SETUP FOR COULOMB-EXCITATION MEASUREMENTS OF RADIOACTIVE IONS

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WHY COULOMB EXCITATION?

- the excitation of nuclear states is caused solely by electromagnetic interaction
- nuclear structure can be studied in a model-independent way
- the excitation cross section $d\sigma/d\Omega$ is given by the product of the Rutherford cross section and the excitation probability expressed in terms of the matrix elements of the e.m. multipole moments
- the matrix elements of the multipole operators can be extracted from the intensities of the deexcitation γ-rays

WHY COULOMB EXCITATION?

- least-squares fitting of the matrix elements provided by GOSIA code
- high cross sections (excitation of the first 2^+ up to a few barns)
- beam energies at exotic beam facilities very appropriate for “safe” Coulomb Excitation (2-5 MeV/A)
- Coulomb Excitation a well understood mean of exciting atomic nuclei suitable for start up SPES experiments

SETUP FOR COULOMB EXCITATION MEASUREMENTS

The setups used at the different facilities are rather similar:

- germanium detectors are utilized to detect γ-rays
- an annular particle detector is used to detect the scattered projectiles and/or recoiling target nuclei

WHY PARTICLE DETECTOR?

- to identify the projectile and target nuclei
- to provide a clean trigger for selecting the events of interest
- to determine the scattering angle, essential to the event-by-event kinematics reconstruction
- to perform Doppler correction
- to collect a large number of experimental data at different scattering angle (overdetermine the problem)

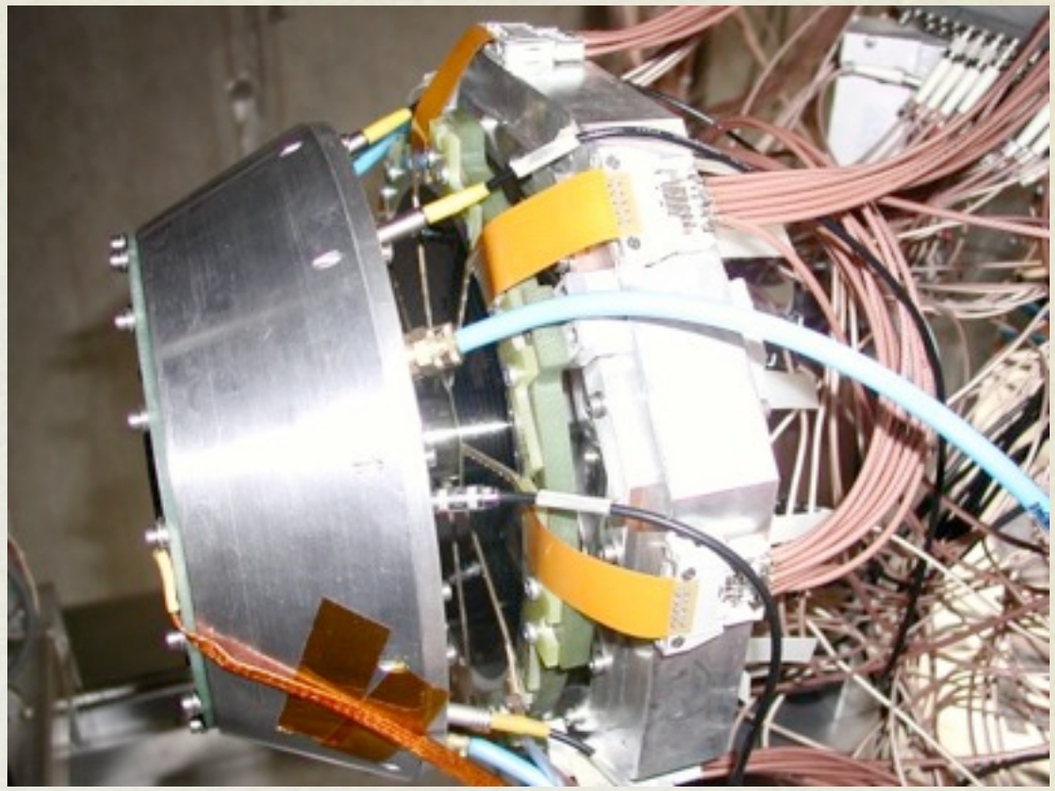
COULOMB EXCITATION WITH RADIOACTIVE BEAMS

- particle detection mandatory due to the high expected background
- low beam intensities: particle detector at forward angles to maximize the statistics
- see e.g. CD and MINIBALL @REX ISOLDE

SPIDER: Silicon PIe DEtectoR

We started from:

- the Ring Counter detector of the GARFIELD apparatus [1]
- the second stage is a disc of silicon strip detectors
- spare strip detectors were available



[1] M. Bruno et al. Eur. Phys. J. A 2013 (49) 128

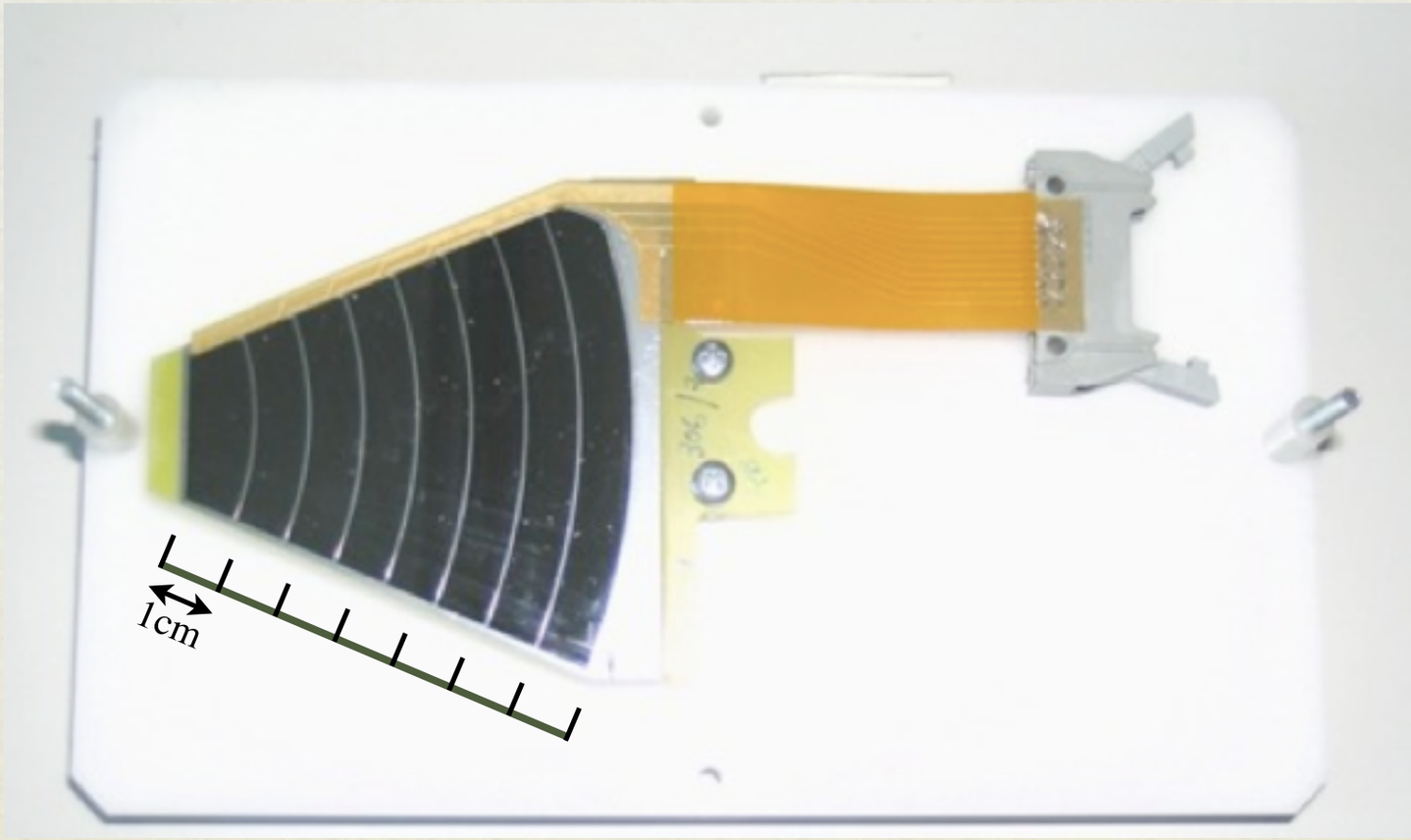
SPIDER: Silicon PIe DEtectoR

- 8 silicon strip detectors of trapezoid shape (sector) arranged to form a disc
- each detector is segmented into eight independent annular strips on the front surface (junction side)
- the rear surface (ohmic side) consists of a unique electrode
- detector thickness is around 300μm
- guard rings in the interstrip region, to minimize charge split and cross-talk between contiguous strips

SPIDER: Silicon PIe DEtectoR

One SPIDER sector

- each one of the eight strips has a width of 8.5 mm
- the full length of the silicon detector is 68.4 mm



SPIDER: Silicon PIe DEtectoR

- when the detector is mounted at 5 cm distance from the target the coverage of the polar angle θ is about 42 degrees (from 18 to 60 degrees)

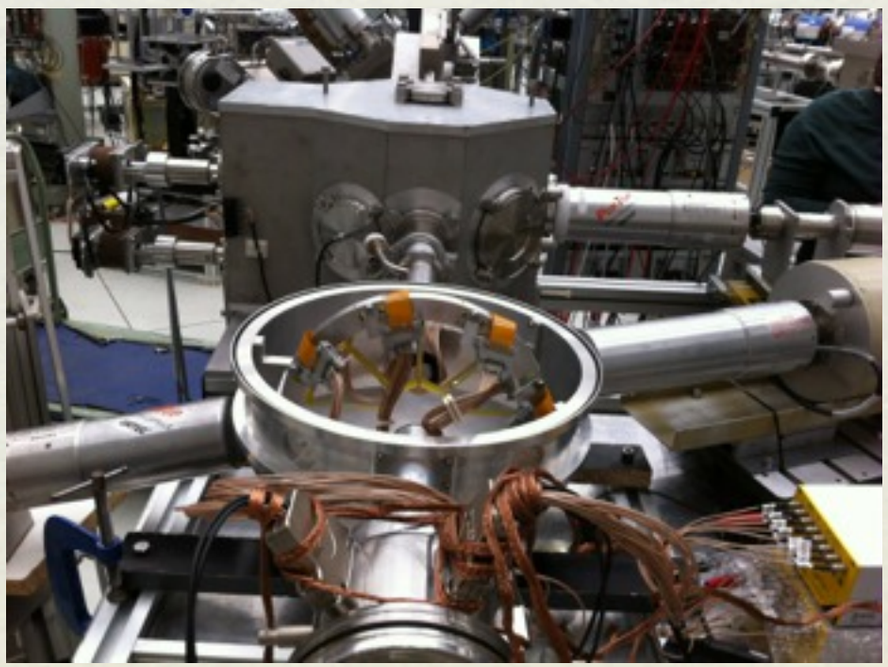
strip no.	inner radius(mm)	outer radius (mm)	θ_{min}(deg)	θ_{max}(deg)
1	76.7	85.0	56.9	59.5
2	68.1	76.4	53.7	56.7
3	59.5	67.9	50.0	53.6
4	50.9	59.3	45.5	49.9
5	42.4	50.7	40.3	45.5
6	33.8	42.1	34.1	40.1
7	25.2	33.6	26.7	33.9
8	16.6	25.0	18.4	26.6

SPIDER: Silicon PIe DEtectoR

- a new scattering chamber containing the detector and the target has been constructed
- the design is compatible with the free space at the center of GALILEO array
- forward or backward positioning of the detector is possible

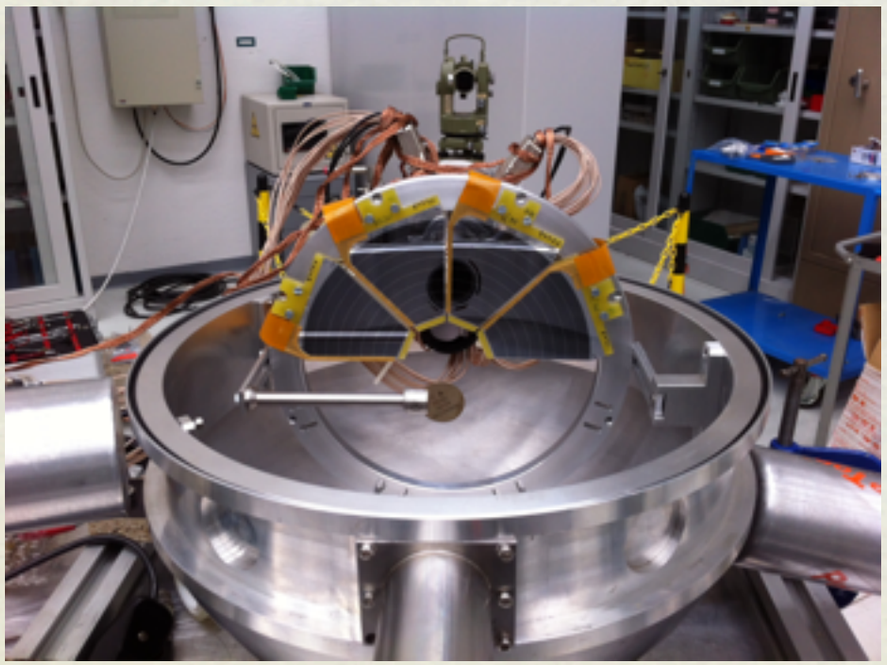
SPIDER: Silicon PIe DEtectoR

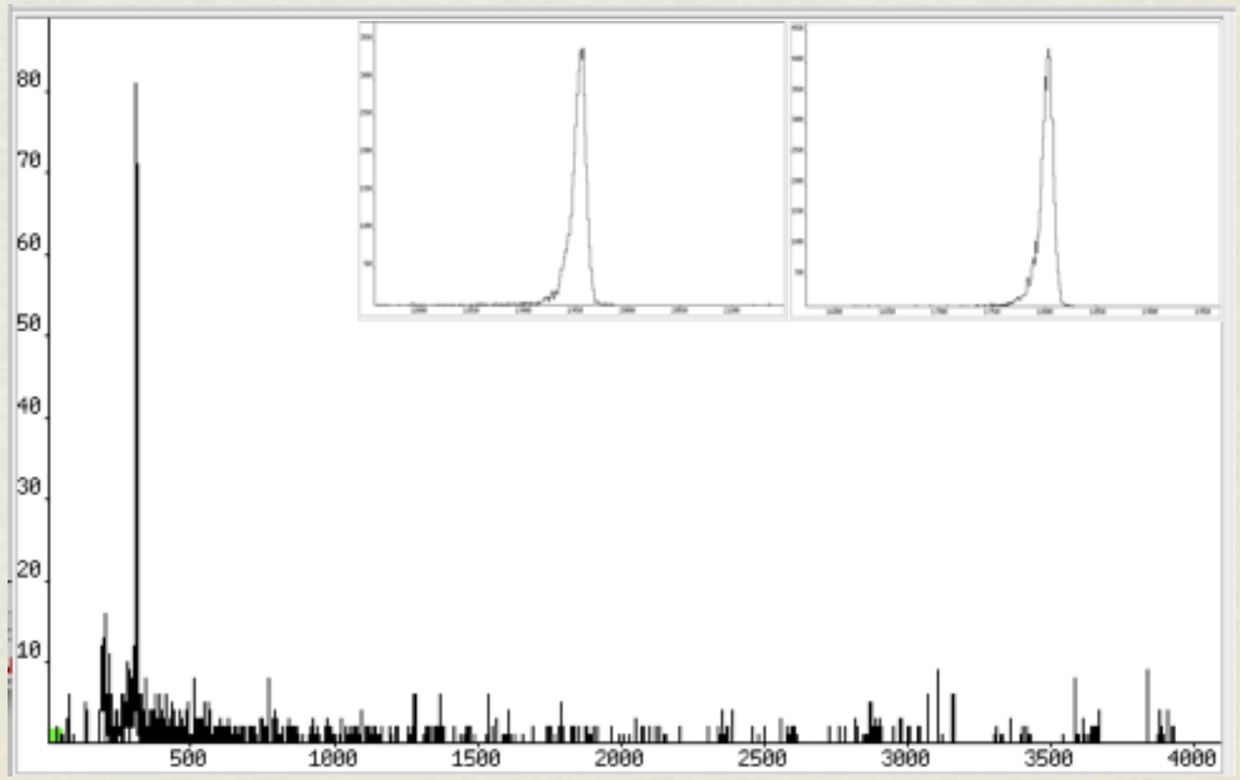
- Coulomb Excitation of ^{108}Pd with a 5 MeV proton beam @LABEC - Firenze
- beam time next week



SPIDER: Silicon PIe DEtectoR

- Gamma spectrum of a ^{241}Am source acquired in coincidence with the two inner rings of the SPIDER sectors





CONCLUSIONS

- a new apparatus for Coulomb Excitation experiments with SPES beams has been presented

- the apparatus will be compatible with the gamma detector array available at LNL

- physics case: see for our group the LoI of Barbara Melon on Wednesday