Hyperball-2による質量数80領域におけるカイラルダブレットの探索

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Physics Motivation

- 1997 – Frauendorf & Meng;
  - The doubling of band in ^{134}Pr is due to formation of handedness (chirality).[**Nucl. Phys A617 131 (1997)**]
    - Three perpendicular angular momentum can form two systems of handedness , the right-handed and the left-handed system.

D. Tonev *et. al.*
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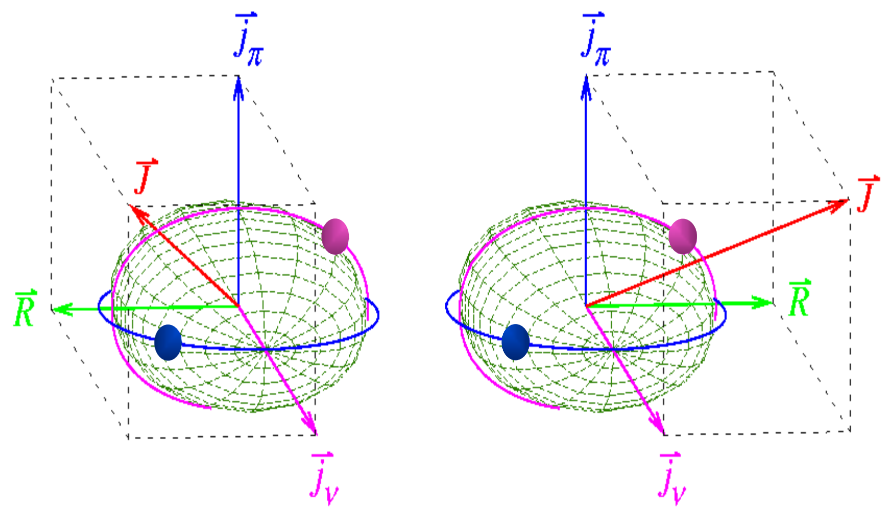
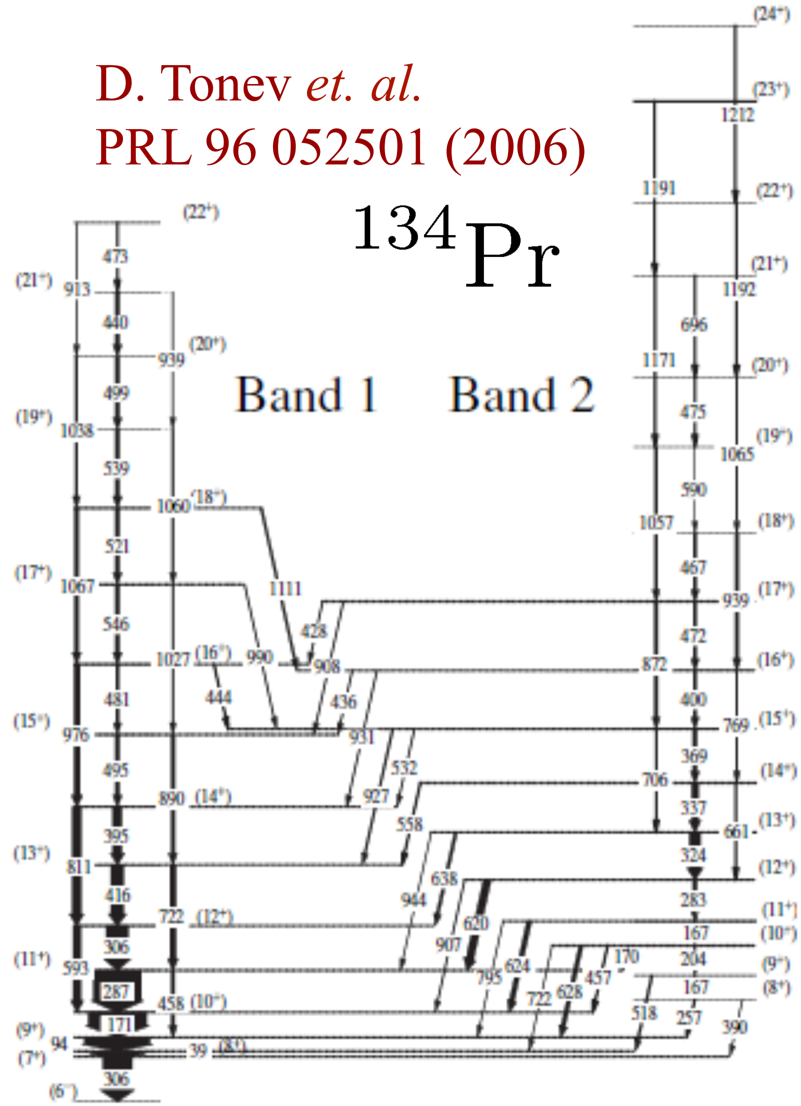




Known regions with chiral candidates

A~130

Odd-Odd ($\pi h_{11/2} \nu h_{11/2}^{-1}$)

^{132}Cs, ^{130}Cs, ^{128}Cs, ^{126}Cs, ^{124}Cs

^{134}La, ^{132}La, ^{130}La

^{134}Pr, ^{132}Pr

^{136}Pm

^{140}Eu, ^{138}Eu

Odd-A ($\pi (h_{11/2})^2 \nu h_{11/2}^{-1}$)

^{135}Nd, ^{135}Ce

A~190

Odd-Odd ($\pi h_{9/2} \nu i_{13/2}$)

^{188}Ir

Even-Even ($\pi h_{11/2}(d_{5/2}, g_{7/2}) \nu (h_{11/2})^2$)

^{136}Nd

A~80 (unexplored)

Odd-Odd ($\pi g_{9/2} \nu g_{9/2}^{-1}$)

^{80}Br(?),

Odd-A ($\pi (g_{9/2})^2 \nu g_{9/2}^{-1}$)

^{79}Kr(?)

A~105

Odd-Odd ($\pi g_{9/2}^{-1} \nu h_{11/2}$)

^{106}Ag,

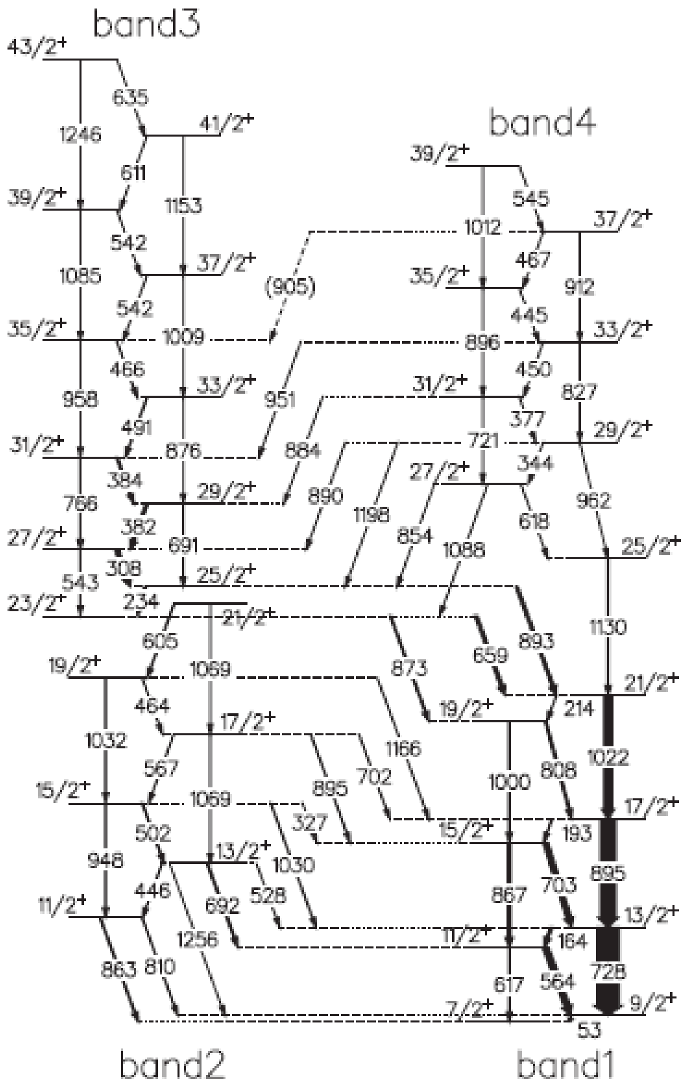
^{106}Rh, ^{104}Rh, ^{102}Rh

^{100}Tc

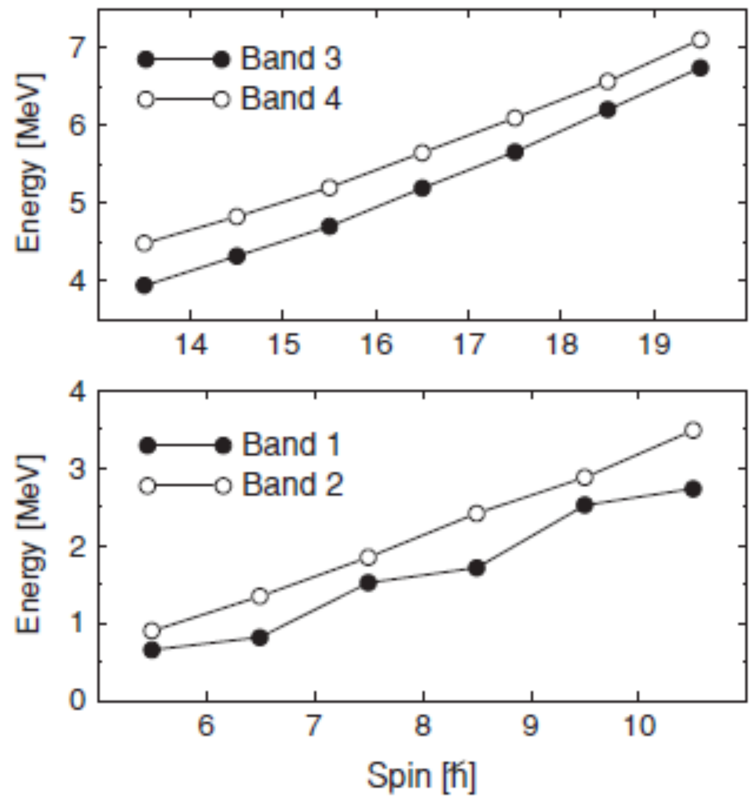
Odd-A ($\pi g_{9/2}^{-1} \nu (h_{11/2})^2$)

^{107}Ag, ^{105}Rh, ^{103}Rh

Doublet bands in $^{103}_{45}Rh_{58}$



J. Timar *et. al.* PRC 73 011301(2006)

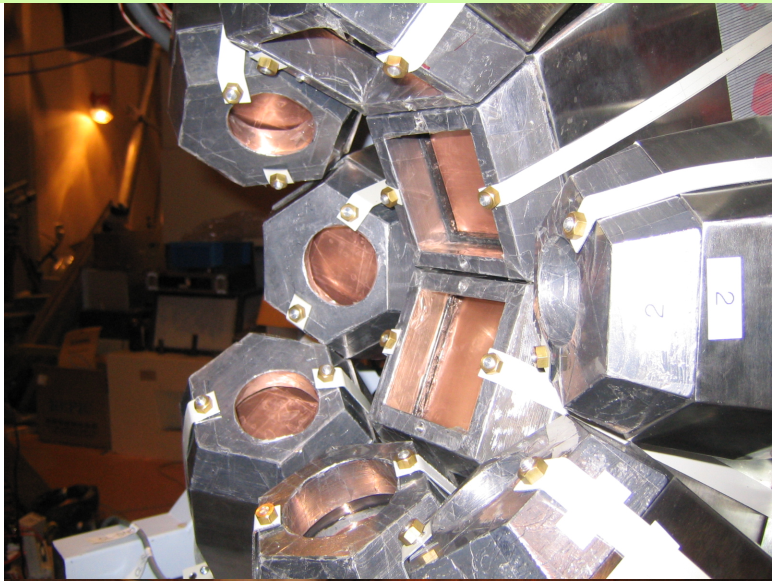


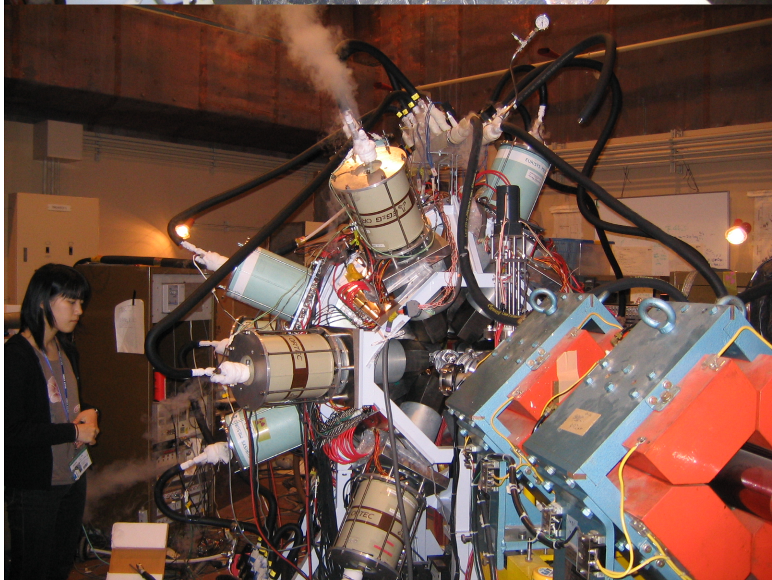
Lifetime was measured at GAMMASPHERE in October 2005.

Hyperball-2

- Total of 20 detectors
  - Photo peak efficiency ~5% at 1MeV
    - Eurisys Coaxial Ge
      - r.e. 60% x 4
    - Ortec Coaxial Ge
      - r.e. 60% x10
    - Eurisys Clover type Ge x 6
      - r.e 20%x4, 125% with add-back
  - Transistor-reset type pre-amplifier

- Target Chamber
- Collimators and Copper absorbers
- High speed data taking system with FERA-VME (double buffering)

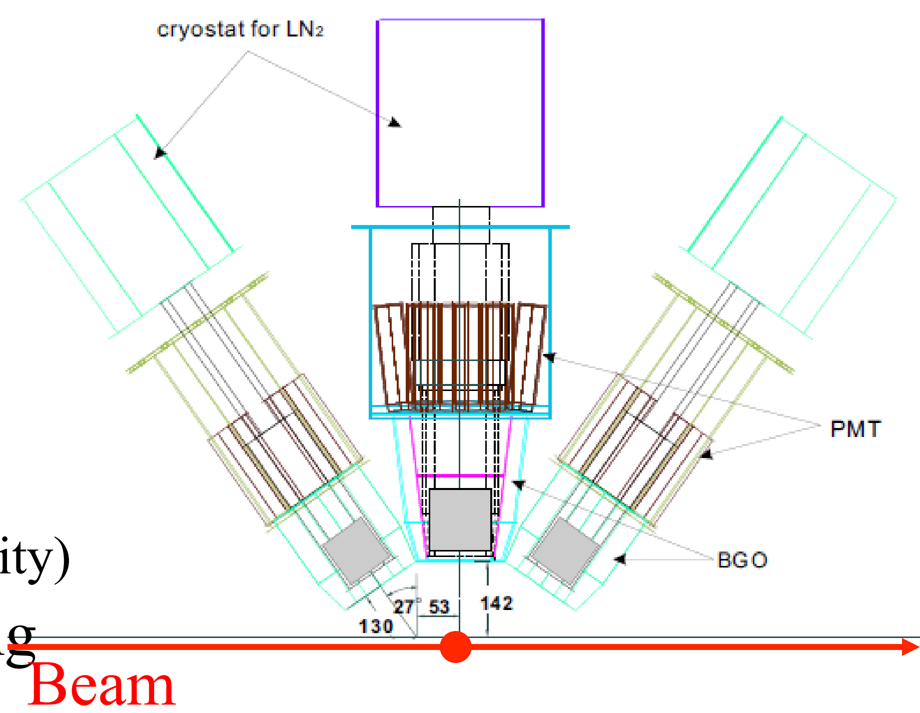




In-beam experiments with Hyperball-2

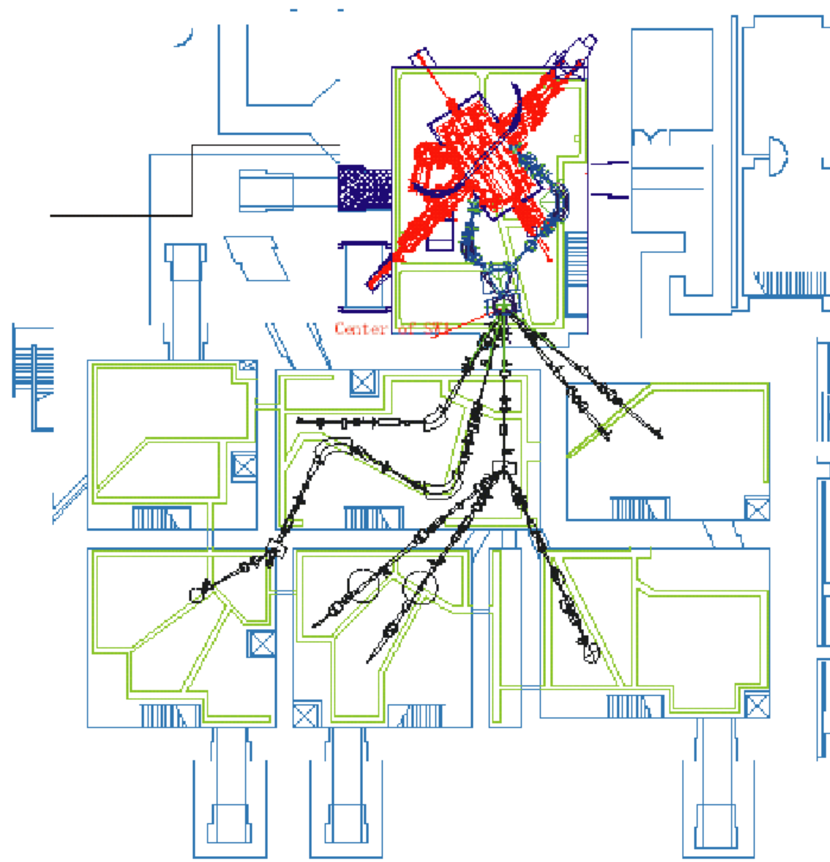
- Advantages
  - Large total photo peak efficiency (γ-γ-γ coincidence measurement)
  - Possible to use high intensity (~10pnA) beam (high counting rate).
- Disadvantages
  - Few angles
    - Detectors placed mostly around 90deg.

      (lower angular correlation sensitivity)
  - Detectors in upper and lower ring point off center

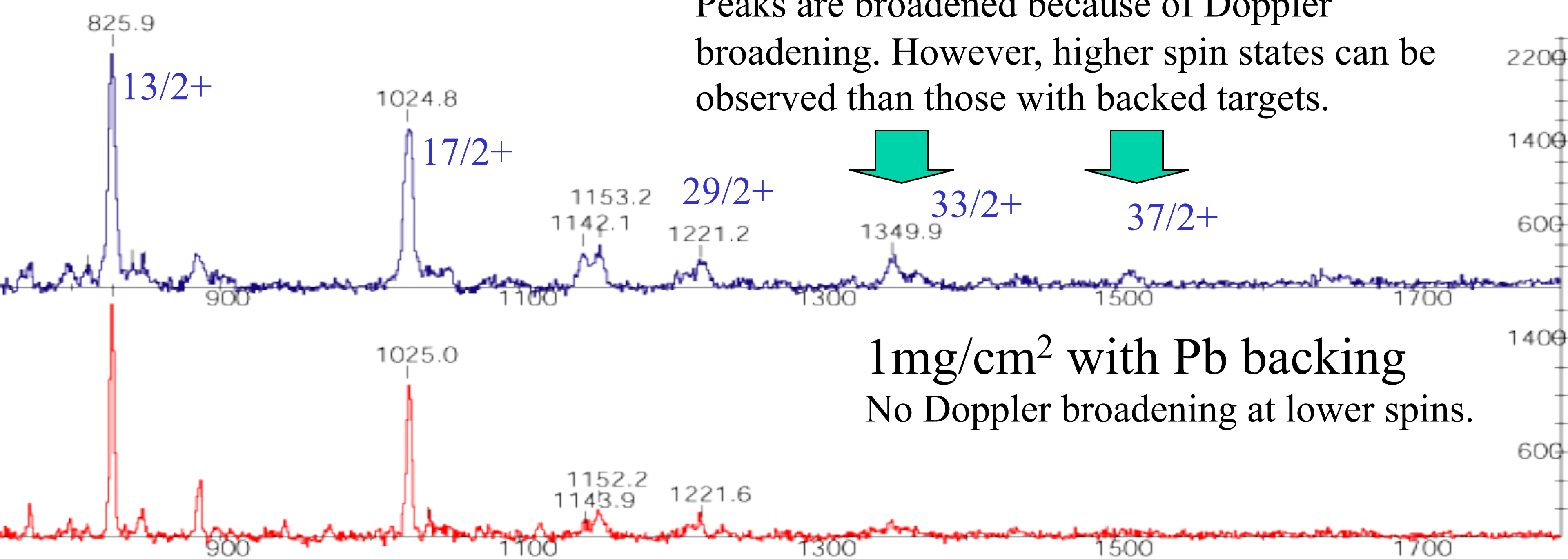


Experiments

- Course 33 at CYRIC, Tohoku University
- Reaction: $^{70}Zn(^{13}C,4n)^{79}Kr$
  - Beam: $^{13}C^{3+}$ @ 65MeV from 930 cyclotron
  - Target: 1mg/cm^2 70% enriched ^{70}Zn (self-supporting and Pb backed)
- HPGe array: Hyperball-2 for γ ray detection



Choice of targets



1mg/cm^2 without backing

Peaks are broadened because of Doppler broadening. However, higher spin states can be observed than those with backed targets.

1mg/cm^2 with Pb backing

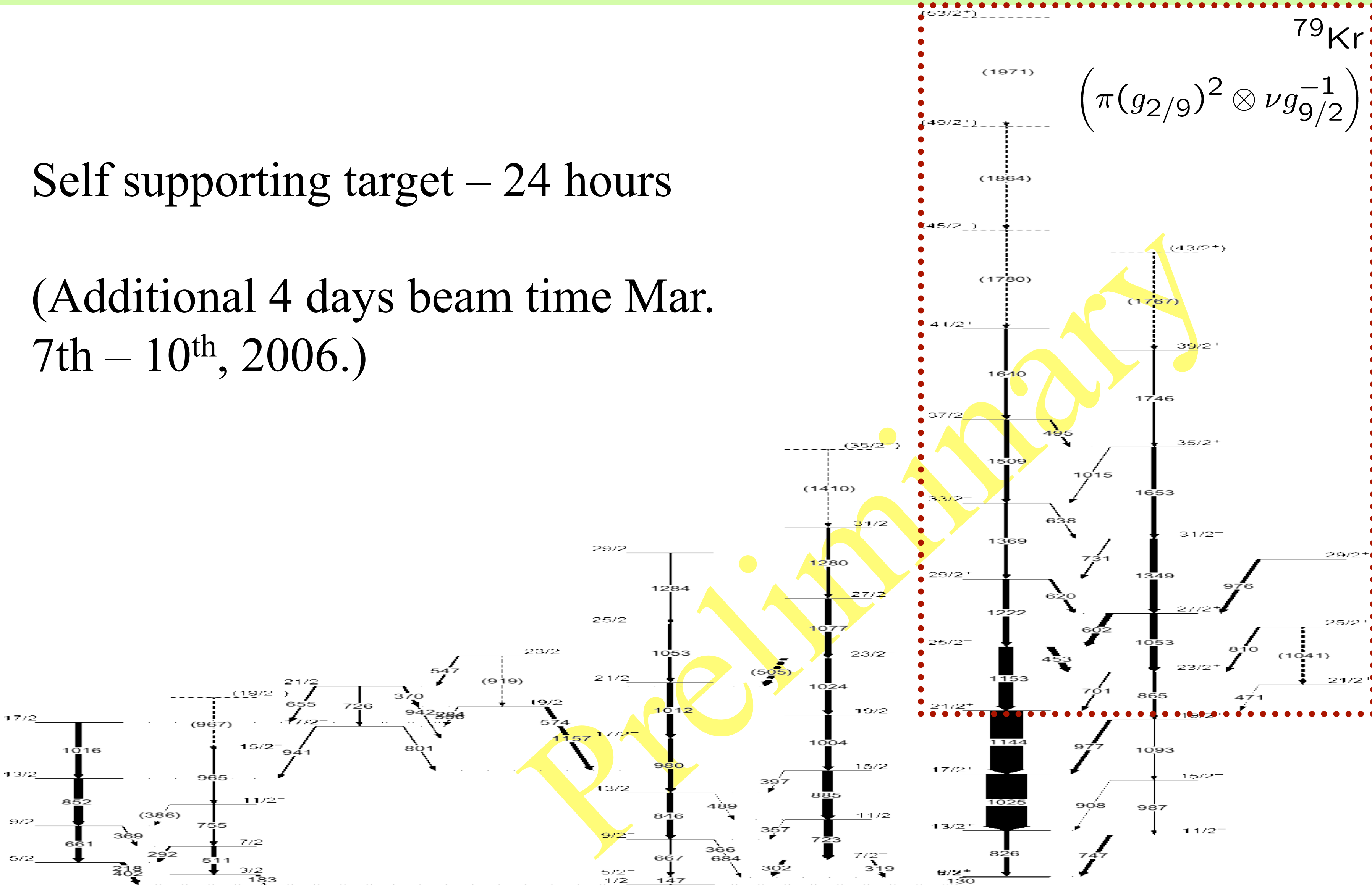
No Doppler broadening at lower spins.

In March experiment, 520+560μg/cm^2 self-supporting target was used.

Deduced Level Scheme

Self supporting target – 24 hours

(Additional 4 days beam time Mar. 7th – 10th, 2006.)



Summary

- Hyperball-2 was optimized for in-beam experiments and installed in CYRIC Tohoku University.
- ^{79}Kr was studied via ^{70}Zn(^{13}C,4n)^{79}Kr for chiral doublet structures in the mass ~80 region.
- Preliminary analysis has identified three side band member candidates.
- Additional data from March experiment are being analyzed.