# Measuring IXS from Thin Films

*Alfred Baron, 2016 Updated 2020*

It is sometimes interesting to measure thin films, as these can be easier to prepare than bulk crystals. In some cases, a sample can *only* be prepared as a thin film. IXS on thin films is possible, but the desirable thickness is typically ~1 micron, or more. The following points should be considered (please also see the advice for single crystals, if relevant):

## 1. Film thickness

The film should be thick enough to

a) Provide sufficient signal

b) Prevent the substrate from dominating the measured response.

The importance of (b) depends also on the energy overlap of the phonons of the substrate and the thin film. But, of course, it is always simpler if one can say the substrate contribution is negligible…

## 2. Projected Beam Size

As one reduces the grazing angle onto a sample, the projected beam spot increases. One must keep the beam spot size, as seen by the analyzer, less than about 0.5 mm. As a very rough rule of thumb, grazing angles onto a thin film of ~100 mrad are probably OK. Smaller can be dangerous, though this also depends sensitively on two-theta (smaller two-theta can allow smaller grazing angles). It is possible to consider using stronger focusing (ie: going to the KBs), however, this will increase divergence which can be an issue, especially if one aims at a true GIXS geometry (see 5 below)

## 3. Motional Degrees of Freedom

For thin films, it can often be desirable to rotate the sample about the film normal, preserving a grazing angle of incidence. Please consider this in advance and make provision to do so, if needed. By default, one will only have the usual circles (omega, chi, phi) of a Eulerian cradle.

## 4. Alignment

It can be non-trivial to align a large (few cm scale) thin film in the center of the circles, as is made harder by working at grazing incidence since then small displacements can cause the beam to walk a long way across a sample. Please consider the alignment process.

## 5. True GIXS Geometry

It is sometimes interesting to operate near the critical angle to control penetration into the sample on the nm scale. This is non-trivial and very low rate. Note that both the beam size and the beam divergence are then an issue.