Behavior of moment of inertia in highly deformed ^{24}Mg and ^{20}Ne

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Formalism

$$J_{Inglis} = 2\sum_{mi} \frac{|<m|J_x|i>|^2}{E_m - E_i}$$

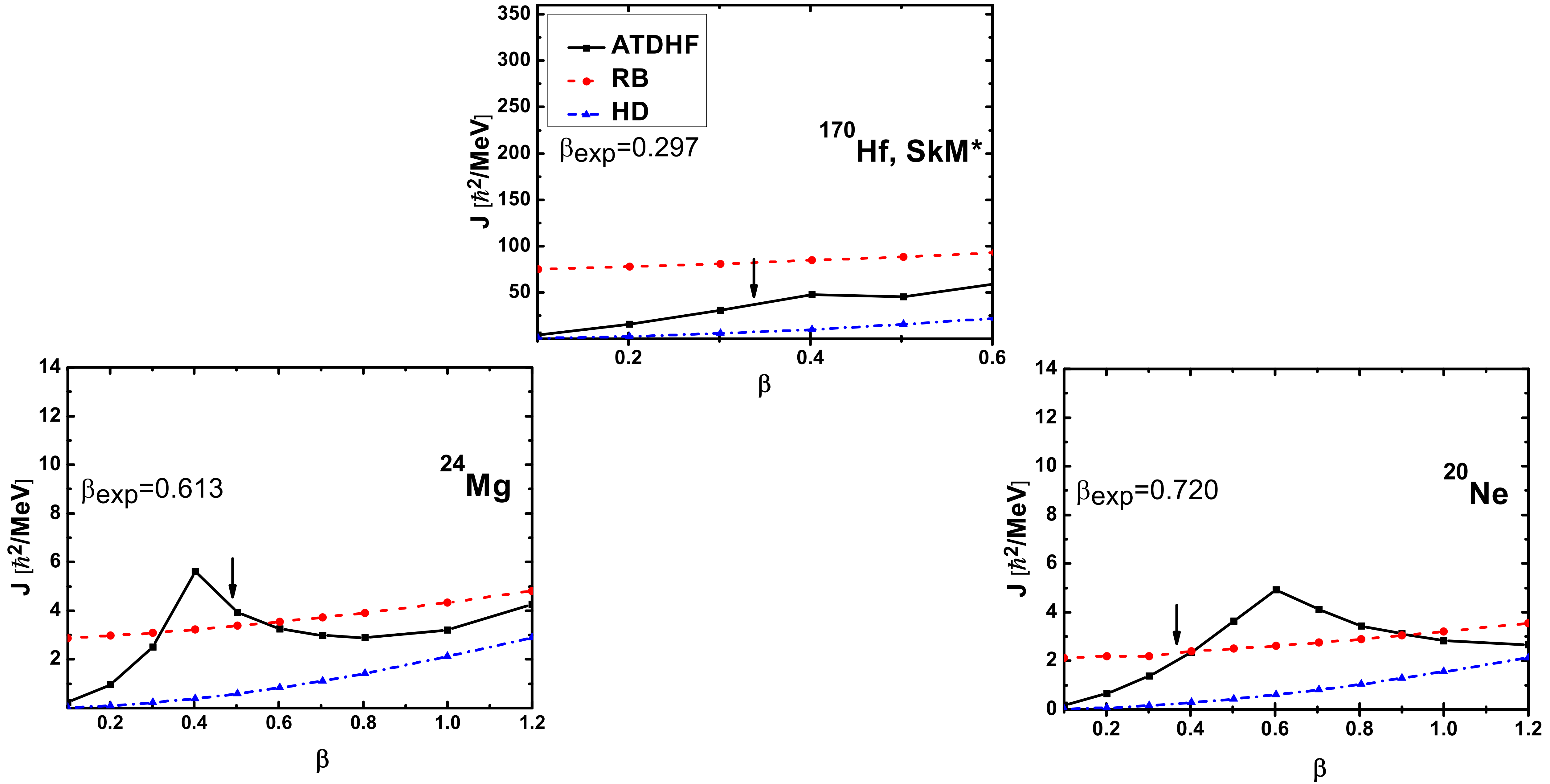
$$J_{\mathrm{RB}} = \frac{2}{5}MR^2\left(1 + \frac{1}{2}\sqrt{\frac{5}{4\pi}}\beta + \frac{25}{32\pi}\beta^2\right)$$

$$J_{IB} = 2\sum_{k,k'>0} \frac{|<k|J_x|k'>|^2}{\varepsilon_k + \varepsilon_{k'}}(u_k v_{k'} - u_{k'} v_k)^2$$

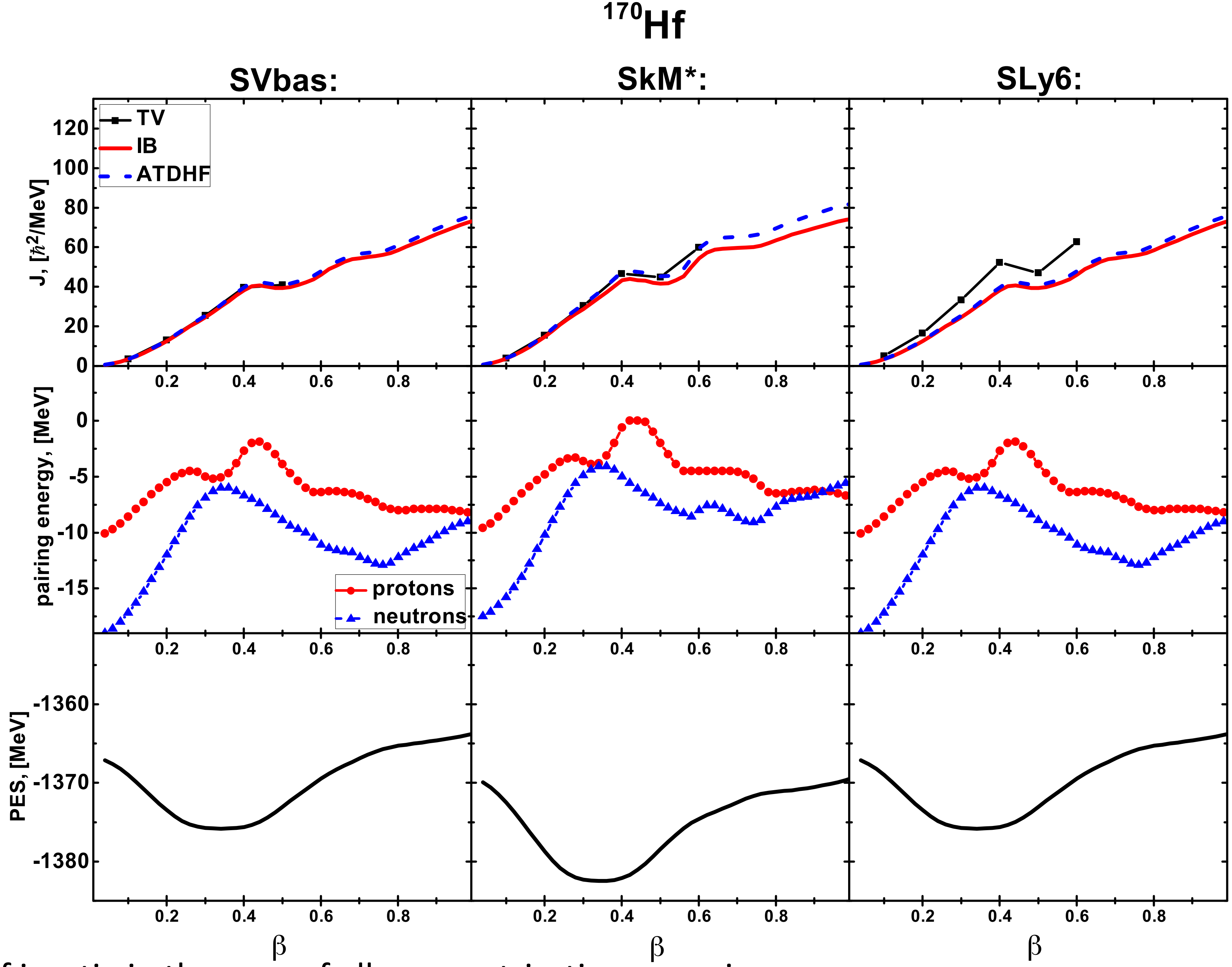
$$J_{\mathrm{HD}} = \frac{9}{4\pi}MR^2 \frac{\beta^2(1+\frac{1}{4}\sqrt{\frac{5}{4\pi}}\beta)^2}{2+\sqrt{\frac{5}{4\pi}}\beta + \frac{25}{16\pi}\beta^2}$$

$$J_{TV} = 2\sum_{\nu>0} \frac{|<\nu|J_x|0>|^2}{E_\nu - E_0}$$

$$J_{ATDHF} = 3B\beta^2$$

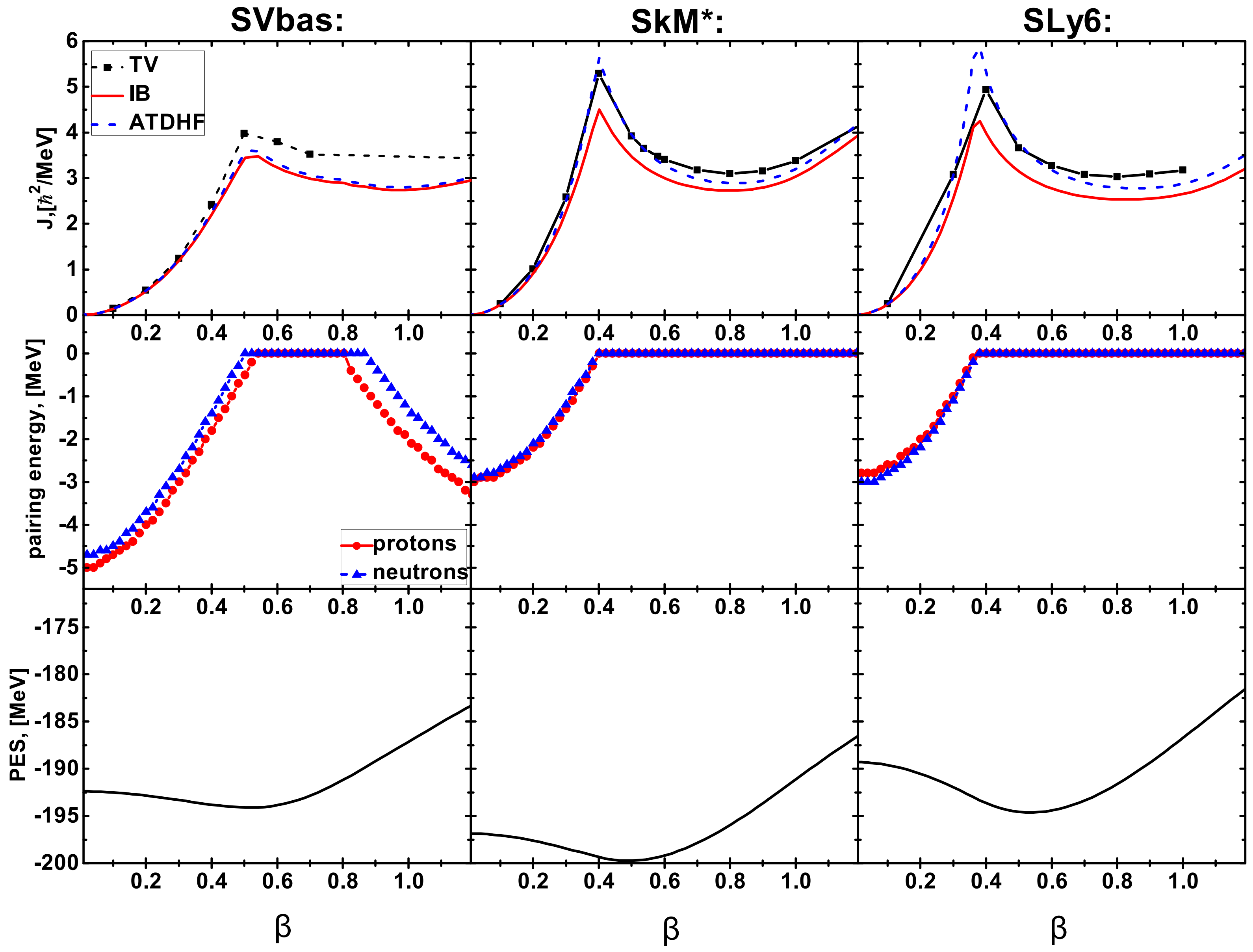


Anomalous behavior of the moment of inertia in heavily deformed light nuclei: decrease in the moment of inertia near the equilibrium deformation

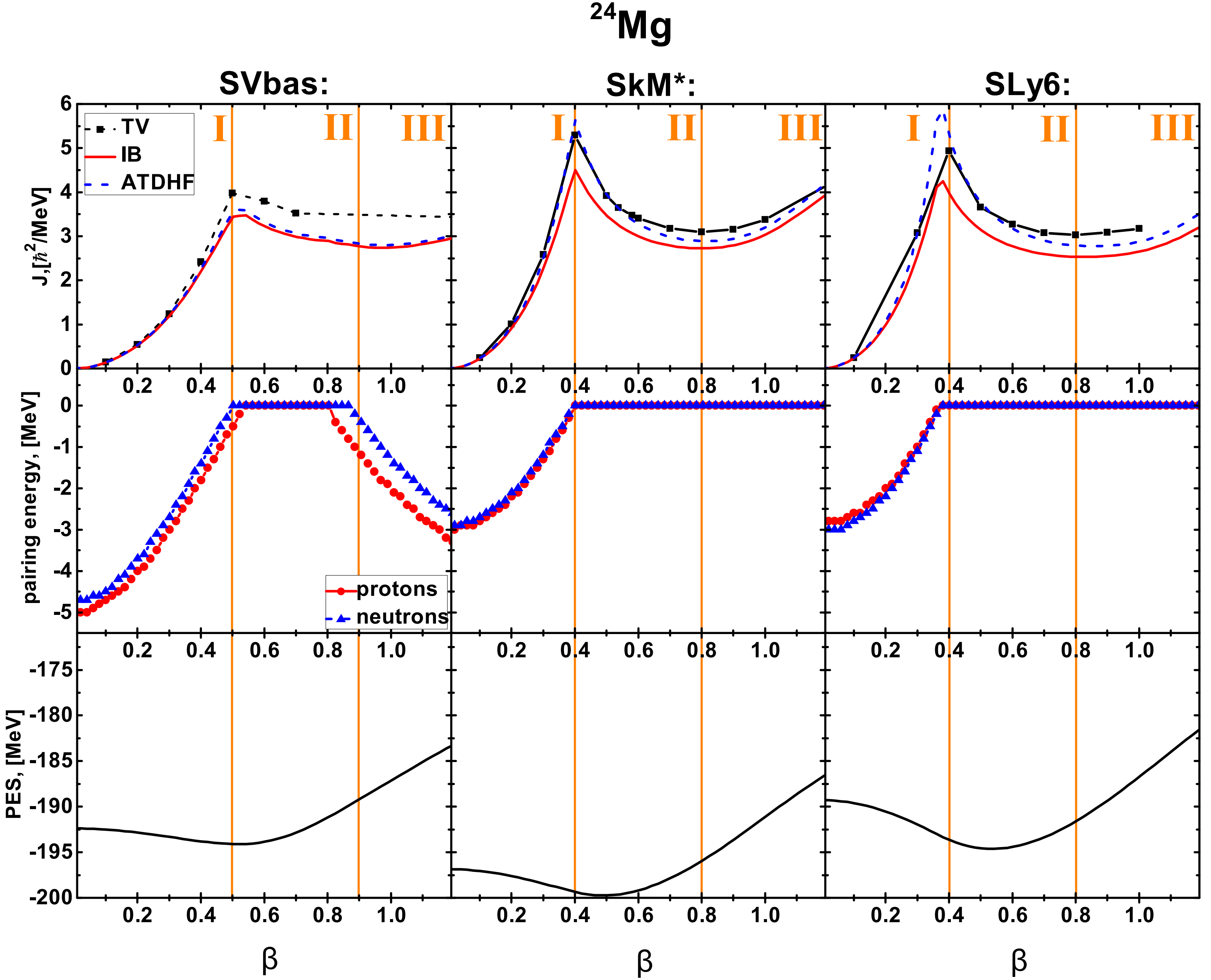


The moment of inertia in the case of all parametrizations growing up

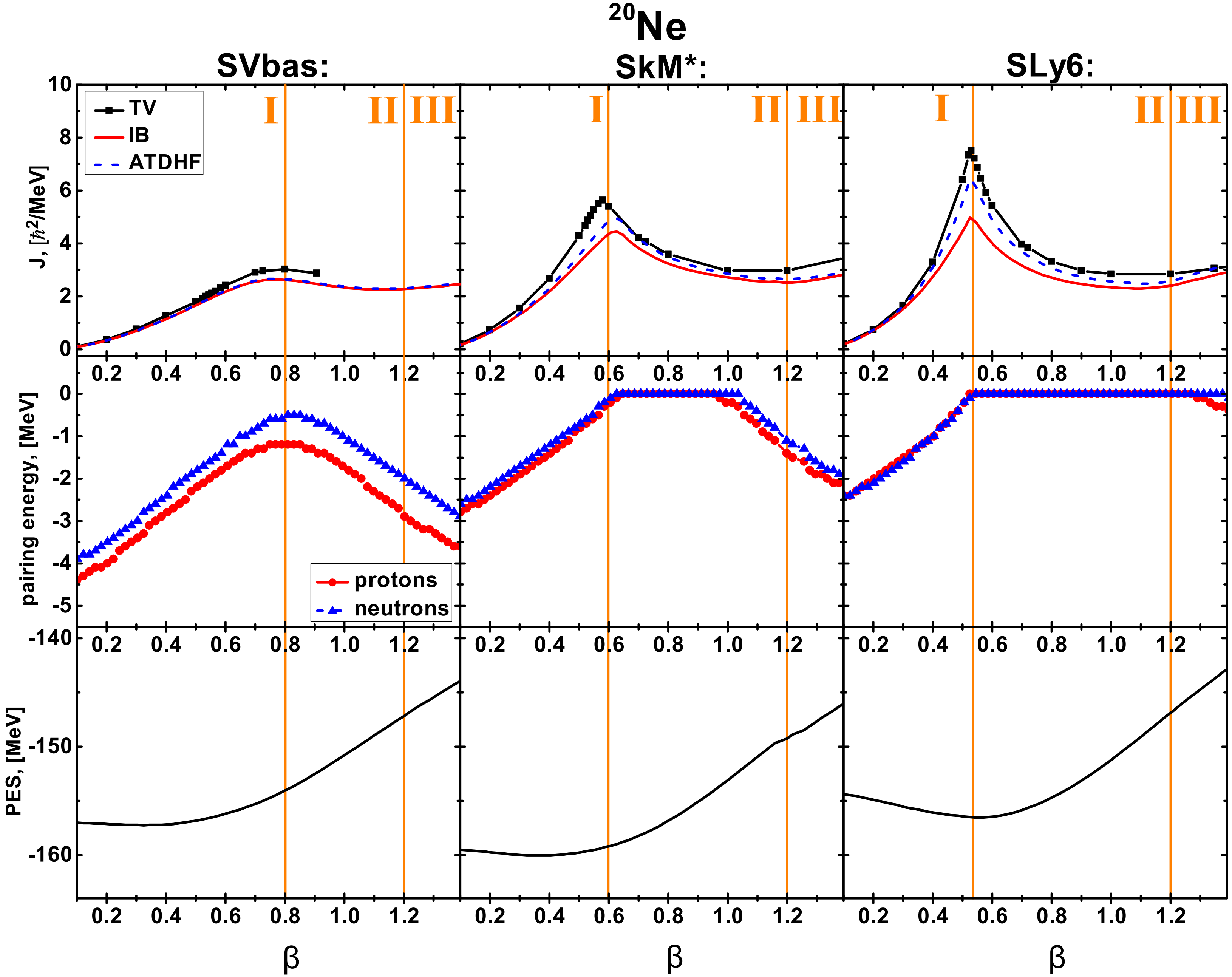
^{24}Mg



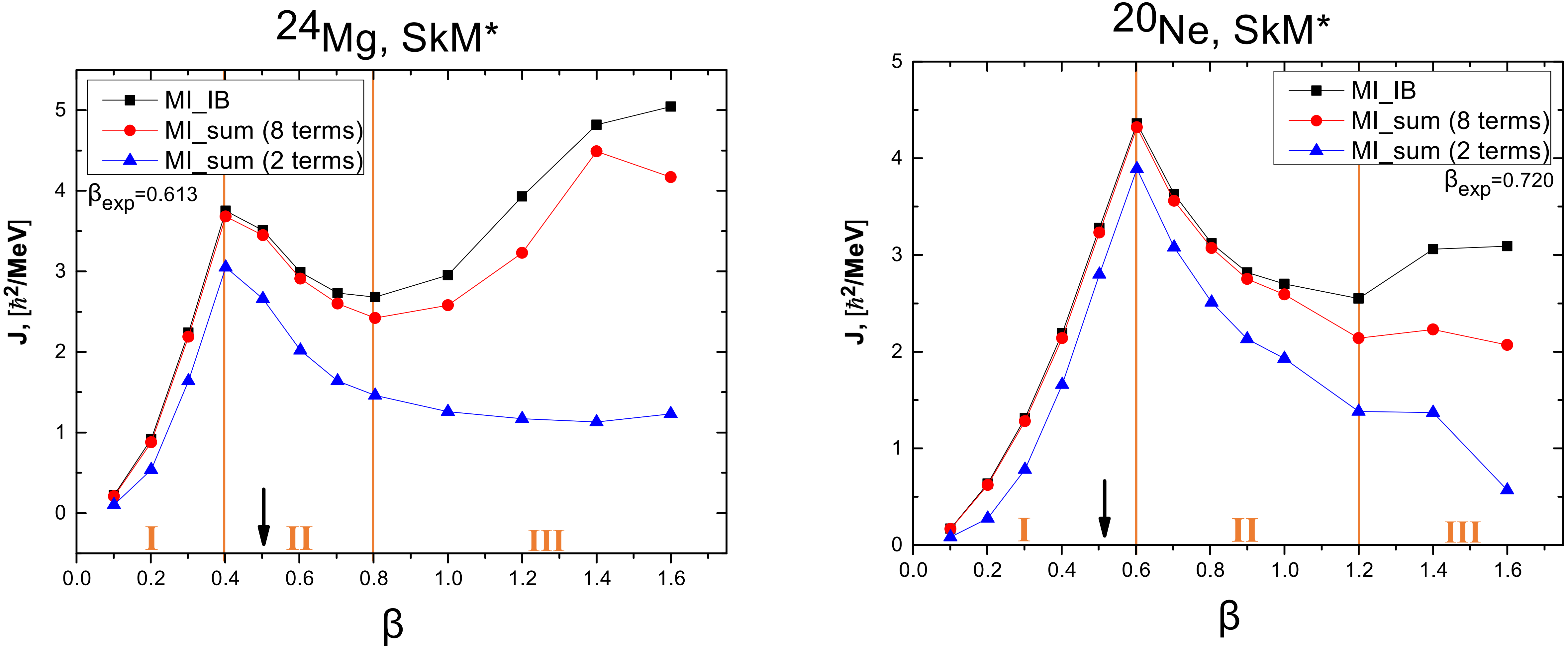
The moment of inertia can be divided into 3 conditional sectors: growth, decline, further growth



$$J_{IB} = 2 \sum_{k,k'>0} \frac{|<k|J_x|k'>|^2}{\varepsilon_k + \varepsilon_{k'}} (u_k v_{k'} - u_{k'} v_k)^2$$

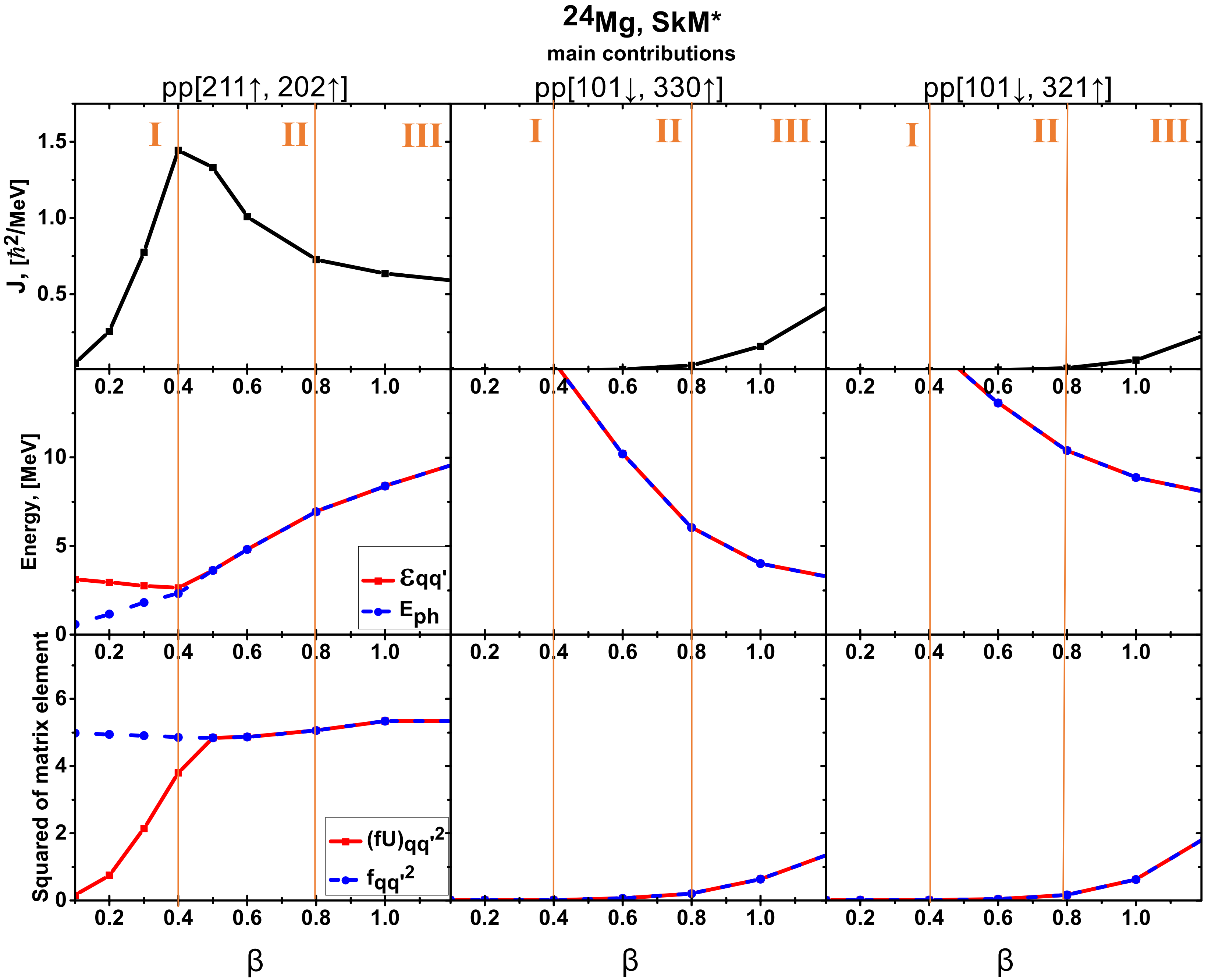


As for ^{24}Mg, for ^{20}Ne it is also possible to distinguish 3 modes of evolution of the moment of inertia of the nucleus: increase, decrease and again increase

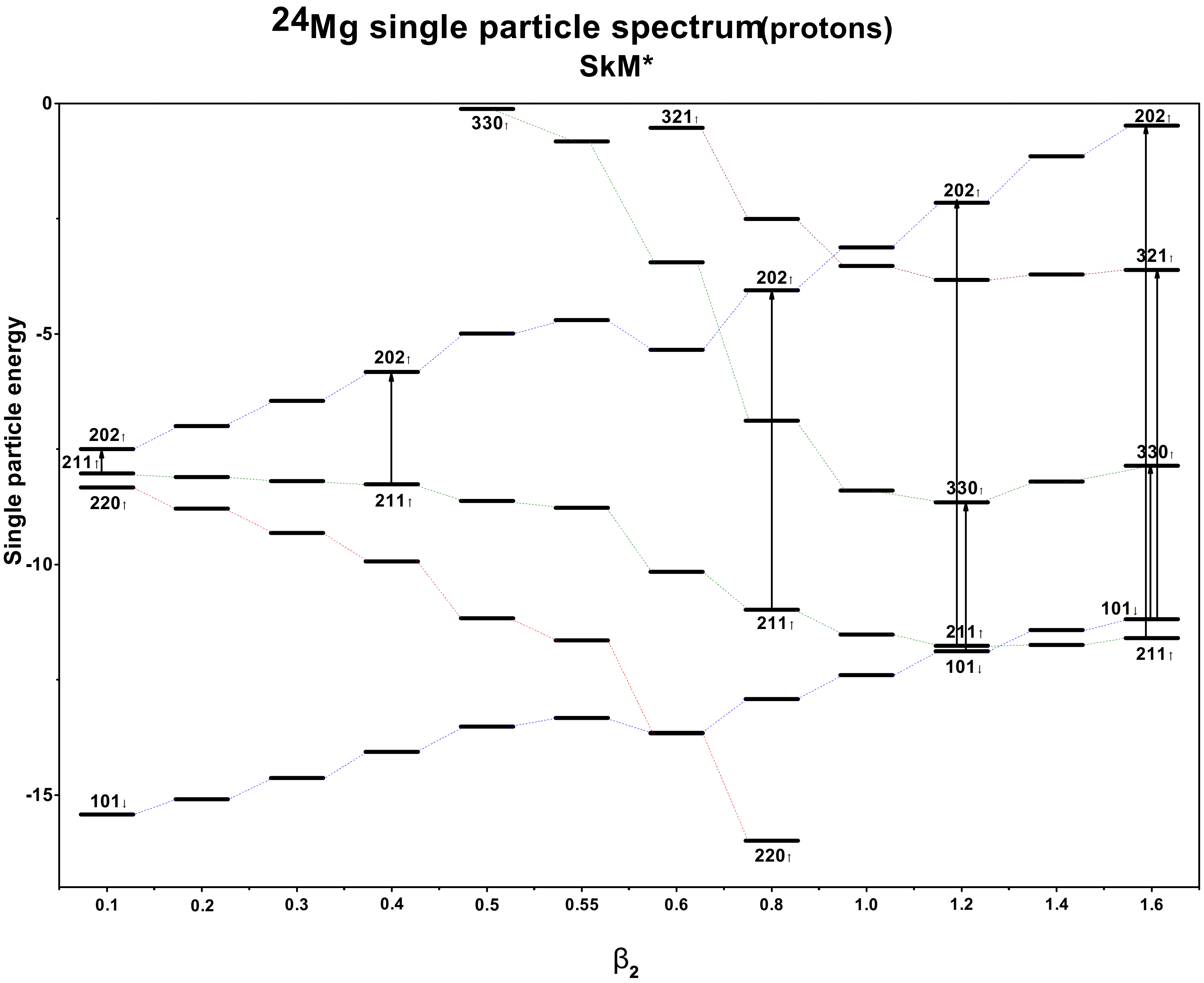


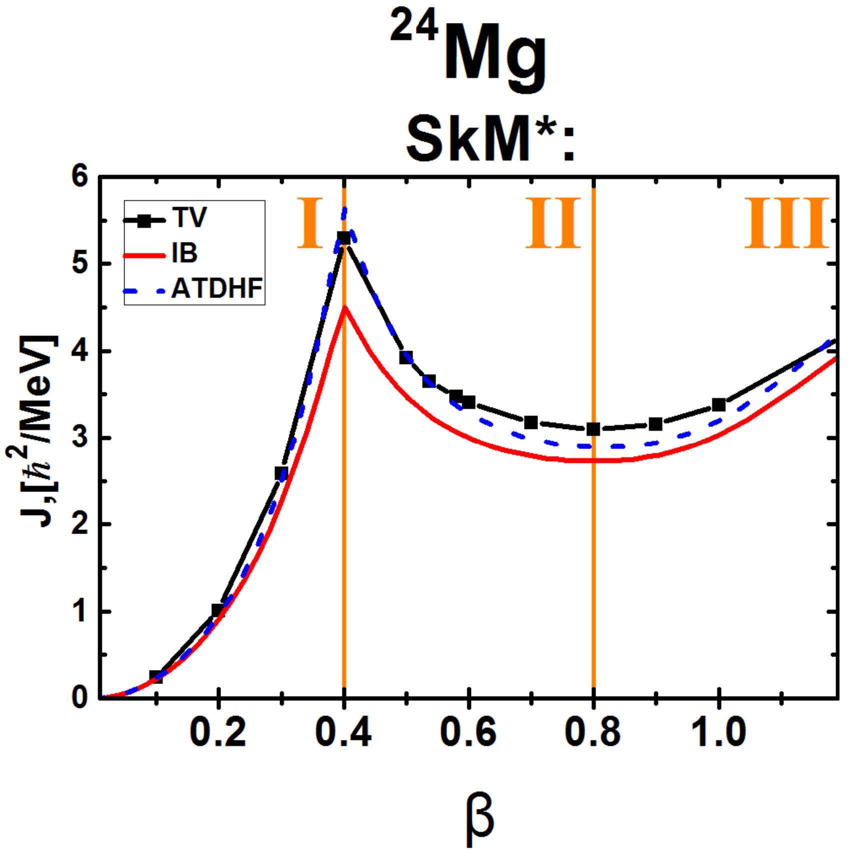
$$J_{IB} = 2 \sum_{k,k'>0} \frac{|<k|J_x|k'>|^2}{\varepsilon_k + \varepsilon_{k'}} (u_k v_{k'} - u_{k'} v_k)^2$$

It turned out that the most optimal for consideration are 8 configurations (4 protons pairs and 4 neutrons pairs). The smallest number of configurations that qualitatively describe the general dynamics of the moment of inertia with increasing deformations - 2 configurations (1 protons pair, 1 neutrons pair).



The bottom panels show the matrix element with pairing - $(fU)_{qq'}^2$ and without pairing - $f_{qq'}^2$;
on average, two quasi-particle energy ($\varepsilon_{qq'}$) and particle-hole energy (E_{ph}); the top panels show the moment of inertia of a two-particle pair.


24Mg single particle spectrum(protons)
SkM*
Single particle energy
0
-5
-10
-15
0.1
0.2
0.3
0.4
0.5
0.55
0.6
0.8
1.0
1.2
1.4
1.6
β2
202↑
211↑
220↑
101↓
330↑
321↑


24Mg
SkM*:
TV
IB
ATDHF
I
II
III
J,[ħ2/MeV]
0
1
2
3
4
5
6
0.2
0.4
0.6
0.8
1.0
β

Conclusion

- The behavior of the moment of inertia near the equilibrium deformation in ^{24}Mg and ^{20}Ne is analyzed

- The behavior of the moment of inertia with deformation in ^{24}Mg and ^{20}Ne can be divided into 3 sectors:
  1) the increase in the moment of inertia due to a decrease in pairing;
  2) anomalous decrease in the moment of inertia due to an increase in the gap between levels with an approximately constant matrix element

     or

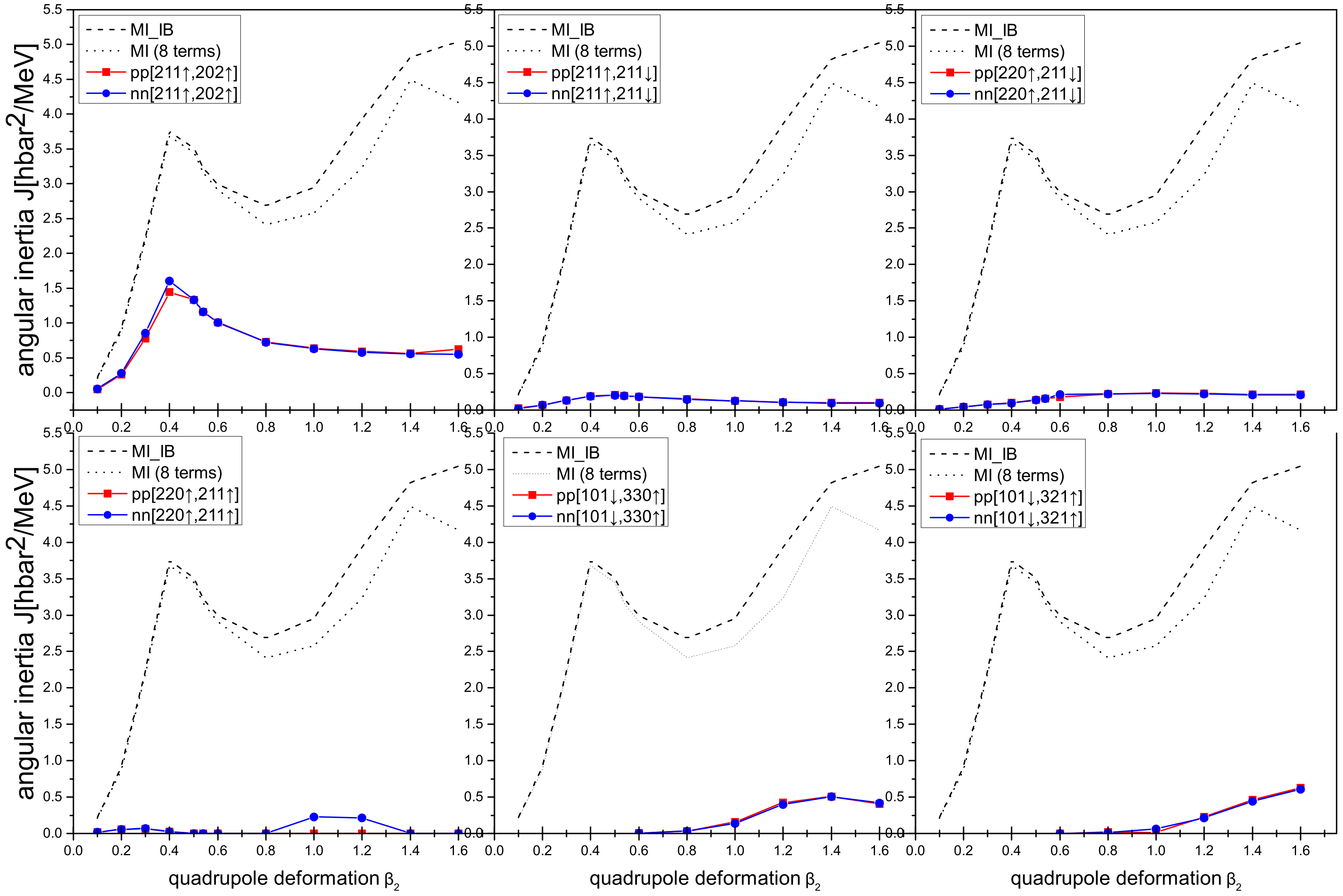
     the decrease in the matrix element with an almost constant energy gap;
  3) growth moment of inertia due to regrouping of levels;

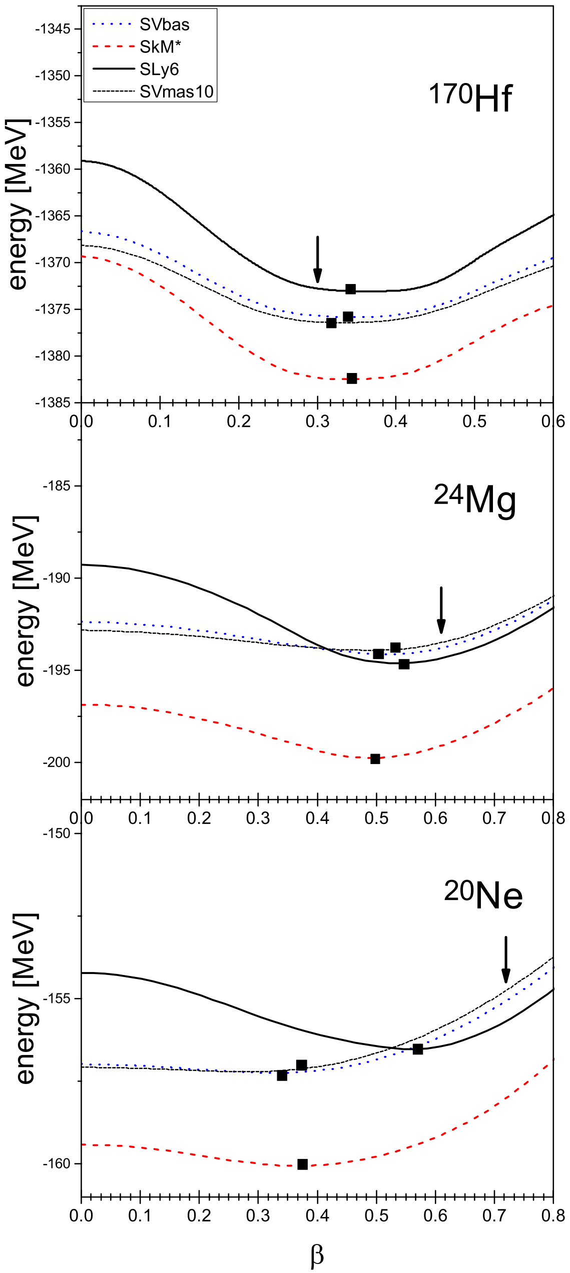
- This behavior is determent by pairing, single-particle level regrouping and strong shell effects

Thank you for your attention!

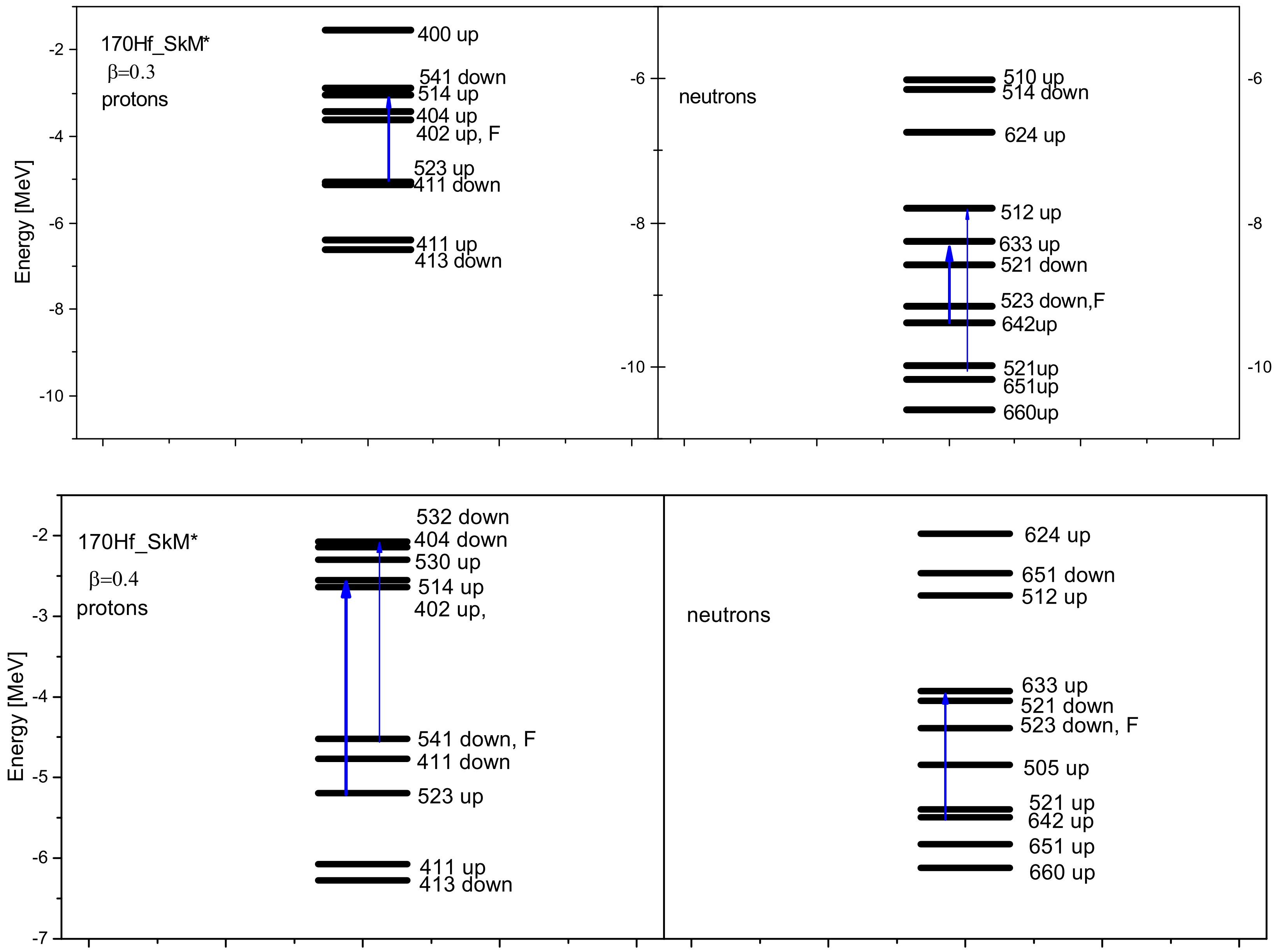
Backup slides

^{24}Mg, SkM*
main contribute





SVbas
SkM*
SLy6
SVmas10
170Hf
24Mg
20Ne
energy [MeV]
β



170Hf_SkM*
β=0.3
protons
400 up
541 down
514 up
404 up
402 up, F
523 up
411 down
411 up
413 down
Energy [MeV]
neutrons
510 up
514 down
624 up
512 up
633 up
521 down
523 down,F
642up
521up
651up
660up
170Hf_SkM*
β=0.4
protons
532 down
404 down
530 up
514 up
402 up,
541 down, F
411 down
523 up
411 up
413 down
neutrons
624 up
651 down
512 up
633 up
521 down
523 down, F
505 up
521 up
642 up
651 up
660 up