The proposal envisaged the use of the simplest MEMS structure (a single externally excited AFM Si cantilever) for chopping a monochromatic X-ray beam at the resonance frequency. The experimental setup is shown in the picture on the side.

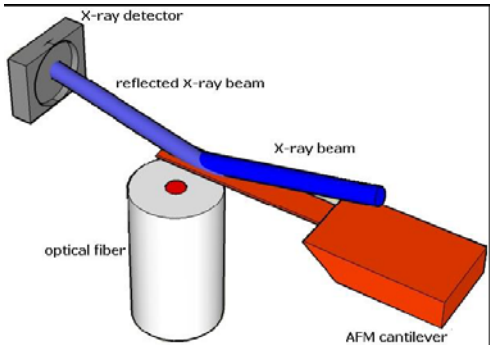

Fig1: Experimental setup: In red is represented the AFM cantilever used to shape the dark blue X-ray beam impinging at the Bragg angle. The bright blue reflected X-ray beam is detected with an X-ray photodiode. The white cylinder represents the optical fiber for the interferometric detection (it forms a Fabry-Perot cavity with the back of the cantilever) of the lever position with sub-Angstrom precision.

The mechanical system used during the experience is a standard Si (1 0 0) AFM cantilever whose dimensions are 300x35x2 µm3. The incoming X-ray beam is impinging on the cantilever at a Si Bragg condition and the X-ray photo detector is positioned at the correspondence angle for the beam reflected by the lever. The spot size of the incoming beam is 50x50 µm2 with 10^{10} ph/s impacting on the cantilever.

At Bragg condition, a constant flux of photons is detected by the photo diode. If the AFM cantilever is periodically excited, the X-ray beam incidence angle is modified by the lever motion. If the lever oscillation amplitude is high enough to change the incidence angle more than the Bragg peak width, the cantilever will periodically switch on and off the Bragg condition. As a consequence the photon flux detected will be no more constant and a periodically modulated current should be measured at the output of the photo diode. The amplitude of the photon flux oscillation is thus strictly linked to the oscillation amplitude of the cantilever.

This behavior has been verified by changing the frequency of the excitation or its amplitude as shown in fig 2 and 3.

Fig. 2: (a) Mechanical response of the AFM cantilever when it is mechanically excited around the first resonant frequency. The resonant frequency for the mechanical system is set at 13 kHz. (b) Current detected at the output of the photodiode.

In (a) and (b) the black curve represents the oscillation amplitude and the red curve the phase lag.

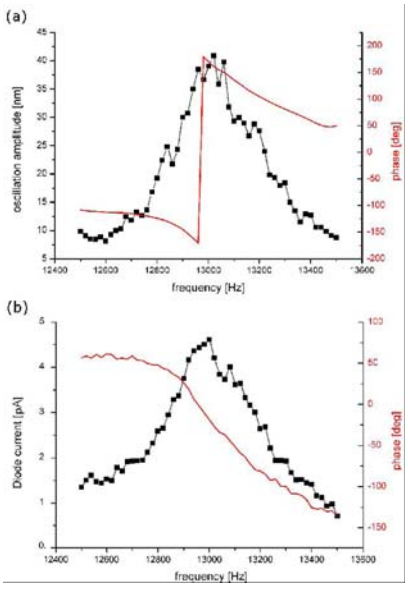

FIG. 3: Current oscillation amplitude measured at the output of the X-ray detector. The experience is performed for different cantilever excitation amplitude. The different oscillation amplitudes of the AFM lever are presented in the inset text box