Miniature X-Ray Sources and the Effects of Spot Size on System Performance

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Goal

- **To gain a better understanding and measure of miniature x-ray sources so that performance can be optimized in your application.**

Brief History of Miniature X-Ray Sources

- Initial challenge was Voltage Standoff and Output
- Spot Sizes down to around 1mm
- Improved Centering and Spot Uniformity
- New Sources in Development with < 100 micron spots

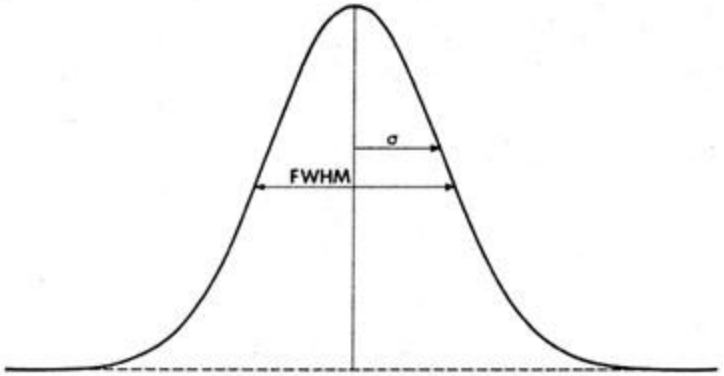
Why Miniature Sources are Different than Traditional Tubes

- Space, Cost and Power Constraints
- Diode vs. Electron Gun Arrangement
- New innovations in miniature x-ray sources are making it more important to match the source with the application

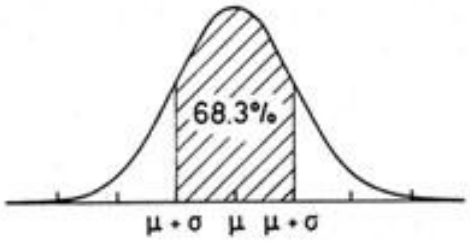
The Problem with using Full Width Half Maximum (FWHM)

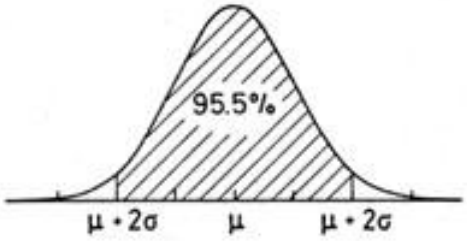
Simple Definition of FWHM

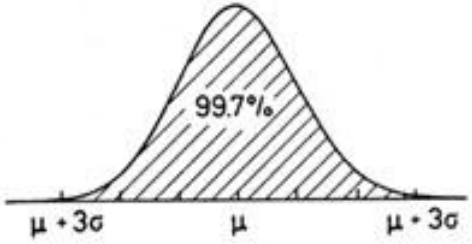
It is given by the distance between points on the curve at which the function reaches half its maximum value.



Works well for Gaussian spots.



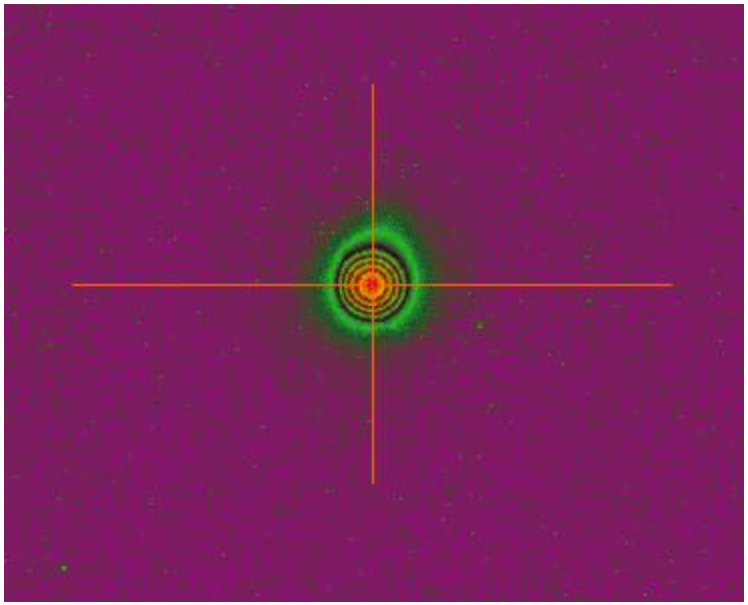


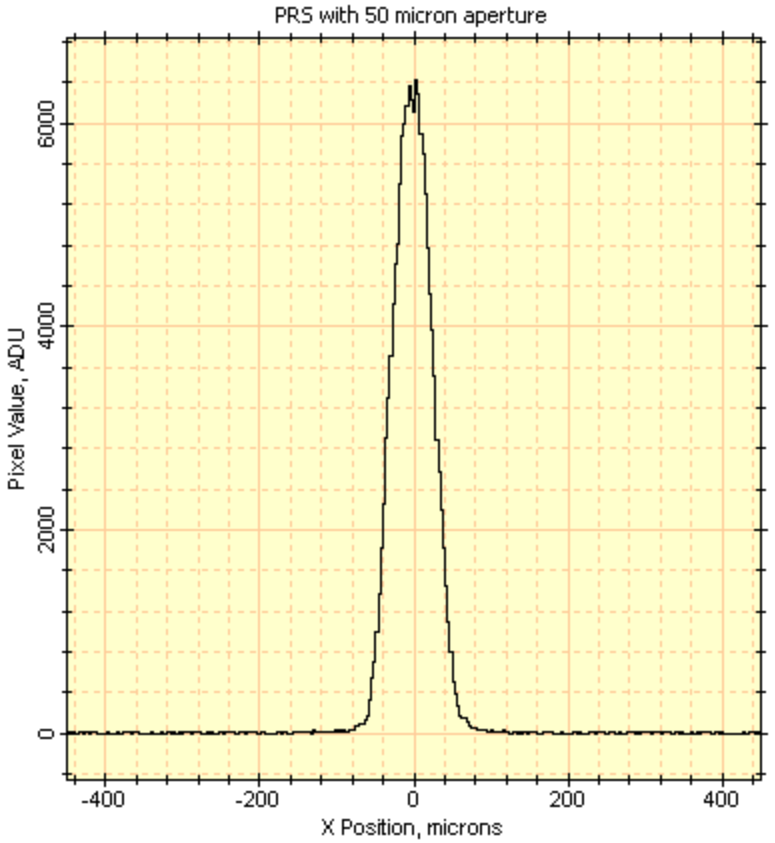


FWHM for Non-Gaussian Examples

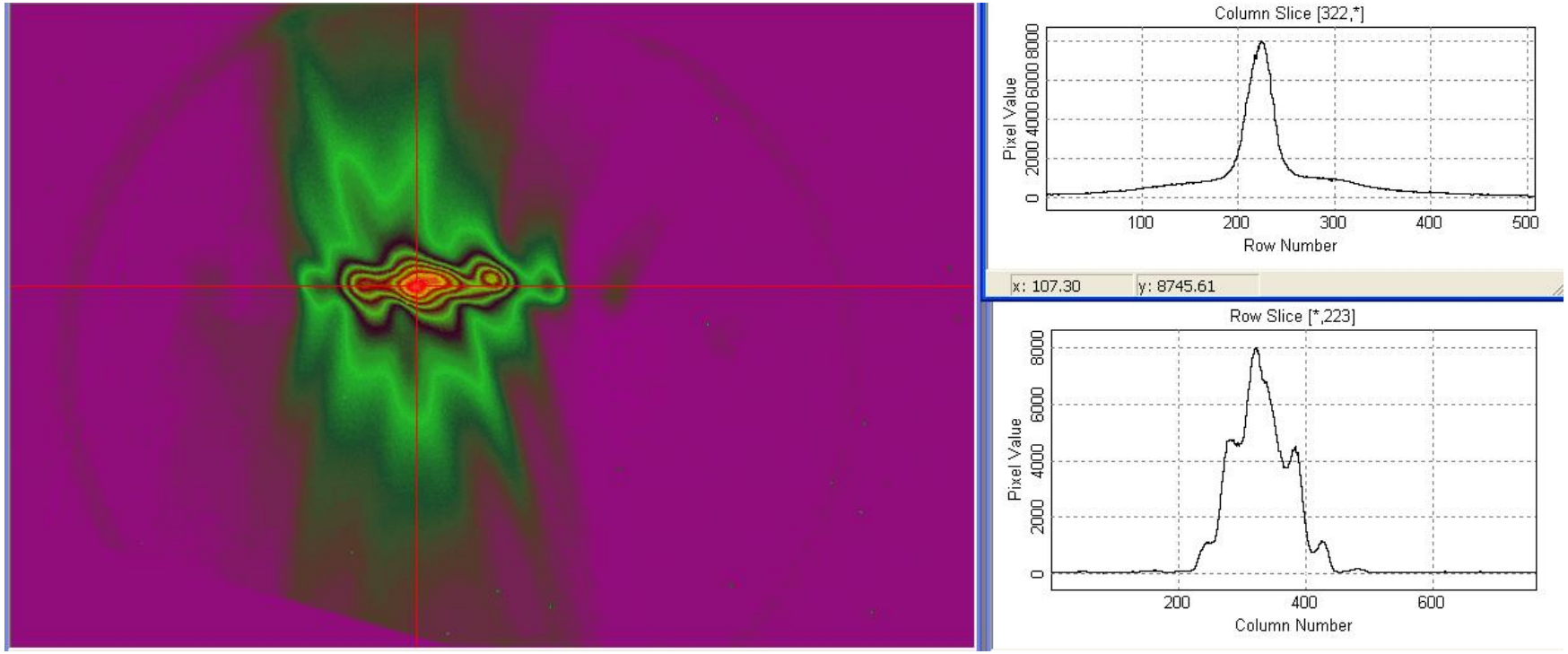
- Artificial 50 Micron for Comparison
- Non Round FWHM
  - Filament orientation can be used to optimize performance somewhat, but a single FWHM number doesn't tell the story.
- Round Spot with "Tails" FWHM
  - The almost background output from a wide area outside of the central spot can account for a large percentage of the total output.

Artificial 50 micron Example

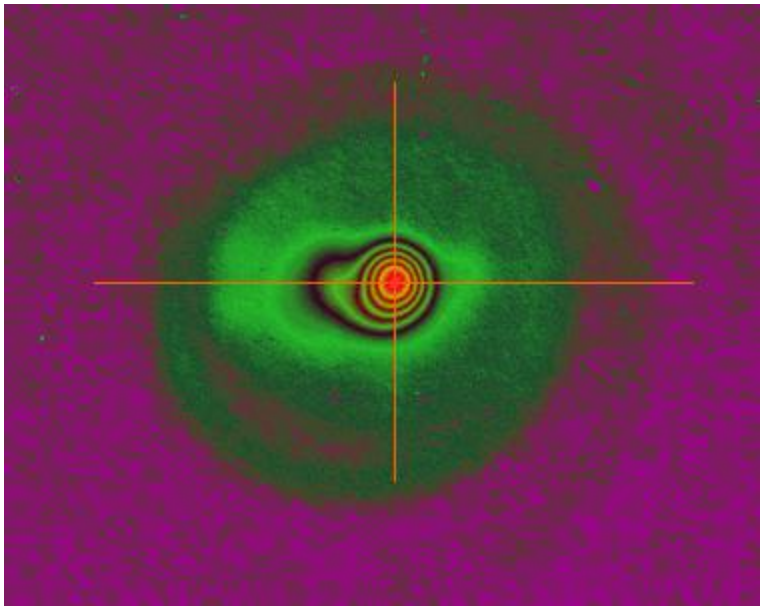


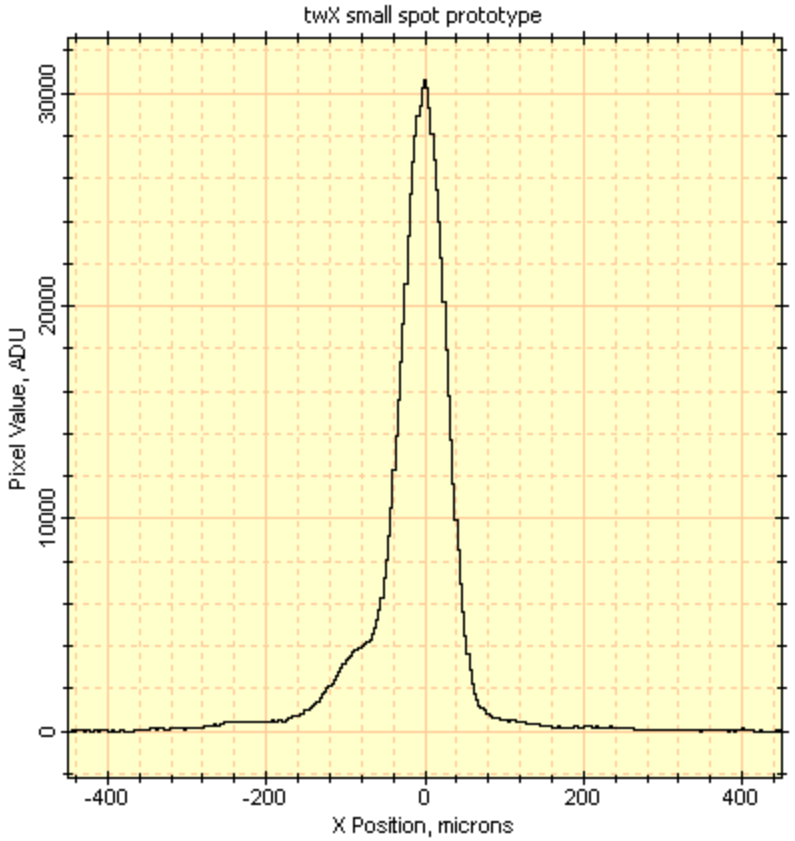


Non-Round Spot Example



Round Spot with “Tails” Example

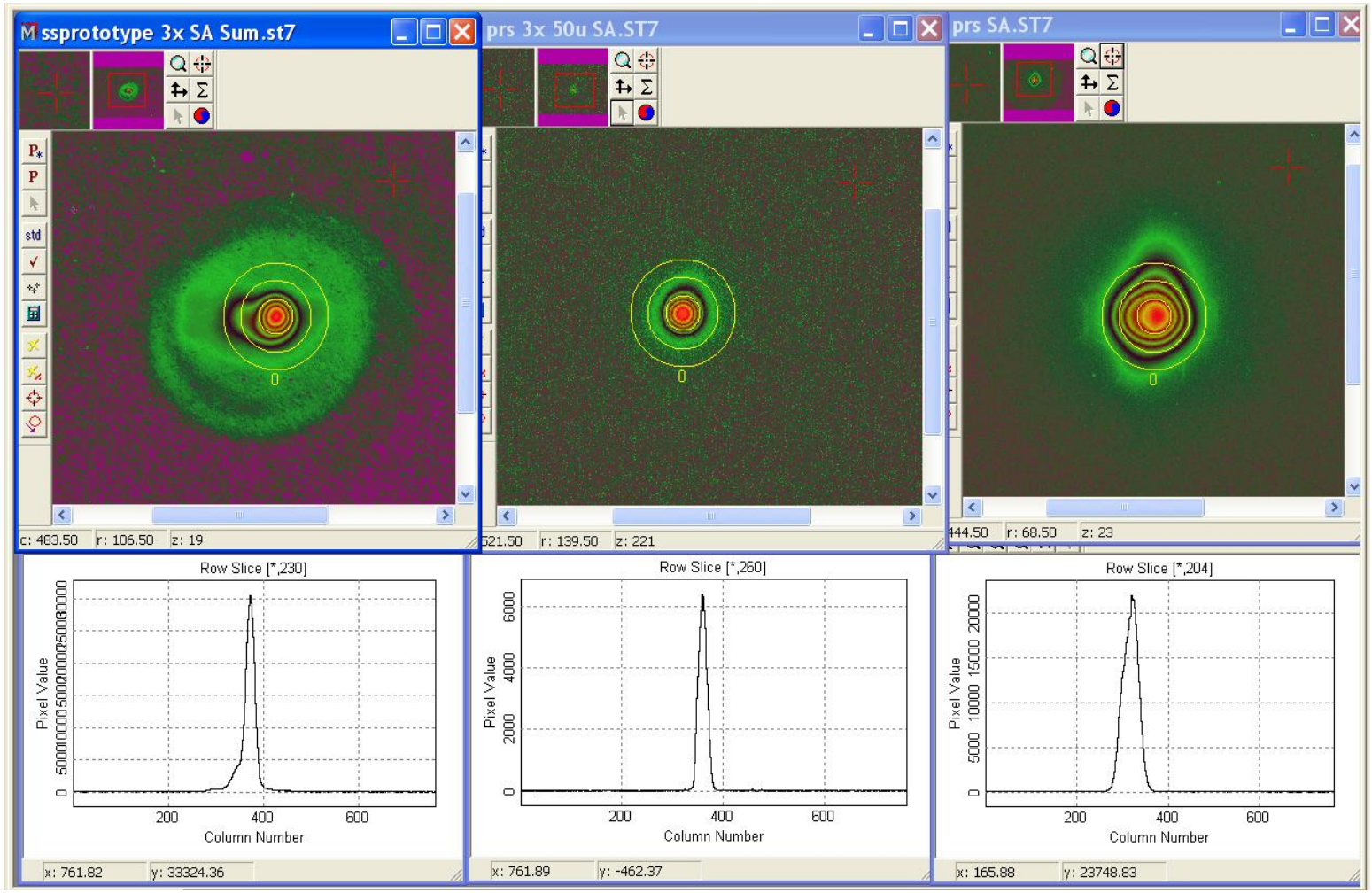




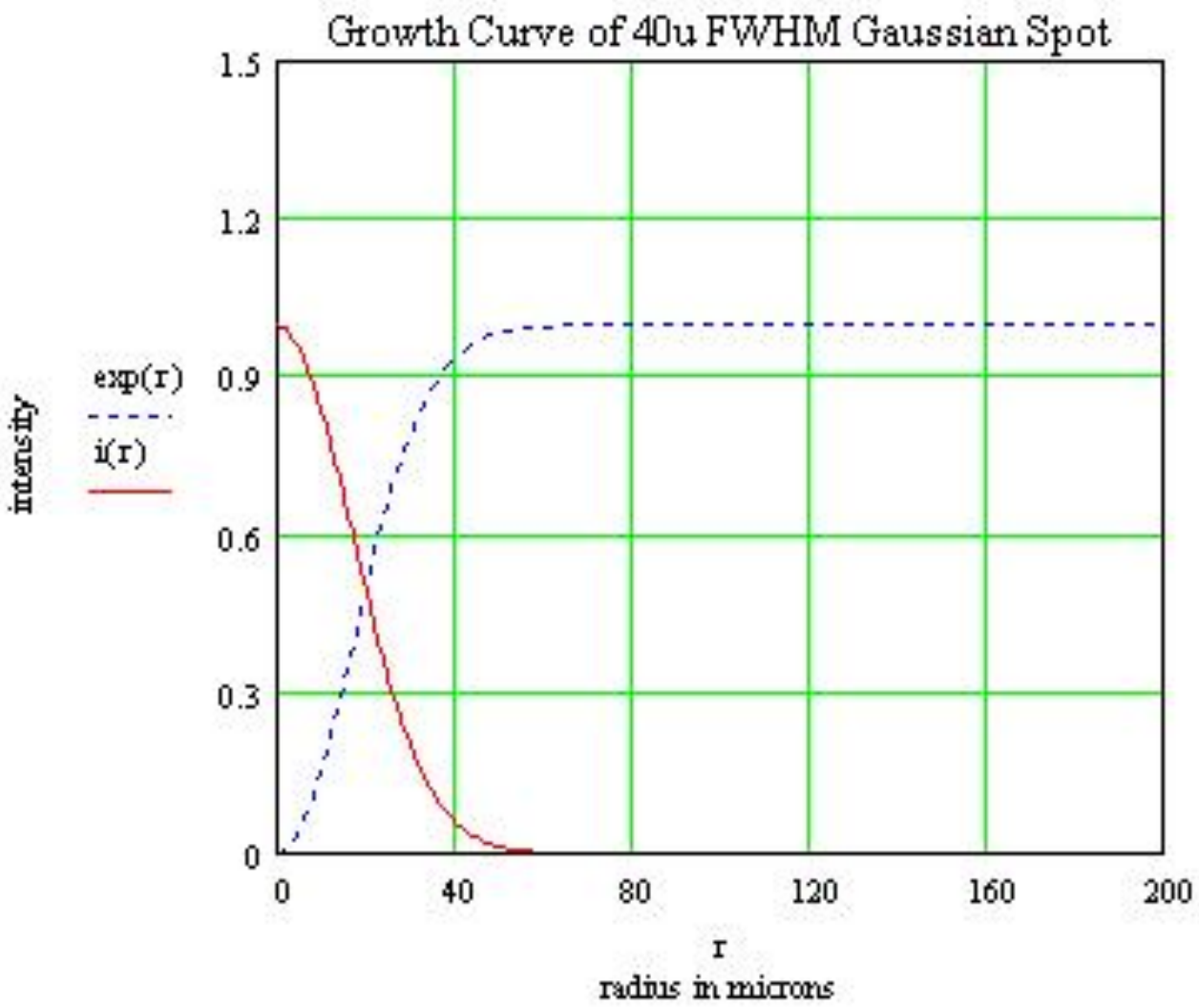
Using a Growth Curve to Define Source Output

- Growth Curve Generation
  - There are a number of ways to generate spot size information, each with their own strengths.
  - The growth curve shows the total percentage of the output captured as you move out radially from the center.
  - Tube Centered vs. Spot Centered Growth Curves
- Gaussian Spot Growth Curve

Creating Growth Curves



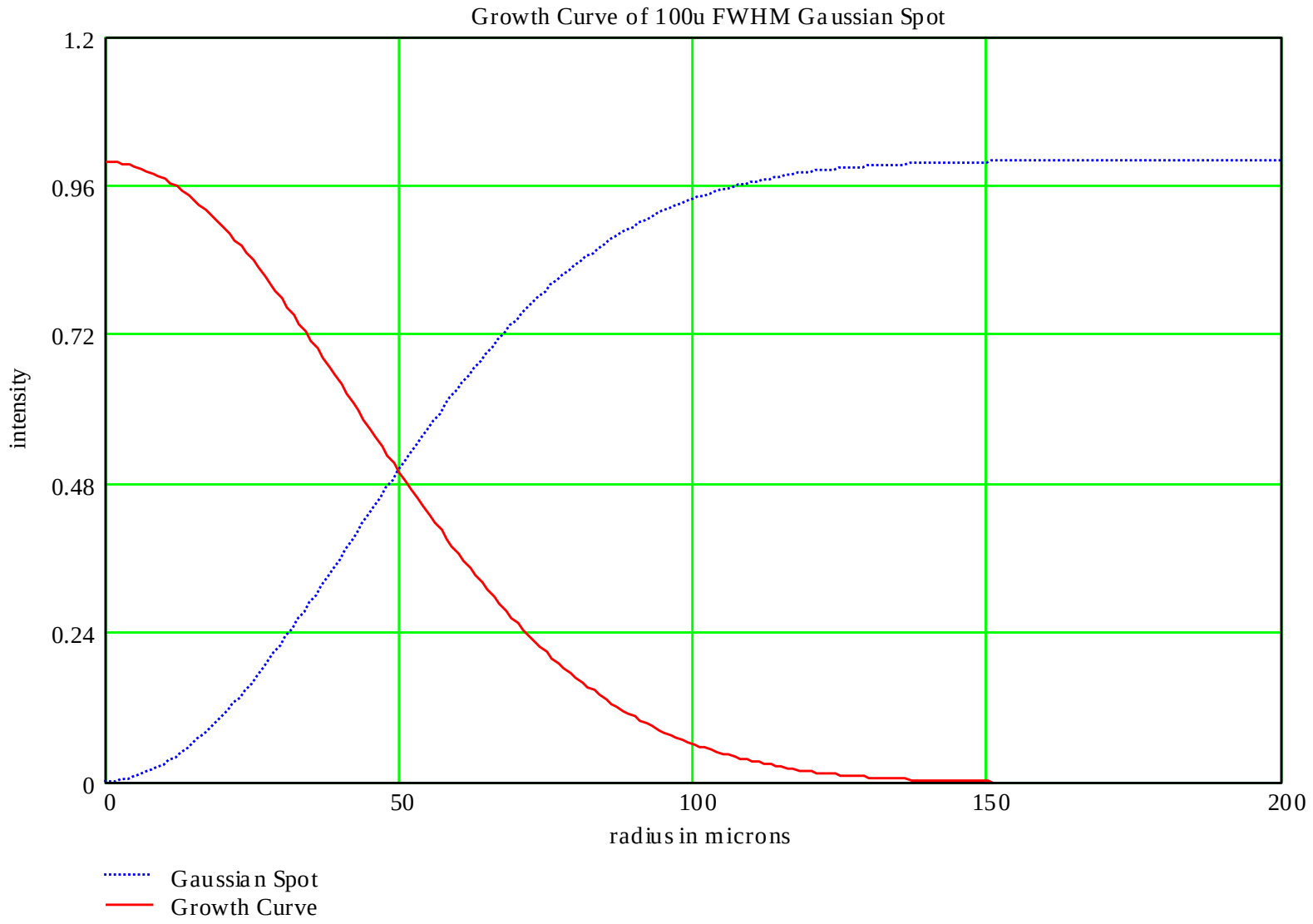
Gaussian Spot Growth Curve



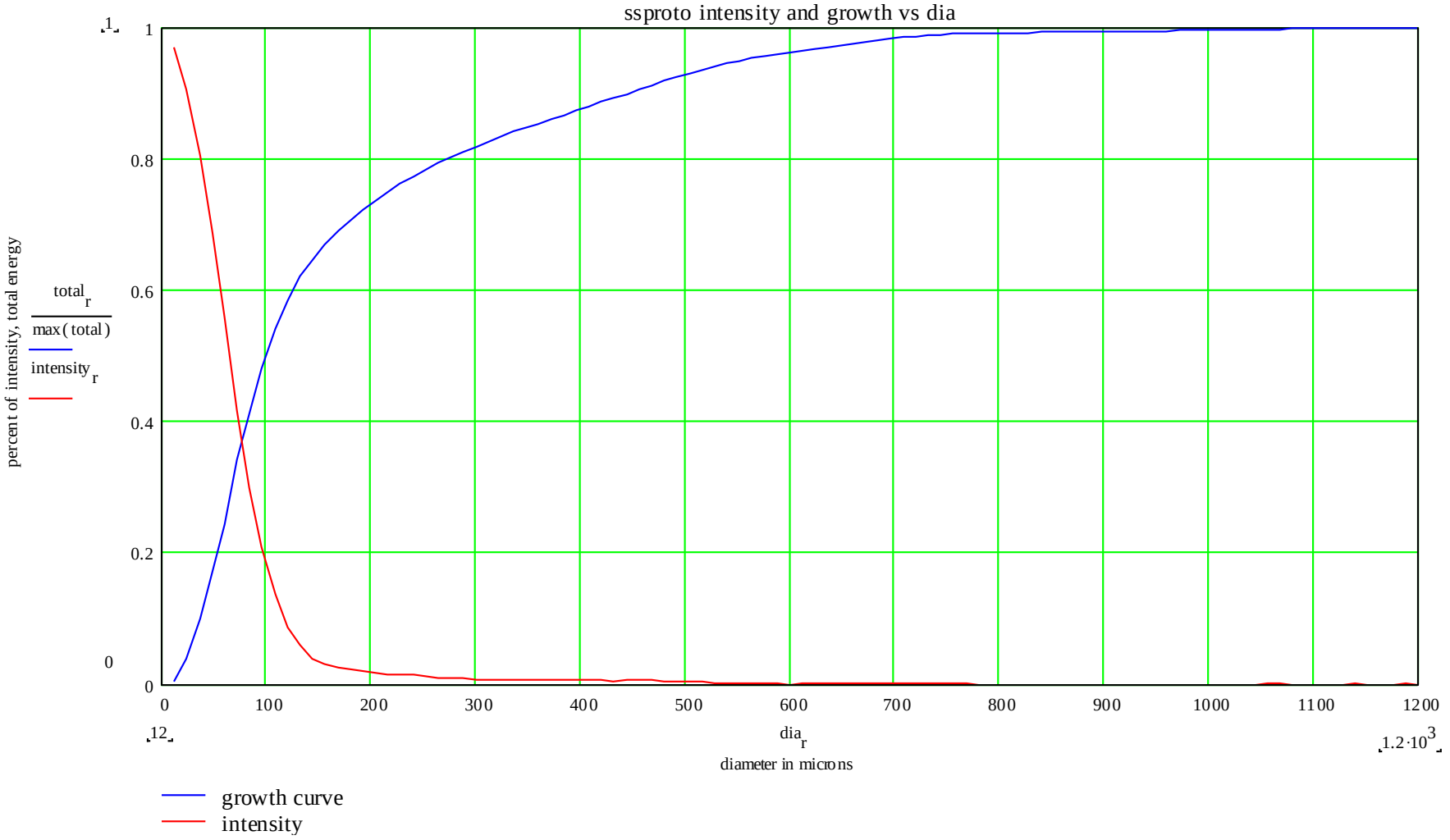
Matching Growth Curves to Specific Applications

- Growth Curve Example #1 – Large Spot but Growth Asymptotes before Aperture
  - Good for Long Term Stability and Lifetime
- Growth Curve Example #2 – Small Spot with Tails
  - Good for focusing applications

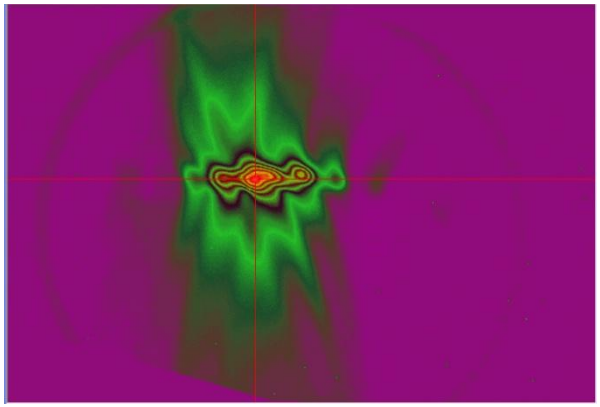
Growth Curve #1 – Larger Spot w/ No Tails

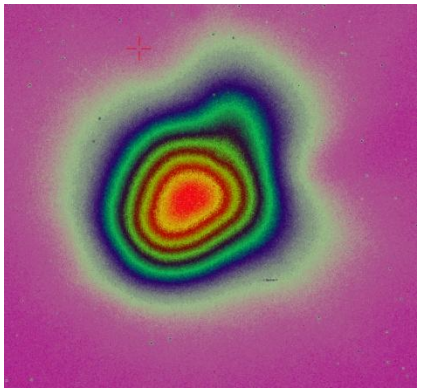


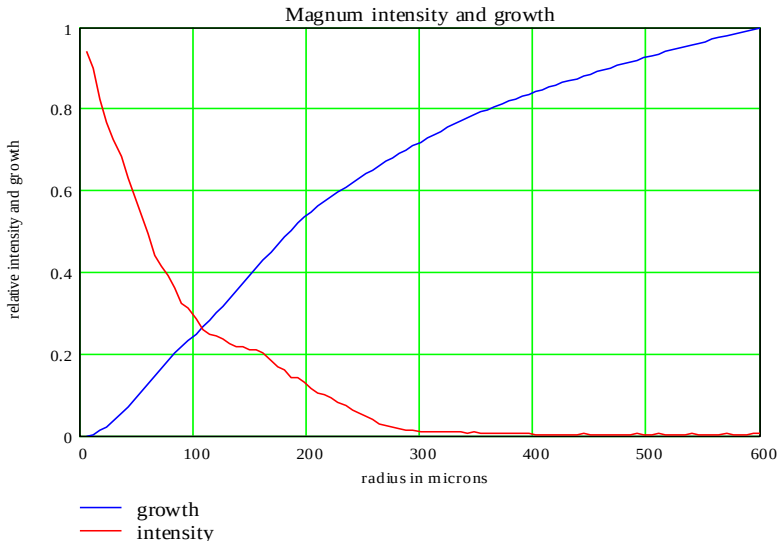
Growth Curve #2 – Small Spot with Tails

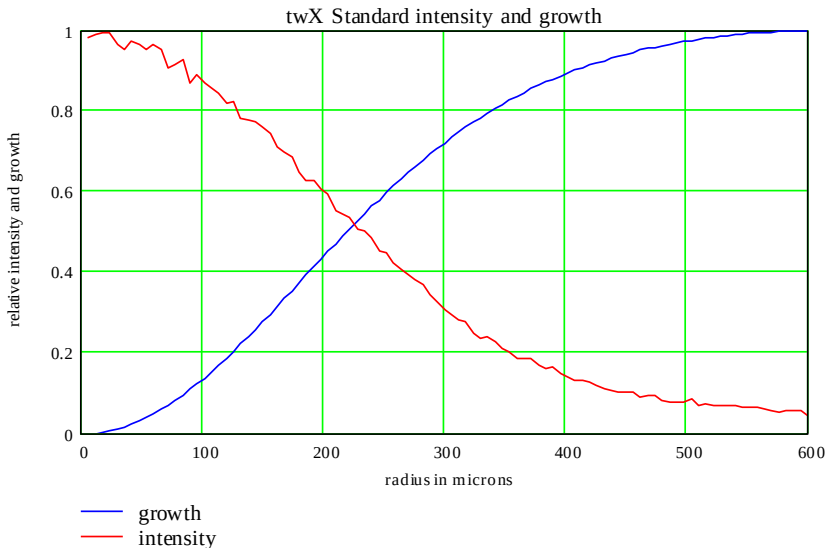


Current Production Tubes

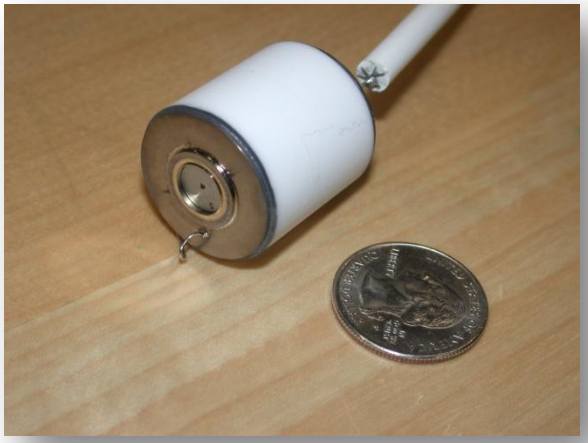


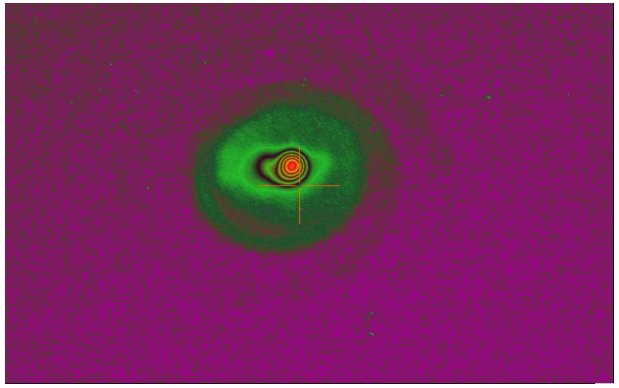


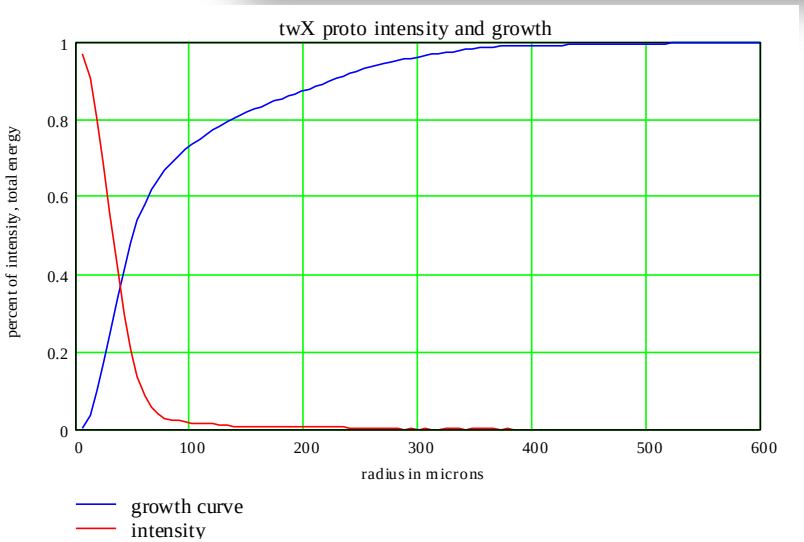




New Tubes in Development







For More Information

- White Paper on Growth Curve Creation for Miniature X-Ray Sources Coming Soon
- Sterling's Poster #F-23 in Exhibit Hall
- Moxtek Booth #41
- Thanks to MiraMetrics for software support and, SBIG for camera support