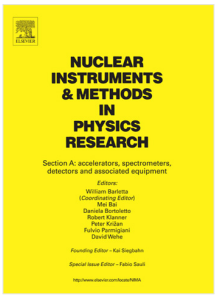
# Accepted Manuscript




Development of a solenoid spectrometer for nuclear astrophysical studies of fusion reactions near stellar energies

X. Fang, B. Bucher, A. Howard, J.J. Kolata, Y.J. Li, A. Roberts, X.D. Tang, M. Wiescher

PII: S0168-9002(17)30807-0
DOI: http://dx.doi.org/10.1016/j.nima.2017.07.050
Reference: NIMA 59999

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

Received date : 17 June 2017
Revised date : 16 July 2017
Accepted date : 24 July 2017

Please cite this article as: X. Fang, B. Bucher, A. Howard, J.J. Kolata, Y.J. Li, A. Roberts, X.D. Tang, M. Wiescher, Development of a solenoid spectrometer for nuclear astrophysical studies of fusion reactions near stellar energies, *Nuclear Inst. and Methods in Physics Research, A* (2017), http://dx.doi.org/10.1016/j.nima.2017.07.050

# Development of a solenoid spectrometer for nuclear astrophysical studies of fusion reactions near stellar energies

X. Fang[a,b,*], B. Bucher[b,c], A. Howard[b,**], J. J. Kolata[b], Y. J. Li[d], A. Roberts[b], X. D. Tang[e], M. Wiescher[b]

[a] *Sino-French Institute of Nuclear Engineering and Technology, Sun Yat-Sen University, Zhuhai 519082, China*
[b] *Joint Institute for Nuclear Astrophysics, Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556, USA*
[c] *Idaho National Laboratory, Idaho Falls, Idaho 83415, USA*
[d] *Department of Nuclear Physics, China Institute of Atomic Energy, Beijing 102413, China*
[e] *Institute of Modern Physics, Chinese Academy of Science, Lanzhou, Gansu 730000, China*

**Abstract**

A solenoid spectrometer for nuclear astrophysics (SSNAP) has been developed to study heavy-ion fusion reactions of astrophysical importance near stellar energies. Charged particles follow helical trajectories within the strong magnetic field of a superconducting solenoid. The $^{12}$C($^{12}$C,p)$^{23}$Na reaction was studied as the first measurement using the solenoid spectrometer at the University of Notre Dame within the energy range of $E_{c.m.}$=4.0 to 6.0 MeV. This experiment demonstrated that the solenoid spectrometer is able to provide outstanding capability for detection of light charged particles produced by nuclear fusion reactions having a relatively wide energy range.

*Keywords:* nucleosynthesis, solenoid spectrometer, magnetic field, $^{12}$C($^{12}$C,p)$^{23}$Na, PSSD, SSNAP

*fangx26@mail.sysu.edu.cn
**Current address: Heinz Maier-Leibnitz Zentrum (MLZ), FRM-II, Technische Universität München, D-85748 Garching, Germany