

3. Verification and Validation

Verification – does code compute what it is supposed to?

Validation – does code compute the answer?

- Verification
 - Particle simulation verified against Trace3D
 - Envelope simulation verified against Trace3D
- Validation
 - Envelope simulation validated against SNS commissioning data

Trace3D Approximation

Space charge envelope simulation requires evaluation of $R_D(x,y,z)$

- XAL numerically evaluates R_D
$$R_D(x, y, z) \equiv \frac{3}{2} \int_0^{\infty} \frac{dt}{(x+t)^{1/2} (y+t)^{1/2} (z+t)^{3/2}}$$

Trace3D approximates R_D
(via lookup table on ξ)

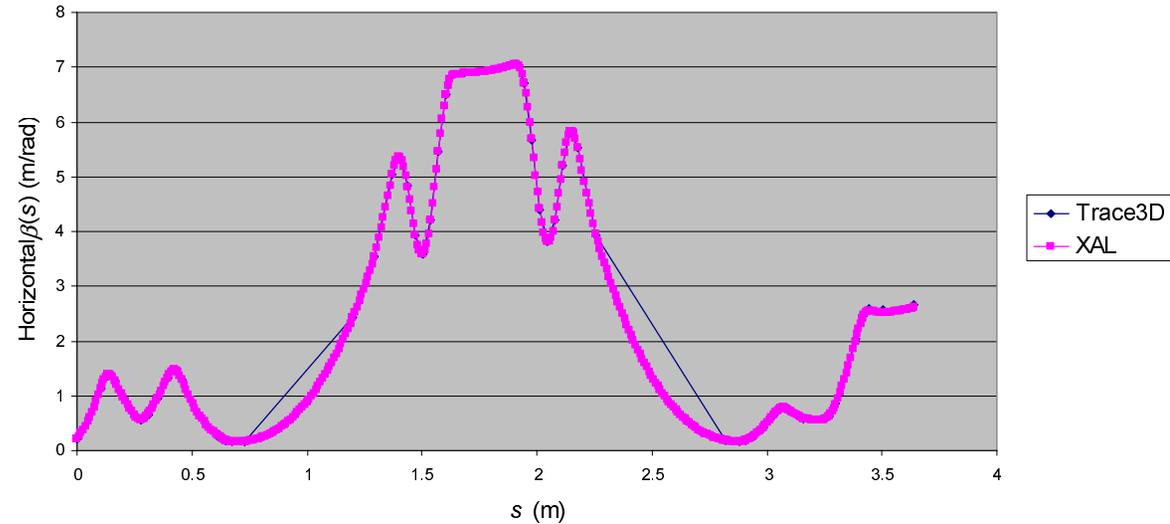
$$R_D(Z^2, Y^2, X^2) \approx \frac{3}{XZ} \frac{1}{X+Y} \left[1 - \xi \left(\frac{Z}{\sqrt{XY}} \right) \right] + O(X-Y)$$

Trace3D Verification - Envelope Simulation

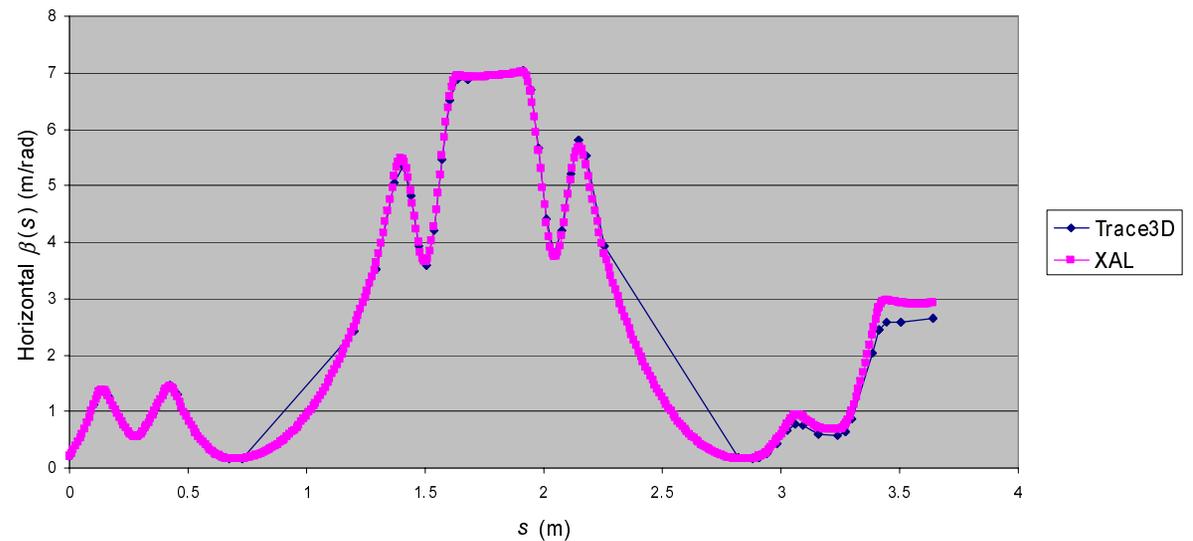
3. Verify/Validate

Implementing Trace3D R_D approximation

SNS MEBT Simulation



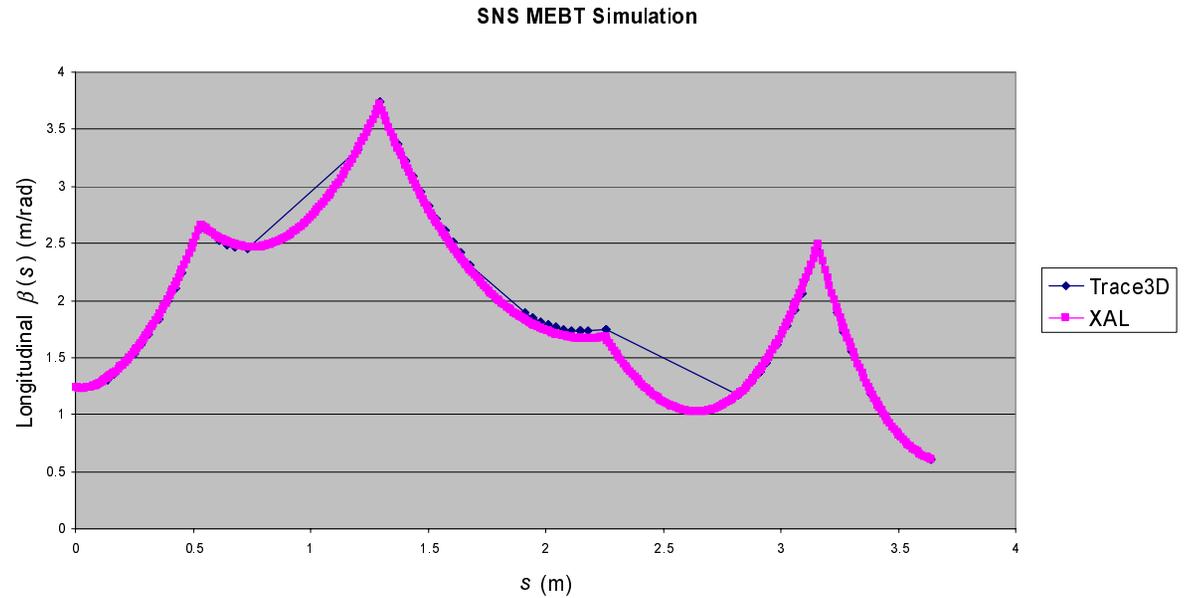
SNS MEBT Simulation



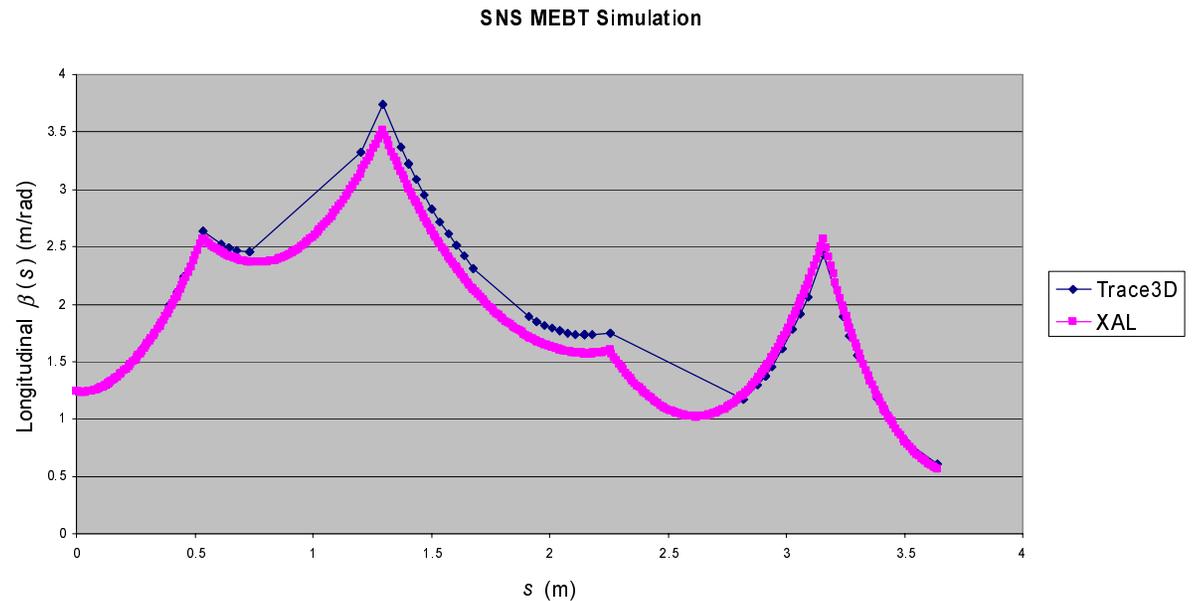
- Numerically evaluating R_D (a la Carlson)

Trace3D Verification - Envelope Simulation 3. Verify/Validate

Implementing Trace3D R_D approximation



Numerically evaluating R_D (*a la* Carlson)



3. Model Validation

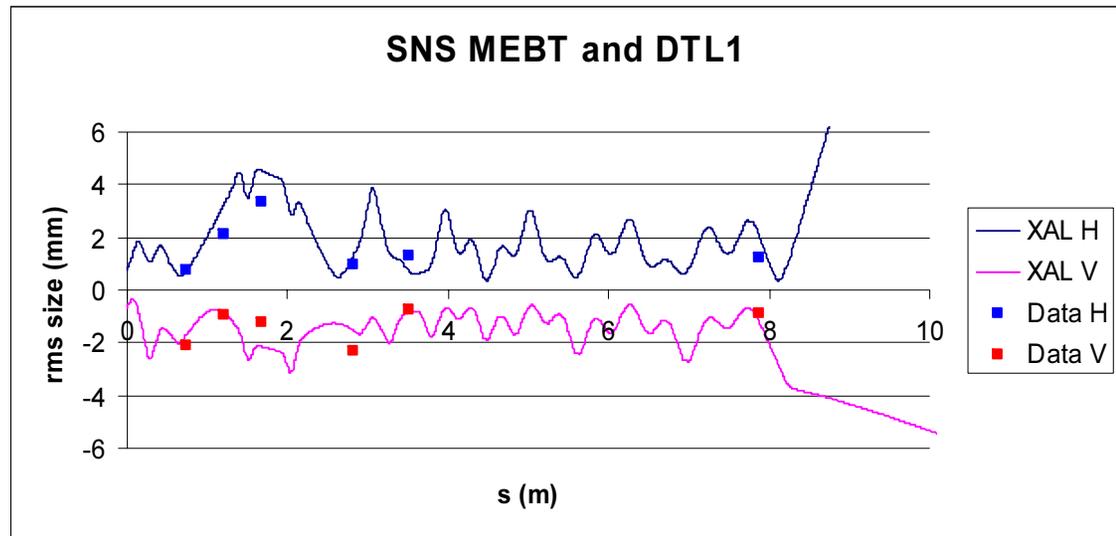
John Galambos, ORNL

- Compared model prediction to live data
 - SNS Accelerator at Oak Ridge
 - Wire scanner data at six (6) beamline locations
- Two measurements
 - Direct comparison
 - Perturbed quadrupole 5 setting

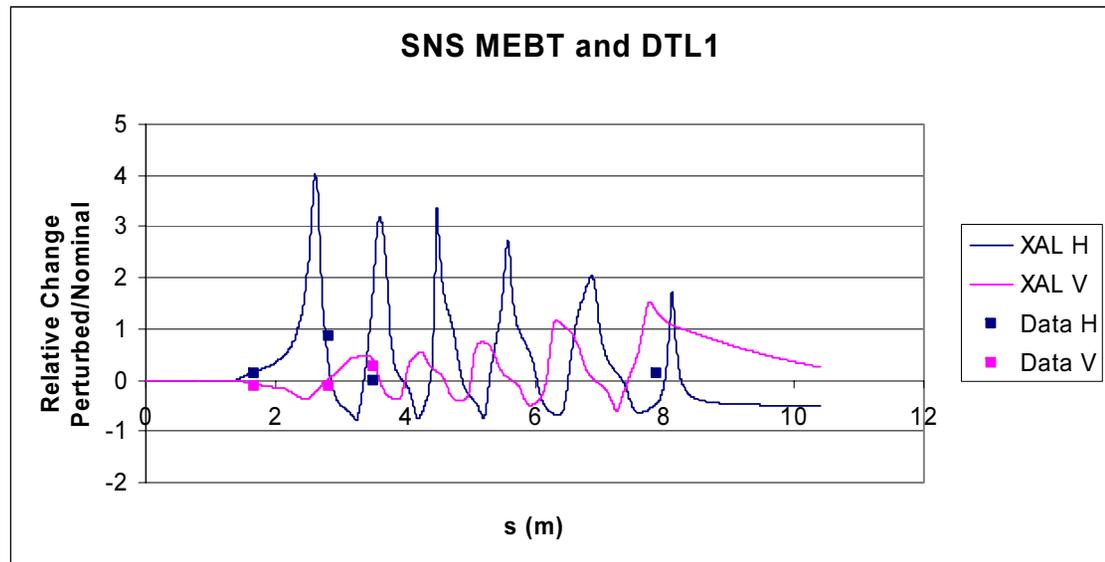
SNS Verification - Envelope Simulation

3. Validate/Verify

First measurement
Wire scanner data



Second Measurement
Perturbed quadrupole 5
setting
Measure percent
difference



Courtesy John Galambos, ORNL