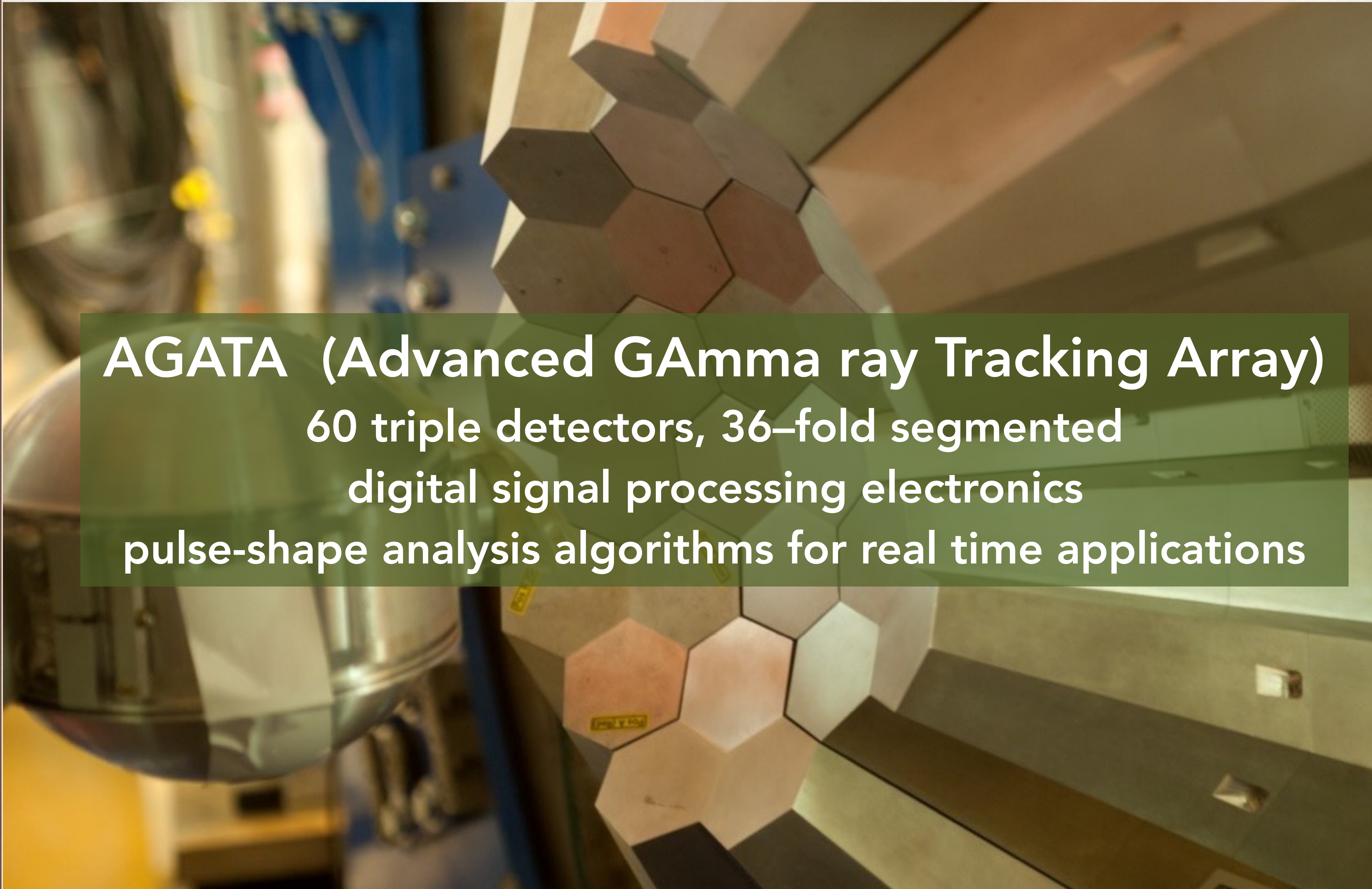


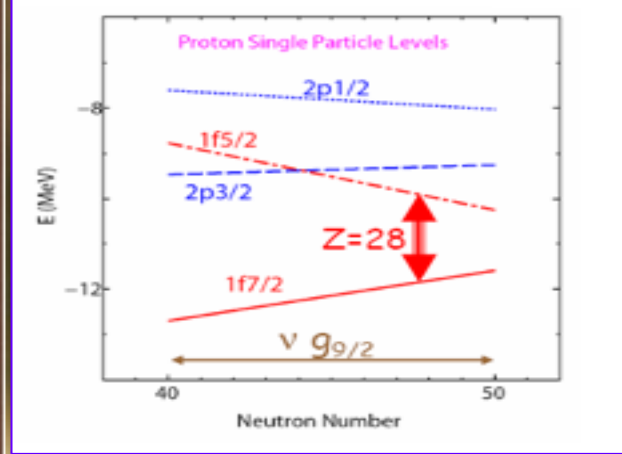
# AGATA (Advanced GAmma ray Tracking Array)

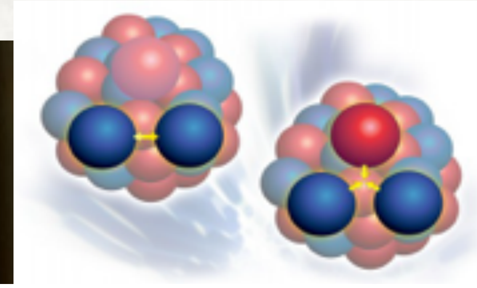
60 triple detectors, 36–fold segmented

digital signal processing electronics

pulse-shape analysis algorithms for real time applications

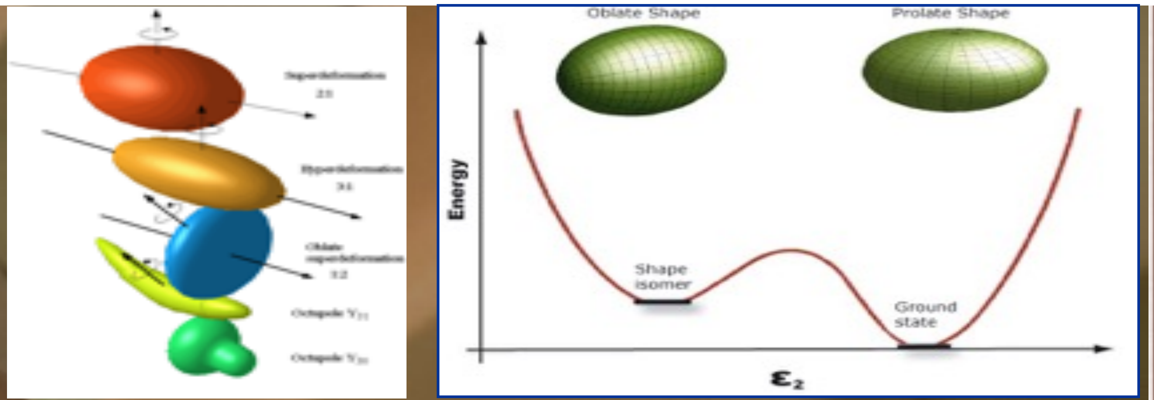
## Shell evolution far from stability



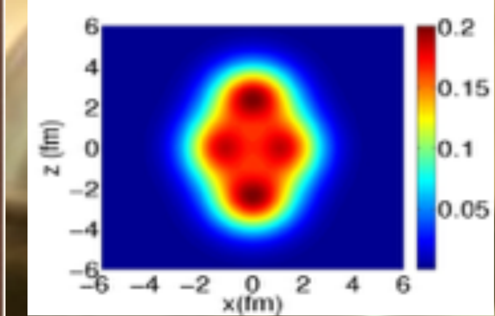



## Three-body forces

## Nuclear shapes and coexistence

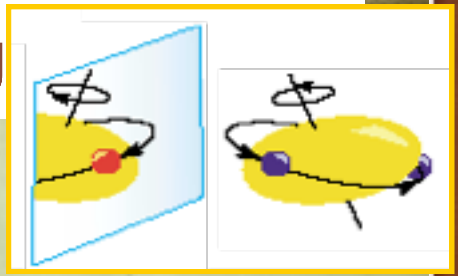



## Clusterization

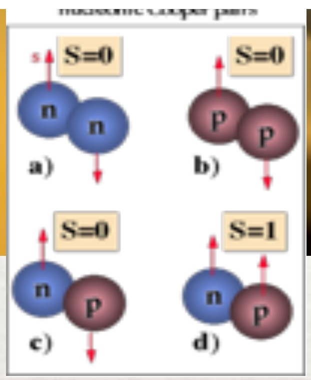


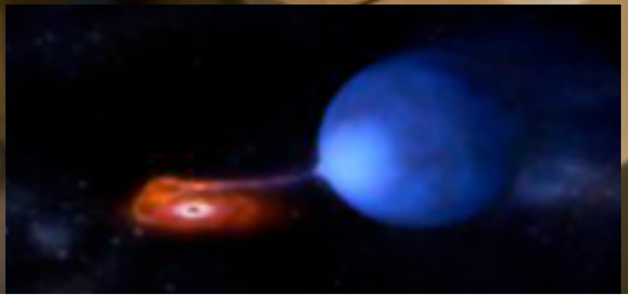

**High-resolution gamma-ray spectroscopy is an optimum tool to study nuclear structure properties and investigate how they emerge from fundamental interactions.**

## Isospin symmetry breaking



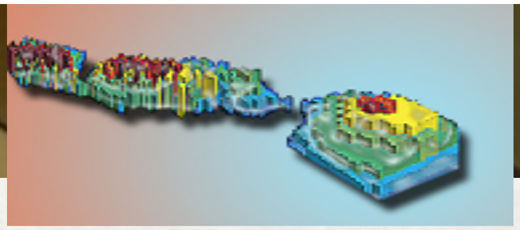
## p-n pairing



## Nuclear Astrophysics

## Super heavy elements



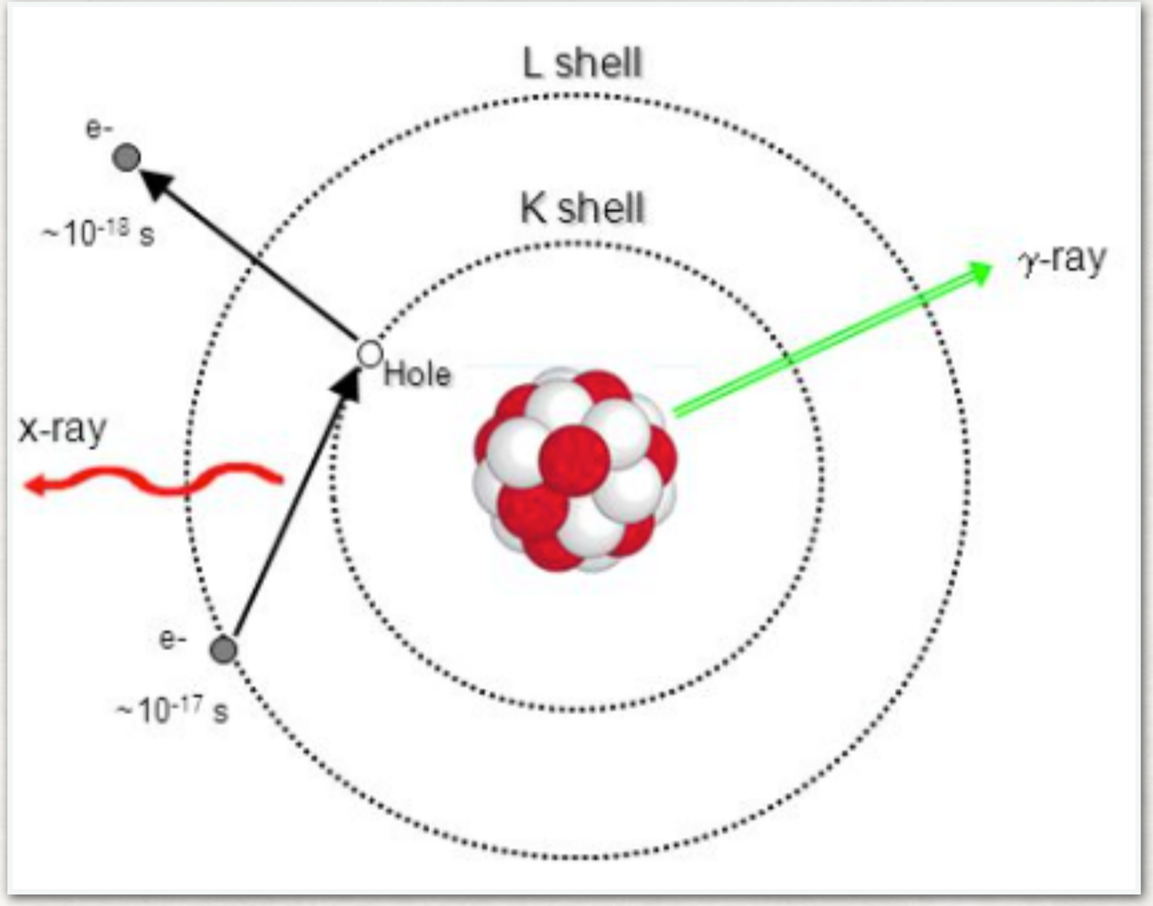
Uno degli obiettivi primari
sarà portare AGATA ai LNL
per la sperimentazione con i primi fasci di SPES

ma nel frattempo….

# CONVERSION ELECTRON MEASUREMENTS AT LNL

## FIRENZE - LNL - MILANO - PERUGIA

Spectroscopy of internal conversion electrons provides an important tool to investigate nuclear structure:




- measurement of internal conversion coefficient

  **spin and parity of the levels**

- study of electric monopole transitions

  **cannot proceed via gamma emission**

# ELECTRIC MONOPOLE TRANSITIONS

## FINGERPRINT OF SHAPE COEXISTENCE

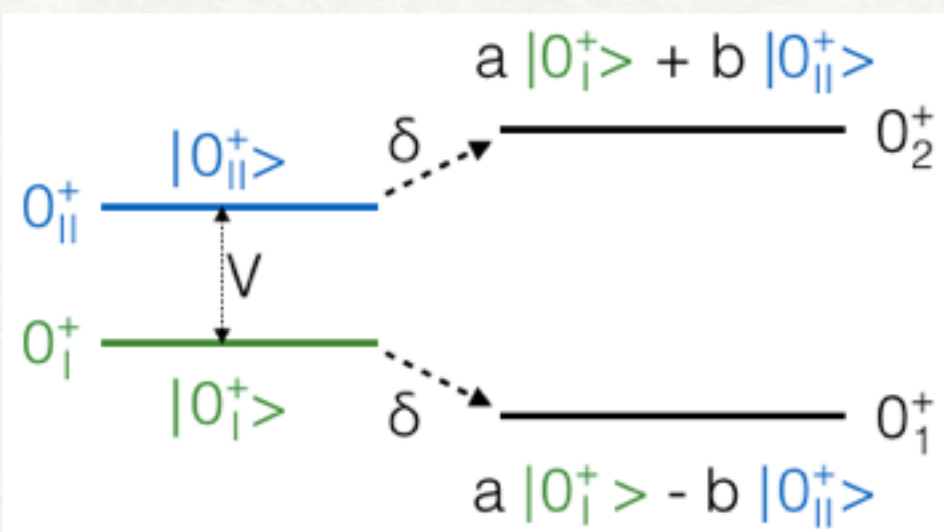
**E0 transition strength**

$$\rho^2(E0) = \left| \frac{\langle f | \, T\,(E0) \, | i \rangle}{eR^2} \right|^2$$

**T(E0) monopole matrix element**

**R nuclear radius**

The $\boldsymbol{\rho}^2$ is correlated to the change of the mean square nuclear radius between the two states and the mixing of the wave functions:

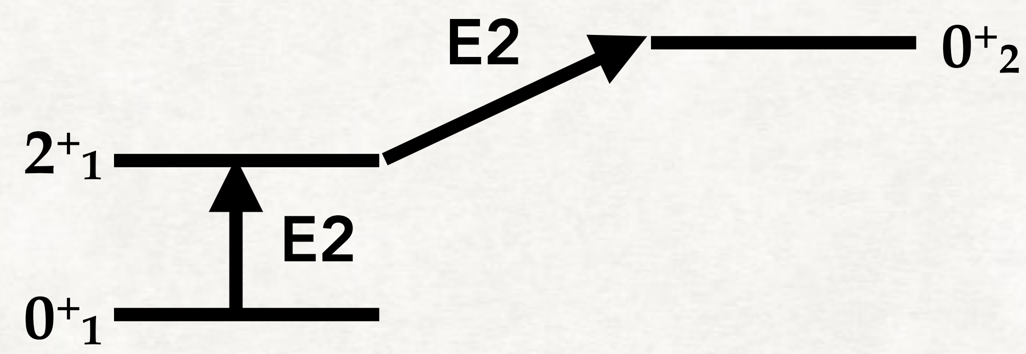



$$\rho^2(E0) = \frac{Z^2}{R^4} a^2 b^2 \left(\Delta \langle r^2 \rangle\right)^2$$

# ELECTRIC MONOPOLE TRANSITIONS

## IMPORTANT FOR COULOMB EXCITATION ANALYSIS

Typical level scheme



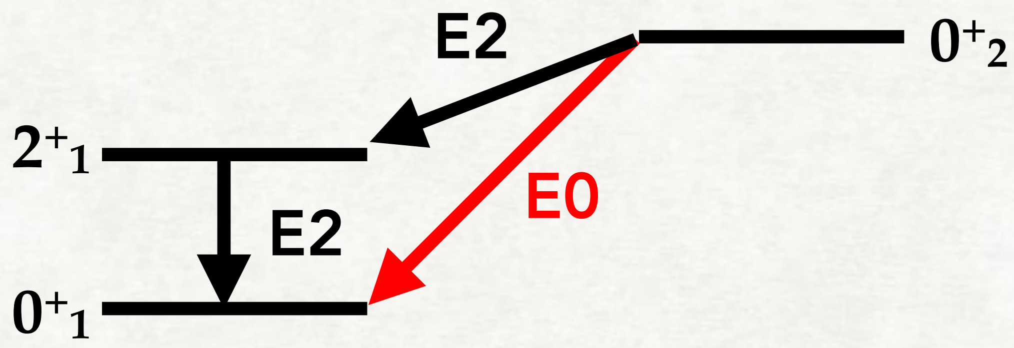

If the $0_2$ is populated, the decay can occur through a gamma (E2) or an electron (E0).

If the E0 is not include in the de-excitation cross section the Coulomb excitation analysis code will consider 100% E2 decay with important effect on the matrix elements (incorrect relative sign).

# ELECTRIC MONOPOLE TRANSITIONS

## IMPORTANT FOR COULOMB EXCITATION ANALYSIS

Typical level scheme

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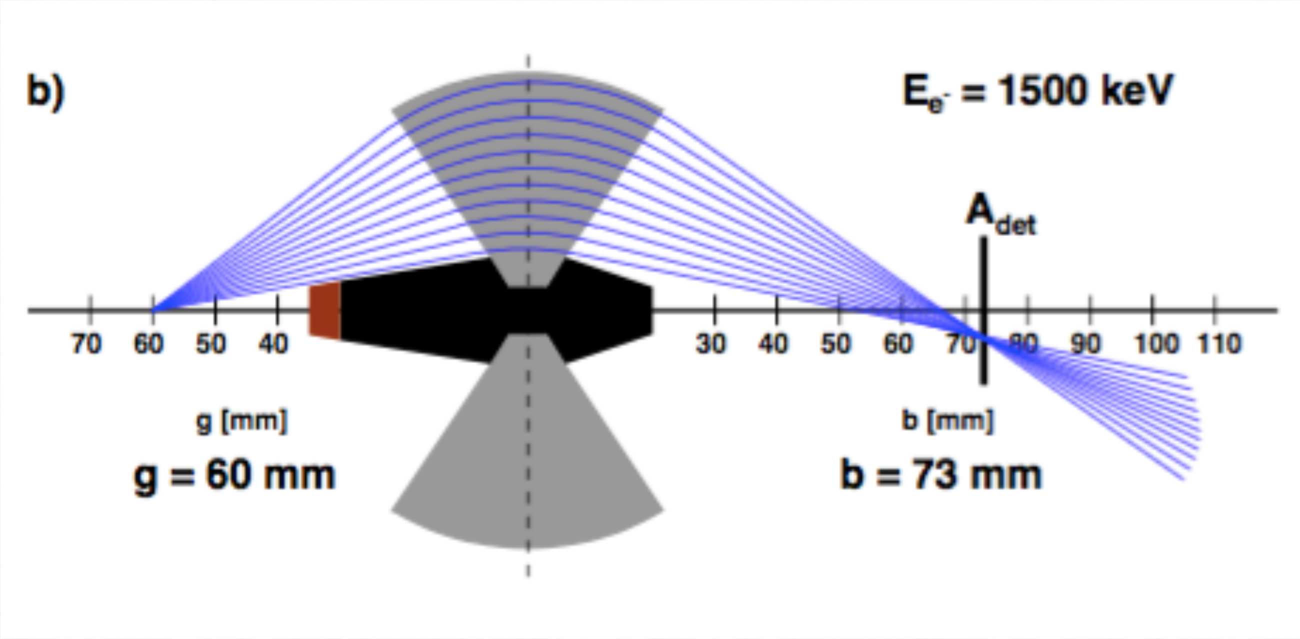
# CONVERSION ELECTRON MEASUREMENTS

- Conversion-electron spectrometers are a combination of a device for electron detection and a device for electron transportation, which guides the particles either around a physical barrier, far away from the target.

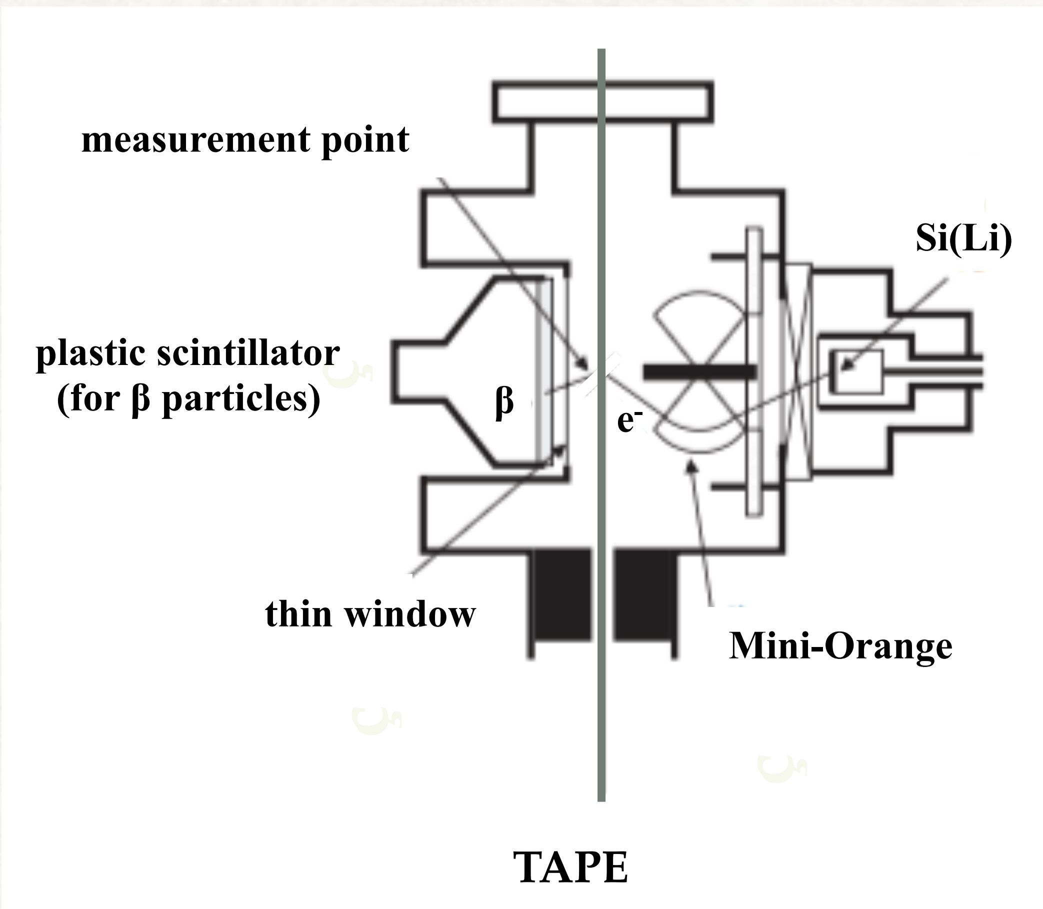
### Mini Orange Spectrometer



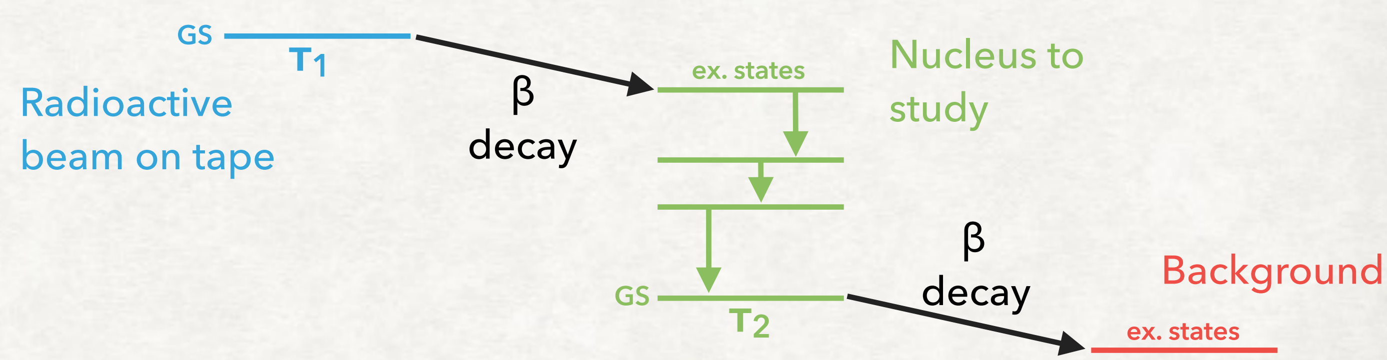

The magnet pieces will be arranged around a central absorber, in an orange-type configuration.

# CONVERSION ELECTRON MEASUREMENTS AT LNL

## SET-UP FOR CONVERSION ELECTRON MEASUREMENT AT THE SPES $1^+$ BEAM LINE




ICE spectra will be acquired in anti-coincidence with the signals in the plastic scintillator in order to reduce the **β**- particle background emitted in the decay of the parent nucleus

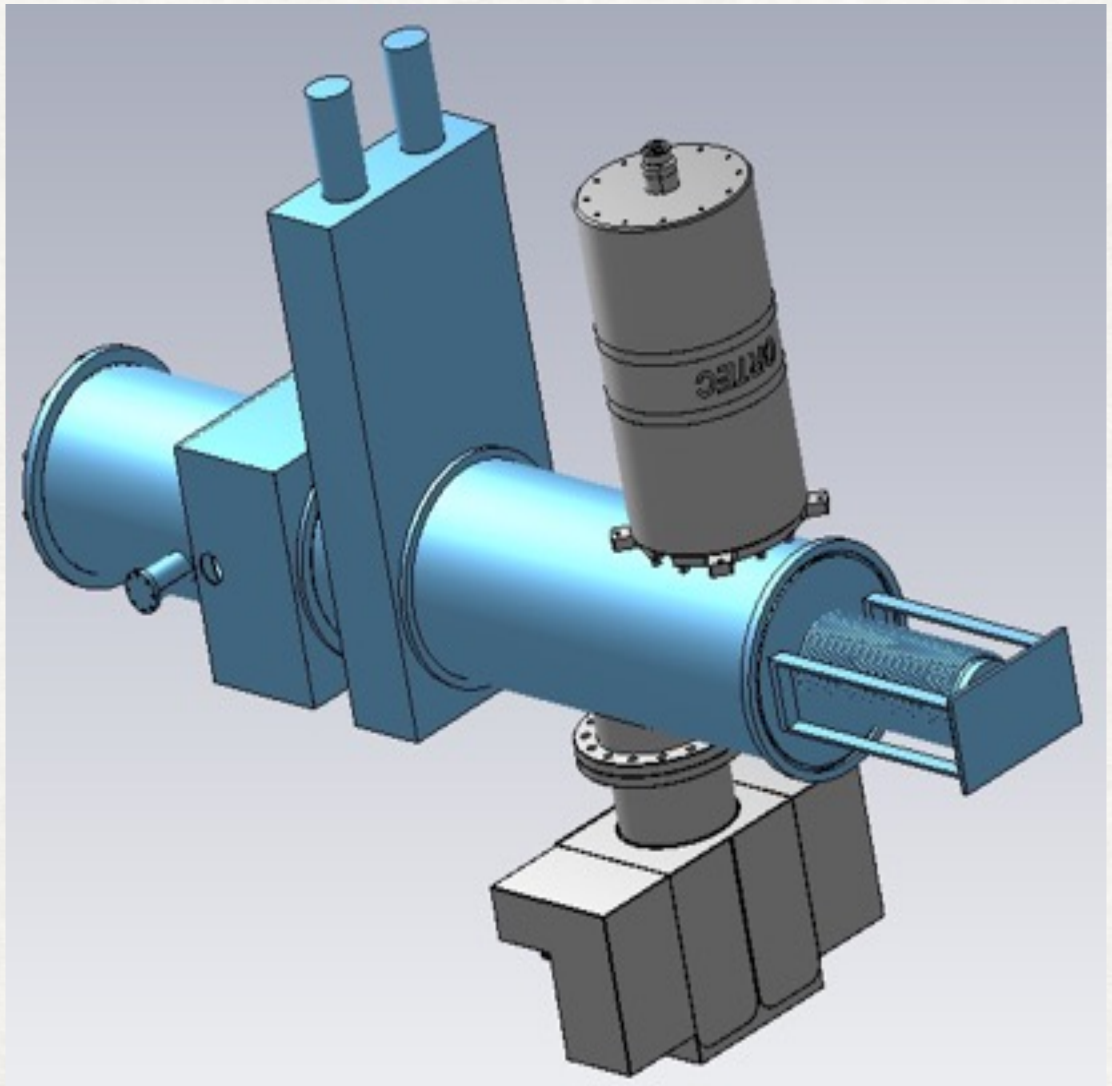



LoI for SPES: measurement of E0 transitions in $^{96}$Sr

# CONVERSION ELECTRON MEASUREMENTS AT LNL

## SET-UP FOR CONVERSION ELECTRON MEASUREMENT AT THE SPES $1^+$ BEAM LINE

A chamber housing the mini-orange and the moving tape will be constructed as well a chamber for the $LN_2$ cooled Si(Li) detector.



To have a wide range of transmitted energies with a single set of permanent magnets we plan to use:

- a remote controlled moving system to change the distance of the mini-orange from the Si(Li) detector.
- a large area Si(Li) detector, thickness from 5 to 7 mm.

# CONVERSION ELECTRON MEASUREMENTS AT LNL

## SET-UP FOR CONVERSION ELECTRON MEASUREMENT AT THE SPES $1^+$ BEAM LINE

A chamber housing the mini-orange and the moving tape will be constructed as well a chamber for the $LN_2$ cooled Si(Li) detector.


To have a wide range of transmitted energies wi… set of … we plan to use:

… moving … e distance … om the Si(Li)

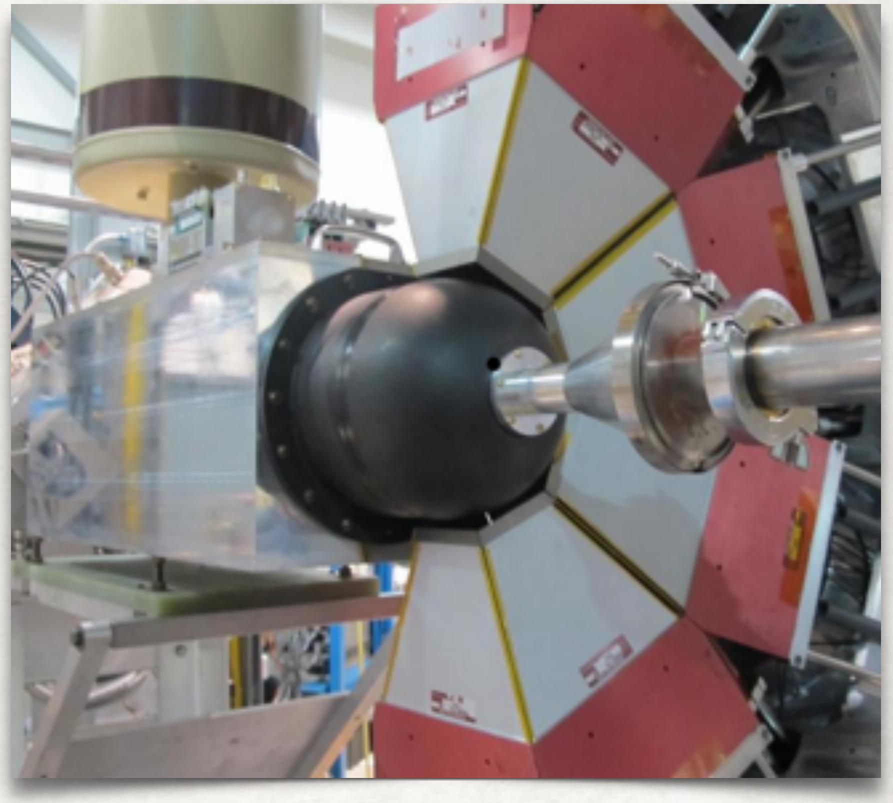
…rge area Si(Li) detector, thickness from 5 to 7 mm.

- servirà lavoro da parte dell'officina meccanica
- una prima camera di test con i rivelatori adesso disponibili verrà realizzata già il prossimo anno per dimensionare meglio i magneti
- test con sorgente $^{90}$Sr per capire se una segmentazione del Si(Li) può servire in questa configurazione

# CONVERSION ELECTRON MEASUREMENTS AT LNL

## SET-UP FOR IN-BEAM CONVERSION ELECTRON AD GAMMA COINCIDENCE MEASUREMENTS

A new apparatus coupling GALILEO to a specially designed in-beam conversion electron spectrometer. A similar apparatus in TRIUMF.



Important issues:

- large size of the magnetic lens and large size detector

  **a wide energy acceptance window**

- non standard annular Si(Li) mounted at backward angles

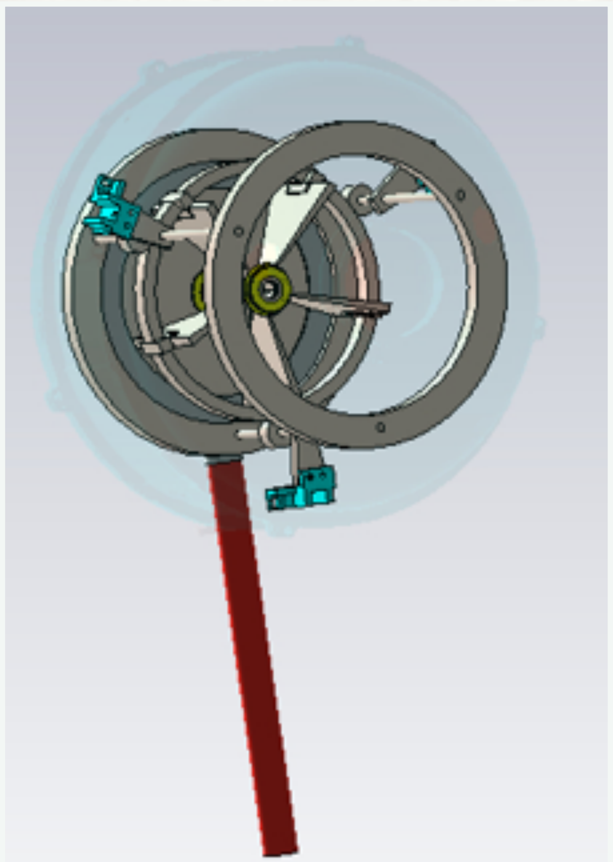
  **reduce the δ electron background**

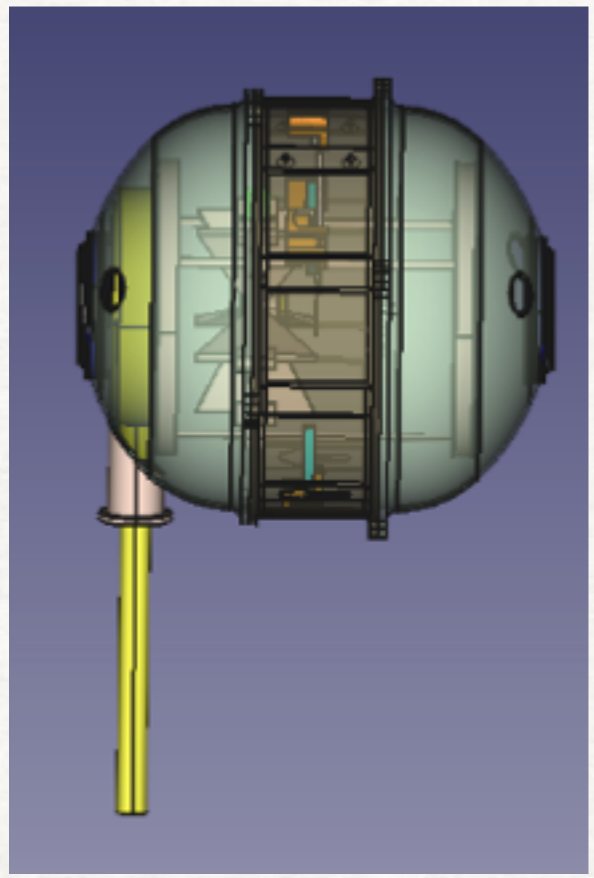
- non standard segmented Si(Li) detector kinematics

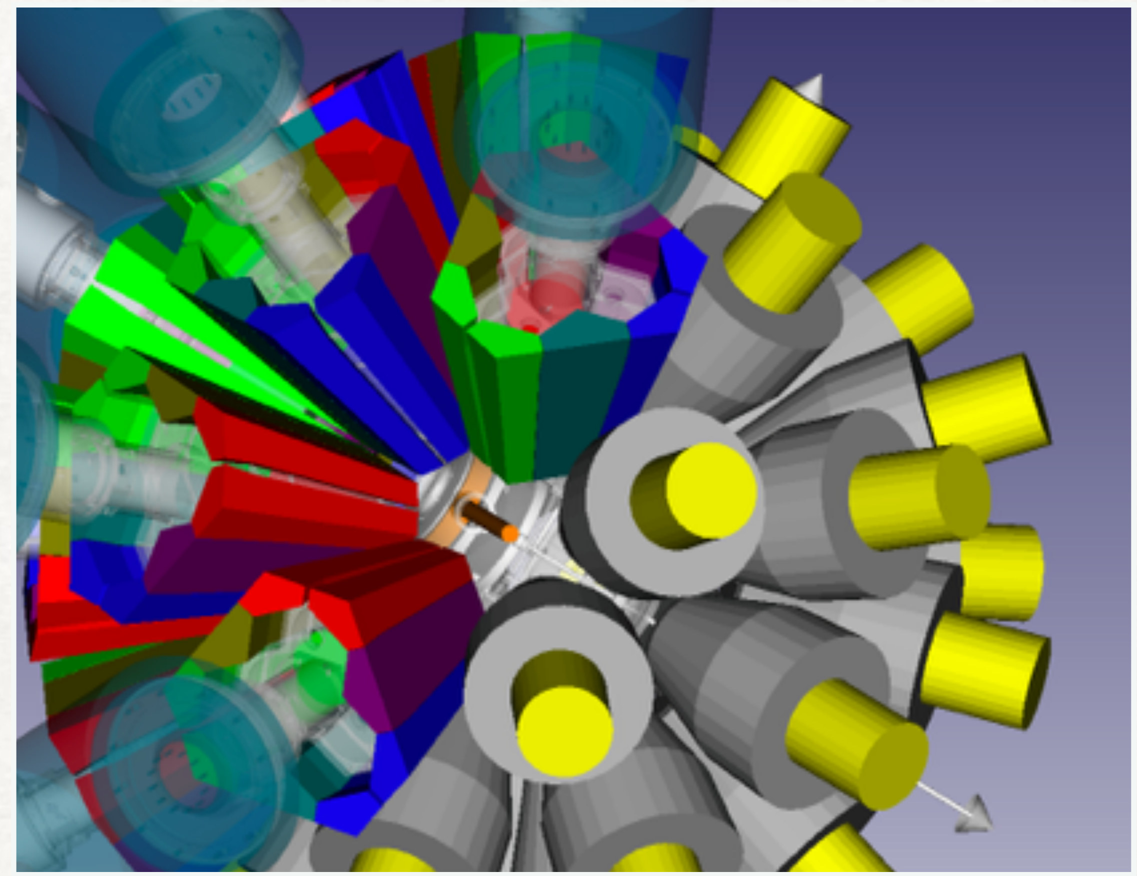
  **correction of the electron energy spectrum**

# CONVERSION ELECTRON MEASUREMENTS AT LNL

## SET-UP FOR IN-BEAM CONVERSION ELECTRON AD GAMMA COINCIDENCE MEASUREMENTS



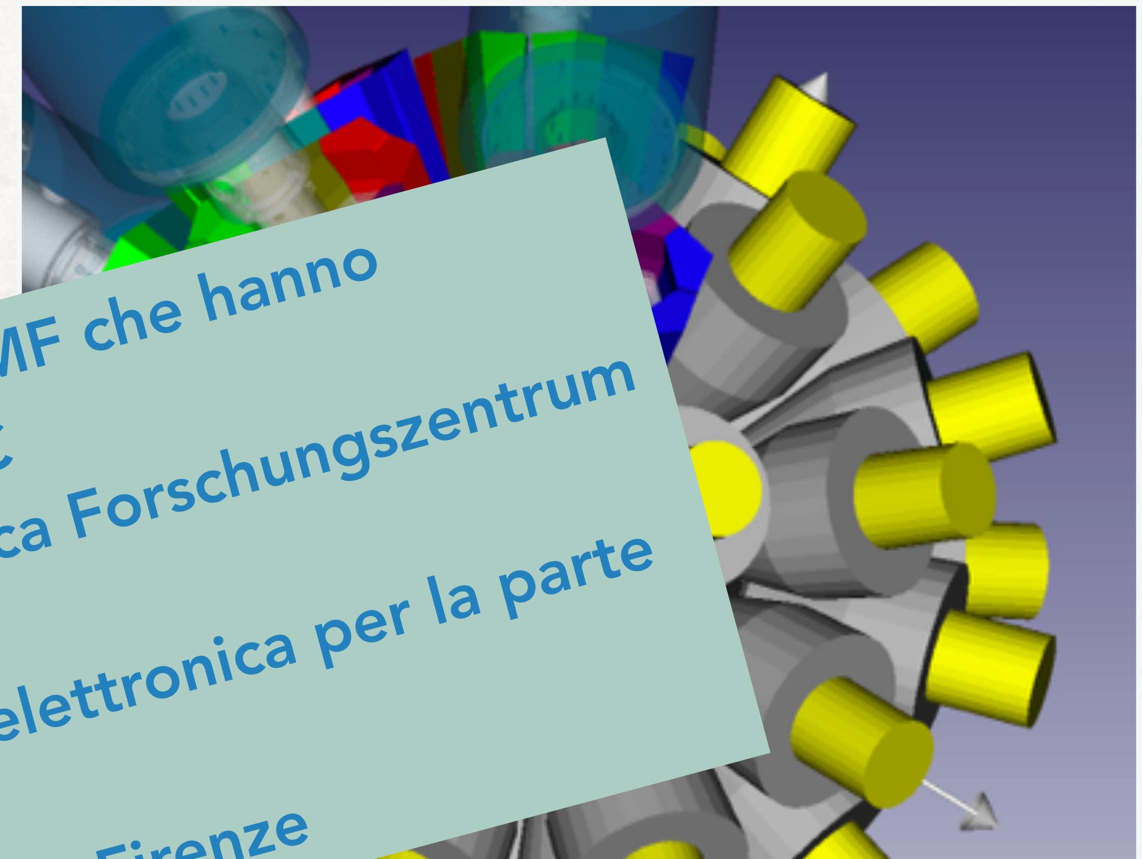




simulation of a possible configuration inside GALILEO

# CONVERSION ELECTRON MEASUREMENTS AT LNL

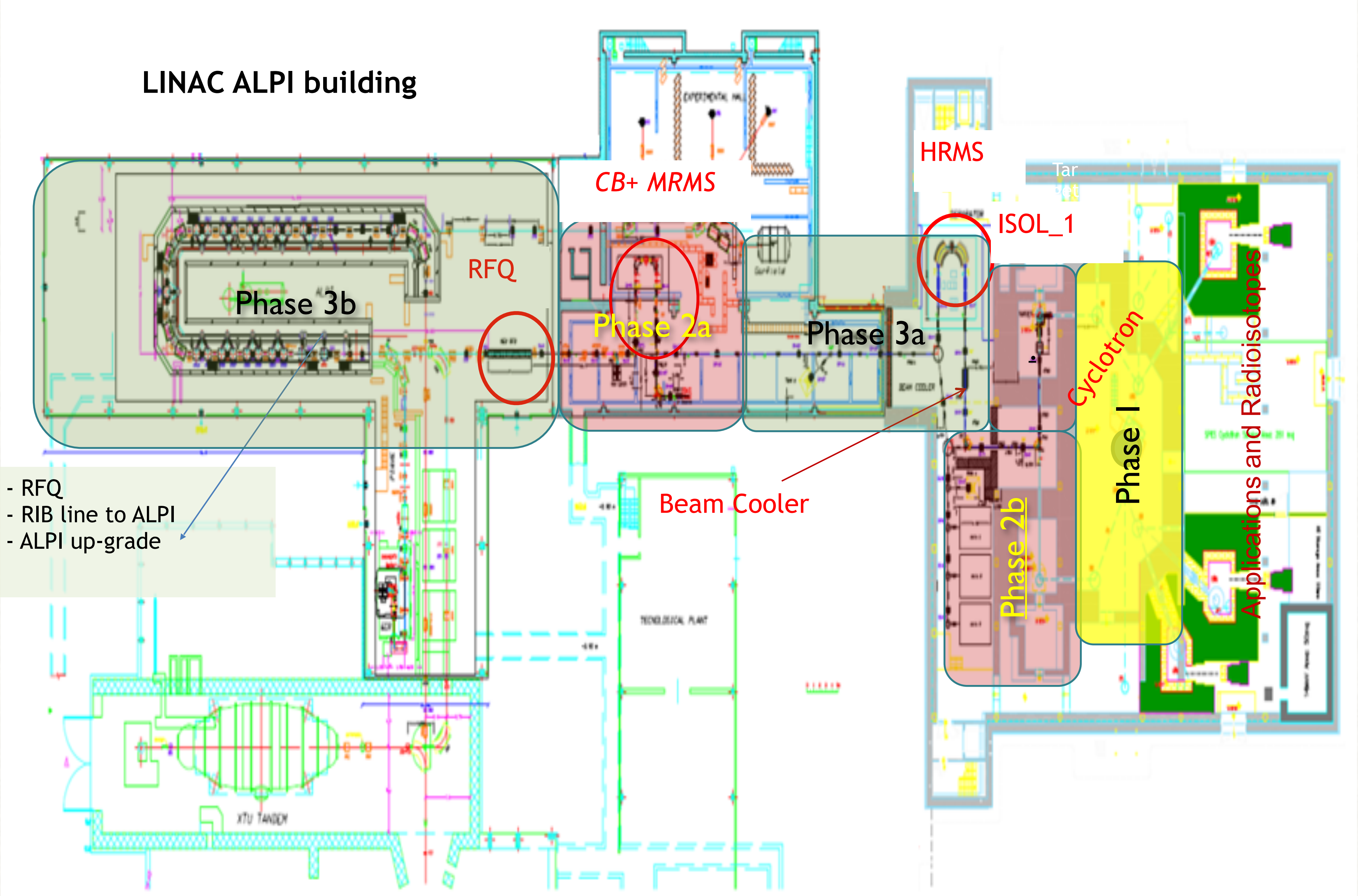
## SET-UP FOR IN-BEAM CONVERSION ELECTRON AD GAMMA COINCIDENCE MEASUREMENTS



- collaborazione con i colleghi di TRIUMF che hanno installato un apparato simile ad ISAC
- collaborazione con l'istituto di ricerca Forschungszentrum Jülich GmbH
- potrà servire aiuto del servizio di elettronica per la parte di preamplificazione
- assegno di ricerca bandito da INFN Firenze

ble configuration inside GALILEO

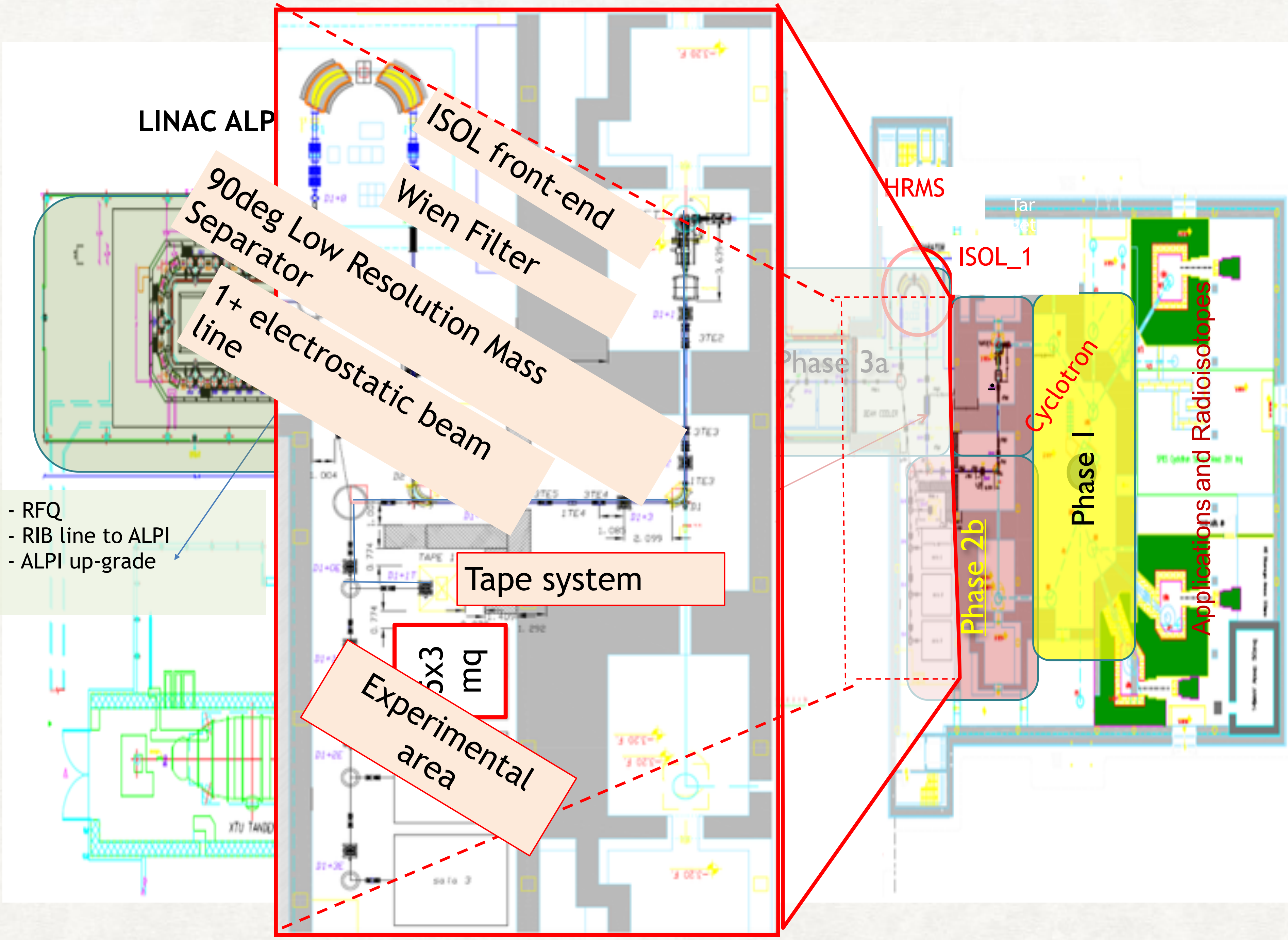
# SPES layout: ISOL facility  installation phases




- **Phase 1. 2016** - Building + First operation with the cyclotron NOW!
- **Phase 2. 2017-18** - From C.B. to RFQ + SPES target, LRMS, 1+ Beam Lines
- **Phase 3. 2019 - 20 -** HRMS-BeamCooler + RFQ to ALPI

**2019: phase2b**
no-reaccelerated
**radioactive**
**beams**

# SPES layout: ISOL facility  installation phases

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