Direct Imaging Assignment

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1 MEDIAN COMBINED IMAGE

1.1 CONTRAST CURVE

The procedure to make the contrast curve is described as following.

1. Add unsaturated PSFs into original un-rotated images as fake planets. Fake planets are evenly placed 0 to 3 arcsec away from the peak of the primary star. A median combination of images with fake planets is presented in Figure 1.2. The peak value of the fake planet is fixed, and defined as Amp_{PSF}

2. Noise is measured in an annulus around the fake planet. The inner and outer radii of the annulus are 15 and 20 pixels. I define the noise as the square root of the second moment of the pixel values in the annulus to avoid negative value due to Primary subtraction.

$$\text{Noise} = \sqrt{\frac{1}{n} \sum_{i=1}^{n} F_n^2}$$

3. S/N is defined as peak value of PSF Amp_{PSF} and the Noise calculated as above. Contrast curve is defined as the relationship of S/N and angular separation. Figure 1.3 presents the contrast curve for median combined image with $\text{Amp}_{\text{PSF}} = 2000$.
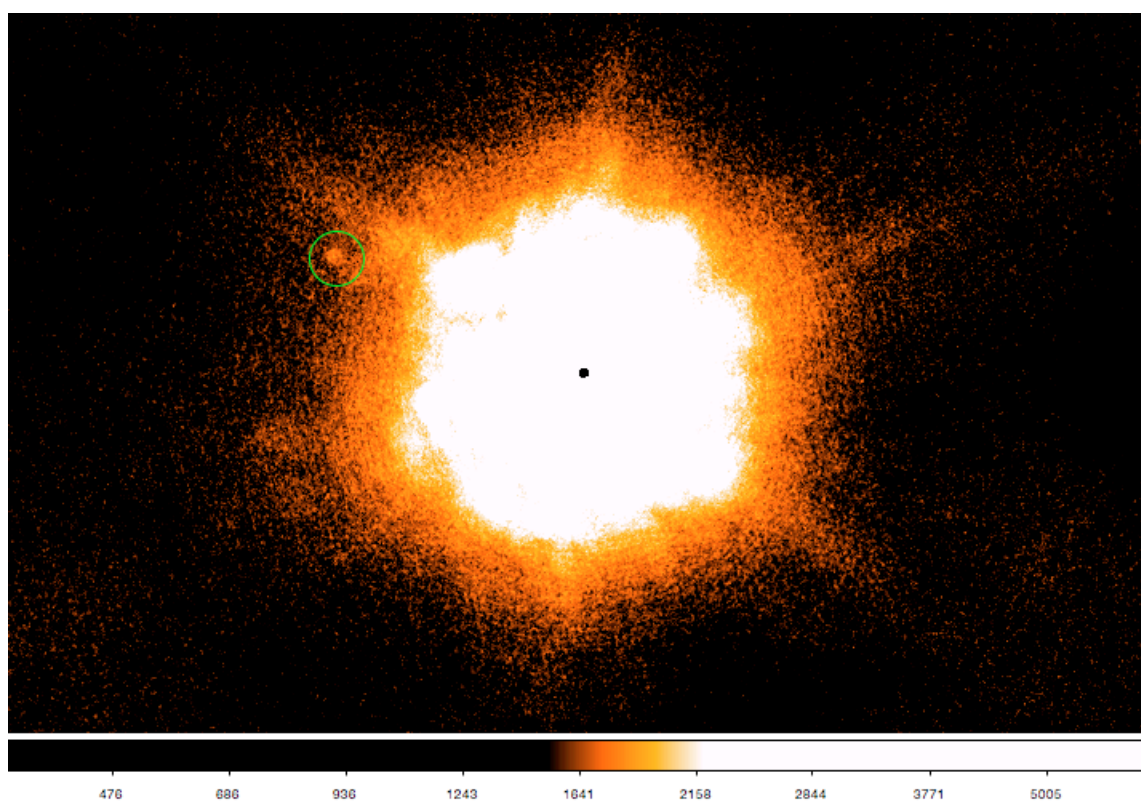
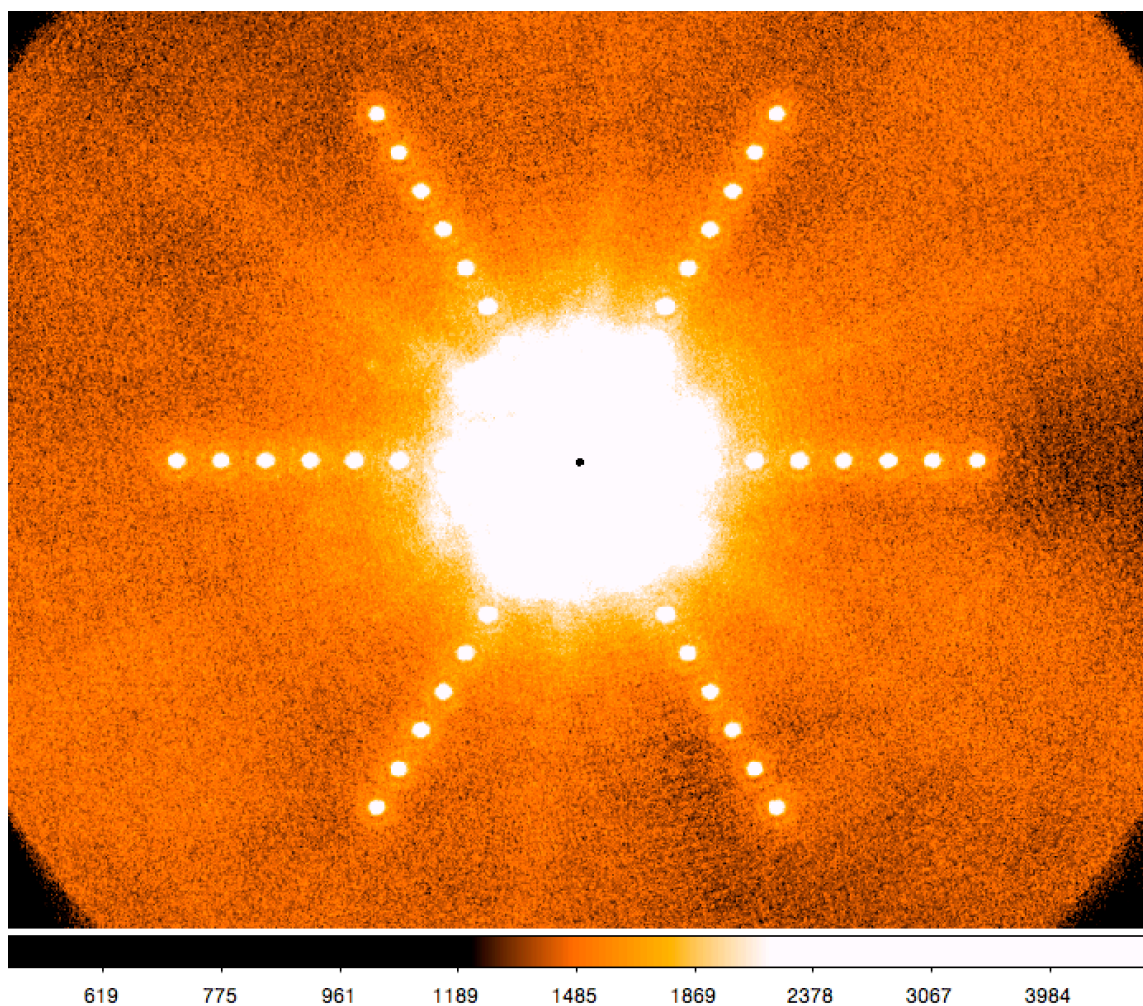Figure 1.1: Median Combined Image for HR8799 system. On this image, only HR8799 b is clearly shown.

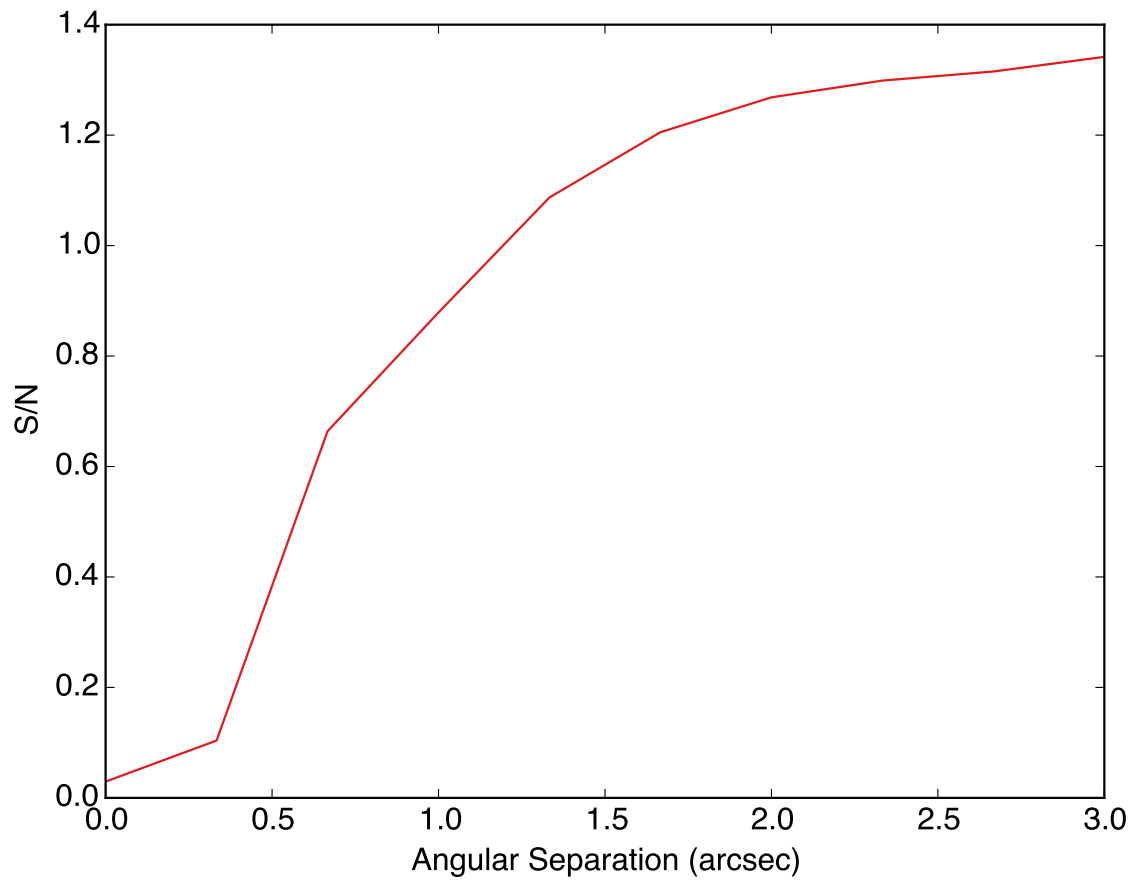Figure 1.2: Median combination of images with fake planets adding in.

Figure 1.3: Contrast curve for meian combined image. The PSF that used as fake planet is scaled so that the peak value is equal to 2000.
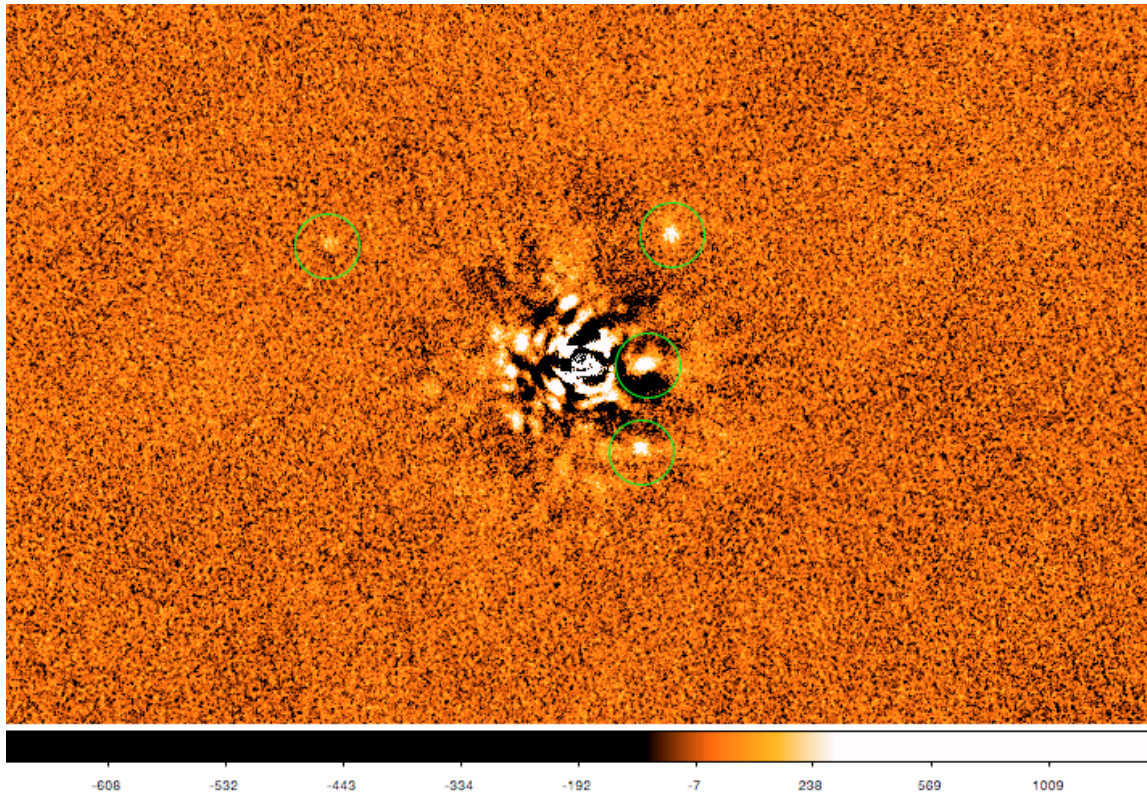
Figure 2.1: HR8799 primary star subtracted with ADI technique. HR8799b, c, d now are clearly shown on the image. The bright spot near HR8799e is hardly tell whether it is the image of HR8799e or it is a quasi bright speckle.
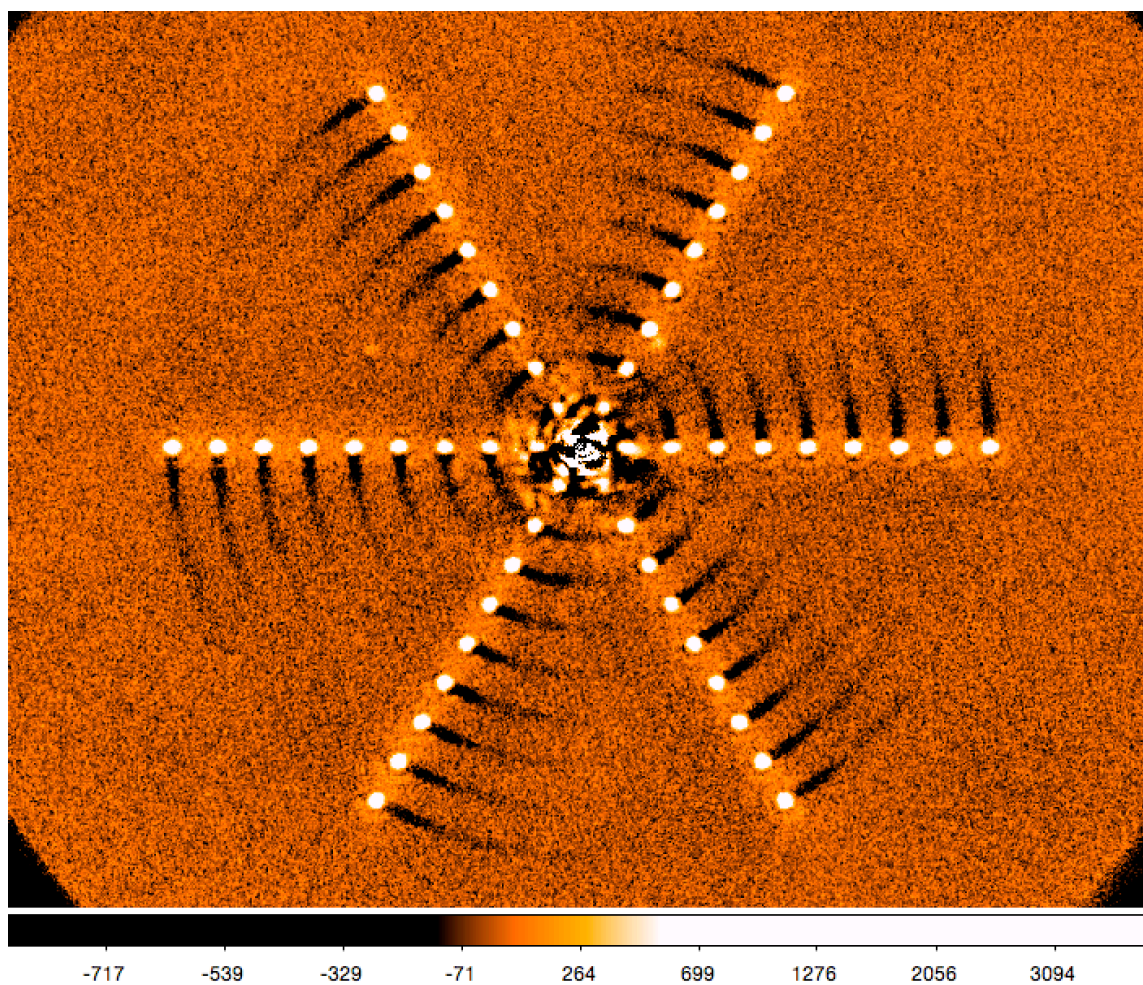
Figure 2.2: Image with primary subtracted using ADI with fake planets adding in.
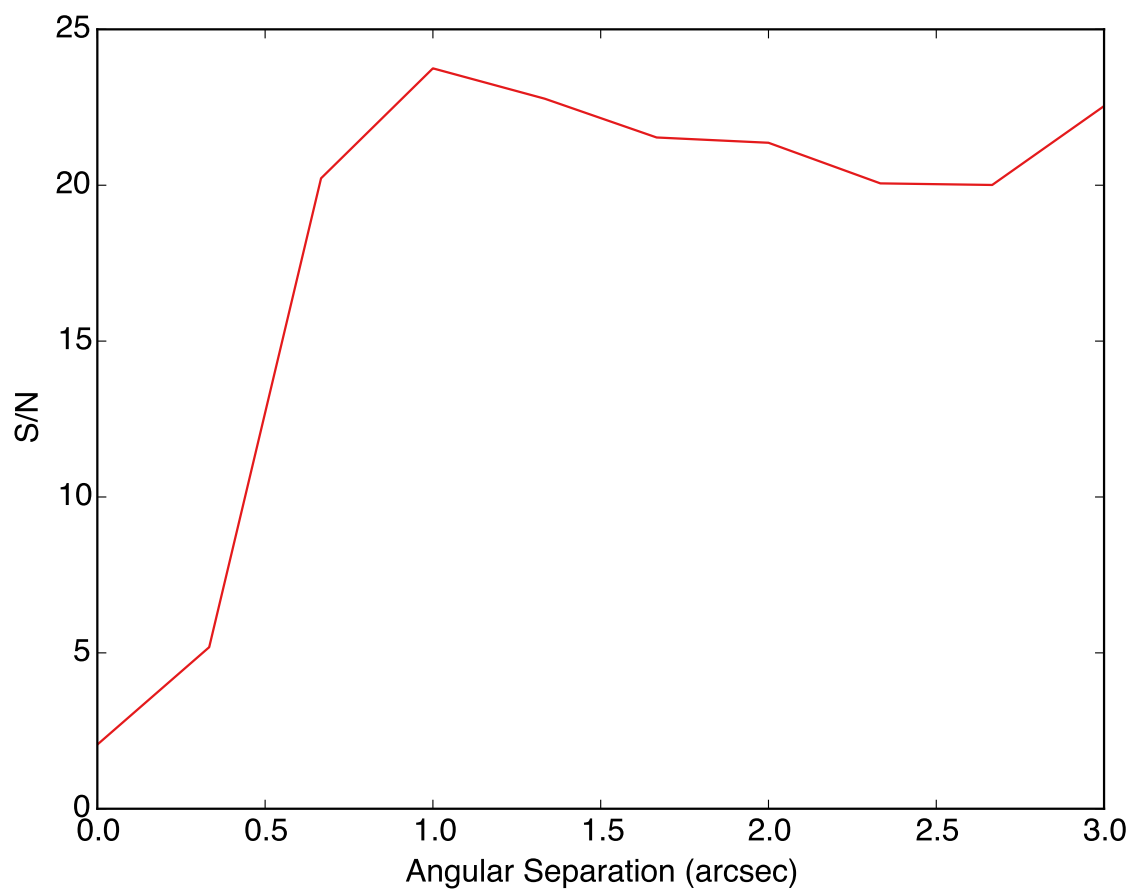
Figure 2.3: Contrast curve for image that is shown in Figure 2.2 . The PSF that used as fake planet
is scaled the same way as in Figure 1.2