Spectroscopy of Nanostructures and Quantum Liquids

Aron Pinczuk, Rm 919, CEPSR

Dept. of Physics and Dept. of Appl. Phys., Columbia University, NY
Bell Laboratories, Lucent Technologies, Murray Hill, NJ

Post-docs and Students

Natasha Collymore, Irene Dujovne,
Cyrus Hirjibehedin, Moonsoo Kang,
Amina Kinkhabwala

Current Collaborators

Sang-W Cheong, Brian Dennis,Tae-Y Koo,
Loren Pfeiffer, Wen Wang (EE), Ken West

Spectroscopy of Nanostructures and Quantum Liquids

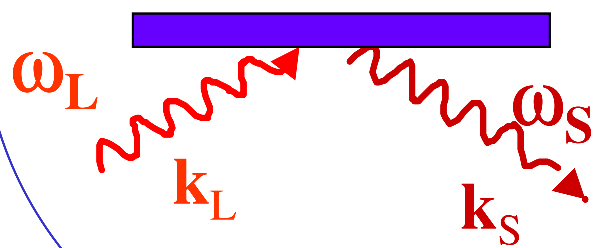
- **Two-dimensional electron systems**
- **“Mesoscopic” ferroelectrics**
- **Novel semiconductor nanostructures**
- **Experimental methods: inelastic light scattering, other optical techniques, etc.**

Inelastic Light Scattering

$\omega_L - \omega_S = \omega$

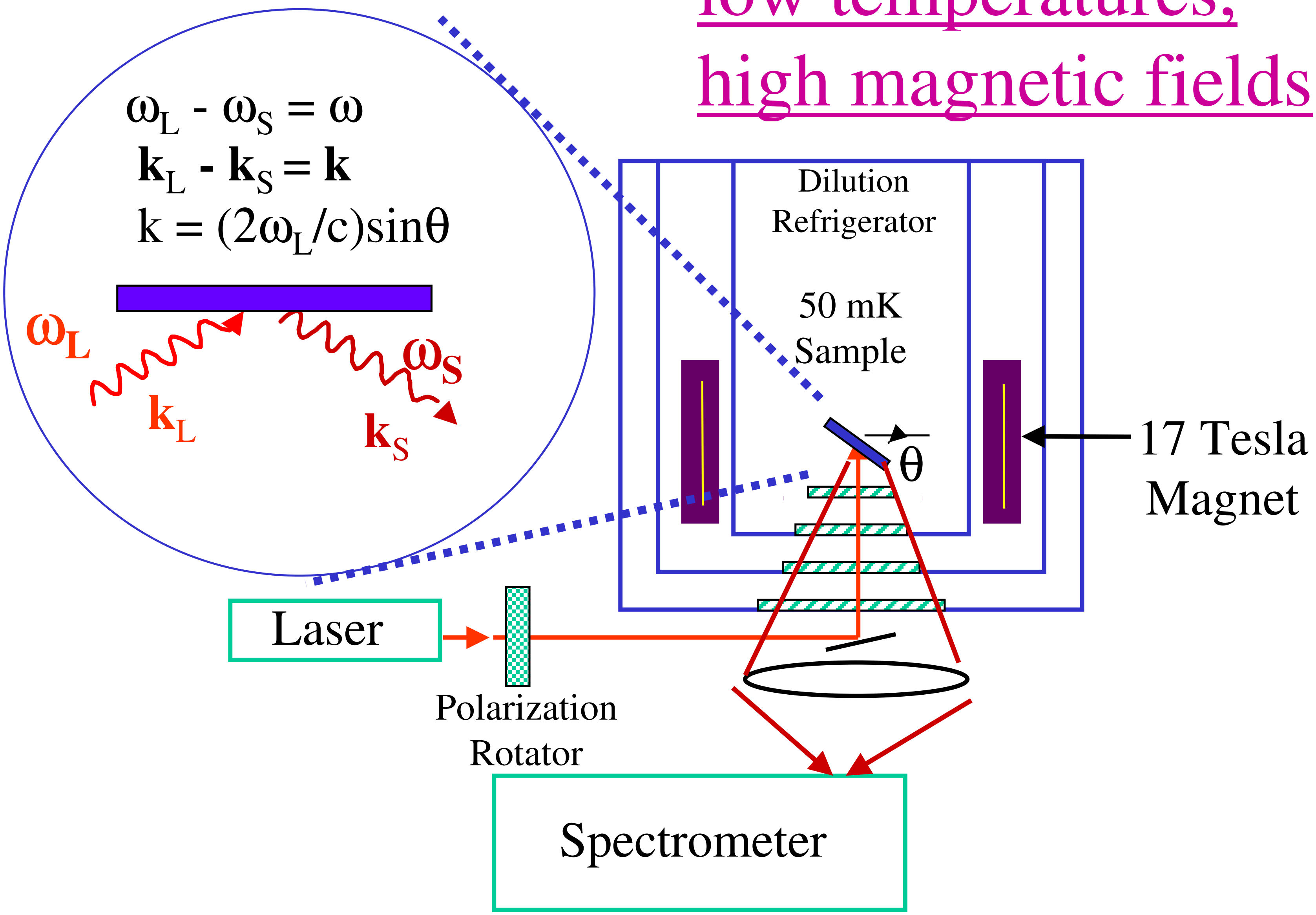
$\mathbf{k}_L - \mathbf{k}_S = \mathbf{k}$

$k = (2\omega_L/c)\sin\theta$



- direct access to excitation modes of systems under examination
- wide range of temperatures:
  300K>T>0.05K
- scattering cross-sections are enhanced to achieve extremely high sensitivity

low temperatures, high magnetic fields



Two-dimensional Electron Systems in Semiconductor Quantum Structures

- **Collective excitation modes of quantum liquids: quantum Hall states and beyond**
- **Quantum phase transitions**
- **Novel behaviors under extreme conditions of density temperature**

“Mesoscopic” Ferroelectrics:
short-range disorder vs. long-range order

- **phase transitions: “soft” vibrational modes**
- **physics of “giant”piezoelectric effects**
- **impact of chemical composition on properties (“chemistry vs. physics”)**

Semiconductor Nanostructures

- **Novel quantum wells**
- **Gallium Nitride based heterostructures**
- **Quantum wires and quantum dots**