

# Experiment considerations: head coils and fields of view

## The design of the 32 channel head coil

Siemens 32 channel head coil has two parts: anterior (*HEA*) and posterior (*HEP*). The former part contains 12 coil elements (or channels) and it is placed on top of the latter part which contains 20 coil elements (see Figure 1).

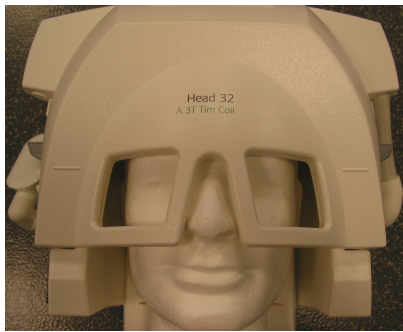


Figure 1: HEA + HEP

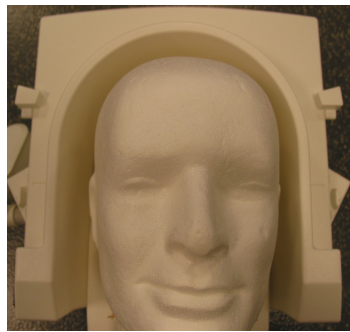


Figure 2: HEP, top view



Figure 3: HEP, side view

The design of the anterior part (*HEA*) resembles a Star Wars helmet with coil elements surrounding subject's eyes. These elements may limit subject's binocular field of view. Let us illustrate this limitation with an example. In our test setup the subject placed his head in the head coil (Figure 1) while the back projection screen was placed so that the viewing distance from the subject's eyes to the back projection screen was 43 cm (see Figure 4). The subject had an unobstructed binocular field of view only if the image width was kept to less than 2 cm. Images wider than this could not be seen by both eyes. If the back projection screen was placed at the back of the MRI scanner at 1.6 meters distance from the subject's eyes, the subject would see the entire 22 cm wide image with his both eyes. We wish to emphasize that this maximum viewing angle should be considered merely as a guideline because the maximum binocular field of view depends on various factors such as the distance between subject's eyes.

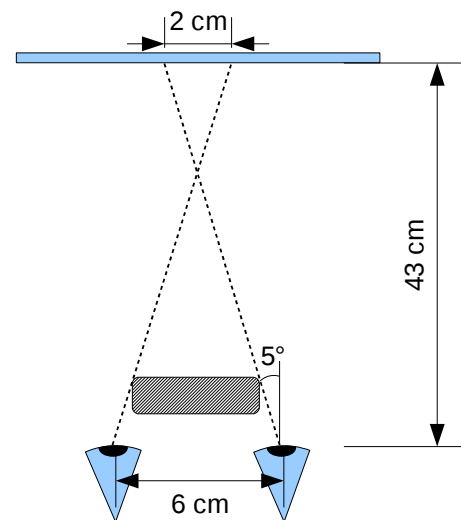


Figure 4: Field of view, 32 ch coil.

If the limitations in the binocular field of view are unacceptable for your experiment, one solution is to remove the anterior part of the head coil (Figure 2). However, this removal of the top part comes at the cost of signal loss especially in the frontal lobe (see page 3 Figure 7).

## The design of the 20 channel head/neck coil

Siemens 20 channel head/neck coil has considerably better binocular field of view even if it also has coil elements close to subject's eyes (Figure 5). Figure 6 shows the corresponding geometry for the 20 channel head/neck coil. The improved field of view enables the subject to easily see the whole screen. In this setup extra pillows were set under the subjects head so that his eyes were as close as possible to the obstructing coil element. However, setting the extra pillows under the subject's head can lead to small signal loss in the occipital lobe because the back of the subject's head is now further away from the bottom coil elements. In our test setup we found roughly 11% loss in the signal-to-noise ratio (see page 4 Figure 8 and Figure 9).

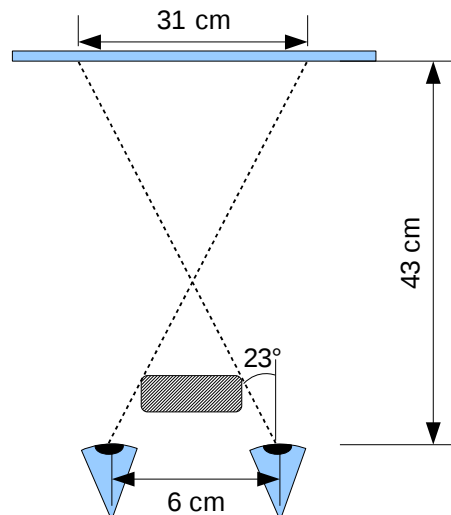
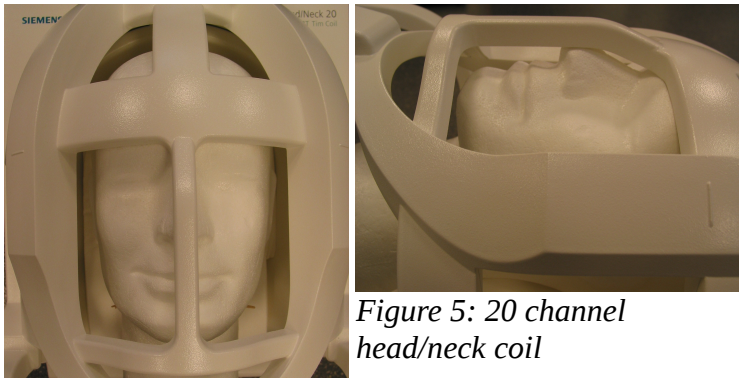


Figure 6: Field of view, 20 channel head/neck coil

## Measurement protocols

The quality of the different coil setups was assessed in MRI scanner by using several different measurement protocols and then the change in the signal levels was monitored. Following measurement parameters were used:

- EPI: TR=1800ms, TE=30ms, slices=29, slice thickness=3mm, resolution: 64x64, 20 time points (the figures show the average over these 20 time points).
- PD (proton density): TR=300ms, TE=6ms, slices=3, slice thickness=5mm, resolution: 384x384.

## Figures, 32 channel head coil

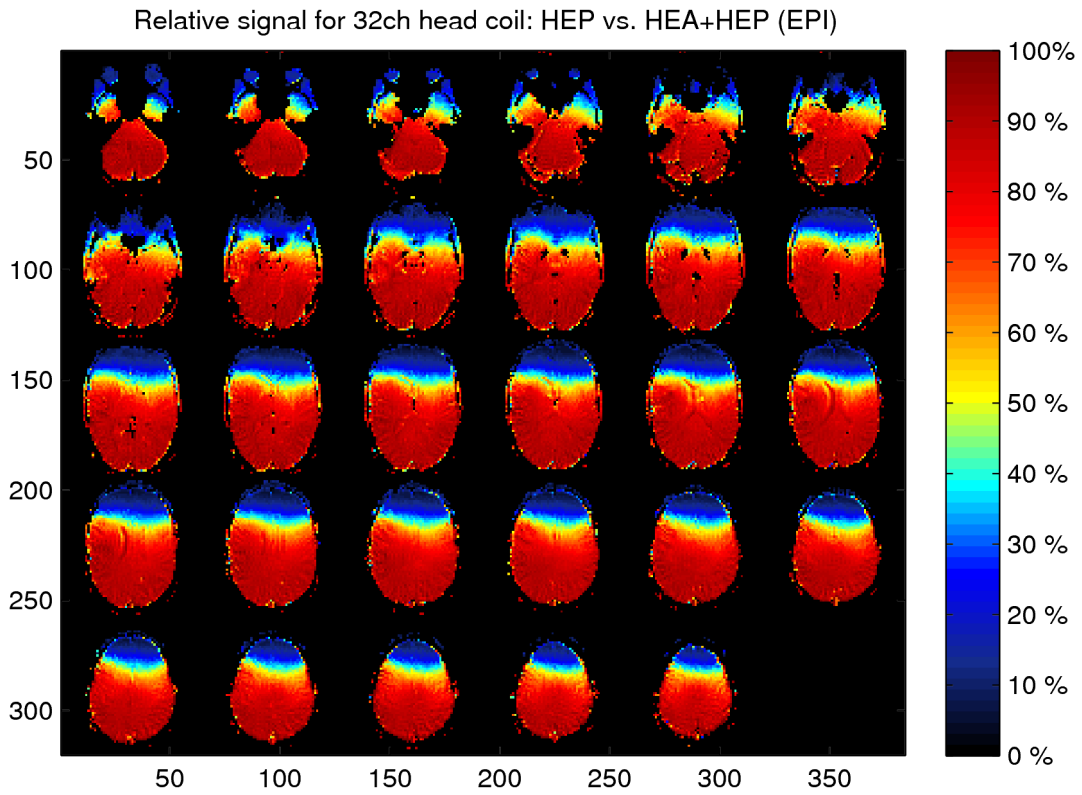
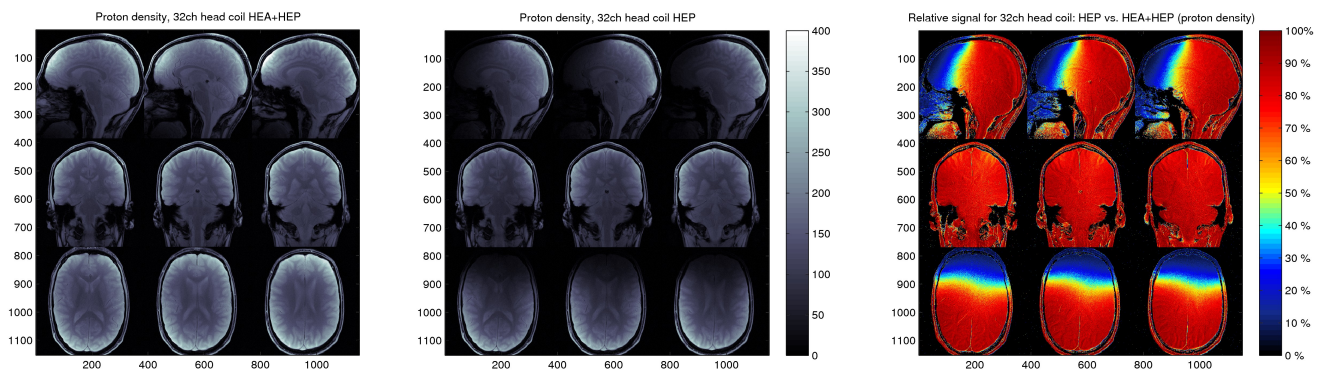


Figure 7: How much signal remains in different parts of the brain if the anterior part of the 32 channel head coil is removed (EPI)?



Proton density weighted images taken with (left) both anterior *HEA* and posterior *HEP* parts of the coil on and (middle) only the posterior *HEP* part on. (right) is the *HEP*-image divided by the *HEA+HEP*-image.

## Figures, 20 channel head/neck coil

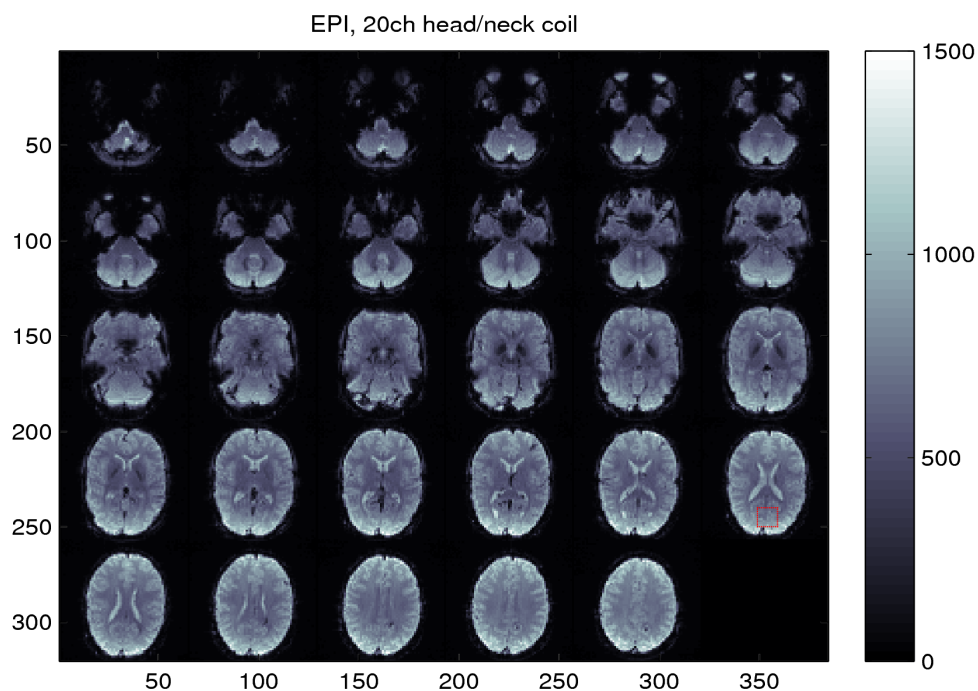


Figure 8: EPI, signal level. Subject has only a thin pillow under his head.

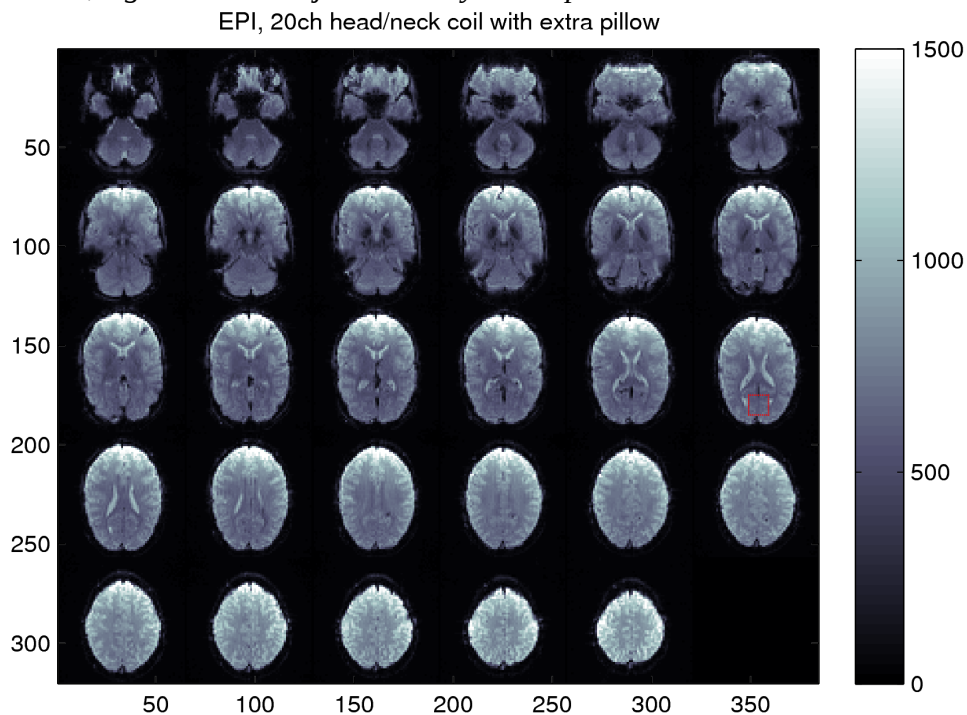


Figure 9: EPI, signal level. Subject has an extra pillow under his head i.e. subject's eyes are as close as possible to the upper part of the head coil. Notice the signal loss in the occipital lobe and the signal gain in the frontal lobe as compared to the previous image. The loss in the SNR in the red rectangle is 11 % (from 402 to 356).