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SMR.959 - 6

MINIWORKSHOP ON STRONG ELECTRON CORRELATIONS
"Disorder and Interaction in Quantum Systems and Their Classical Analogs"

(1 - 19 July 1996)

"Quantum AFM's in a field"

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These are preliminary lecture notes, intended only for distribution to participants.

Quantum AFM's in a field

- Theory
  - Analytic expression for lowest excited state with given $\tilde{q}$, S_{tot}
  - Exact results for $S(q\omega)$ X-Y chain
  - Exact diagonalization of finite length chains

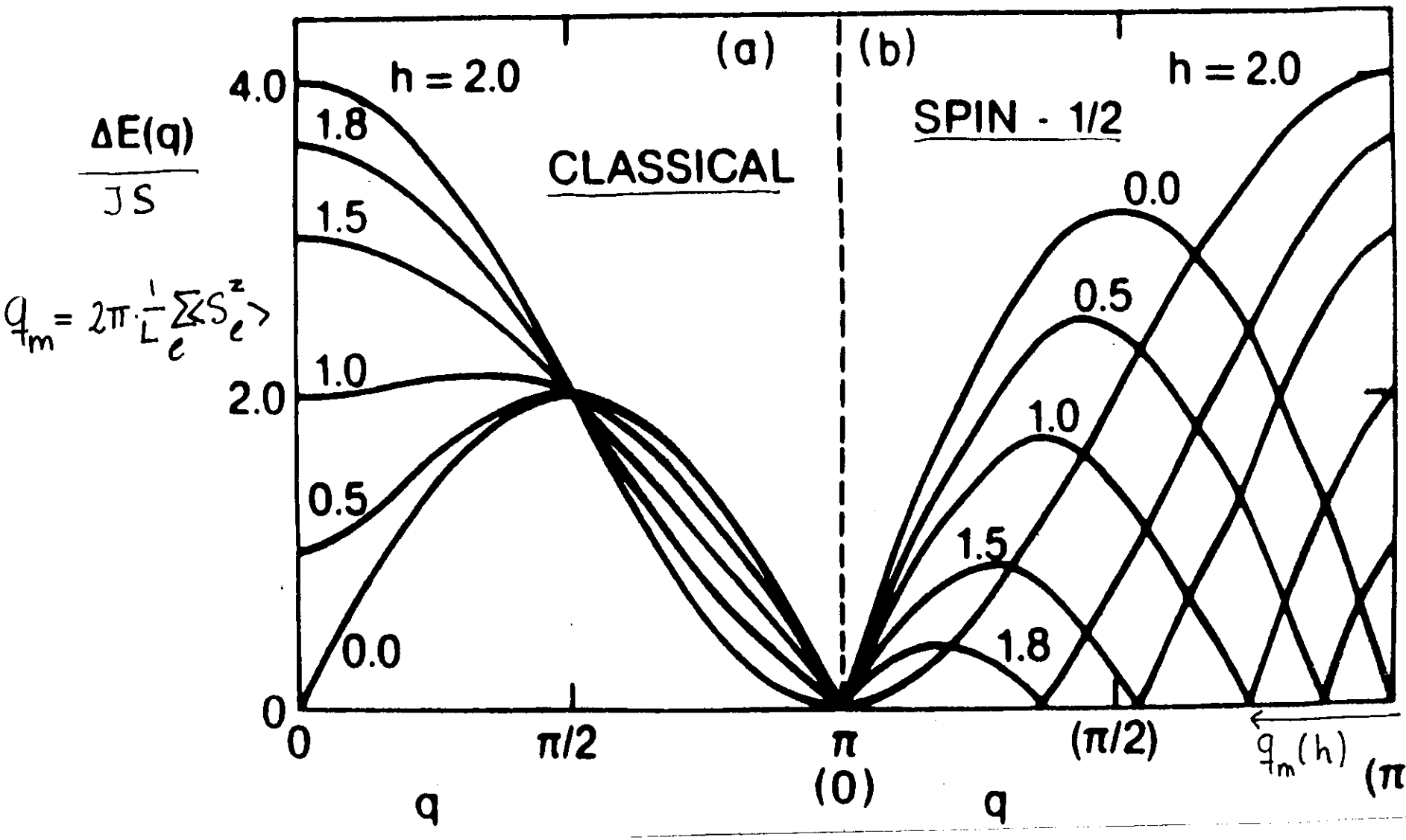
    Ishimura & Shiba (1980)
    Müller, Thomas, Beck, Bonner (1981)
    Parkinson & Bonner (1985)
  - Exact results $1/r^2$ interactions in a field Haldane (1995)

- Experiment

  $S = 5/2$ (classical) TMMC Heilmann (1979)

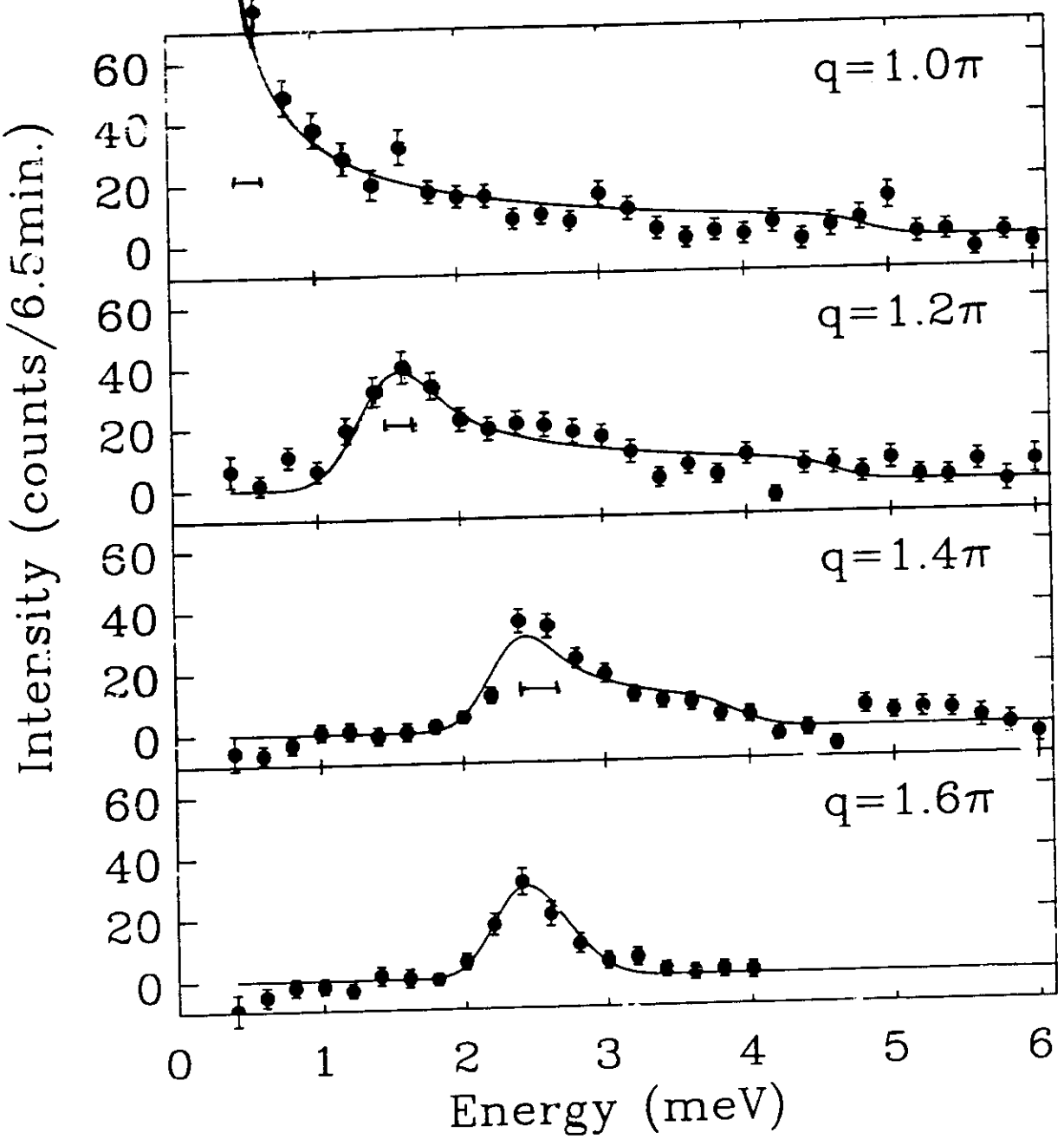
  $S = 1/2$ CPC $\boxed{h < 0.21}$ Heilmann (1978).

Field Dependent Dispersion : $h = g\mu_B H / JS$



Information in the Line shapes:

$$S(q\omega) = \frac{A}{\sqrt{\omega^2 - \epsilon_1^2(q)}}\,\theta(\omega - \epsilon_1(q))\,\theta(\epsilon_2(q) - \omega)$$

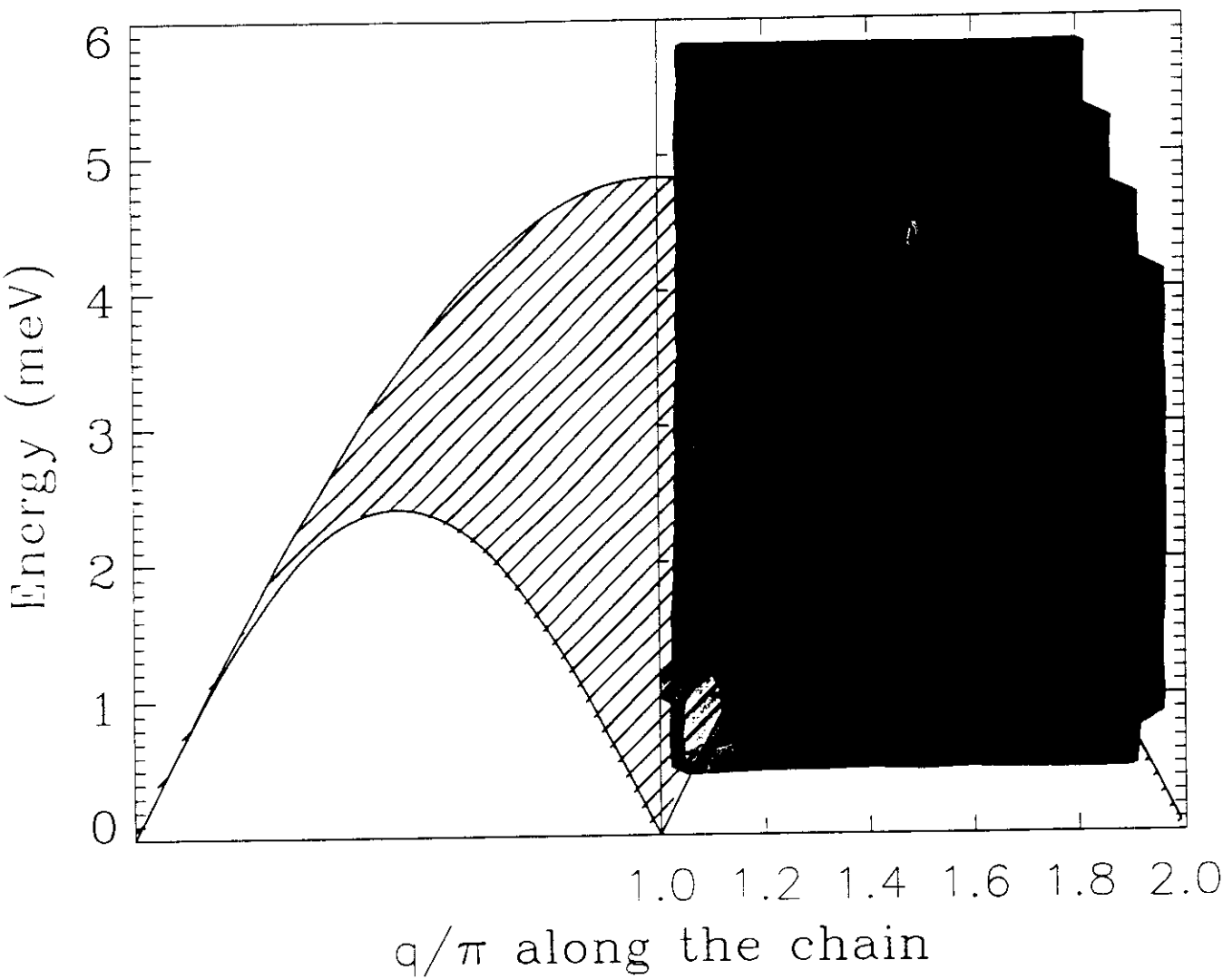


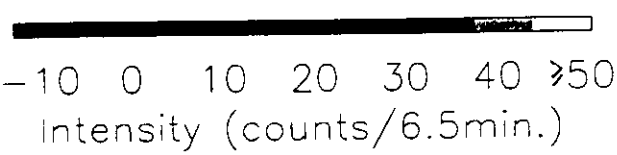
Dender et al. Risø TAS7 1993.

Cu - Benzoate.

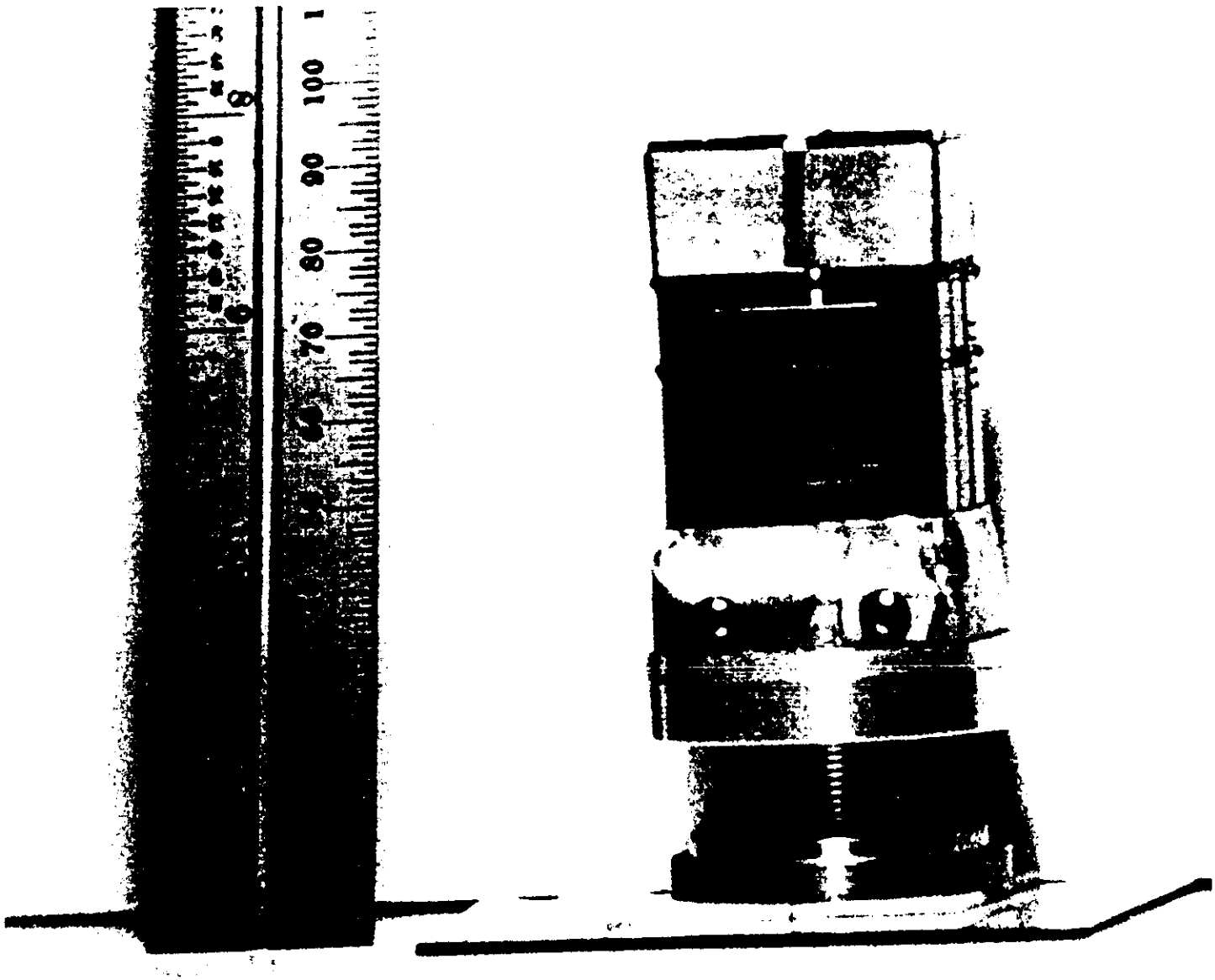
Two-Magnon Continuum in a Quantum ($s=1/2$) Spin Chain.

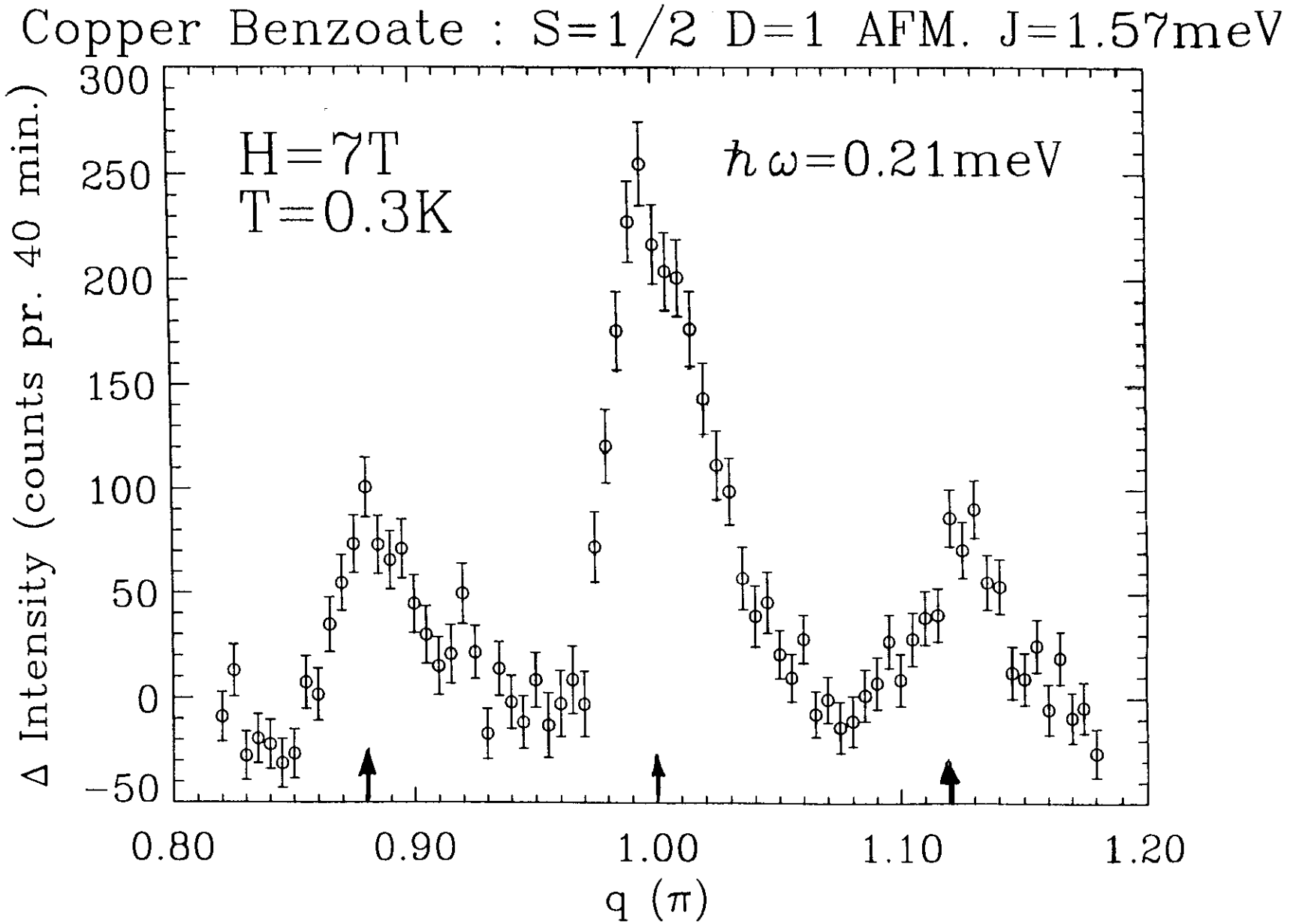
$J = 1.5\text{meV} \approx 15\text{T} \Rightarrow$ Can study field effects.





Risø 1993.
TAS7.
Cu-Benzoate.


8
90
80
70


Copper Benzoate : S=1/2 D=1 AFM. J=1.57meV
H=7T
T=0.3K
ħω=0.21meV
Δ Intensity (counts pr. 40 min.)
300
250
200
150
100
50
0
−50
0.80
0.90
1.00
1.10
1.20
q (π)

Summary : Cu-Benzoate

$S = 1/2$ $D = 1$ AFM.

- Clear observation of spin wave continuum.
- Theory of Müller et al. accounts for data.
- First experimental observation of field induced incommensurate length scale in $S = 1/2$ Heisenberg spin chain.