DECONVOLUTION

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1. SPATIAL DECONVOLUTION

Method used to spatially deconvolve images for rasters and CVFs:
Multi-resolution Lucy's algorithm developed by J-L Starck.

Deconvolution of CVF spectra

$\sim$150 fits to find the best PSF; $\sim$150 deconvolutions for a CVF. Example: Mrk 171 (Arp 299): Interacting galactic system with 5 sources (point-like).

Photometric correction

After subtracting the PSF contamination from other sources: Application of a variable aperture correction as a function of wavelengths.

2. SPECTRAL DECONVOLUTION

$I = O * T + N$ with
I = Spectra from CVFs.
O = Deconvolved spectra.
T = Transmission (variable with wavelengths).
N = Noise

Each method described in the following parts is regularized using a multiresolution filtering to remove the noise at each scale: $R^{(k)} = I(\lambda) - T(\lambda) * O^{(k)}(\lambda) \longrightarrow FILTER \longrightarrow \overline{R^{(k)}}$

1. Van Cittert Method

We begin with $O^{(k=0)}(\lambda) = I(\lambda)$:
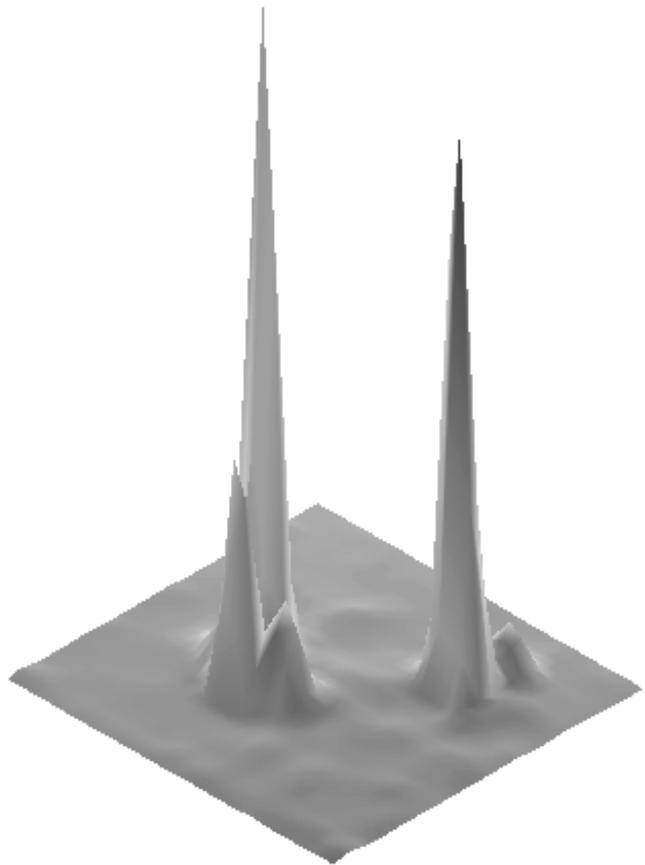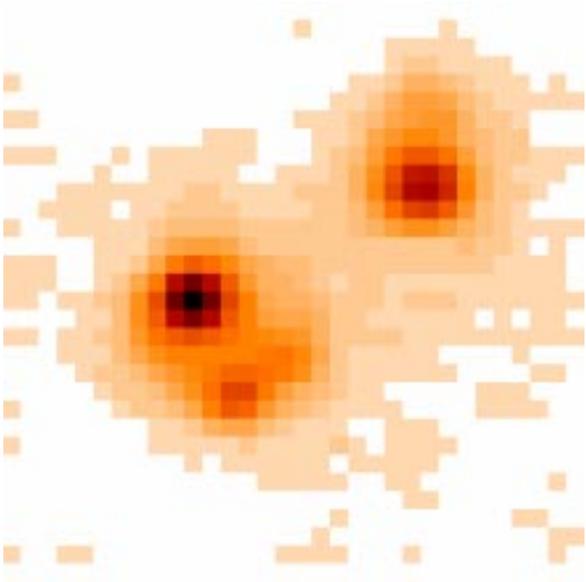We assume $O^{(k)} > 0$ for each iteration.
Filter: Nscale = 1-5, Sigma = 5

$$O^{(k+1)}(\lambda) = O^{(k)}(\lambda) + I(\lambda) - T(\lambda) * O^{(k)}(\lambda)$$

2. Landweber Method

We begin with $O^{(k=0)}(\lambda) = I(\lambda)$:
We assume $O^{(k)} > 0$ for each iteration.
Filter: Nscale = 1-5, Sigma = 5

$$O^{(k+1)}(\lambda) = O^{(k)}(\lambda) + T(-\lambda) * [I(\lambda) - T(\lambda) * O^{(k)}(\lambda)]$$

3. Richardson-Lucy Method

We begin with $O^{(k=0)}(\lambda) = I(\lambda)$:
We assume $O^{(k)} > 0$ for each iteration.
Filter: Nscale = 1-5, Sigma = 5

$$O^{(k+1)}(\lambda) = [\frac{I(\lambda)}{O^{(k)}(\lambda)*T(\lambda)} * T(-\lambda)]O^{(k)}(\lambda)$$

Each method converge with good S/N spectra and we stop the algorithm when we reach : $(\sigma_{R^{(k-1)}} - \sigma_{R^{(k)}})/\sigma_{R^{(k)}} < 10^{-3}$
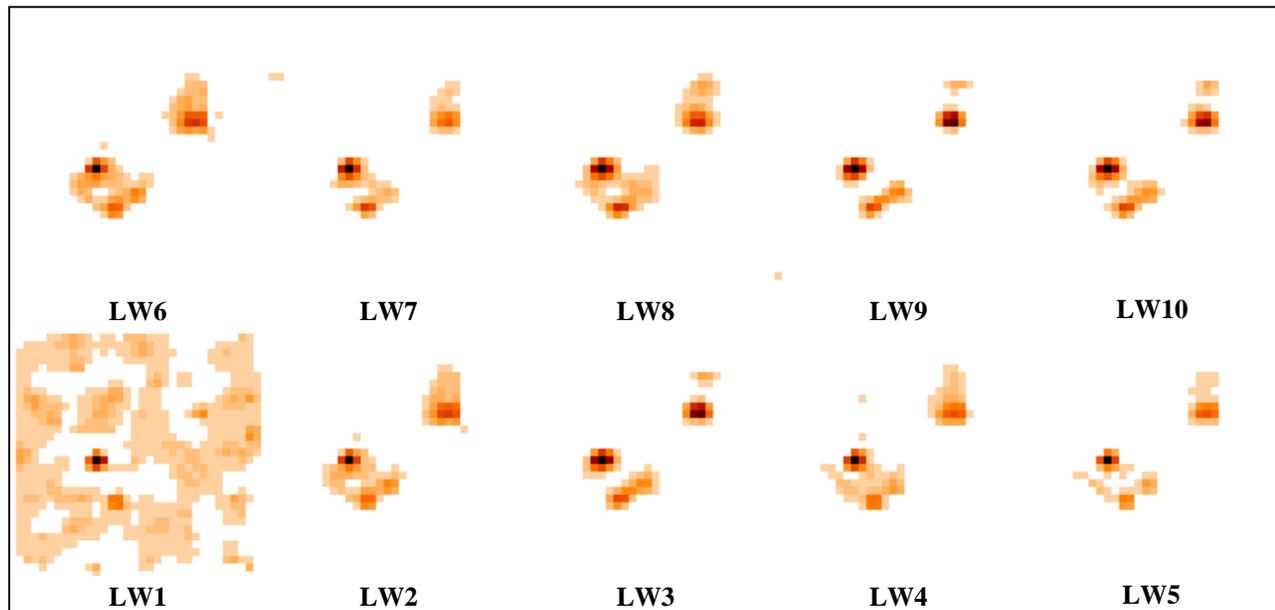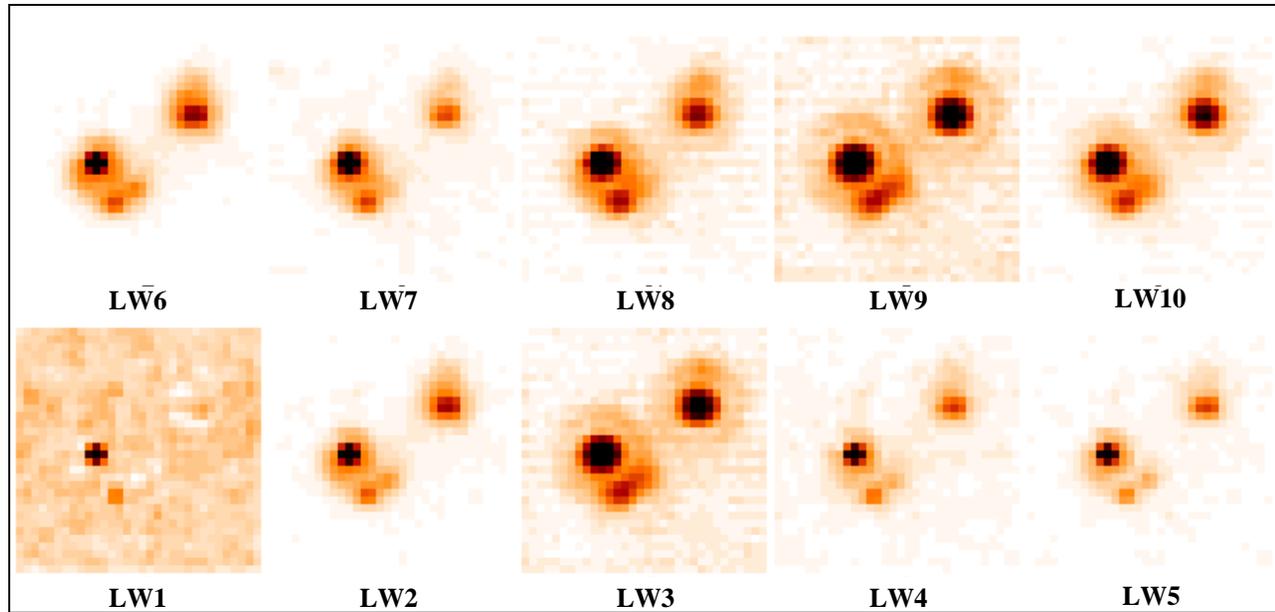
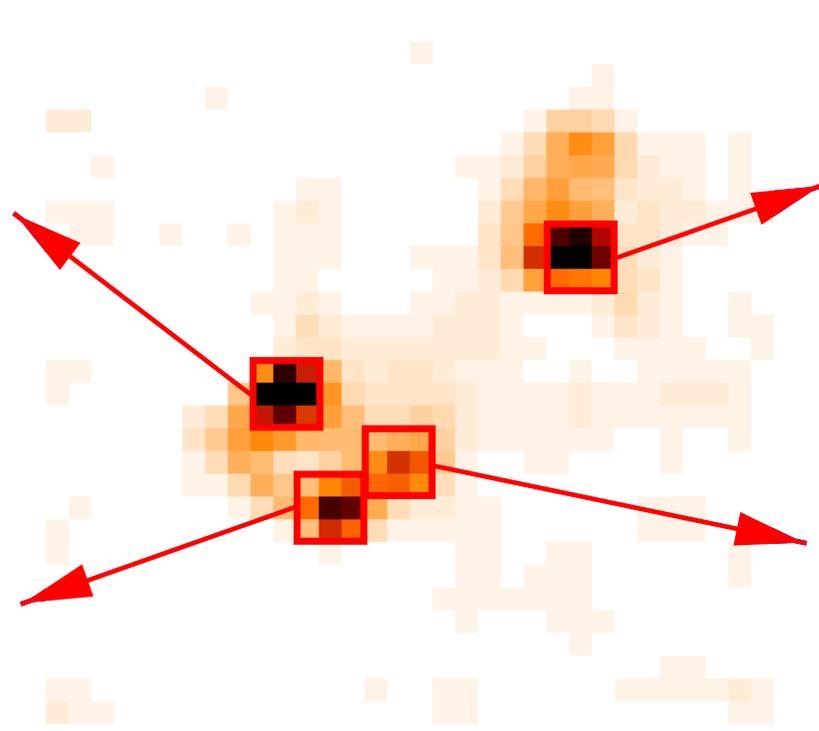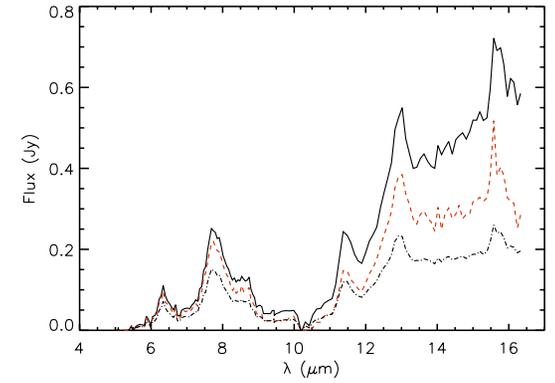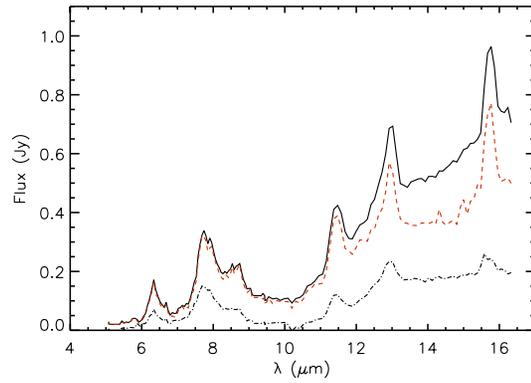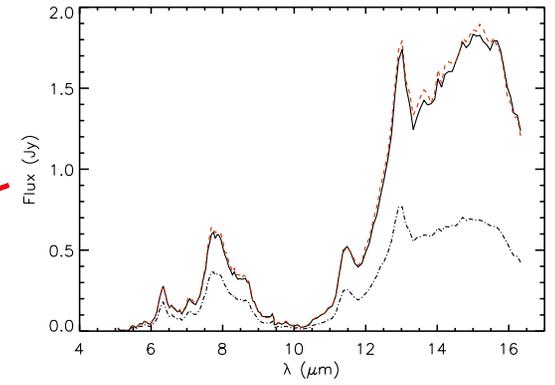# SPATIAL   DECONVOLUTION

(EXAMPLE : Mrk 171, pixel=1.5")
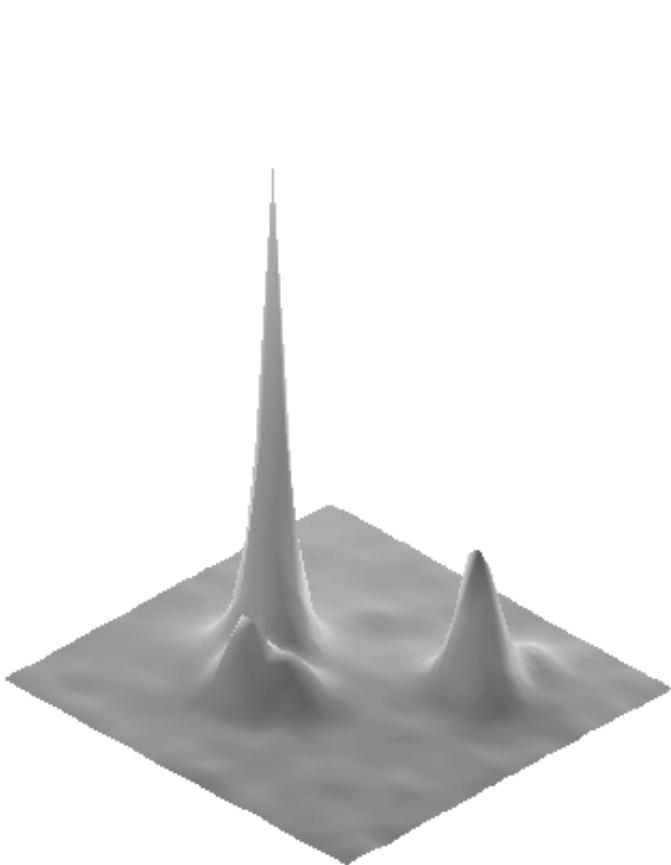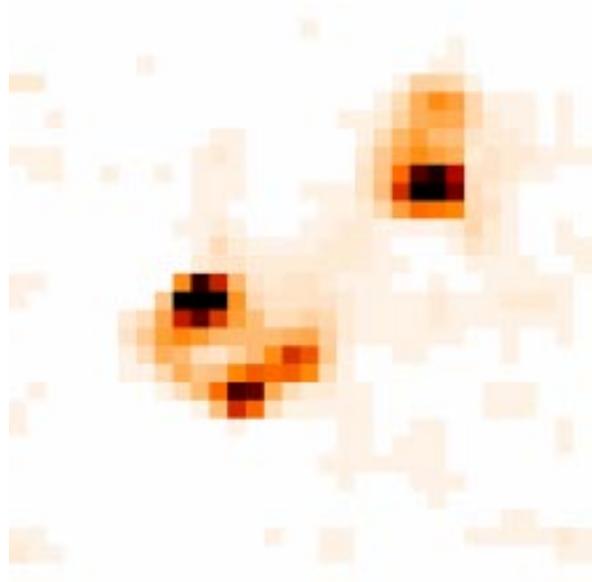
DECONVOLUTION

LW→CVF

LW6   LW7   LW8   LW9   LW10

LW1   LW2   LW3   LW4   LW5

LW6   LW7   LW8   LW9   LW10

LW1   LW2   LW3   LW4   LW5

DECONVOLUTION
AND
PSF   CONTAMINATION
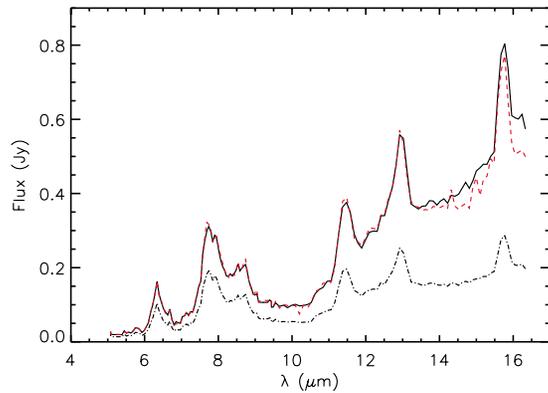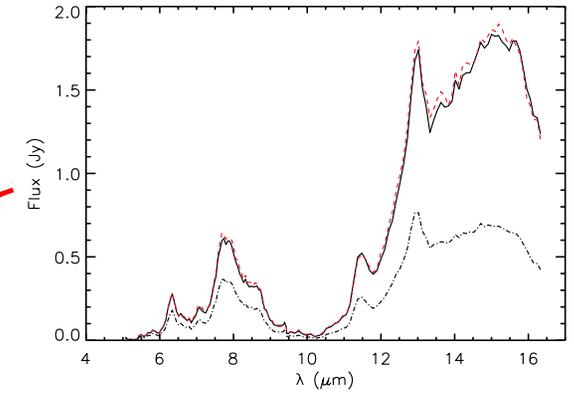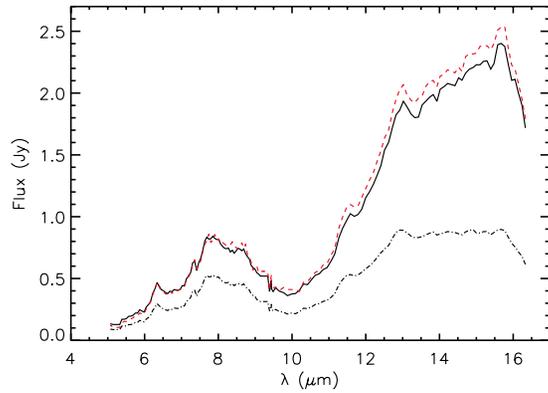### APERTURE   CORRECTION
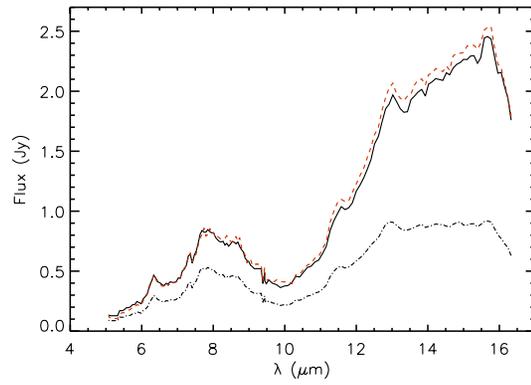
Legend:
- ·–·–·– 3*3pixels
- —— (red) 3*3pixels (DECONVOLUTION)
- —— (black) 3*3pixels (APERTURE CORRECTION)

DECONVOLUTION
AND
APERTURE CORRECTION

CVF   TRANSMISSION
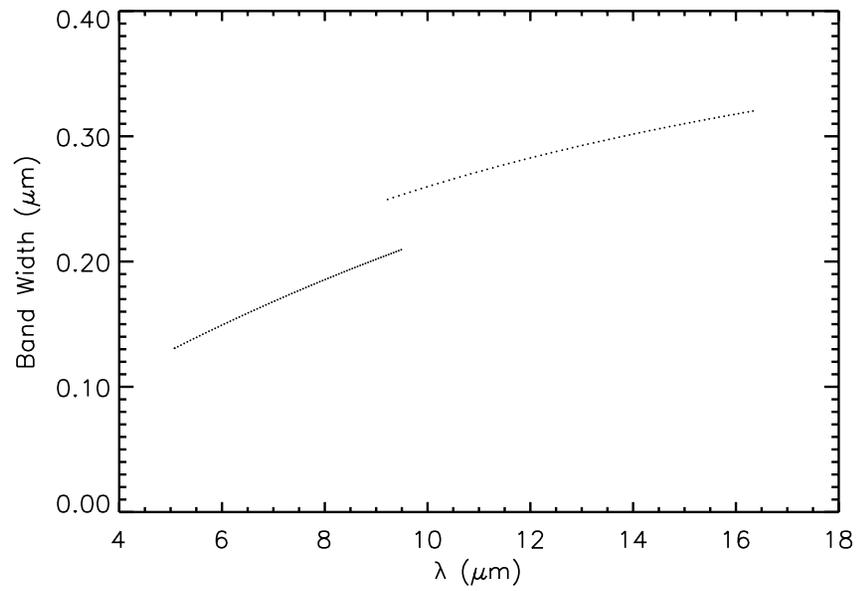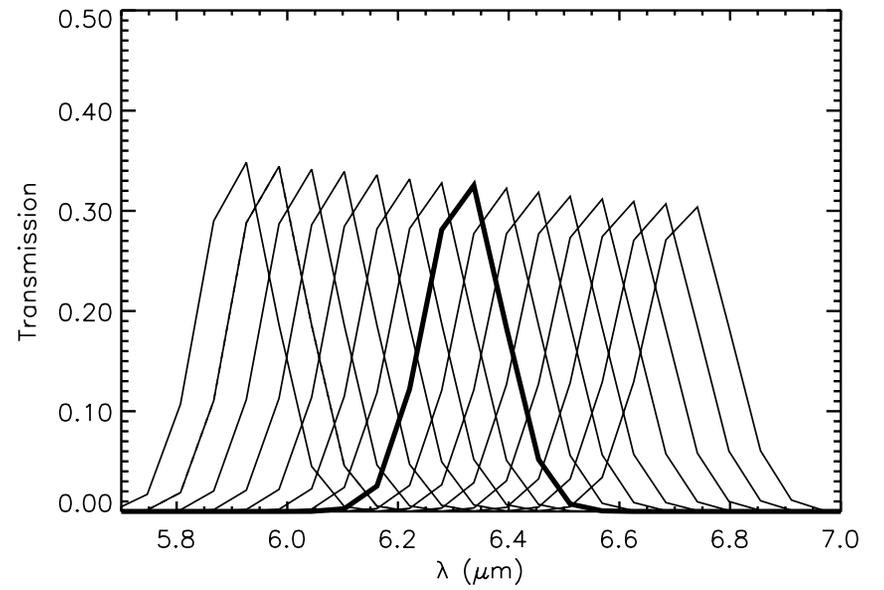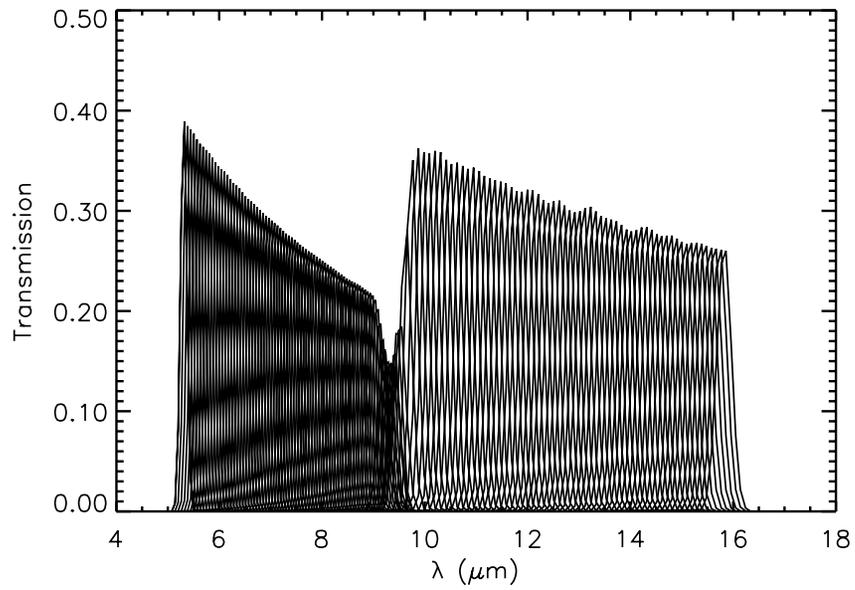
SPECTRAL   DECONVOLUTION

VAN   CITTERT
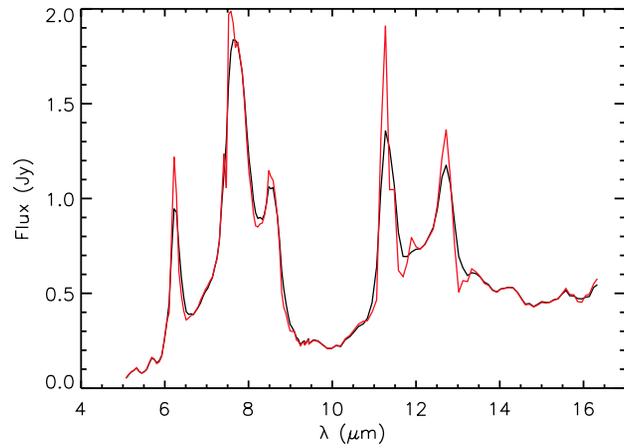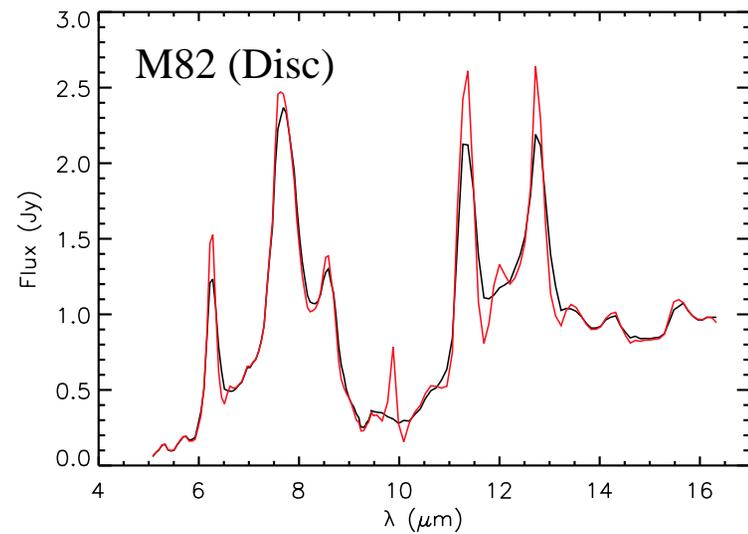
LANDWEBER
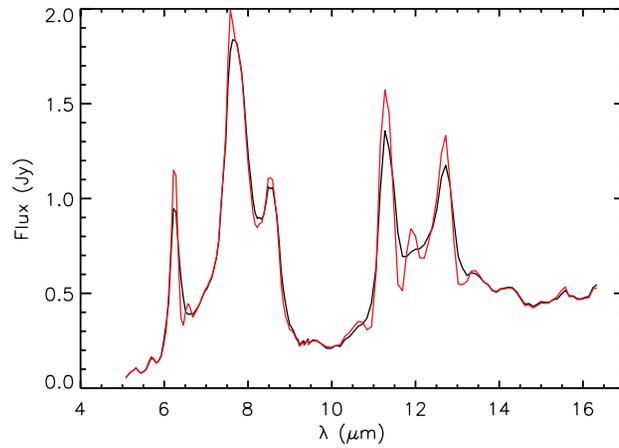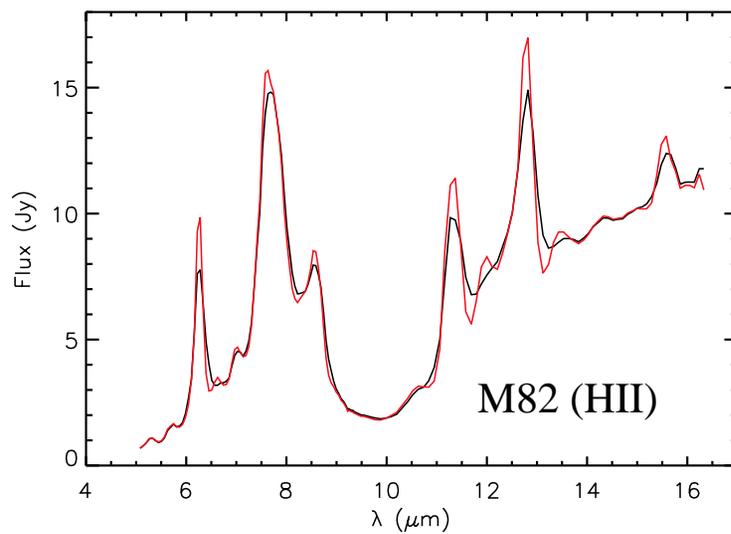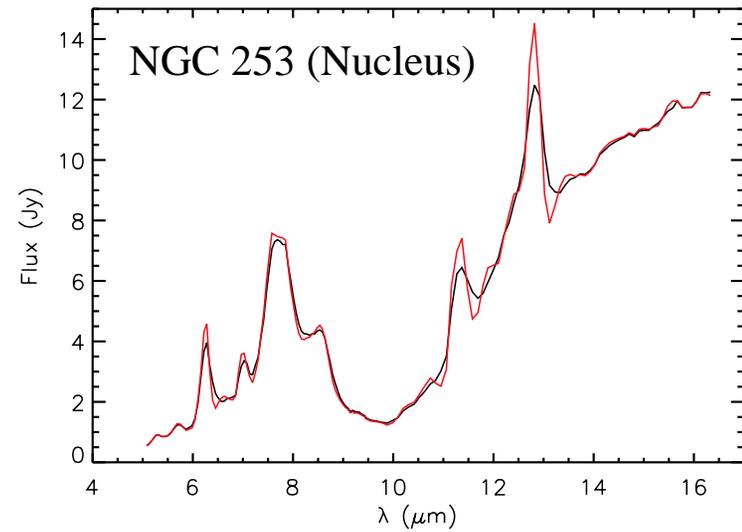
RICHARDSON-LUCY
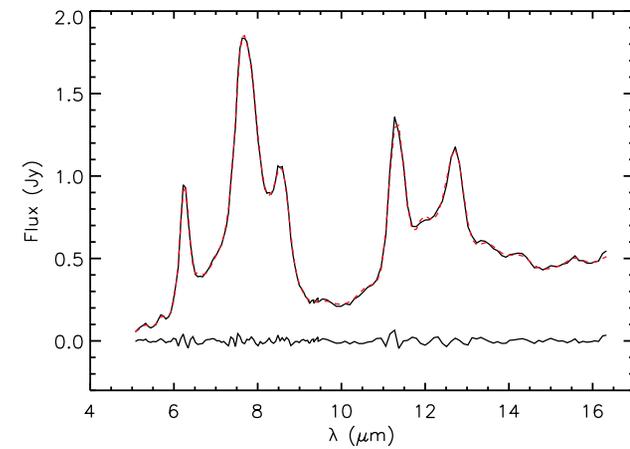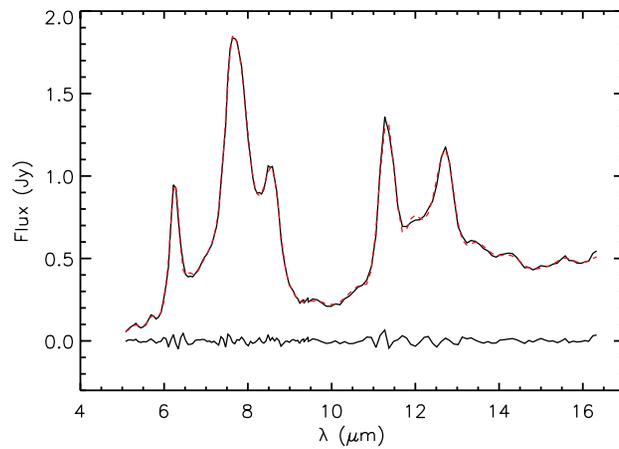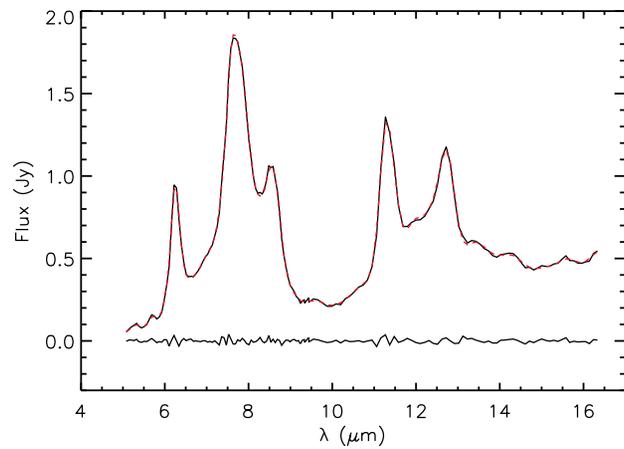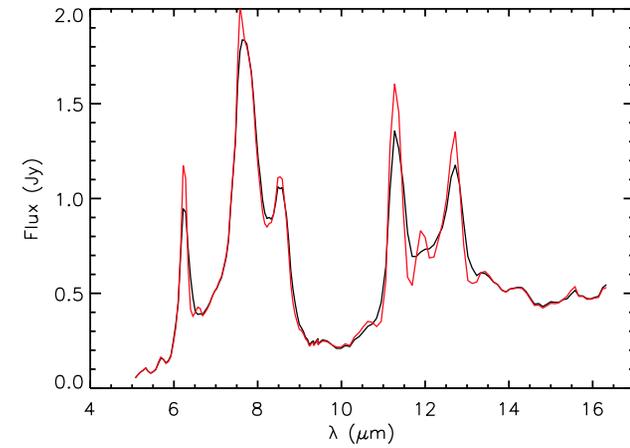
DECONVOLUTION
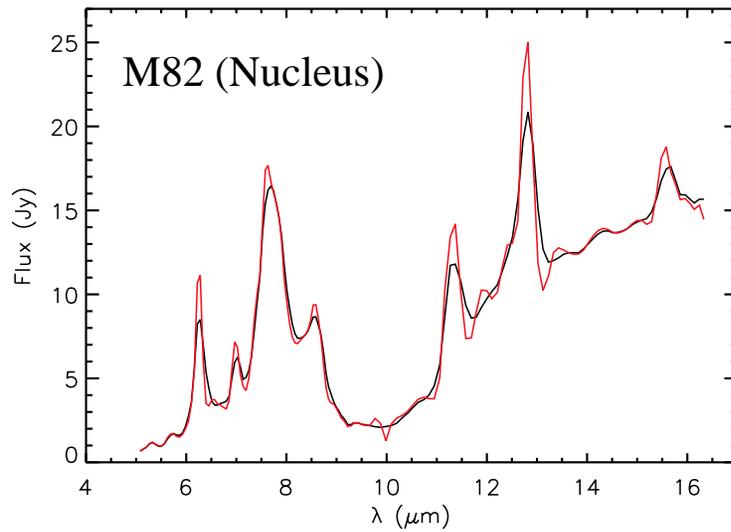## RICHARDSON-LUCY METHOD

—— SPECTRA   —— DECONVOLVED SPECTRA

RESTORATION
RICHARDSON-LUCY METHOD