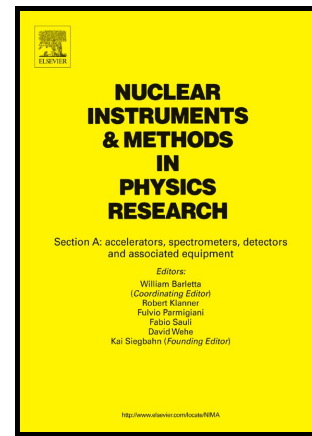


# Author's Accepted Manuscript

Simulation study of an X-ray diffraction system for breast tumor detection

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PII: S0168-9002(17)30477-1  
DOI: <http://dx.doi.org/10.1016/j.nima.2017.04.026>  
Reference: NIMA59814

To appear in: *Nuclear Inst. and Methods in Physics Research, A*

Received date: 4 July 2016  
Revised date: 19 March 2017  
Accepted date: 16 April 2017

Cite this article as: F. Marticke, G. Montemont, C. Paulus, O. Michel, J.I. Mars and L. Verger, Simulation study of an X-ray diffraction system for breast tumor detection, *Nuclear Inst. and Methods in Physics Research, A* <http://dx.doi.org/10.1016/j.nima.2017.04.026>

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1 Simulation study of an X-ray diffraction system for  
2 breast tumor detection

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9 **Abstract**

10 X-ray diffraction (XRD) is a powerful technique used to determine the molec-  
11 ular structure of biological tissues. In breast tissues for example, the scattering  
12 signatures of dense fibroglandular tissue and carcinoma have been shown to be  
13 significantly different. In this study, XRD was used as a second control level  
14 when conventional mammography results were unclear, for instance because of  
15 overly high breast density. A system optimized for this issue, called multifocal  
16 XRD, was developed combining energy dispersive spectral information at dif-  
17 ferent scattering angles. This system allows depth-imaging in one go but needs  
18 an x,y-direction scan to image the region conventional mammography identified  
19 as suspect. **The scan-time for about 10 cm<sup>3</sup> with an incident flux of about**  
20 **4.8·10<sup>7</sup> photons per second would be around 2 seconds.** For this study, breast  
21 phantoms with and without cancerous nodule were simulated to assess the sep-  
22 aration power of the method and to determine the radiation dose required to  
23 obtain nearly ideal separation. For tumors situated in the center of the breast,  
24 the required dose was only about 0.3 mGy, even for breasts with high density.  
25 The tumor position was shown to have a low impact on detectability provided  
26 it remained in a zone where the system was sufficiently sensitive. The influence  
27 of incident spectrum maximum energy was also studied. The required dose re-  
28 mained very low with any of the incident spectra tested. Finally, an image slice  
29 was reconstructed in the x-direction and showed that the system can detect the

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*Preprint submitted to Nuclear Instruments and Methods in Physics Research Section April 17, 2017*

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