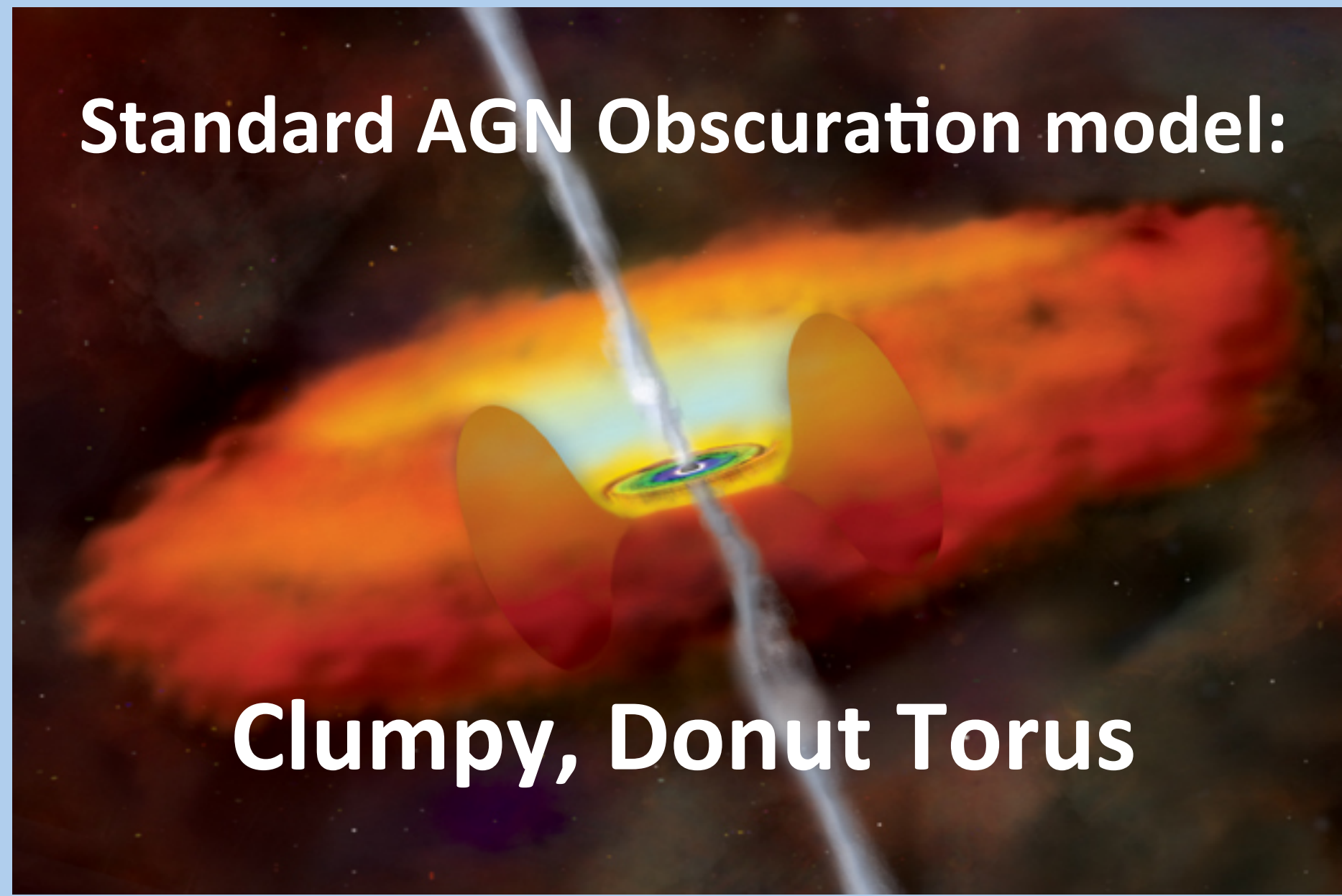


## THE TORUS PROBLEM:

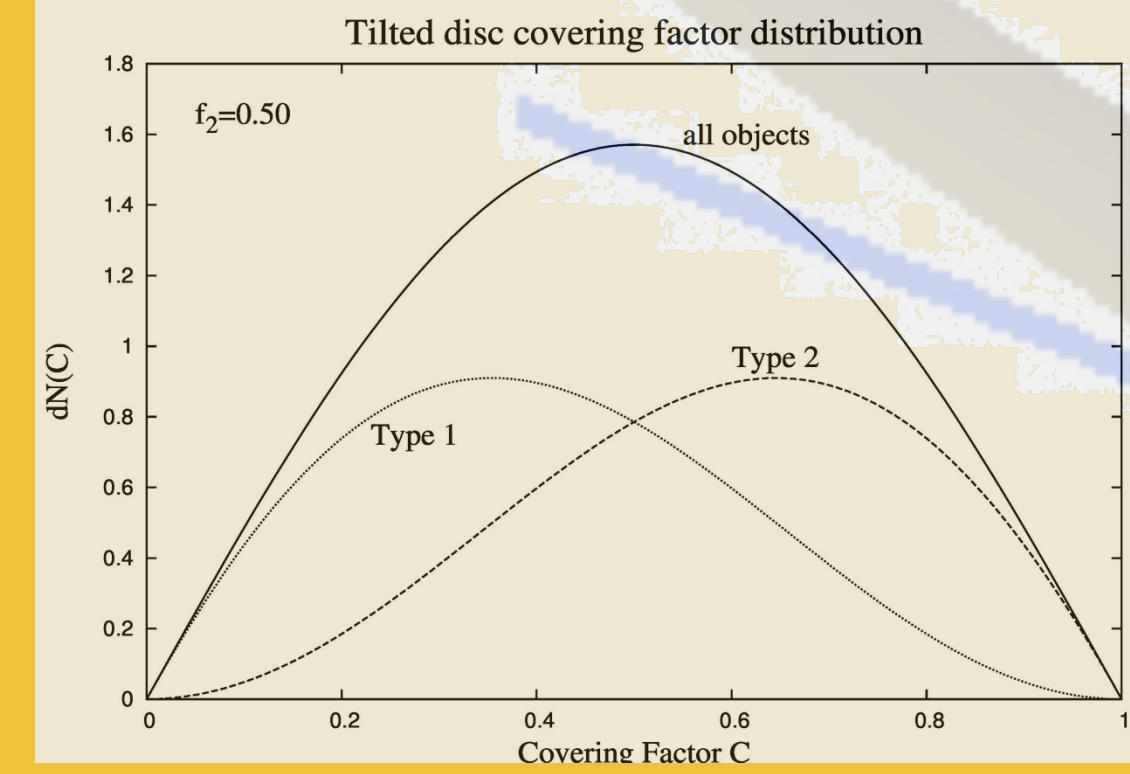
- The cold, large scale height, "donut" torus of standard AGN Unification Schemes –
- is theoretically implausible (even if clumpy)
  - Hinders feedback



## Is the answer a *TILTED TORUS*?

Lawrence & Elvis 2010

- Large covering factor from thin disk
- Arises naturally from isotropic black hole feeding scenarios (Volonteri et al. 2007)
- Predicts type 1 & type 2 covering factor distributions

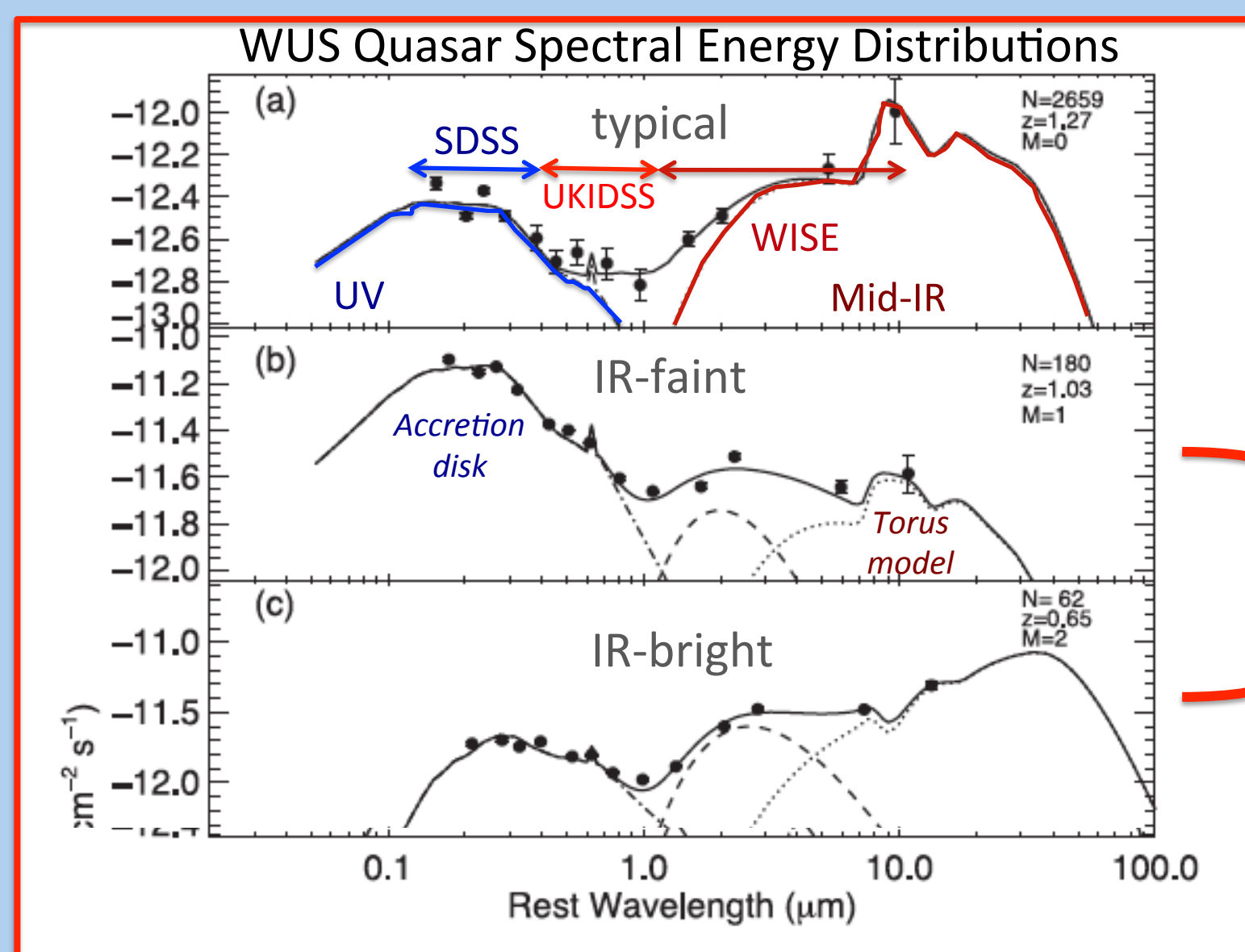


Torus tests with  
WISE  
& SDSS, UKIDSS/2MASS  
*Tilted Torus works for Type 1 AGN*  
Unclear for Type 2 AGN

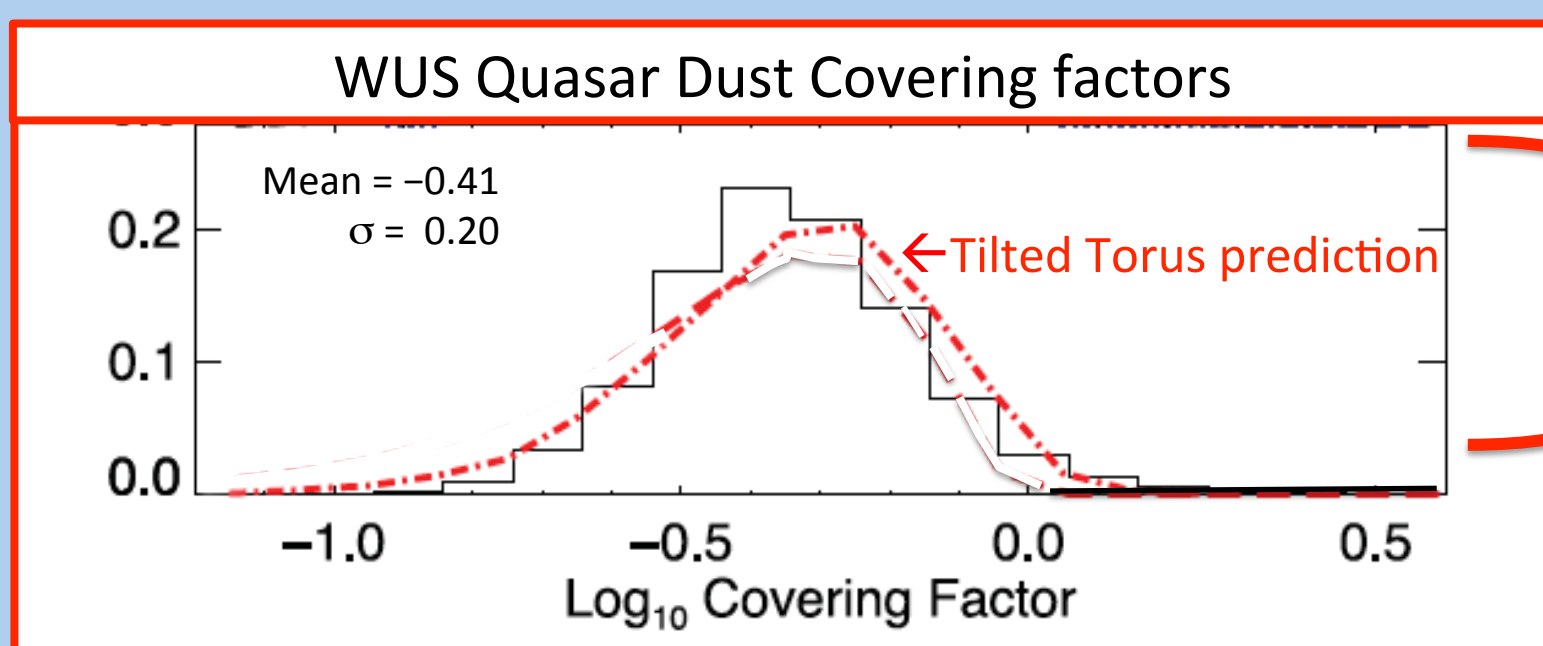
## Test Torus covering factor in Type 1 AGN

Roseboom et al. 2013

- WUS sample = SDSS/DR7 quasars + UKIDSS YJHK + **WISE 1,2,3 & 4** → 5281 quasars
- SDSS photometry gives accretion disk luminosity
- **WISE**+UKIDSS gives reprocessed dust luminosity via Nenkova et al, 2008 torus models
- Ratio gives "torus" covering factor.



Find:  
Wide range of torus covering factor  
Extremes ~ factor 10;  $\sigma(\log f_c) = 0.2$   
Not in standard donut torus model

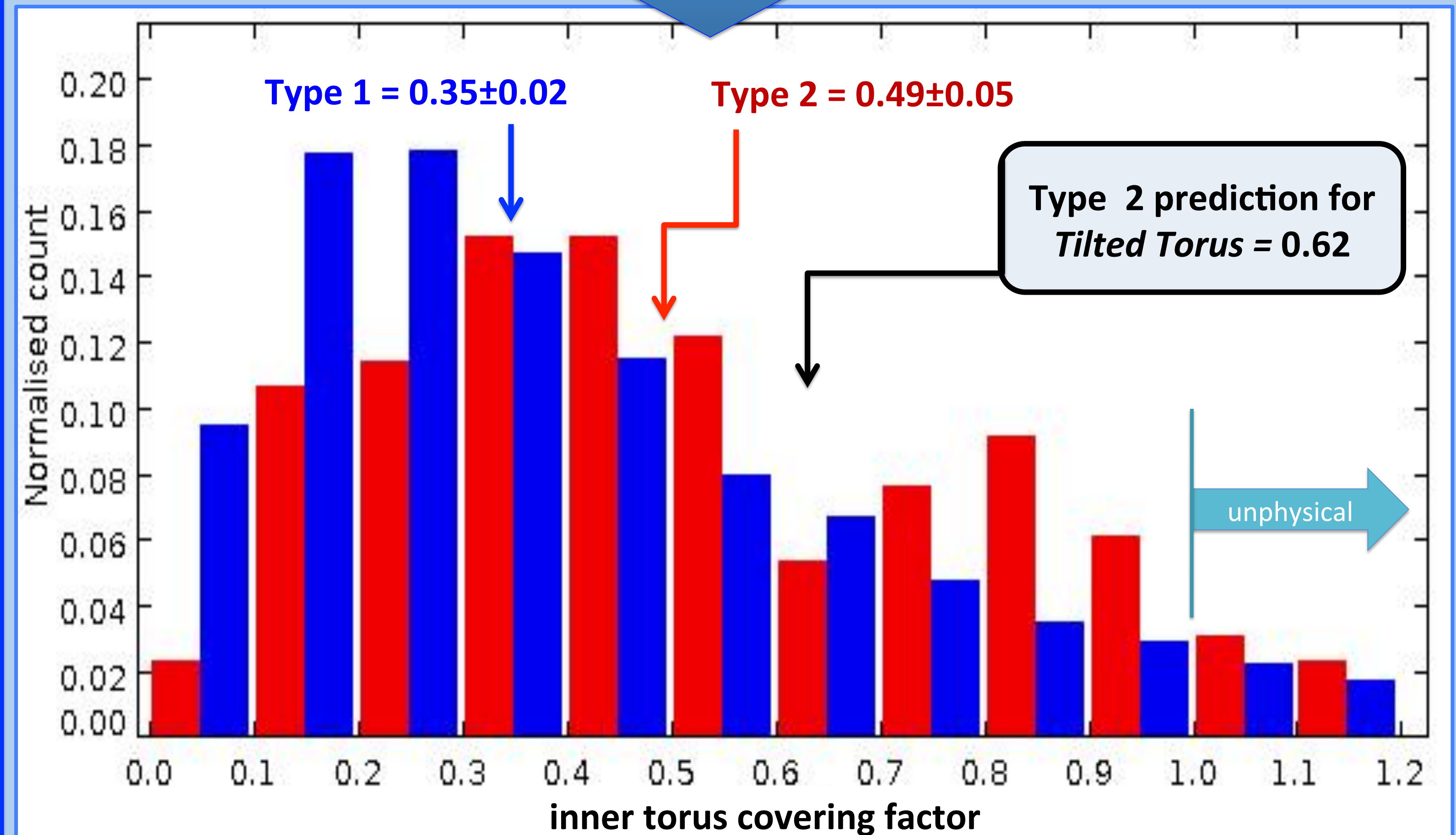


Find:  
Dust covering factor agrees with  
**Tilted Torus prediction**

## Does *Tilted Torus* also work for Type 2 AGN?

- Use WUS SEDs for Reyes et al. SDSS Type 2 sample ( $z < 0.84$ ): 279 quasars
- Measure  $L(\text{hot dust})$  from SED
- **Problem** is how to measure  $L_{\text{bol}}$  as UV/opt is obscured.
- **Solution:** Measure  $L(\text{bol}) = 45C_{\text{NLR}} L([\text{OIII}])$  from SDSS type 1 AGN (cf Heckman)
- Low scatter hence ~uniform NLR covering factor at 2.4%
- Ratio is torus covering factor

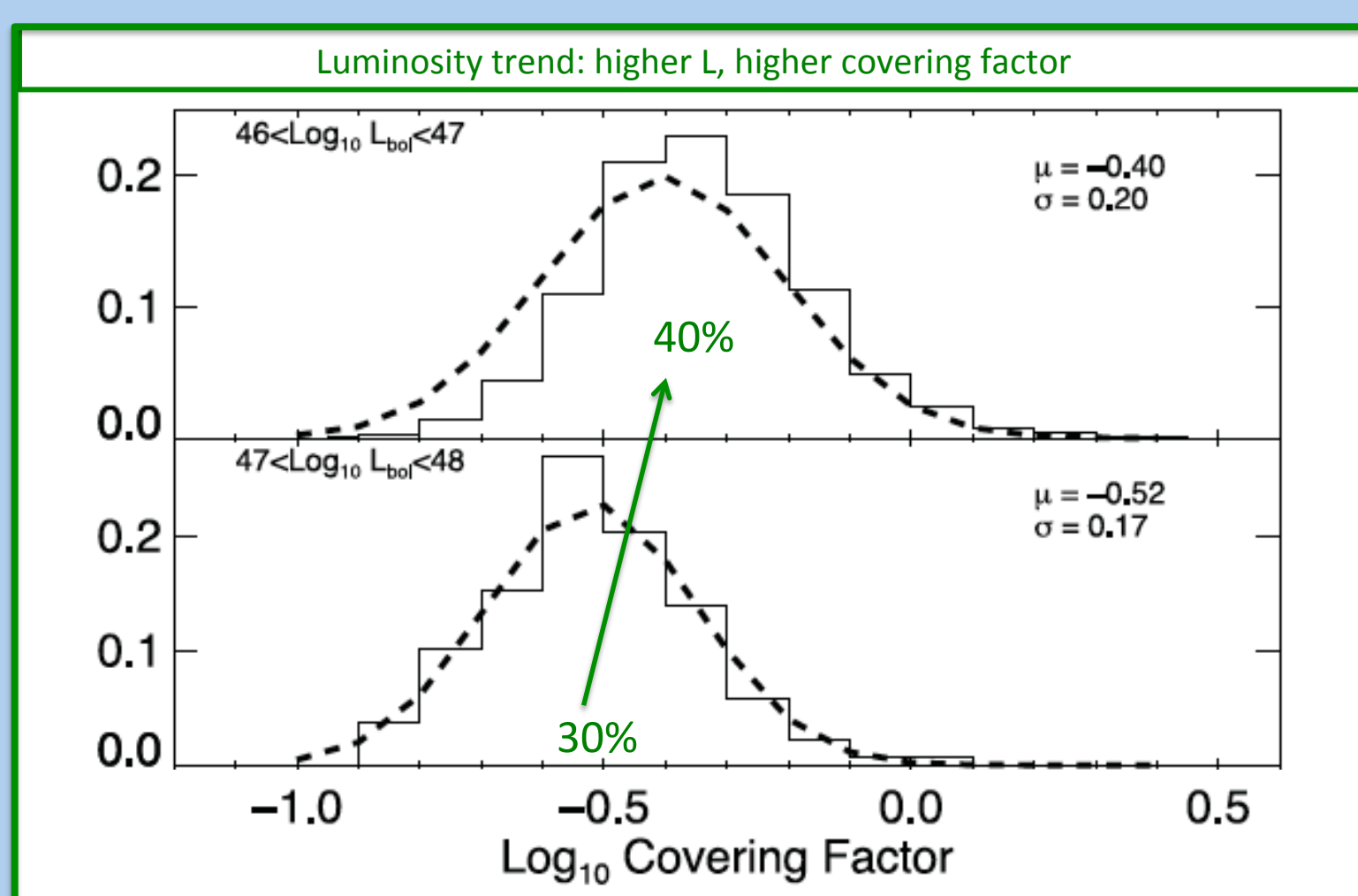
result



## More donut torus problems

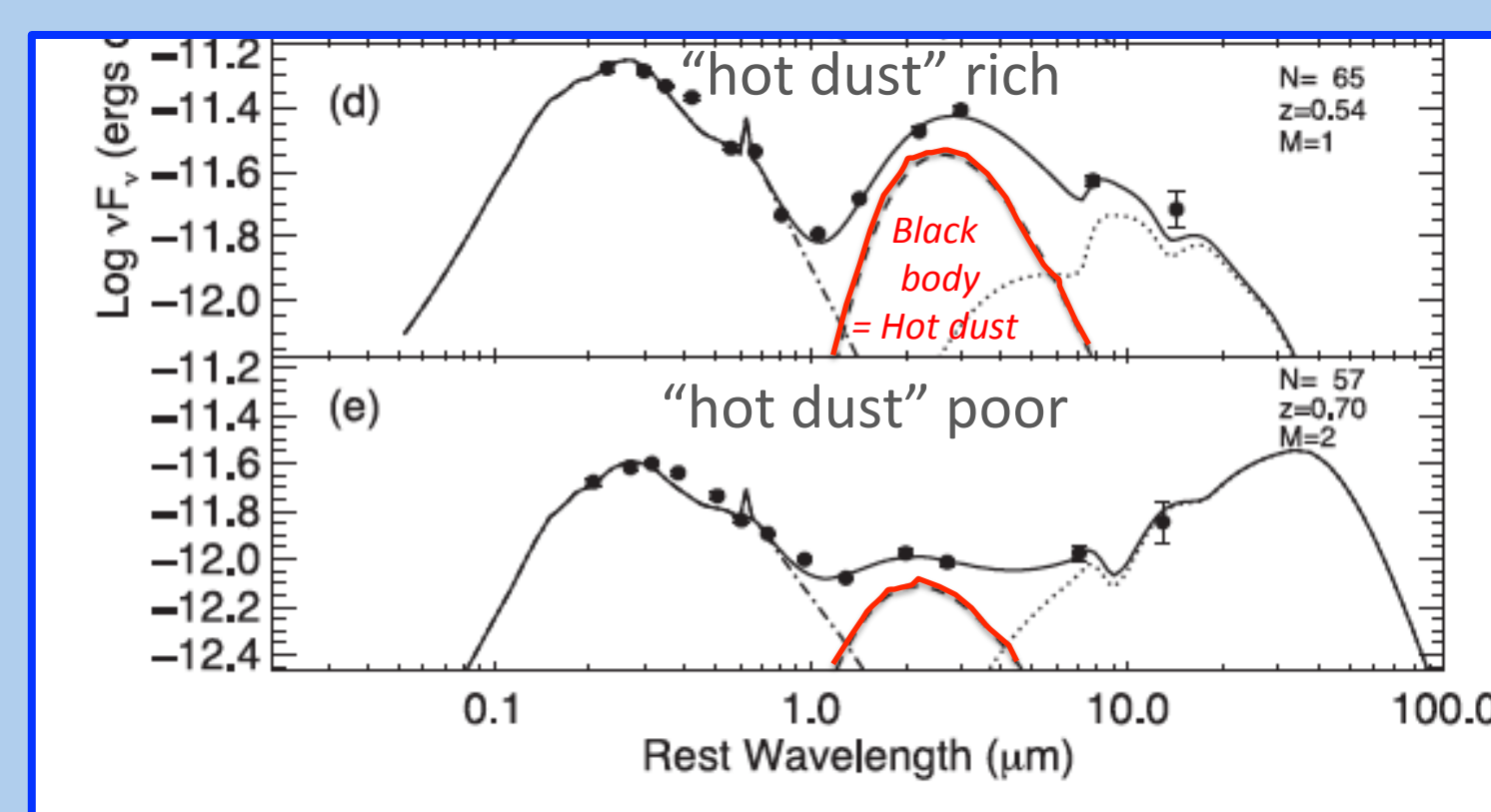
Roseboom et al. 2013

(1) Higher Luminosity have higher covering factor  
Not in standard donut torus model  
Opposite of e.g. X-ray trend



(2) Hot dust (~1200 K) varies independent of "torus"?

Not in standard donut torus model  
See "Hao diagram" →



## Why the mismatch?

Options:

1. *Tilted Torus is the wrong model?* Not so fast!
  2. **Bimodal** distribution for Reyes+ type 2 AGN – *Narrow Line Seyfert 1 "contamination"?* – check X-ray/optical ratio: should be low for true type 2 AGN.
  3. **Self-shielding** by torus lowers mid-IR flux?
  4. **NLR dust extinction?**
  3. **Ambiguous SED template fitting, esp. torus mode?**
- Test with "**Hao Diagram**" (Hao et al. 2013) →

