Large Area Sputtering Solutions for Stationary Substrate Applications

By: R Newcomb

Angstrom Sciences, Inc.

- Presentation
  - Review software options which can be used for thin film deposition profile modeling
  - Present modeling and applied results for thin film deposition profiles from a rotating cylindrical magnetron
  - Overview of tools used and results obtained to uniformly deposit a thin film on a stationary substrate with multiple cylindrical magnetrons

Software Options

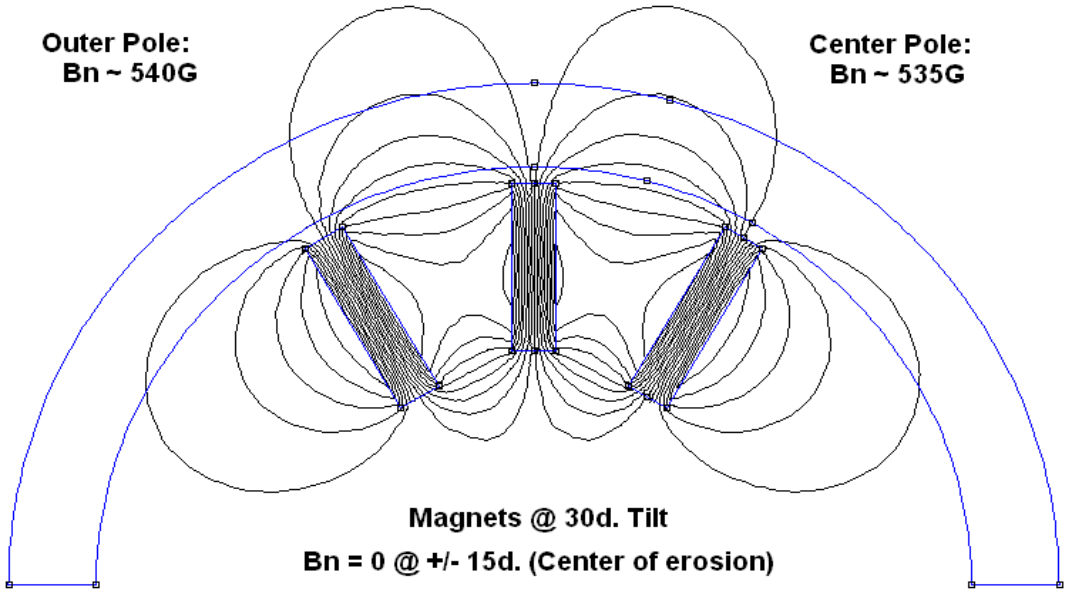
- FEA tools – Developing a magnetic configuration

- Spreadsheets – Developing models and plotting

- Programming – predicting results of variable configurations
  - Use VBA or macros from spreadsheets
  - Favorite programming language

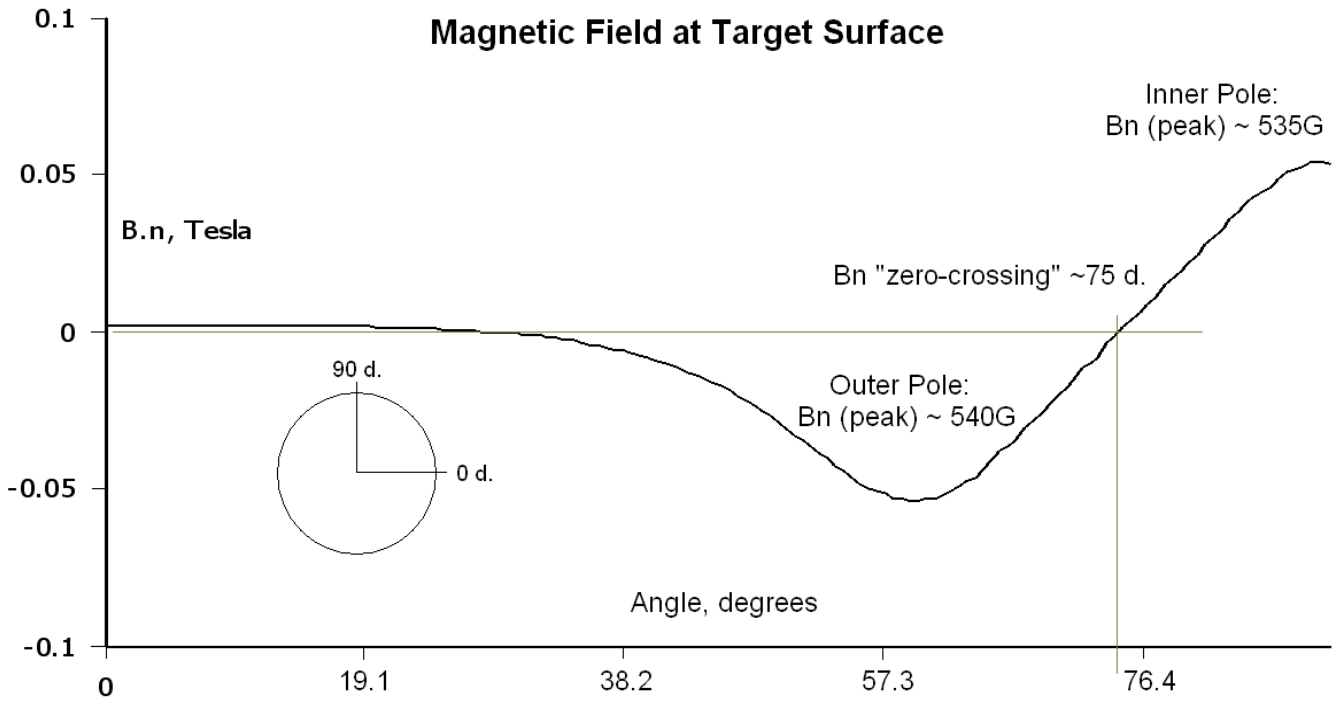
Finite Element Software – FEMM

- Small steps = Simple models
- Our model assumes all flux is from a point source located on the target surface ...
- Magnet geometries, logistics, field intensities

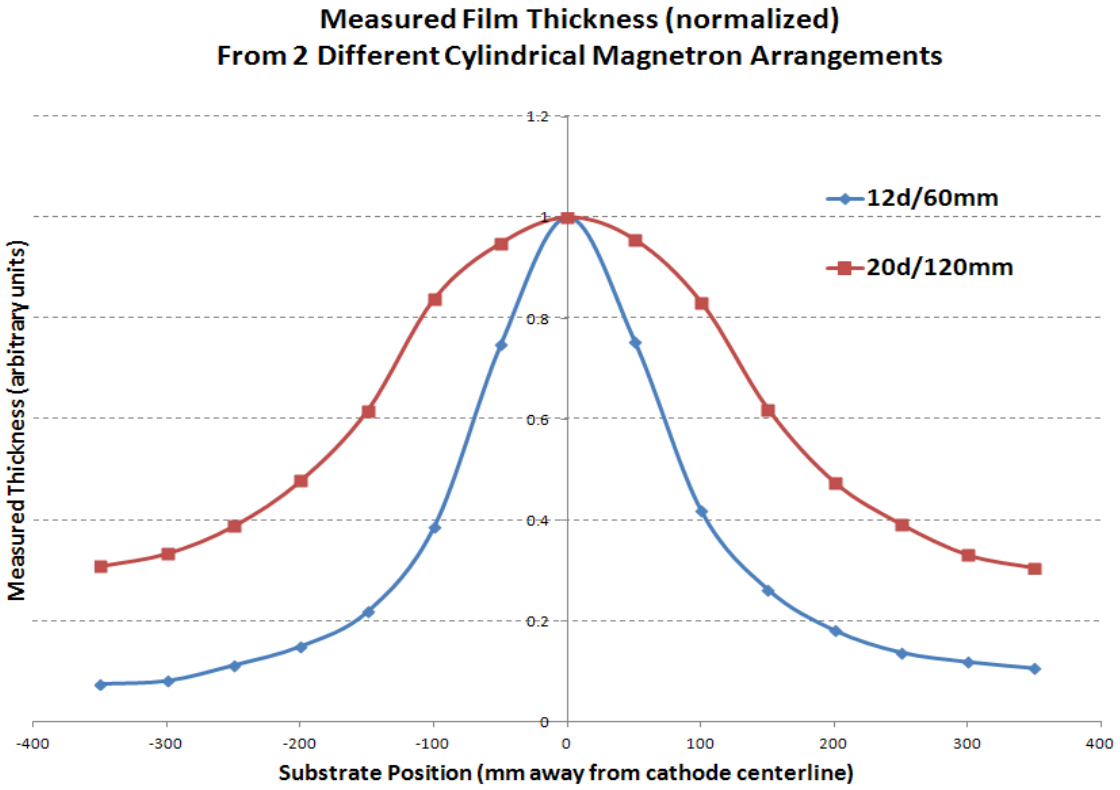


Finite Element Software – FEMM

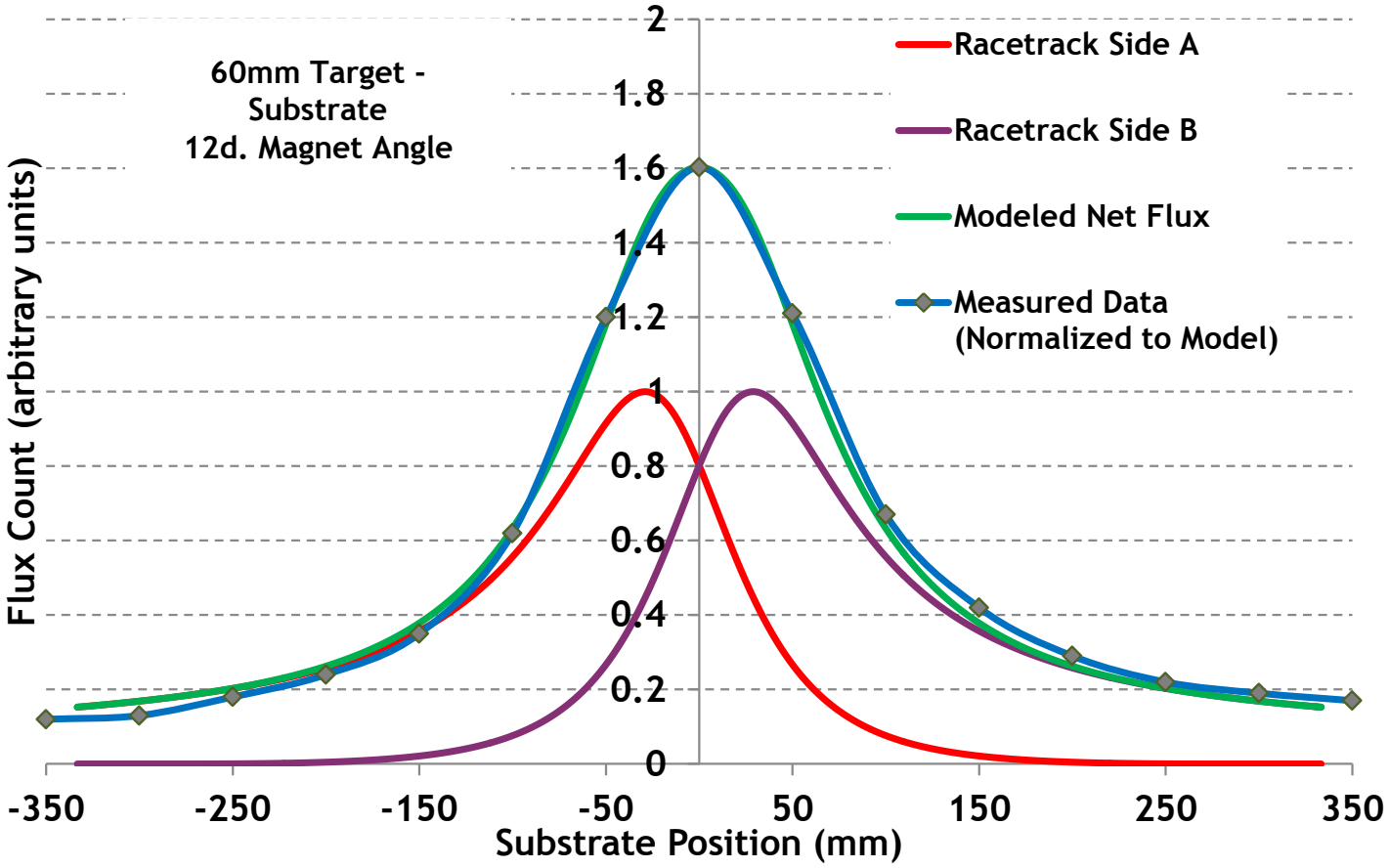
- Balanced Peak Intensities - ✔
- Peak located at +/- 30 deg. – ✔
- “Point” located at +/- 15 deg. - ✔



- Build the tool, build the model, compare
  - Single cylindrical magnetron, 3mT, argon, metal …
  - Generate deposition profile to be used as the “target” for the modeling

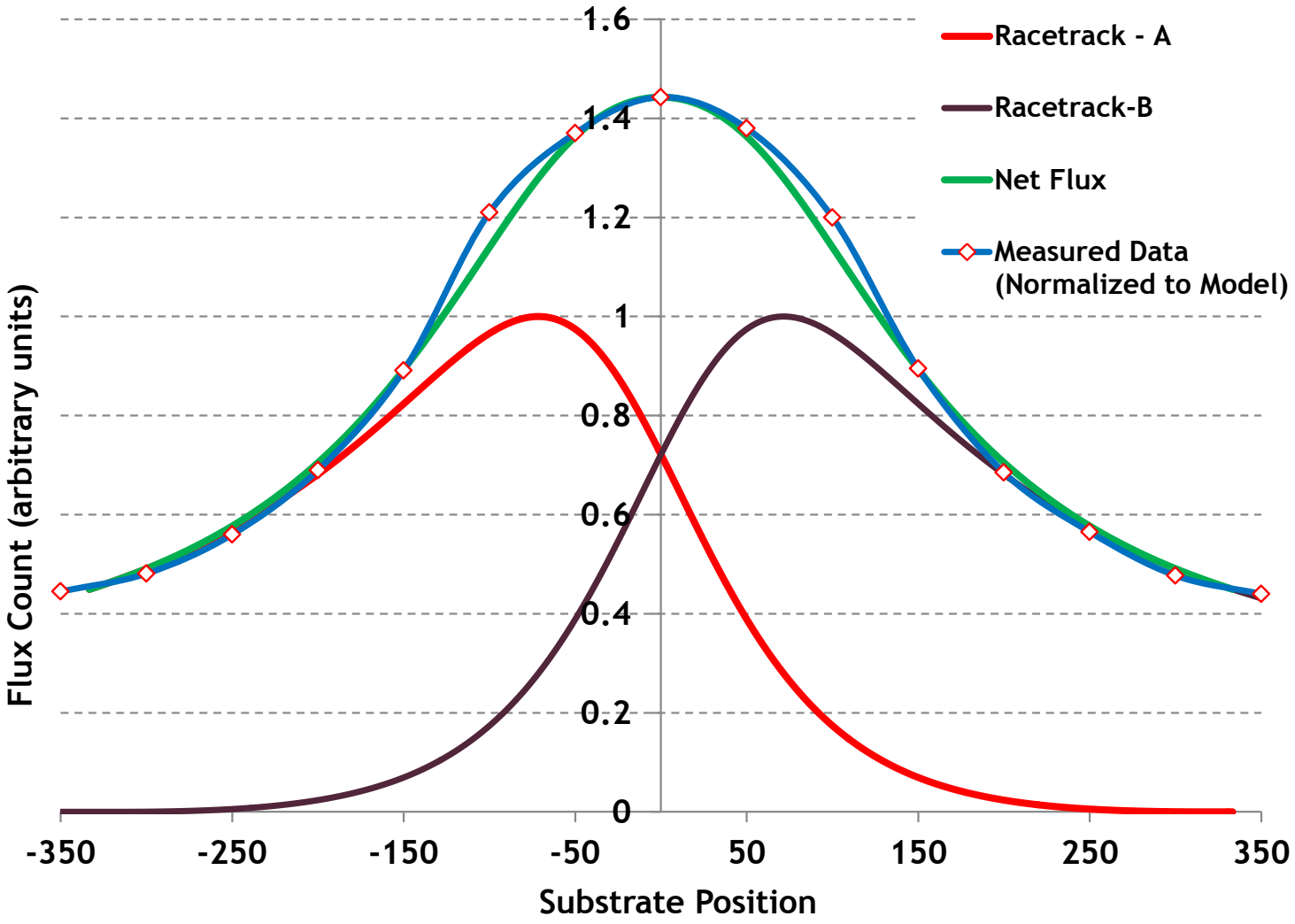


- Build the tool, build the model, compare
  - Create model, and solve for 1 side of racetrack
  - Add the 2nd side
  - Compare to test data



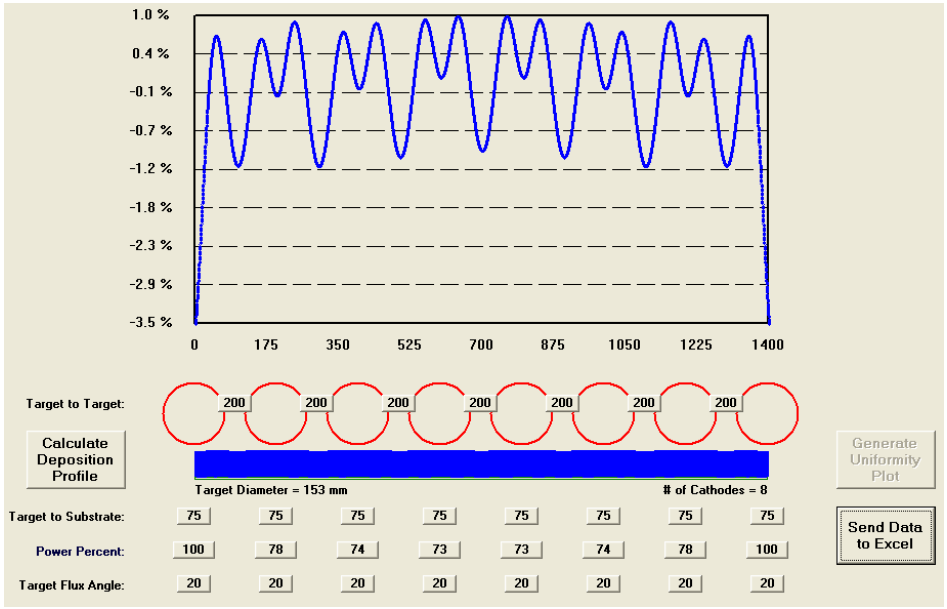
Repeat process with different parameters

(20d. Magnets, 120 mm Target-Substrate)



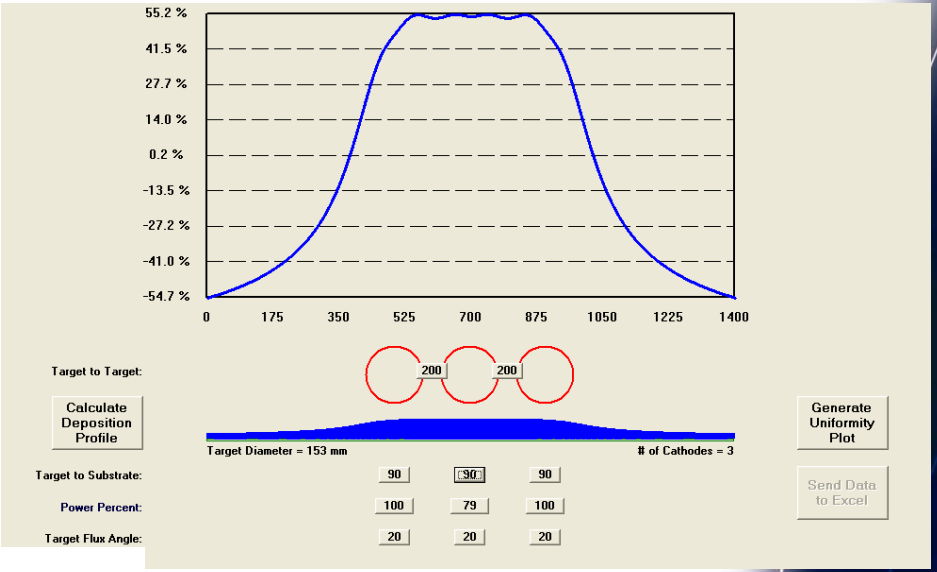
Modeling for Multiple Deposition Sources

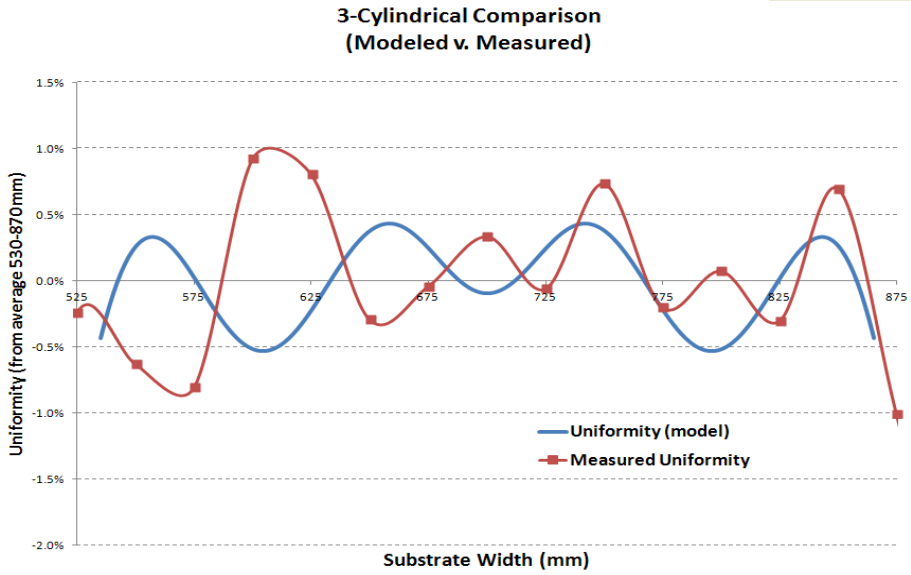
- Use equations gained from previous work
- Use variables available
  - power
  - target spacing
  - # targets as variables



Test Applied v. Model for multi-cylindrical

- 3-cylindricals
- Uniformity over ~360 mm

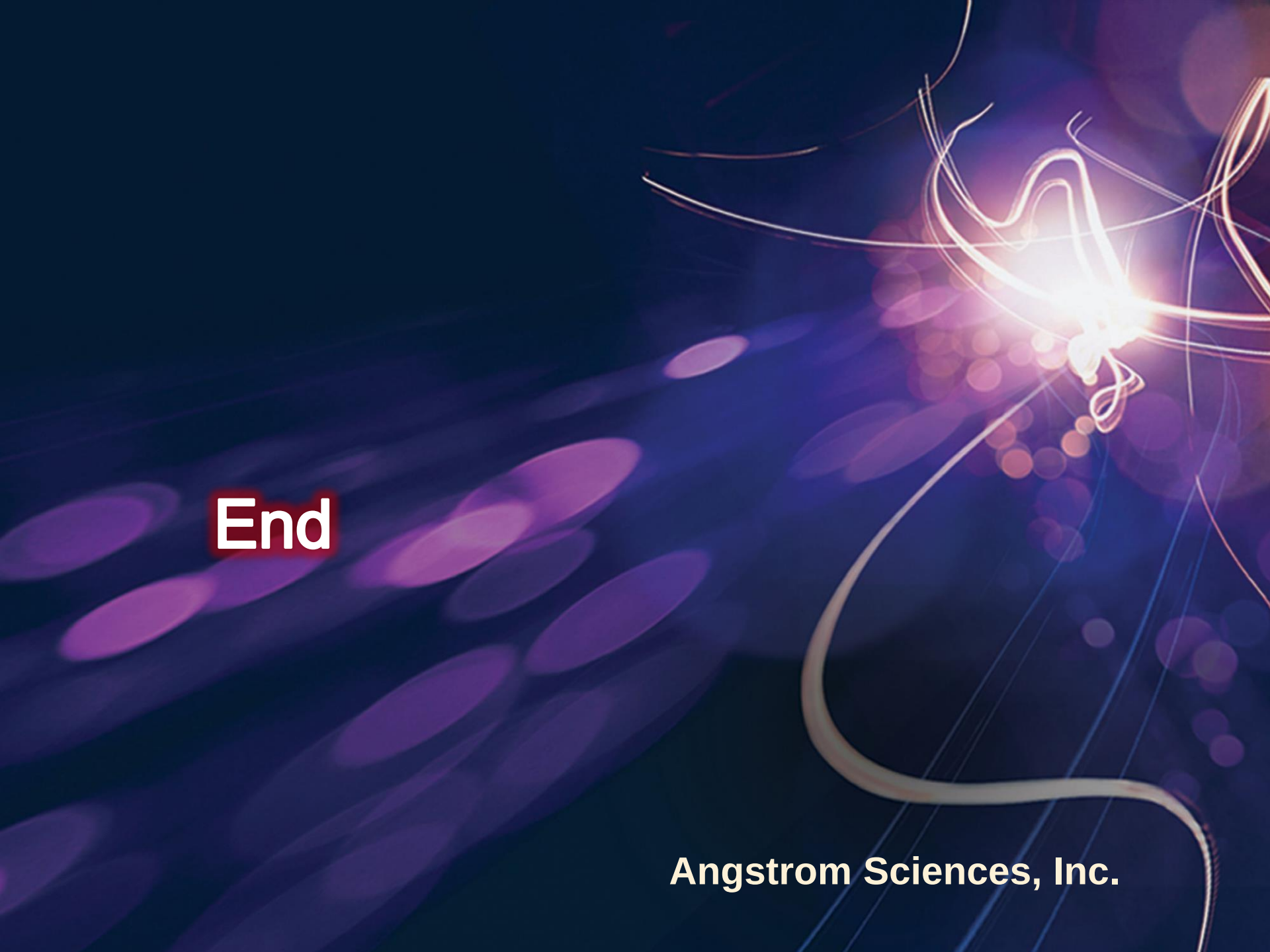




- Model suggests better than +/- 1%
- Measured data in same range

Summary

- Simplistic and economical approaches to modeling deposition flux can be used under a controlled set of parameters to predict sputtered film uniformity.
- Rotating cylindrical magnetrons have several degrees of freedom to enable uniform coatings on static substrates, the most important being magnet angle
- The modeled uniformities achieve good agreement with measured results within a +/-1.5% range across a substrate width.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