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

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- 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

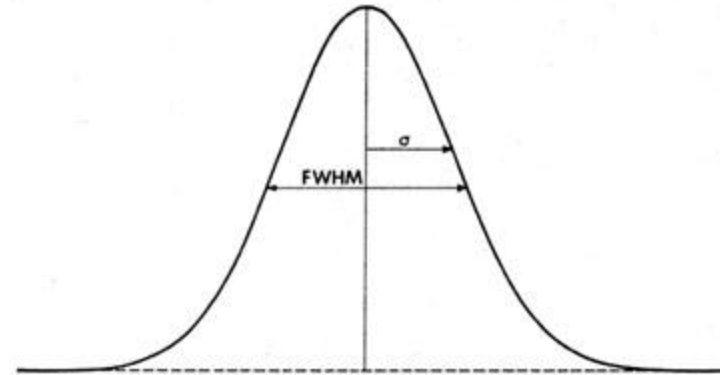
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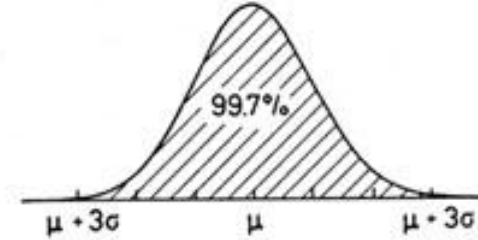
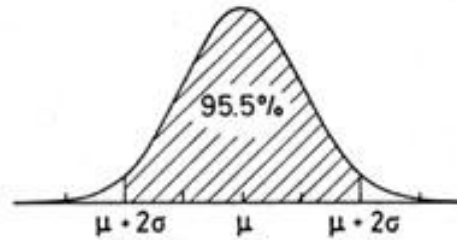
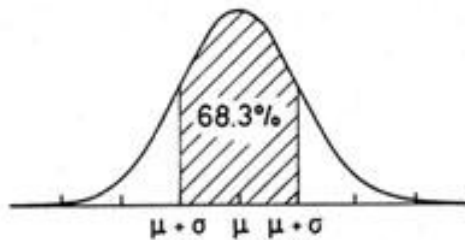
- **Space, Cost and Power Constraints**
- **Diode vs. Electron Gun Arrangement**
- **New innovations in miniature x-ray sources are making it more important to match the source with the application**

## Simple Definition of FWHM

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

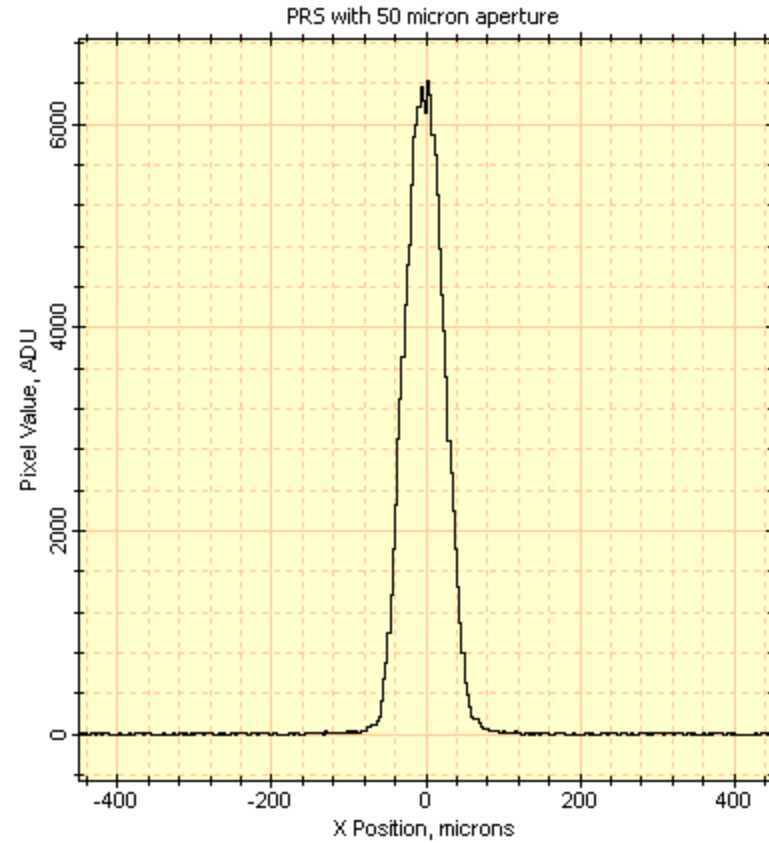
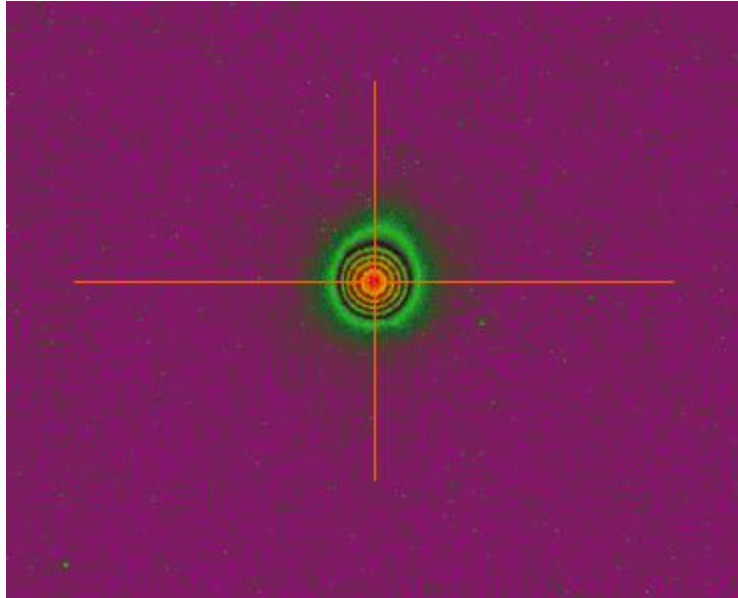


Works well for Gaussian spots.

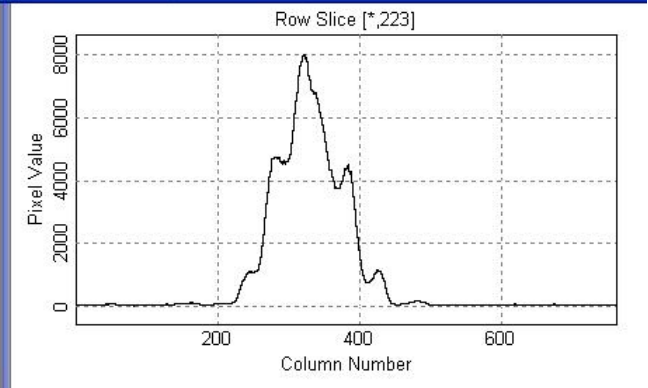
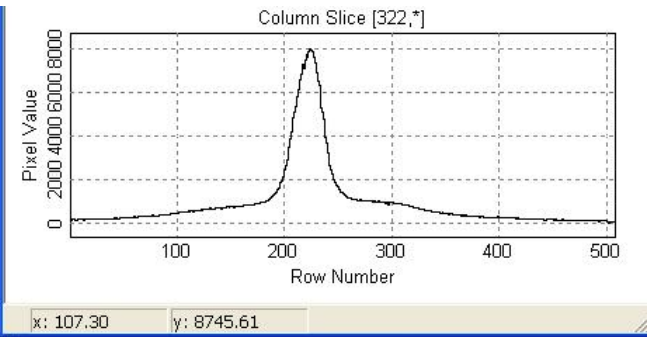
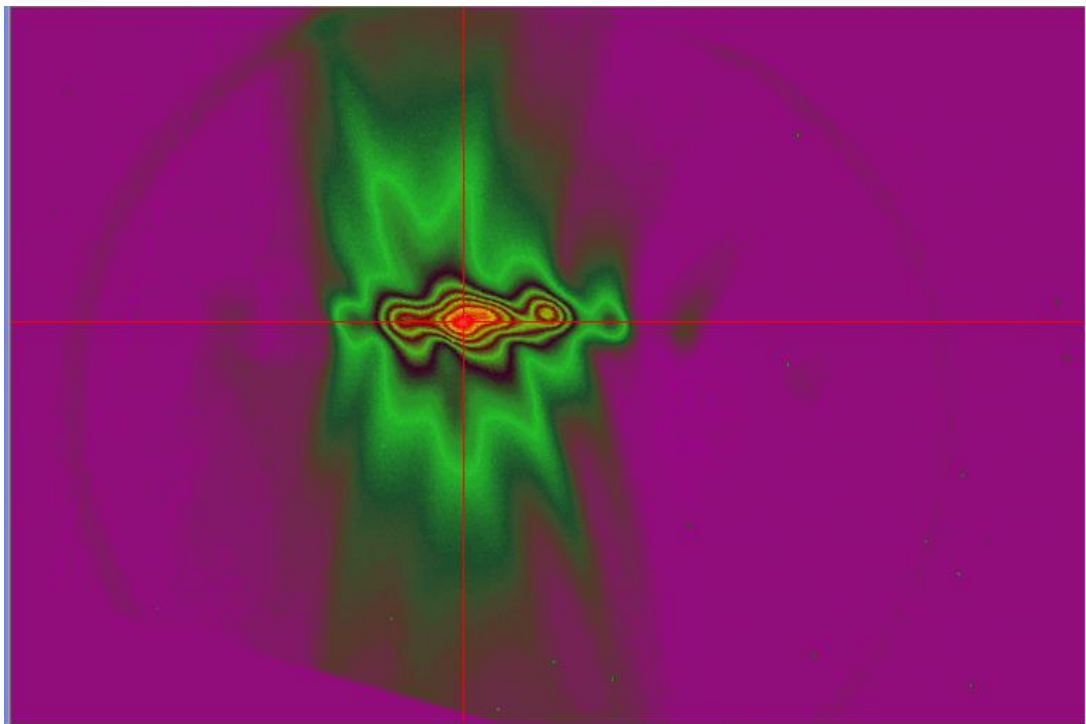


- **Artificial 50 Micron for Comparison**
- **Non Round FWHM**
  - **Filament orientation can be used to optimize performance somewhat, but a single FWHM number doesn't tell the story.**
- **Round Spot with "Tails" FWHM**
  - **The almost background output from a wide area outside of the central spot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

# Artificial 50 micron Example

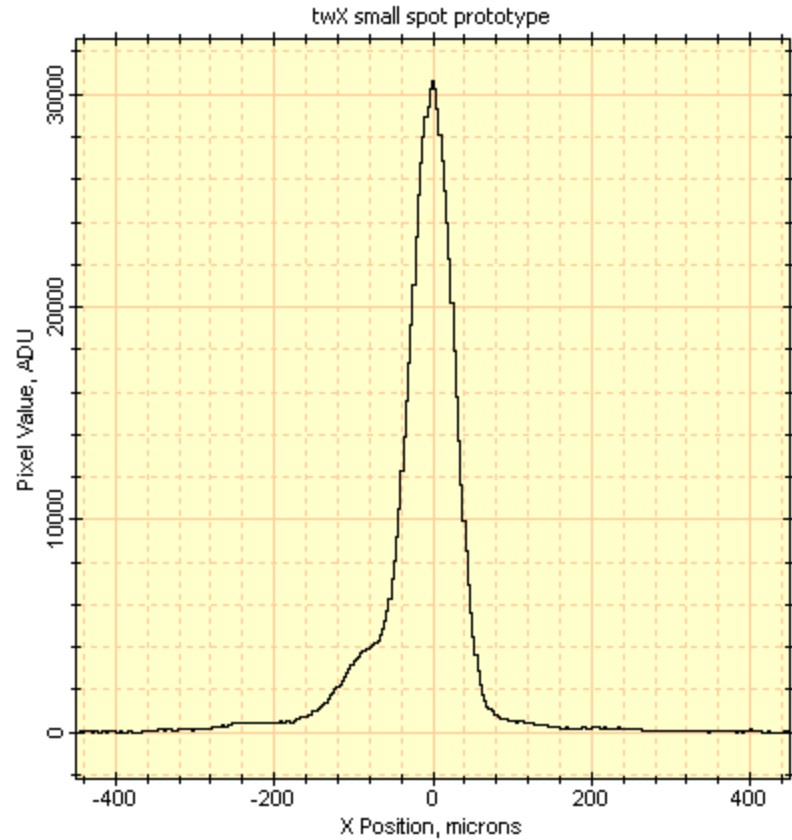
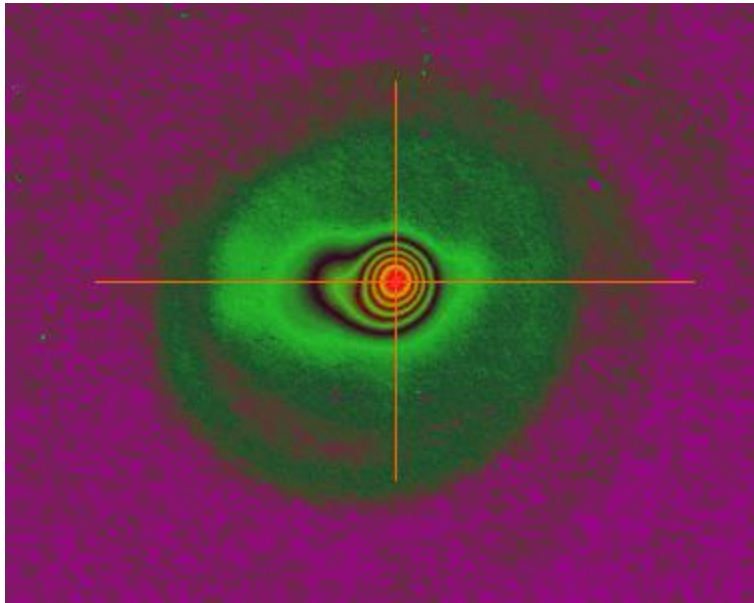


# Non-Round Spot Example

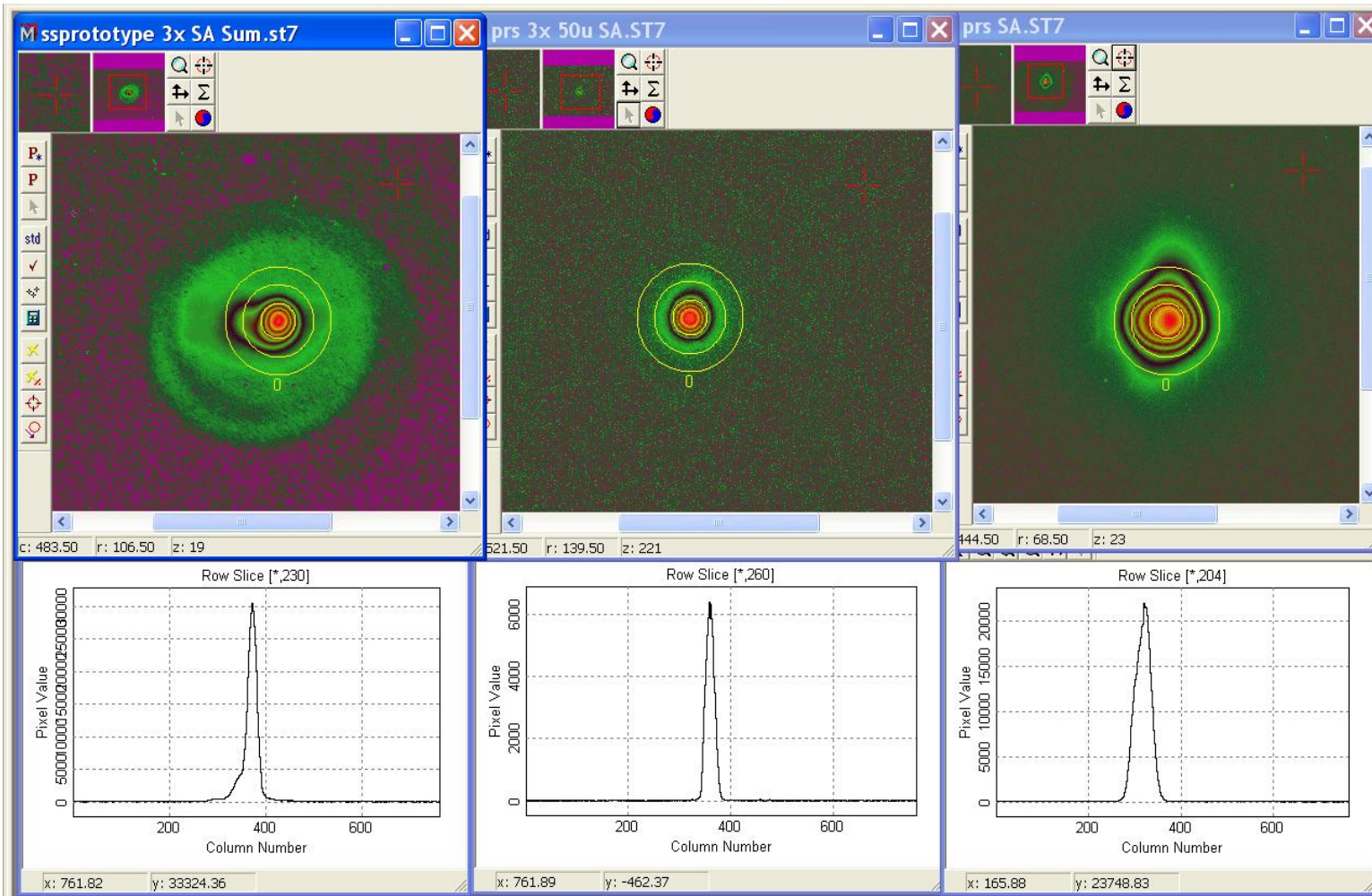




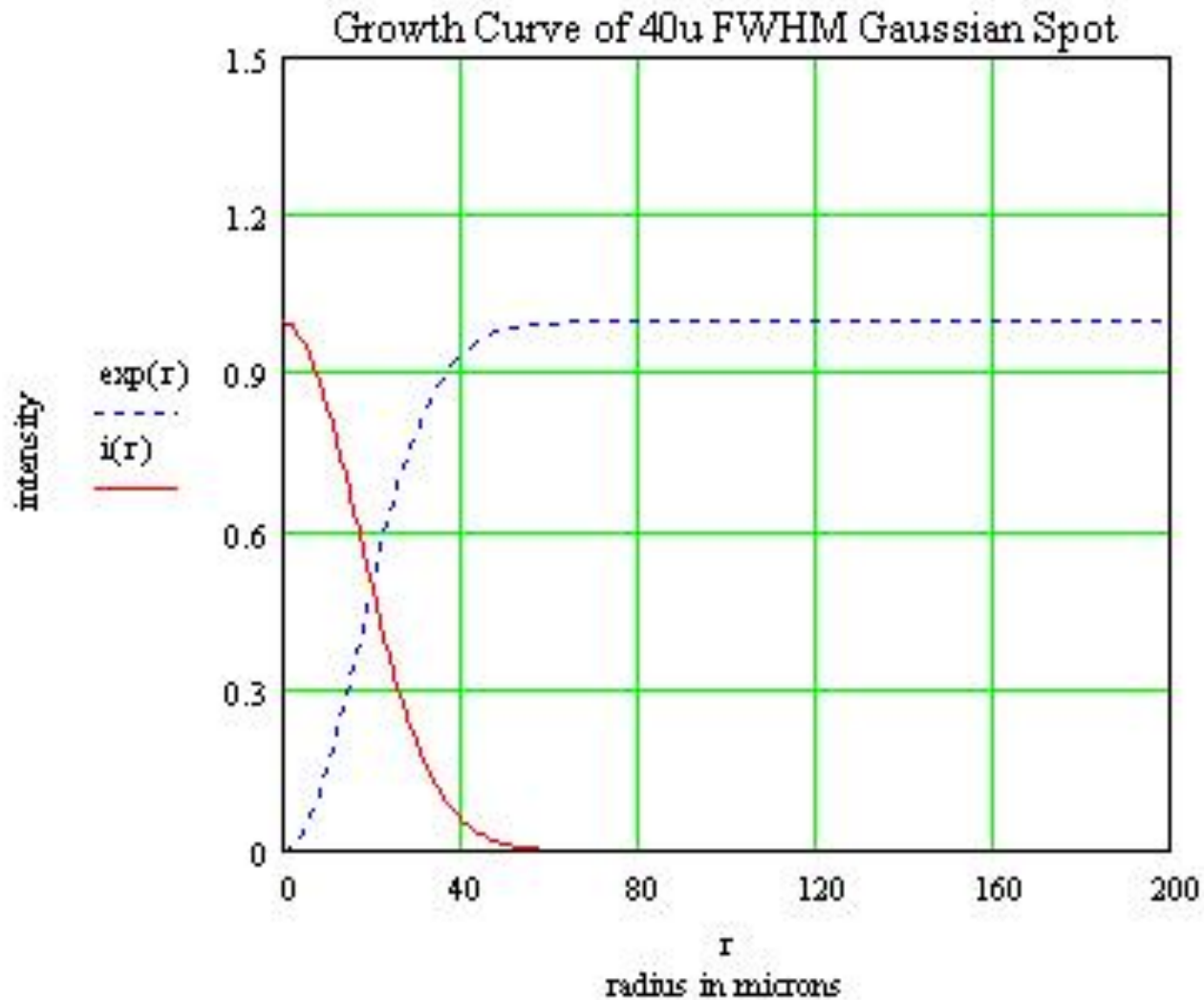
# Round Spot with “Tails” Example



- **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**



# Gaussian Spot Growth Curve





# Matching Growth Curves to Specific Applications

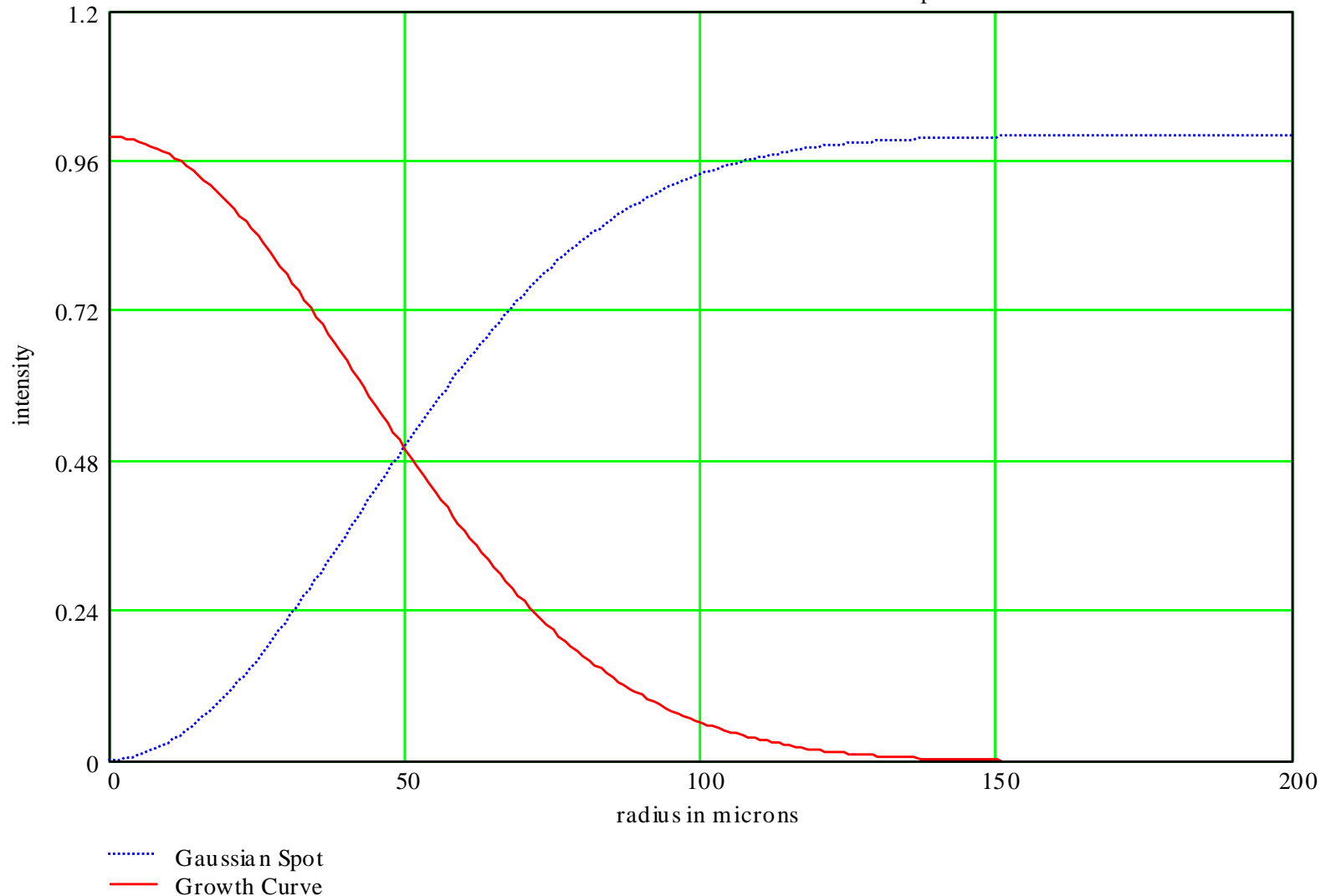
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- **Growth Curve Example #1 – Large Spot but Growth Asymptotes before Aperture**
  - Good for Long Term Stability and Lifetime
- **Growth Curve Example #2 – Small Spot with Tails**
  - Good for focusing applications

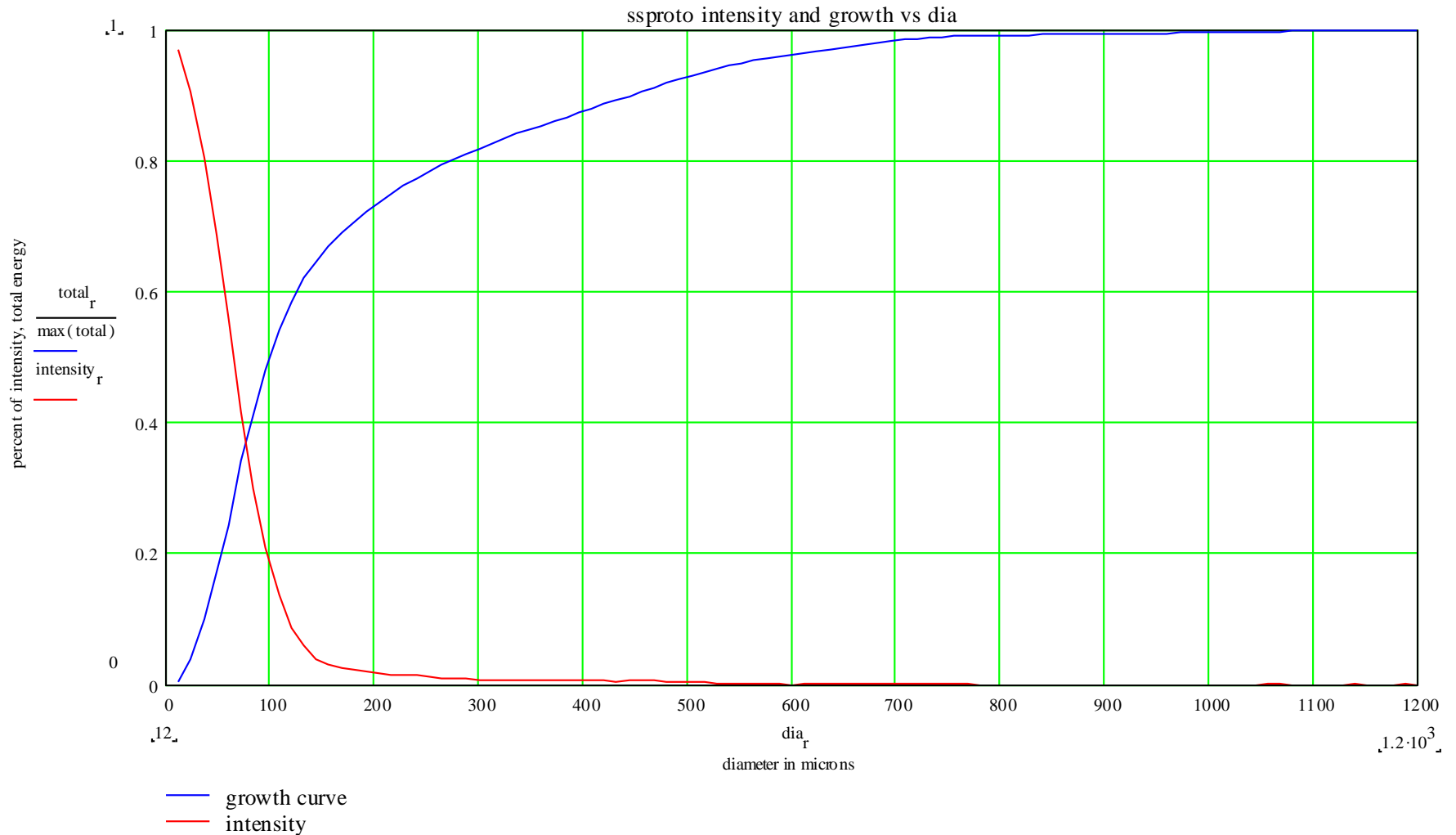
# Growth Curve #1 – Larger Spot w/ No Tails

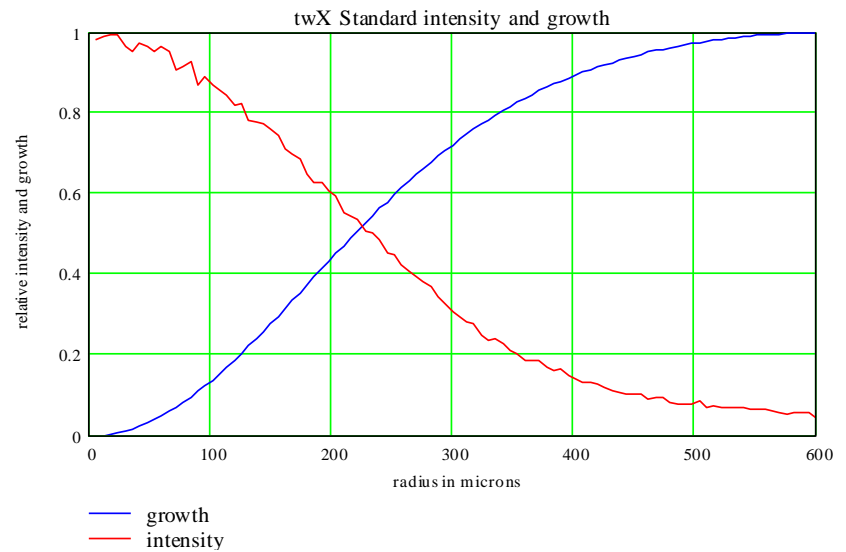
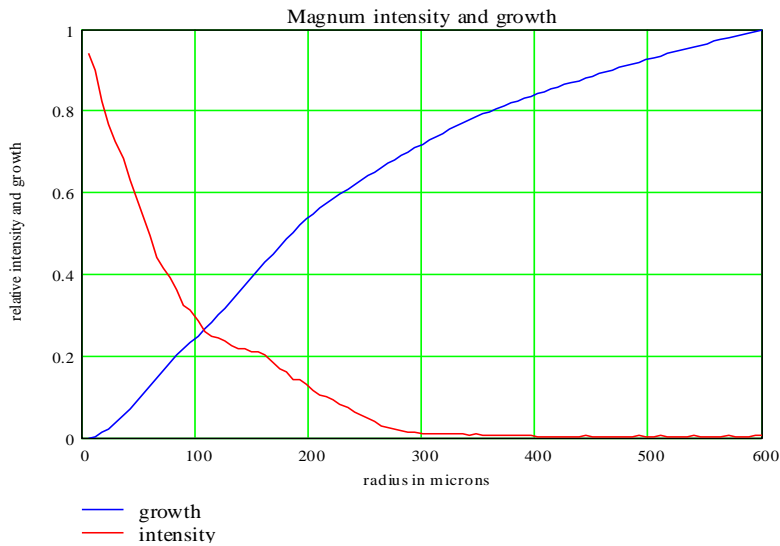
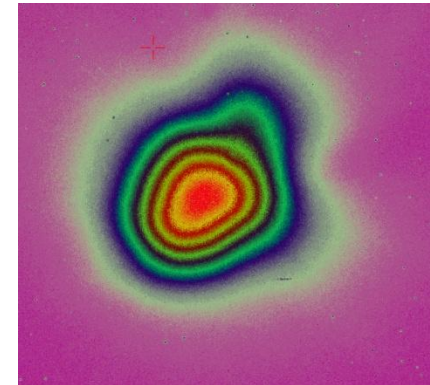
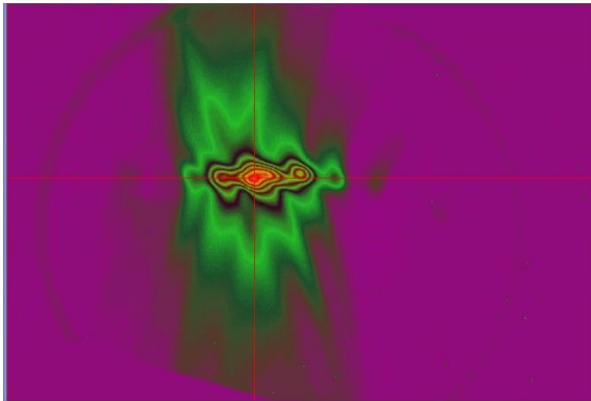
Growth Curve of 100u FWHM Gaussian Spot



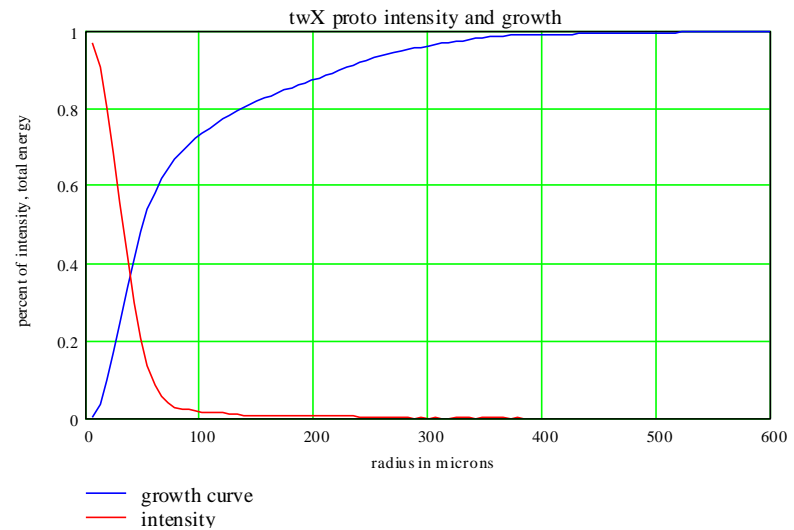
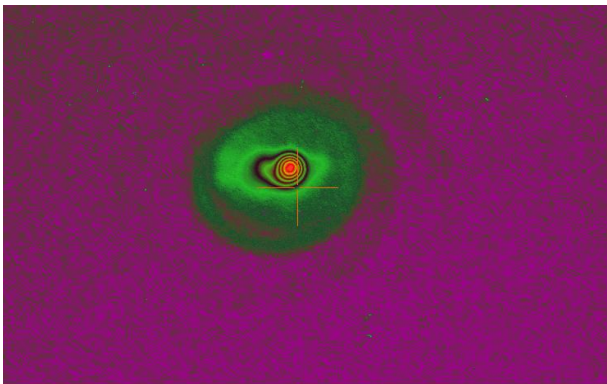
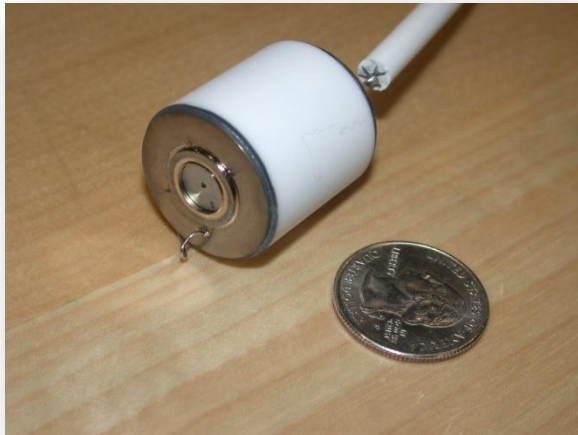


# Growth Curve #2 – Small Spot with Tails











## 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**