

# **PROJECT-X: NUCLEAR PHYSICS**

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**What we want to do?**

**What experimental set-up is being planned?**

**Which part of experiments from Indian side can be involved?**

**If we can propose new setup?**

**Our experience!!!**

**What we can do for strengthen INDIA-US  
the collaboration!!!**

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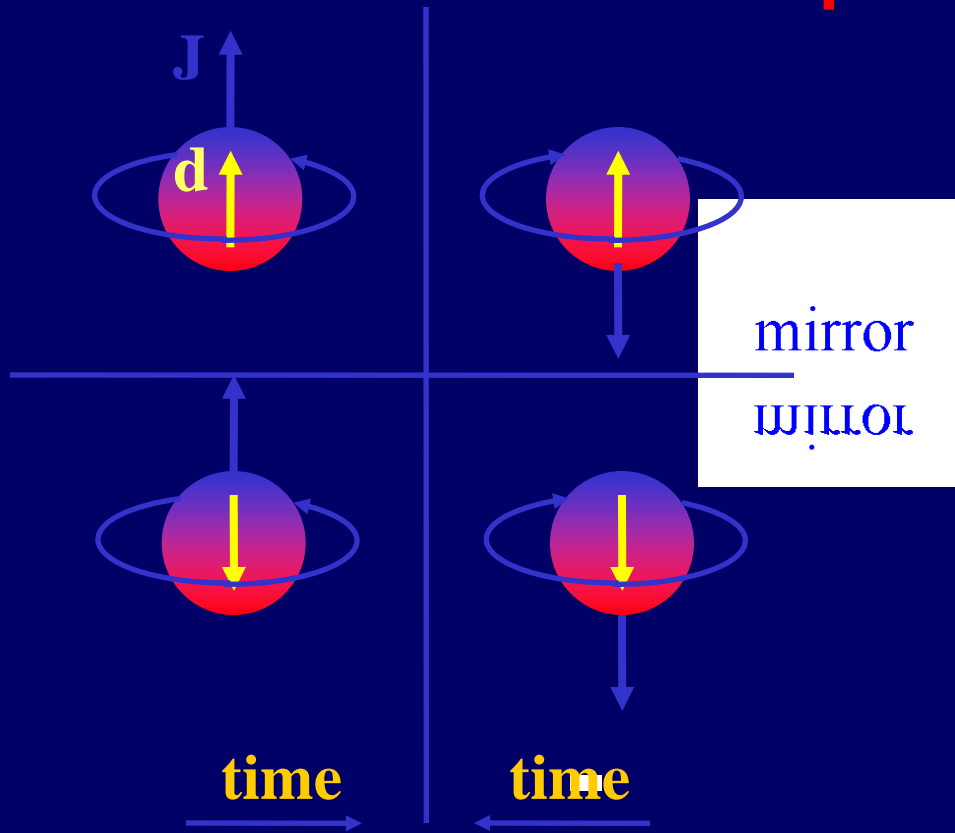
# Exploring exotic nuclei at intermediate energy to probe exotic world of physics

## **\*\* Beyond STANDARD model**

### **Tests of the Standard Model at low energy**

- **Low energy tests**
  - e.g. Time reversal violation**
  - precision measurements**
- **Stable  $\leftrightarrow$  unstable nuclides**
  - nuclear & atomic physics**
- **The role of trapping nuclides**
  - sample manipulation & detection**
- **Applications and examples**
- **WORLD-WIDE DEVELOPMENT**

# Time reversal violation and the Electric Dipole Moment

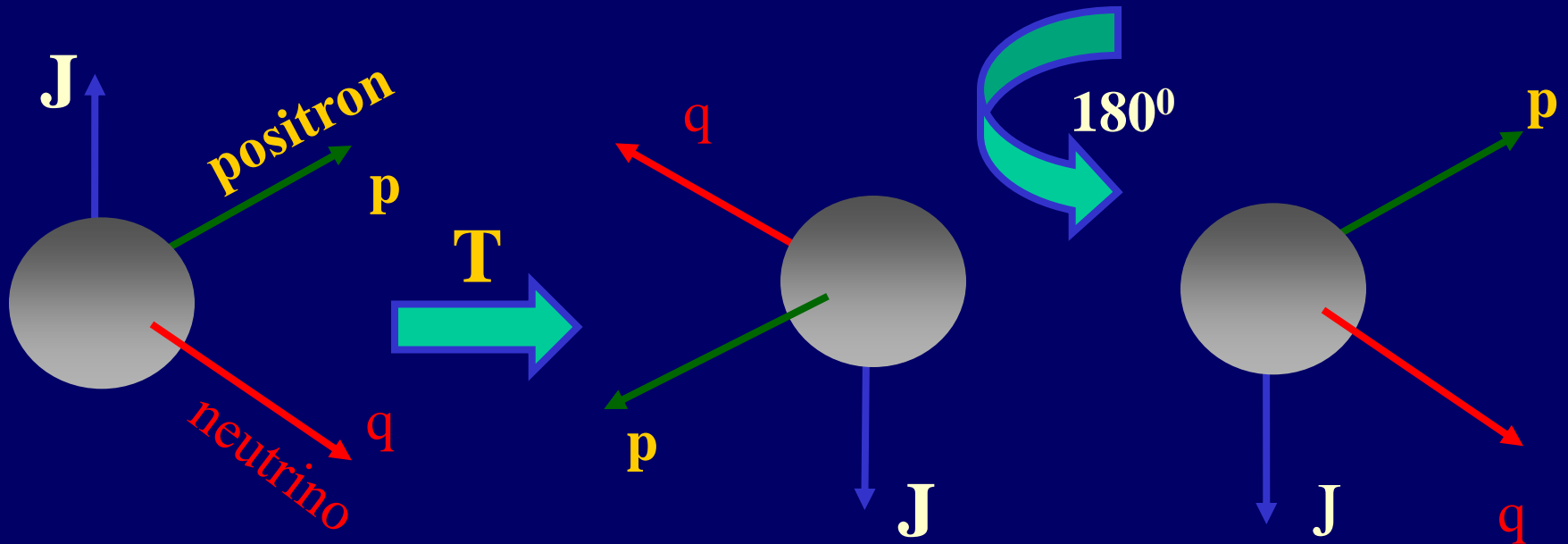


- any particle will do
  - $d_n < 0.6 \cdot 10^{-27} \text{ em}$
  - $d_e < 1.6 \cdot 10^{-29} \text{ em}$
  - $d_e \text{ (SM)} < 10^{-39} \text{ em}$
- find suitable object
  - Schiff
- need amplifier
  - atomic ( $Z^3$ )
  - nuclear
- suitable structure

Consider all nuclides

EDM violates parity and time reversal

# Time reversal violation in $\beta$ -decay



$$\langle \vec{J} \cdot \vec{p} \times \vec{q} \rangle \neq 0 ?$$

nuclide & appropriate structure  
neutrino detection  $\rightarrow$  recoil measurement

## In Project-X

1 GeV Proton beam on target  
Production and separation of  
Exotic nuclei, thermalised

MOT  
Trap

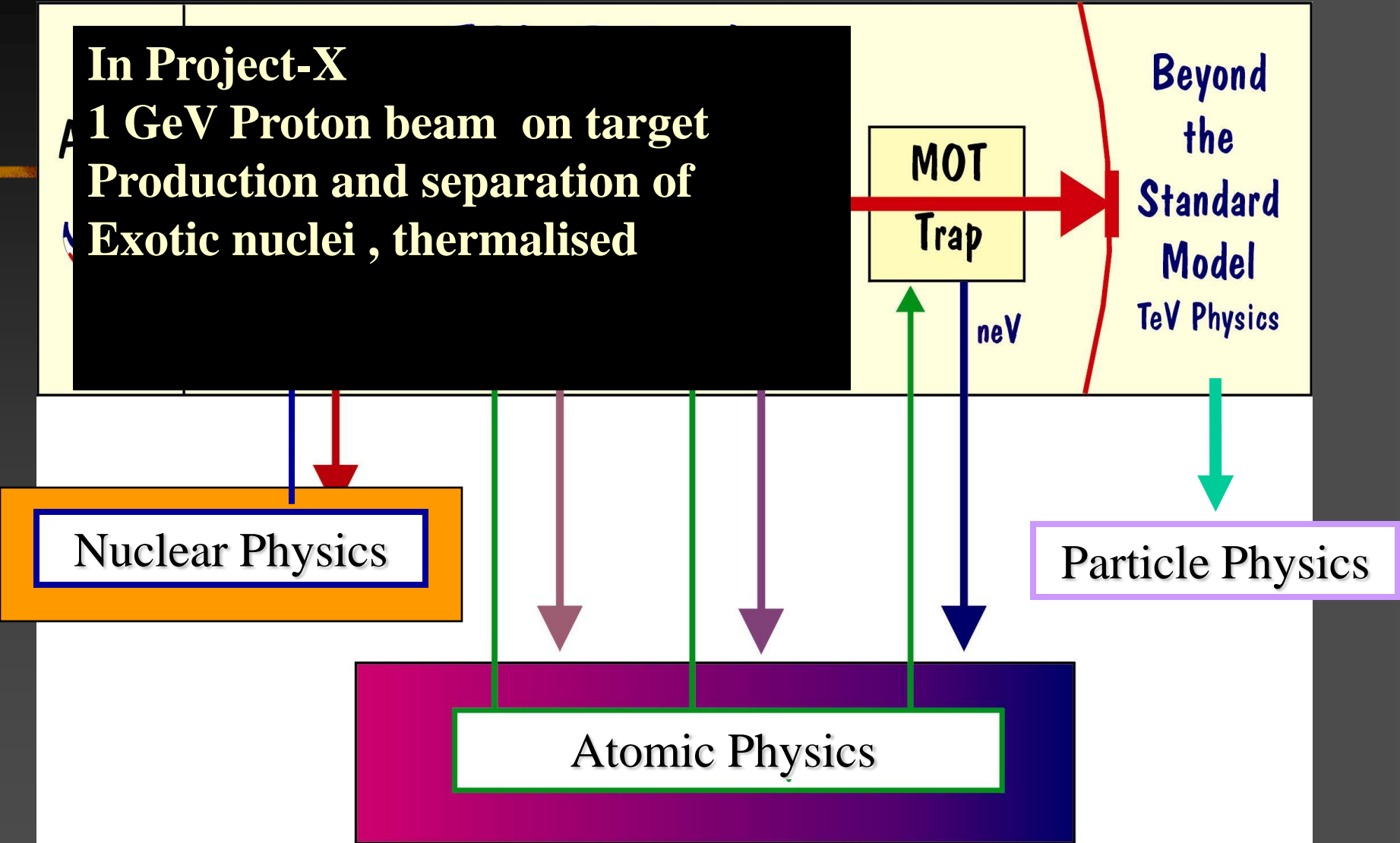
neV

Beyond  
the  
Standard  
Model  
TeV Physics

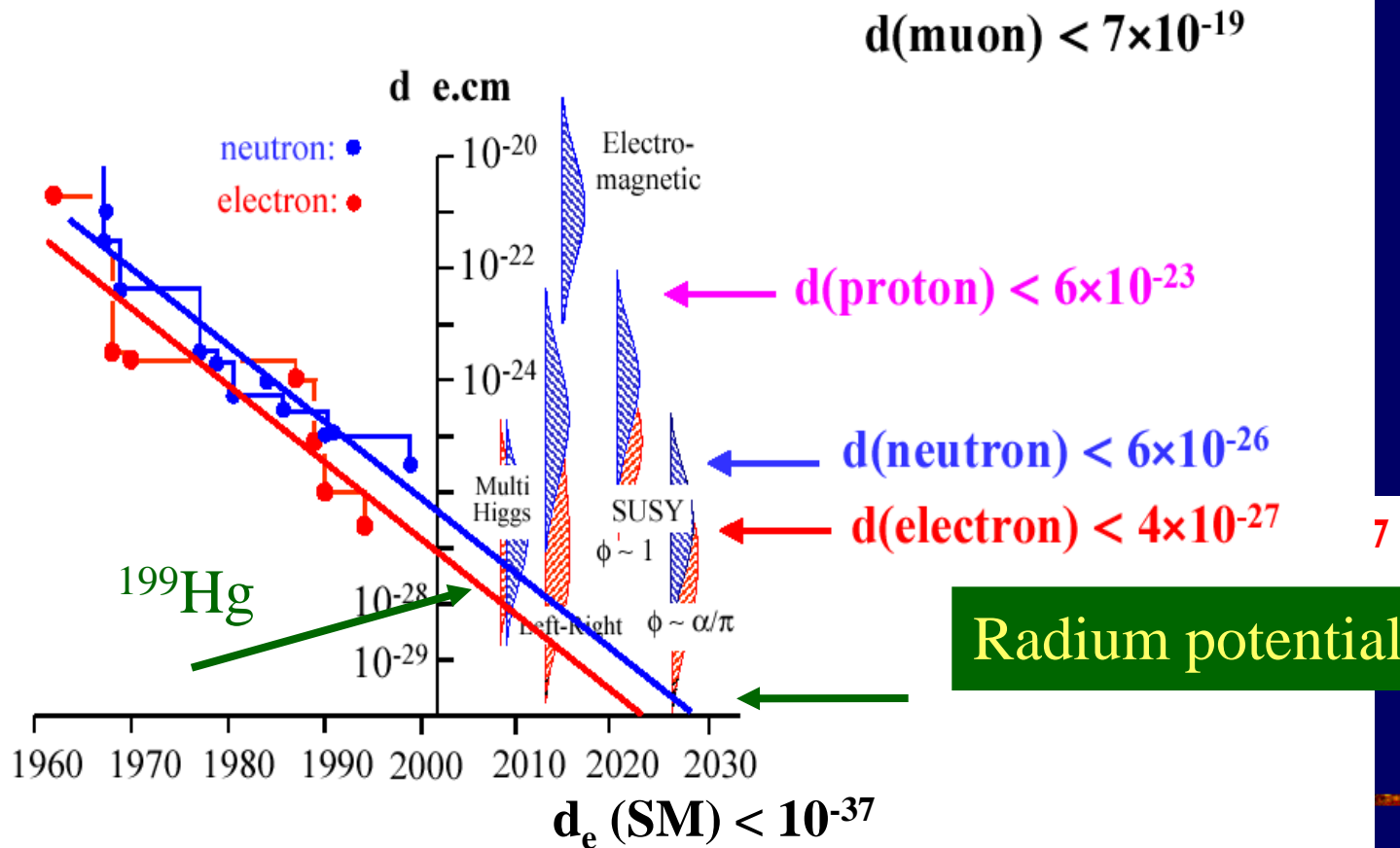
Nuclear Physics

Particle Physics

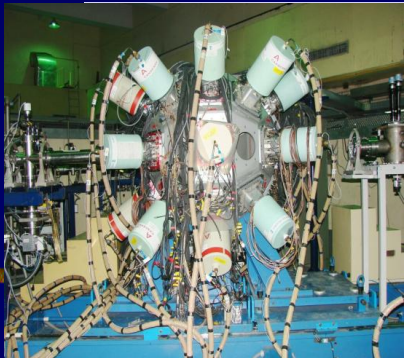
Atomic Physics



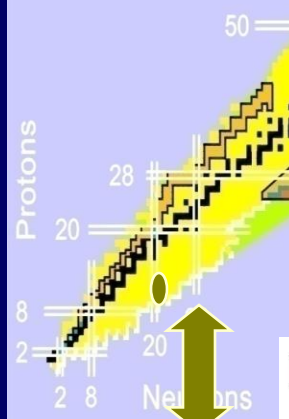
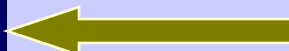
# EDM Now and in the Future



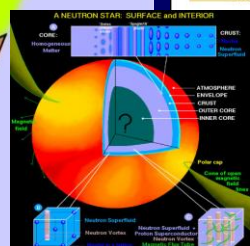
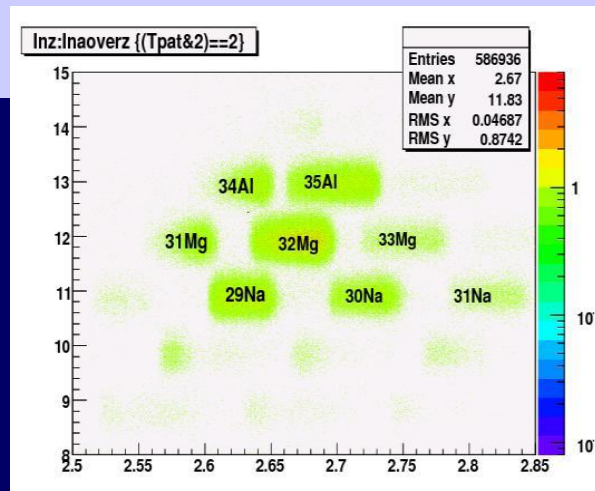
# WHAT WE HAVE DONE IN XITH PLAN



**INGA**



New magic no  
Failure of  
magic no

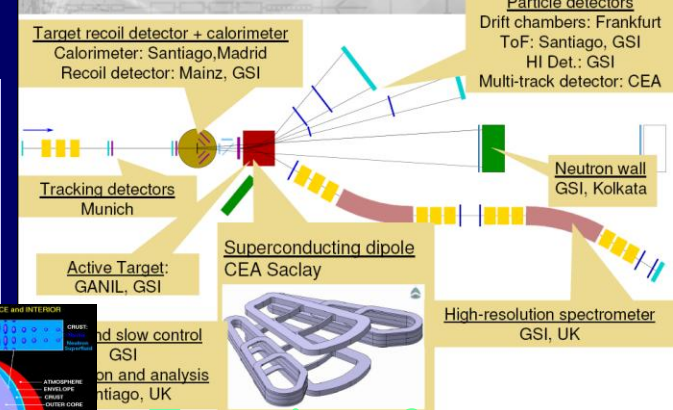


Equation of state  
(asym. Nucl. Matter)

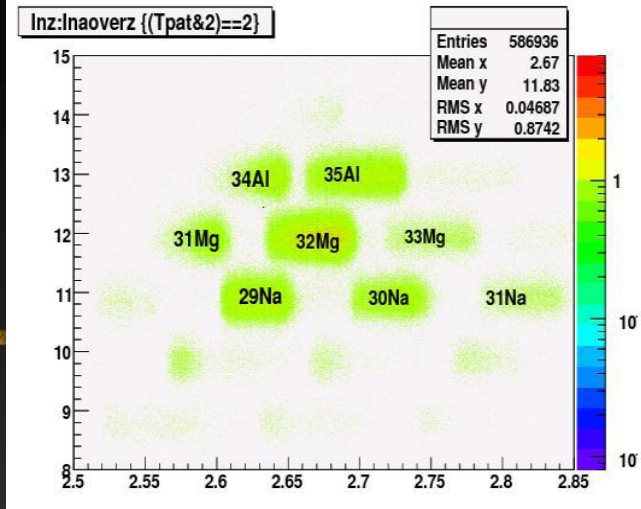
Neutron star

XIth plan ,

- ✓ First time in INDIA build
- ✓ MMRPC (dt<100ps) using
- ✓ local facility
- U.Datta pramanik et al NIM A 2010
- ✓ Perform leadership expt. at GSI,
- Michigan







Expt. (GSI) Jan, 2009



Expt. Sept, 2010

$^{33}\text{Mg}, ^{33}\text{Mg}, ^{32}\text{Mg}, )$   
 Tripathi et al. PRL101 (2008)  
 Yordanov et al., PRL 99 (2007),  
 R. Kanungo et al PLB,(2010)  
 No conclusion on gr state yet.



developed MMRPC  $\sigma t < (65\text{ps}), 100\text{ps}, 150\text{ps}$   
 Efficiency  $\sim 95-40\%$   
 $\sigma x \sim 1.5 \text{ cm}$

U.Datta Pramanik, S.Chakraborty, P.Basu et al NIM A , article in press

doi:10.1016/j.nimaa.2010.10.055

Anisur Rahaman , Santosh Chakraborty Ph.d Student



## **PLAND to do**

- **Test the Standard Model of Nuclear Structure;**
  - **Study nucleon interactions in neutron-rich matter.**
- 
- **A new setup for charge and matter radii measurements**
  - **Involvement if MOT developments by**
  - **Measurements of cosmic exposure through luminescence technique (irradiation of proton with meteorites)**
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- **Look for suitable new exotic nuclei for EDM measurements**

INDIA INSTITUTE OF NUCLEAR PHYSICS

