Point-by-point response to the reviewers

Reviewer #1

> I could not find a significant advance in this work. X-ray Talbot-Lau interferometers with high-energy x-rays have been already reported (Ref. 18-20, 23, D. Stutman et al., Appl. Opt. 49 (2010) 4677 etc.). The authors mention that the edge-on- illuminated grating interferometry breaks the current limitations of x-ray phase-contrast imaging, but I don't think that there is clear evidence showing that the authors' method is much more promising than the methods reported in the previous papers. If the authors want to show that the edge-on-illumination method is by far the most promising for high-energy and large-field-of-view x-ray phase imaging, I think that the authors have to quantitatively compare the method with those previously reported in terms of the total exposure time, spatial resolution, signal-to-noise ratio, and so on, and show that the authors' method is much better than the others.

We think that the experiments presented in the current manuscript show indeed significant progress with respect to the cited references. The method presented by Stutman et al. has a fundamental limitation that prevents it from achieving curved structures and large aspect ratios. Moreover, those experiments were performed on a source with 60 kVp, which is significantly lower than the 160 kVp of our source and the 100 keV used as the design energy for our interferometer.

The other works also present results in a much lower energy range or very different conditions, thus preventing a meaningful comparison. Reference 23 reported images taken at 30 and 60 keV, reference 20 also has a design energy of 47.9 keV. Finally, references 18 and 19 present Talbot interferometry at 82 and 123 keV respectively, but only the first result is published on a peer reviewed journal, and both experiments were performed at the ESRF synchrotron, with a monochromatic and coherent beam that is incomparable to a conventional tube.

> Furthermore, the authors mention that the results in Fig. 3 show the benefit of the phase nature of the image, but I think that the authors should provide a more detailed explanation about the contrasts in the images because the contrast of soldering points underneath the resistors should not be reduced in the differential attenuation image for monochromatic x-rays. The authors

> should explain quantitatively why the contrast is reduced. Otherwise, the authors' assertion is suspicious.

A paragraph was added to discuss the different beam hardening behaviour of the absorption and differential phase image to address the reviewer's concerns.

Reviewer #2

> However, this solution comes with significant drawbacks in terms of very limited fields of view 3 cm horizontally, a single detector pixel in the vertical direction), which at the moment seem hard to overcome.

There is no fundamental limitation on the horizontal field of view in our approach. On the contrary, our solution actually solves precisely this issue, by easily matching the spherical wave front with the curved structures. Any limitation to horizontal the field of view given by large glancing angles is therefore removed. The gratings could already be fabricated on larger wafers with the existing technology.

The limitations in the vertical field of view do not come at the expense of an increased dose with our proposed scanning solution. Larger areas could in principle be scanned with short exposure times by stacking an array of edge-illuminated gratings. This scanning technique is already offered in commercial X-ray diagnostic devices, such as the Philips MicroDose mammography system, to reduce scattering.

> Moreover, in the methods section the authors talk of a 5 % visibility, which is even lower than that of the quoted papers by Pfeiffer's group (refs 18, 19), which, at least nominally, reach even higher energies (123 keV). Hence, the reduction in field-of-view does not seem to be counterbalanced by significant improvements in visibility. This is also supported by the relatively poor quality of the differential phase image compared to the derivative of the absorption image, where the only advantage seems to be the visibility of the soldering points beneath the resistors (primarily due to the fact that these do not produce area contrast in the DPC image), while everywhere else the contrast of the differentiated absorption image seems to be higher.

The visibility in our experiment is still low, and this obviously affects the quality of the images, but we also mentioned that this is the first attempt in building gratings with our new design, while the fabrication of traditional structures has been developed for over a decade now. The remarks above about references 18 and 19 (synchrotron source, unpublished results) should also be taken into account here.

> Finally, the novelty of the result is diminished by previous demonstrations that high energies in phase-contrast x-ray imaging could be reached by other methods (e.g. Ignatyev et al JAP 110 (2011) 014906), albeit in that case image quality seems to be lower.

In the paper from Ignatyev et al., an admittedly lower image quality was achieved again with softer X-rays, from 60 to 100 kVp. Thus, we claim that our results are a significantly more promising than the technique described therein.

Reviewer #3

> An extended object is imaged by axial scanning, which results in very long exposure times due to phase stepping. The legend of Fig. 3 indicates that one image line of 0.1 mm width is acquired in 6 min. The authors admit this situation in the last sentences of the manuscripts without giving a convincing solution to the problem.

This is indeed an issue, as the exposure time is mostly affected by the low visibility. The manuscript was amended to include a more detailed discussion of our plans to reduce the exposure time. We briefly mention here that raising the visibility to 15 %, a value already reached in lower energy experiments, would immediately cut the exposure by 9 times.

> The authors suggest that the only imaging methods that can be used with conventional x-ray sources are the in-line phase contrast technique and Talbot interferometry. They fail to mention that analyzer-based imaging systems with x-ray tube sources have been built and successfully used for imaging rather large biological objects. The current exposure times are shorter or comparable to those of the present work, but there are clear indications how the exposure times in x-ray tube based ABI can be reduced by an order of magnitude or more. On the other hand, the upper limit of photon energy is that of the tungsten Kalpha line, 60 keV. For references, see Nesch et al.(2009), Rev. Sci. Instrum. 80, 093702, and Parham et al.(2009), Acad.Radiol. 16, 911-917.

We now included references to these papers, but we point out that our experiments do not have any intrinsical limit to the photon energy.