteristics

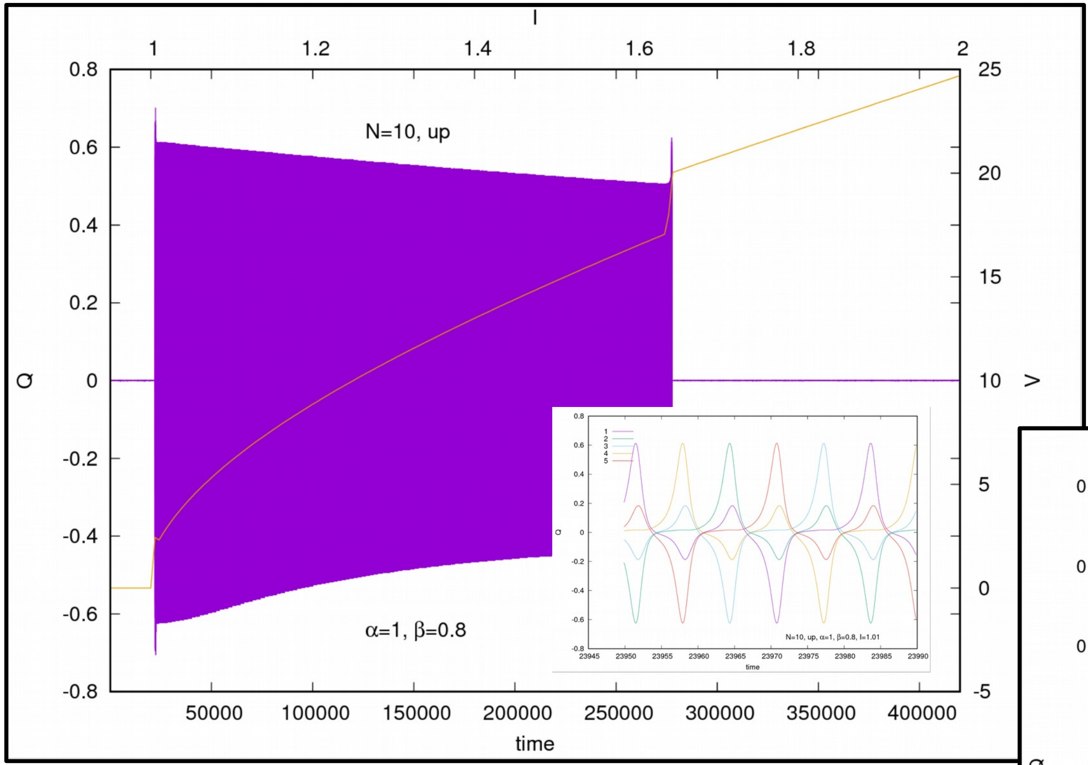


Appearance of the second hysteresis zone with increasing of dissipation parameter from 0.2 to 0.8 for an array of 10 JJ with constant coupling parameter.
The reduction of McCumber zone was observed.

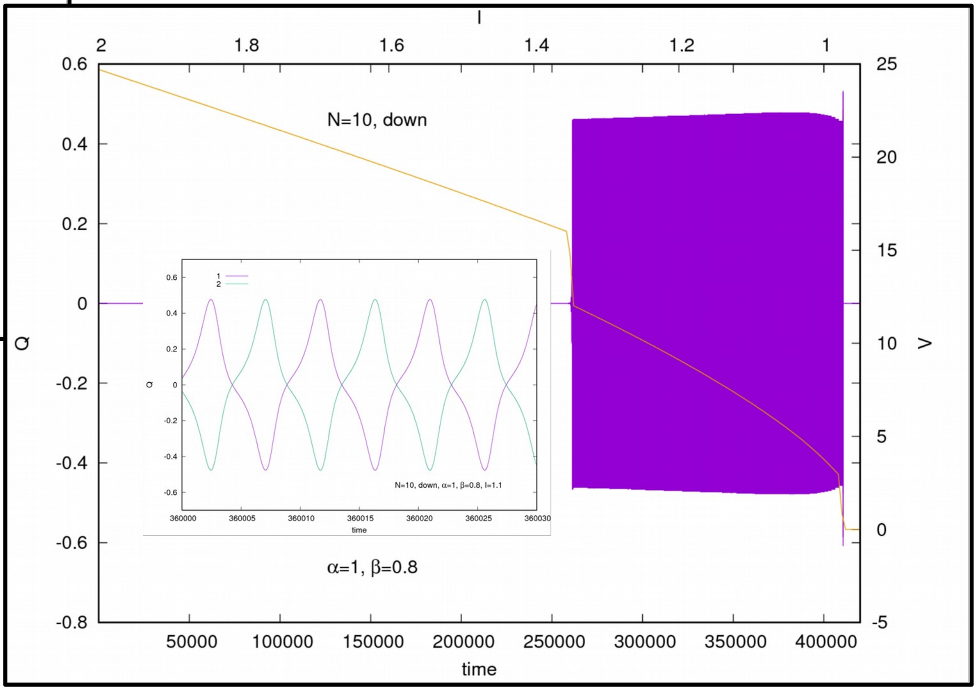


Modification of current voltage characteristic with increasing of coupling between Josephson Junctions.
The effect is similar with dissipation increasing.

Charge oscilations

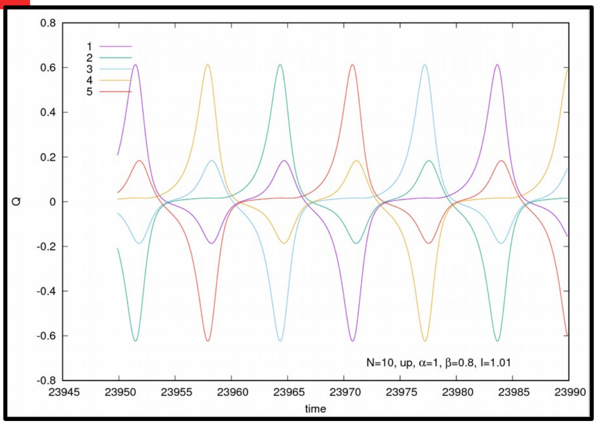


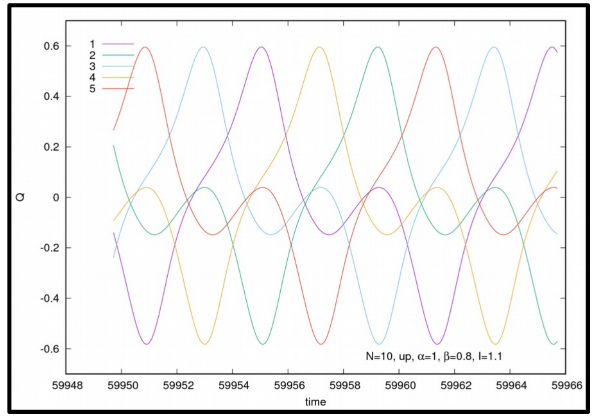
Variation of charge oscilations amplitude with increasing of current. Charge oscilations are present in the second hysteresis zone.

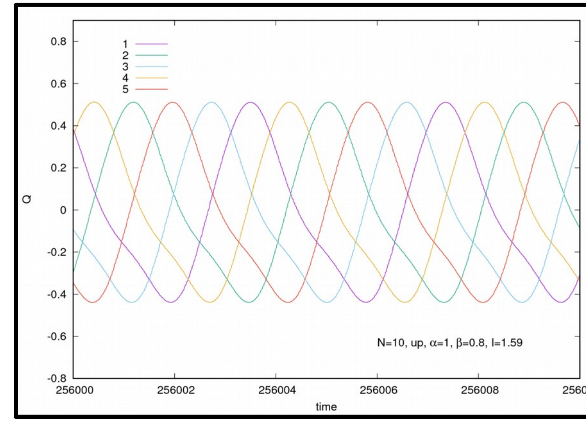


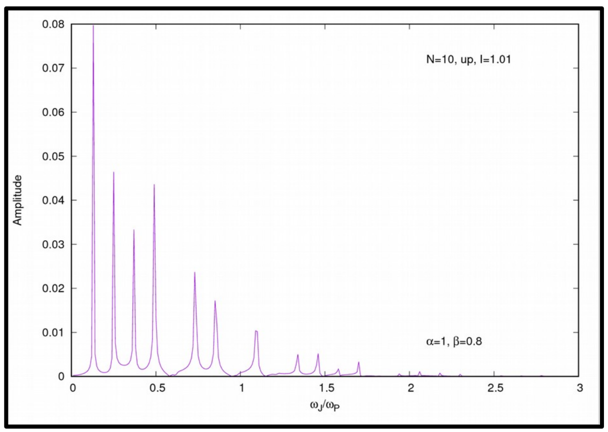
Variation of charge oscilations with decreasing of current. Charge oscilations are present in the second hysterezis and McCumber zones.

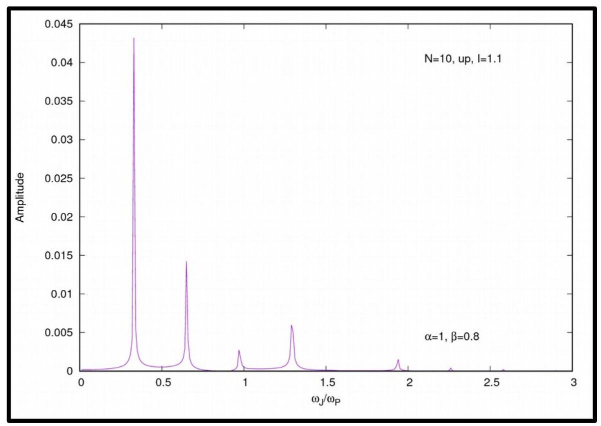
Study of Plasma Wave (Up)

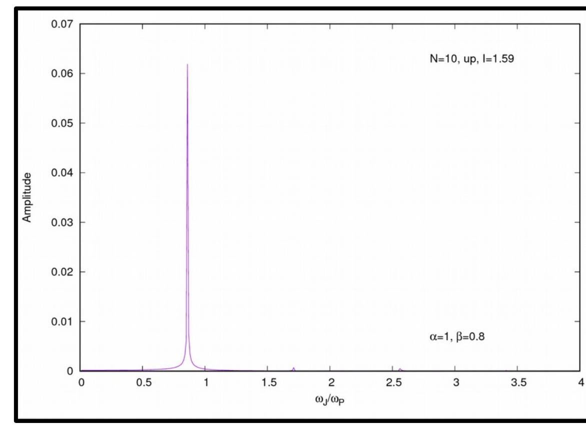


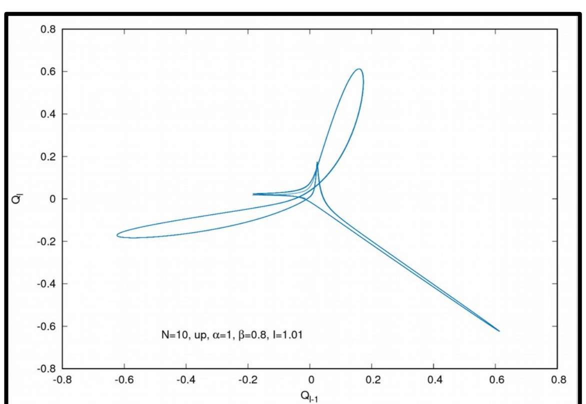


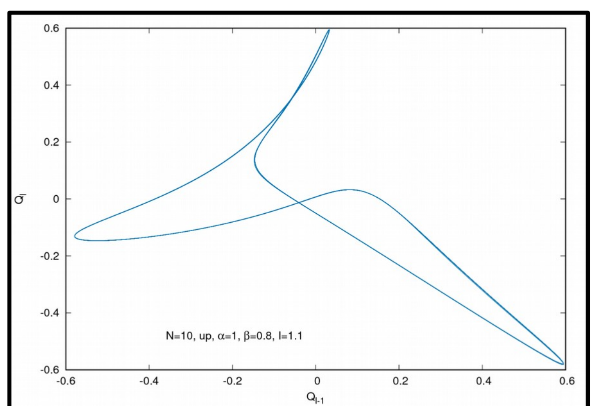


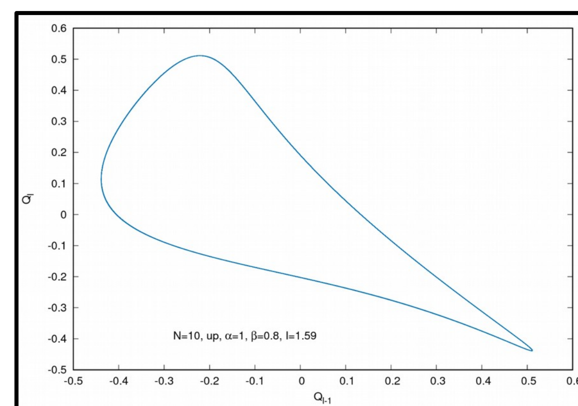




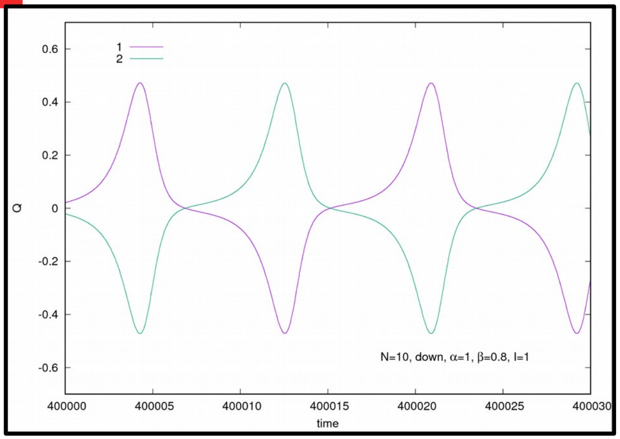


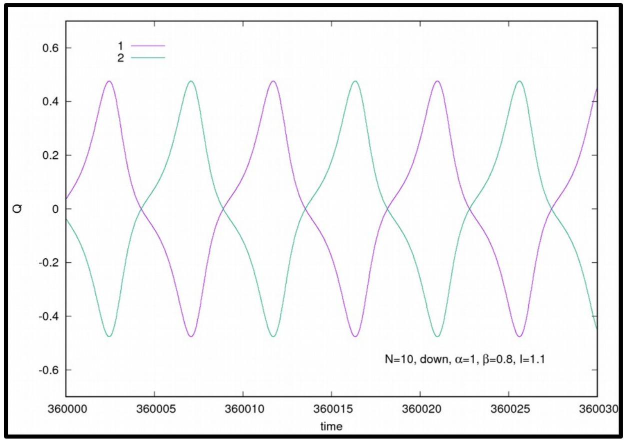


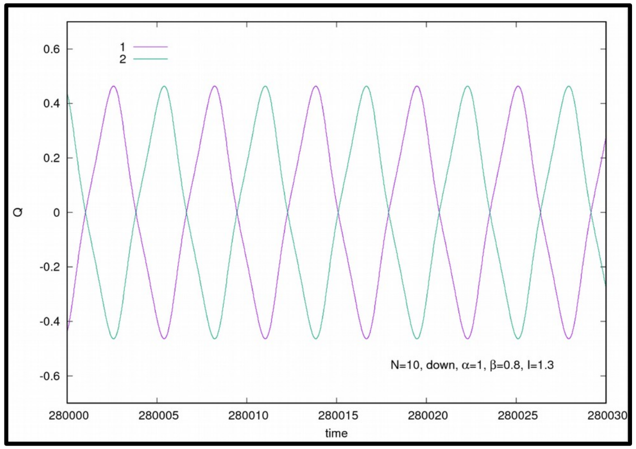


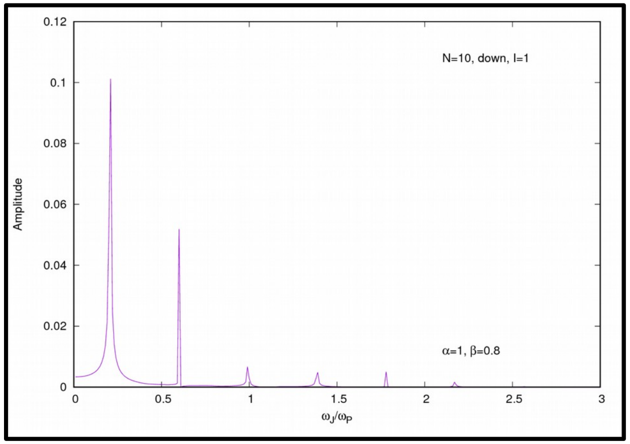


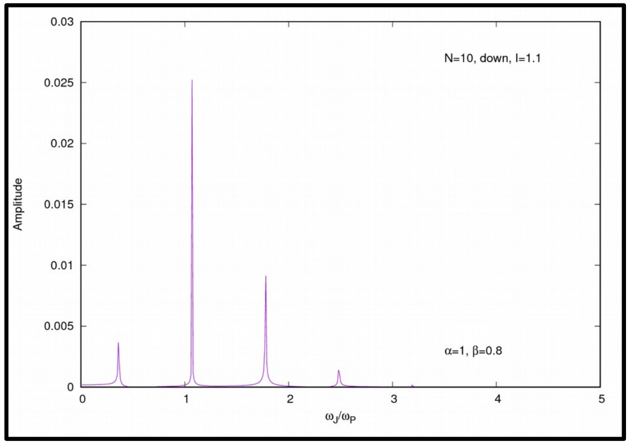
Study of Plasma Wave(Down)

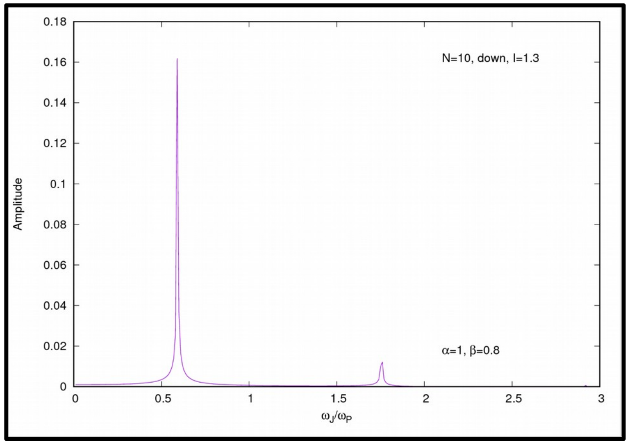




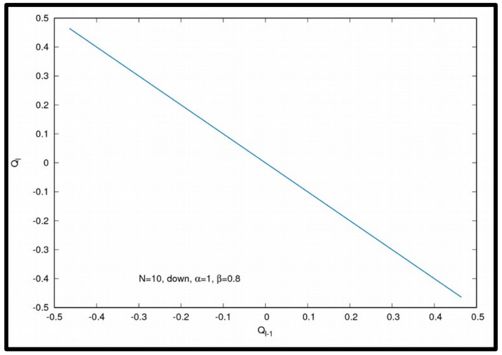




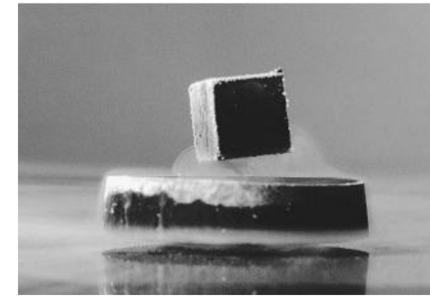




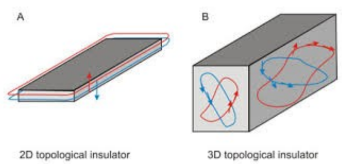
The osculations became more harmonically at the end of the second hysteresis zone.
The dissipation effect is compensated by nonlinearity.



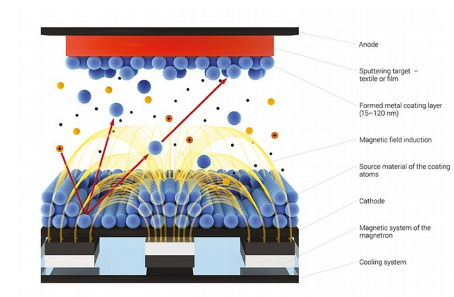
Future experiments



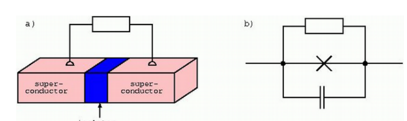
- Synthesis of high-T superconductors
- Synthesis of topological insulators

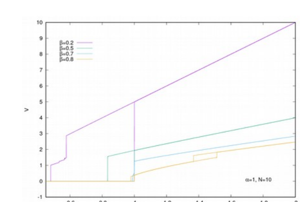


- Thin films production



- Assembling of Josephson arrays





- Confirmation of theoretical predictions

Conclusions

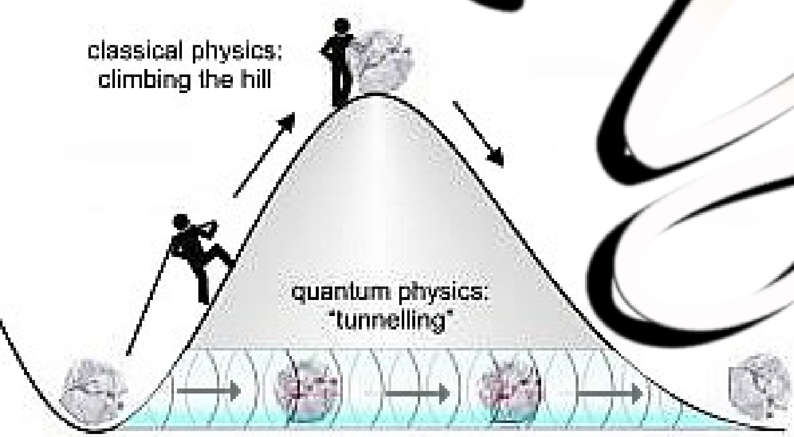
- Arrays of Josephson Junctions represent interest for science and industry
- Was studied JJ arrays with hight dissipation and strong coupling
- Collective states in stacks of Josephson Junctions was discovered
- The collective state occurs apparition of the second hysteresis zone
- The collective oscillations are possible recourse the nonlinearity is equilibrated by the dissipation.

The project participants

- ***Faculty of Physics***
- Stamatin Ioan
- Stefan Iordache
- Ana-Maria Iordache
- Zubarev Alexei
- Cuzminschi Marina
- Valentin Ghirleanu

- ***JINR Dubna***
- Shukrinov Yuri
- Ilhom Rahmonov
- Kirill Kulikov
- Svetlana Medvedeva
- Moitri Maiti
- Rodin Kirill

Thank You!


classical physics:
climbing the hill
quantum physics:
"tunnelling"