Can MLC Leakage and Transmission Be Used to Obtain Megavoltage CT Images During Treatment?

The NOMOS Corporation has developed an early form of axial tomotherapy through the use of its binary, temporally modulated MIMiC collimators. While these collimators do provide for highly conformal intensity-modulated treatments, they do not incorporate full treatment verification possibilities, such as megavoltage CT (MVCT), found in an integrated tomotherapy system. Another problem with the NOMOS implementation of tomotherapy is that the MIMiC collimator has been shown to leak and transmit radiation to the patient.

However, these problems may culminate in megavoltage CT imaging with No Additional Dose. That is, the leakage through the MIMiC during a typical treatment is sufficient to create MVCT images showing contrasts of better than 10%.

Tests of this imaging method were conducted on the University of Wisconsin Tomotherapy Benchtop. It was found that during a 220 cGy treatment, enough leakage is transmitted through the closed leaves to generate MVCT images of the patient. While such images are not of diagnostic caliber, they do show the patient's position and the locations of high-contrast objects without any additional dose.

Ultimately, the goal is to merge the high dose treatment signal with the very low dose signal from leakage and transmission. This will allow for MVCT imaging of the entire patient during a conformally modulated treatment to a limited region of the patient, utilizing the high dose signal inherent to the treatment, but without contributing any additional dose beyond the leakage and transmission.