

A neutron detector coupled to Magnex

Francesco Cappuzzello

Università di Catania e INFN-Laboratori Nazionali del Sud (Italy)

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Optical characteristics	Actual values
Maximum magnetic rigidity	1.8 T m
Solid angle	50 msr
Momentum acceptance	$\pm 13\%$
Momentum dispersion for $k = -0.104$ (cm/%)	3.68
First order momentum resolution $R_p = \frac{D}{M_x \Delta x}$	5400

Upper bending limit

$$2 < A < 40$$

$$E = 30 \text{ AMeV}$$

Angular acceptance

Setting $\theta = 6^\circ \rightarrow 0 < \theta_{\text{lab}} < 14$

Setting $\theta = 90^\circ \rightarrow 85^\circ < \theta_{\text{lab}} < 96^\circ$

Measured resolution

Energy $\Delta E/E \sim 1/1000$

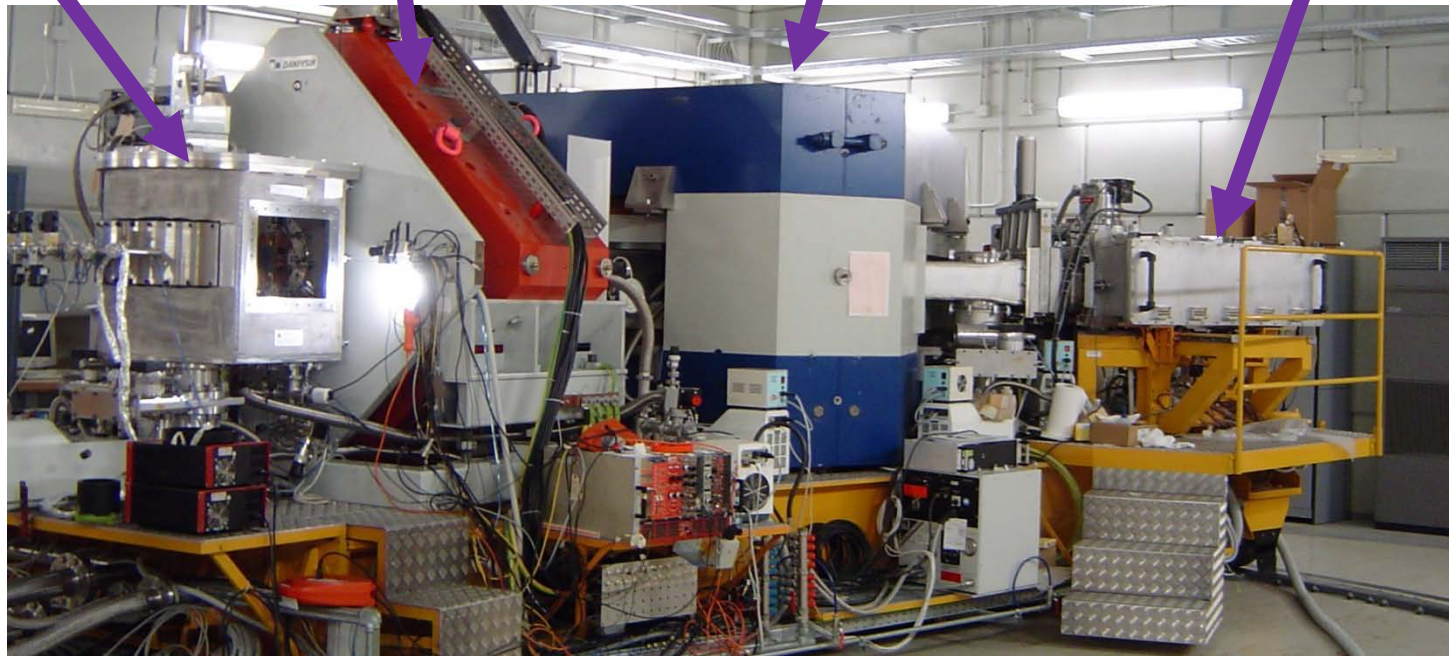
Angle $\Delta \theta \sim 0.3^\circ$

Mass $\Delta m/m \sim 1/100$ (not optimized)

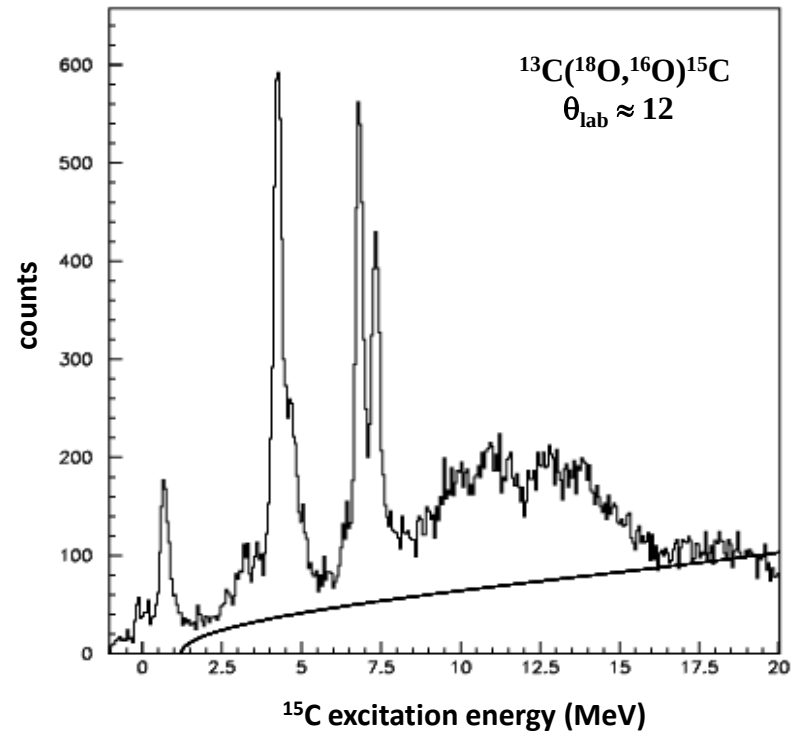
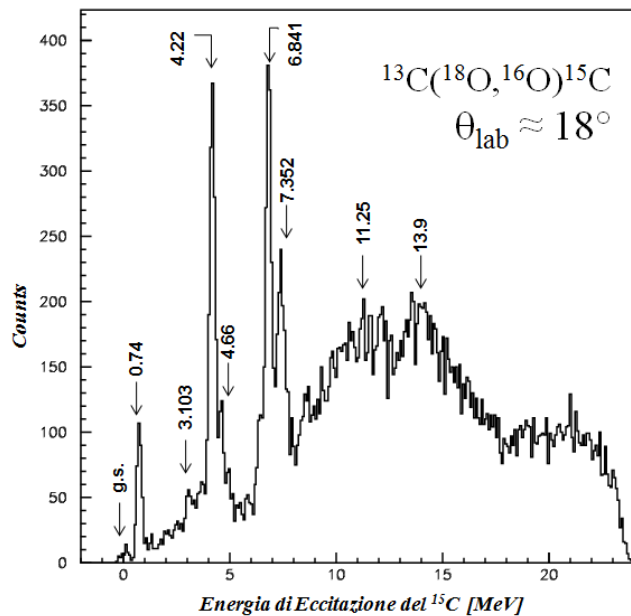
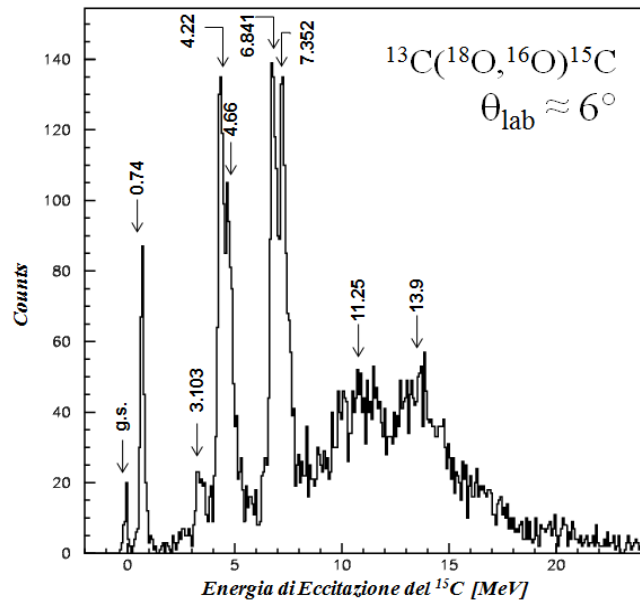
Scattering
Chamber

Quadrupole

Dipole



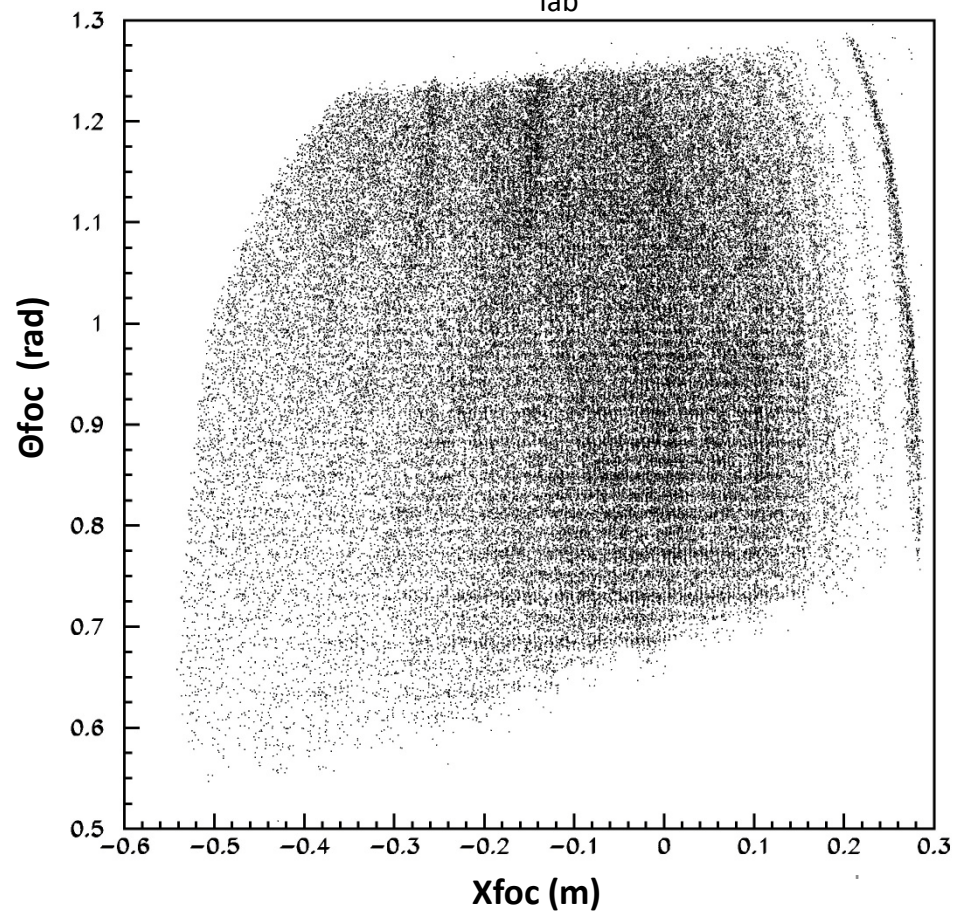
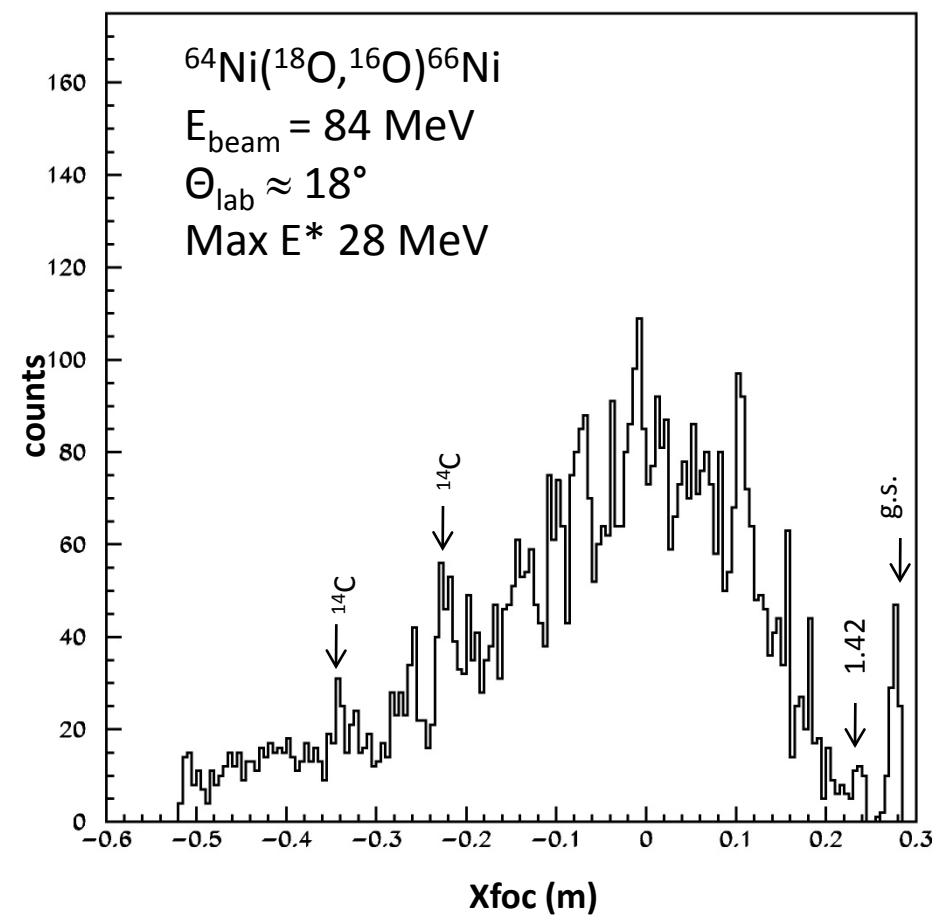
$^{13}\text{C}(^{18}\text{O}, ^{16}\text{O})^{15}\text{C}$



$^{64}\text{Ni}(^{18}\text{O}, ^{16}\text{O})^{66}\text{Ni}$

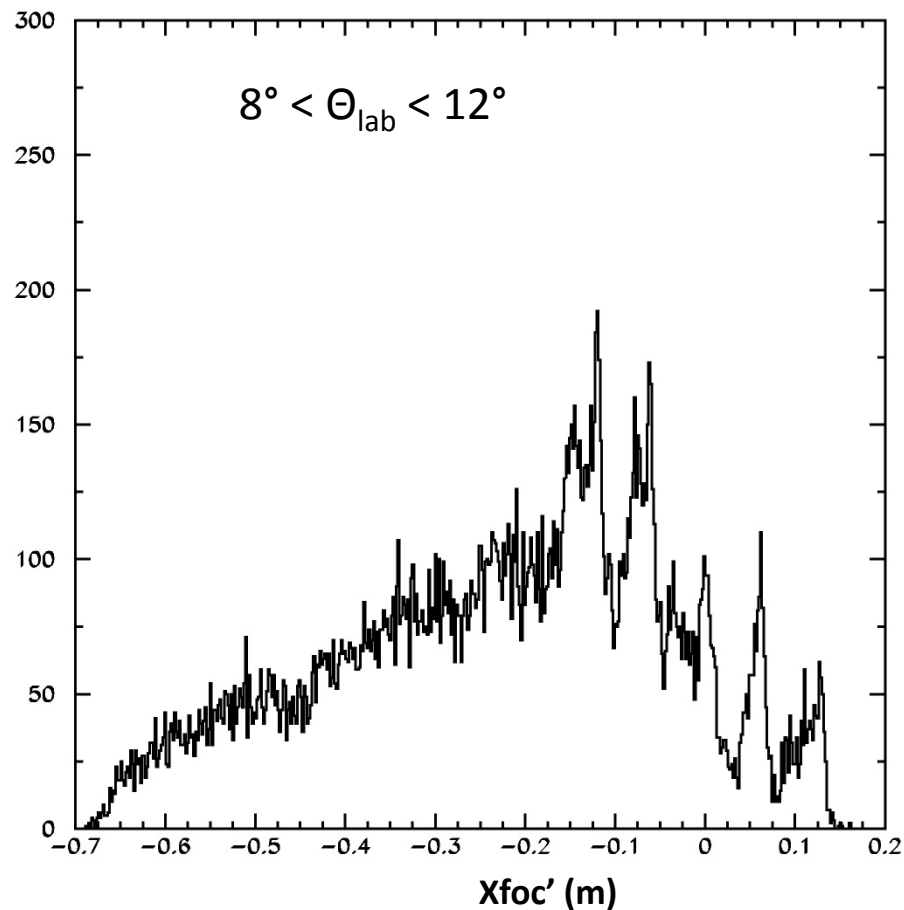
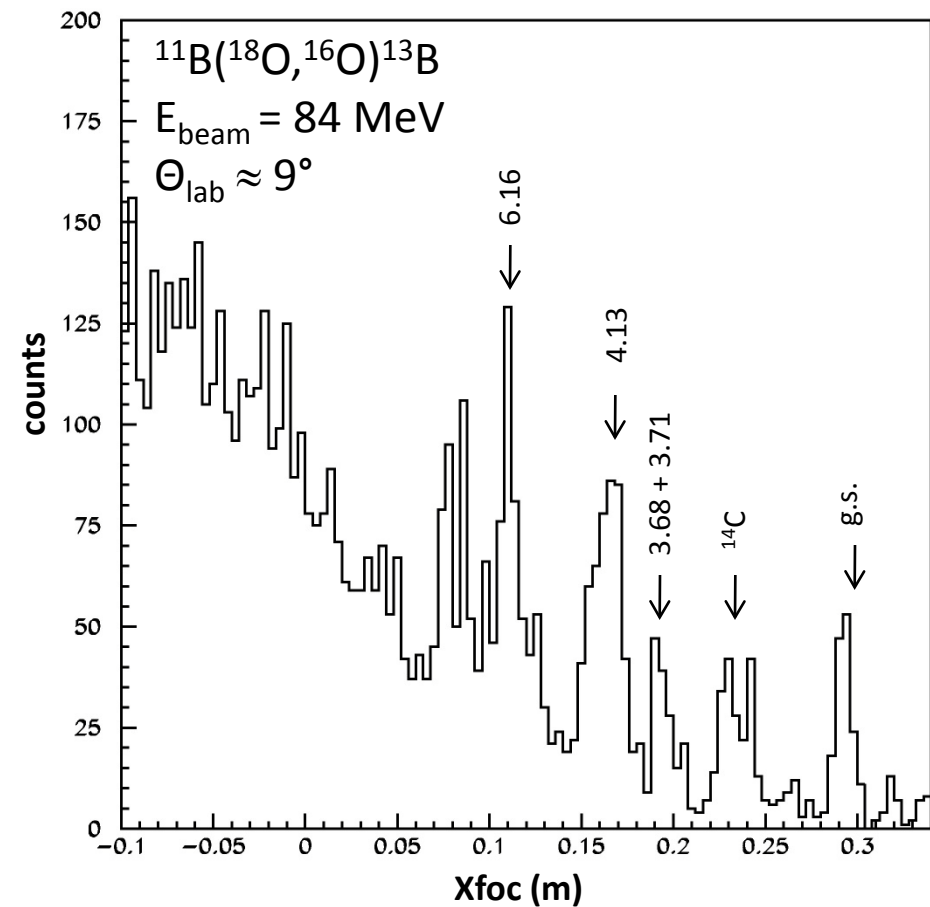
PRELIMINARY

$12^\circ < \Theta_{\text{lab}} < 24^\circ$



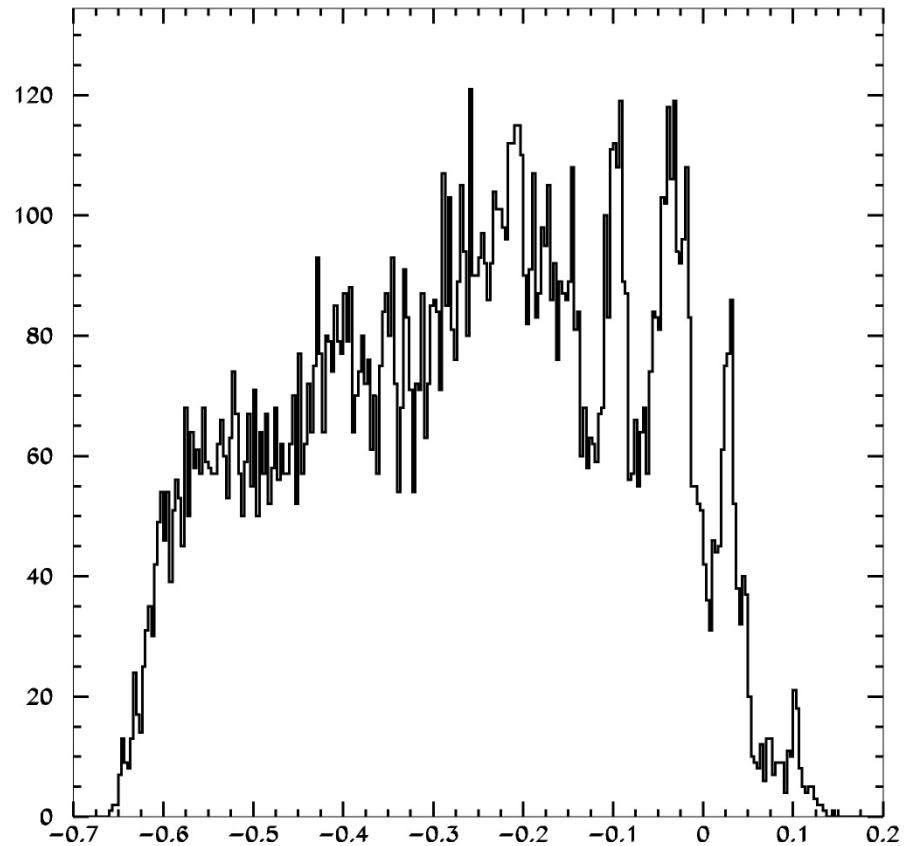
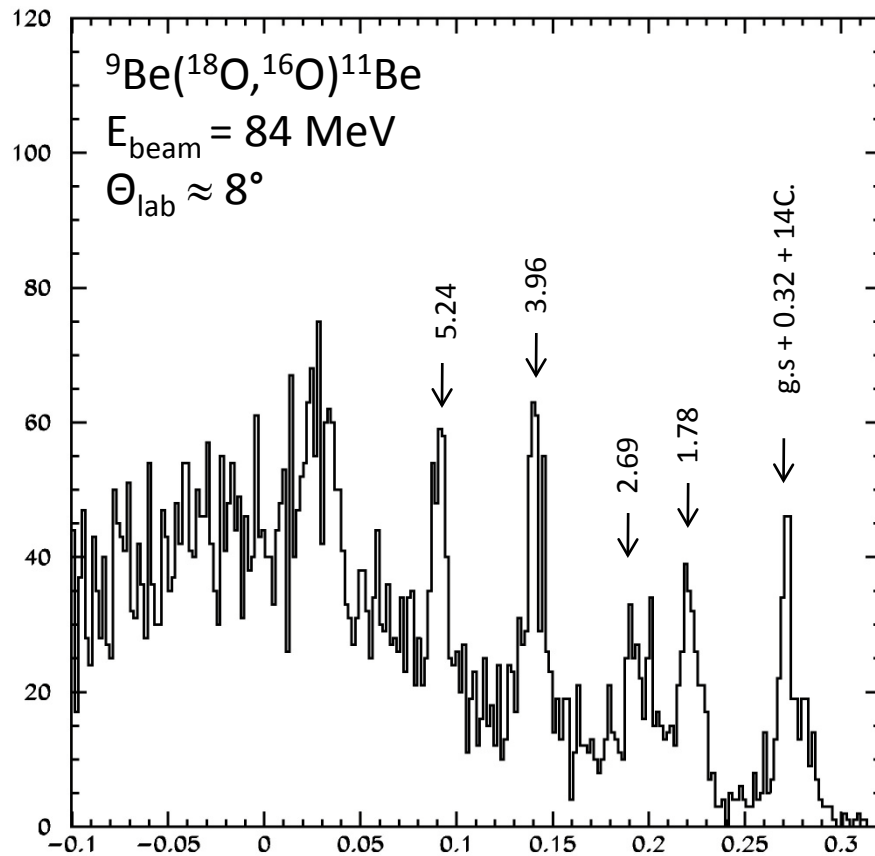
$^{11}\text{B}(^{18}\text{O}, ^{16}\text{O})^{13}\text{B}$

PRELIMINARY



${}^9\text{Be}({}^{18}\text{O}, {}^{16}\text{O}){}^{11}\text{Be}$

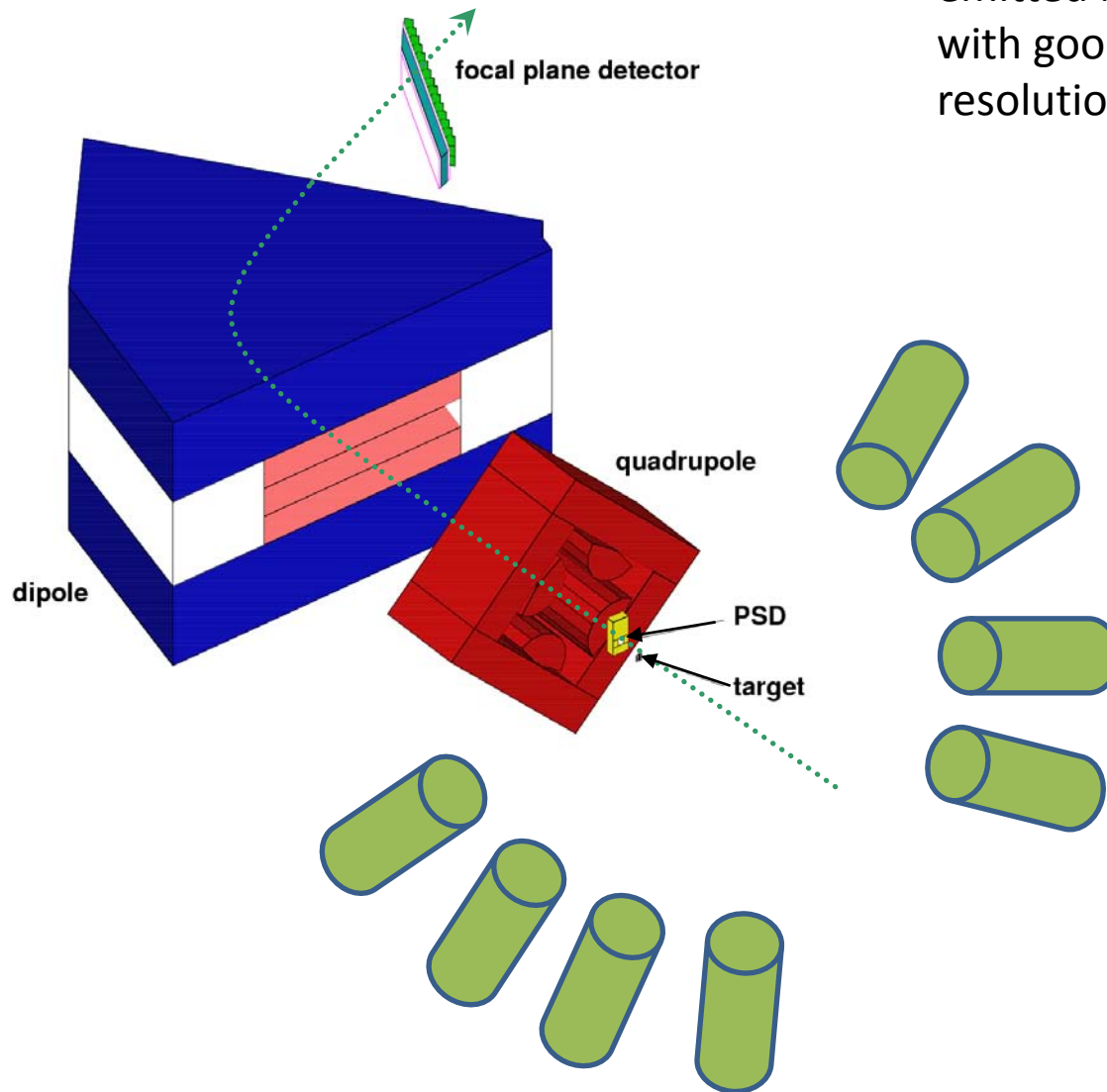
PRELIMINARY



MAGNEX + EDEN

MAGNEX to measure high resolution energy spectra for well identified reaction products

EDEN to study the **decaying neutrons** emitted by the observed resonances with good efficiency and energy resolution



Unique facility to study the resonant states of neutron rich nuclei (low separation energy)

The EDEN Time Of Flight multidetector

H. Laurent et al., NIM A326 (1993) 417-525

Main features

- ✓ 40 NE213 liquid scintillators from the IPN-Orsay
- ✓ Possibility of **n - γ discrimination** by pulse shape analysis
- ✓ **Time resolution of 0.9 ns** for TOF measurements
- ✓ Typical energy resolution at a 1.7 m distance from the target: 60 keV/850 keV and 350 keV/3.6 MeV
- ✓ **Intrinsic efficiency $\sim$ 50%** for 1 MeV and 30% for 6 MeV neutrons
- ✓ Mechanic assembly easily configurable for different experimental requirements

Just one problem

- ✓ **Obsolete and unreliable CAMAC electronics** for the signal treatment

MAGNEX + EDEN 2011-2013

MOU

INFN -LNS

Francesco Cappuzzello

Angelo Cunsolo

Manuela Cavallaro

Diana Carbone

Salvatore Tudisco

Antonino Foti

Pierpaolo Figuera

Luciano Calabretta

Silvio Cherubini

Stefano Romano

Francesca Rizzo

Clementina Agodi

IN2P3 – IPN Orsay

Jean-Antoine Scarpaci

Faical Azaiez

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Serge Franchoo

Iolanda Matea

Elias Khan

Didier Beaumel

Jacques Guillot

Fairouz Hamache

David Verney

Fadi Ibrahim

Marlene Assié

Francois Leblanc

Brigitte Roussiere

EDEN Electronics Upgrading

Present pulse shape based on

GANELEC Costant Fraction Discriminators 8 channels NIM(model FCC8)

Gate and Delay Generators 8input/16output NIM (model RDV 8/16)

Charge to Digital Converters 16 channels CAMAC (model QDC 1612F)

New project based on

BaF-PRO processor 16 inputs / 32 analog outputs NIM (developed at the INFN-MI)

32 channels peak sensing ADC VME(model Caen V785)

EDEN Electronics Upgrading

TOF measurement based on

16 channels Time to Digital Converters CAMAC (model GANELEC TDC 812F)

New project based on

32 channel TDC VME (model Caen V775)

32 channels high stability ECL delay line NIM(developed at the INFN-MI)

Time schedule

- ✓ **October 2010**: arrival of the first two EDEN modules at the LNS
- ✓ **October-December 2010**: Test of the modules with the new electronics
- ✓ **January-February 2011**: arrival of the complete EDEN array at the LNS
- ✓ **March-April 2011**: installation of EDEN on the MAGNEX experimental area
- ✓ **May-July 2011**: in beam-test of MAGNEX-EDEN
- ✓ **September 2011**: start the experimental activity

Proposal at the LNS PAC for the commissioning

Requested 15 BTU at the Tandem LNS facility for studying the

$^{12}\text{C}(^{18}\text{O}, ^{17}\text{O})^{13}\text{C}$ at 84 MeV

To setup electronics and
study efficiency and
resolution

$^{16}\text{O}(^{18}\text{O}, ^{17}\text{O})^{17}\text{O}$ at 84 MeV

and the

$^{13}\text{C}(^{18}\text{O}, ^{16}\text{O})^{15}\text{C}$ at 84 MeV

2 neutron coincidences

Conclusions

✚ The **MAGNEX – EDEN** system is going to be installed in 1 year at the LNS

✚ It **will be a unique instrument worldwide** opening a very wide range of possibilities in the field of experimental nuclear physics