Determining the limits to K isomerism

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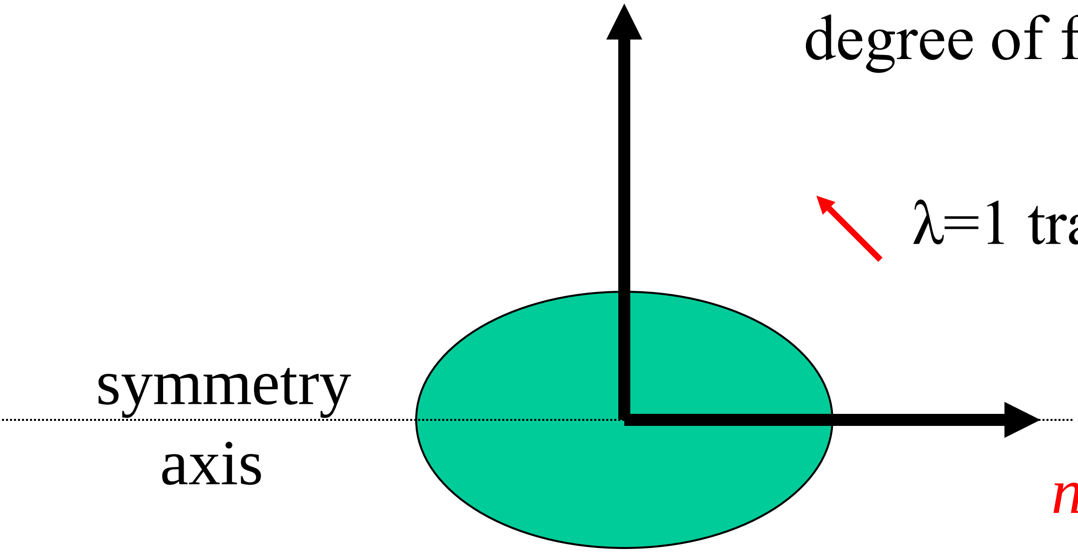
- K-isomer perspectives
- ends of isomer chains with short half-lives
- reduced-hindrance dependence on N_pN_n
- multi-quasiparticle states in ^{178}W

K-forbidden γ-ray transitions



degree of forbiddenness, $\nu = \Delta K - \lambda$

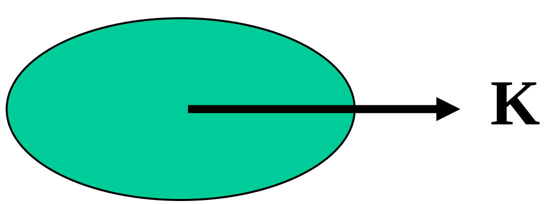
λ=1 transition is 7-fold forbidden

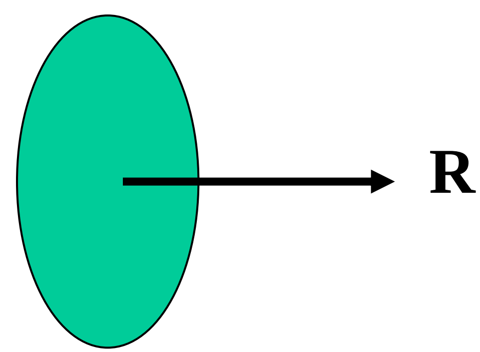
(ν = 7)

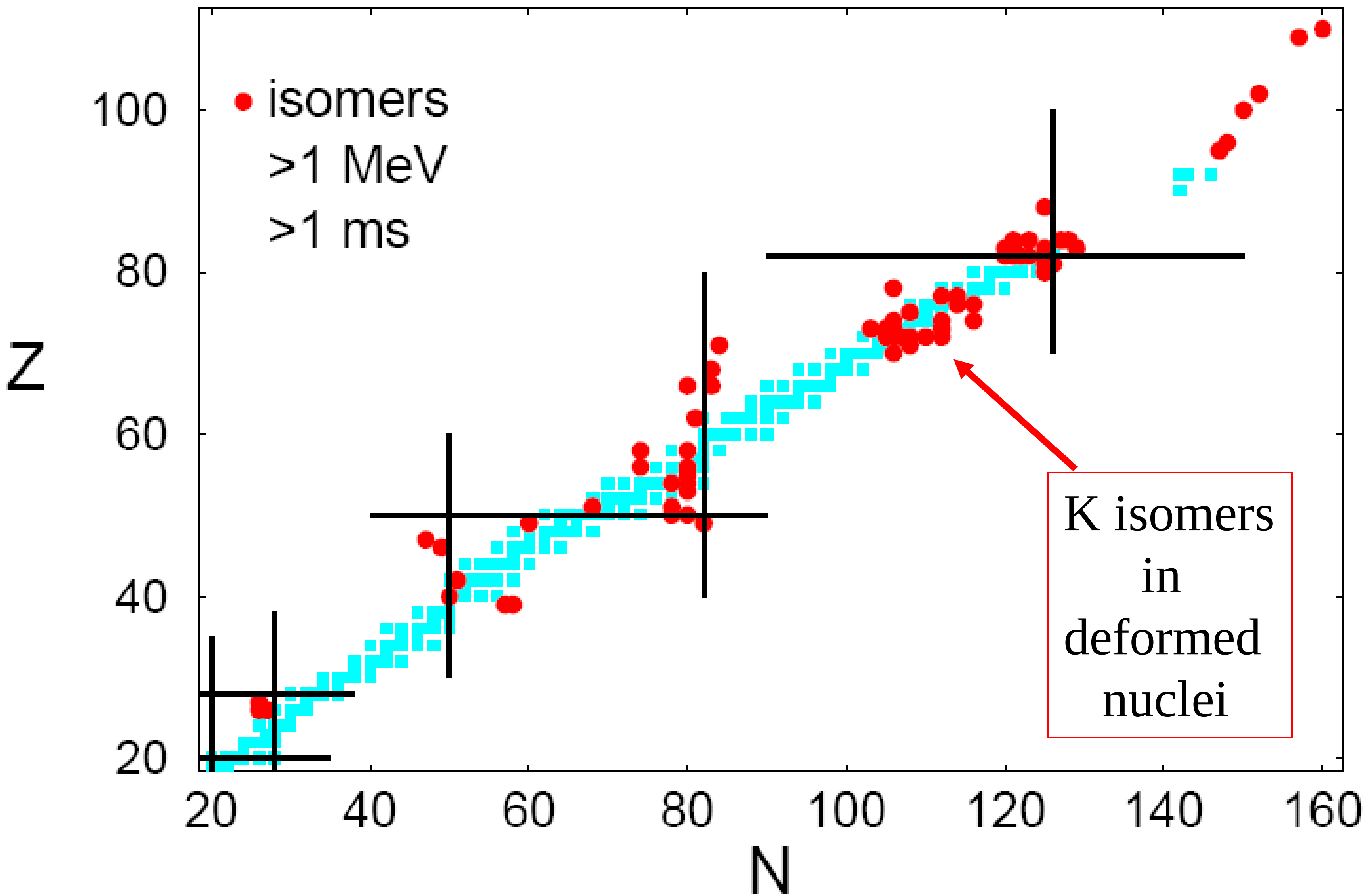
angular momentum has both magnitude and direction!

K-mixing mechanisms

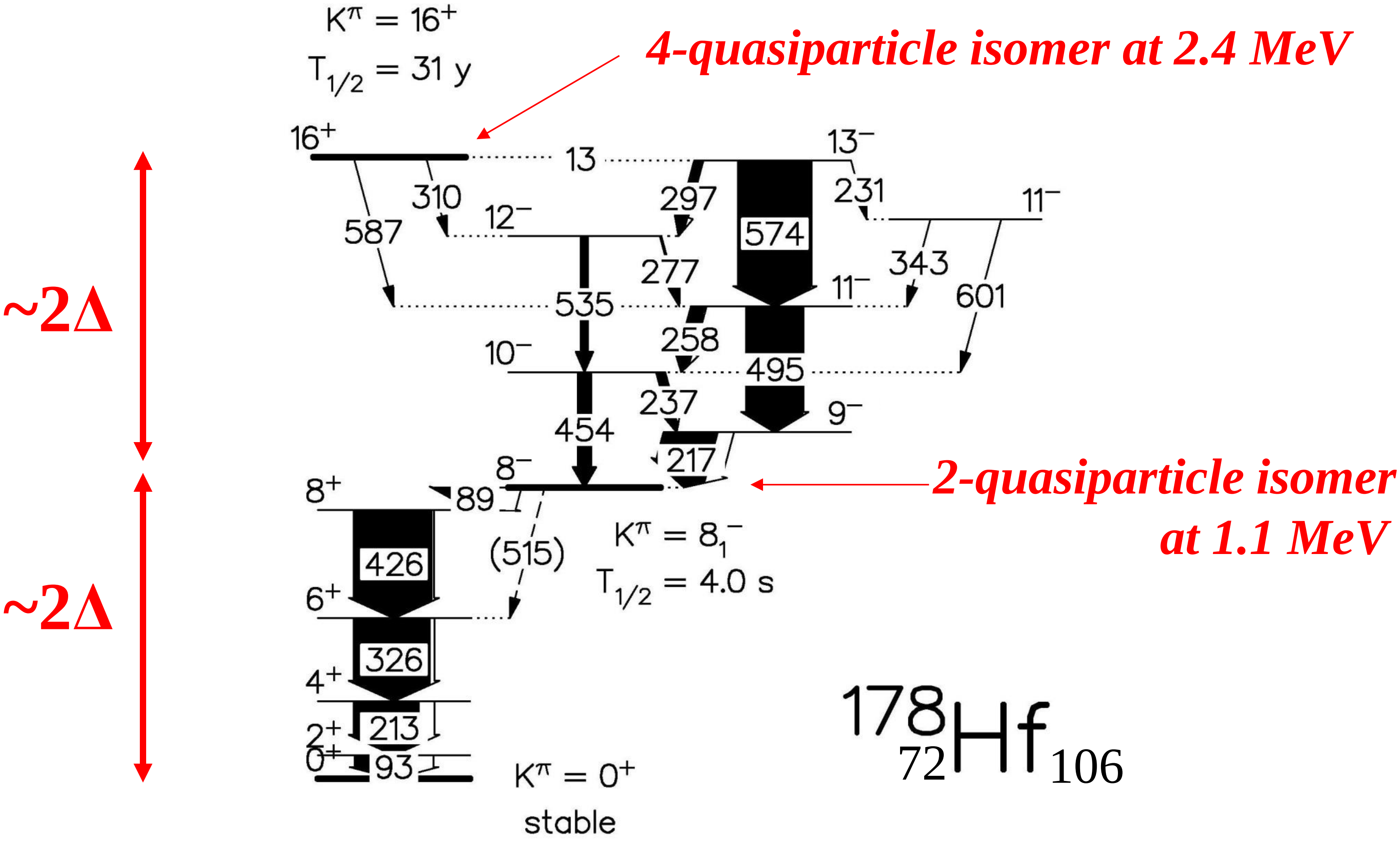
- chance near-degeneragies – hard to predict!
- Coriolis mixing (rotational – orientation change)
- γ tunnelling (vibrational – shape change)
- level density (thermal – statistical)





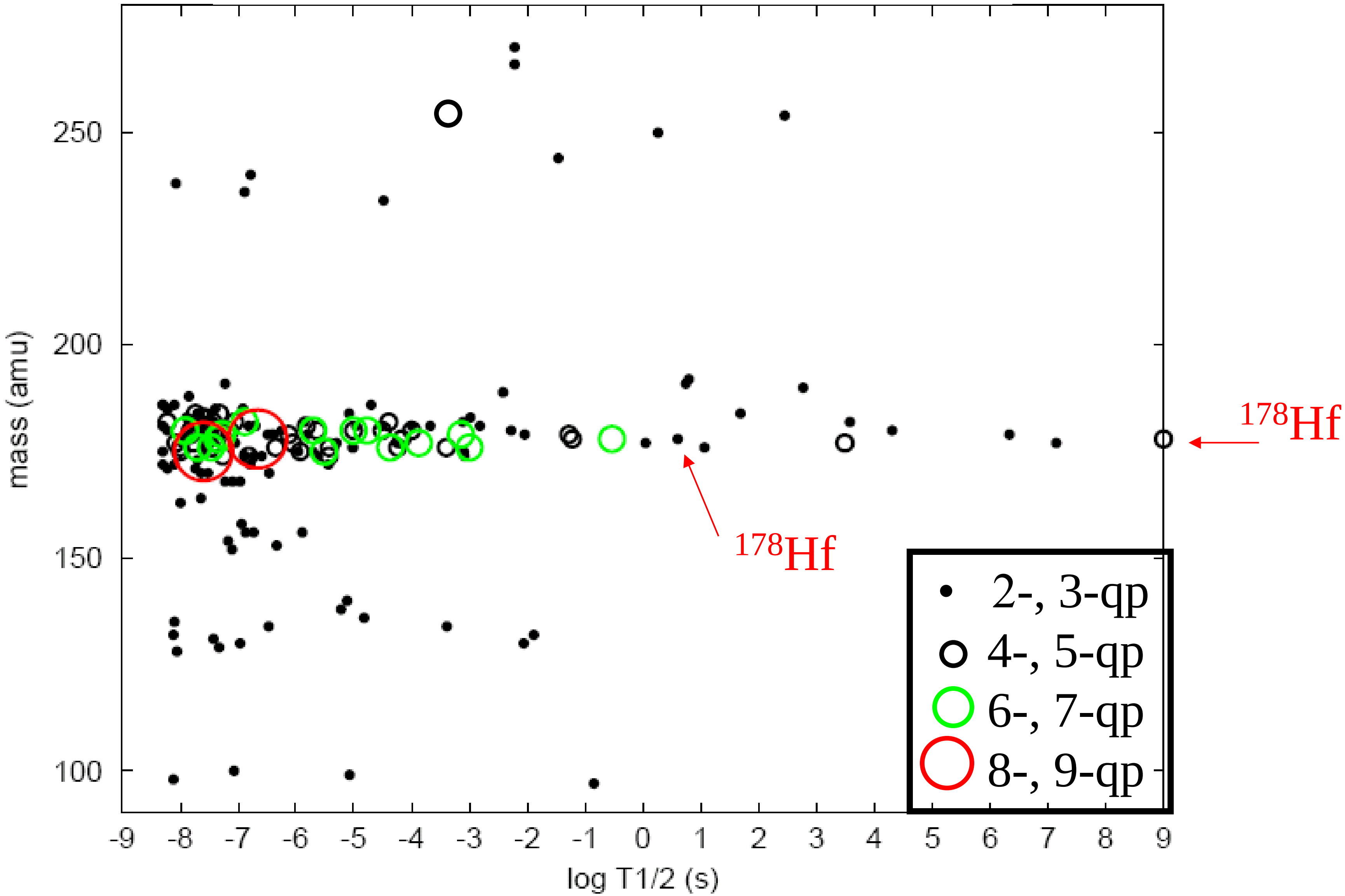


adapted from Walker and Dracoulis, Nature 399 (1999) 35



[Smith et al., Phys. Rev. C68 (2003) 031302(R)]

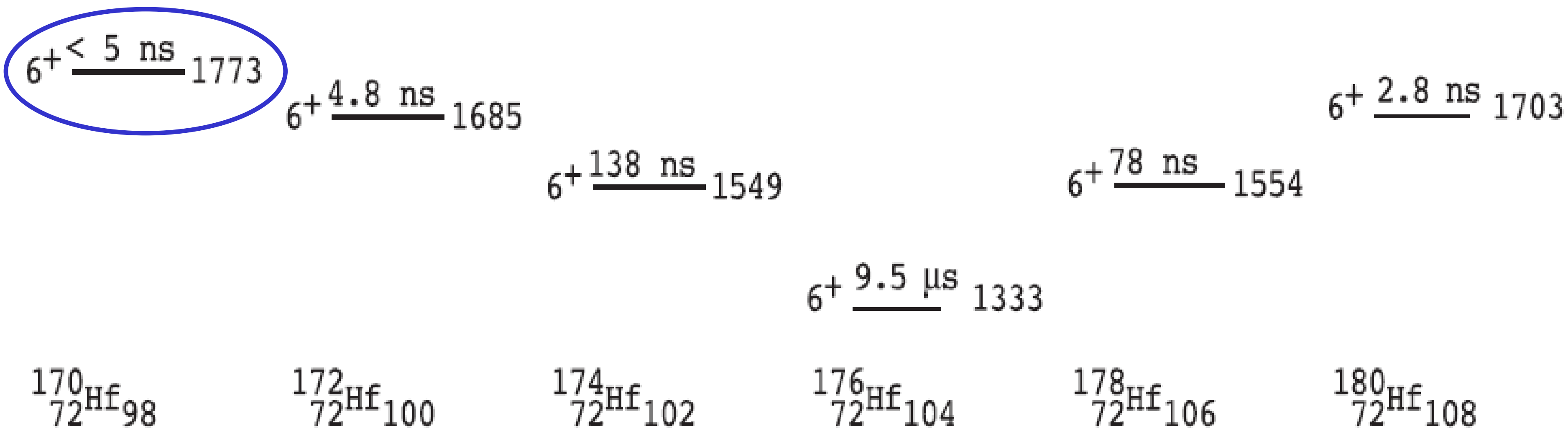
multi-quasiparticle K isomers > 5ns



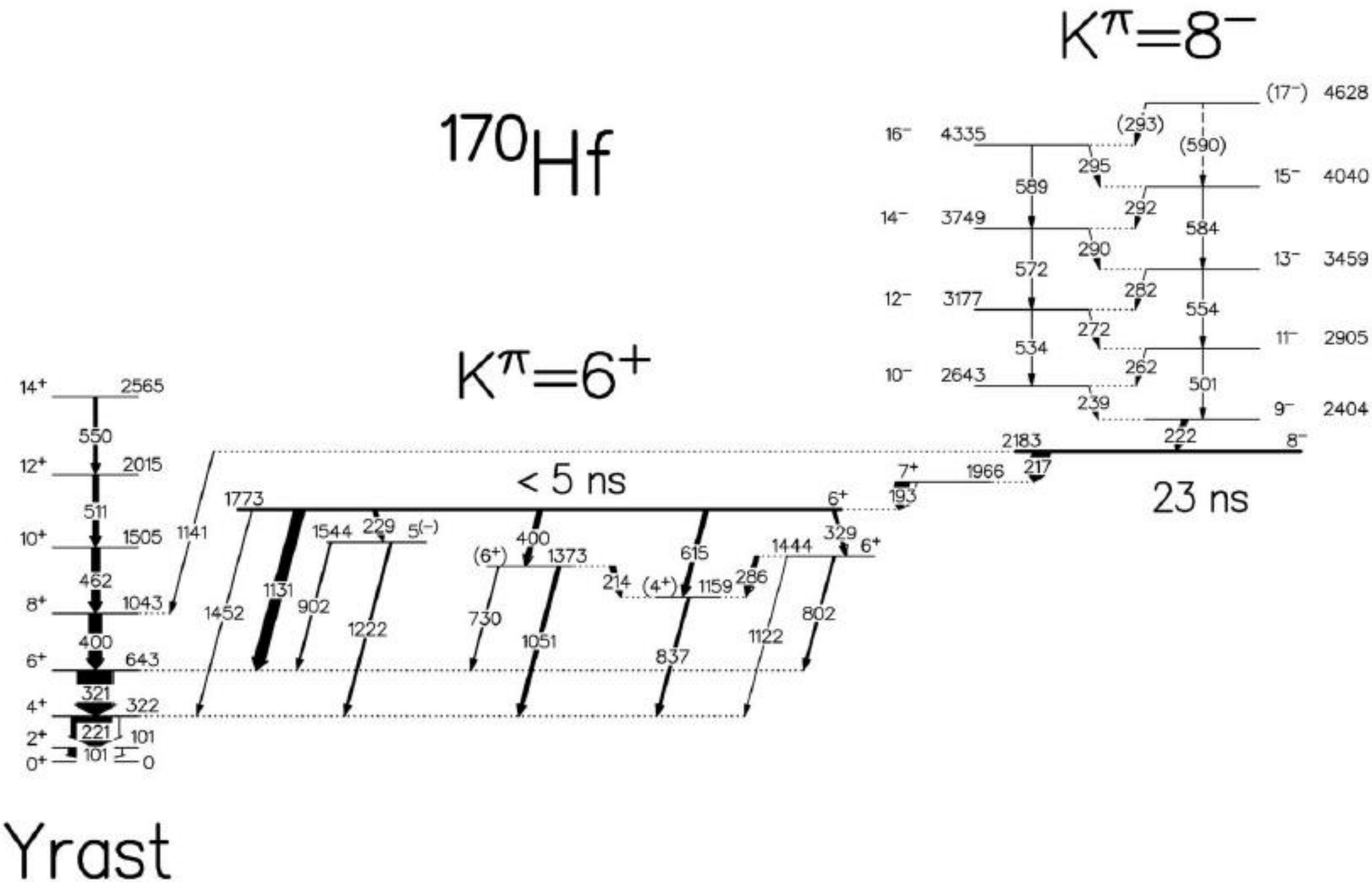
excludes 2-qp isomers in odd-odd nuclei

Walker, AIP-CP819 (2006) 16

$K^{\pi} = 6^{+}$ isomers (Z = 72)



Kondev et al., ADNDT in press



Cullen et al., Phys. Rev. C60 (1999) 057303

transition-rate hindrance factors

$$F_W = T^{\gamma}_{1/2} / T^{W}_{1/2}$$

Weisskopf hindrance

$$\nu = \Delta K - \lambda$$

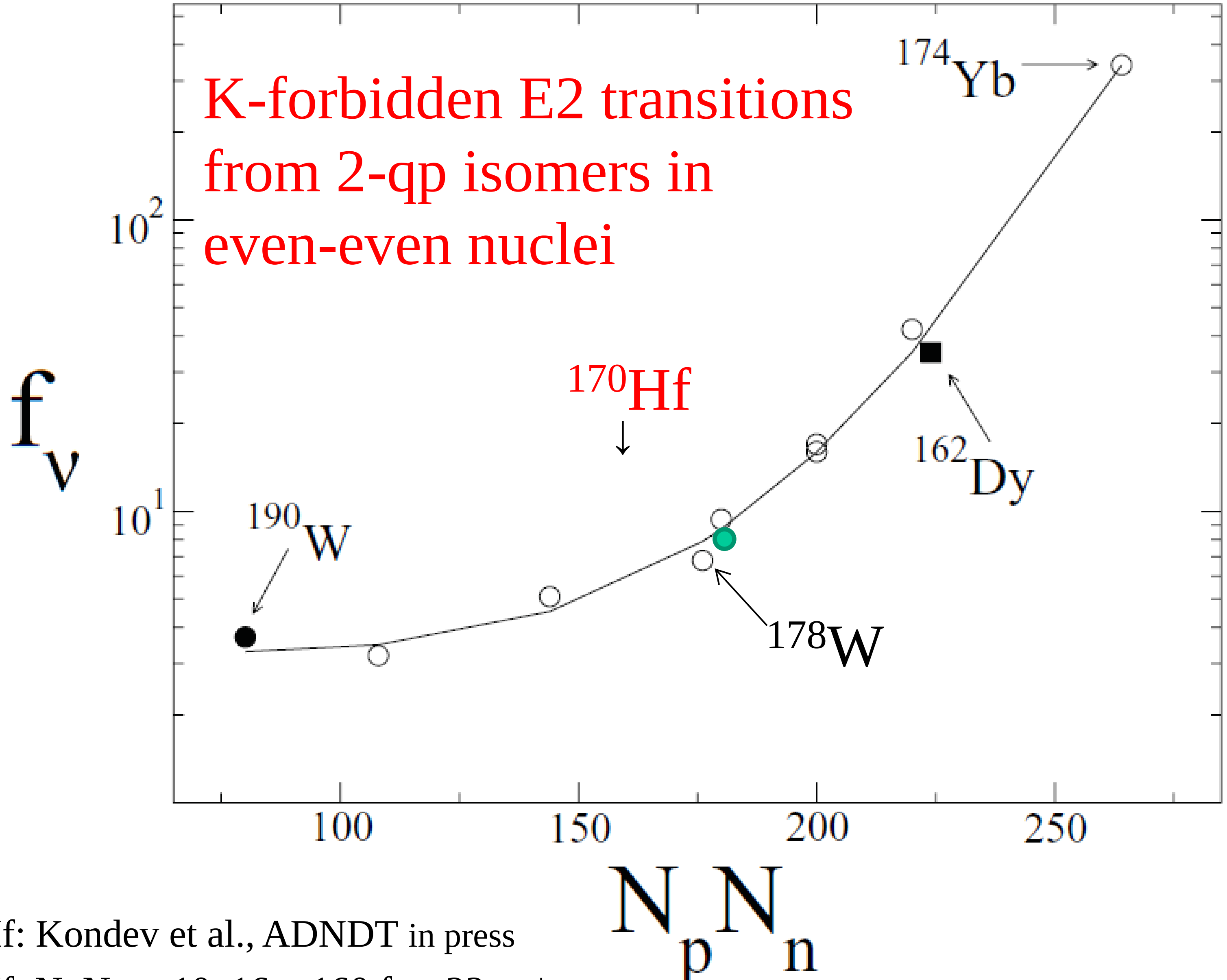
degree of K forbiddenness

$$f_{\nu} = (F_W)^{1/\nu}$$

reduced hindrance

(hindrance per degree of K forbiddenness)

contains the physics

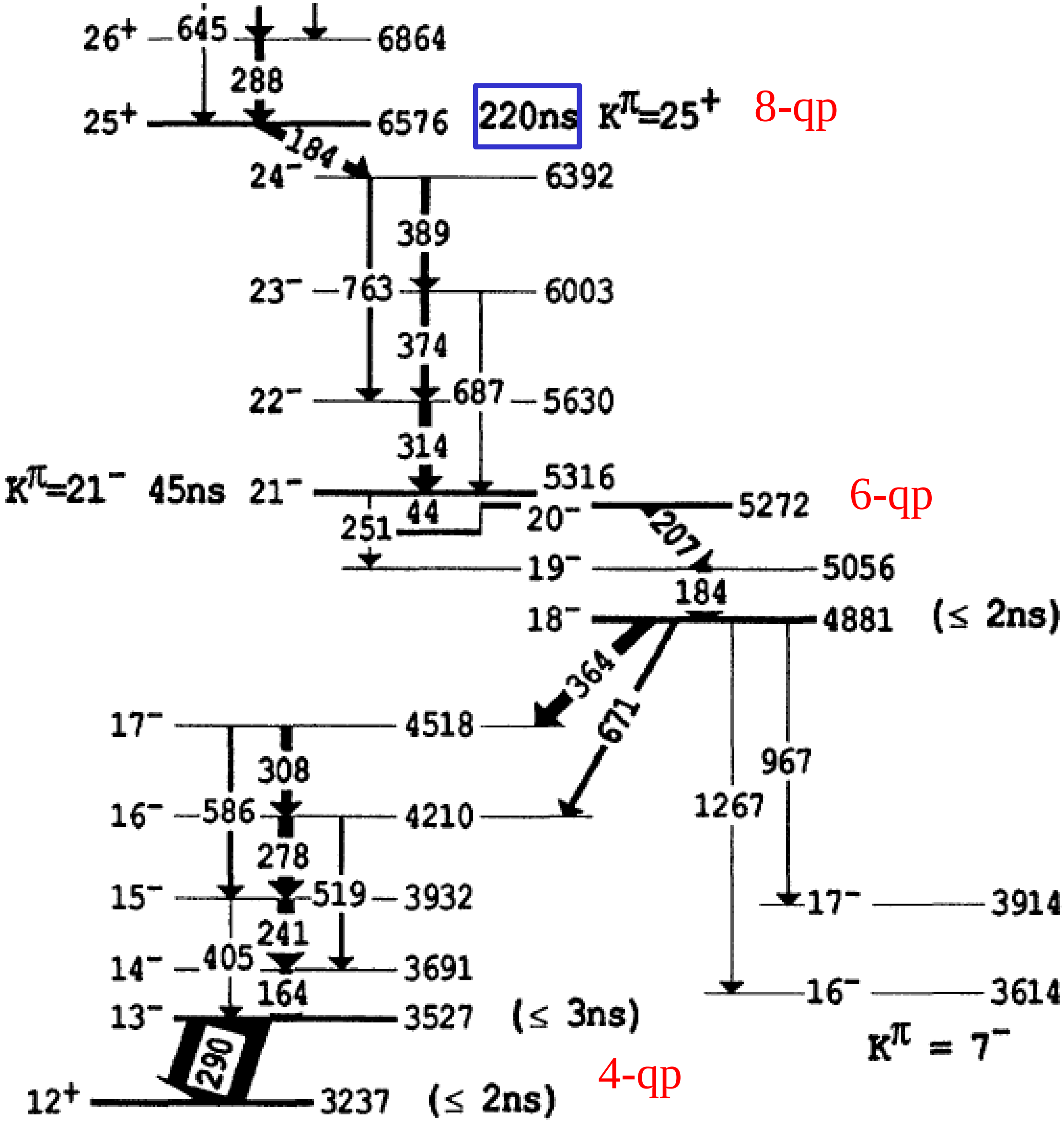


^{180}Hf: Kondev et al., ADNDT in press

^{170}Hf: NpNn = 10x16 = 160 f_ν < 23 ↓

^{180}Hf: NpNn = 10x18 = 180 f_ν = 7.3 ●

Swan et al., Phys. Rev. C83 (2011) 034322

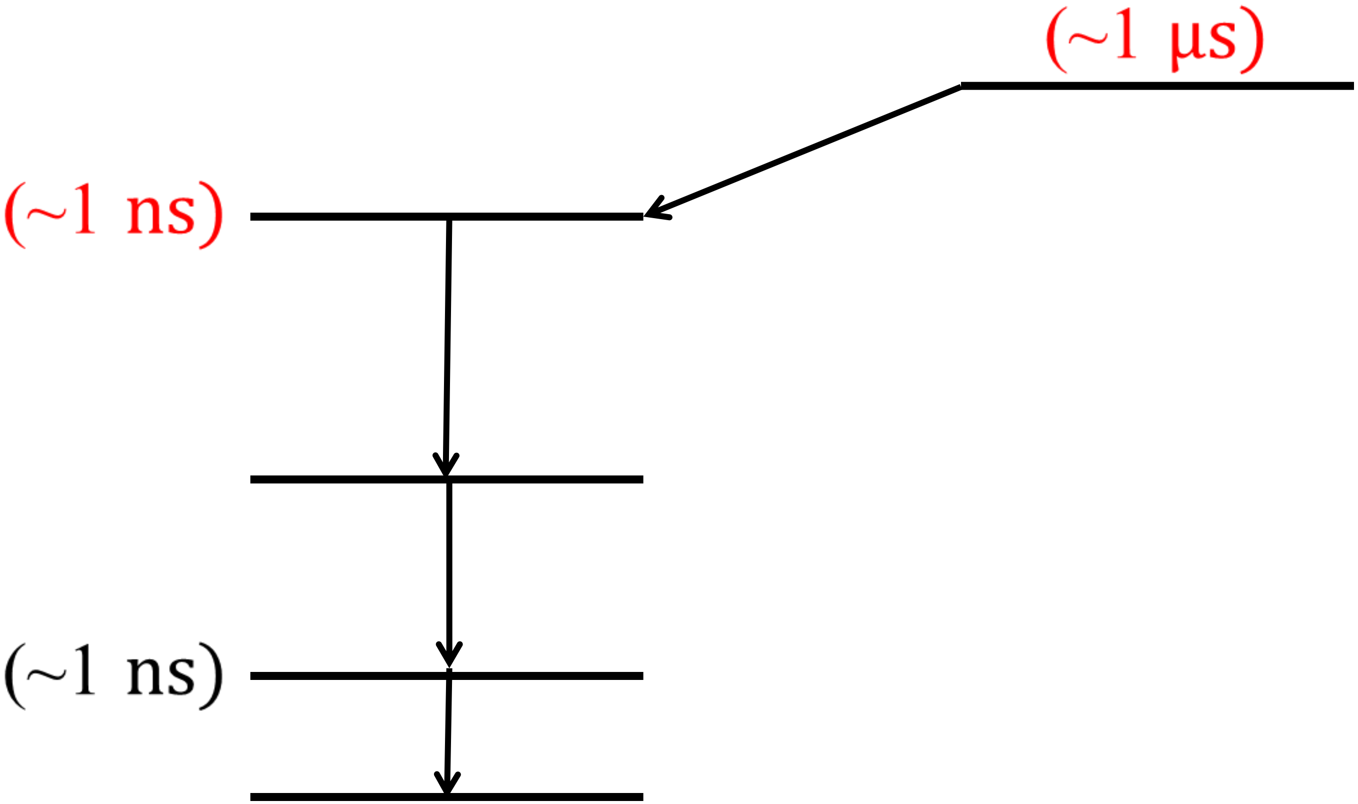


^{178}W

partial scheme

Purry et al., PRL75 (1995) 406

Short-lived isomer (~1 ns) below long-lived isomer (~1 μs)



Summary

K isomer limits

f_ν dependence: N_pN_n (E2 transitions, 2-qp isomers)

Coriolis effects

γ tunnelling

level-density

chance near-degeneracy

Half-lives needed for short-lived K isomers