Structure and Shape of ^{66}Zn nuclei

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- Nuclear Physics Facilities at IUAC
- Motivation of the Experiment
- Experiment And Analysis
- Interpretation
- Conclusion


India


Delhi

Inter-University Accelerator Centre

Formerly Nuclear Scinece Centre

- Established in 1984 as an autonomous institution funded by UGC
- Accelerator facility operational by 1991

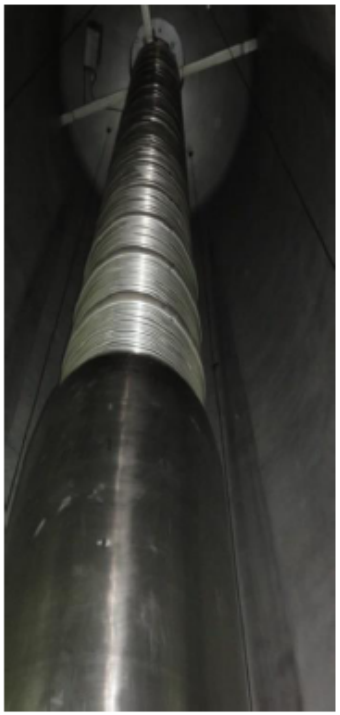
Mission

"To provide within the university system, world class facilities for accelerator based internationally competitive research in focussed areas of Nuclear Physics, Materials Science, Atomic Physics and Radiation Biology."

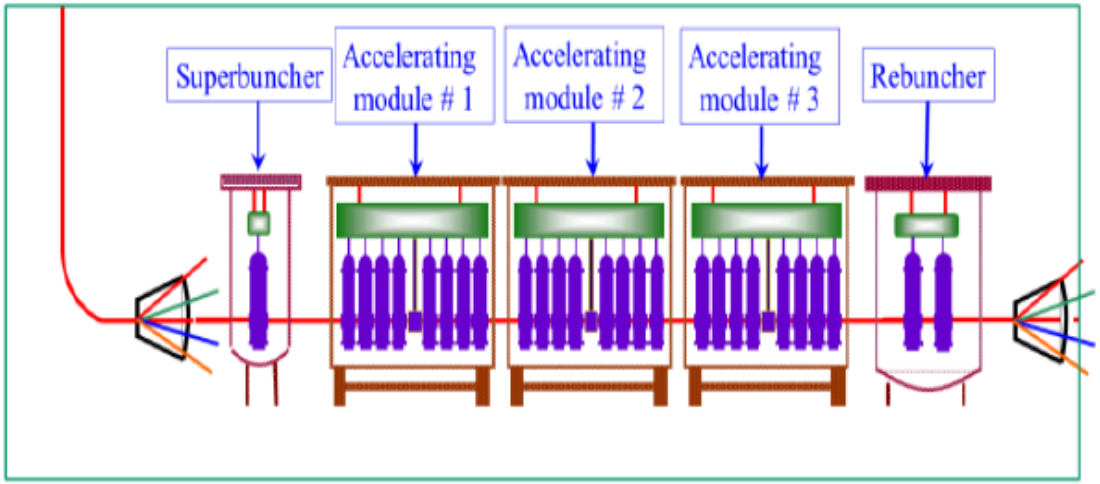
Augmentation of Accelerator and experimental facilities.

- New Accelerators
- Earth and environmental sciences
- Accelerator Mass Spectrometry and Geochronology programs

ION ACCELERATORS AT IUAC



15 UD Pelletron



Nb QWR based LINAC

1.7 MV RBS/C Facility

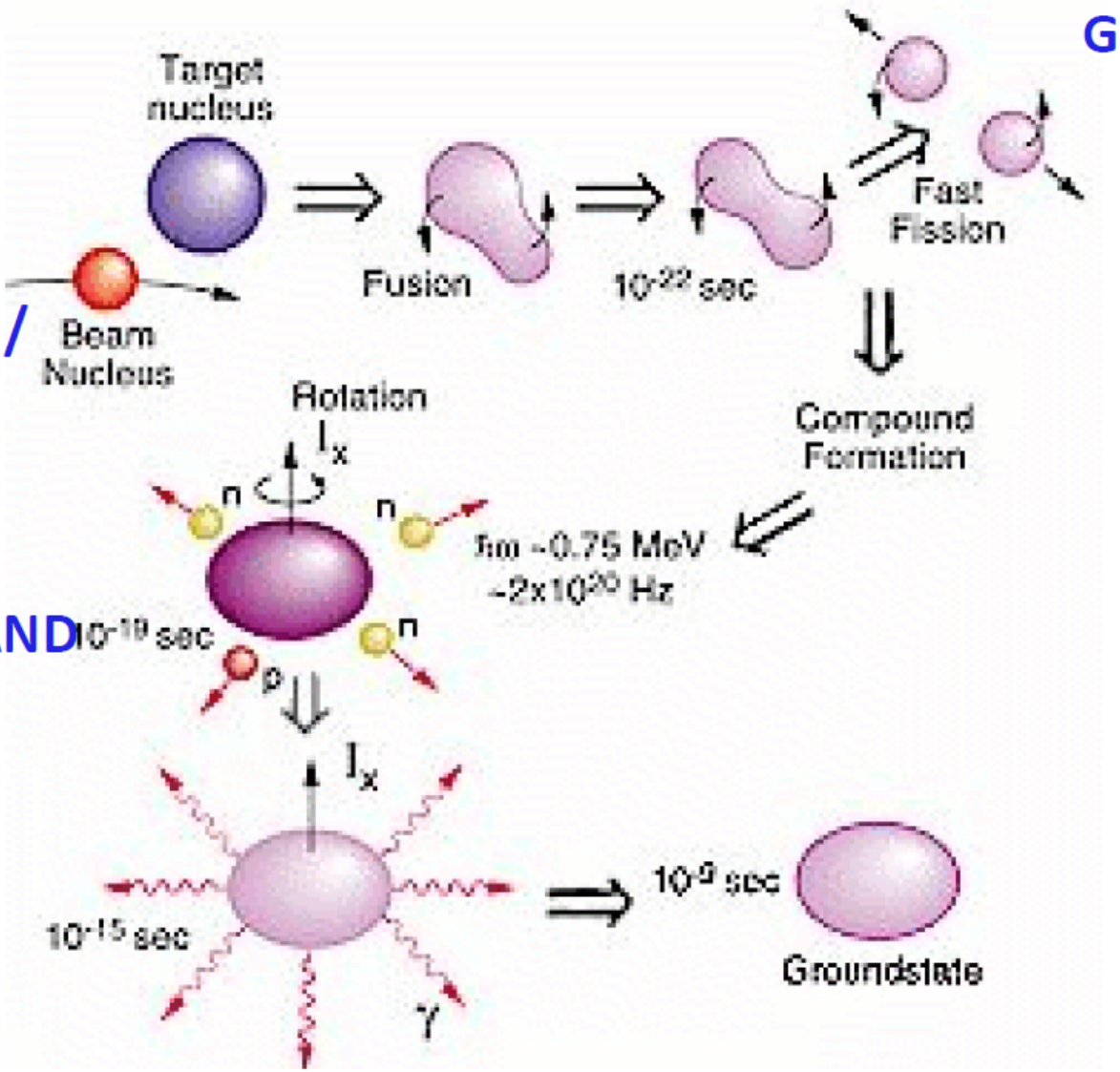
Dedicated ^{14}C AMS Facility

LEIBF-1: ECR
Positive Ion Facility

LEIBF-2: MC-SNICS
Negative Ion Facility

50 kV Acceleration system

Nuclear Physics Research Facilities at IUAC



GPSC

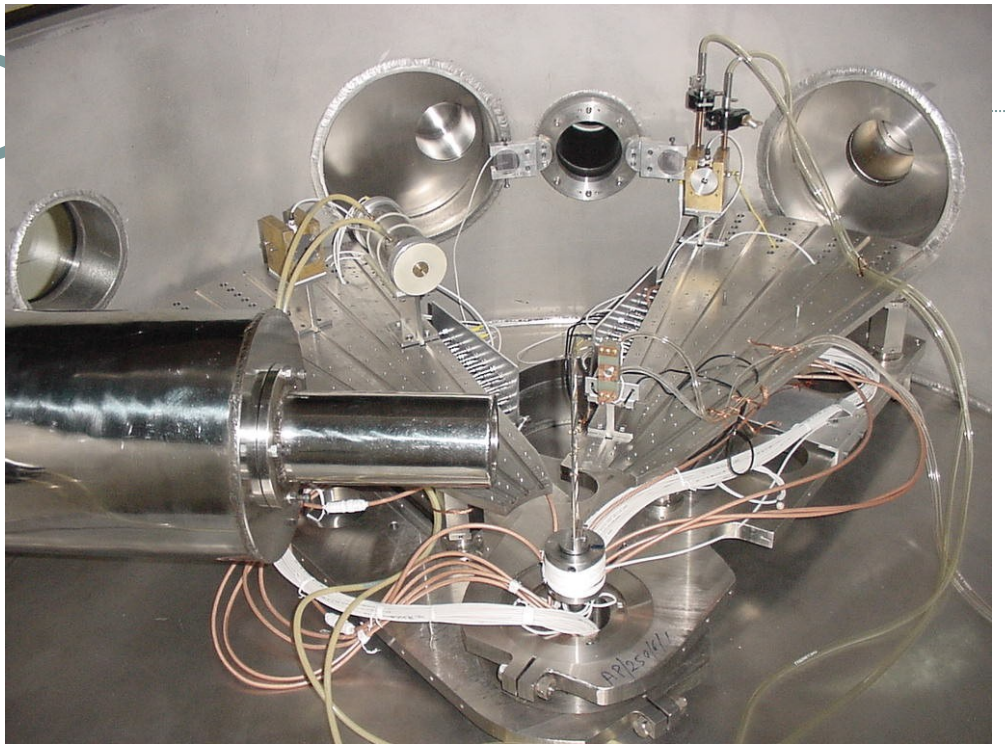
PELLETRON / LINAC

CPDA / NAND

HIRA / HYRA

GDA / INGA

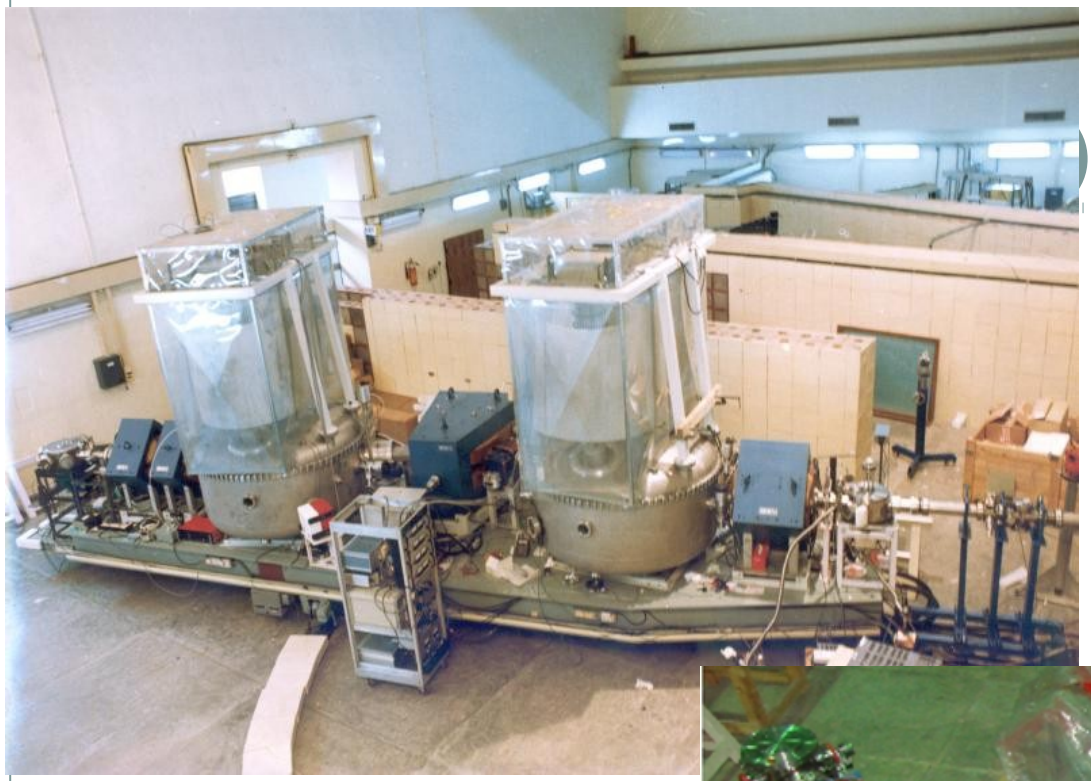
GPSC

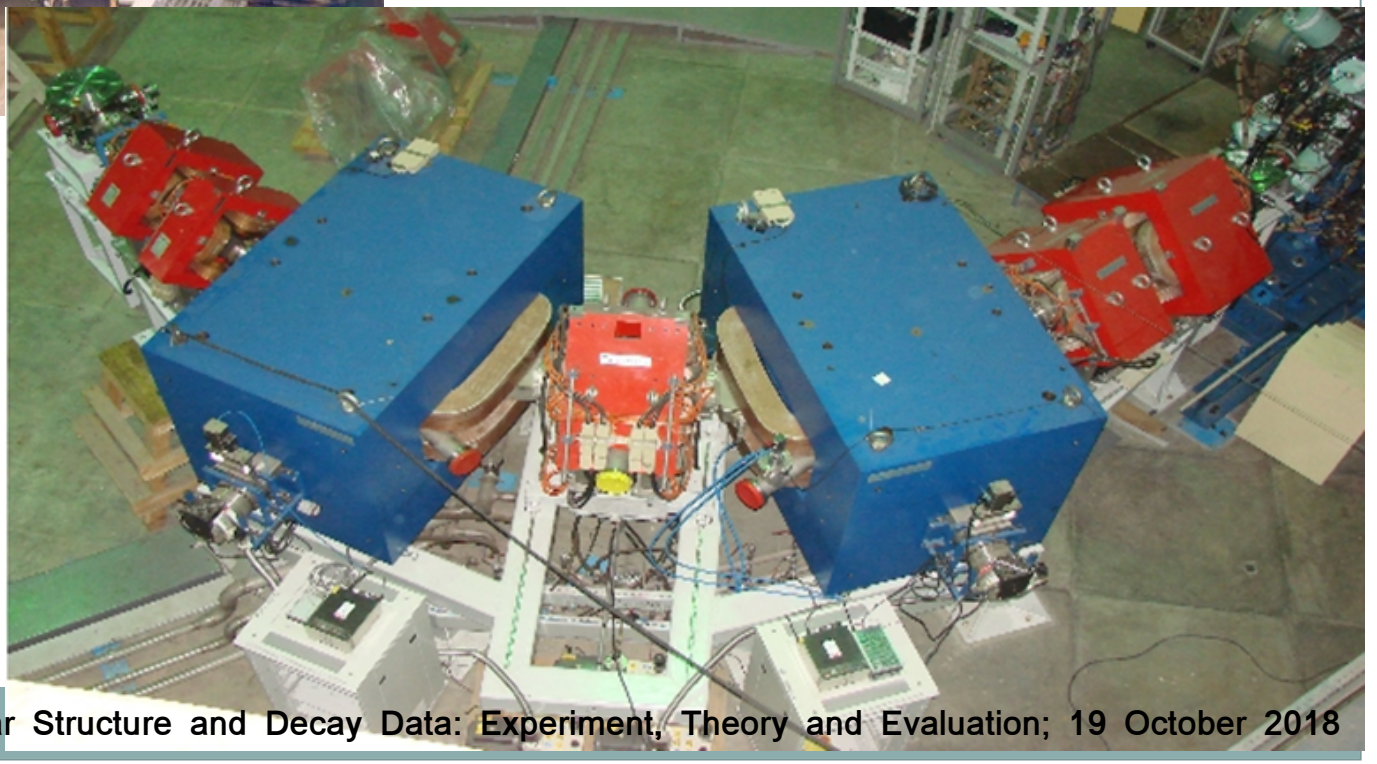


- 1.5 metre diameter scattering chamber
- Equipped with rotating arms for mounting detectors
- Equipped with In-vacuum target transfer system

- Fusion cross section studies with light ions
- Study of **in-elastic scattering** in microscopic formalism
- Dynamical and entrance channel effect in fusion reaction via **neutron multiplicity** measurement
- Heavy ion induced **fission fragment angular and mass distribution** at near/sub-coulomb barrier
- Anomalous fusion-fission reactions on deformed actinide targets in near/sub-barrier region
- Study of **complete and incomplete fusion and pre-equilibrium emission** in nuclear reactions induced by heavy ions

HIRA / HYRA





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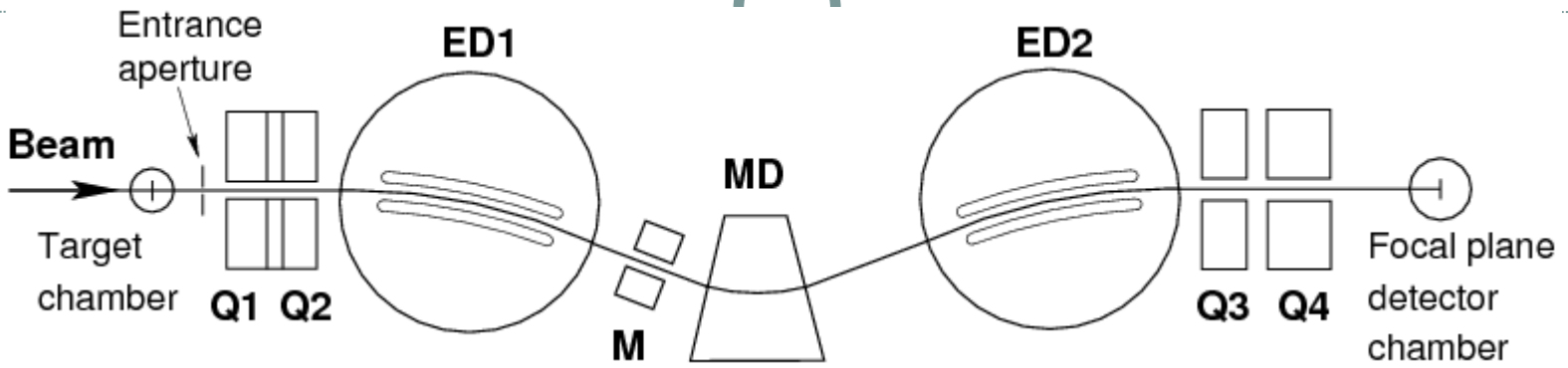
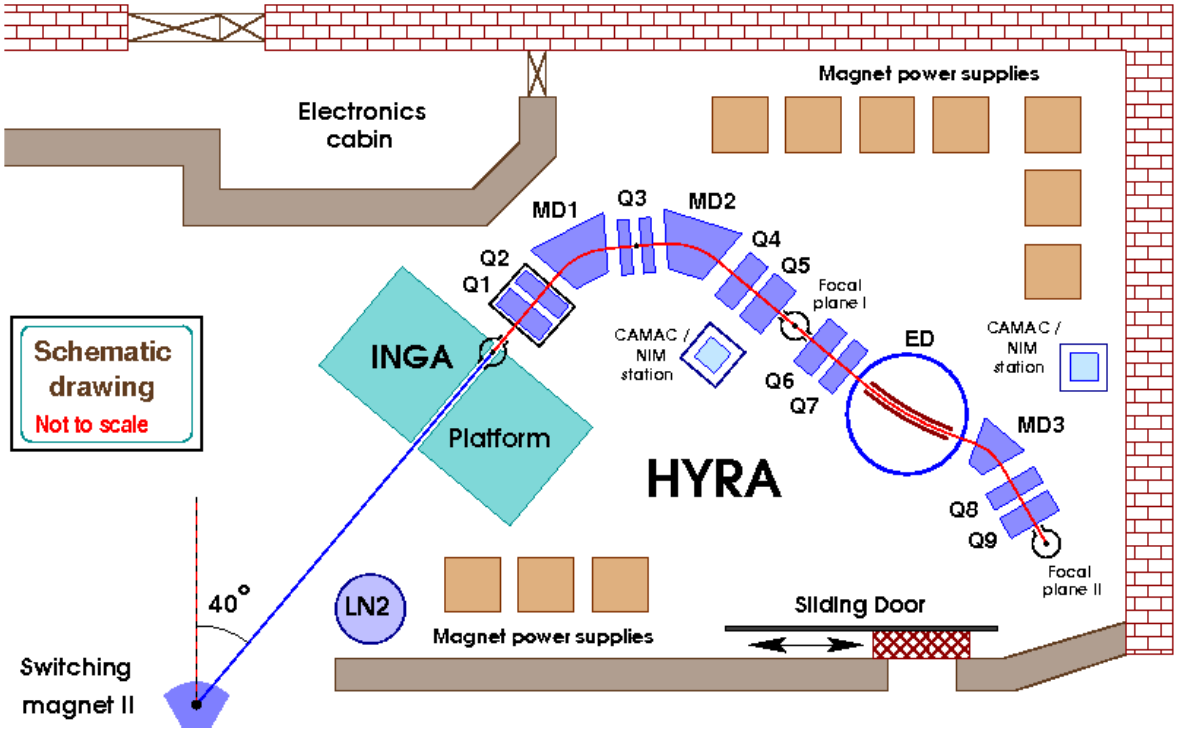
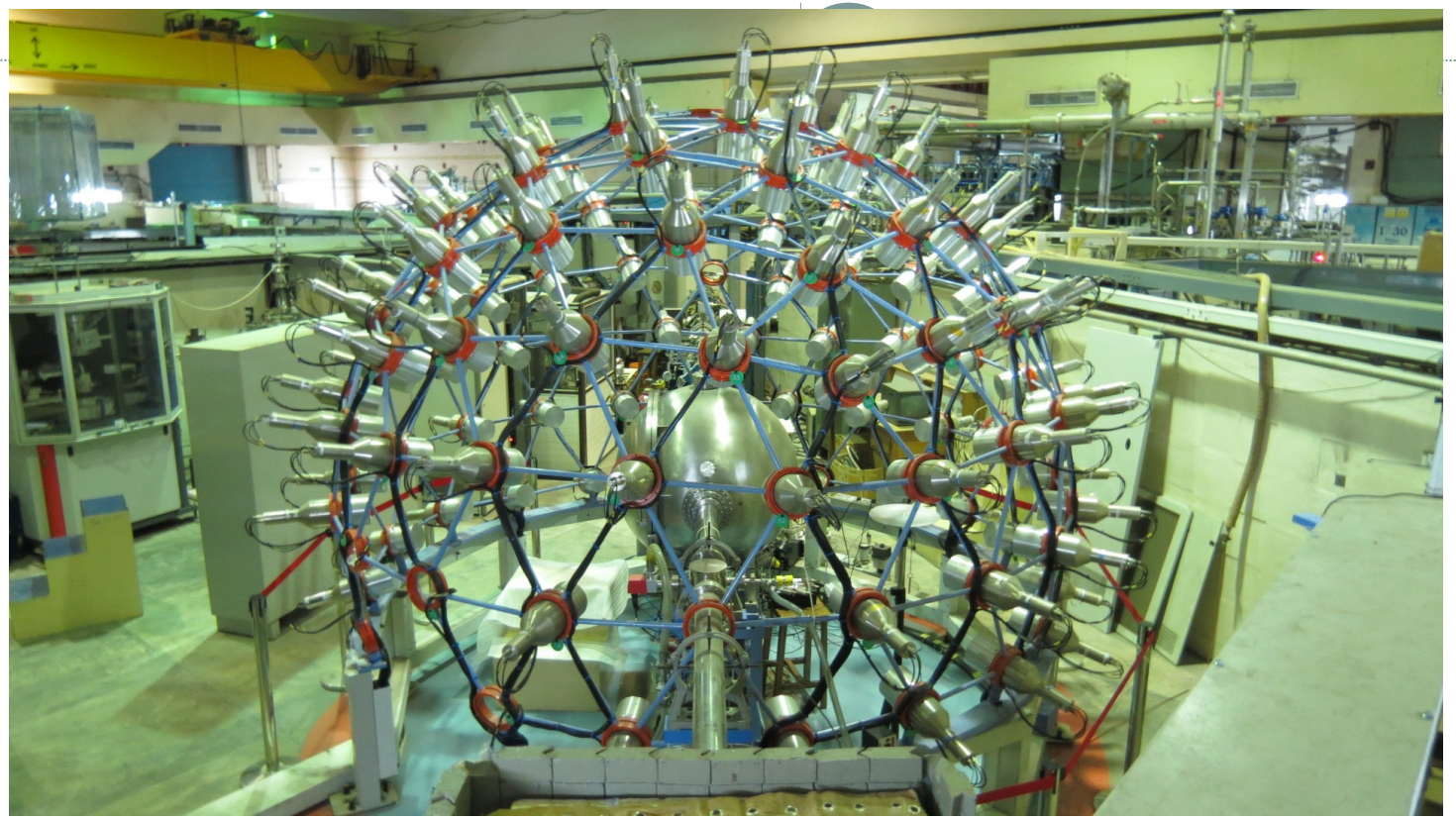


- Fusion-fission dynamics in heavy mass region
- Entrance channel effects in formation and decay of heavy nuclei
- Fission hindrance by ER cross section and spin distribution measurements
- ER-tagged γ-spectroscopy of trans-lead nuclei

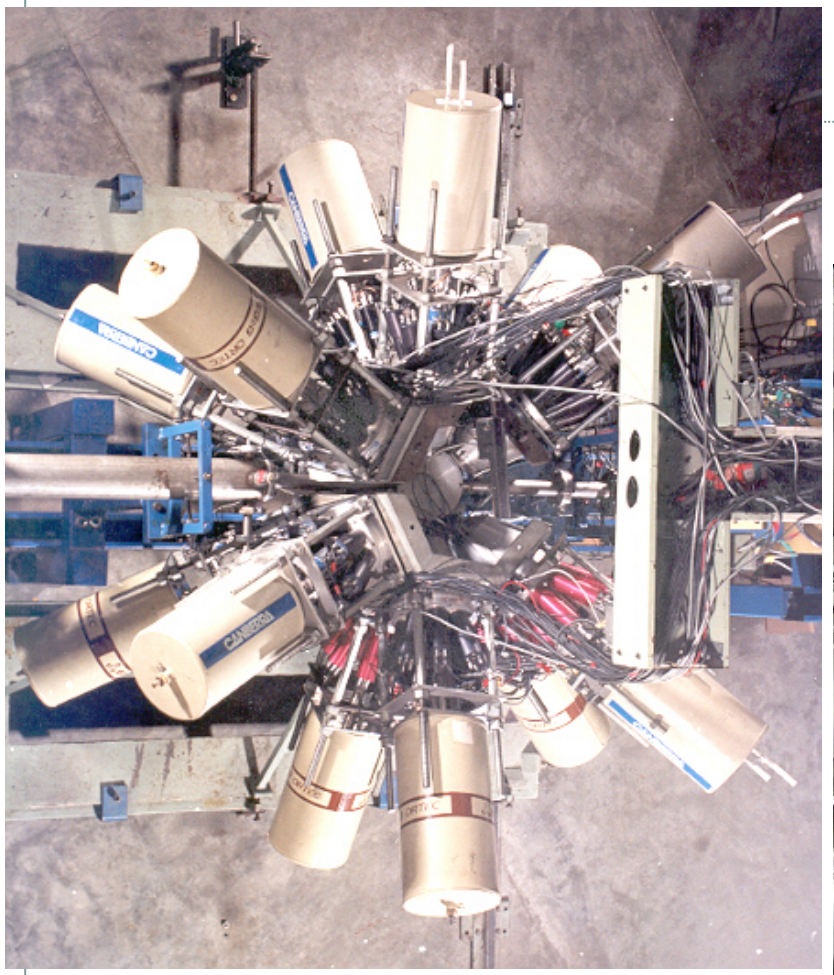


National Array of neutron Detectors (NAND)

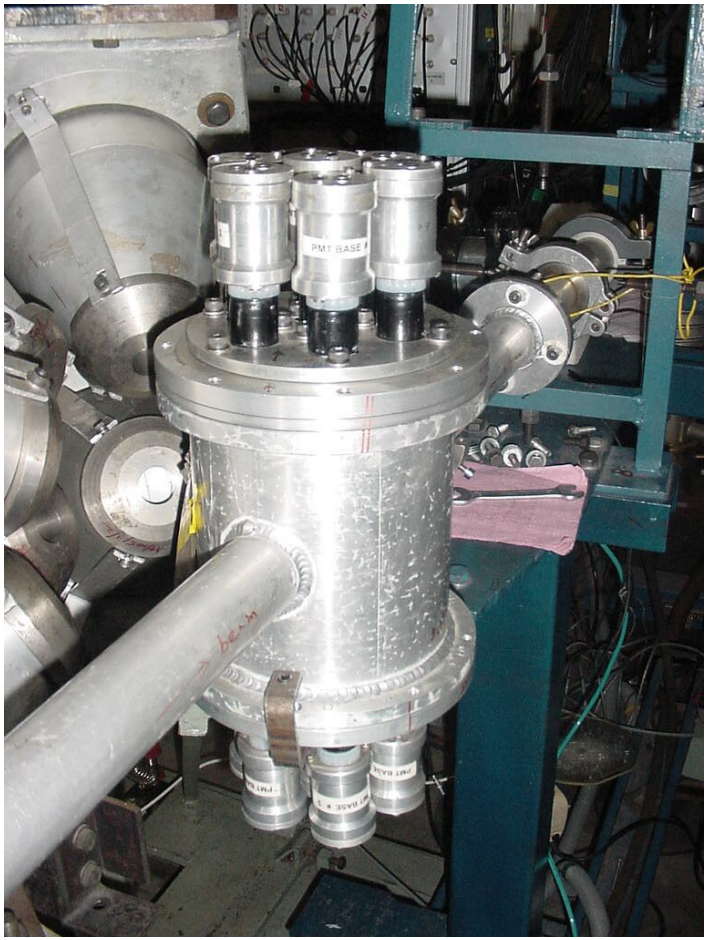


- Time scale and dynamics associated with fusion-fission process
- Neutron multiplicity distribution measurements
- Formation and understanding of unstable heavy nuclei
- Study of nuclear viscosity
- Complete and incomplete fusion reactions
- Weakly bound neutron halo nuclei

GDA

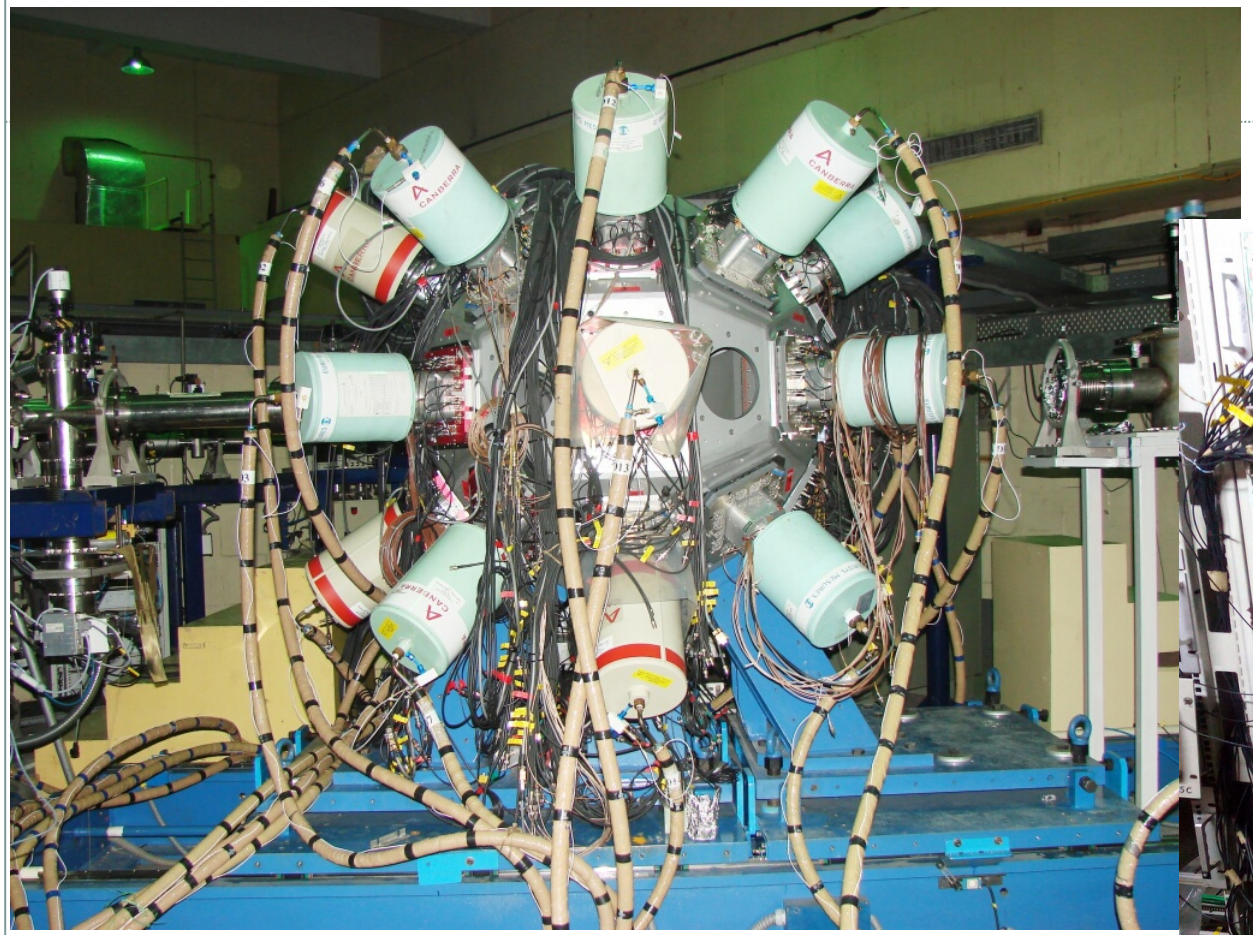


GDA



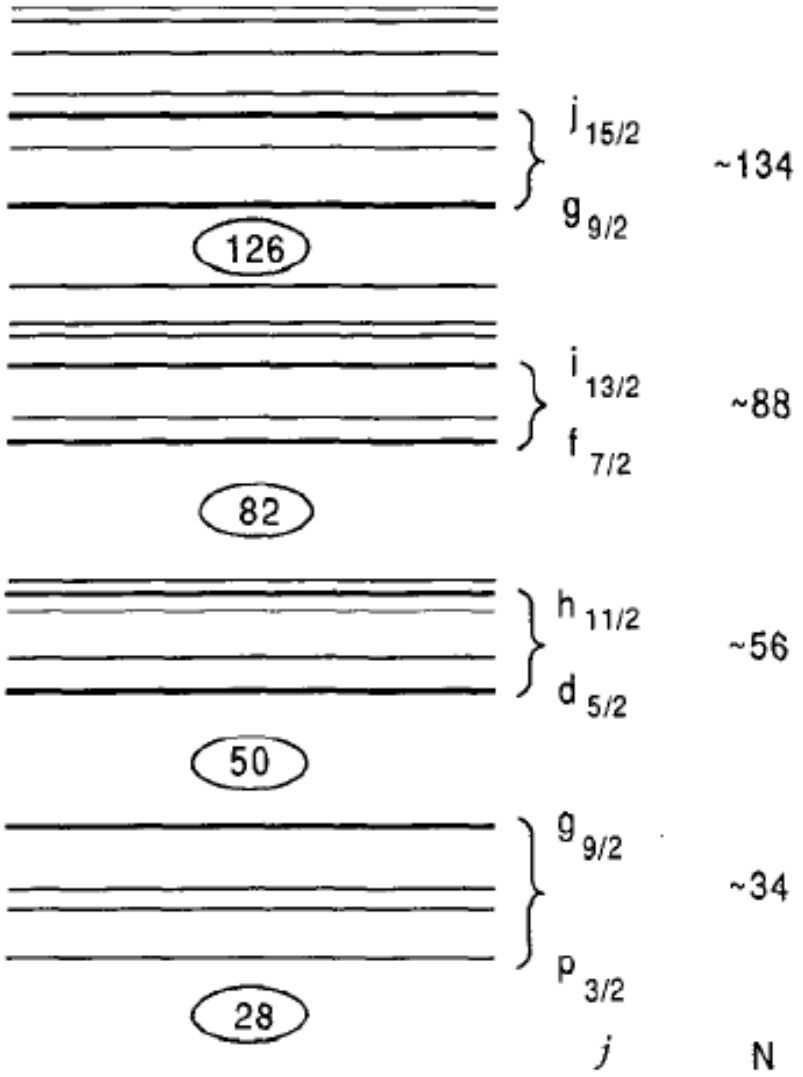
CPDA

INGA



- 24 Compton Supressed Clovers Detectors
- Geometrical Coverage ~ 24% of 4π
- Photopeak Eff. ~ 5%

Motivation

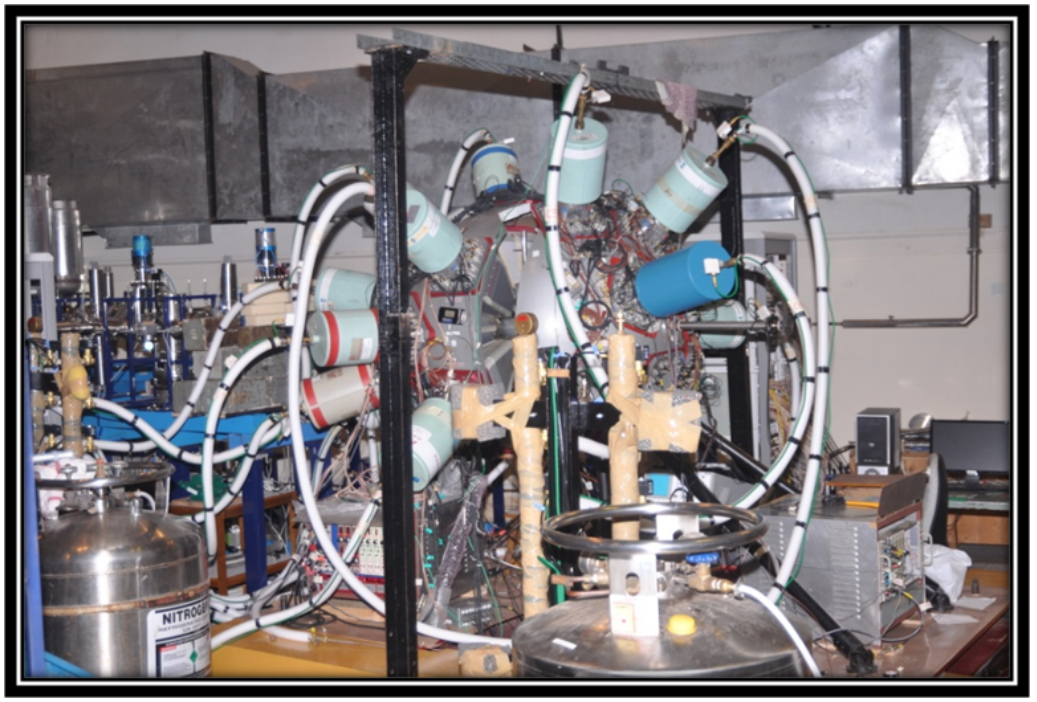


- Atoms with octupole deformed nuclei are very important in the search for ***permanent atomic electric-dipole moments(EDMs).***
- **The observation of a non-zero EDM at the level of contemporary experimental sensitivity would *indicate time-reversal(T) or equivalently charge–parity (CP) violation due to physics beyond the standard model.***

Experiment

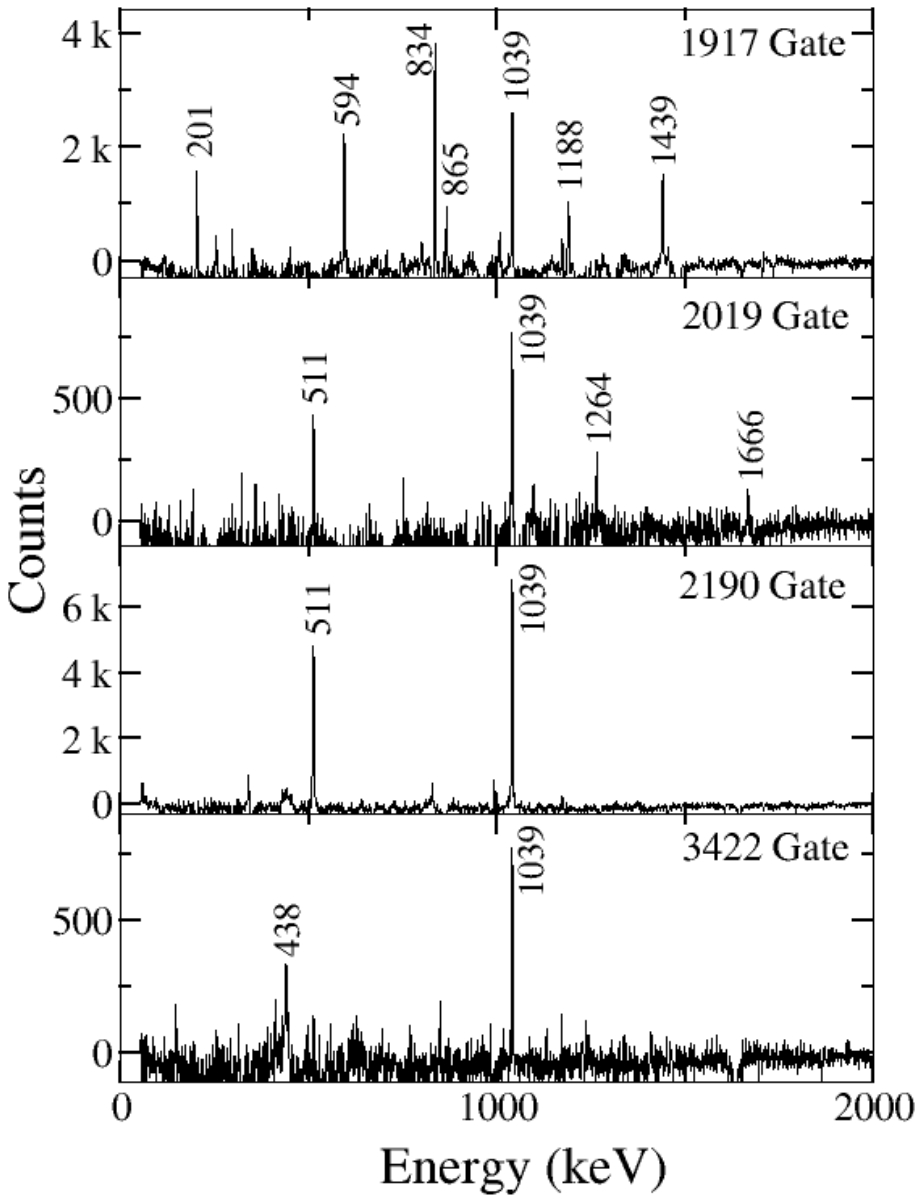
Reaction : ^{56}Fe (^{12}C, 2p) ^{66}Zn

Beam Energy : 62 MeV

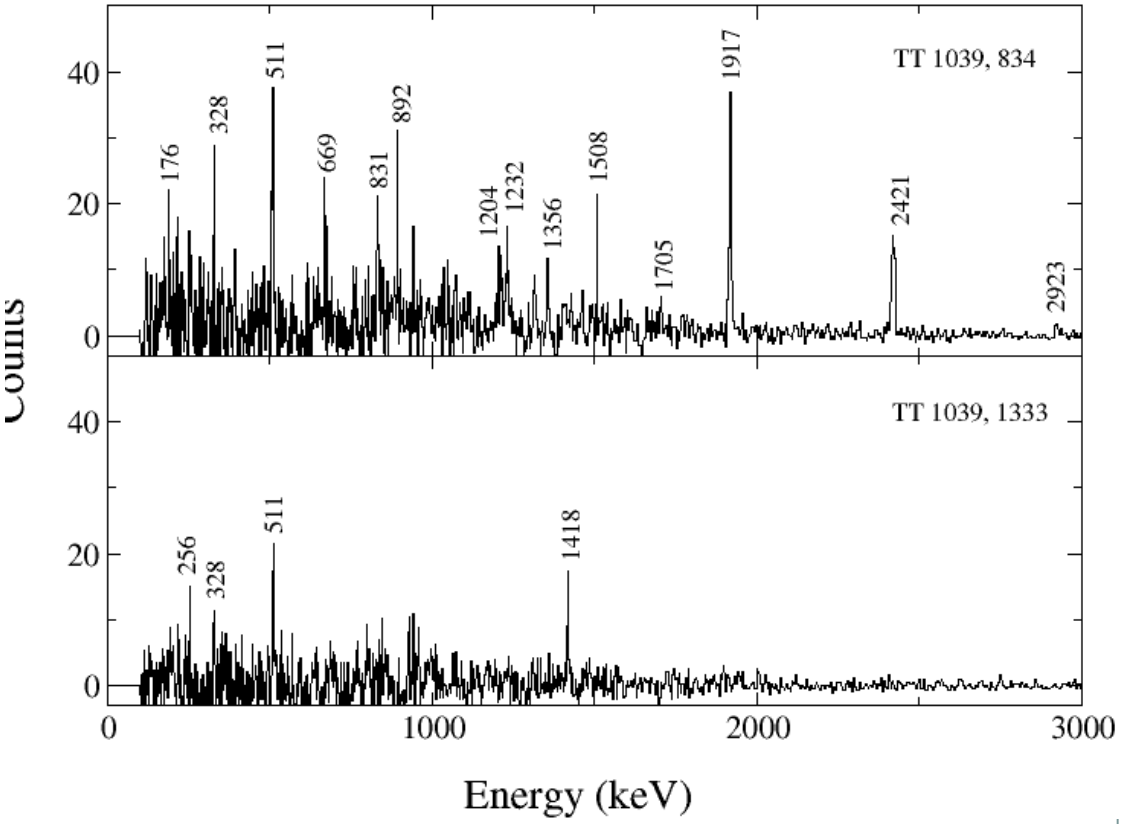


TIFR 14UD Accelerator at INGA facility

- 15 Clover Detectors were used at different angles
- DSP Data Acquisition system was used
- The data was sorted using TIFR programs
- Symmetric matrix was made and analysed using RADWARE programs and asymmetric matrix was analysed by CANDLE and INGASORT programs.

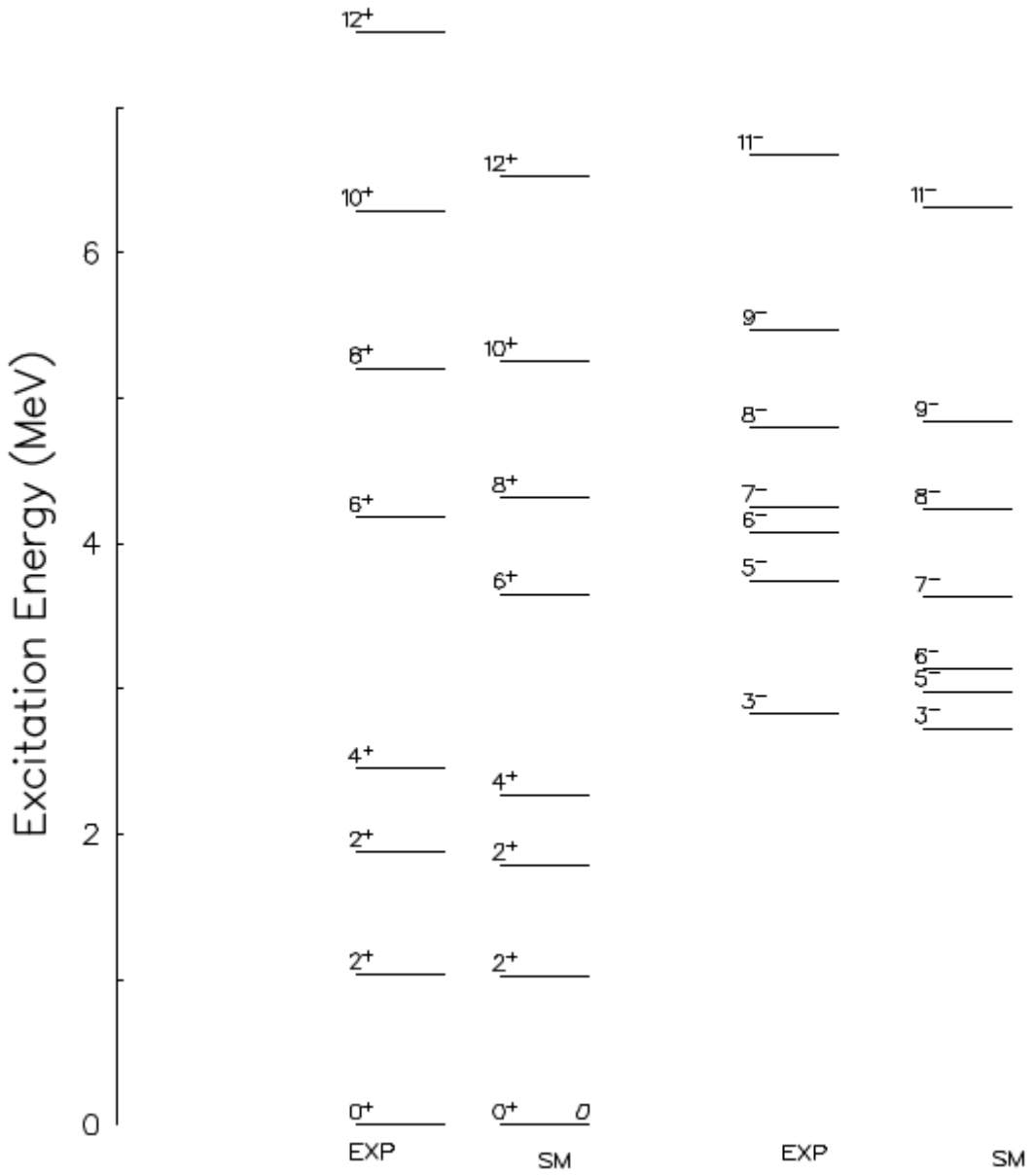


Projected Spectrum from Eγ-Eγ matrix with gate on gamma enrgy on one axis



Projected Spectrum from Eγ-Eγ-Eγ matrix with gate on gamma enrgies on two-axes

Shell Model Calculations using NuSHELLX



- jj44pn model space
- model space basis restricted to the 0f 5/2 , 1p 3/2 , 1p 1/2 and 0g 9/2 orbitals which is known as jj44pn model space
- jj44bpn interaction
- eight valence neutrons and two valence proton in the four active orbitals

Shell Model Calculations using NuSHELLX

- jj44pn model space
- Invloves fpg orbitals
- jj44bpn interaction

Occupation Probabilities of different shells for different spin levels

J^π	E_{expt} (keV)	E_{SM} (keV)	Particles	$0f_{5/2}$	$1p_{3/2}$	$1p_{1/2}$	$0g_{9/2}$
0^+	0	0	p	0.46	1.07	0.29	0.18
			n	3.09	2.89	0.78	1.24
2^+	1039	1026	p	0.50	0.99	0.37	0.14
			n	3.08	2.88	0.77	1.27
2_2^+	1873	1791	p	0.42	1.09	0.35	0.15
			n	3.04	2.92	0.98	1.07
4^+	2450	2273	p	0.83	0.80	0.28	0.09
			n	3.06	2.69	0.71	1.54
6^+	4179	3137	p	0.55	0.91	0.41	0.13
			n	3.11	3.04	0.55	1.30
8^+	5206	4314	p	0.73	0.73	0.46	0.08
			n	2.90	2.44	0.52	2.14
10^+	6291	5255	p	0.76	0.71	0.46	0.72
			n	2.87	2.48	0.52	2.13

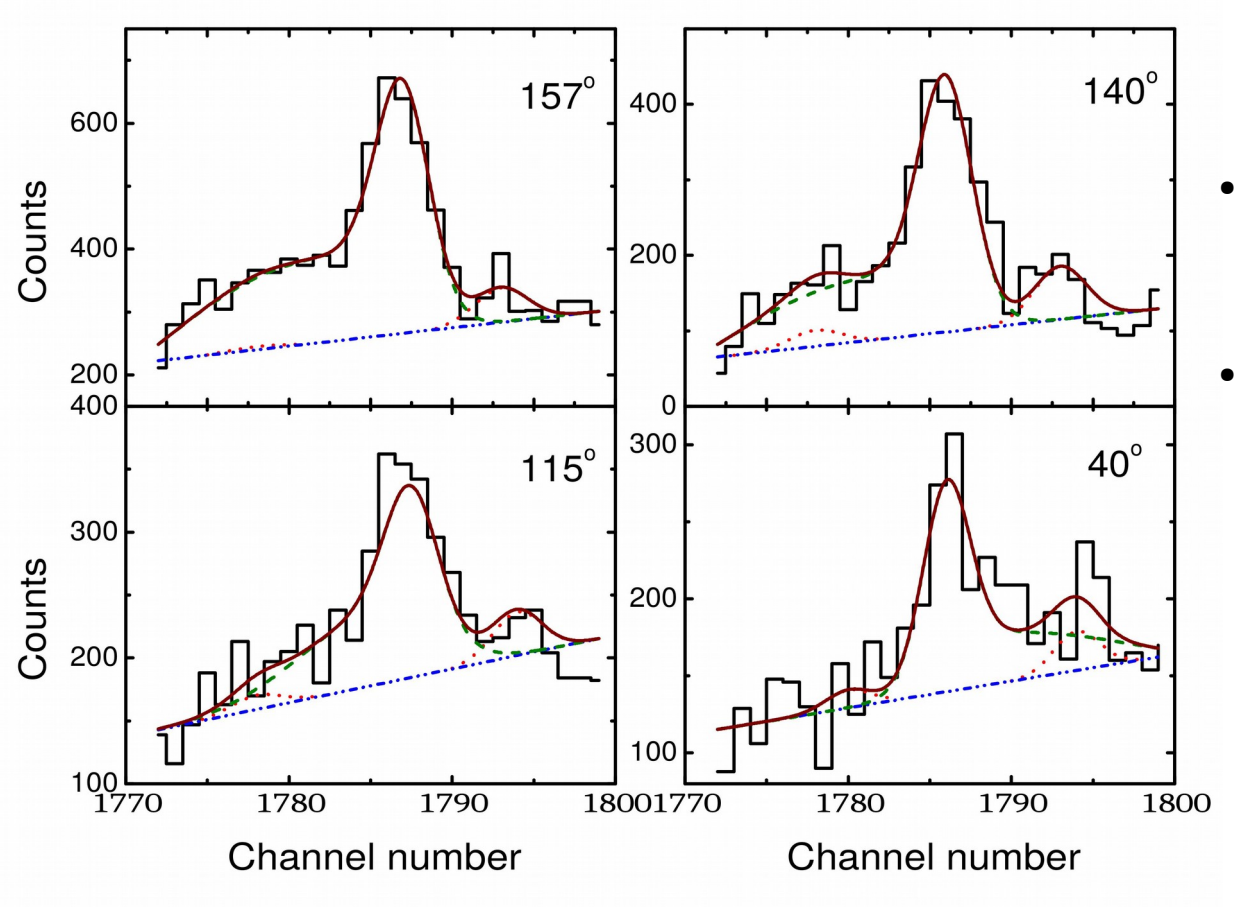
Shell Model Calculations using NuSHELLX

- jj44pn model space
- Invloves fpg orbitals
- jj44bpn interaction

Occupation Probabilities of different shells for different spin levels

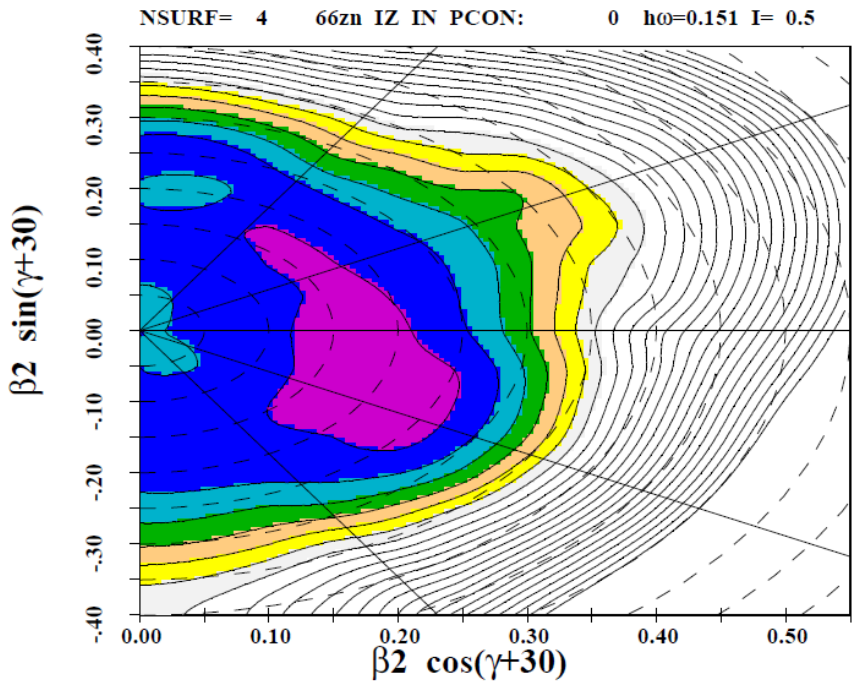
J^π	E_{expt} (keV)	E_{SM} (keV)	Particles	$0f_{5/2}$	$1p_{3/2}$	$1p_{1/2}$	$0g_{9/2}$
3^-	2826	2726	p	0.45	1.00	0.24	0.31
			n	3.28	2.47	0.80	1.44
1_2^-	3381	3480	p	0.67	0.82	0.38	0.13
			n	3.42	2.58	0.62	1.37
5^-	3746	2981	p	0.54	0.91	0.43	0.12
			n	3.13	2.93	0.60	1.34
6^-	4074	3137	p	0.55	0.91	0.41	0.13
			n	3.11	3.04	0.55	1.30
7^-	4251	3631	p	0.56	0.90	0.43	0.11
			n	2.97	3.03	0.62	1.37
1_3^-	4796	4714	p	0.70	0.90	0.22	0.18
			n	2.87	2.93	0.90	1.30
9^-	5464	4833	p	0.73	0.82	0.36	0.08
			n	2.98	3.02	0.62	1.38

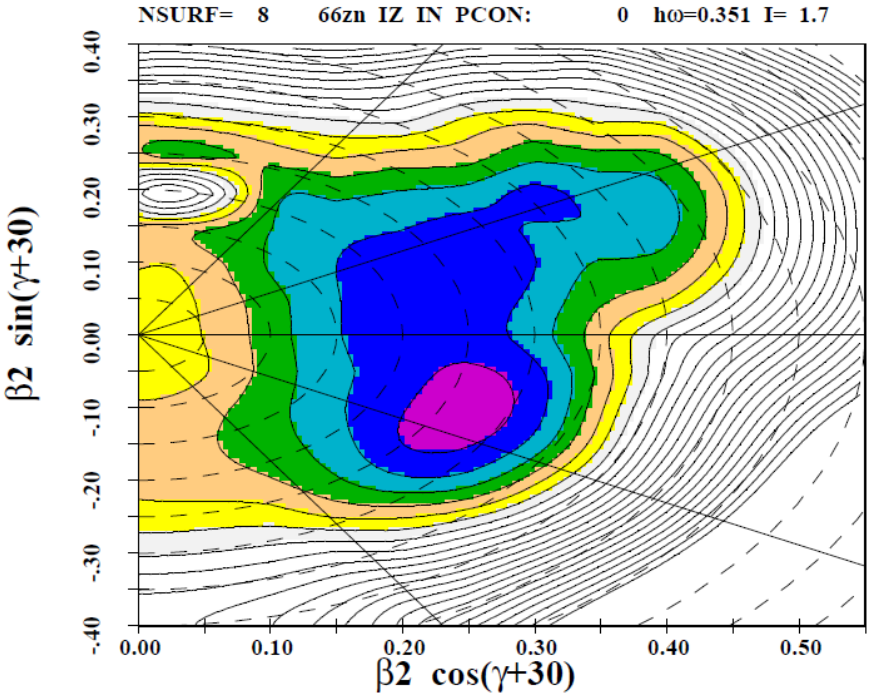
LineShape Analysis of 1787 keV



- Lineshape Program
  - DECHIST
  - HISTAVER
  - LINESHAPE
- Included cross-section dependence at different energies (depths)

Total Routhian Surface Calcualtions





Thanks !!

To the origanisers of this workshop and All my colaborators