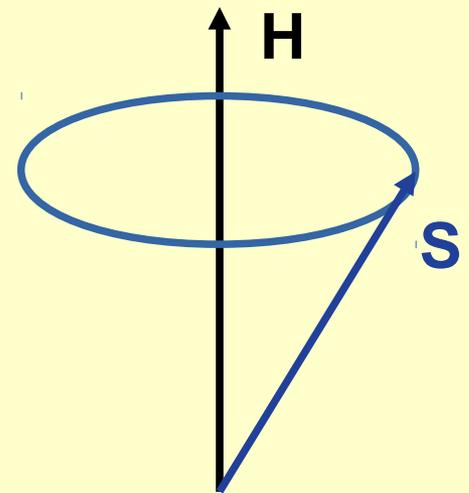


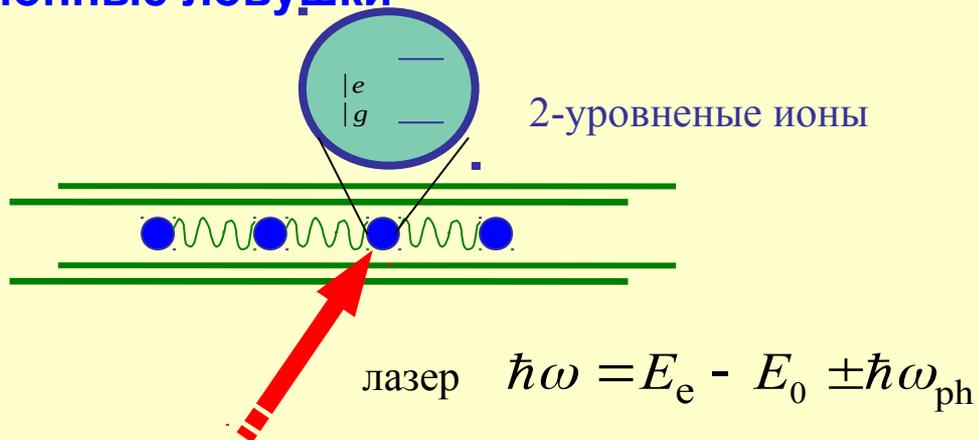
# Могут ли квантовые биты быть большими?

Ю. Махлин

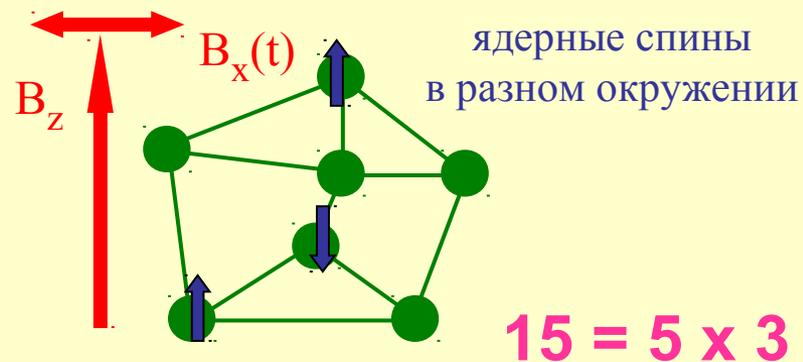


# Физические реализации кубитов

## Ионные ловушки

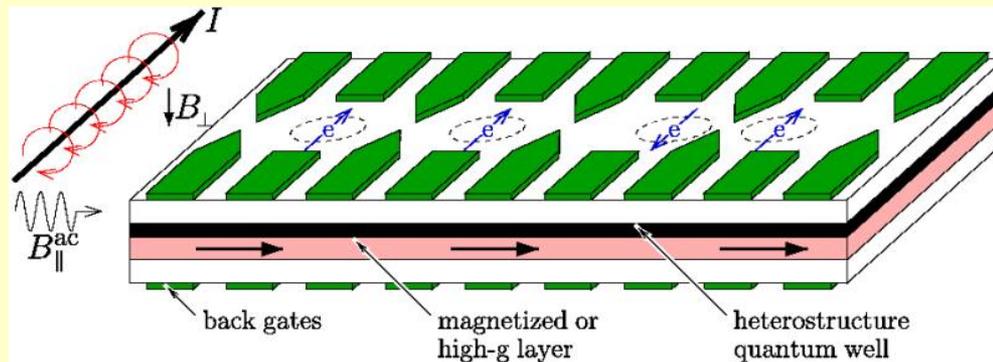
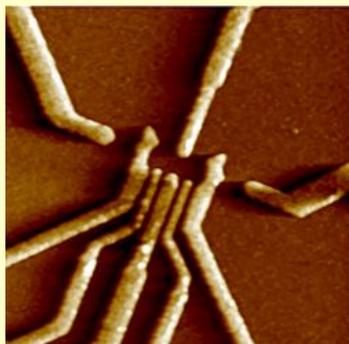


## ЯМР



## Электронные спины в полупроводниковых структурах

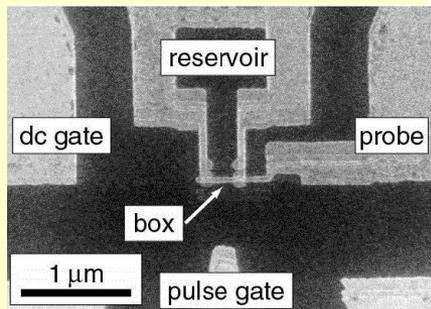
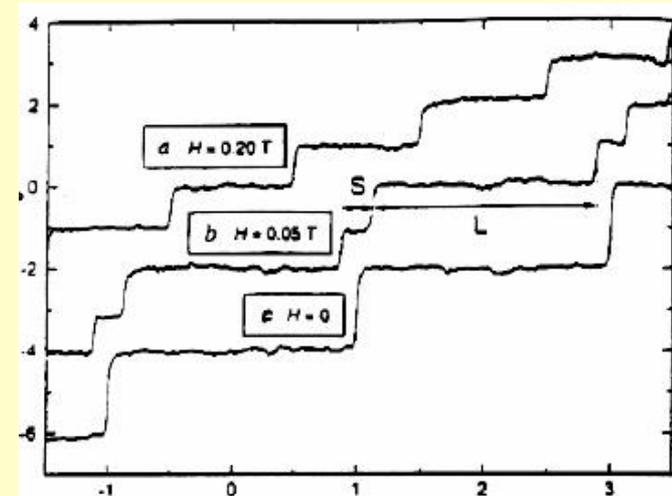
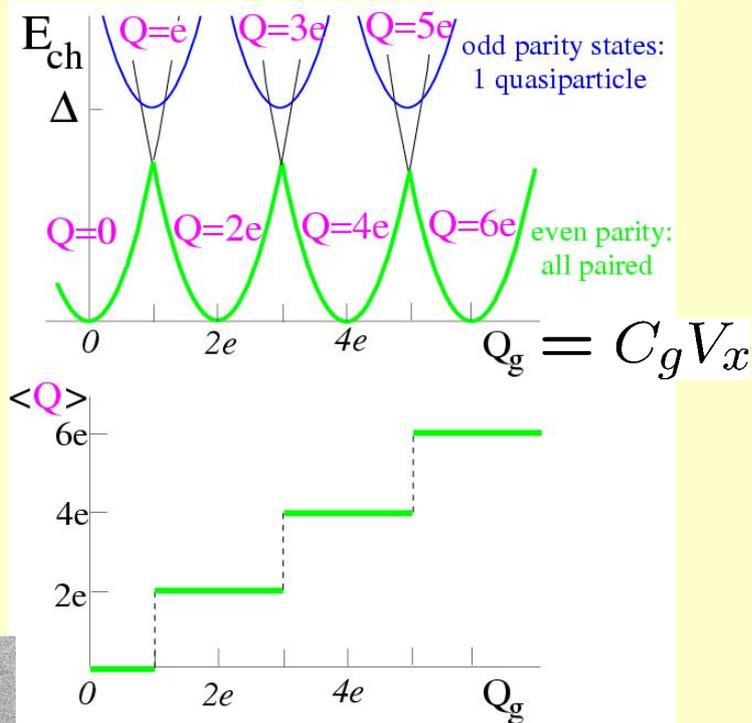
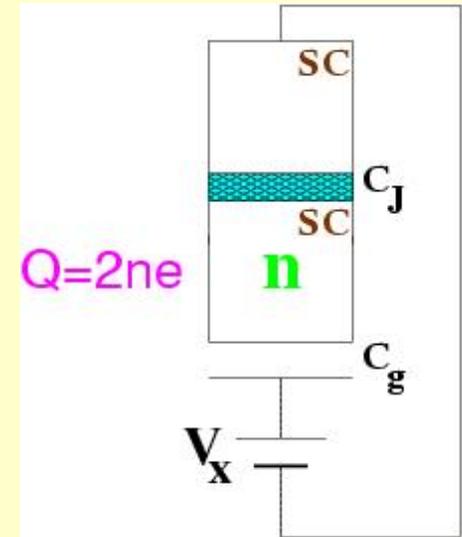
Loss & DiVincenzo, 1998

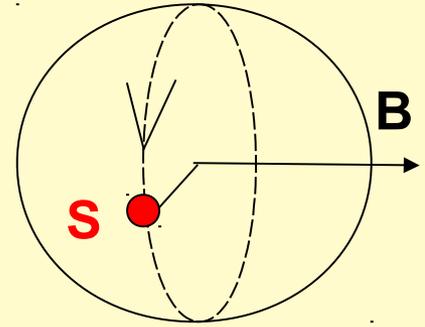
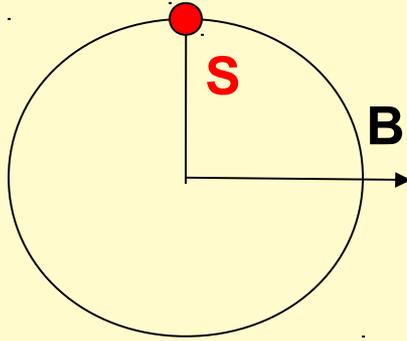
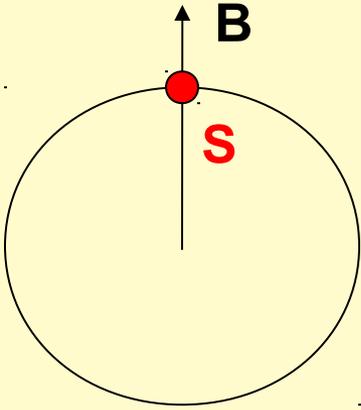


Kouwenhoven et al. (Delft)

# Зарядовые явления в сверхпроводящей одноэлектронной ловушке

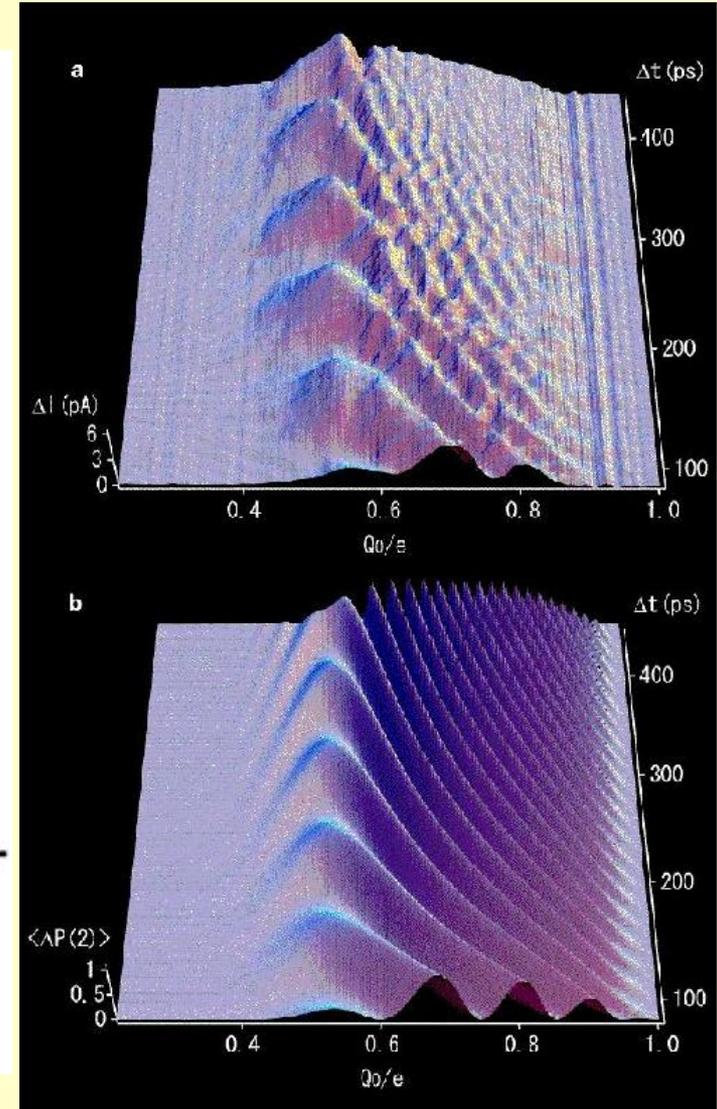
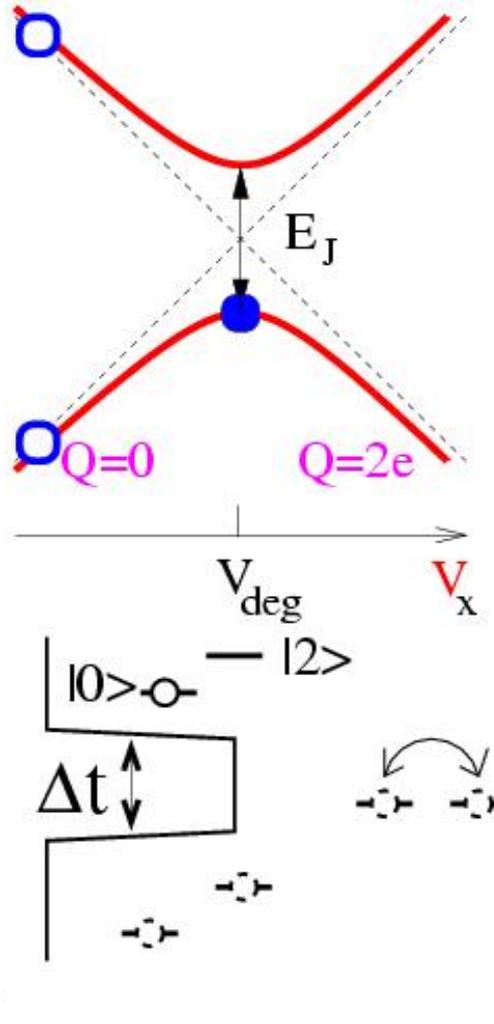
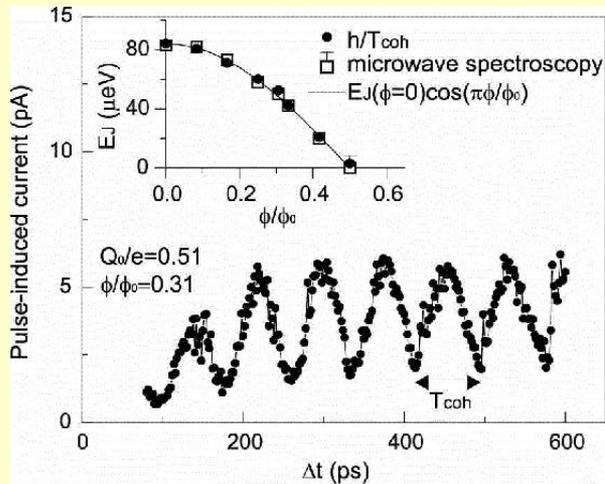
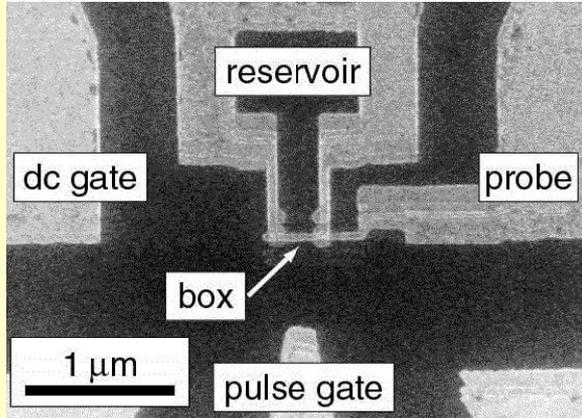
зарядовая энергия: 
$$E_{\text{ch}}(n, V_x) = \frac{(2ne - C_g V_x)^2}{2(C_g + C_J)}$$





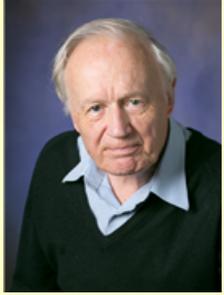
# Эксперимент: когерентные колебания

Я. Накамура и др., 1999

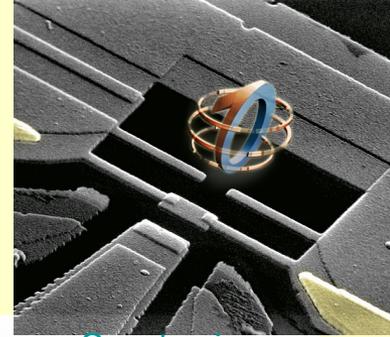


$$U_x^i = \exp(-iH_x^i \hat{\sigma}_x^i \tau / \hbar) = \begin{pmatrix} \cos \alpha & i \sin \alpha \\ i \sin \alpha & \cos \alpha \end{pmatrix}, \quad \alpha = \frac{H_x^i \tau}{\hbar}$$

# Джозефсоновские квантовые биты

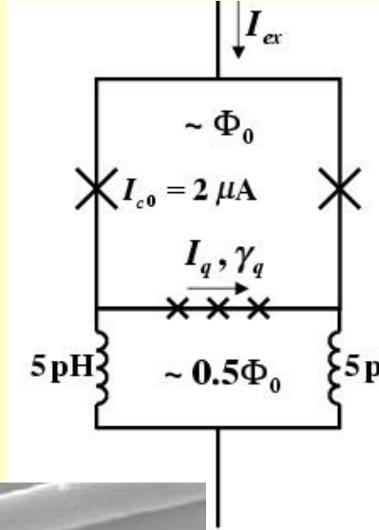


макроскопическая квантовая физика

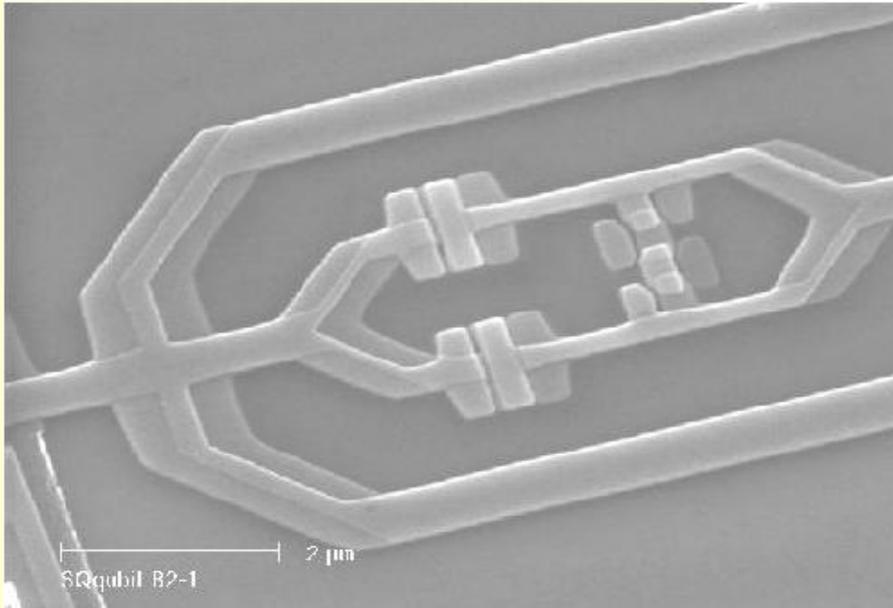
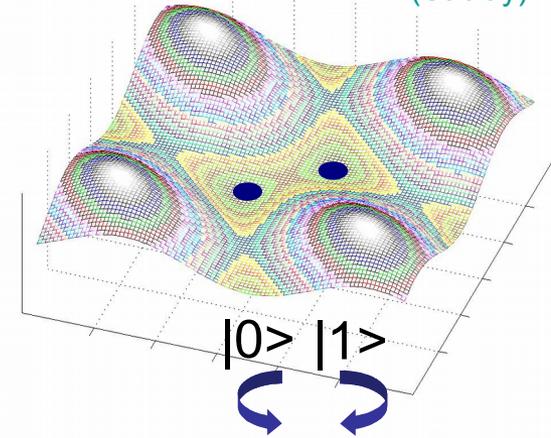


Quantronium (Saclay)

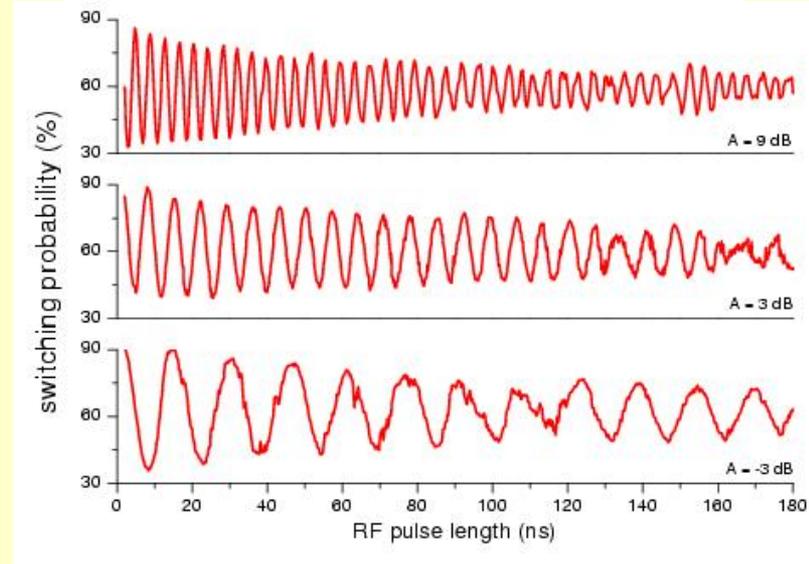
Джозефсоновские  
потокосные кубиты



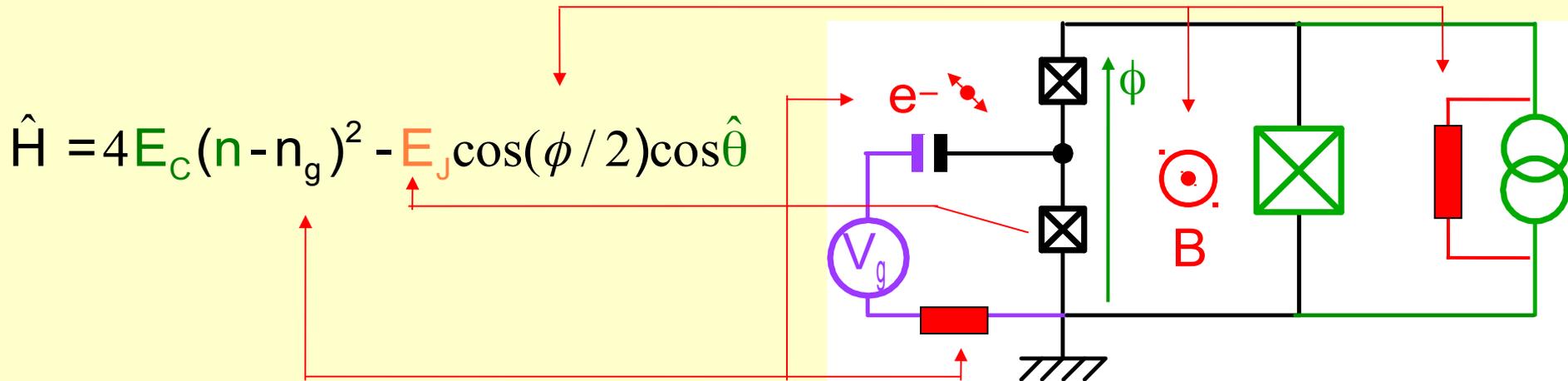
Mooij et al. '99



Chiorescu et al. '02



## Потеря когерентности: источники шума



## Подавление когерентности

- внешняя цепь,  $Z(\omega)$
- низкочастотный шум,  $1/f$