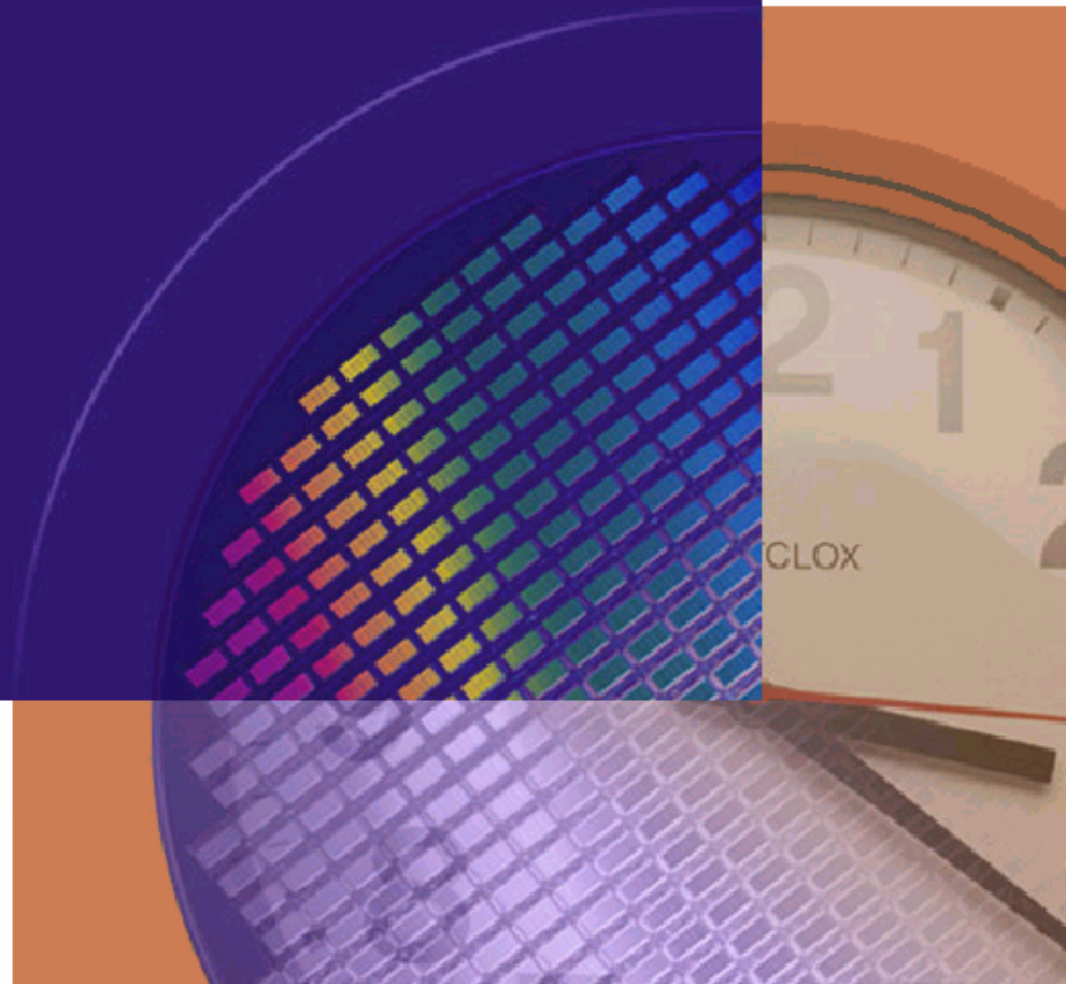




The Yield Management Company

Modeling in FaST Division

G. Janik 11/14/03



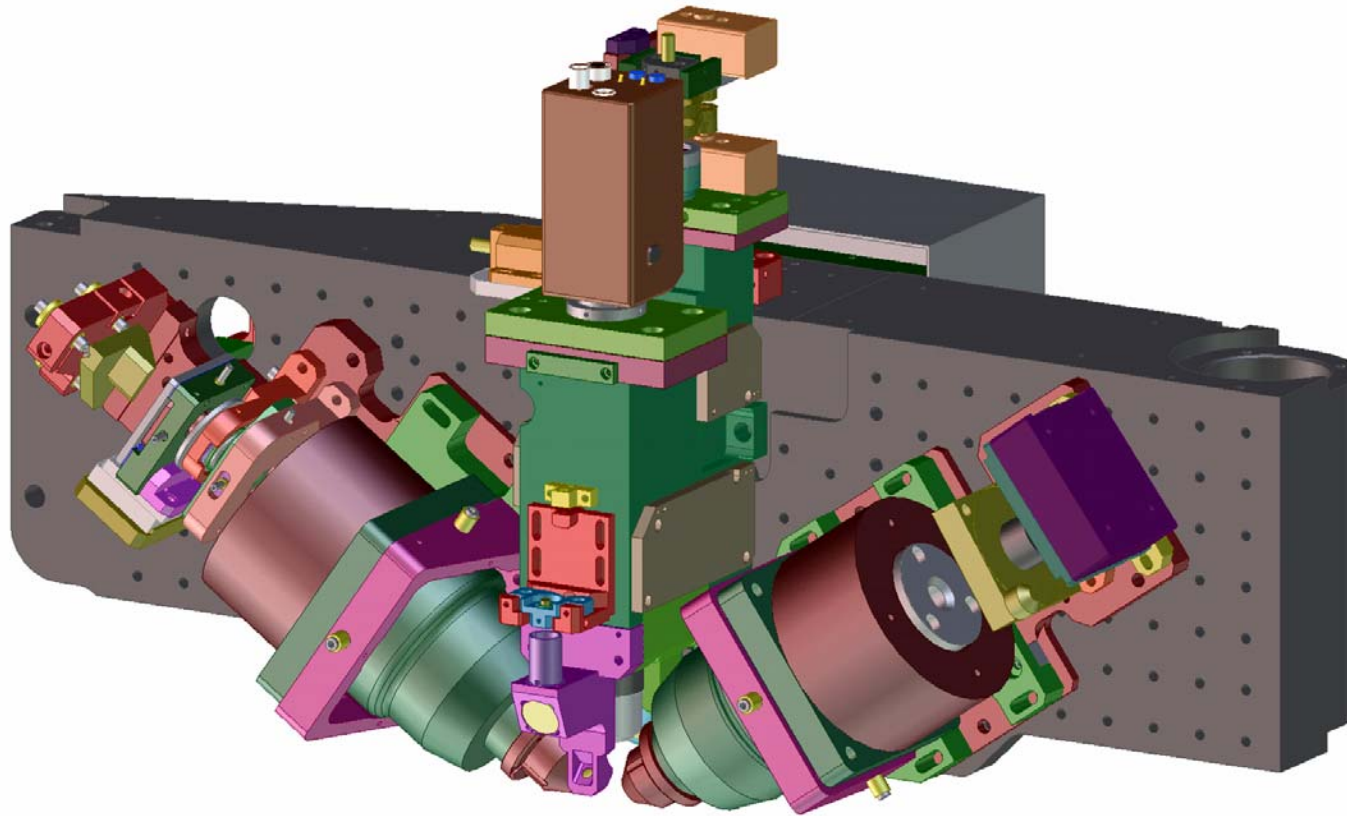
FaST Modeling

- **Uses of modeling:**
 - Hardware design
 - Measurement performance analysis
 - Film properties and materials
- **Instruments:**
 - Spectroscopic Ellipsometer (F5x, SpectraFx 100)
 - Single Wavelength Ellipsometer (Accufilm)
 - Electron Microprobe Analyzer (Metrix 100)
 - New products

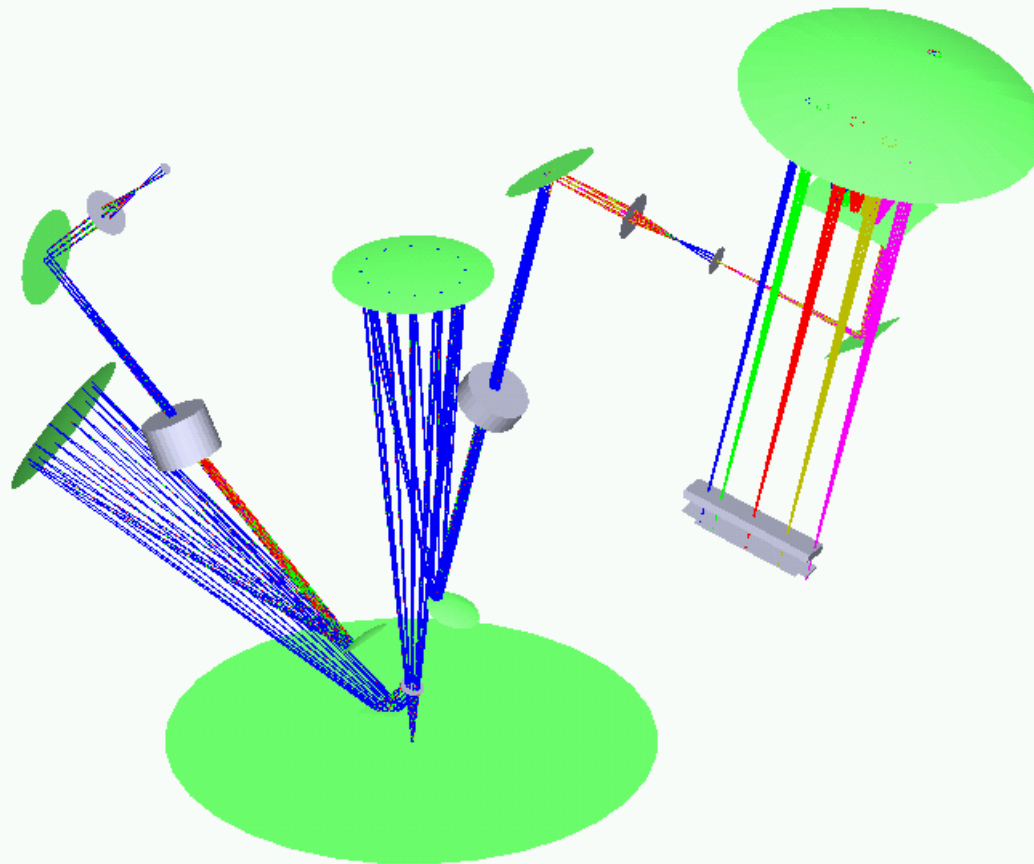
FaST Modeling – Hardware Design

- **Mechanical Design:**
 - 3-D solid models
 - Finite Element Analysis for structure and vibration
- **Electrical Design:**
 - Logic simulation of FPGAs
 - Spreadsheet analysis of analog circuits
- **Optical Design**
 - System ray tracing
 - X-ray ray tracing
- **Electron beam Design**
 - Electron optics simulation

FaST Modeling – Hardware Design

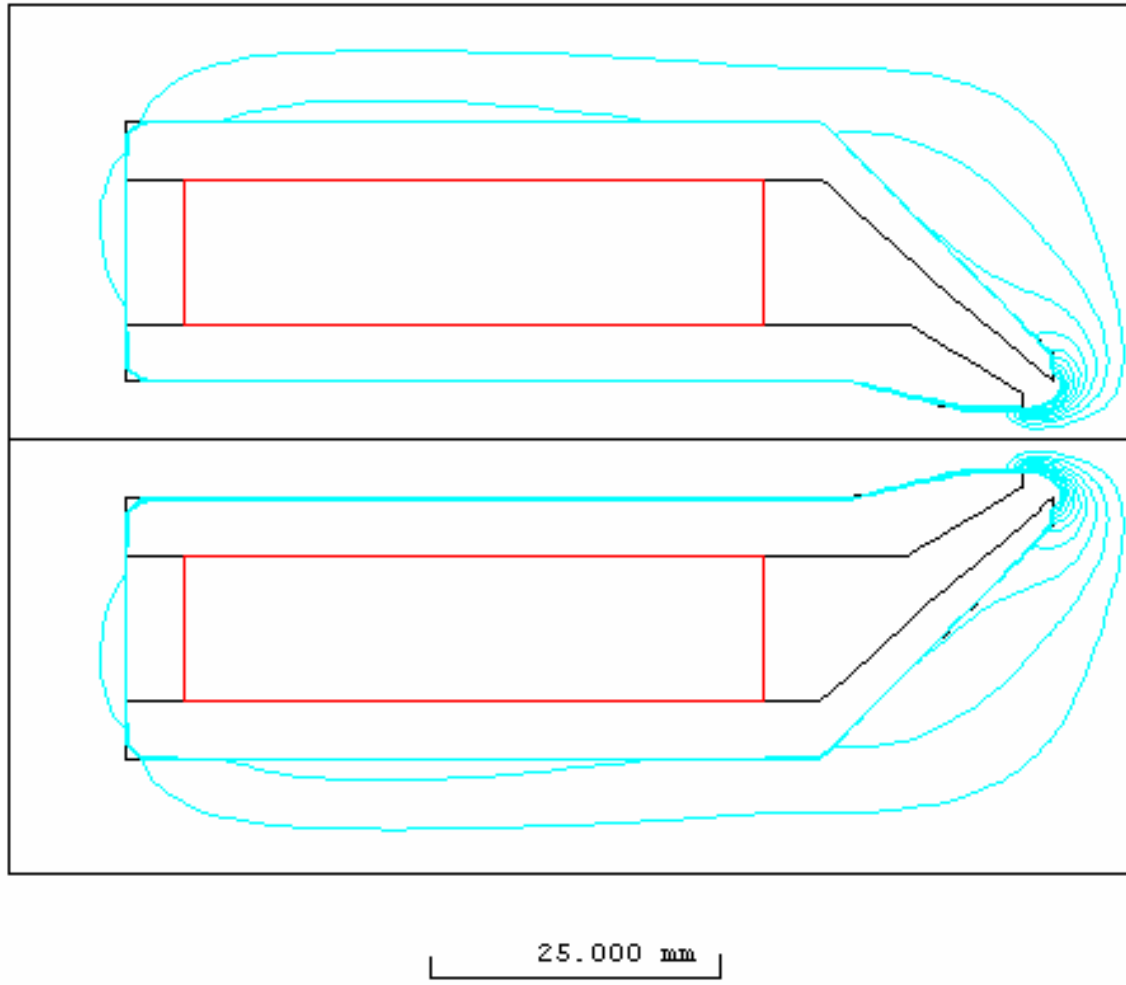


FaST Modeling – Hardware Design



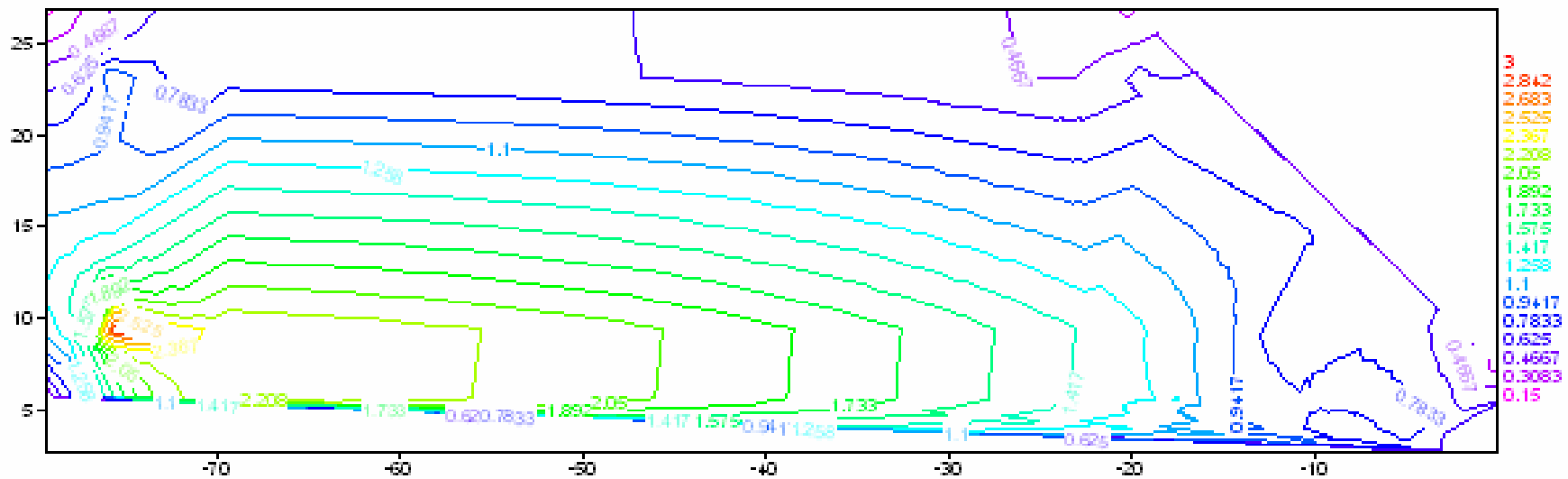
FaST Modeling – Hardware Design

Magnetic lens for Metrix 100 column



FaST Modeling – Hardware Design

Magnetic contour map of lens interior

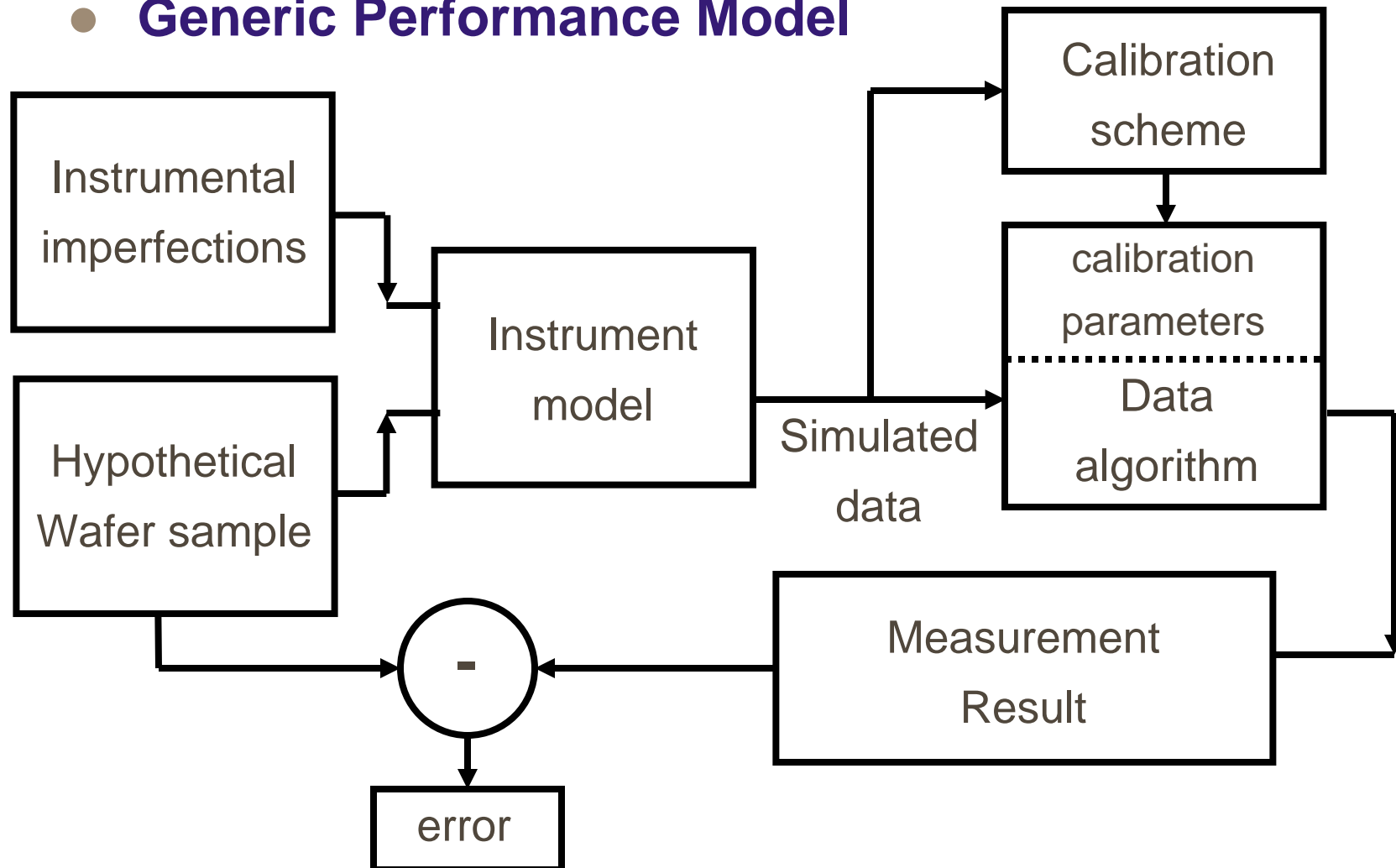


FaST Modeling – Performance Analysis

- **Spot size analysis for SE on SpectraFx 100**
 - in-house software including diffraction, and polarization effects
- **Precision analysis for SE on SpectraFx 100**
 - custom model developed including shot noise, lamp noise, and vibration
- **Calibration analysis for SE on SpectraFx 100**
 - custom model developed to investigate different calibration schemes
- **Matching analysis for SWE on SpectraFx 100**
 - custom model developed including various optical imperfections, misalignments, and motor speed variations
- **Wafer damage analysis for Metrix 100**
 - custom model including direct and indirect electron and x-ray damage mechanisms

FaST Modeling – Performance Analysis

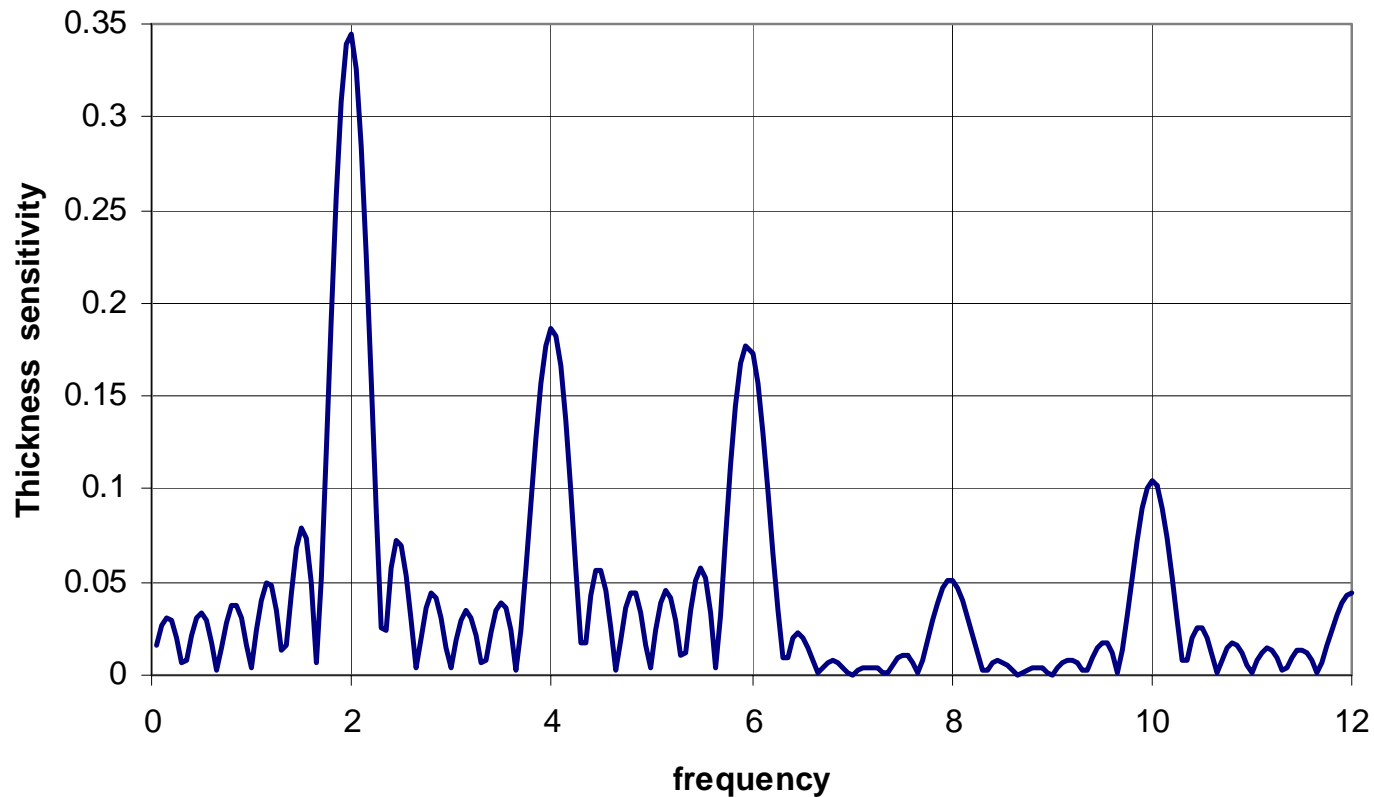
- **Generic Performance Model**



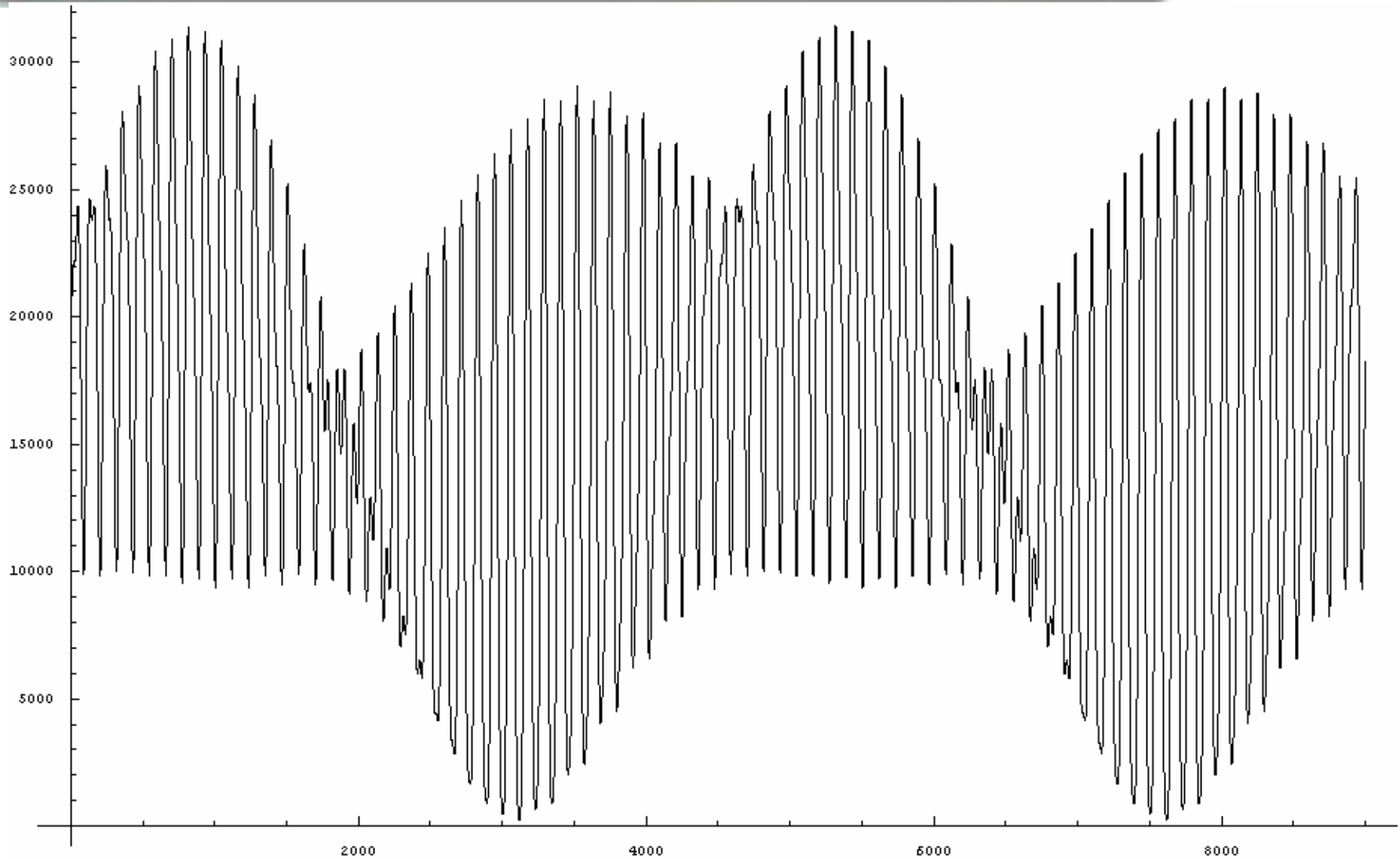
FaST Modeling – Performance Analysis

Results from a precision model:

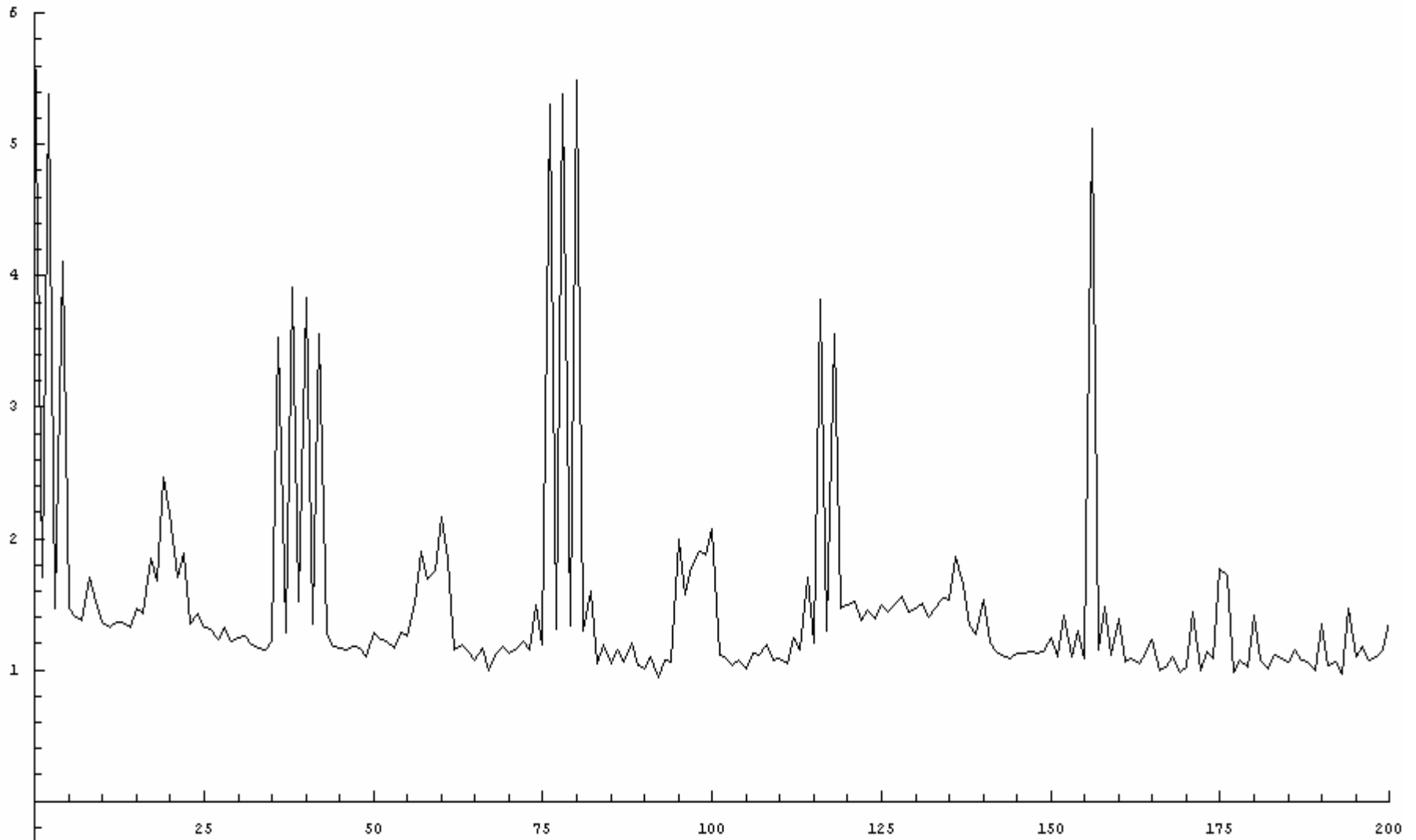
Figure 2
Thickness Sensitivity to Intensity Noise



FaST Modeling – Simulated SWE data

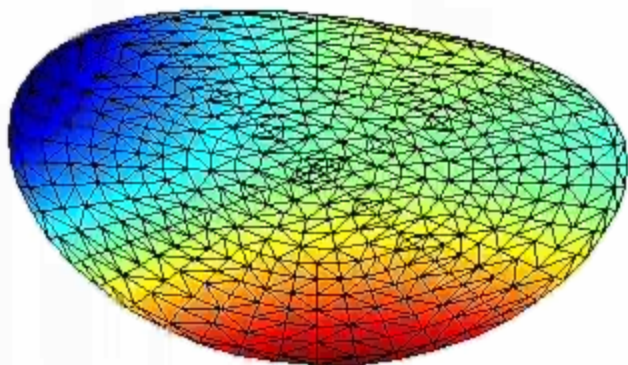


FaST Modeling – Simulated SWE data

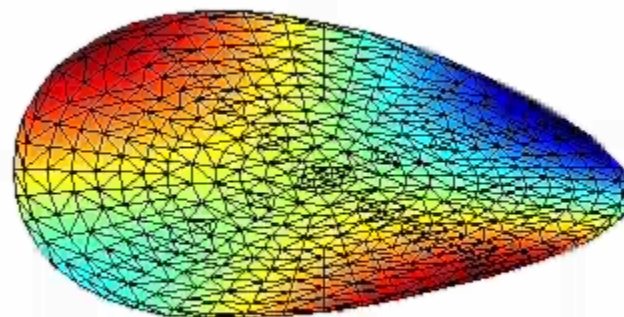


FaST Modeling – Wafer vibration

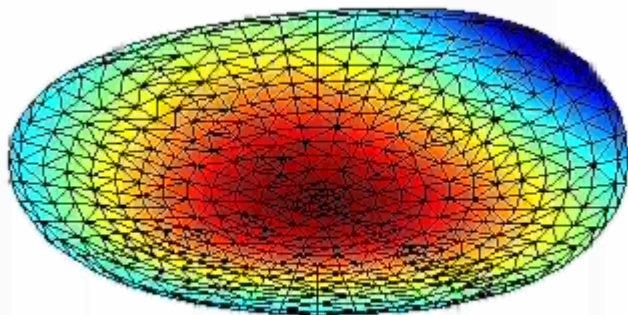
Mode 1: 42 Hz



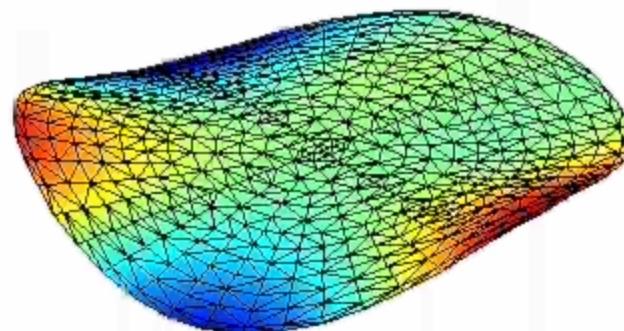
Mode 2: 55 Hz



Mode 3: 90 Hz



Mode 4: 133 Hz



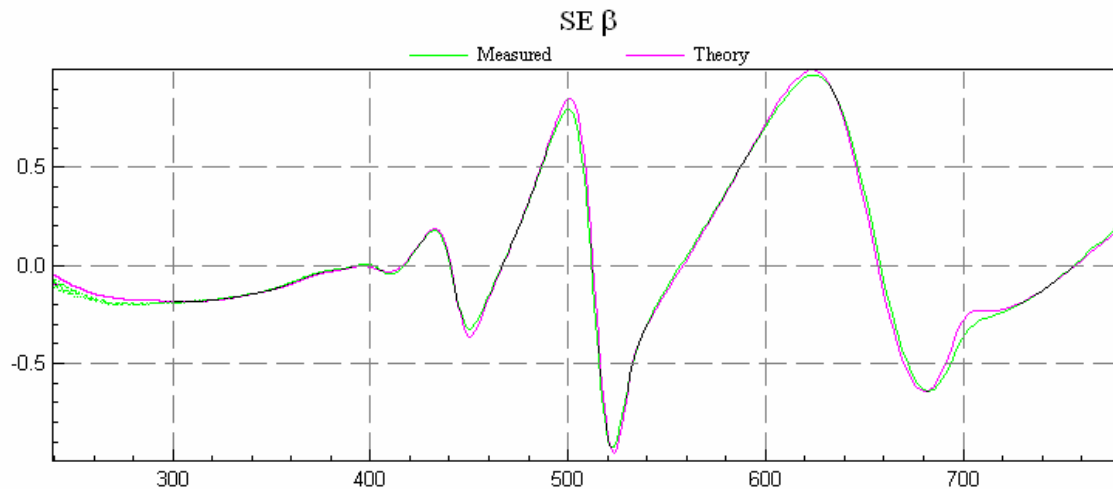
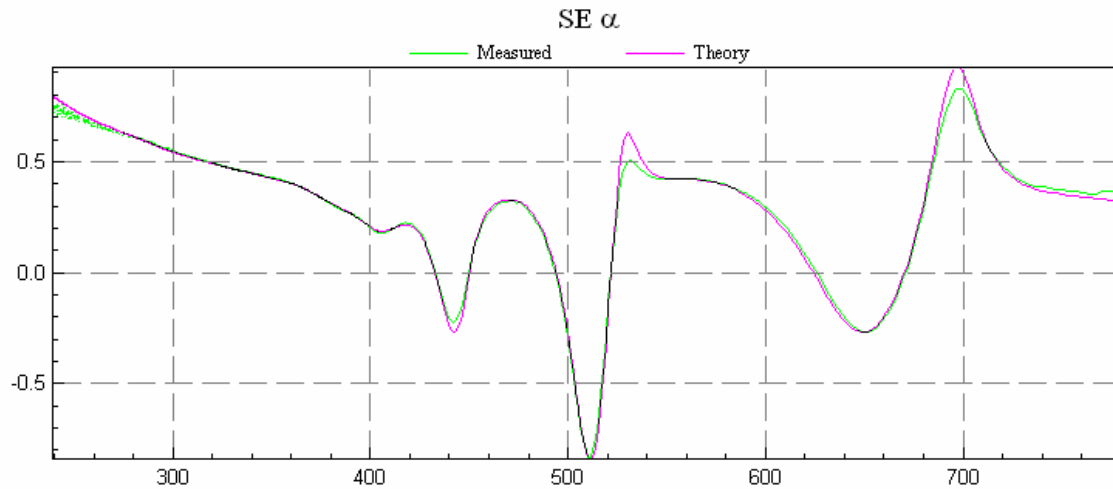
FaST Modeling: Film – Probe Interaction

- **Optical properties of films: Spectra Fx 100**
 - OLSA – offline spectral analysis
 - Standalone version of modeling and regression algorithms contained in the tool software
 - Simulates reflectivity and polarization effects in multi-layer films
- **X-ray emission from films: Metrix 100**
 - Models electron beam interaction with multilayer films
 - Models x-ray emission

FaST Modeling: SpectraFx 100 OLSA

File Edit Options Regression Dataset Graph

<input type="checkbox"/> W	240.0:781.8
<input type="checkbox"/> AOI	71.8061
<input checked="" type="checkbox"/> T3	340.971
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<input type="checkbox"/> S3	0
<input type="checkbox"/> S2	0
<input checked="" type="checkbox"/> Fraction1[2]	0.235594
<input type="checkbox"/> S1	0
<input type="checkbox"/> S0	0
<input type="checkbox"/> A[°]	-25
<input type="checkbox"/> NA	0.0436
<input type="checkbox"/> P0[°]	0



GOF=0.4641
Corr=0.9989

NGOF = 0.9723

$\chi^2 = 1001.7$

FaST Modeling: Metrix 100 OLSA

