School of Physics & Astronomy
FACULTY OF MATHEMATICS & PHYSICAL SCIENCES

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The Near-IR Extinction Law

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UKIDSS Galactic Plane Survey

Reddening in a colour-colour diagram

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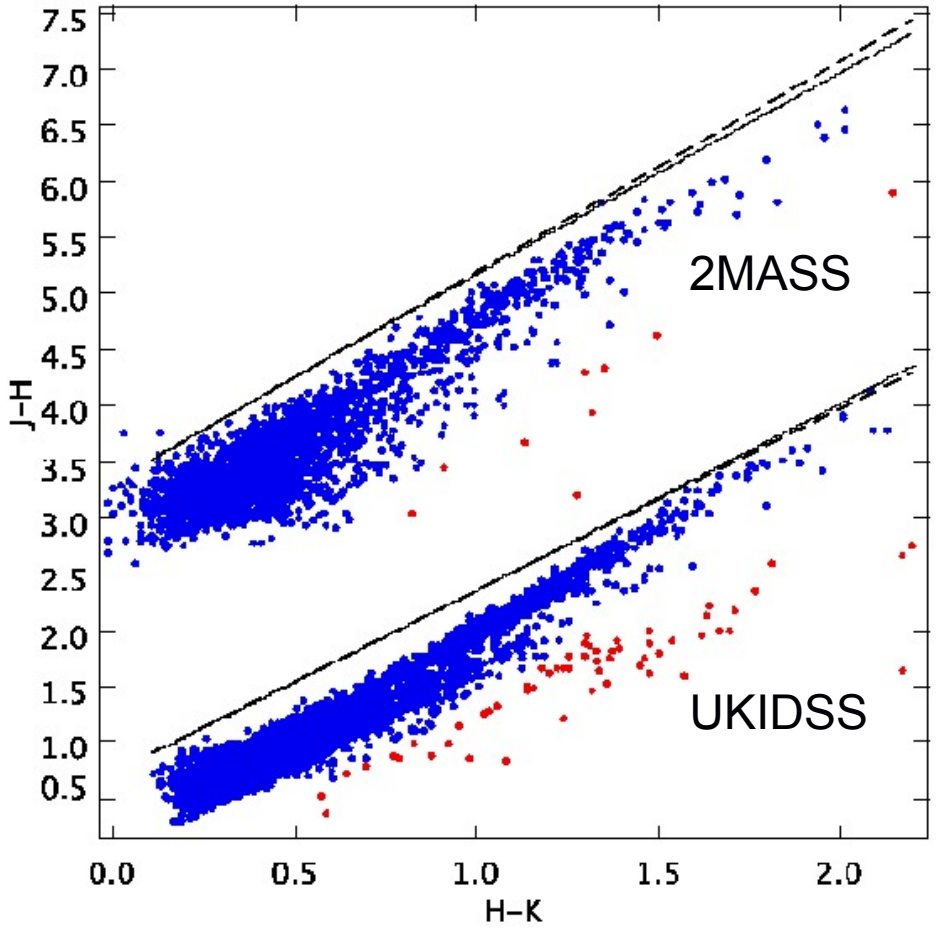
- Traditionally, reddening is represented as a straight ‘vector’ on a colour-colour diagram

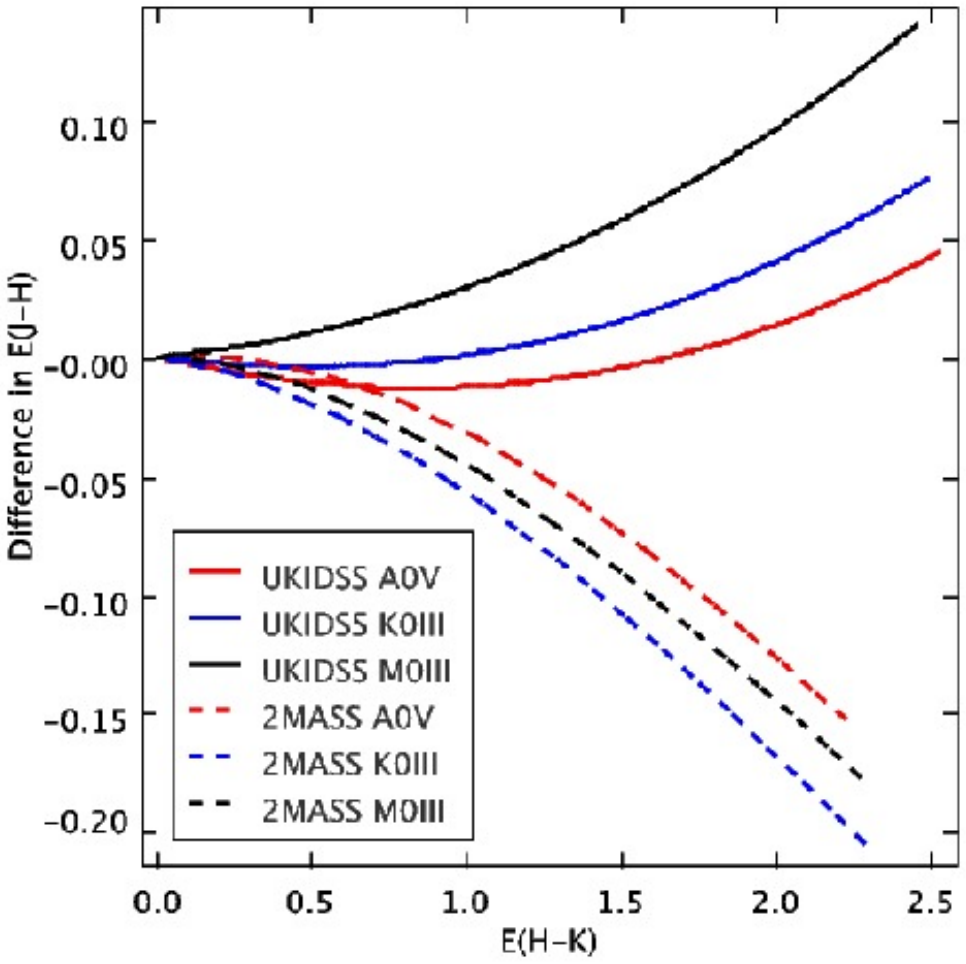
- However, the changing effective wavelengths with reddening result in curved reddening ‘tracks’ instead



Data for 60' x 6' region l=49º b=-0.3º

Reddening Tracks

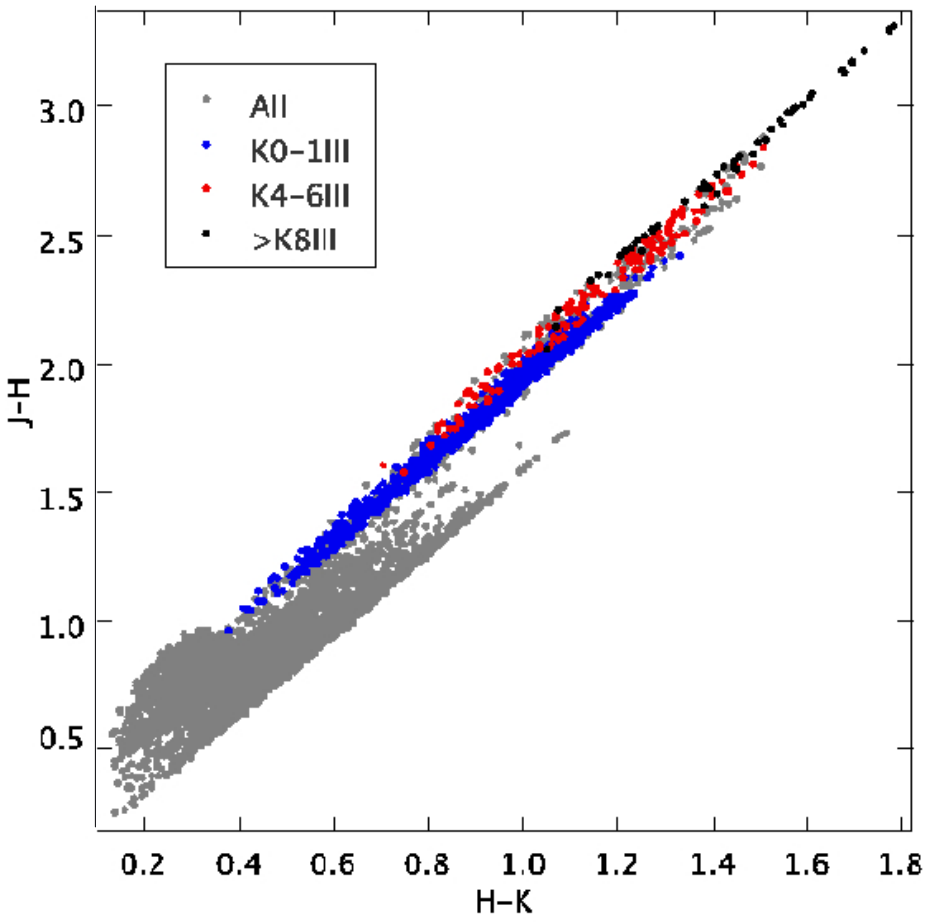
- Shape of the reddening tracks depends on the filter system and the spectral type
- Tracks calculated by convolving reddened Kurucz model atmospheres with the filter profiles



Difference in colour between using a static reddening vector and curved reddening tracks

Colour-colour diagram morphology

- Curvature at the top of the giant sequence on a colour-colour diagram is dominated by the changing spectral type with increasing reddening (distance)



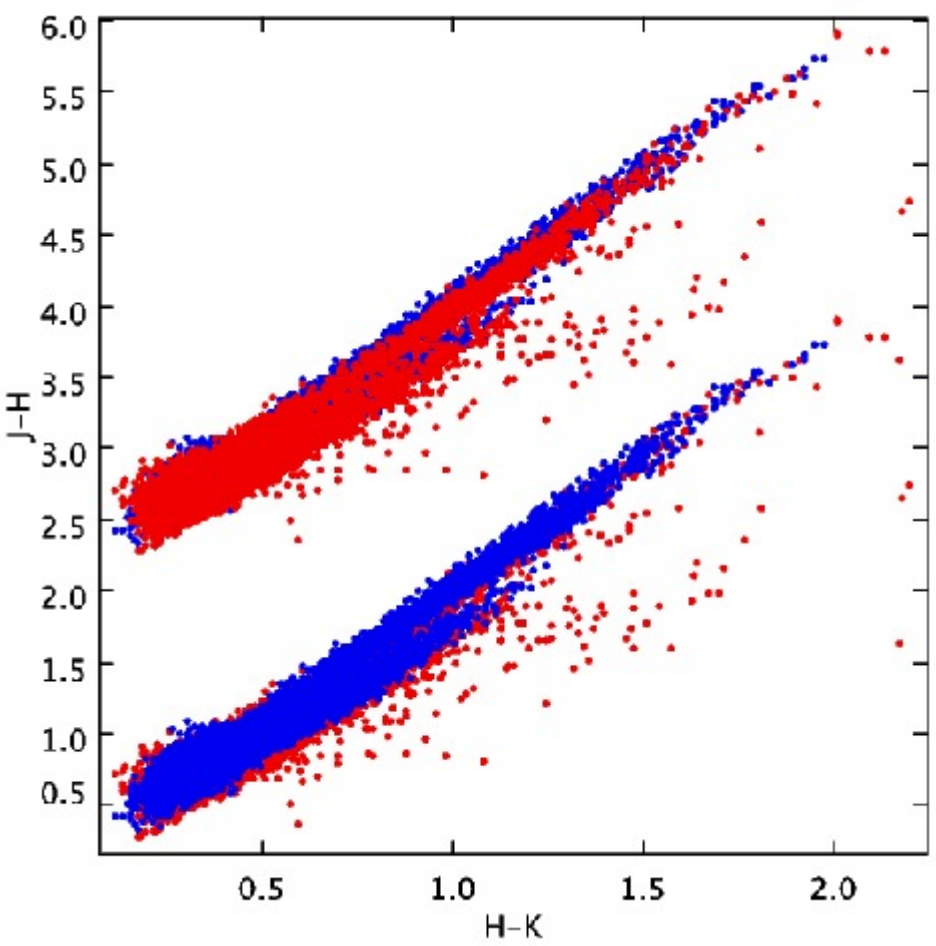
Besançon model data (Robin et al. 2003)

Synthetic colour-colour diagrams

- Model stellar population using Besançon model with uniform thin disc extinction/kpc
- Re-redden using curved reddening tracks and assumed reddening law

$$A_\lambda \propto \lambda^{-\alpha}$$

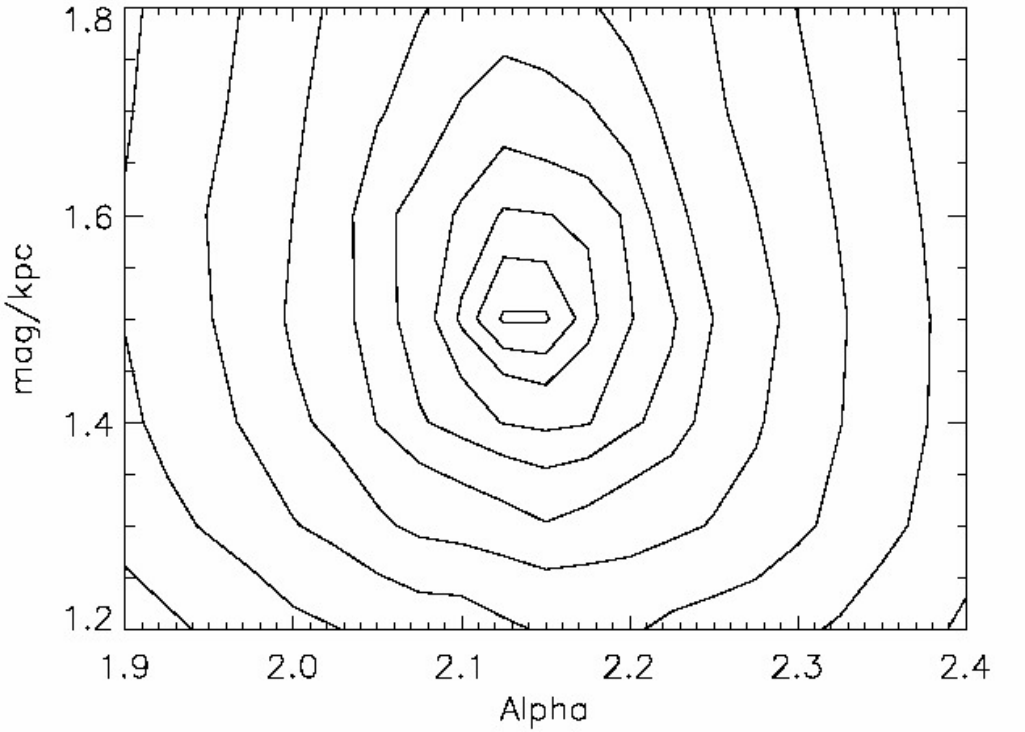
- Repeat for range of α

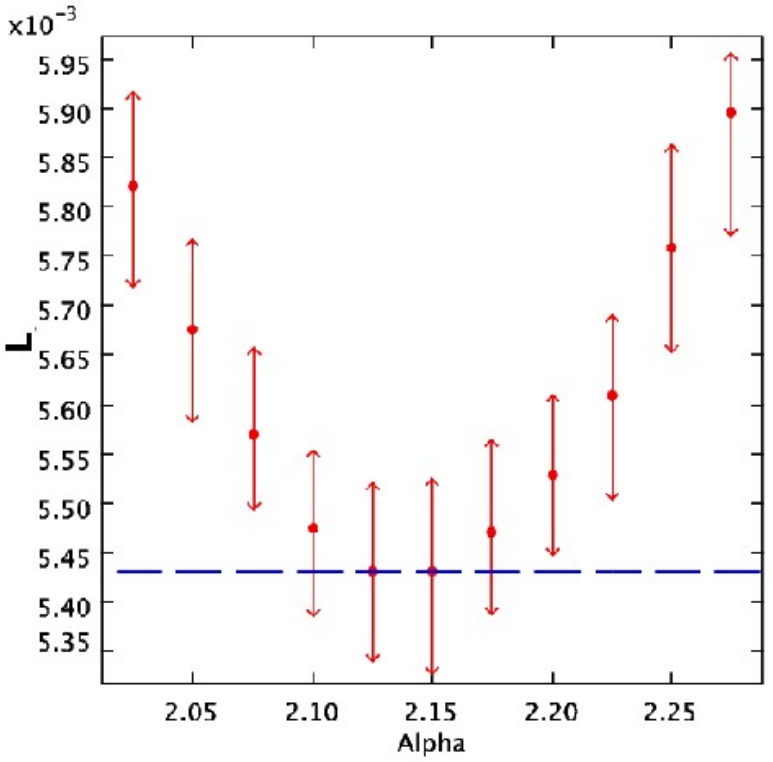


α = 2.30

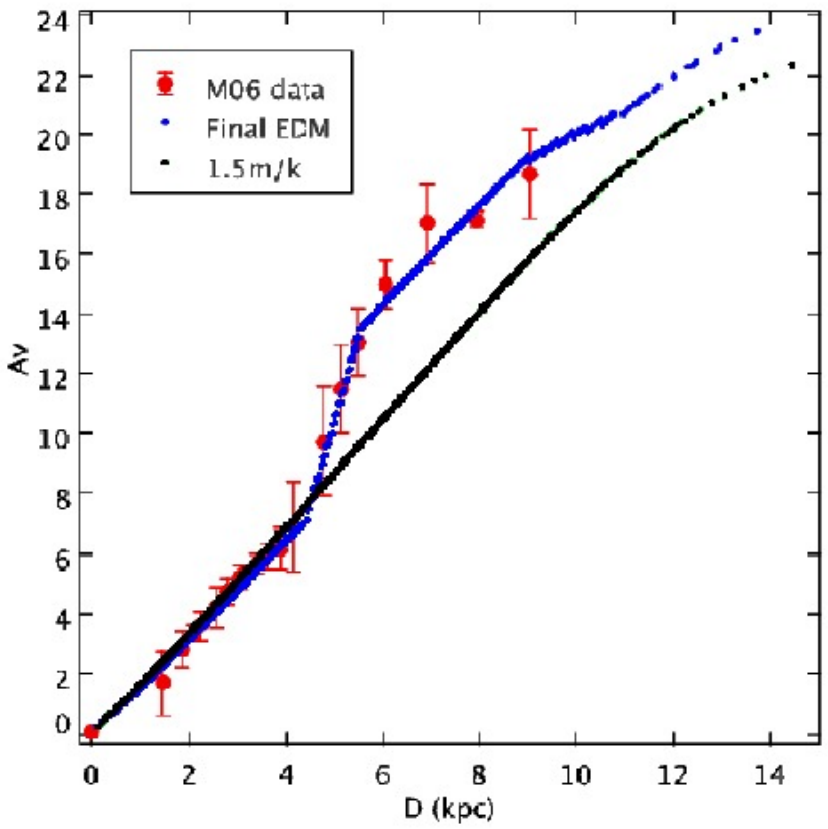
Monte Carlo Simulations

- Minimize separation between model and data
- Monte Carlo to get error on α and extinction/kpc

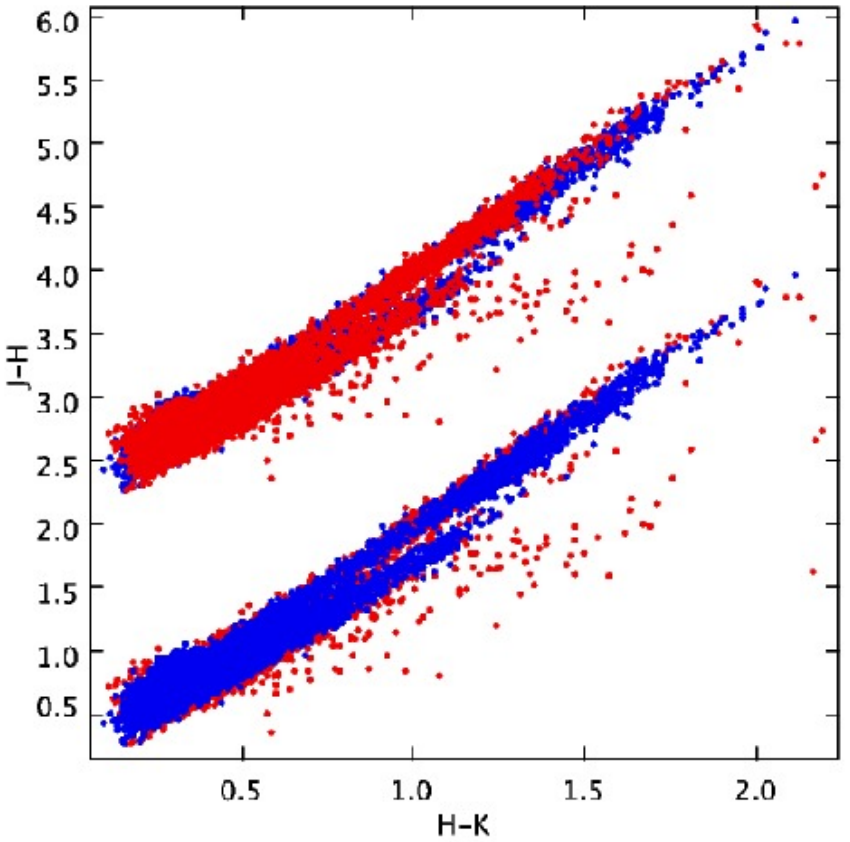




Realistic Extinction Distribution



Use the Marshall et al. (2006) to include discrete clouds



α = 2.15 ± 0.06 for UKIDSS

α = 2.05 ± 0.15 for 2MASS

The slope of the extinction law

- Repeated for 8 different regions along the Galactic Plane from l=30º to 100º obtaining consistent values for α in each
- Each centred on massive star forming region from RMS survey but dominated by diffuse ISM
- Final weighted mean $\alpha = 2.14 \pm 0.05$
- Previous literature values from stellar colour excess ratios give $\alpha = 1.7 \pm 0.1$

Filter Wavelengths

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- Problem due to choice of filter wavelengths in conversion to α

$$A_\lambda \propto \lambda^{-\alpha} \qquad \frac{E_J - E_H}{E_H - E_K} = \frac{\left(\lambda_H / \lambda_J\right)^\alpha - 1}{1 - \left(\lambda_H / \lambda_K\right)^\alpha}$$

- E.g. Indebetouw et al. (2005) determine $\frac{E_J - E_H}{E_H - E_K} = 1.86 \pm 0.11$

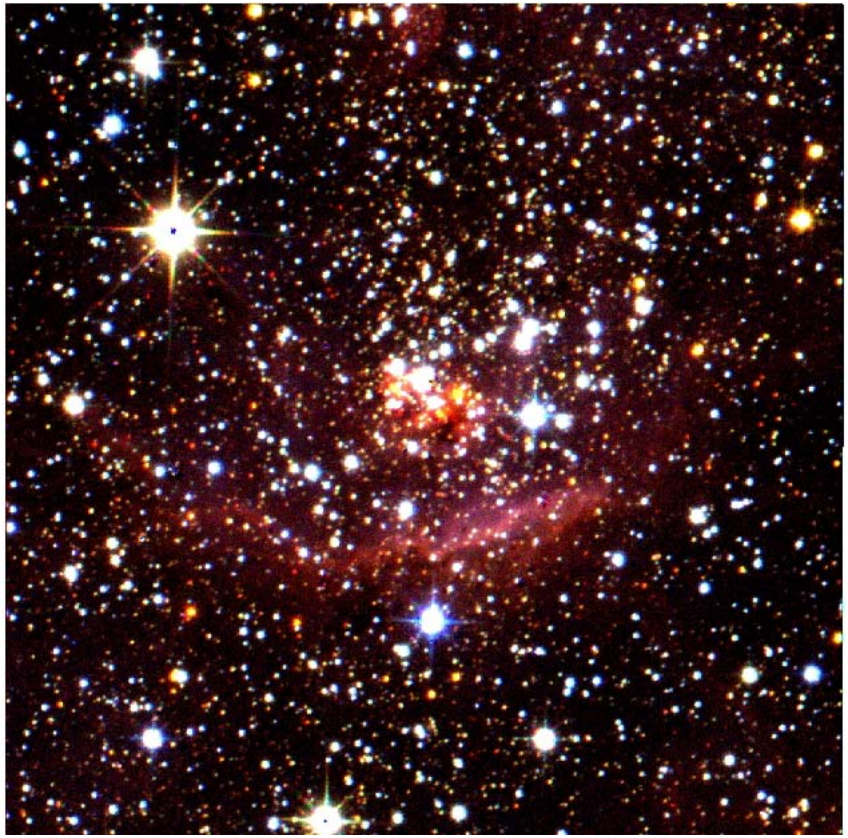
- Using isophotal 2MASS wavelengths α = 1.81 ± 0.20
- Using effective 2MASS wavelengths α = 2.05 ± 0.20
- Using appropriate reddening track α = 2.10 ± 0.20

- (UCHII recombination lines α=1.86 ± 0.16 Moore et al. 2005)

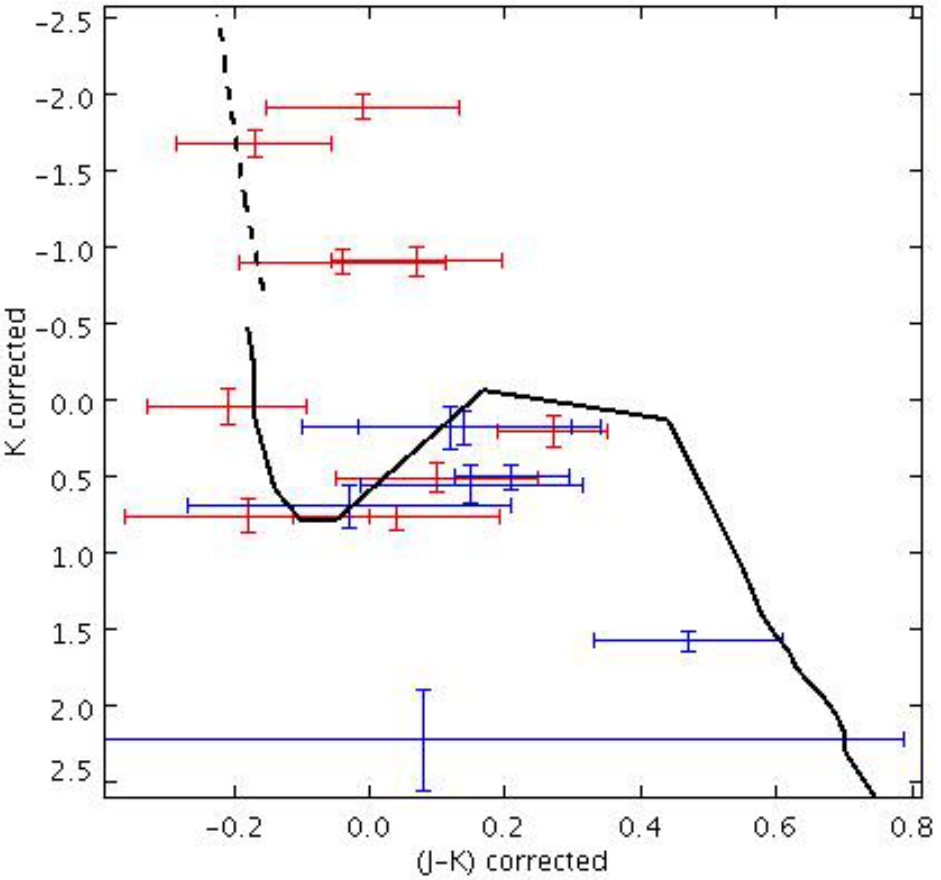
Conclusions

- The slope of the near-IR extinction law is α = 2.14 ± 0.05
- This is steeper than previous determinations
- Accurate de-reddening needs to use reddening tracks not vectors
- Will be applied to young embedded clusters to de-redden individual members to determine distances, ages, stellar content

Future Work



G48.9897-0.2992 UKIDSS
Kinematic distance 5.2 kpc



De-reddened colour-magnitude diagram with Seiss et al. isochrone
d ~ 5 ± 1 kpc, age ~ 3 ± 1 Myr