AGN : five problems

- ionisation budget
- wind momentum
- BBB temperature
- variability timescale
- variability co-ordination

Ionisation problem : v1

- Ly α / Total requires $\alpha_{FUV} \sim 0$
  - Netzer 1985, Collin-Souffrin 1986, Dumont et al 1998
- but observed $\alpha_{FUV} \sim 1.8$
  - Zheng et al 1997
- recent FUSE obsns find range of slopes
  - Scott et al 2004
  - some do have $\alpha_{FUV} \sim 0$?

Ionisation problem : v2

- $EW_{H\beta} \sim 100$ A on average
- requires $\alpha \sim 0$ from opt to UV
- but mean $\alpha_{opt} = 0.5/1.4$ (quasars/Sy)
- deficit of ionising photons by factor 5-50
  - Binette, Fosbury and Parker 1993.

Ionisation solutions ?

- anisotropy ?
- reddening ?
- BB isn't the primary radiation ?
  - mechanical heating : the French solution

momentum problem

- increasing evidence for winds in AGN
- new results : high vel. high ionisation flows
  - PG 1211+143 : Pounds et al 2003 v =0.1c
- massive flow : $\dot{m}_{out} \approx \dot{m}_{accn}$
- $\dot{m}v = L/c$ ==> radiation driven wind
- at radius 100R_S where $v_{esc}=v_{obs}$
- outward $\tau=1$: modified BBB ?

momentum excess

- more outflows in N4051, N5548, N3783
- krongold, netzer, pounds et al et al et al
- define $\eta = \dot{m}v / L/c$

	vel	L_{BB}/L_{Edd}	η	Mo/yr
PG1211	30000 km/s	0.15	1.0	0.5
N4051	6500 km/s	0.02	8.1	0.03
N5548	3000 km/s	0.02	0.4	0.1
N3783	750 km/s	0.02	117	75

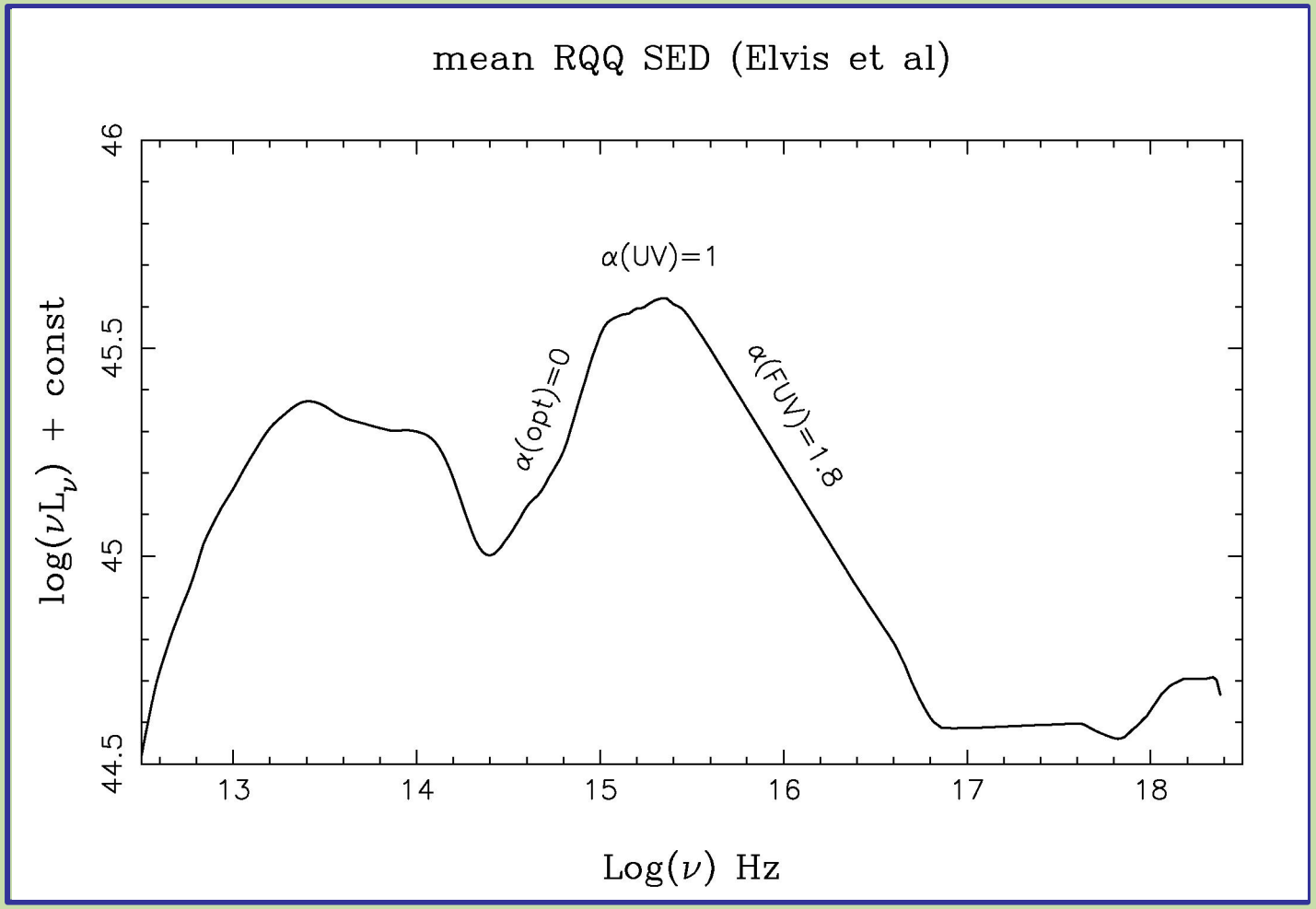
- Lawrence, King and Elvis in prepn.

issues

- strongly suggests hidden radiation source
  - N4051 and N3783 both have $\alpha \sim 1.5$: reddening ?
- not radiation driven after all ?
- where does the energy go ?
  - IR ?
  - KE of wind ?
- wind photospheres may be common

BBB temperature problem

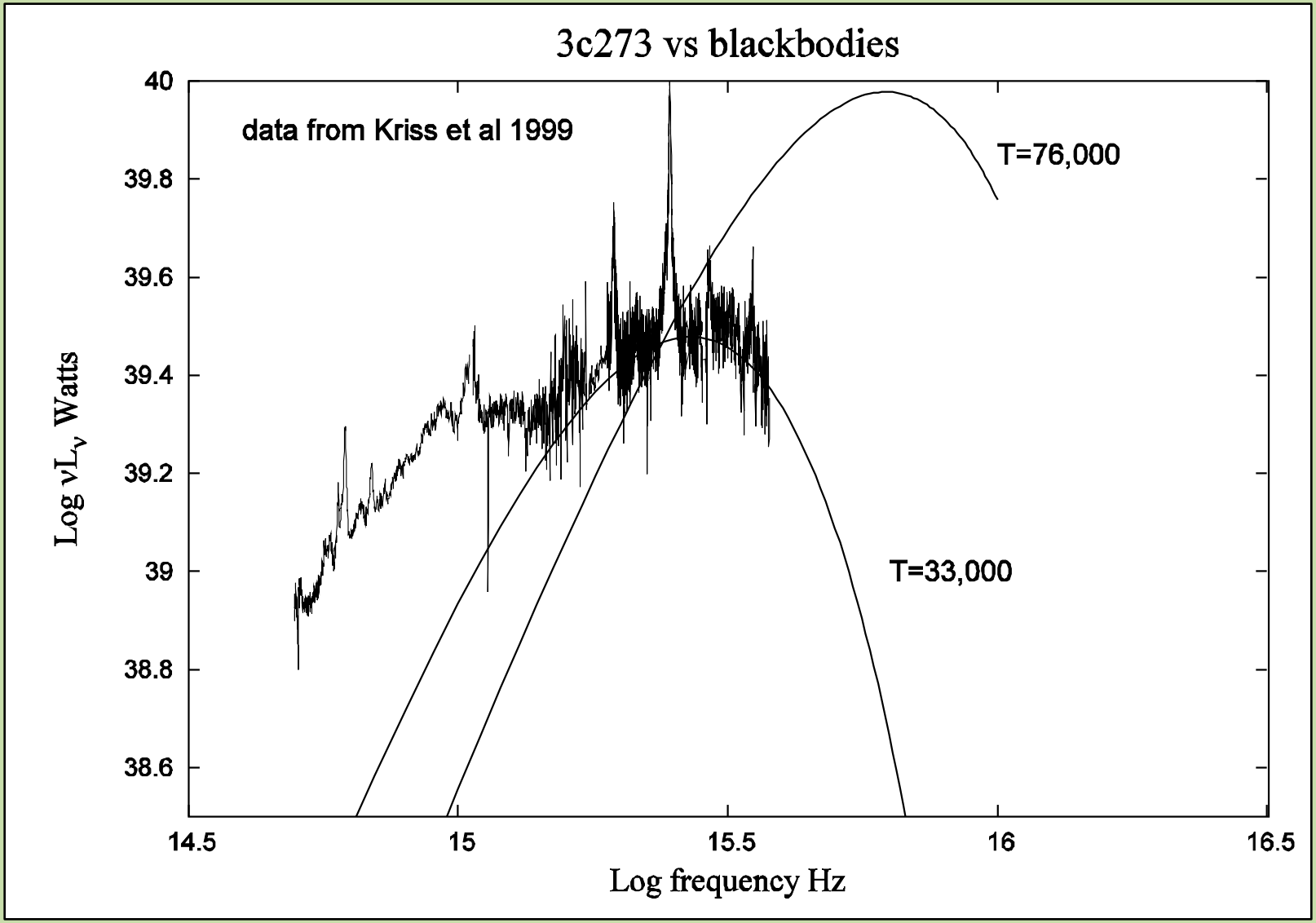
T_{obs}~40,000



$$T_{ch} = 95{,}00\left(\frac{L}{L_{Edd}}\right)^{1/4}\left(\frac{M}{10^9 M_{sun}}\right)^{-1/4}\left(\frac{R}{5R_{Sch}}\right)^{-1/2}$$

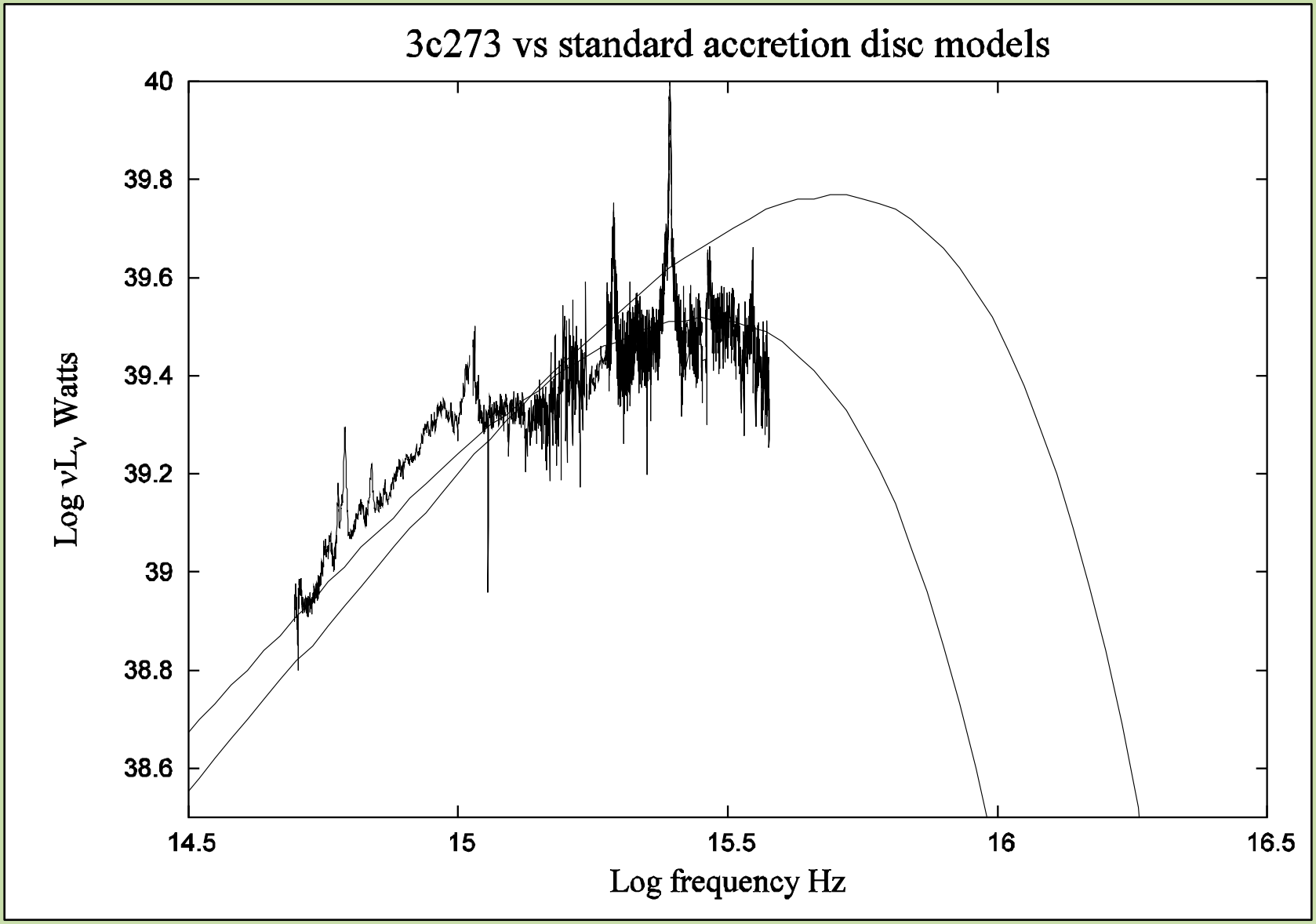
3C273

M=1e9 L/LE=.4
==> T=76000



3C273

M=1e9 L/LE=.4



3C273

Kriss et al 99 model

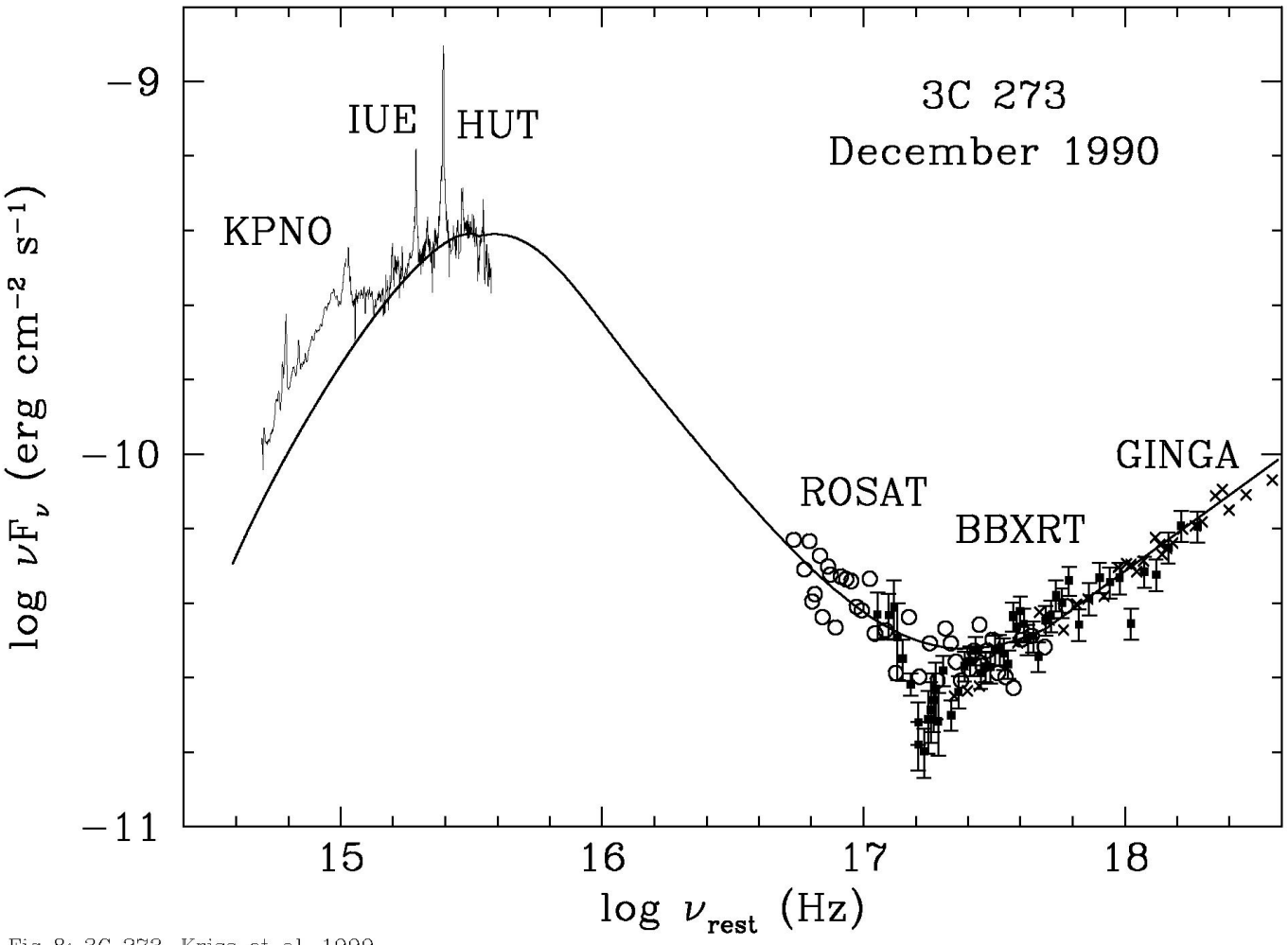


Fig 8: 3C 273, Kriss et al. 1999

Temperature problem

- Quasar SEDs too cool
- T~30,000 vs 100,000
- solutions ....
  - reddening ?
  - Ly absorption
  - emerges at 30 Rs photosphere ?

timescale problem

- N5548 varies on timescale ~20 days
- M and L/L_{Edd} known
- optical should come from R=52Rs
- sound crossing time 28 years
- light crossing time 10 hours

- dynamical time R/v_{circ} = 6 days ...
  ===> must be a global system effect

co-ordination problem

- optical and UV from very different radii
- but vary simultaneously
- get bluer when brighter
- disc heated by X-rays not by local gravity ?
  - Krolik 1991 and others
- confirmed by 0.5 day delays in N7469 ?

problems with heated disc model

- $L_{BBB} > L_X$
- X-ray variations do not lead UV
- doesn't follow expected BB-track

  could be EUV heating rest of disc but

- outer disc can't see enough of inner disc
- still expect BB-track

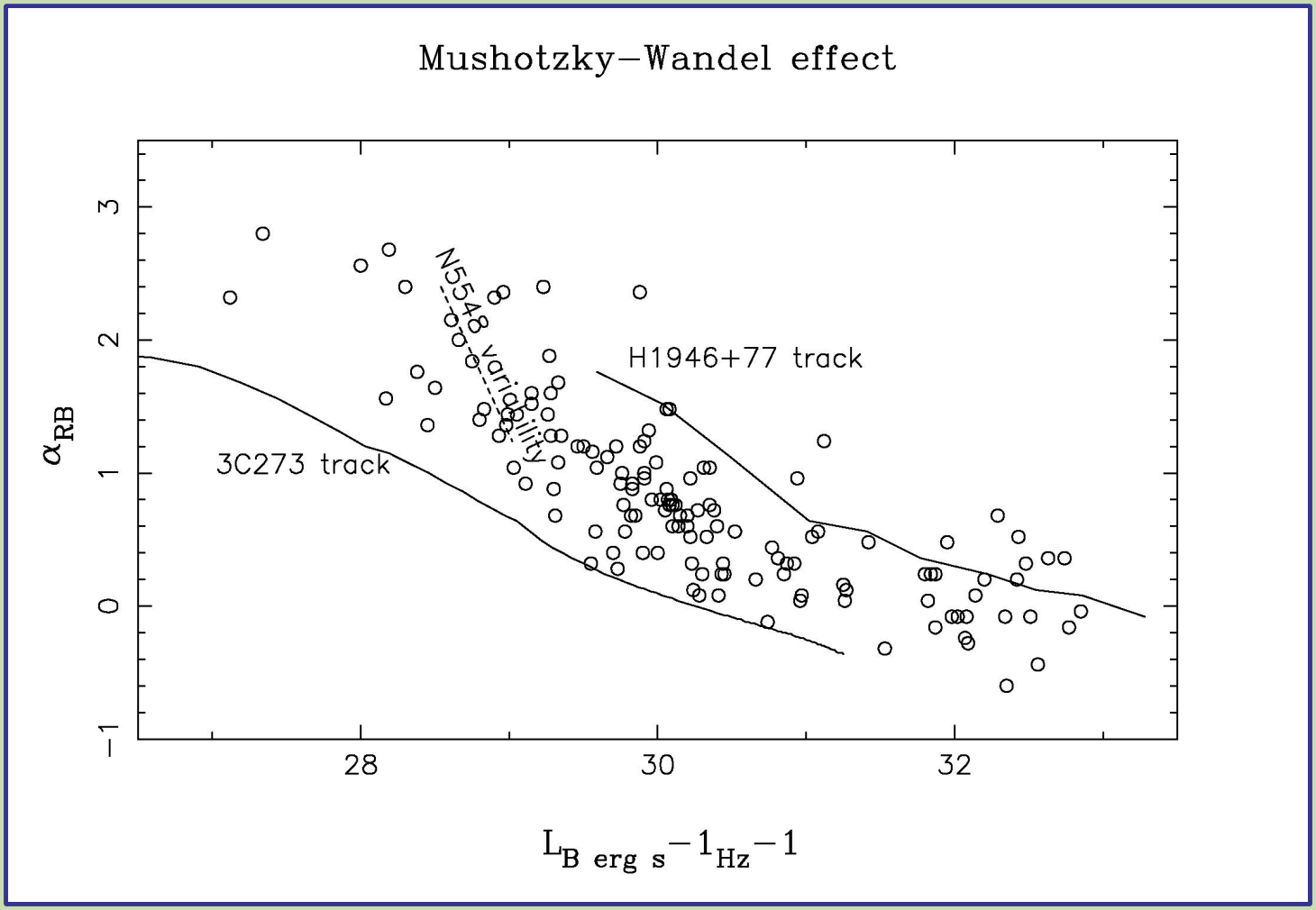
predicted L-α track

tracks varying heating rate at fixed MH (Lawrence 2004)

heating of whole disc should produce characteristic BB track

not seen

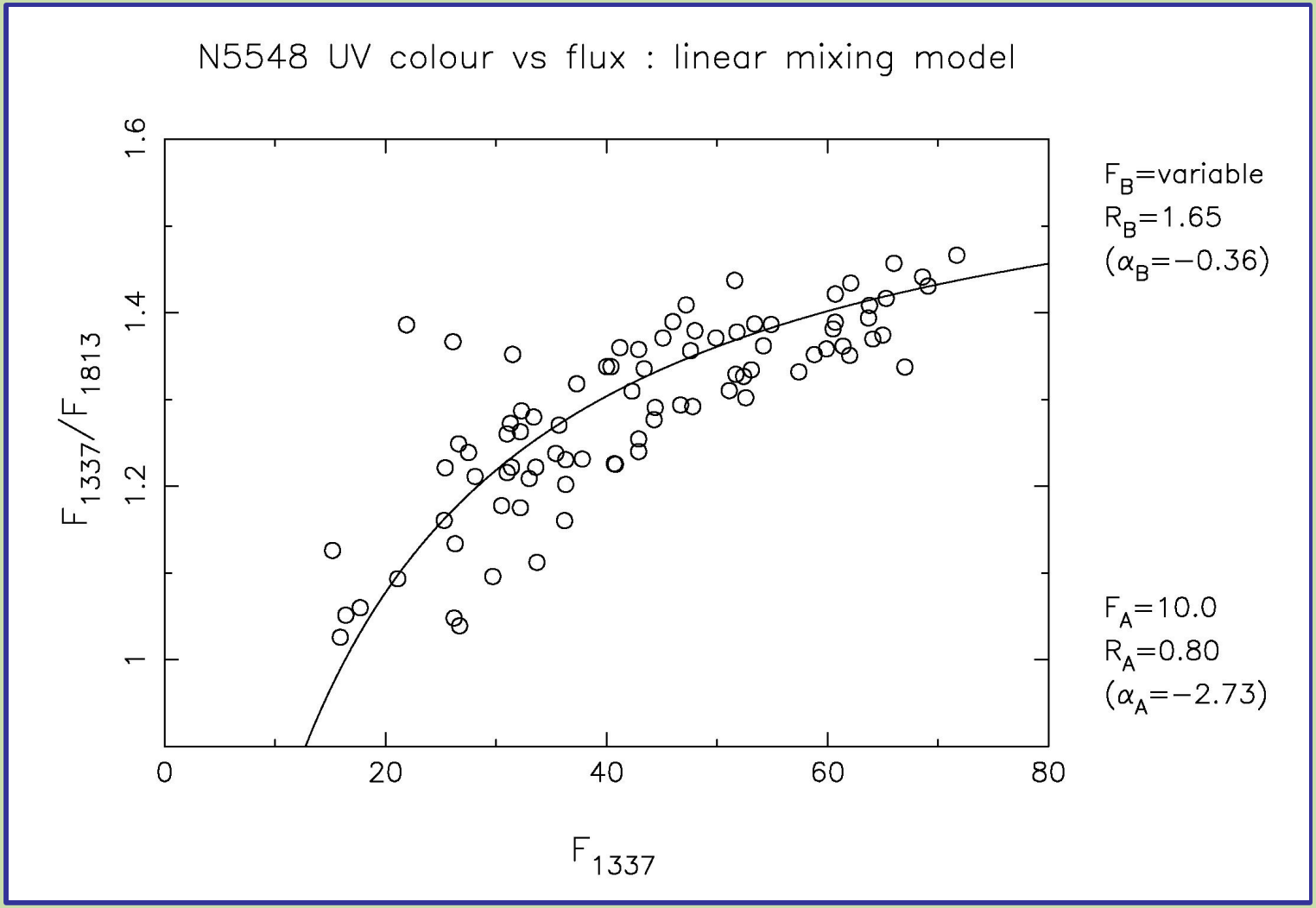
colour change much steeper



separate variable component ?

- colour changes well fitted by mixing model
- expected delays would be those of variable component not whole disk
- but still doesn't explain timescale problem

simple mixing



optically thick central region

- explain vblty/temp probs together ?
- outer disc steady / inner disc hidden
- photosphere at R/Rs ~30ish
- inner luminosity reprocessed to T~35000
- unstable at transition
  timescale = dynamical at transition
  delay = light travel in hidden inner region

SED models : disc + photosphere

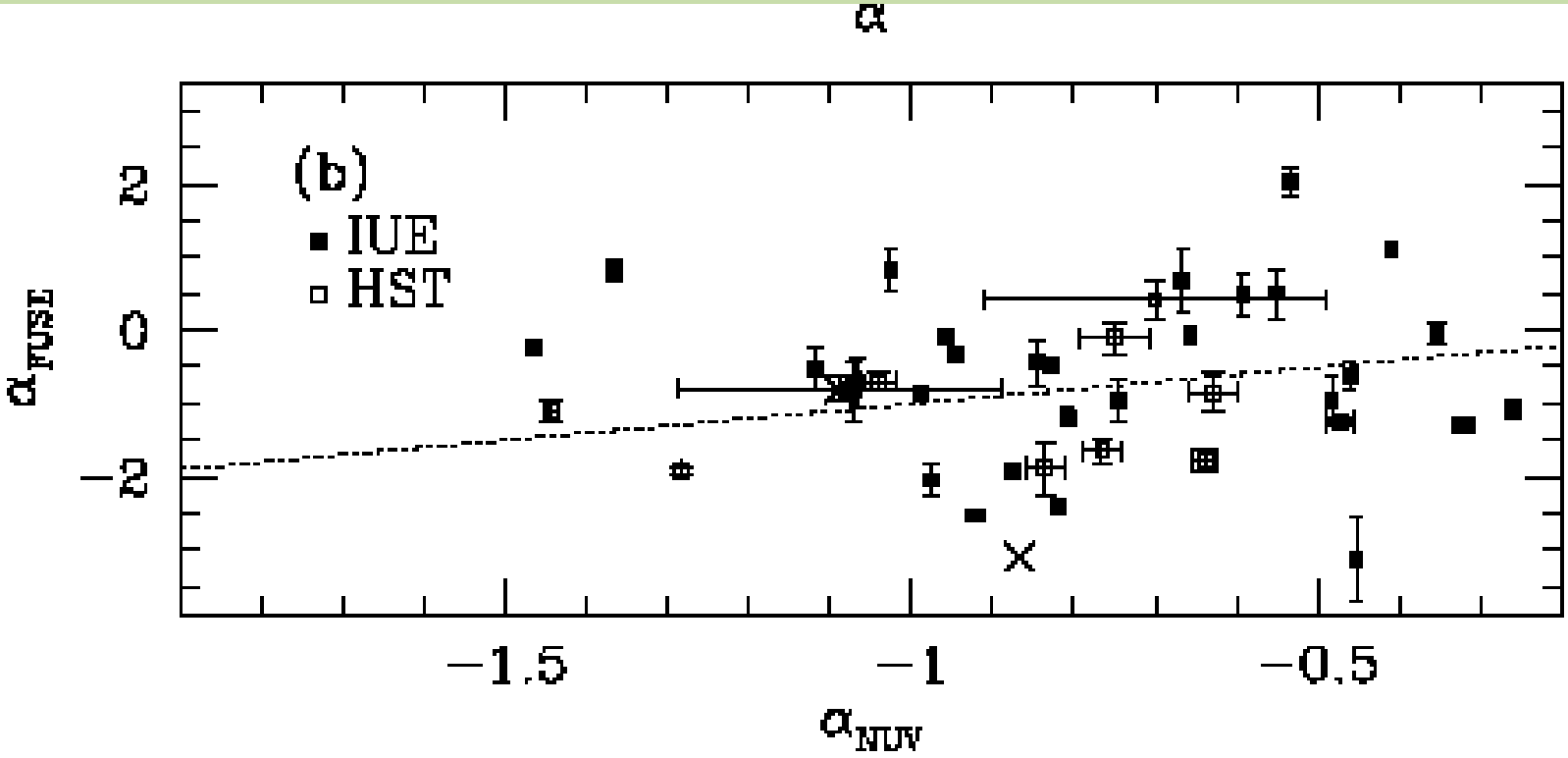
- still working on this ..

relationship to AGN winds

- out~in occurs quite naturally
- observed winds assumed launched at 100Rs
- but what if outflow all the way from centre ?
- if $v = v_{esc}$ all the way and $\dot{m} =$ const get total optical depth $\tau_{es} = 5.8\,(\dot{m}/\dot{m}_E)$
- gives photosphere at $R/R_S = 101.5\,(\dot{m}/\dot{m}_E)^2$

issues

- can explain co-ordination and temp problems
- but momentum and ionisn probs require hidden EUV to escape
- X-vblty and Fe-K line imply *can* see central regions ?
- partial covering may be a solution - clumpy cloud system ?
- FUSE data implies some EUV upturns ?


α
(b)
IUE
HST
2
0
−2
−1.5
−1
−0.5
α_{EUV}
α_{NUV}

FIN