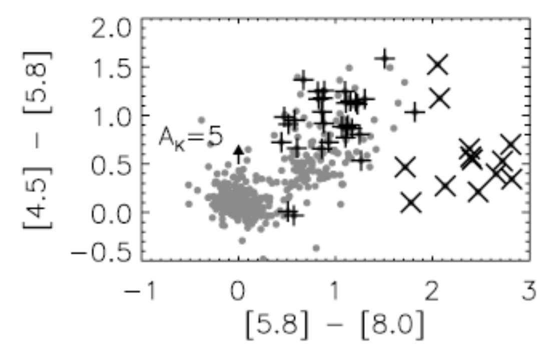
Gutermuth method, broken down

- **Drop** things that meet all of these 3 criteria

$$[4.5] - [5.8] < \frac{1.05}{1.2}([5.8] - [8.0] - 1),$$

$$[4.5] - [5.8] < 1.05,$$

$$[5.8] - [8.0] > 1.$$



Things that meet these criteria are galaxies with PAH emission.

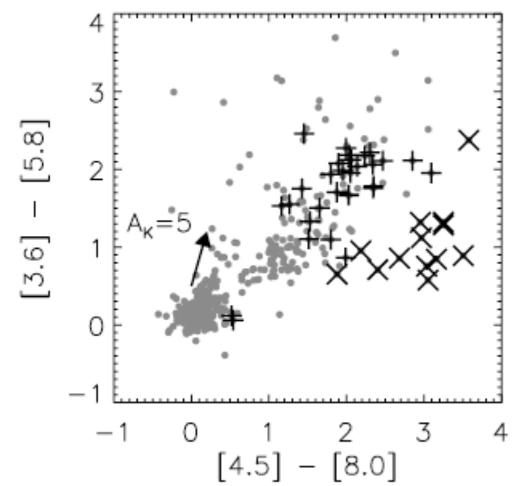
Gutermuth method, broken down

- **Drop** things that meet all of these 3 criteria

$$[3.6] - [5.8] < \frac{1.5}{2}([4.5] - [8.0] - 1),$$

$$[3.6] - [5.8] < 1.5,$$

$$[4.5] - [8.0] > 1.$$



Things that meet these criteria are also galaxies with PAH emission.

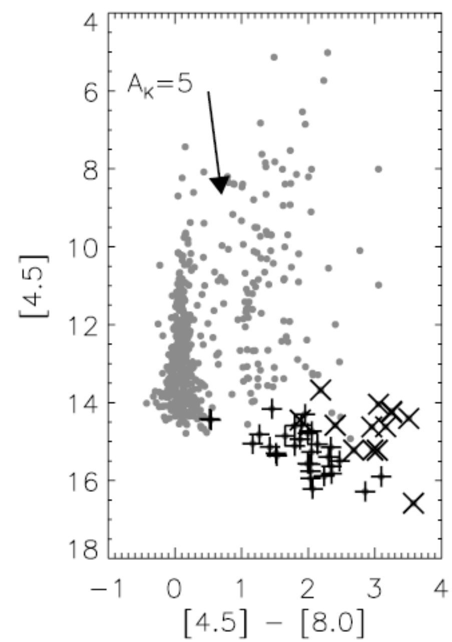
Gutermuth method, broken down

- **Drop** things that meet all of these criteria

$$[4.5] - [8.0] > 0.5,$$

$$[4.5] > 13.5 + ([4.5] - [8.0] - 2.3)/0.4,$$

$$[4.5] > 13.5.$$



- AND these as well:

$$[4.5] > 14 + ([4.5] - [8.0] - 0.5),$$

$$[4.5] > 14.5 - ([4.5] - [8.0] - 1.2)/0.3$$

$$[4.5] > 14.5.$$

Things that meet these criteria are AGN.

Gutermuth method, broken down

- **Drop** things that meet all of these 3 criteria

$$[3.6] - [4.5] > \frac{1.2}{0.55}([[4.5] - [5.8]] - 0.3) + 0.8,$$

$$[4.5] - [5.8] \leq 0.85,$$

$$[3.6] - [4.5] > 1.05.$$

Things that meet these criteria are likely unresolved blobs of dust (e.g. things that LOOK like points sources but really aren't), whose colors are dominated by shock emission.

Gutermuth method, broken down

- **Keep** things that meet all of these 3 criteria and don't fail the earlier tests.

$$[4.5] - [8.0] > 0.5,$$

$$[3.6] - [5.8] > 0.35,$$

$$[3.6] - [5.8] \leq \frac{0.14}{0.04}([[4.5] - [8.0]] - 0.5) + 0.5.$$

Things that meet these criteria are likely Class II young stars.

Gutermuth method, broken down

- **Keep** things that meet all of these 3 criteria and don't fail the earlier tests.

Sources are likely protostars if they have an extremely red discriminant color ($[4.5] - [5.8] > 1$). In addition, any sources with a moderately red discriminant color ($0.7 < [4.5] - [5.8] \leq 1.0$) that also have $[3.6] - [4.5] > 0.7$ are likely protostars (see Fig. 7), although in rare cases a highly reddened Class II source could have these colors as well.

Things that meet these criteria are likely Class 0 or I young stars.

Gutermuth method, broken down

- You can keep going. (I didn't.)
- Rest of his method provided here for completeness.
- Go to slide 32 for summary.

First we measure the line of sight extinction to each source as represented by the E_{J-H}/E_{H-K} color excess ratio, using baseline colors based on the classical T Tauri star (CTTS) locus of Meyer et al. (1997) and standard dwarf-star colors (Bessell & Brett 1988). To accomplish the latter task, we force $[J-H]_0 \geq 0.6$, a simplifying approximation for the intrinsic colors of low-mass dwarfs. These are the equations used to derive the adopted intrinsic colors from the photometry we have measured:

$$[J-H]_0 = 0.58[H-K]_0 + 0.52,$$

$$[H-K]_0 = [H-K]_{\mathrm{meas}} - \left([J-H]_{\mathrm{meas}} - [J-H]_0\right)\frac{E_{H-K}}{E_{J-H}},$$

$$[H-K]_0 = \frac{[J-H]_{\mathrm{meas}} - [E_{J-H}/E_{H-K}][H-K]_{\mathrm{meas}} - 0.52}{0.58 - [E_{J-H}/E_{H-K}]}.$$

Gutermuth method, broken down

Once we have measured the component of the $H - K$ color excess that is caused by reddening, we compute the dereddened $K - [3.6]$ and $[3.6] - [4.5]$ colors using the color excess ratios presented in Flaherty et al. (2007), specifically $E_{J-H}/E_{H-K} = 1.73$, $E_{H-K}/E_{K-[3.6]} = 1.49$, and $E_{H-K}/E_{K-[4.5]} = 1.17$:

$$[K - [3.6]]_0 = [K - [3.6]]_{\rm meas} - ([H - K]_{\rm meas} - [H - K]_0) \frac{E_{K-[3.6]}}{E_{H-K}},$$

$$[[3.6] - [4.5]]_0 = [[3.6] - [4.5]]_{\rm meas} - ([H - K]_{\rm meas} - [H - K]_0) \frac{E_{[3.6]-[4.5]}}{E_{H-K}},$$

$$\frac{E_{[3.6]-[4.5]}}{E_{H-K}} = \left(\left[\frac{E_{H-K}}{E_{K-[4.5]}} \right]^{-1} - \left[\frac{E_{H-K}}{E_{K-[3.6]}} \right]^{-1} \right)^{-1}.$$

Gutermuth method, broken down

- Having done the prior two steps, add things meeting all of these criteria to the YSO list.

$$\sigma_1 = \sigma[[3.6] - [4.5]]_{\mathrm{meas}},$$

$$\sigma_2 = \sigma[[K] - [3.6]]_{\mathrm{meas}};$$

$$[[3.6] - [4.5]]_0 - \sigma_1 > 0.101,$$

$$[K - [3.6]]_0 - \sigma_2 > 0,$$

$$[K - [3.6]]_0 - \sigma_2 > -2.85714([[3.6] - [4.5]]_0 - \sigma_1 - 0.101) + 0.5.$$

All sources classified as Class II with this method must have $[3.6]_0 < 14.5$,

Things that meet these criteria are likely Class II young stars.

Gutermuth method, broken down

- Add objects that meet all criteria on prior slide, plus these criteria, to the YSO list.

$$[K-[3.6]]_0-\sigma_2>-2.85714([[3.6]-[4.5]]_0-\sigma_1-0.401)+1.7.$$

All sources classified as
protostars must have $[3.6]_0<15$.

Things that meet these criteria are likely Class 0/I young stars (protostars in his nomenclature).

Gutermuth method, broken down

- Add objects that meet all criteria on prior slide, plus these criteria, to the YSO list.

We reinclude flagged sources as likely protostars if they have both bright MIPS 24 μm photometry ($[24] < 7$, as before) and convincingly red IRAC/MIPS colors ($[3.6] - [5.8] > 0.5$ and $[4.5] - [24] > 4.5$ and $[8.0] - [24] > 4$).

Things that meet these criteria are likely Class 0/I young stars (protostars in his nomenclature).

Gutermuth method, broken down

- Check everything on the YSO list.

Finally, all previously identified protostars that have 24 μm detections are checked to ensure that their SEDs do indeed continue to rise from IRAC to MIPS wavelengths. All protostars that have MIPS detections must have $[5.8] - [24] > 4$ if they possess 5.8 μm photometry, otherwise they must have $[4.5] - [24] > 4$.

Protostars in his nomenclature == Class 0 or I.