Experimental report

25/01/2024

Proposal: TEST-3263 **Council:** 4/2023

Title: Magnetically frustrated dynamics on the Cairo pentagonal lattice

Research area: Physics

This proposal is a new proposal

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Samples: Bi2Fe4O9

Instrument	Requested days	Allocated days	From	To
ORIENTEXPRESS	1	1	29/06/2023	30/06/2023
IN20	4	4	26/05/2023	30/05/2023

Abstract:

We have synthesized a large high quality 2.35 g single crystal of Bi2Fe4O9, a quasi two-dimensional Cairo pentagonal lattice, a new motif in geometrical frustration. Previous studies on a smaller sample (0.6 g), by another group, found spin waves in the energy range 5-25 meV with a gap detected up to 5 meV. Two of the spins in the pentagon couple strongly (28 meV) and the others less strong (3-6 meV), with all couplings found to be AFM. We have independently investigated the low-energy spin wave excitations at 10 K with high energy resolution in the energy range, 0-9 meV using CAMEA at PSI, and have uncovered inconsistencies with previous work. For instance, our data show a clear double spin gap. In this proposal we wish to extend our inelastic neutron scattering studies to access medium energy spin waves. IN20 is ideally suited to probe the subtle effects found in this compound.

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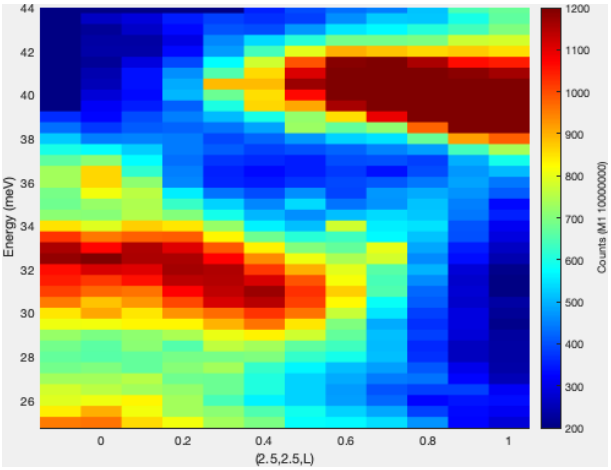
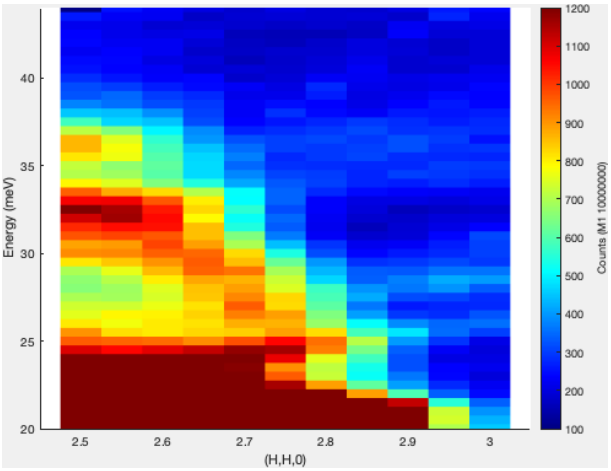
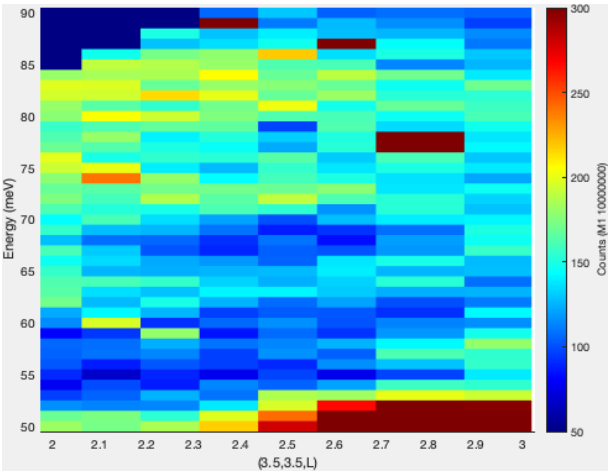
Unpolarised part

- IN20 w. PG-monochromator and PG-analyser + single detector
- Measurements done for the most part kf = 2.662 Å-1, and a few scans with kf=4.1 Å-1 for the high energy part
- Two PG-filters in kf, neutron velocity selector (NVS) in for scans where the energy transfer <45 meV
- Sample environnement: IN20 orange cryostat
- Sample: BiFeO aligned in (H,H,L) scattering plane.
- Measurement time : monitor 20000000 approx. 150 s.

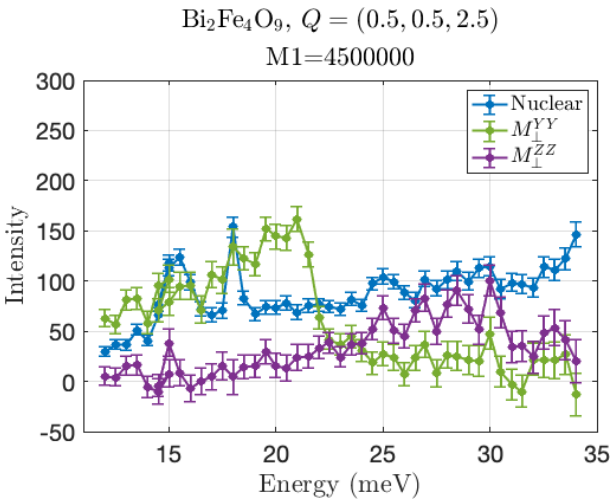


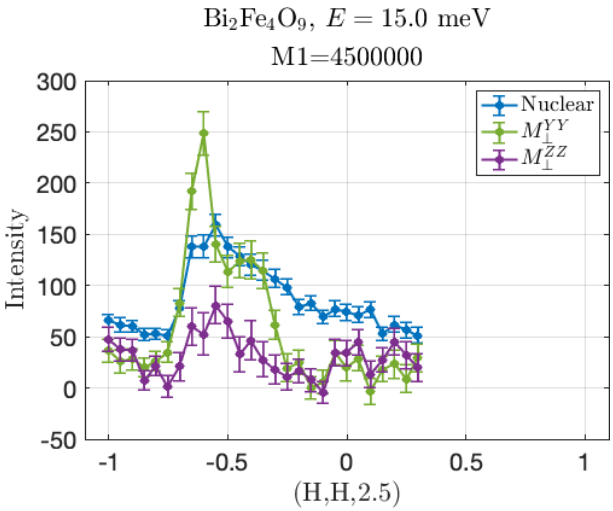


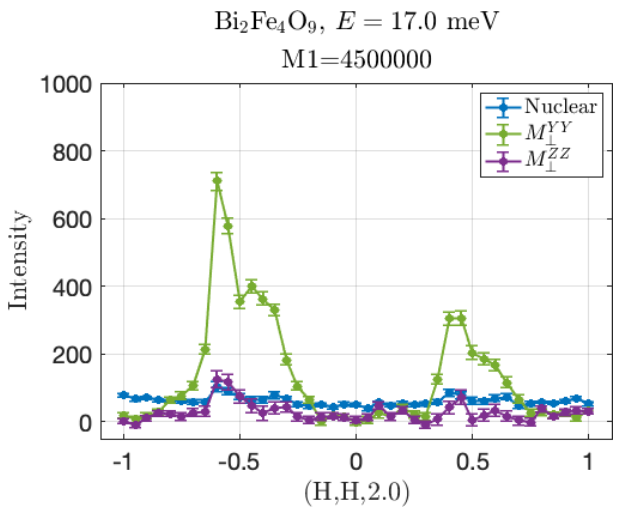


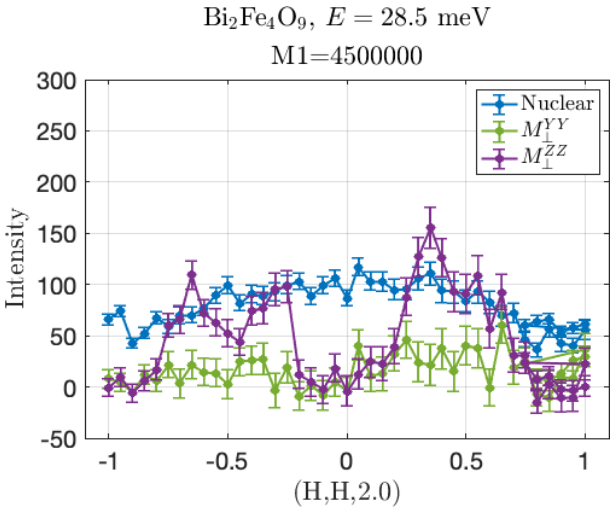
Polarised part

- IN20 w. PG-monochromator and PG-analyser + single detector + PASTIS3 setup for polarisation
- Measurements done with kf = 2.662 Å-1
- No PG-fileters in kf, neutron velocity selector in for scans where E<35 meV
- Sample environnement: PASTIS3 + PASTIS3 orange cryostat
- Sample: BiFeO aligned in (H,H,L) scattering plane.
- Polarisation analysis done in a ‘D7 style’ with 25 min pr point for all polarisation cross-sections


Bi2Fe4O9, Q = (0.5, 0.5, 2.5)
M1=4500000
Nuclear
$M_\perp^{YY}$
$M_\perp^{ZZ}$
Intensity
Energy (meV)


Bi2Fe4O9, E = 15.0 meV
M1=4500000
Nuclear
$M_\perp^{YY}$
$M_\perp^{ZZ}$
Intensity
(H,H,2.5)


Bi2Fe4O9, E = 17.0 meV
M1=4500000
Nuclear
$M_\perp^{YY}$
$M_\perp^{ZZ}$
Intensity
(H,H,2.0)


Bi2Fe4O9, E = 28.5 meV
M1=4500000
Nuclear
$M_\perp^{YY}$
$M_\perp^{ZZ}$
Intensity
(H,H,2.0)