AN X-RAY TRANSMISSION GRATING SPECTROMETER FOR LYNX

**Hans M. Günther**, Ralf Heilmann

MOTIVATION

- Plenty of X-ray observations require high-res spectroscopy, e.g.
  - temperature and density sensitive line ratios
  - narrow line WHIM absorption
  - resolve kinematic profile of wind emission lines
  - ...
- Microcalorimeters are good at high energies
- Grating spectroscopy is better at low energies
- Lynx PSF + advanced gratings: > 10 times Chandra resolution
- Lynx mirror + advanced gratings: up to 1000 times Chandra area at O VII

SIMULATION INPUT

- MARXS ray-trace code (Günther et al, ApJ, 2017):
  - Freely available at https://github.com/Chandra-MARX/marxs/
  - Hundreds of unit tests
  - Tested against lab data and Chandra observations
  - Written in Python
- Data:
  - Mirror PSF: Assuming 0.5 arcsec half-power diameter
  - Critical angle transmission gratings (CAT), etched from Si. Using predicted efficiencies for 5.7 micron deep gratings.
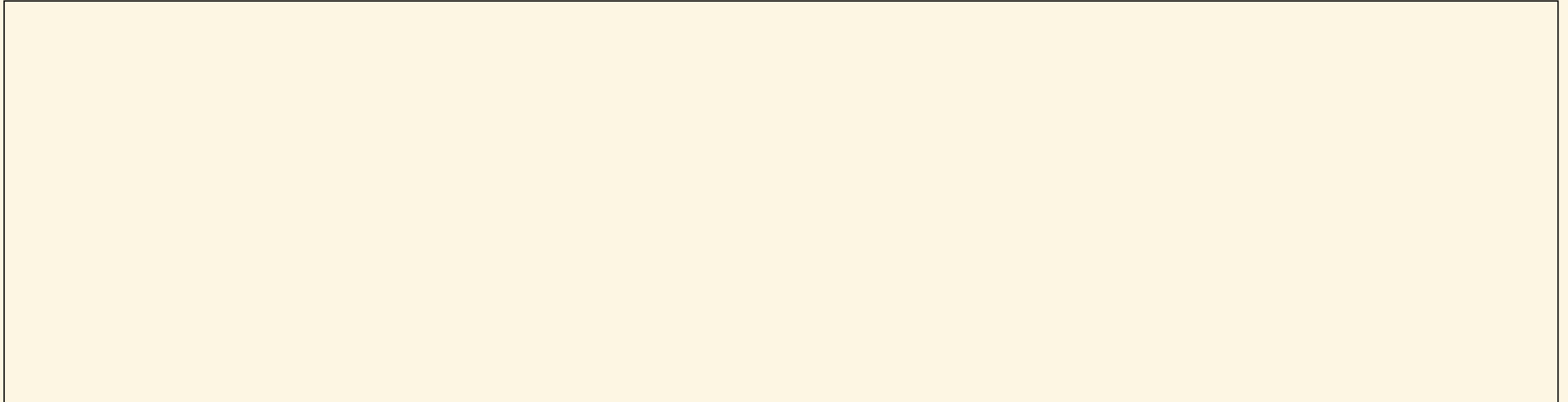 - Various filter curves, CCD QEs etc.

SIZE OF GRATING FACETS

- Small grating facets follow the Rowland torus well, but more area is lost for mounting structures, also number goes up.
- Large gratings use the space better, but diverge from the ideal form more.
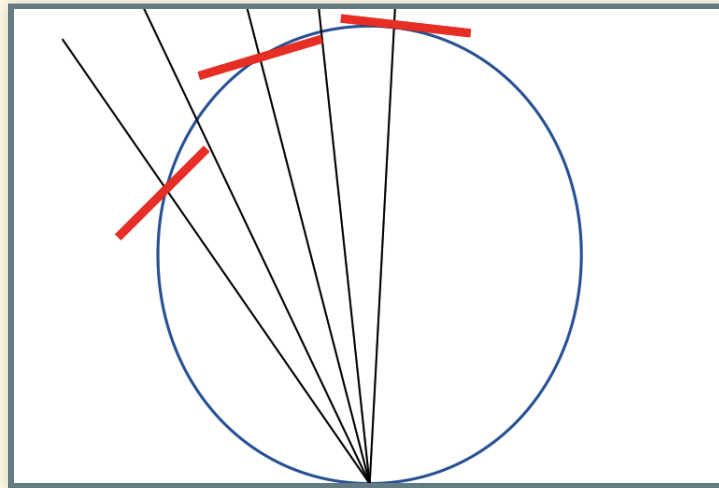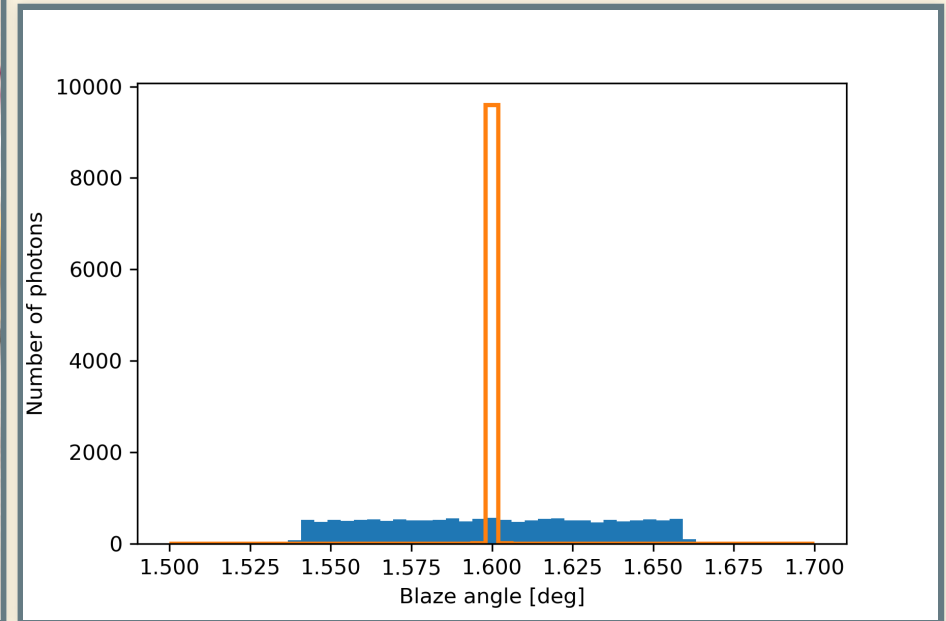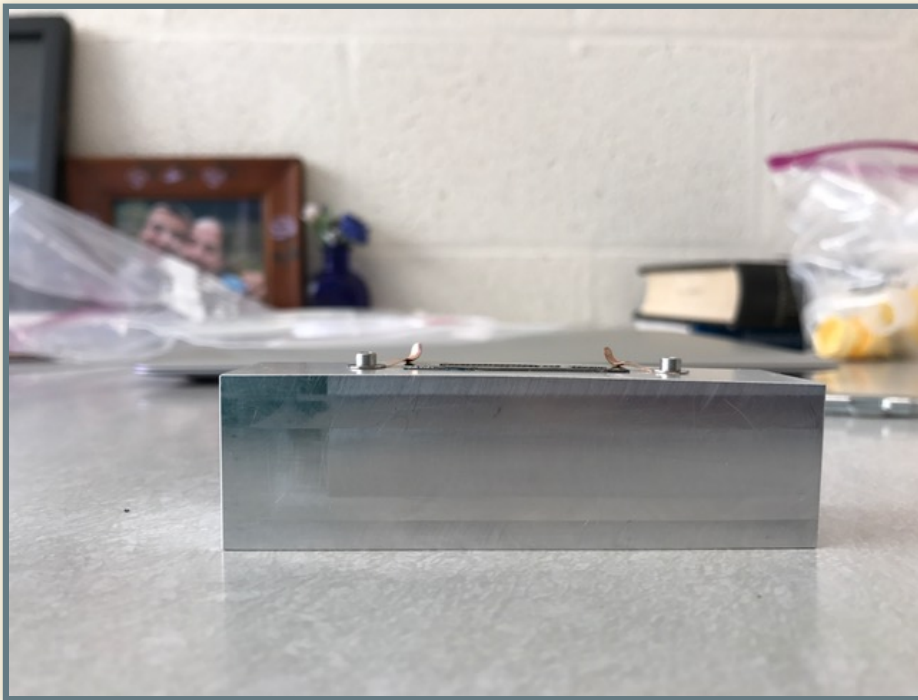
CAN WE HAVE OUR CAKE AND EAT IT, TOO?

THE SIMPLE APPROACH: RECTANGULAR GRATINGS

CAN WE HAVE OUR CAKE AND EAT IT, TOO?
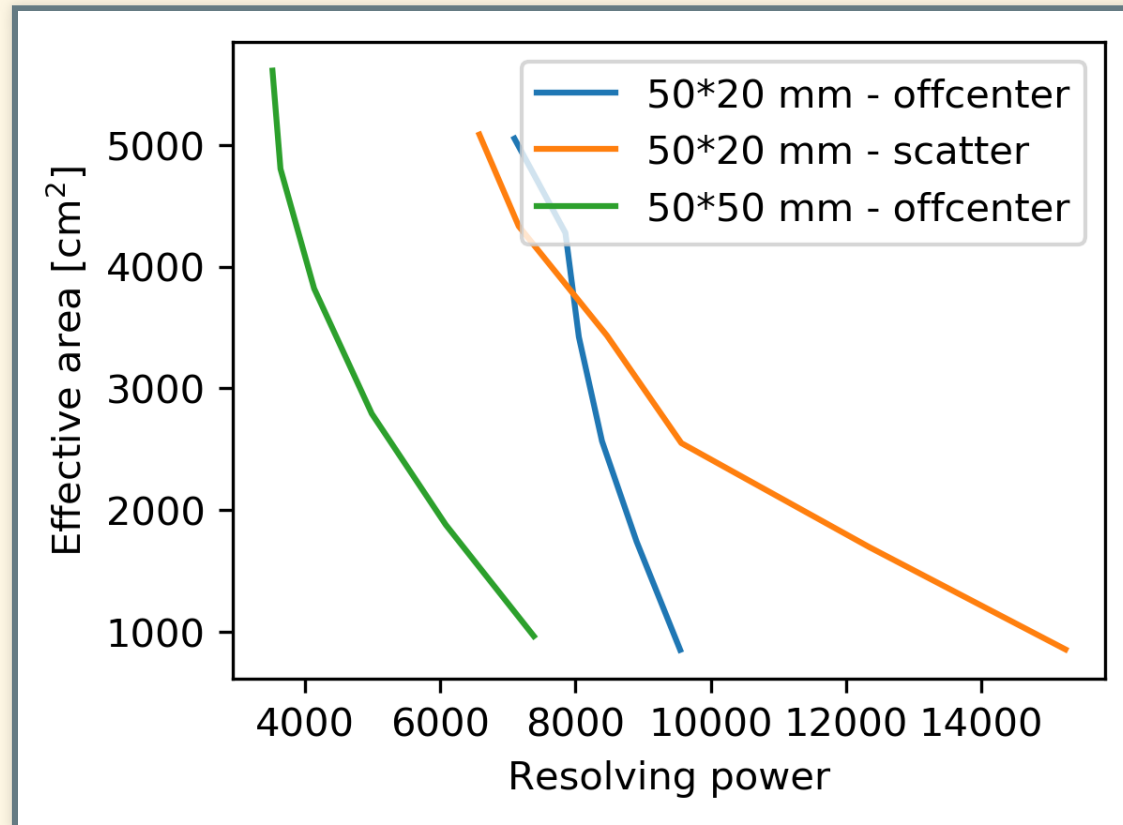
PRESERVING THE BLAZE: BEND GRATINGS
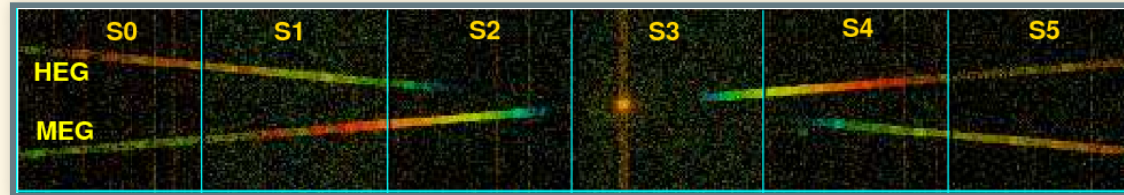
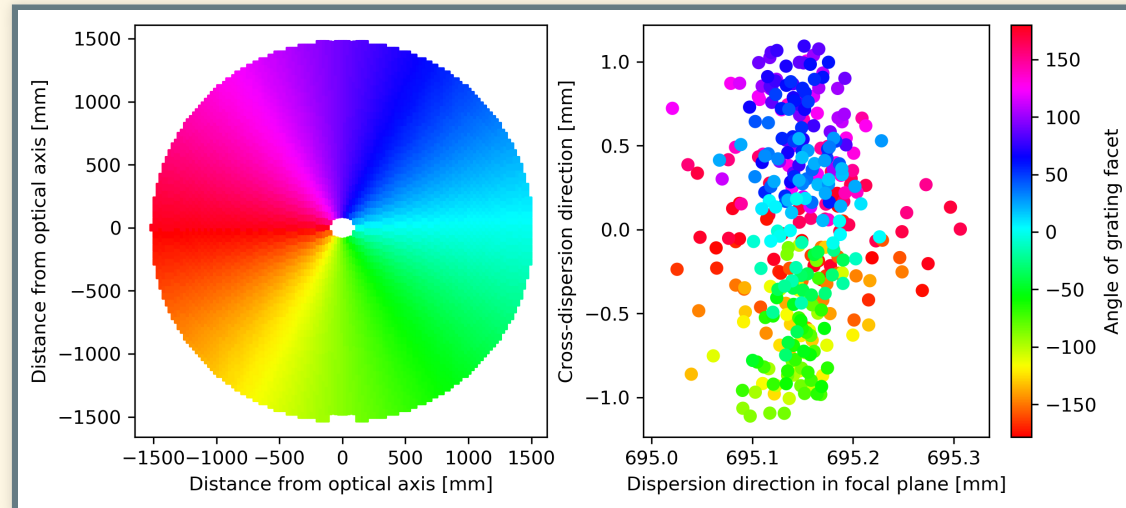# CAN WE HAVE OUR CAKE AND EAT IT, TOO?

RECOVERING THE RESOLUTION: CHIRPED GRATINGS

- projection lithography masks can be written in any pattern
- CAT grating production process with projection lithography is used for ARCUS
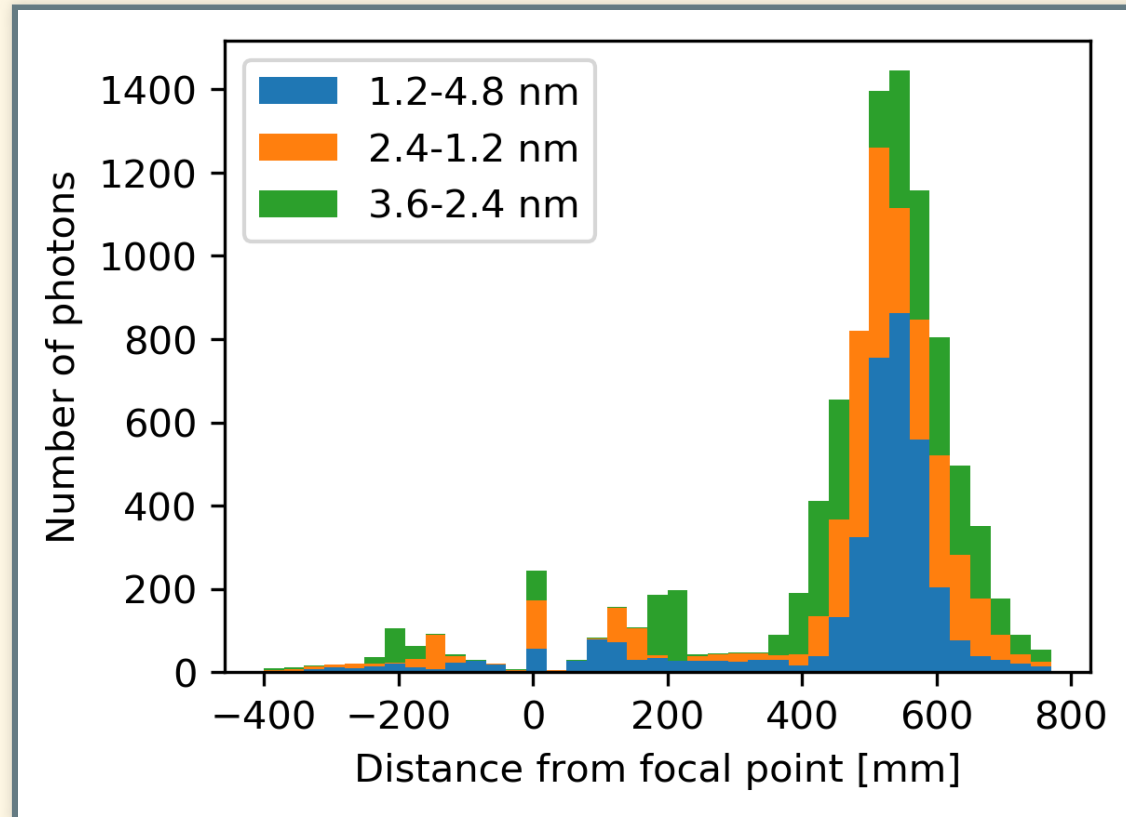- talk to Ralf Heilmann

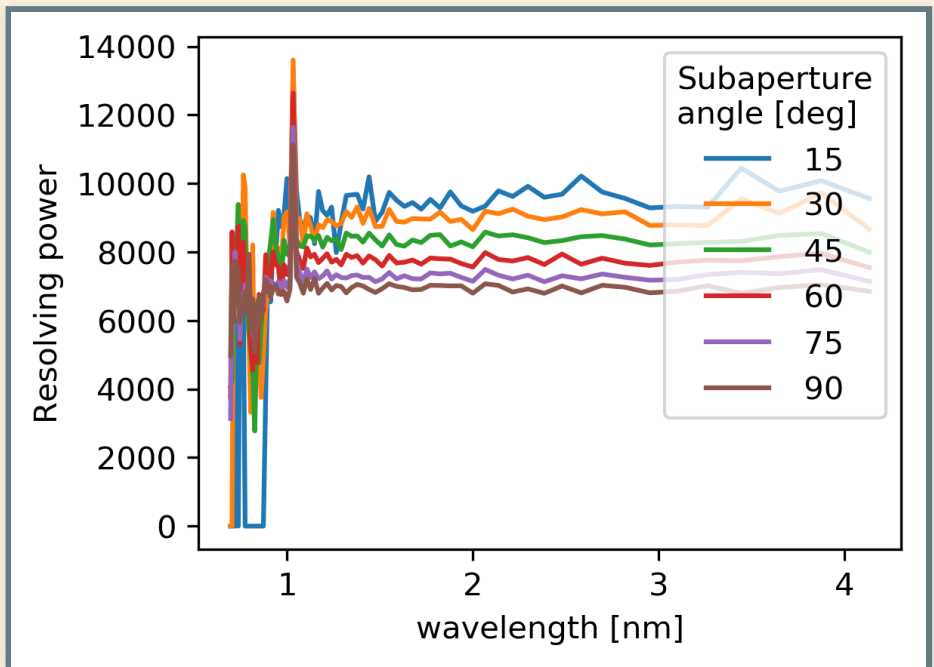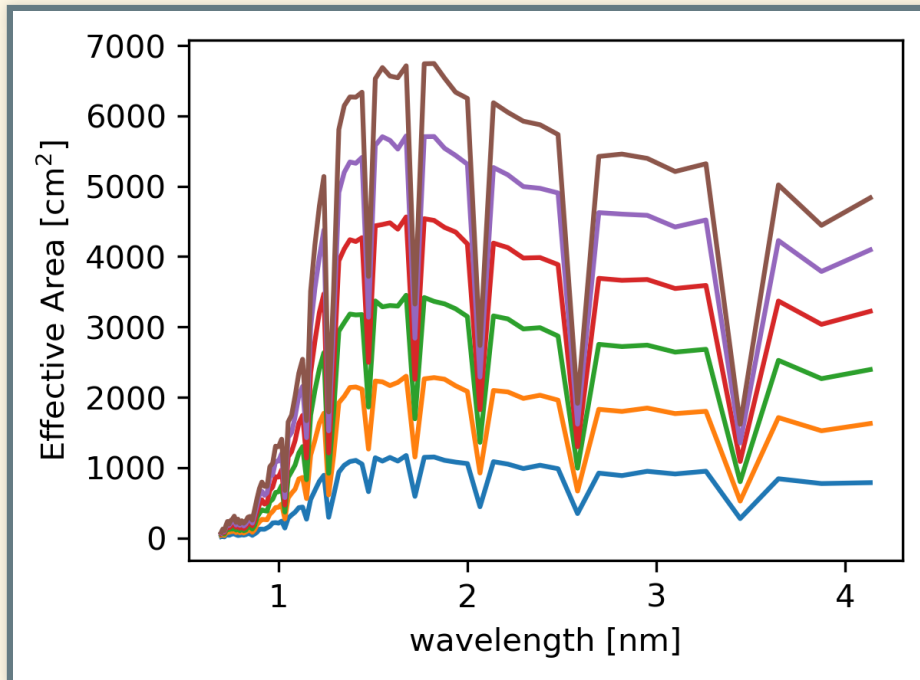# TRADE OFF RESOLVING POWER AND EFFECTIVE AREA
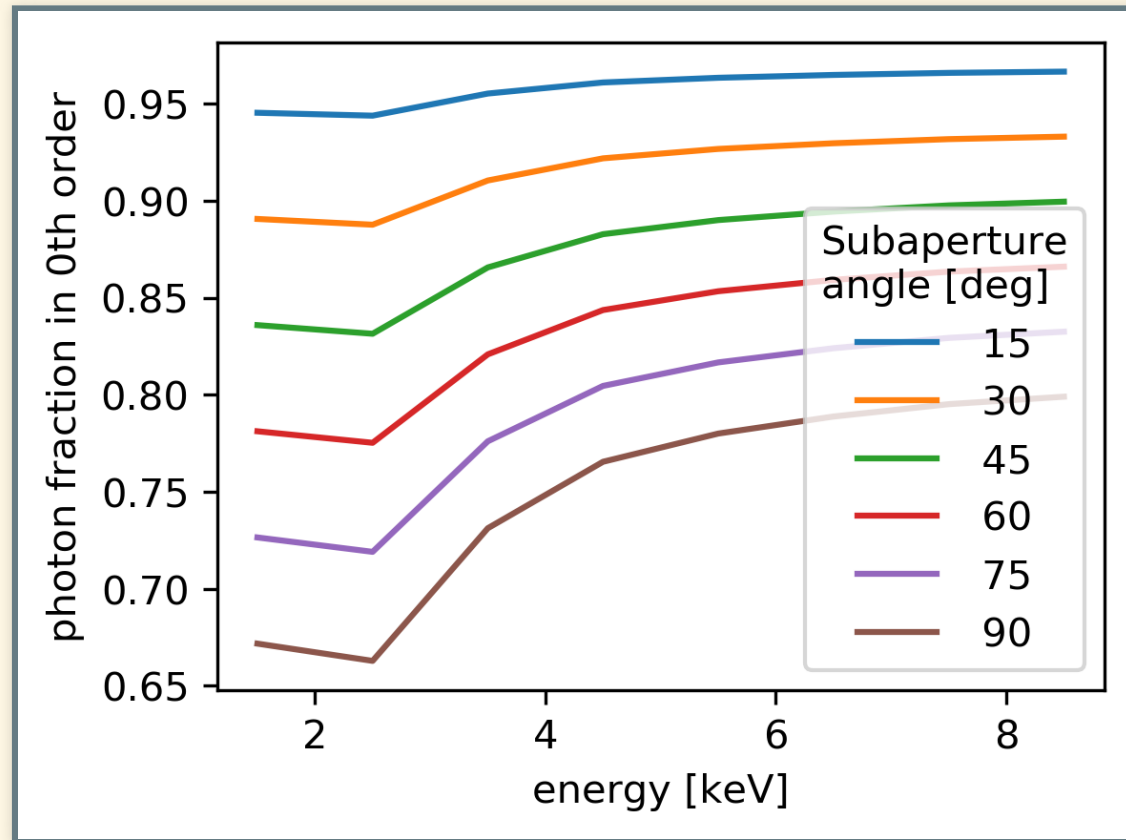
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CCD PLACEMENT

EFFECTIVE AREA AND RESOLVING POWER

HIGH-ENERGY PHOTONS PASS RIGHT THROUGH

SUMMARY

- CAT gratings can deliver the R, Aeff required by the Lynx science with (mostly) todays technology
- Alignment tolerances are very forgiving
- Trades and options:
  - Chirped gratings
  - Two traces
  - Grating coating