Ambiguous Hits in the IST:

Howard Wieman has recently written up a calculation for the number of ambiguous hits that are seen in the proposed Pad+Strip configuration for the IST.

http://www-rnc.lbl.gov/~wieman/StripPlusPadPileup.htm

The IST detector configuration is very nice. The first half of an IST layer is a detector consisting of a series of strips that are 3.8 cm long and 60 microns wide. The second half of an IST layer is a detector consisting of an array of 1.9 mm long by 1.2 mm wide pads. The two detectors layers are sandwiched together to form one IST layer.

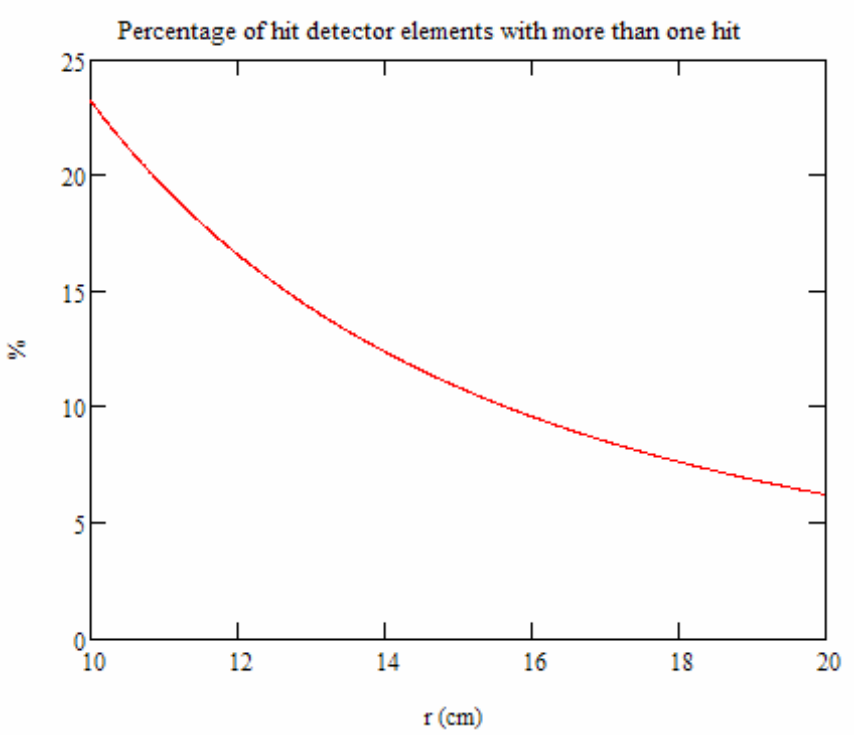
The purpose of the pads is to lower the effective occupancy on a strip by giving it course segmentation along the length of the strips. It works.

However, this technique is projective and therefore leads to the possibility of ambiguous hits (sometimes called ghost hits). The ambiguities are found when two hits on the strips lead to four possible combinations on the strips plus pads. You cannot tell which are the real hits and which are the ambiguous hits unless you have extremely good tracking leading up to the detector; which we don't have.

This is not a problem if the occupancy on the strips is sufficiently low. There is a rough rule of thumb that suggests that the occupancy, and rate of ambiguous hits, should be less than 10%. Many successful detectors have been built where the occupancy and ambiguous hits are in the range from 1% to 10%.

Obviously, the number of ambiguous hits depends on the event multiplicity and the size of the detector elements.

So Howard's web page documents one calculation of the rate of ambiguous hits as a function of radius of the proposed detector. He assumes the standard IST detector geometry, and he assumes that we want to observe central Au-Au collisions. He uses the primary track multiplicty (~700) as input to the calculation. His results are shown in the figure, below, and on his web page.



The net result is that a detector at 17 cm radius may suffer from an ambiguous hit rate of about 7 or 8%. This is fine.

However a detector at 12 cm radius is beginning to get into an uncomfortable range where the ambiguous hit rate is over 15%. And a detector at 9.5 cm radius has (I believe) and unacceptable ambiguous hit rate of 25% or more.

These results are not new. Howard discussed this problem at the Yale R&D workshop many years ago. I have also discussed this problem in various informal specification documents for an intermediate tracker.

So the bad news is that it is not a good idea to move an IST layer to a radius of 9.5 cm. Especially since these calculations use the primary track rate in a central collision, whereas the global track rate is measured to be double this rate (not including background).

On the other hand, the good news is that I do not believe we need the inner IST layer to sit at a radius of 9.5 cm. In a separate note, I will show that a layer at 12.0 cm is perfectly adequate as a pointing device for the HFT.

See: http://rnc.lbl.gov/~jhthomas/public/HFT/ISTat12cm.pdf

Finally, as a postscript, it is worth noting that these ambiguous hits are *not* simulated and not included in our Monte Carlo calculations and are not included in the so-called hand calculations. Howard's note is the only available estimate of this effect.