Scientific issues for ADAS

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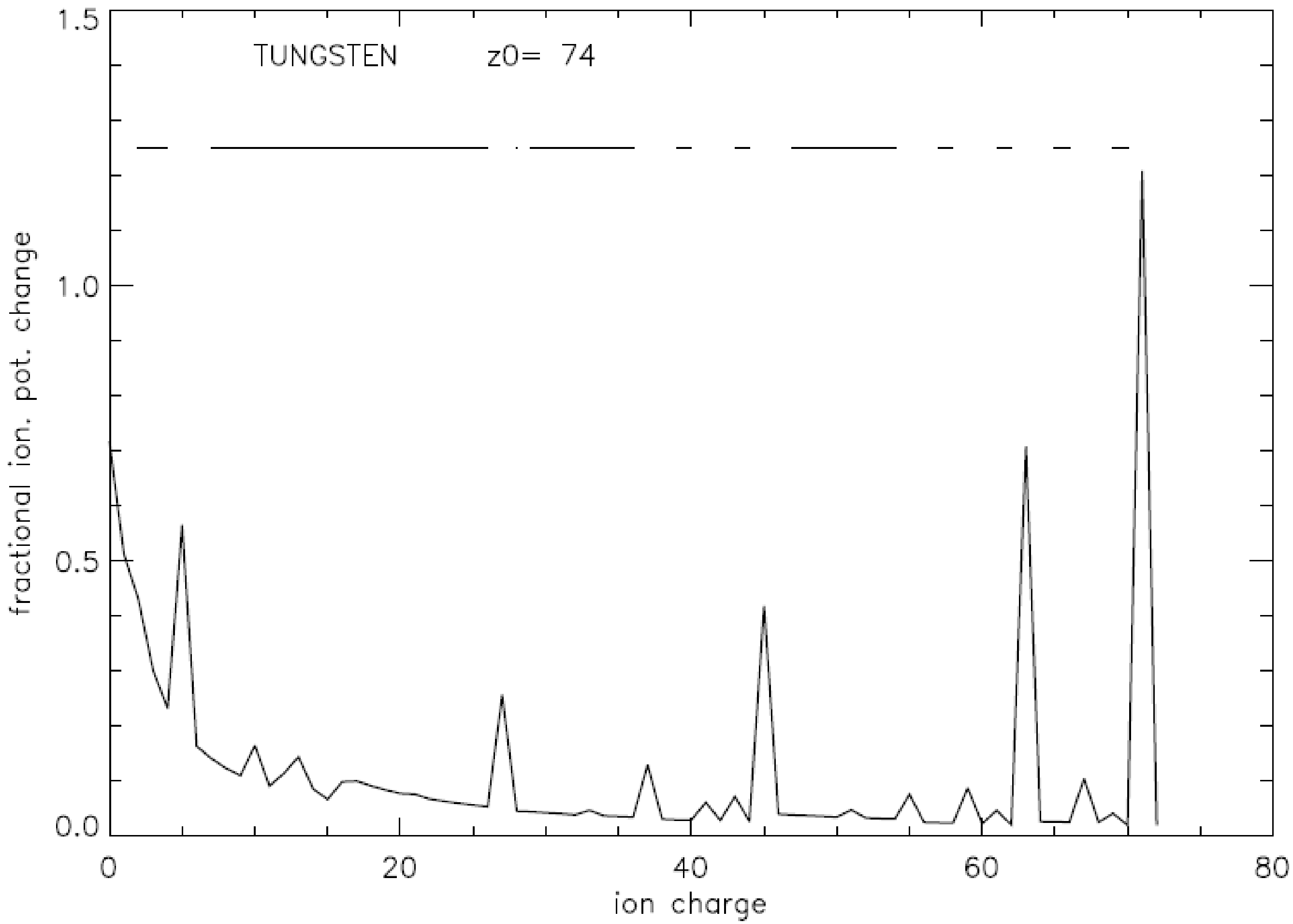
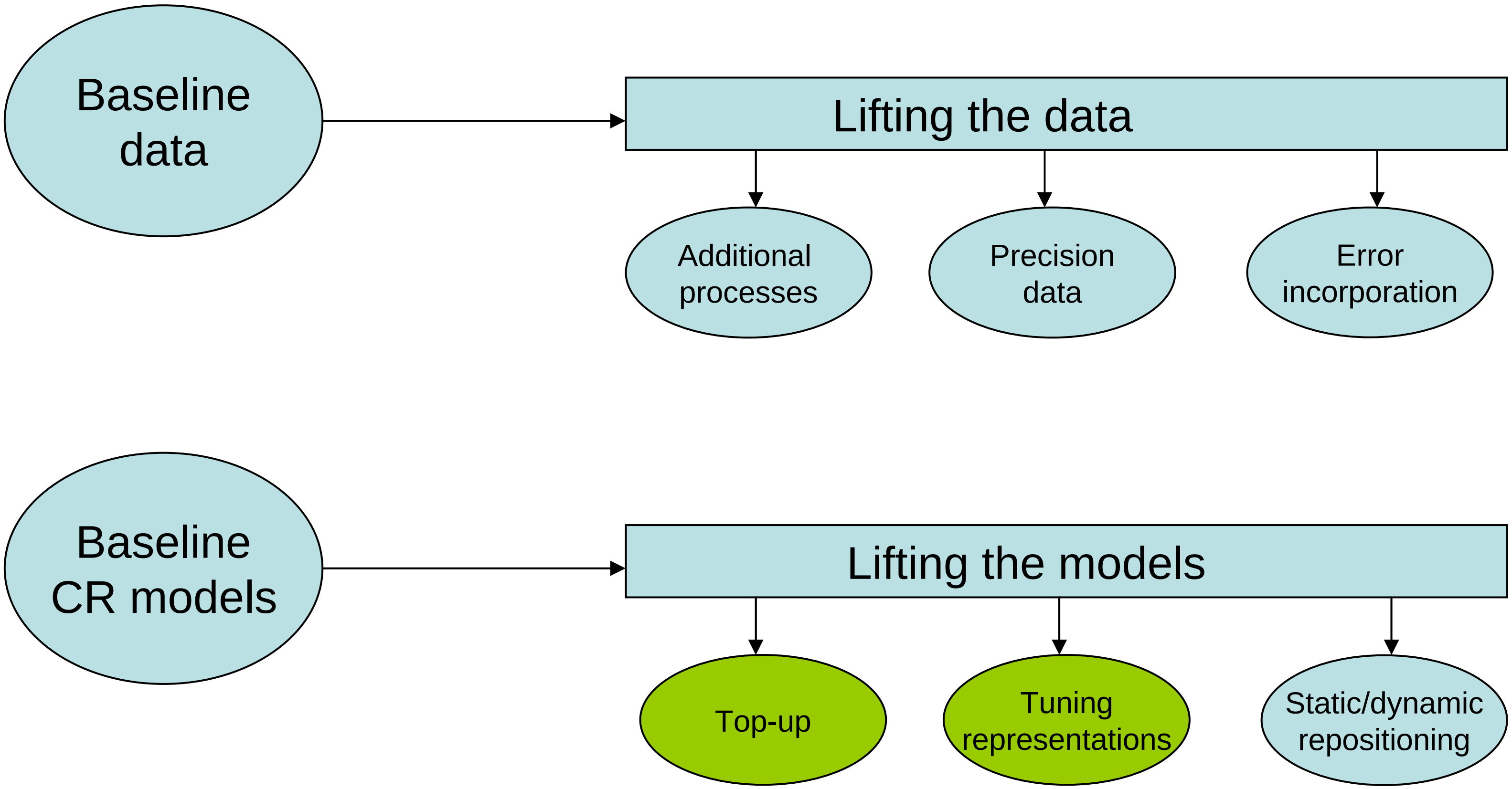
Ringberg

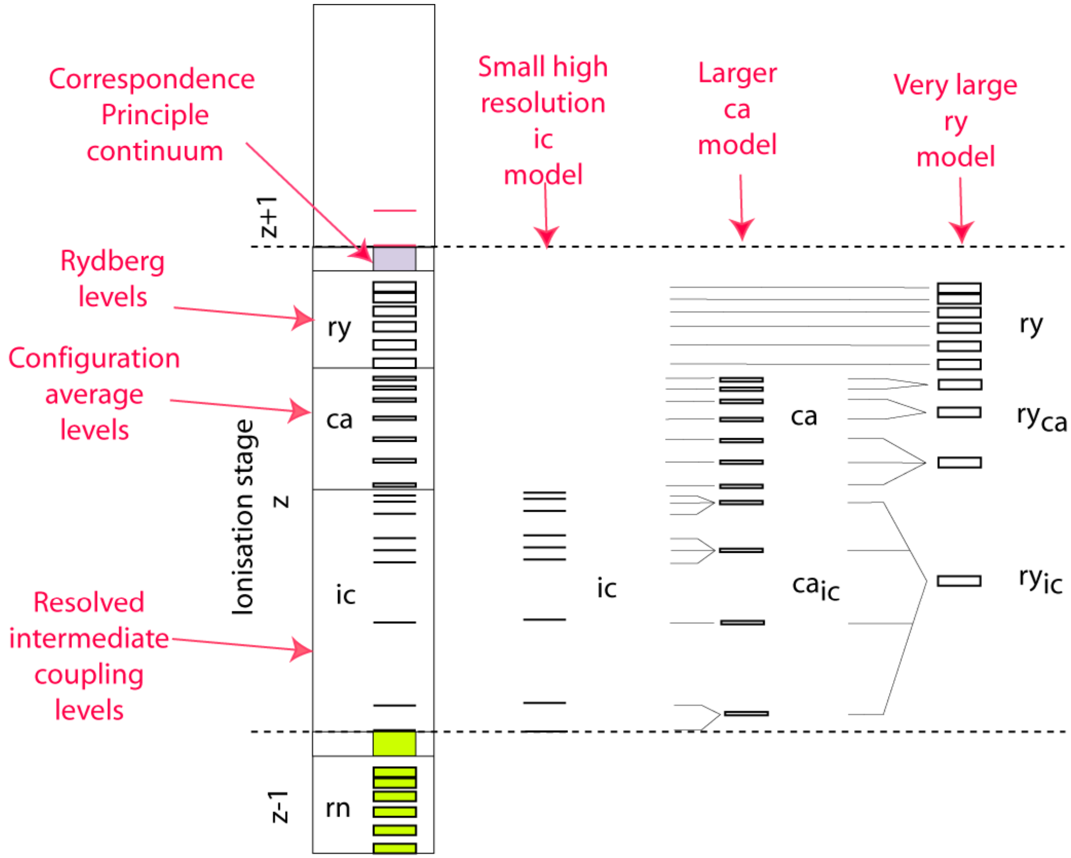
The natural partition



Paths to ADAS improvement



Lifting CR models: simple top-up



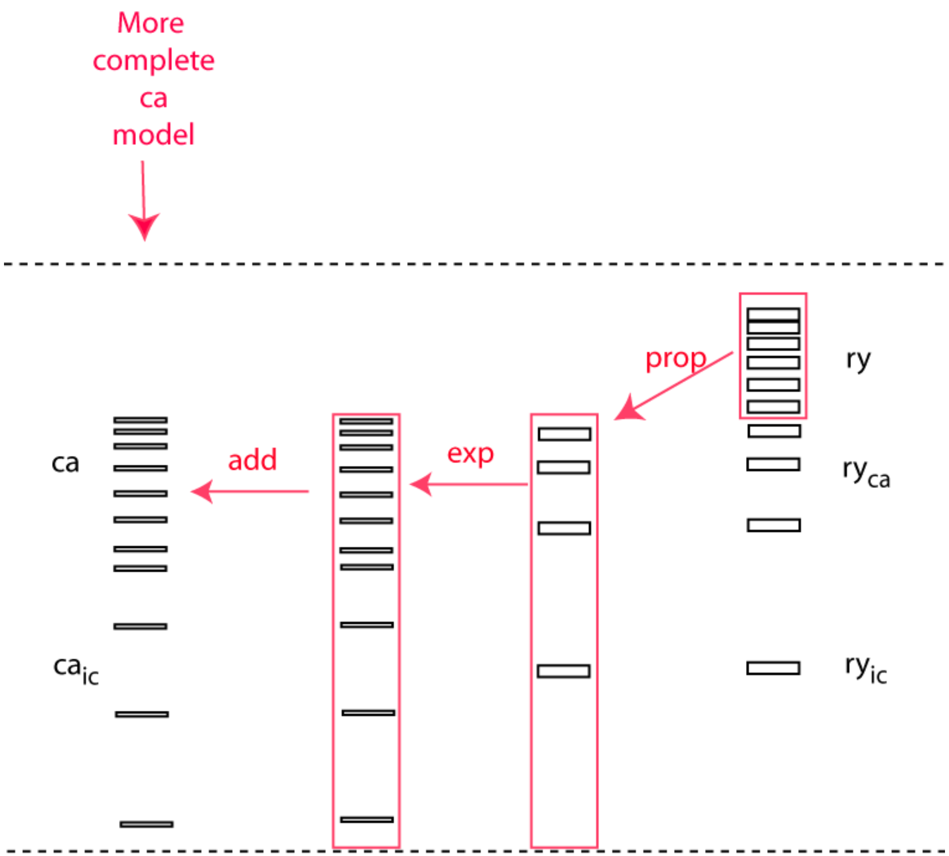
Yields a series of population calculations of varying resolution and span

Hence   Power $P = P_{ic} + (P_{ca+ca_{ic}} - P_{ca_{ic}}) + (P_{ry+ry_{ca}+ry_{ic}} - P_{ry_{ca}+ry_{ic}})$

ca top-up   ry top-up

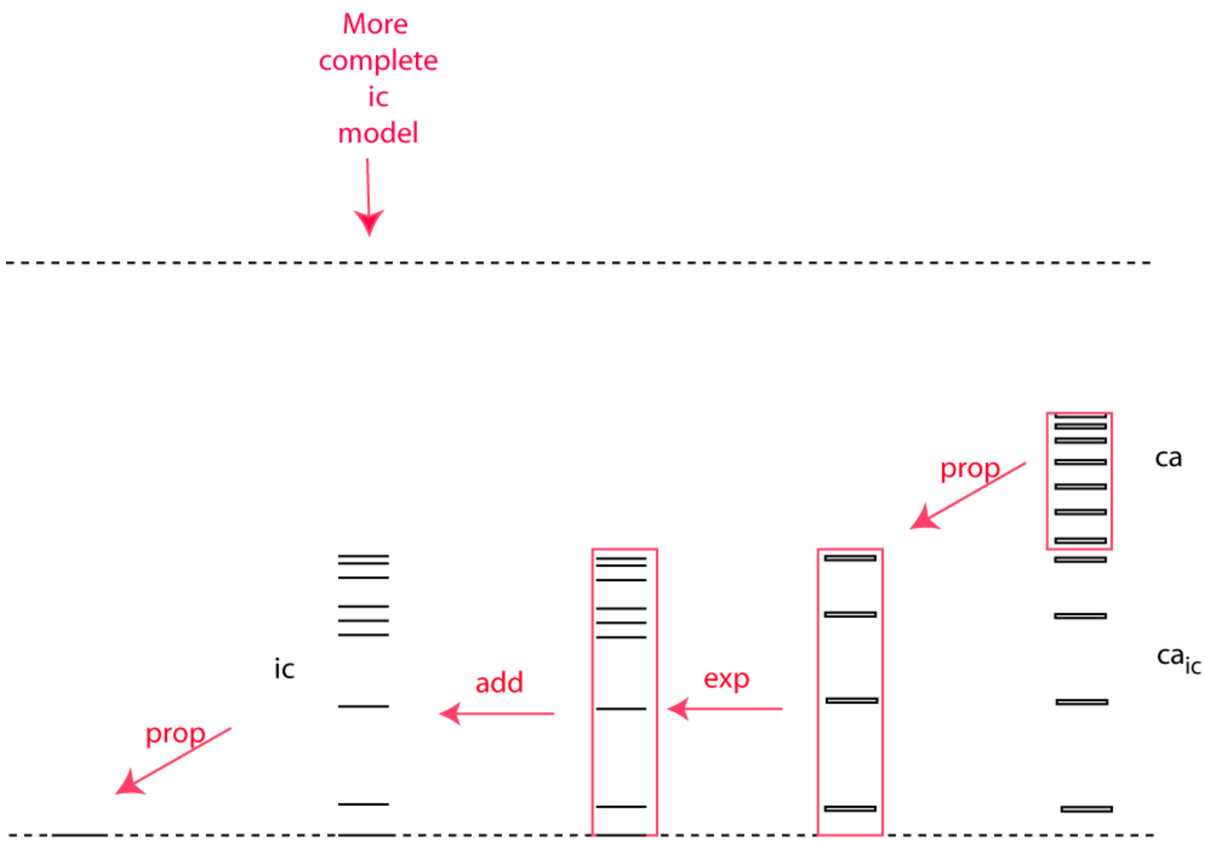
A modest elaboration is suitable for handling of the dielectronic parent system

Lifting CR models: propagated top-up



ry collisional-radiative matrix propagated onto the $ry_{ca} + ry_{ic}$ manifold, expanded over the higher resolution $ca + ca_{ic}$ manifold and added to the direct $ca + ca_{ic}$ collisional-radiative matrix.

Lifting CR models: propagated top-up



ca collisional-radiative matrix propagated onto the ca_{ic} manifold, expanded over the higher resolution *ic* manifold and added to the direct *ic* collisional-radiative matrix.

Repeat similar process to obtain α_{cd} and S_{cd} coefficients

Suitable approach for higher precision spectrsocopy and GCR modelling

Lifting CR models: top-up comments

- Never at a complete loss for any system
- Adjust zones to available computer resources
- Completeness – traded against precision
- Resolution zones appear naturally from the collisionality
- Connection to flexible partitioning

Rydberg level population models

	n-bundled		nl-bundled single system	nlj-bundled single system	nkm (extended)
	single ystem	spin system separated			
ADAS use	heavy element α_{cd} , S_{cd}				
		light element prop. for full ls-resol. GCR		heavy element prop. for full ic-resol. GCR	
	heavy element H-like ion CXS q_{eff}		heavy element H-like ion prop. for CXS q_{eff}		
	hydrogen beams stopping	helium beams stopping			hydrogen beams stopping
	hydrogen beams prop. beam emission	helium beams prop. beam emission			hydrogen beams prop. beam emission
	thermal hydrogen emission	thermal helium emission	thermal H very low temperature emission		

Operational | Final development/test | Development | Rework

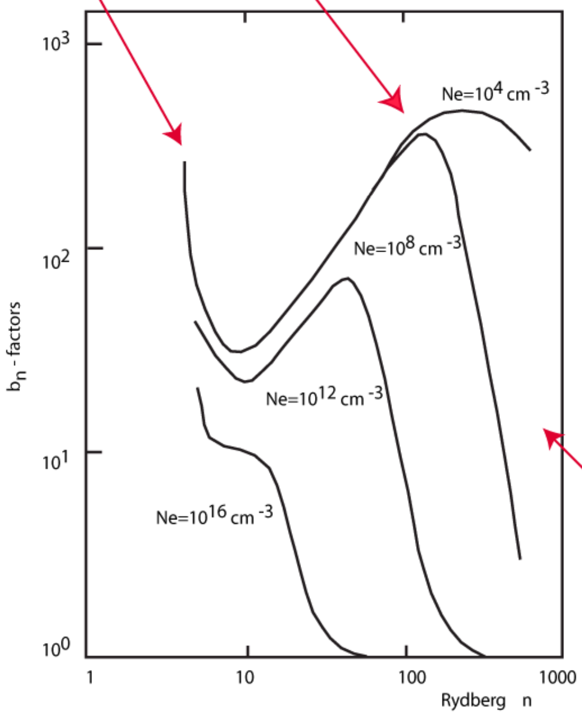
Lifting CR models: representations

b_i - factor defined in term of population $N_i = N_i^{(Saha)} b_i = 8 (\pi a_0{}^2 I_H/kT_e)^{3/2} (\omega_\iota/2\omega_+) \exp(I_i/kT_e)\, b_i$

$c_i = b_i - 1$, $\mathrm{expb}_i = \exp(I_i/kT_e)\, b_i$ $\longrightarrow$ b_i , c_i , expb_i representations

expb_i representation required for very low Te

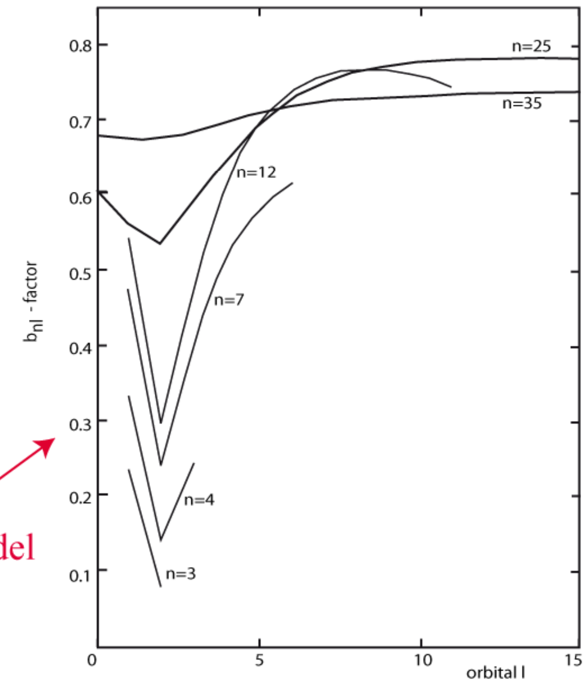
c_i representation required



iron population structure Fe^{+14}

b_n model

b_{nl} model



Hydrogen population structure. Case B depopulated, $Ne=10^4\ cm^{-3}$ Te= 1eV

Lifting CR models: top-up comments

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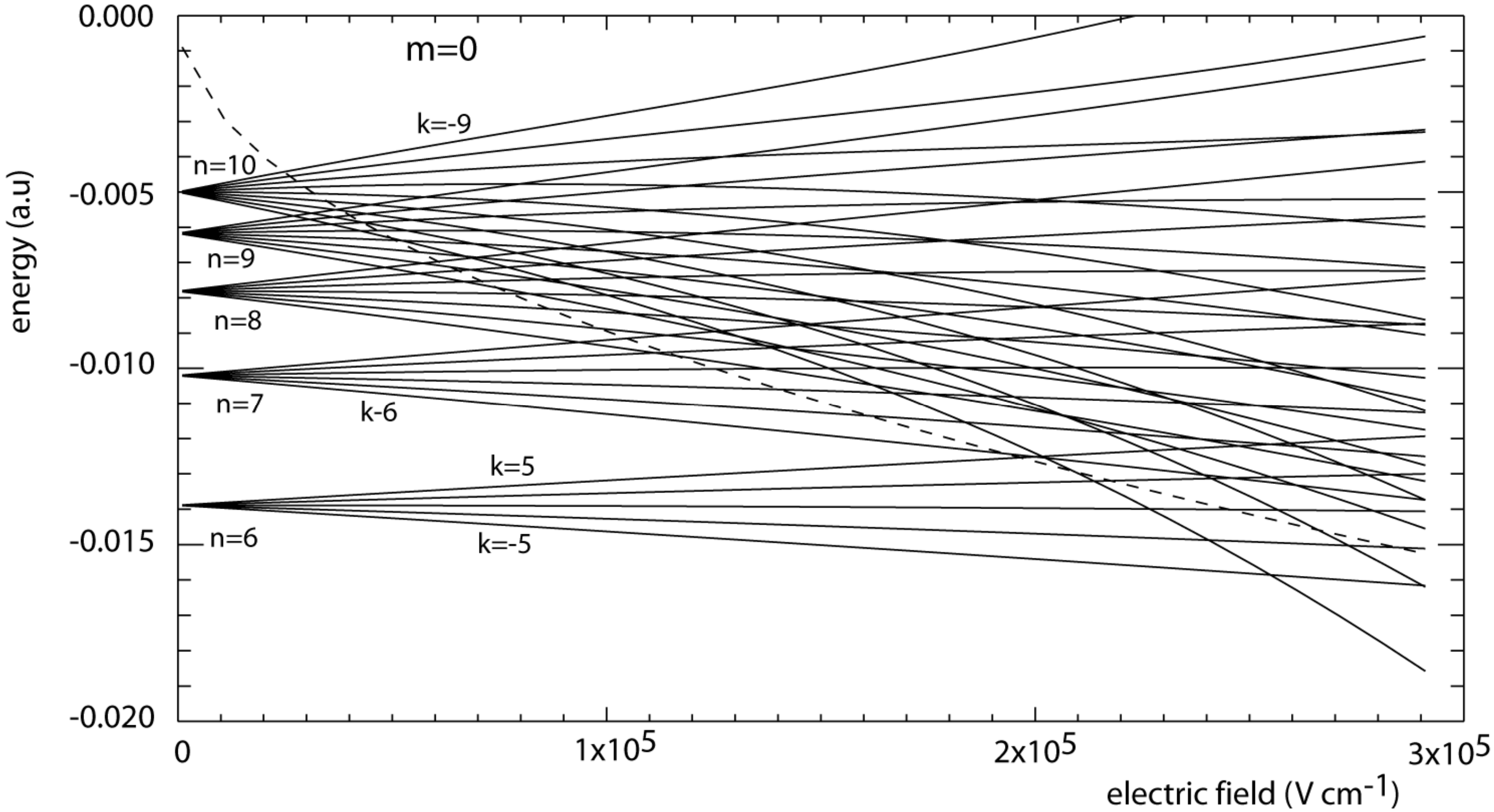
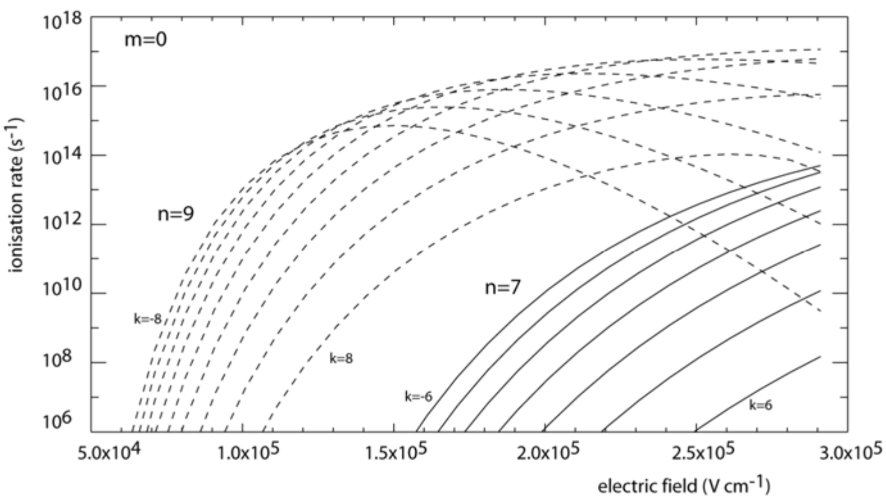
nkm (extended) : hydrogen beam emission

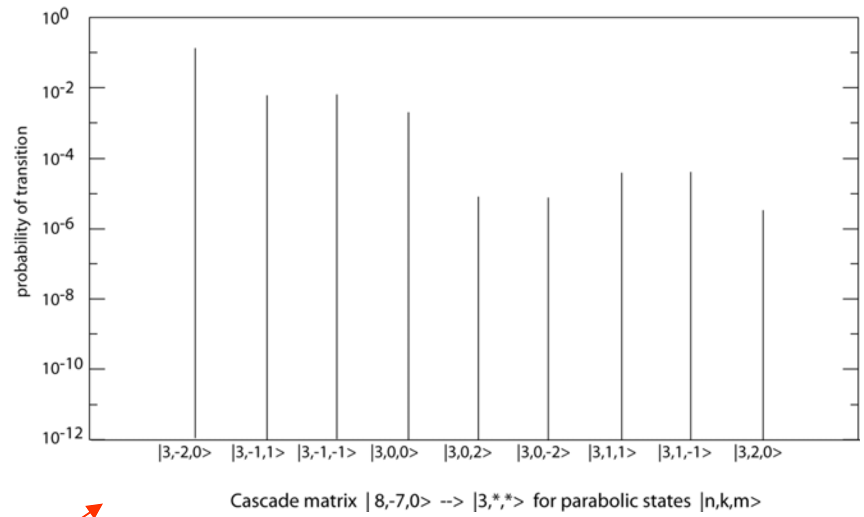
- Basic ADAS hydrogen isotope beam stopping/emission model is bundle-n
- ADAS has a fully resolved model up to the collision-limit (~ n=4)
  - diagonalises e**r.vxB**, **μ.B** and e**r.E** perturbations explicitly for n=1-4 to evaluate atomic properties
  - bundle-n above
- With the fresh interest in full-feature beam emission spectroscopy prompts us to look further into model improvements
  - investigate small corrections/omissions above the collision limit
  - more accurate collision-cros-sections
  - revisit bundling and more accurate propagation onto the spectroscopic shells

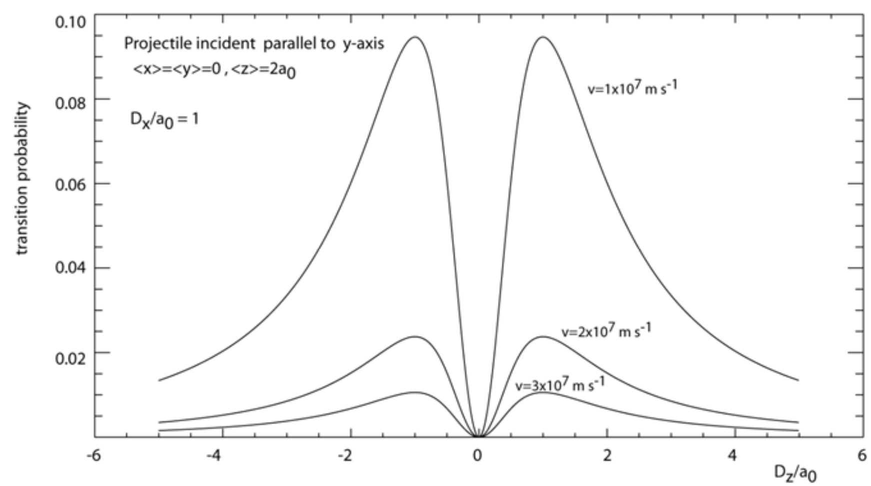
Stark energy levels



Some issues







1. Field ionisation
2. k-cascade
3. Directional, angular differential cross-sections

Conclusions

- Detailed plans for continued lifting the ADAS database.
- To be achieved by:
  - targetted high precision atomic calculations and measurements
  - By introduction of more sophisticated collisional-radiative variants to complement the fundamental data precision
- Expect to have the model developments described here in place in the next two years and report on them at the next workshops
  - Beam emission development in 2010
  - Low temperature strengthening 2010
  - Rydberg nlj projection 2011