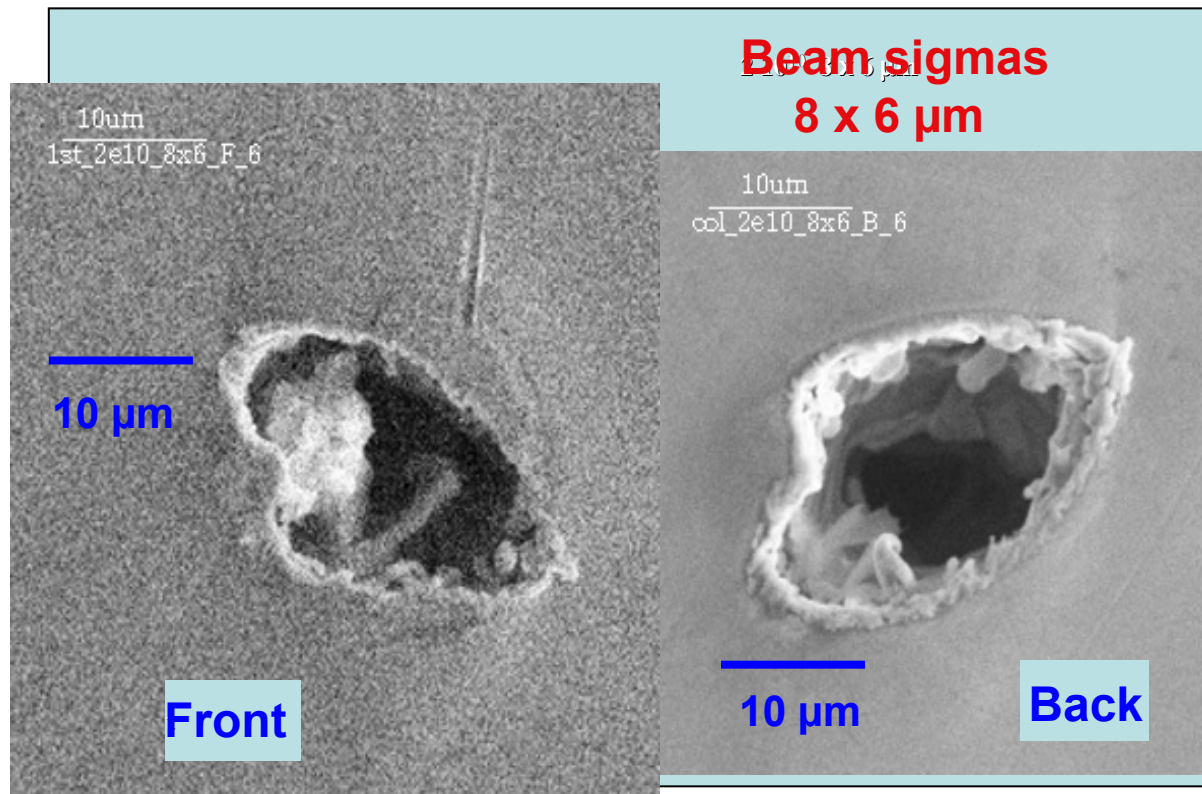L. Keller, 13 Mar. 2007

# Collimation Performance vs. Spoiler Length

**This is Work in Progress – preliminary results until**
**Drozhdin (STRUCT), Jackson (MERLIN), et. al. look at it.**

**Electron micrograph of single 2 x 10$^{10}$ electron bunch through 1.4 mm Cu target.**



Beam sigmas
8 x 6 µm

10 µm

Front

10 µm

Back

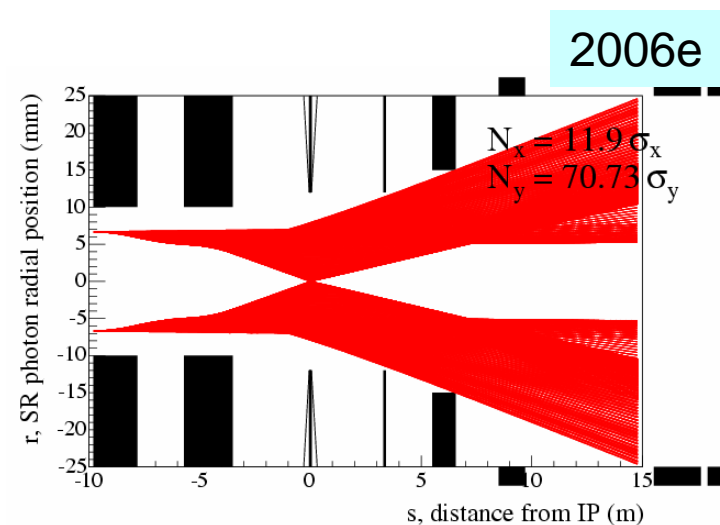This is not expected to happen for one bunch into our 0.6 rl titanium spoilers, but may happen in 4 to 5 bunches, 1000 µ$^2$.

Would like to reduce the spoiler length to get more headroom below the damage threshold and reduce wakefield kicks – keeping good collimation performance of course!

# RDR collimation depth

2006c

beamcal & low-Z mask
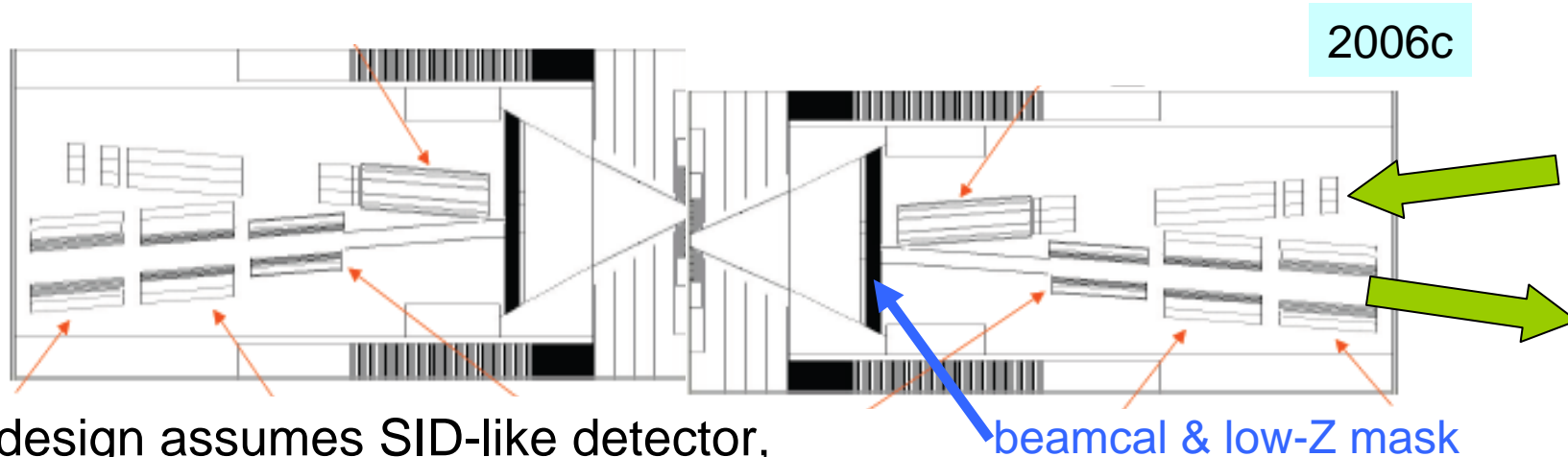
- IR design assumes SID-like detector, L* = 3.51

- Collimation depth constraint comes from first extraction quad (R= 15mm)

- Beamcal mask (r=12mm) comes close to SR fan

- $11.9\sigma_x$, $70.7\sigma_y \rightarrow$ spoiler full gaps 2.7mm (x) 1.3mm (y)

2006e

$N_x = 11.9\sigma_x$
$N_y = 70.73\sigma_y$

r, SR photon radial position (mm)

s, distance from IP (m)

**Baseline spoiler settings are 8 $\sigma_x$ and 57 $\sigma_y$**

# Parameter Sets

- Calculation has been done for nominal parameter set
- Other parameter sets have smaller $\beta^* \to$ larger IP angles $\to$ tighter collimation
- 'Low P' & 'high lumi', $\beta^*$ twice as small as nominal
- Reduced collimation depth by factor $1/\sqrt{2}$
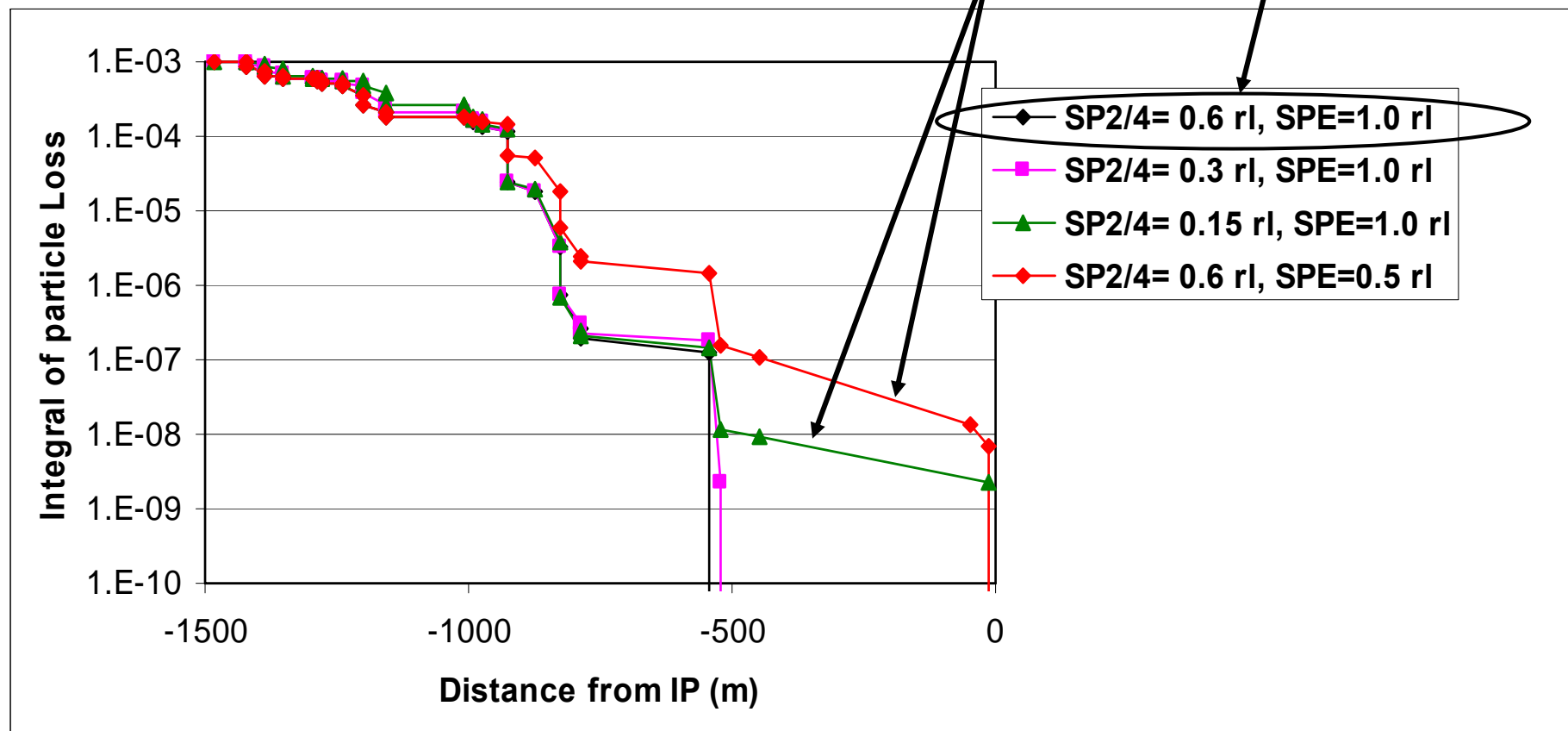  - $\sim 8.5\sigma_x$, $50\sigma_y$
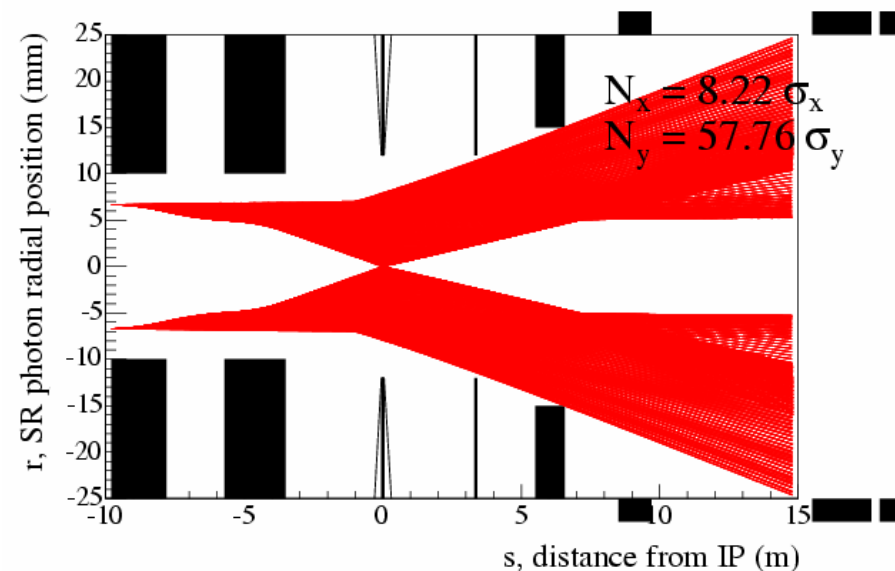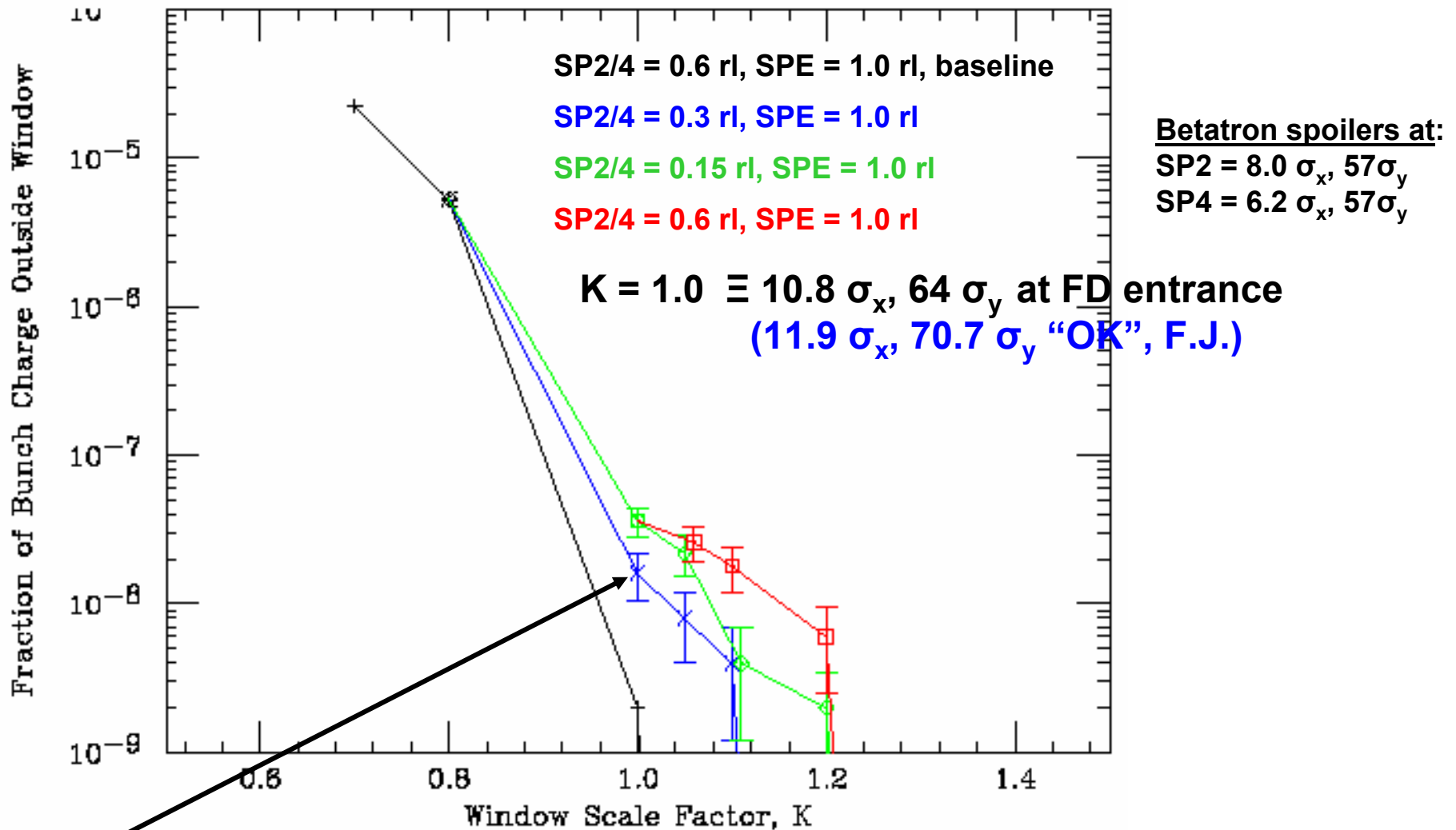
# Results

L. Keller, Mar. 2007

## Halo Particle Loss for Four Spoiler-Length Combinations - TURTLE

**SP2/4 = 0.15 rl** and **SPE = 0.5 rl** are <u>not</u> acceptable

# Collimation Performance for Four Spoiler-Length Combinations - TURTLE



SP2/4 = 0.6 rl, SPE = 1.0 rl, baseline

SP2/4 = 0.3 rl, SPE = 1.0 rl

SP2/4 = 0.15 rl, SPE = 1.0 rl

SP2/4 = 0.6 rl, SPE = 1.0 rl

Betatron spoilers at:
SP2 = 8.0 $\sigma_x$, 57$\sigma_y$
SP4 = 6.2 $\sigma_x$, 57$\sigma_y$

K = 1.0 $\equiv$ 10.8 $\sigma_x$, 64 $\sigma_y$ at FD entrance
(11.9 $\sigma_x$, 70.7 $\sigma_y$ "OK", F.J.)

This is 8 "events" out of 500 K halo started (i.e. 320 per 2x10⁷ collimated)
– **they all hit SP4 but their trajectories don't pass near any collimator apertures**

## <u>Very Tentative Conclusions</u> <span style="color:red">(Work in Progress)</span>

1) Reducing the betatron spoiler length from 0.6 rl to 0.3 rl gives an acceptable loss distribution, but the "sharpness" of the collimation depth at the FD entrance needs more study.

2) Reducing the energy spoiler length from 1.0 rl to 0.5 rl gives unacceptable collimation performance.

3) For particles outside the collimation depth at the FD, need to look at backscattered synchrotron radiation in the detector. (The collimation depth is presently defined by the first extraction quad aperture for L* = 3.51 m).

4) For different spoiler lengths, i.e. 0.3 rl, need to once again simulate heating for missteered bunches.