Dust attenuation in external galaxies

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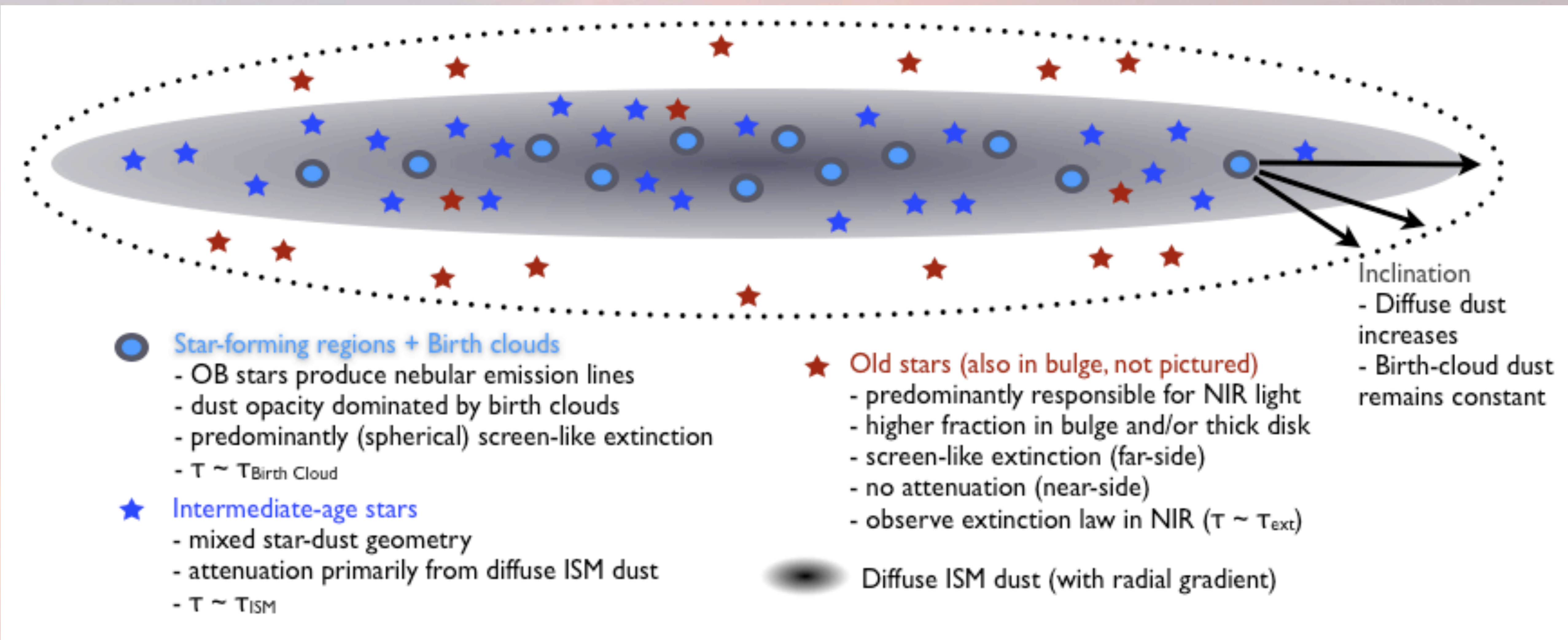
Dust geometry in SFing galaxies



When do we need to measure dust attenuation?

- To measure many key physical properties from a galaxy spectrum/SED.
  - Star formation rates
    - From emission lines
    - From optical-UV continuum
  - Star formation histories
  - Stellar masses (stellar population models better in optical than NIR)
    - Mass functions
- To make mock observations from galaxy evolution models
  - e.g. luminosity functions

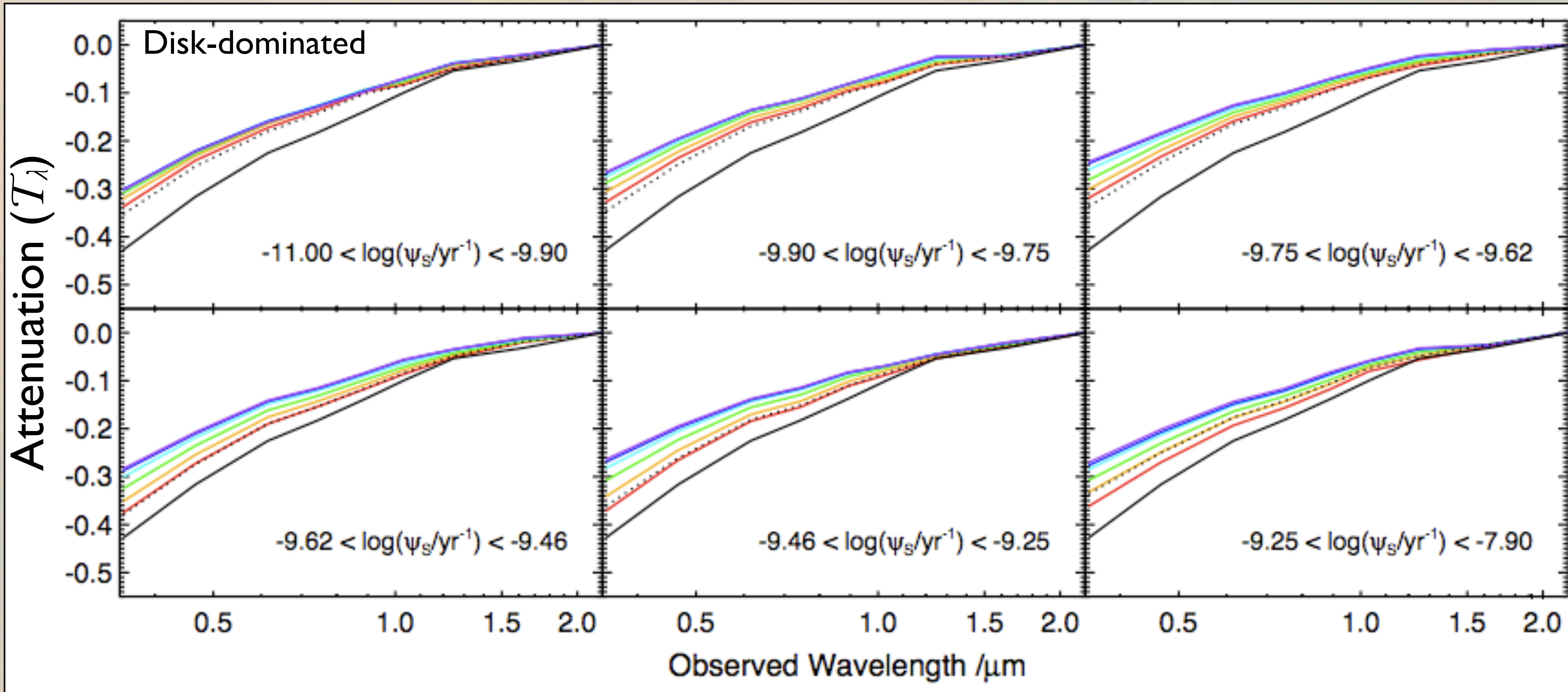
Usual procedure

- Choose a dust curve (i.e. attenuation as fn. wavelength)
  - Calzetti
    - derived from 40 local starburst galaxies
    - tells us about attenuation of light from OB stars
  - MW/LMC/SMC
    - Extinction laws, i.e. a dust “screen”
  - Something else
    - e.g. $\lambda^{-0.7}$
- Estimate an amplitude
  - Balmer decrement (correct for $\tau_{line}/\tau_{continuum}$)
  - Model fitting to multiwavelength SEDs

Measuring dust laws

- MW/SMC/LMC
  - Colour difference technique
  - 2 stars of same type, different intervening dust columns
  - Divide SEDs
- Calzetti
  - Same idea, but using stacks of starburst spectra
  - Starburst galaxies easiest type (homogeneous SEDs)
- Wild et al. 2011b
  - Same idea, but use 23,000 SEDs to find close SED matches
  - Ordinary SFing galaxies, and as function galaxy properties
  - With spectra to measure absolute dust content

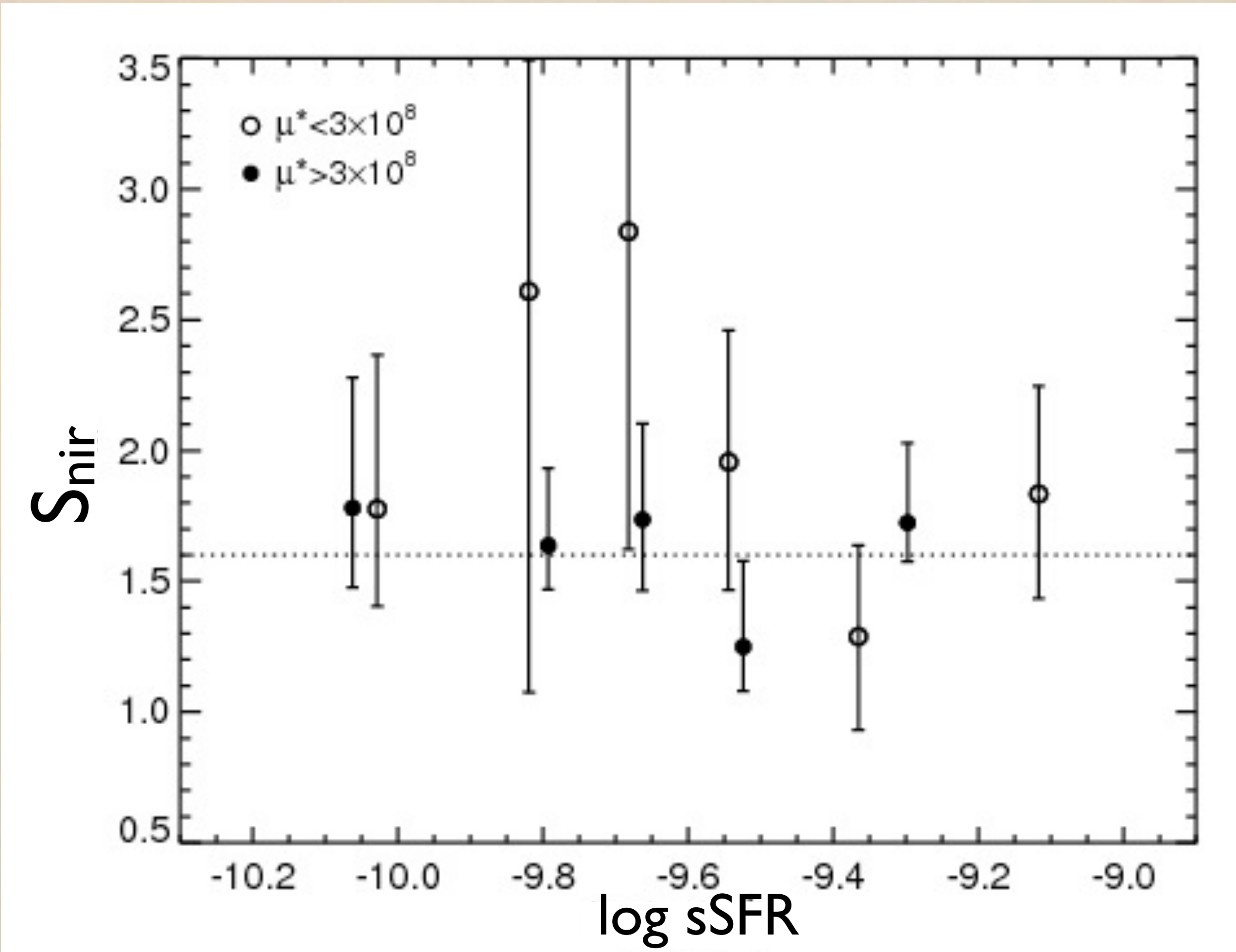
Results: Attenuation curves

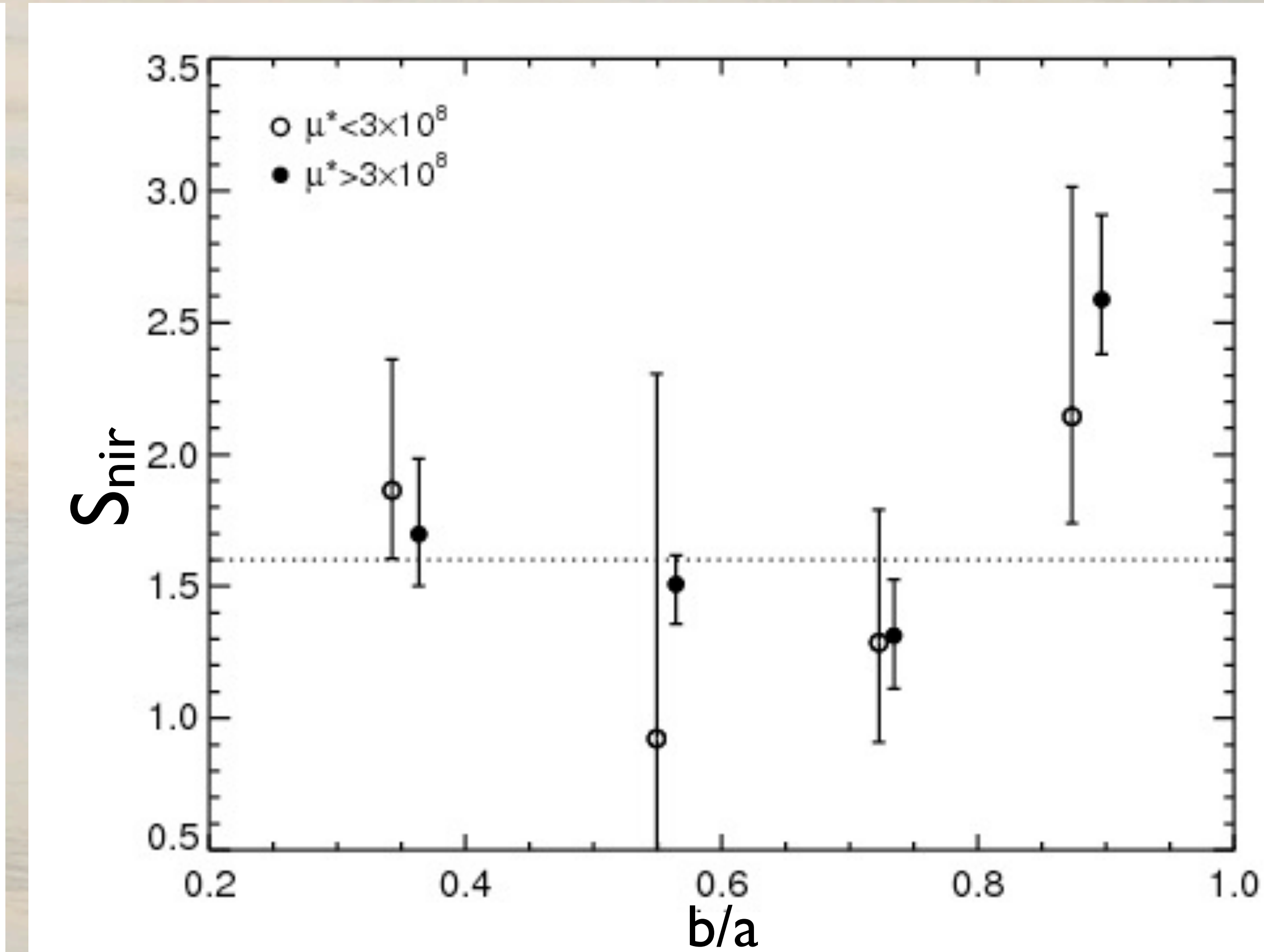


25% R_{pet}
35% R_{pet}
50% R_{pet}
70% R_{pet}
90% R_{pet}
100% R_{pet}

Matched (physical) apertures, relative to each galaxy's Petrosian radius in r-band

The importance of the NIR





- A universal NIR slope
  - Also invariant along different lines-of-sight in the MW
  - **Large** dust grain properties are invariant with environment and galaxy properties
  - Global geometric effects unimportant in the NIR

Dust attenuation curves for SFing galaxies

- ✦ Provide dust attenuation curves for use with "normal" galaxies
- ✦ Measure how dust attenuation curve shape changes with galaxy properties
  - Measure slopes over key wavelength regions
- ✦ Radial gradients as function of galaxy properties
  - Compare amplitudes of curves
- ✦ Variation of 2175A dust bump strength with galaxy properties
  - Using GALEX bands
- ✦ Line vs. continuum dust as a function of galaxy properties
  - For 3" apertures, compare with Balmer decrement

See Wild et al. 2011b, MNRAS, 417, 1760