拡大IRT研究会高分解能分科会
2009年8月6日

冷中性子ディスクチョッパー型分光器 アマテラス

AMATERAS

The Cold-Neutron Disk-Chopper Spectrometer in MLF, J-PARC

中島健次

J-PARCセンター

物質・生命科学実験施設　中性子利用セクション

AMATERAS Contributors

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Cold-Neutron Disk-Chopper Spectrometer, AMATERAS

- AMATERAS is a Multi-Chopper Spectrometer, dedicated to High Resolution Quasi & Inelastic Measurements @ Cold ~ Thermal Region (E_i=1~80meV)
- Construction April, 2006 - March, 2009

Fast Disk-Choppers
Max. Rev. =350Hz
R=700mm
Δt_{ch_min}=7.5μsec.

4m

30m from the source

Scattering Chamber
V=59m^3
P<10^{-5} Torr

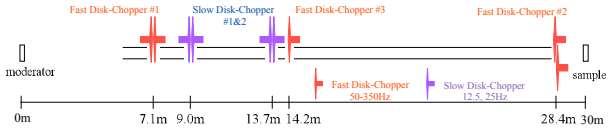
Beam Transport
3Qc&3.8Qc Super Mirror
Horizontal: Curved (R=2Km)
Vertical: Straight + Elliptical

Detector:
^{3}He 1D-PSD × 448 tubes
ϕ=1inch, L=3m, 10atm
Coverage: 0.67πSr.
Set in Vacuum

TOSHIBA Leading Innovation

Moderator & BL: Coupled-H$_2$ (BL#14)
L_1(moderator-sample) = 30 m
L_2(sample-detector) = 4 m
L_3(monochromating chopper-sample) = 1.6 m
E_i=1~80 meV (at its best @ 1~20 meV)
Energy Resolution: $\Delta E/E_i$>1% @ E_i=20meV
Q Resolution: $\Delta Q/k_i$ ~ a few %
Horizontal Scat. Ang.: -40° < 2θ$_S$ < 140°
Vertical Scat. Ang.: -16° < 2θ$_S$ < 22°
Detector Coverage: 0.67πSr

Cold-Neutron Disk-Chopper Spectrometer, AMATERAS



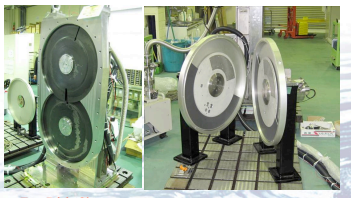
Fast Disk-Chopper #2
Δt_{ch}>7.5μsec.

Slow Disk-Chopper×2
Variable Band Chopper
Open Angle=0~175deg.

Fast Disk-Chopper #3
Pulse (Tail) Remover

Fast Disk-Chopper #1
Δt_{ch}>23μsec.

新開発のチョッパーシステム（国産）



Fast Disk-Chopper
(Fast Disk-Chopper #2)
max rev. 350Hz

Slow Disk-Chopper
25 & 12.5Hz

Cold-Neutron Disk-Chopper Spectrometer, AMATERAS

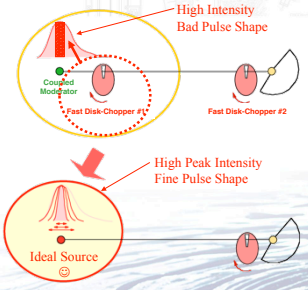
- Coupled Moderator Source & Pulse Shaping

Fast Disk-Chopper #2
Δt_{ch}>7.5μsec.

Slow Disk-Chopper×2
Variable Band Chopper
Open Angle=0~175deg.

Fast Disk-Chopper #3
Pulse (Tail) Remover

Fast Disk-Chopper #1
Δt_{ch}>23μsec.

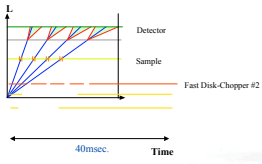


- High peak intensity of couple moderator source can be used without degrading the resolution.
- Resolution (=pulse width) can be optimized for each experiments.

Cold-Neutron Disk-Chopper Spectrometer, AMATERAS

- multi-E_i Measurements on AMATERAS

AMATERAS (High Intensity Mode)



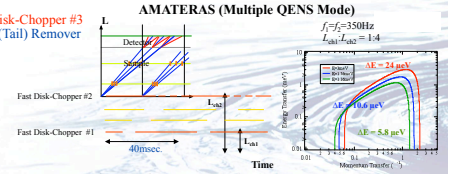
Fast Disk-Chopper #2
Δt_{ch}>7.5μsec.

Slow Disk-Chopper×2
Variable Band Chopper
Open Angle=0~175deg.

Fast Disk-Chopper #3
Pulse (Tail) Remover

Fast Disk-Chopper #1
Δt_{ch}>23μsec.

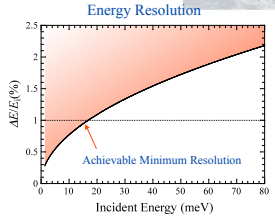
AMATERAS (Multiple QENS Mode)



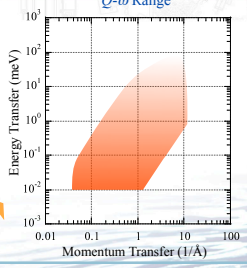
M. Nakamura *et al.*: J. Nentron Res. **15** (2007) 31

Cold-Neutron Disk-Chopper Spectrometer, AMATERAS

Energy Resolution



Q-ω Range



AMATERAS covers from a few tens μeV to a few tens meV

Q Resolution of AMATERAS

$\Delta Q/k_i$ = 1~2% in over all

Flux at Sample Position @ Fixed Resolution (McStas)

10^4~10^5 (neutrons/cm^2/sec) for $\Delta E/E$=1%
10^4~10^6 (neutrons/cm^2/sec) for $\Delta E/E$=3% at 1MW

Construction of AMATERAS: Shielding

- Shielding: February, 2008 ~ August, 2008

Construction of AMA

Construction of AMATERAS: Detectors

- 266 tubes (60% of full installation) have been deliv
- 32
- 23

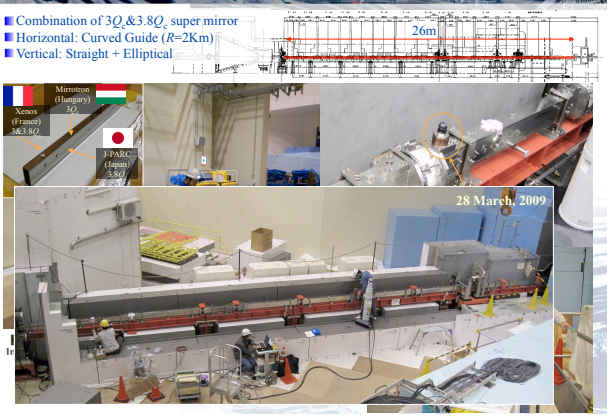
SK

Construction of AMATERAS: Chopper System

- isk-Choppers (9 Disks)
- 009

Construction of AMATERS: Beam Transport

- Combination of $3Q_c$&$3.8Q_c$ super mirror
- Horizontal: Curved Guide (*R*=2Km)
- Vertical: Straight + Elliptical



Construction of AMATERAS: Vacuum System

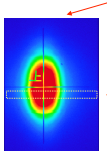
- Vacu
  - M
  - Su
- Instal

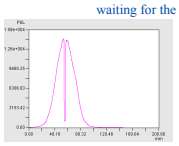
Commissioning of AMATERAS

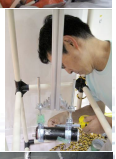
- Construction was finished in April, 2009!
  - ✓ Shielding
  - ✓ Vacuum Tank
  - ✓ Chopper System
  - ✓ Guide System: L<28.4m
  - ✓ DAQ & Detectors: 32 PSDs @ 22~35deg.
  - ✓ 4K CCR
- AMATERAS Got the First Neutron Beam on 27 May, 2009! (RUN #24&#25)

Commissioning of AMATERAS

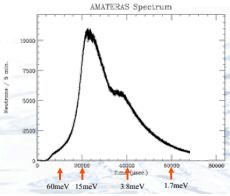
- 1st Commissioning of AMATERAS done in RUN #24 & #25 (only 17 days)
  - Beam Characterization: IP, C-TOF, gold-foil, ^{3}He-monitor...
    - waiting for the final results



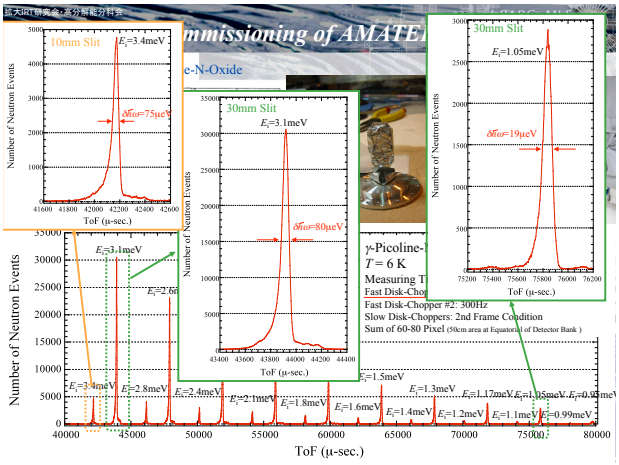




- Chopper System Commissioning
- Detector Calibration
- Background Study
- Test Experiments



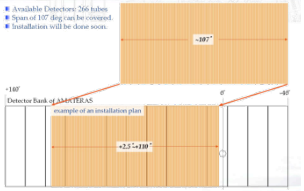
Commissioning of AMATERAS



AMATERAS of This Year

- This Summer...
  - Installing the lest of detectors (234 tubes)
  - Counter Background Measure
  - Beam Narrower Installation
  - Monitor Installation
  - Fixing the Found Problems
- This Autumn...
  - Lest of Commissioning Works
    - Chopper Commissioning
    - DAQ & Detectors Commissioning
    - Commissioning of Newly Installed Devices
    - Background Study
    - Newly Installed Devices

User Program will be Started Soon!!

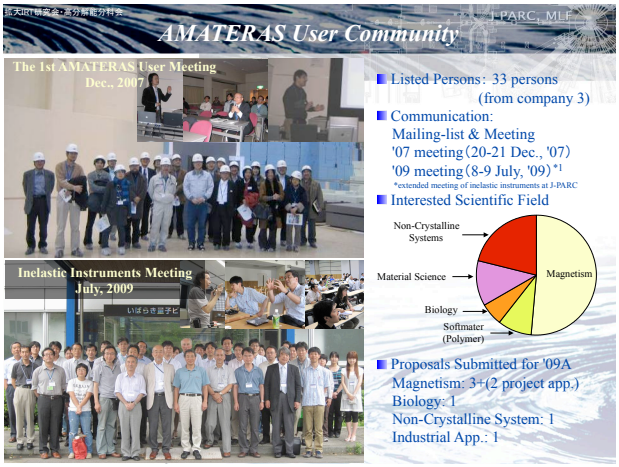


AMATERAS & ISSP Instruments

- エネルギー領域などが重なる装置がある
  - 実験手法
  - 解析
  - その他の情報

  } 情報交換、情報共有
- 実験課題が重なる領域がある
  - 複数の装置の横断的利用
  - 柔軟なユーザーアクセス

今後ともよろしくお願いいたします


AMATERAS User Community
J-PARC, MLF
The 1st AMATERAS User Meeting
Dec., 2007
Inelastic Instruments Meeting
July, 2009
Listed Persons: 33 persons
(from company 3)
Communication:
Mailing-list & Meeting
'07 meeting (20-21 Dec., '07)
'09 meeting (8-9 July, '09) *1
*extended meeting of inelastic instruments at J-PARC
Interested Scientific Field
Non-Crystalline Systems
Material Science
Biology
Softmater (Polymer)
Magnetism
Proposals Submitted for '09A
Magnetism: 3+(2 project app.)
Biology: 1
Non-Crystalline System: 1
Industrial App.: 1