Evaluation of Natural Diamond Detectors as Low Energy Heavy Ion Spectrometers

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Scope of the Talk

Introduction

Motivation

Radiation hard natural diamond detectors (NDDs) might be an attractive alternative to silicon ones as energy spectrometers in low energy heavy ion experiments in particular, for heavy ion AMS, however, so far a few is known about the feasibility of NDDs for heavy ion spectroscopy. In this talk, some results on the NDD performance as an low energy heavy ion spectrometer are presented.

Detectors & electronics

- An effective diameter of the NDDs ~ 2mm
- Very thin (~20μg/cm^2) electrical contacts, of gold (NDD#1) or carbon (NDD#2)
- Commercial electronics for nuclear spectroscopy with the c-s preamplifier

Irradiation conditions

- Beam line of the VERA Accelerator, Vienna
- Ions: ^{13}C, ^{197}Au, ^{238}U at 1 - 20 MeV
- Maximal fluence for ^{238}U ~ 3x 10^{9} ion/cm^{-2}

Conclusions and outlook

- The NDDs are developed which have proven feasible for spectroscopic measurements of heavy ions with an energy cut-off of about of 1 MeV

- The NDDs exhibited an energy resolution comparable to that of standard silicon detectors under heavy ion beams, in spite of specific peculiarities in PH distributions

- No polarization effects were observed under U^{238} ion beams with the fluence of 3×10^{9} ion/cm^{2}

- Small size of the NDDs can be compensated by using a detector array

- In our further research, we plan :
  i) to study the spectroscopic features of NDDs in more details,
  ii) to carry out comparative tests of the radiation hardness of the NDDs together with SC artificial diamonds,
  iii) to search for possibilities to improve a fabrication yield of high resolution NDDs

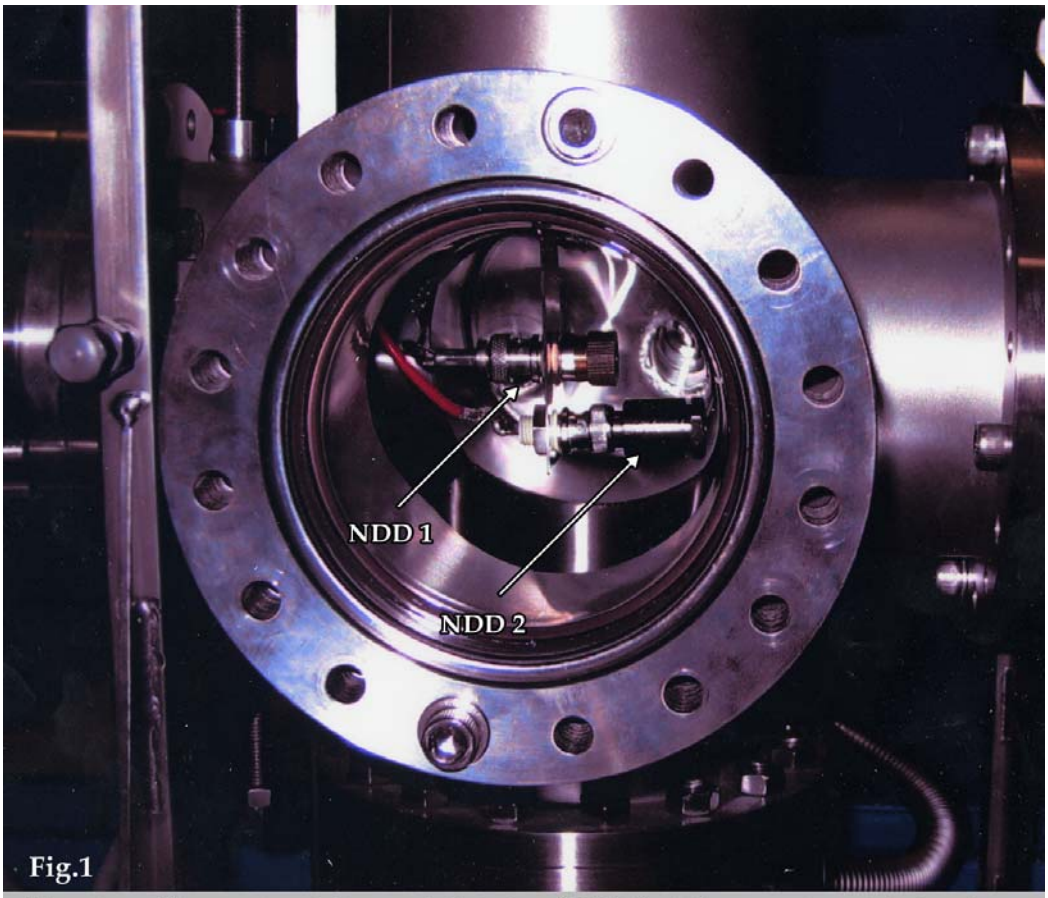


Fig.1

The view of two natural diamond detectors (NDDs) at the experimental chamber.

"Pumping" in the NDD under ^{13}C beam at 11.99 MeV

Sample "NDD2"

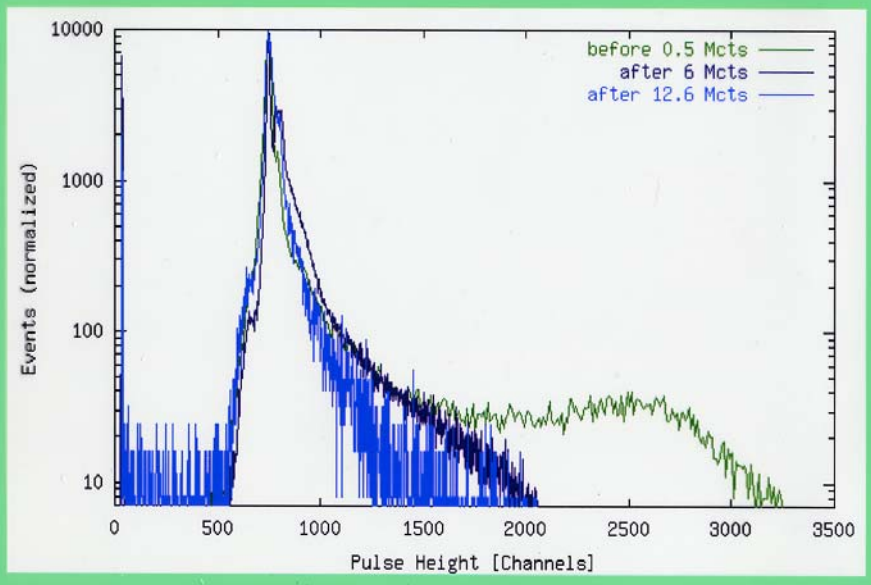


Fig.2

Comparison of two different NDD detectors (after pumping)

^{197}Au at 13.03 MeV

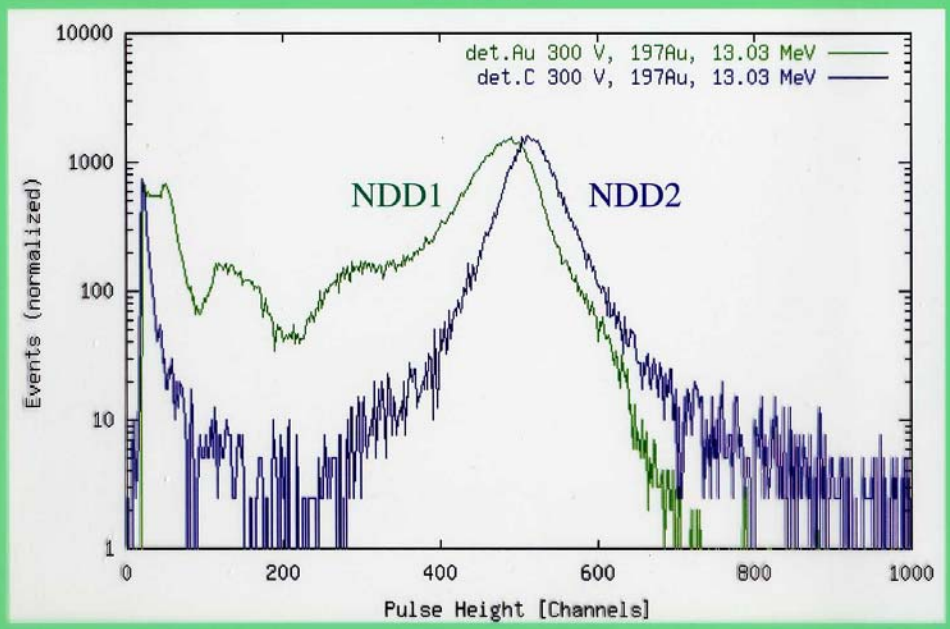


Fig.3

Influence of Bias Voltage on Pulse Height and Resolution

("NDD1")

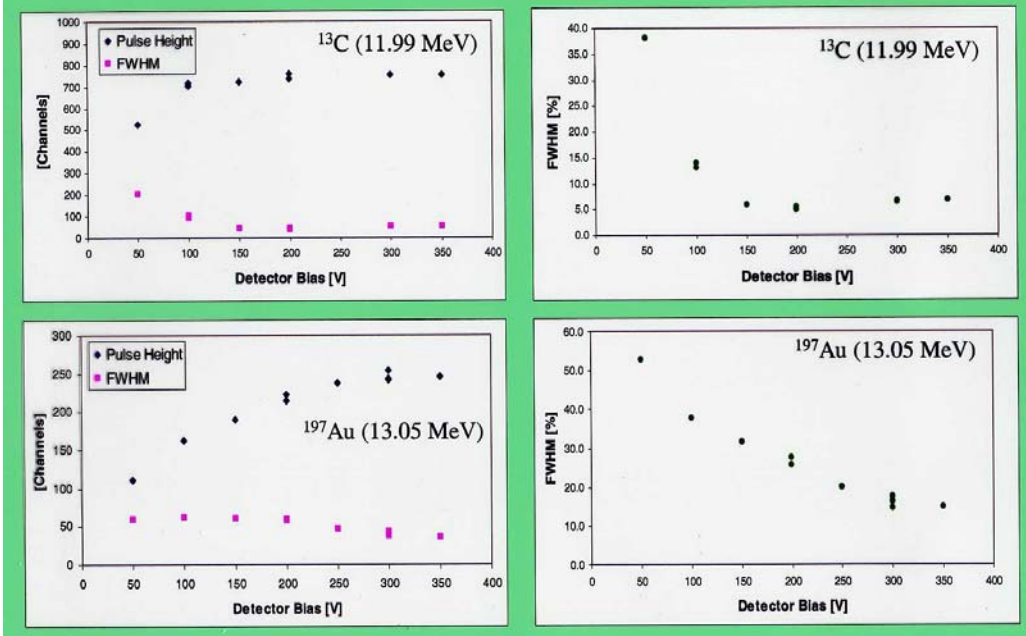
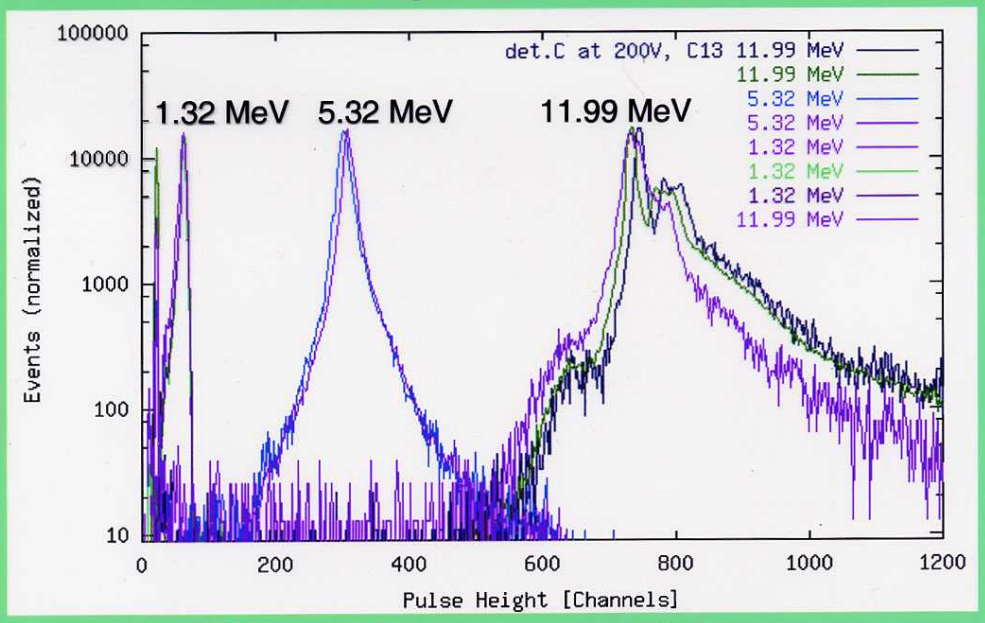


Fig.4

Pulse height spectra of ^{13}C



Pulse height spectra of ^{197}Au

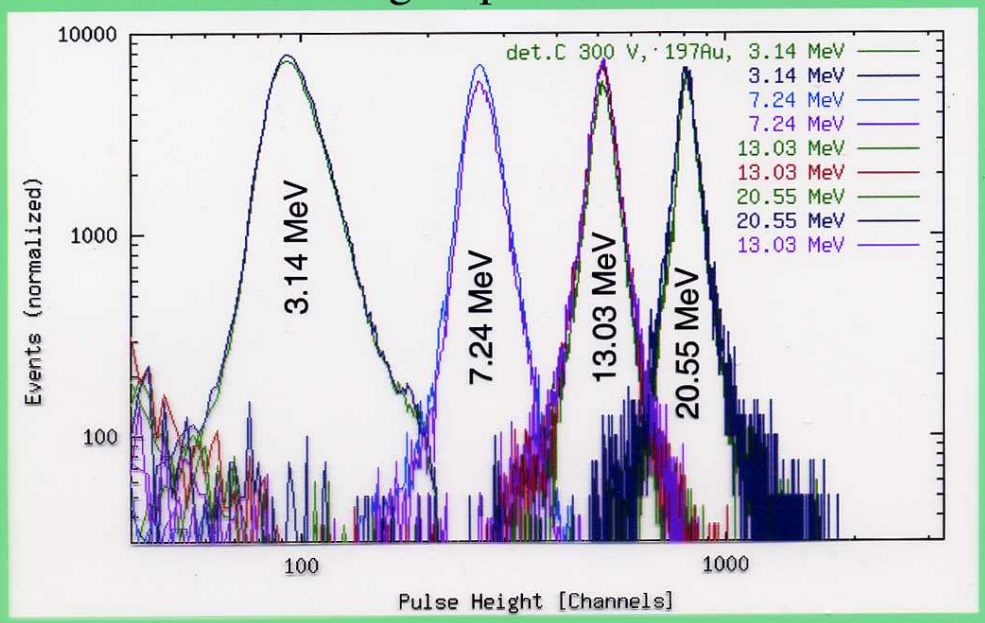


Fig.5

Energy calibration and cut-off for two different NDDs

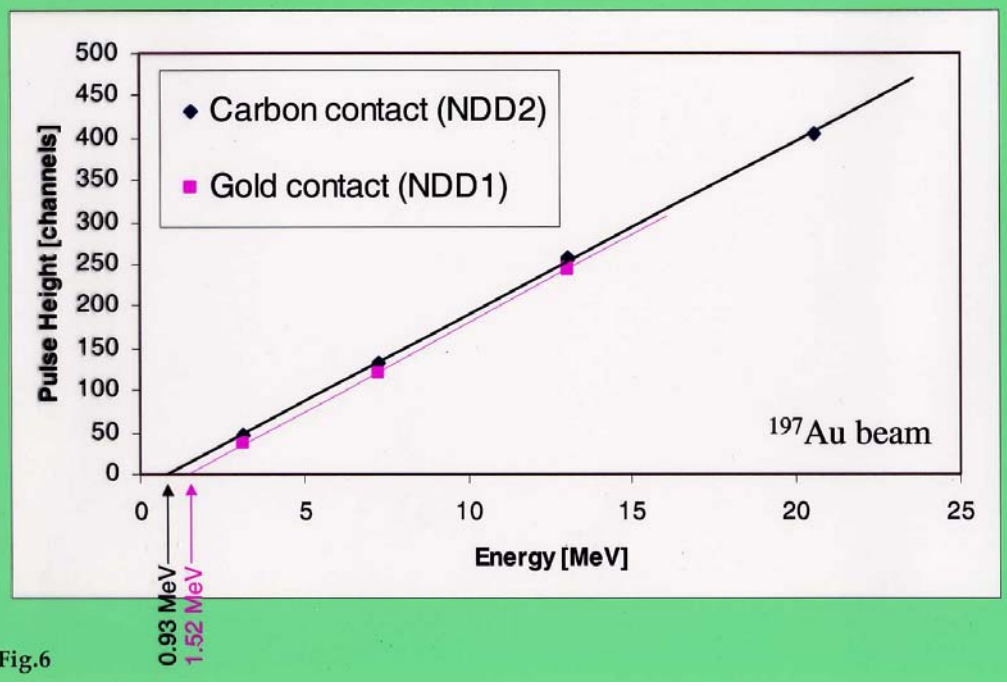


Fig.6

Best spectrum for heavy ions at medium energy obtained so far

("NDD2", 400 V bias)

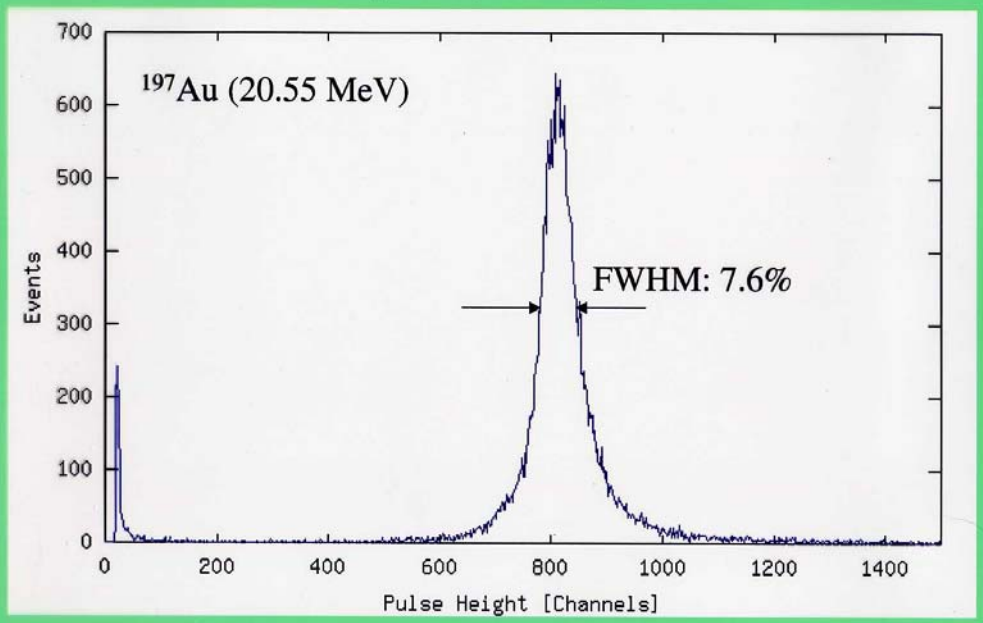


Fig.7