

Проблемы подготовки специалистов по неупругому рассеянию и развитию пользовательской базы в области неупругого рассеяния нейтронов



Оценка числа специалистов и пользователей

Спектроскопия на реакторе ПИК (первая «неупругая» очередь)

5 спектрометров: 3 TAS + 1 TOF + 1 SE

2 ответственных на каждую установку

10 ученых + 1 лидер группы = 11 человек

6 TAS + 2 TOF + 2 SE

для ИБР-2 $2 \times 2 = 4$ (TOF), для ИР-8 $1 \times 2 = 2$ (TAS)

Всего в стране $8 \text{ TAS} + 6 \text{ TOF} + 2 \text{ SE} = 16$ специалистов

Число квалифицированных юзеров в области НРН

2018 - менее 20

Цель (к середине 2020х) - 200-300 специалистов

Опыт подготовки

Теоретическая

Школы:

ФКС ПИЯФ - СПб,

СИН-НАНО - Мск

НИЦ "КИ" - Мск

ЛНФ ОИЯИ - Дубна

НИКОНС - СПб

Конференции:

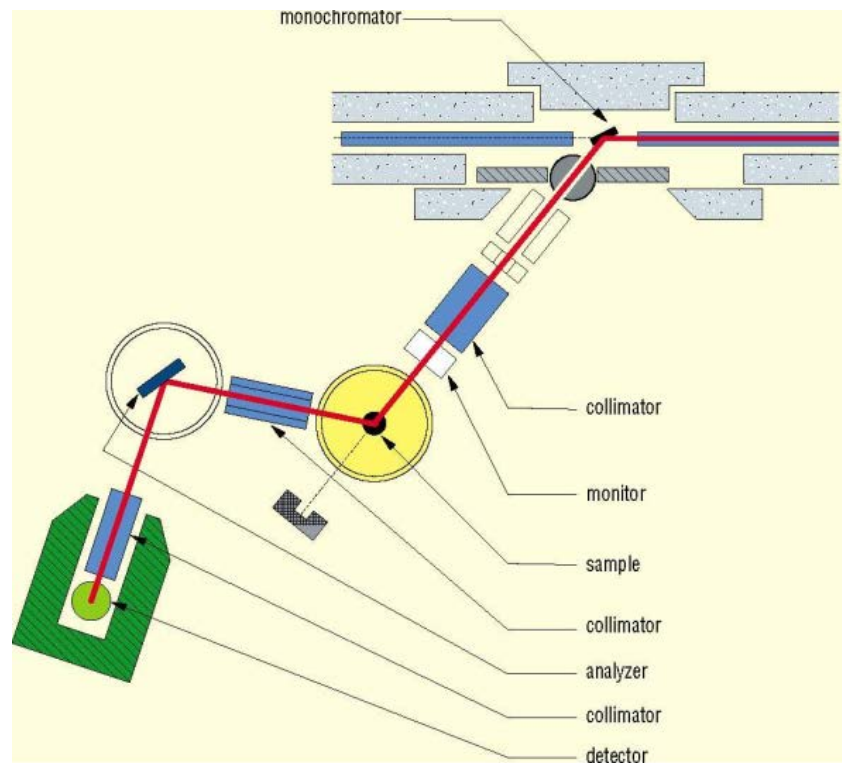
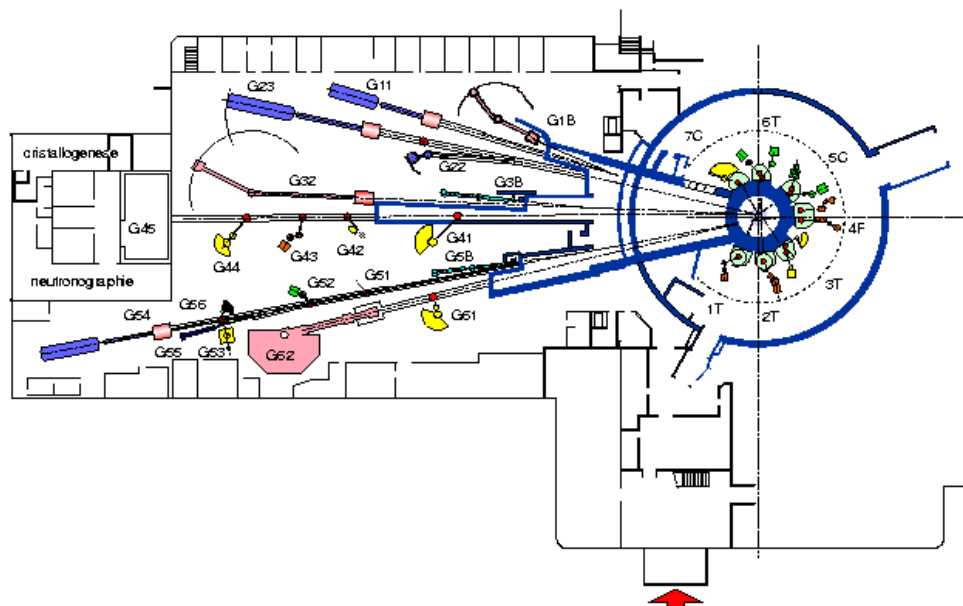
РНИКС

СМР

Практикумы

G43 TAS в LLB, Сакле (2 + 4 = 6 человек)

IMPLANTATION GENERALE DES SPECTROMETRES



TAS и образцы

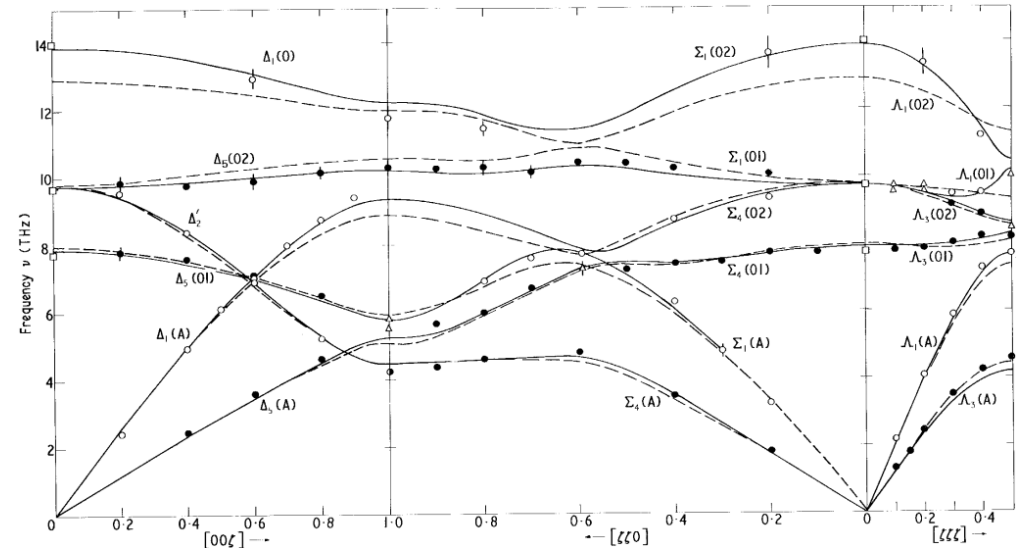
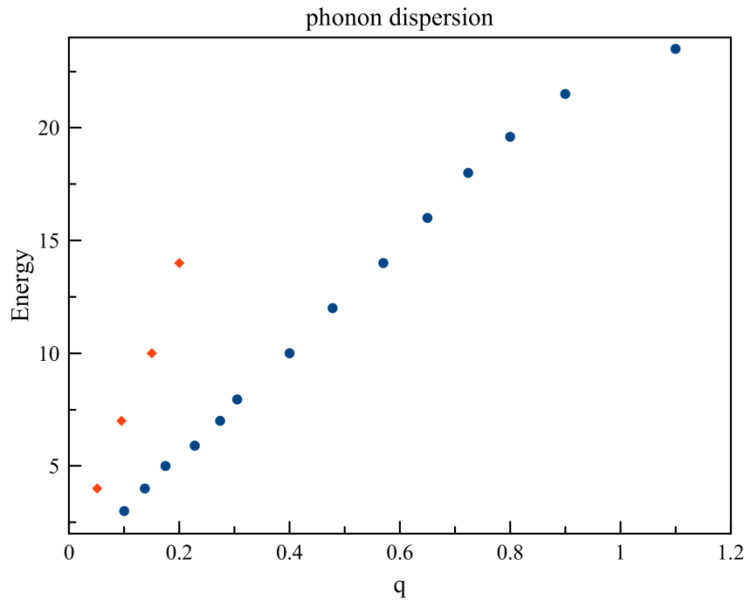
Трехосный спектрометр G43 ($k_i = \text{const mode}$, $T=300\text{K}$)

CaF_2 монокристалл - фононы

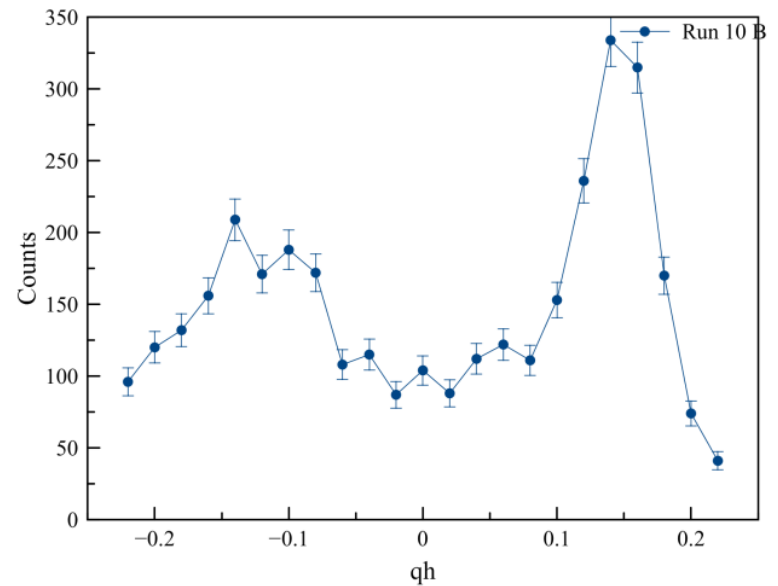
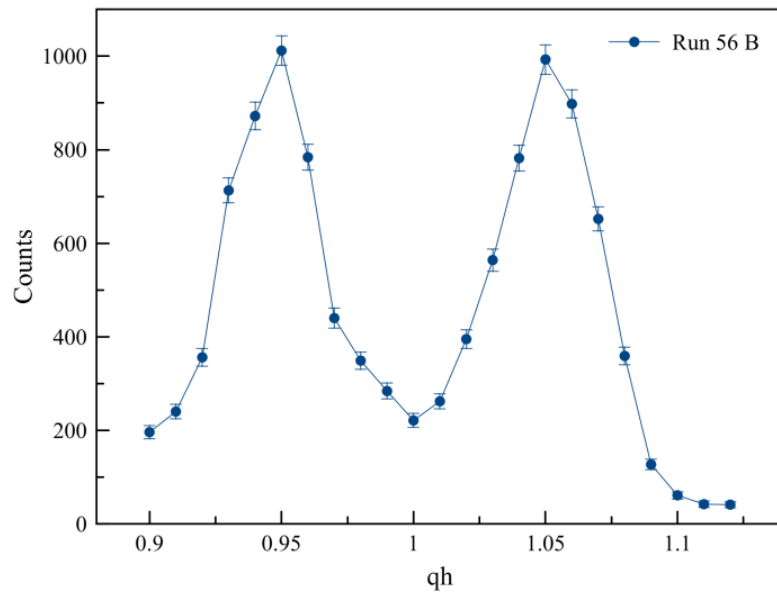
Fe-Ni монокристалл - фононы и магнитные возбуждения

V ванадий поликристалл, фононная DOS

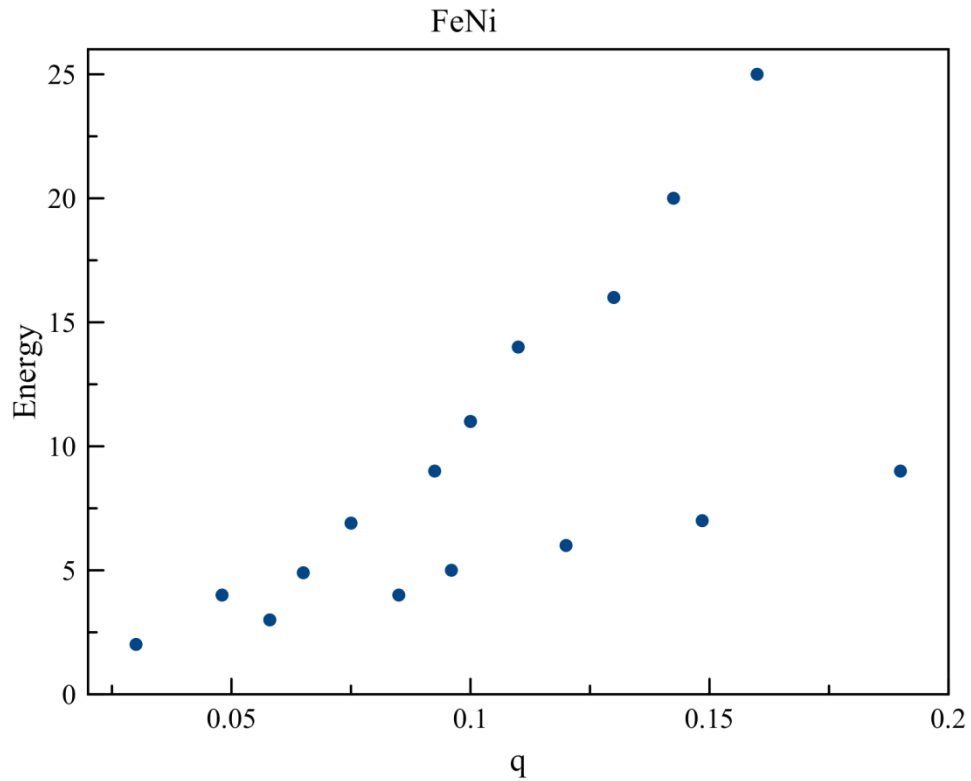
Фононы в CaF_2 . Измерения и литературные данные



Типичные нейтронные спектры

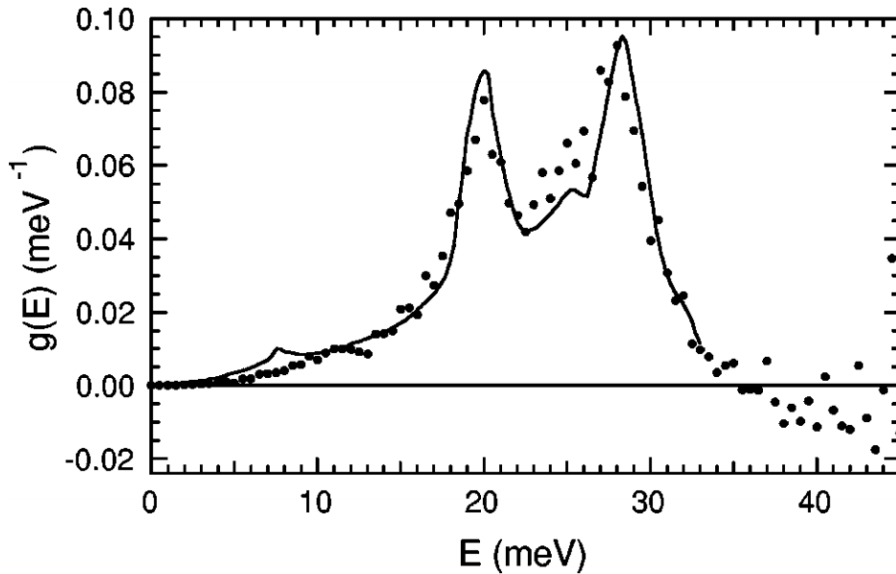


Законы дисперсии для Fe-Ni

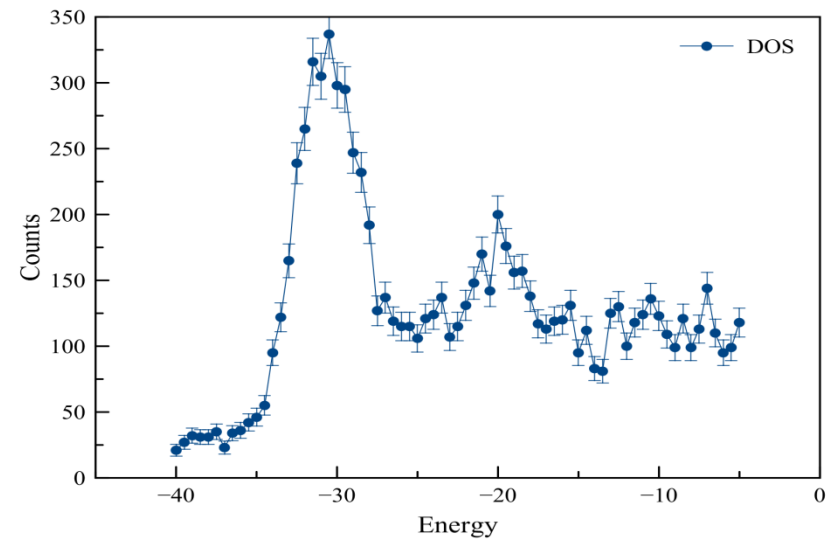


Vanadium PhDOS

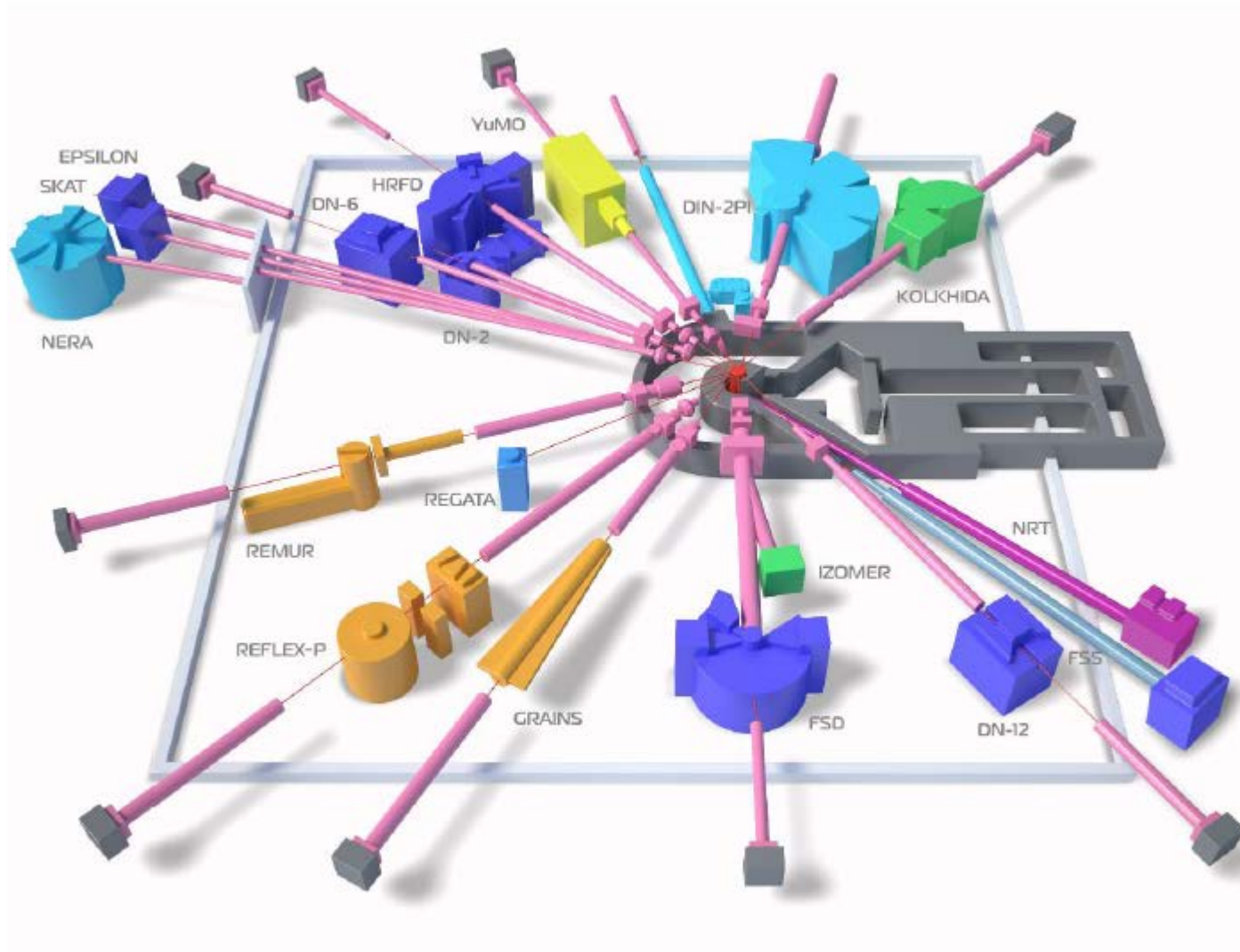
PhDOS from the literature



spectrum measured on G43 as is
(neutron energy gain mode at 300K)

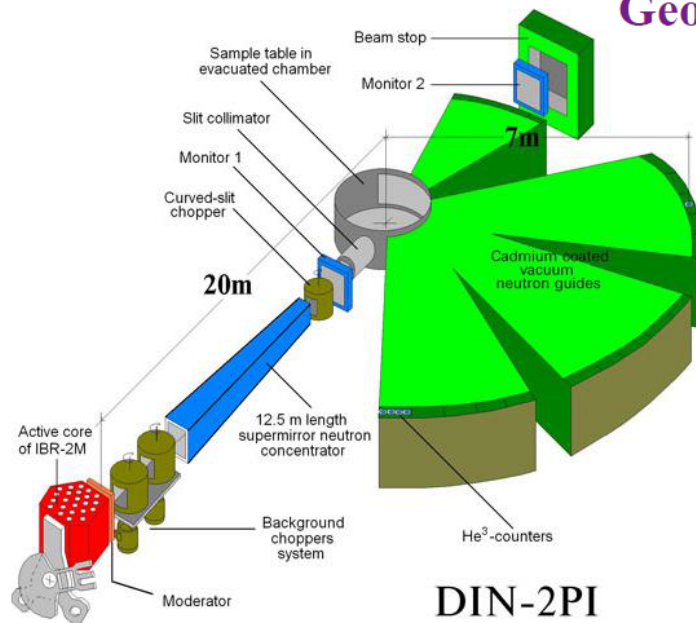


IBR-2 JINR instrument layout



DIN-2PI at IBR-2

DIN-2PI – Inelastic Neutron Scattering Spectrometer in Direct Geometry

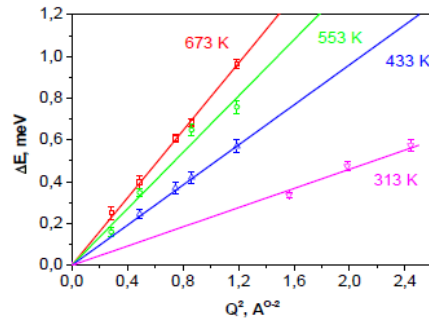


Neutron flux at sample position:
 $4 \cdot 10^6 \text{ n/cm}^2/\text{s}$

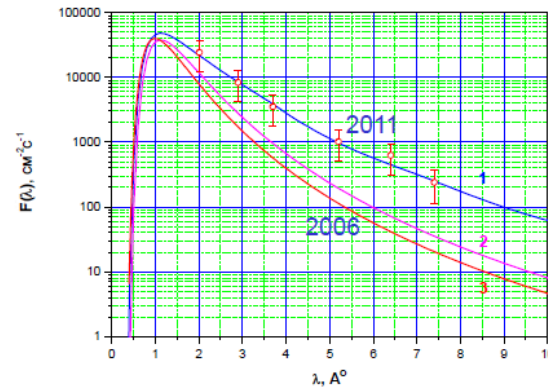
2θ range: $5\text{-}135^\circ$

Incident neutron energy range:
 $1\text{-}300 \text{ meV}$

Energy resolution: $\Delta E/E = 4\text{-}10 \%$



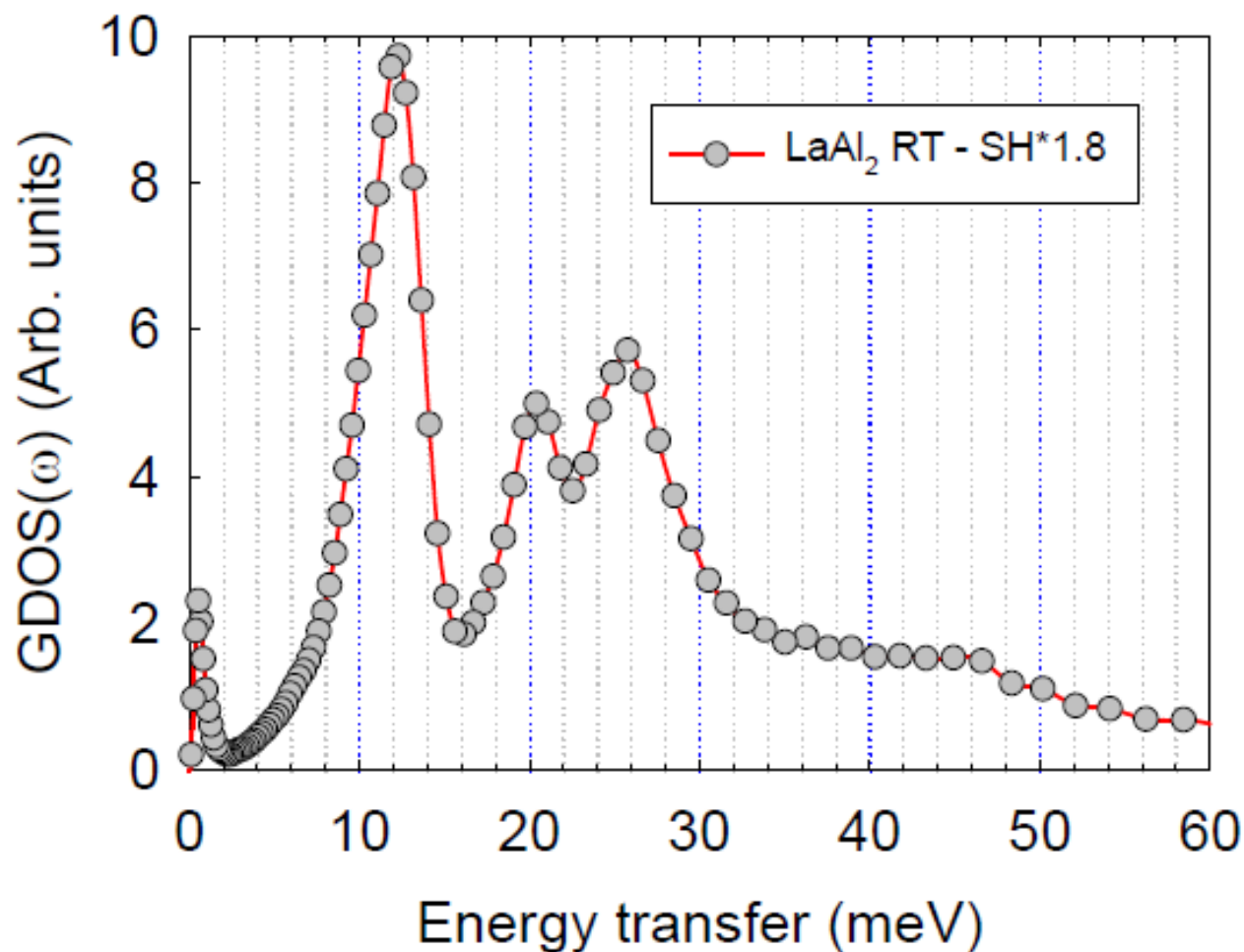
FWHM of incoherent QENS peak in liquid Ga



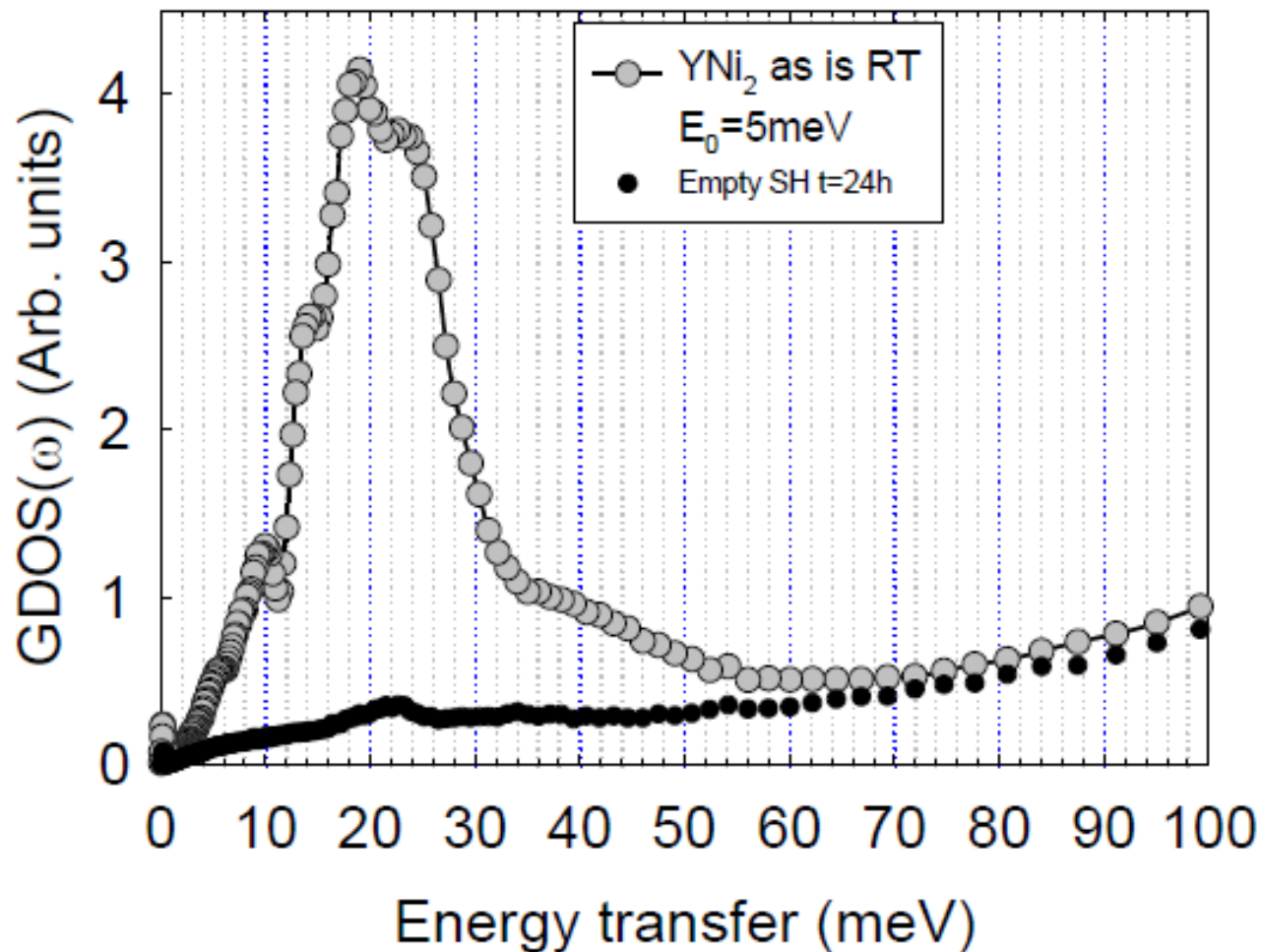
Installation of neutron concentrator
 gives an order of magnitude increase
 of neutron flux at sample position

DIN-2PI direct geometry TOF at IBR-2 JINR

Data collected on the 9th of April 2018



DIN-2PI direct geometry TOF at IBR-2 JINR



Возможные практикумы

- на ИБР-2 в ОИЯИ, Дубна (DIN-2PI + NERA)
- На ИР-8 в НИЦ КИ Москва (АТОС)

- на G43 в Сакле до 2019 включительно
- FRM-II в Гархинге
- в ILL в Гренобле

Возможные практикумы

- на ИБР-2 в ОИЯИ, Дубна (DIN-2PI + NERA)
- на ИР-8 в НИЦ КИ Москва (АТОС)

- на G43 в Сакле до 2019 включительно
- FRM-II в Гархинге
- ILL в Гренобле

- +
- на компактном источнике нейтронов в СПбГУ в отдаленном будущем

Practical skills (TAS)

sample alignment

kinematic restrictions

focusing and defocusing configurations

the resolution issue (energy and Q)

measuring transverse and longitudinal modes

magnetic excitations in an itinerant system

phonons

acoustic branches

optic branches

density of states (powder sample)

single-ion excitations (crystal field)

magnetic modes in a localized magnet (Rare earth-based)


detailed balance factor

Lessons learned and conclusions

- G43 is well-suited a comfortable and efficient training course (long in time and without any external pressure)
- trainees in a small group are getting basic knowledge and skills very fast
- feeling of a real experiment is only possible in a small group involved into TAS activity for 4 to 5 days
- two persons were converted into independent TAS users
- training of a real TAS responsible require extra efforts
- specific training is required for two subgroups
 - a) focused on techniques and instruments
 - b) focused on phenomena and objects of studies

First practical skills (TOF)

- choosing the E_i & getting estimates of the role of the k_f/k_i factor
- choosing the frequencies and fighting with the frame overlap
- kinematic restrictions, understanding the Q - E space
- the resolution issue
- the multiple scattering issue
- measuring powder samples
- measuring single crystals
- data treatment and reduction

A 3D visualization of a molecular structure. The structure consists of several atoms represented by spheres: purple spheres in the top left, green spheres in the top right, and brown spheres in the bottom left. A central part of the molecule is highlighted with blue, semi-transparent electron density lobes. The entire structure is set against a light blue background with a pink and yellow ground plane at the bottom.

СПАСИБО ЗА ВНИМАНИЕ!