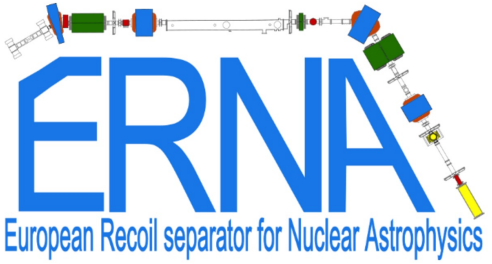
Università
degli Studi
della Campania
Luigi Vanvitelli
Dipartimento di Matematica e Fisica



ERNA commissioning for $^{12}C(\alpha,\gamma)^{16}O$

Claudio Santonastaso

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Quinto Incontro Nazionale di Fisica Nucleare INFN 2022 - LNGS

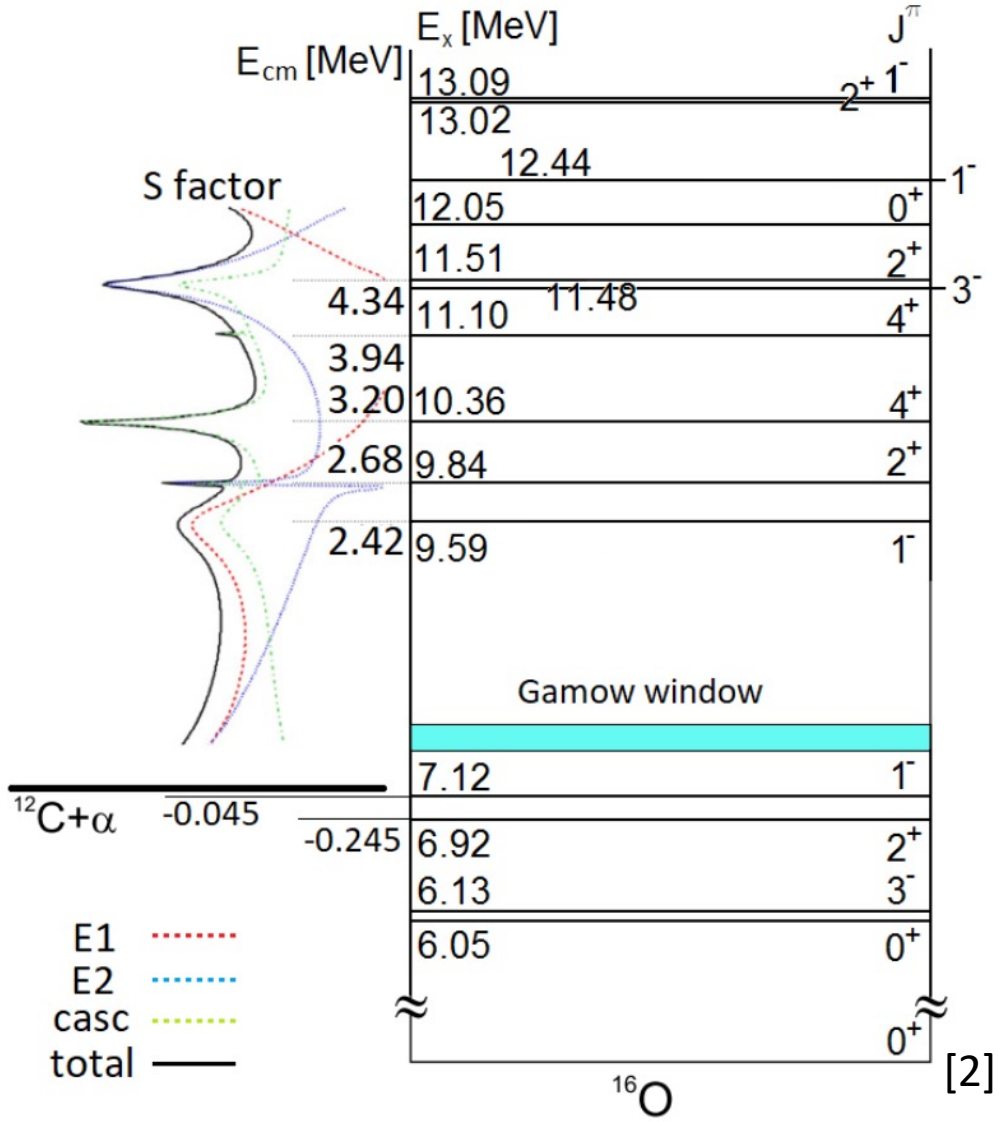
$^{12}C(\alpha,\gamma)^{16}O$ reaction

Burning Stage	Astrophysical site	Gamov energy range (MeV)
Core helium burning	AGB stars and massive stars	0.15 - 0.65 [1]

$$\frac{dY(12C)}{dt} = \frac{1}{3!}Y^3(^4He)\rho^2\lambda_{(3\alpha)} - Y(^4He)Y(^{12}C)\rho\lambda_{^{12}C(\alpha,\gamma)^{16}O}$$

$$\frac{dY(16O)}{dt} = Y(^4He)Y(^{12}C)\rho\lambda_{^{12}C(\alpha,\gamma)^{16}O} - Y(^4He)Y(^{16}O)\rho\lambda_{^{16}O(\alpha,\gamma)^{20}Ne}$$

$$S(E) = \sigma(E)Ee^{2\pi\eta}$$



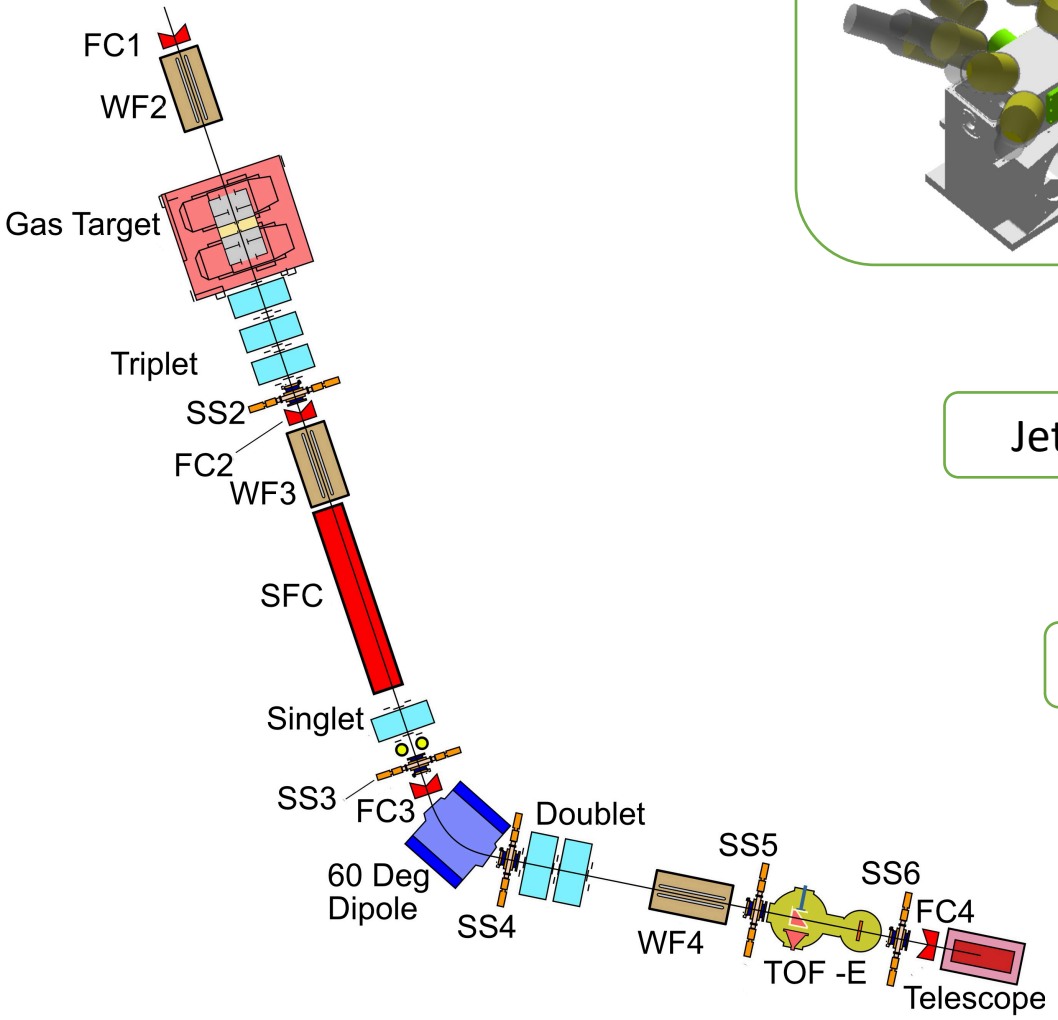
[2]

[1] deBoer et al. 2017
[2] Schürmann et al. 2012

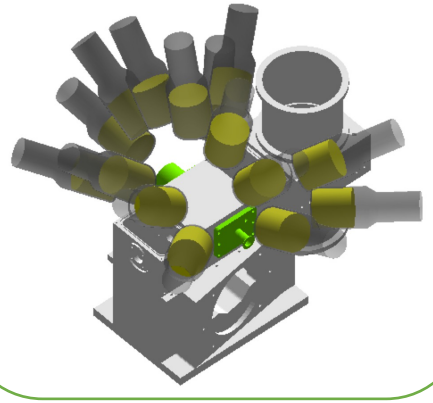
ERNA layout

ERNA at Bochum

Ruhr-Universität



Gamma array detector



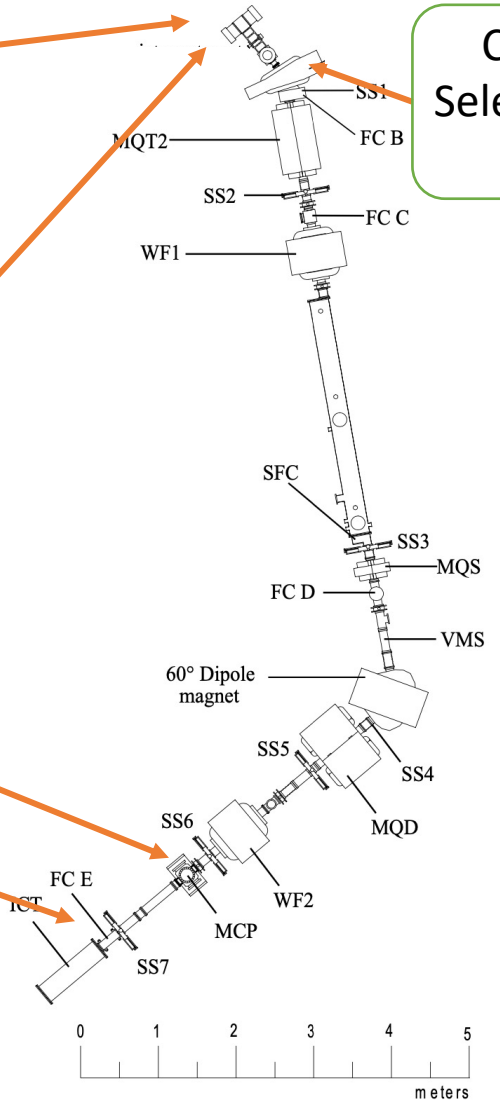
ERNA at CIRCE Laboratory

Università degli studi della Campania

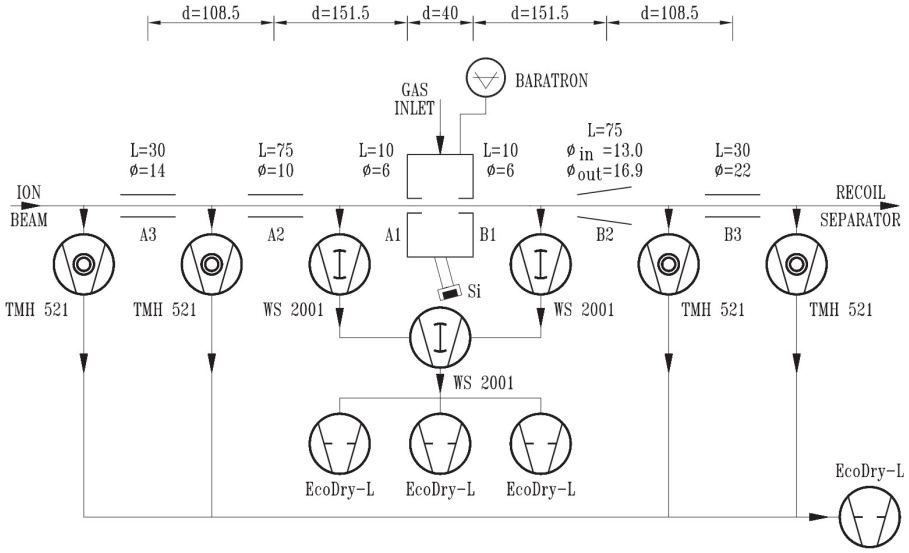
Charge State Selection Magnet (CSSM)

Jet He target

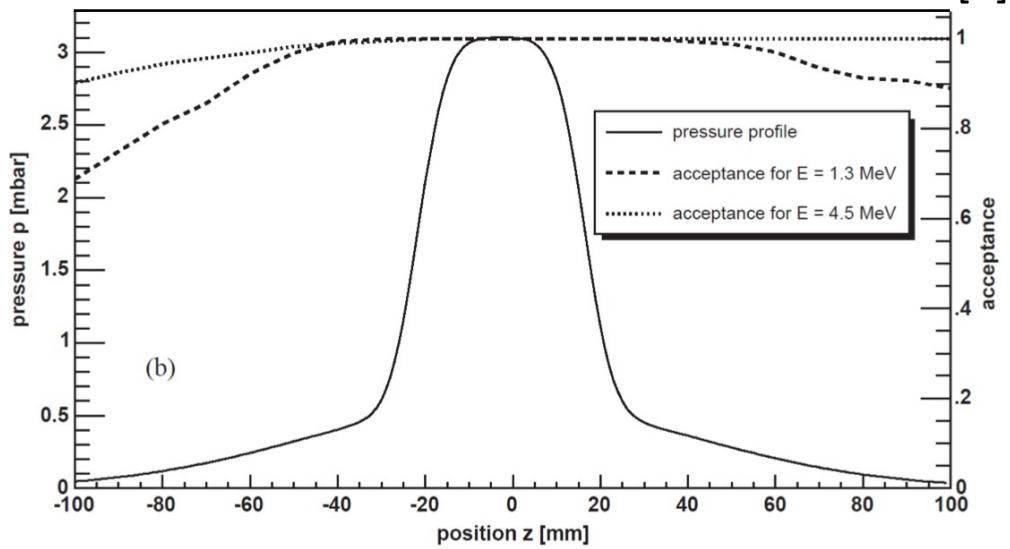
Recoil detector



Extended Gas Target

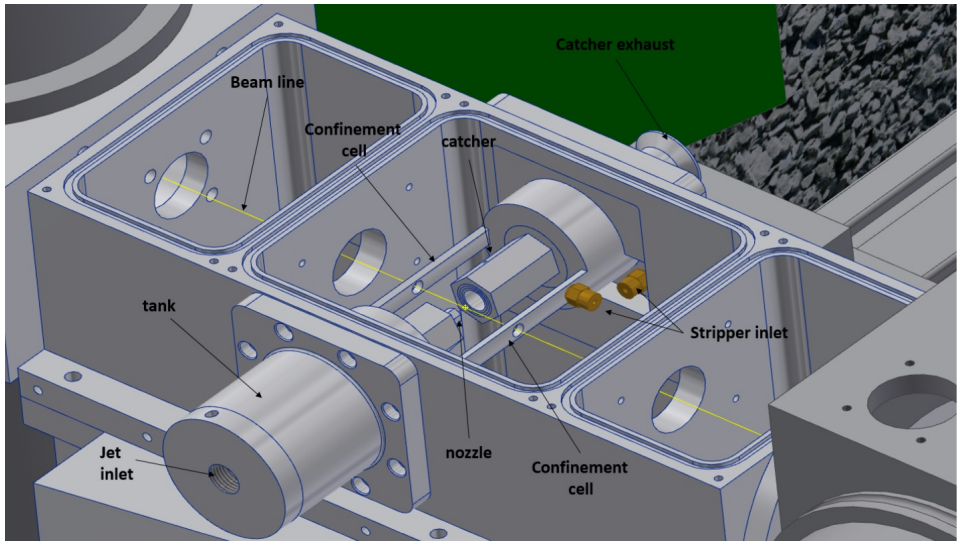


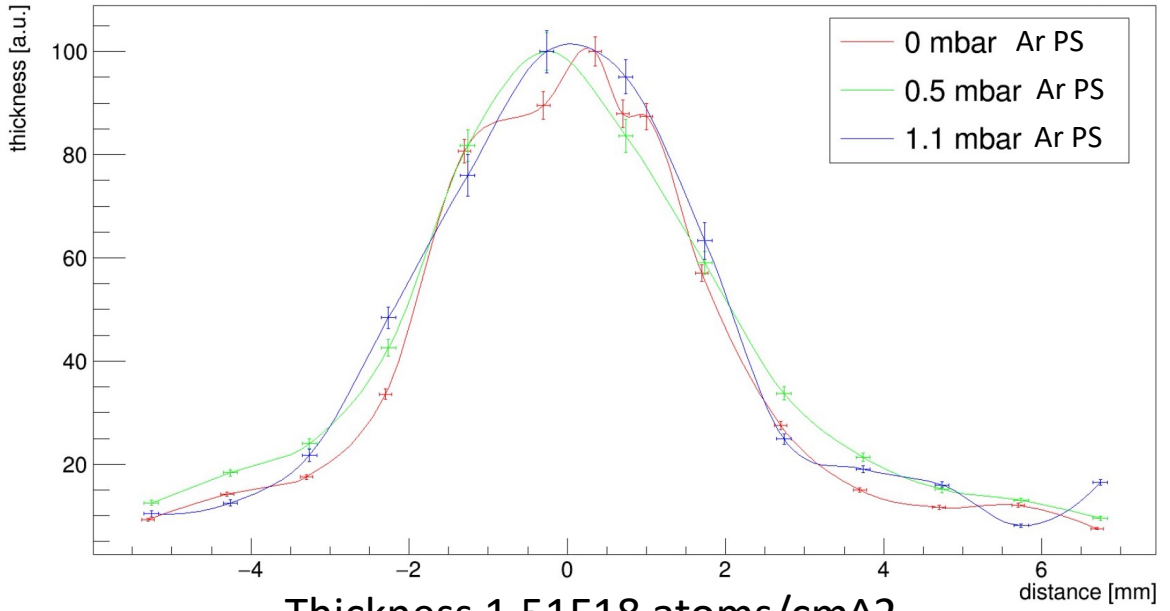
[3]



[3] Gialanella et al. 2004

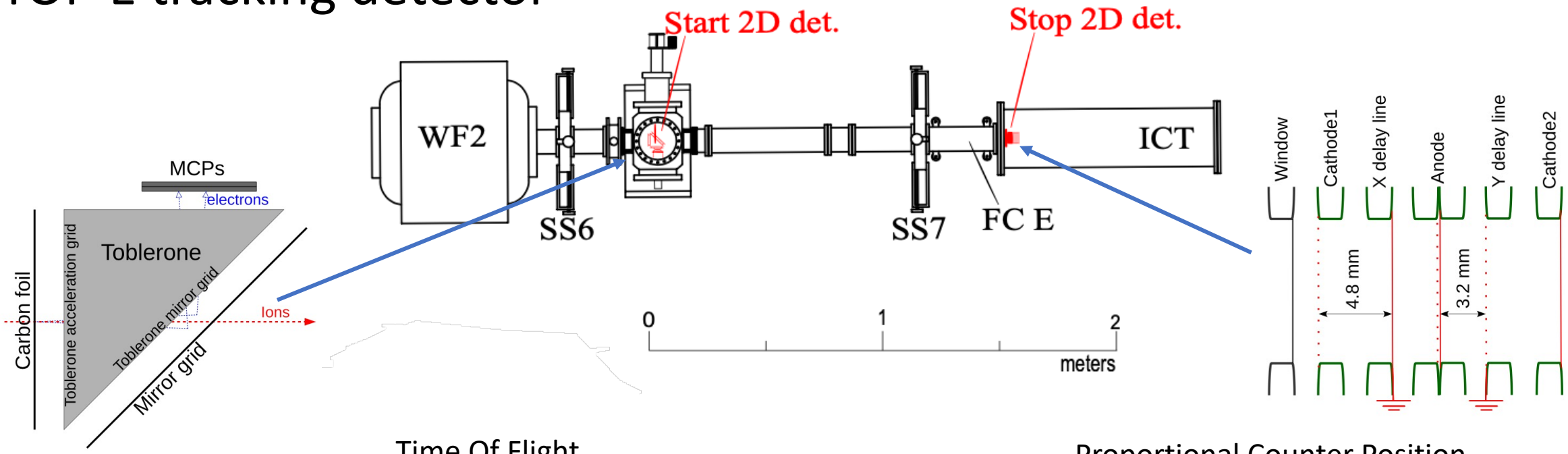
Recirculated He Jet Gas Target



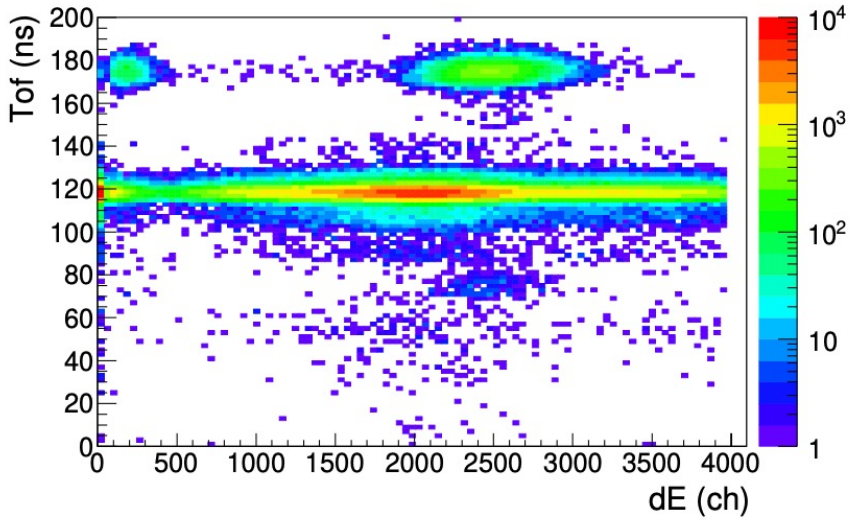


Thickness 1.51E18 atoms/cm^2

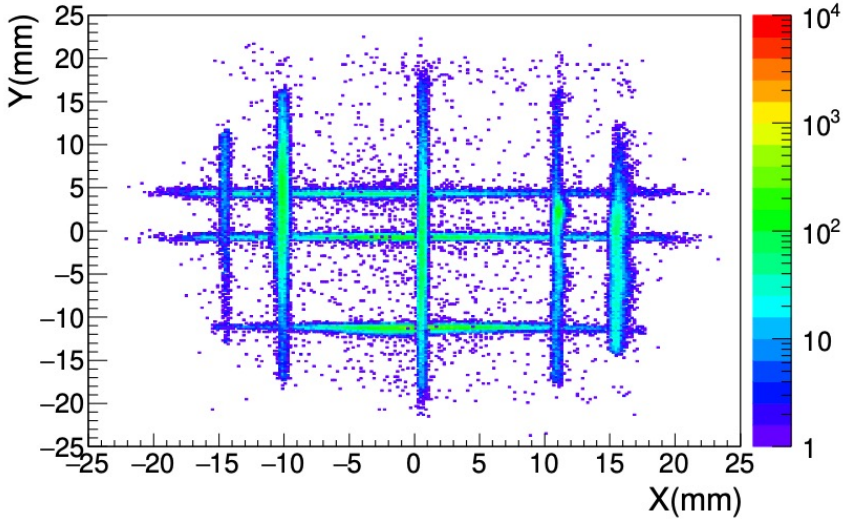
TOF-E tracking detector



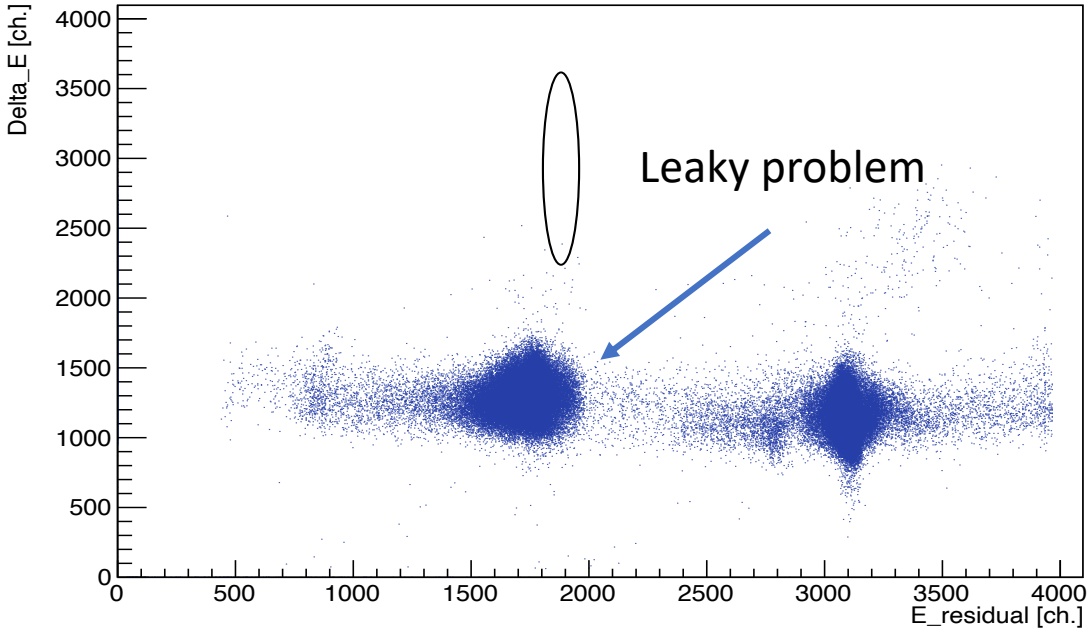
Time Of Flight



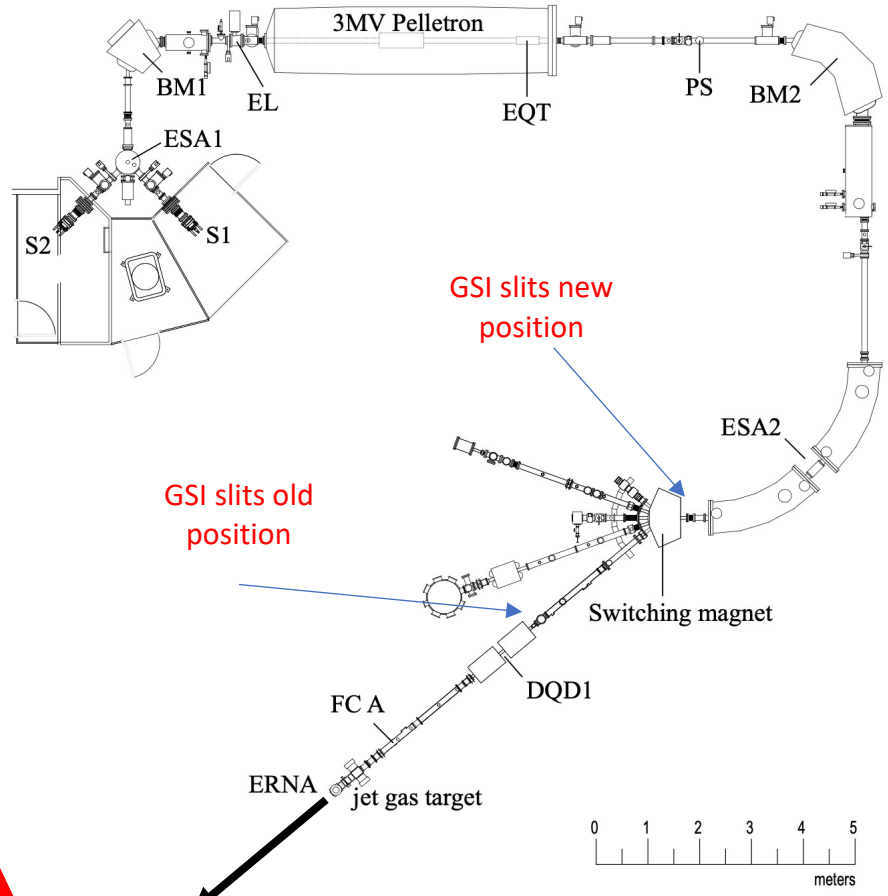
Proportional Counter Position



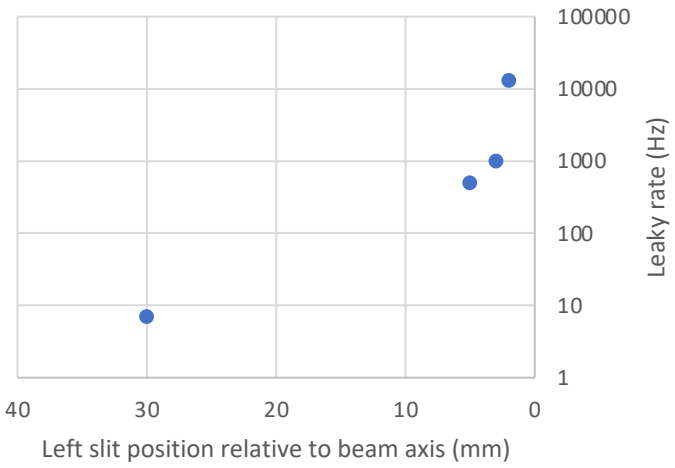
Leaky problem

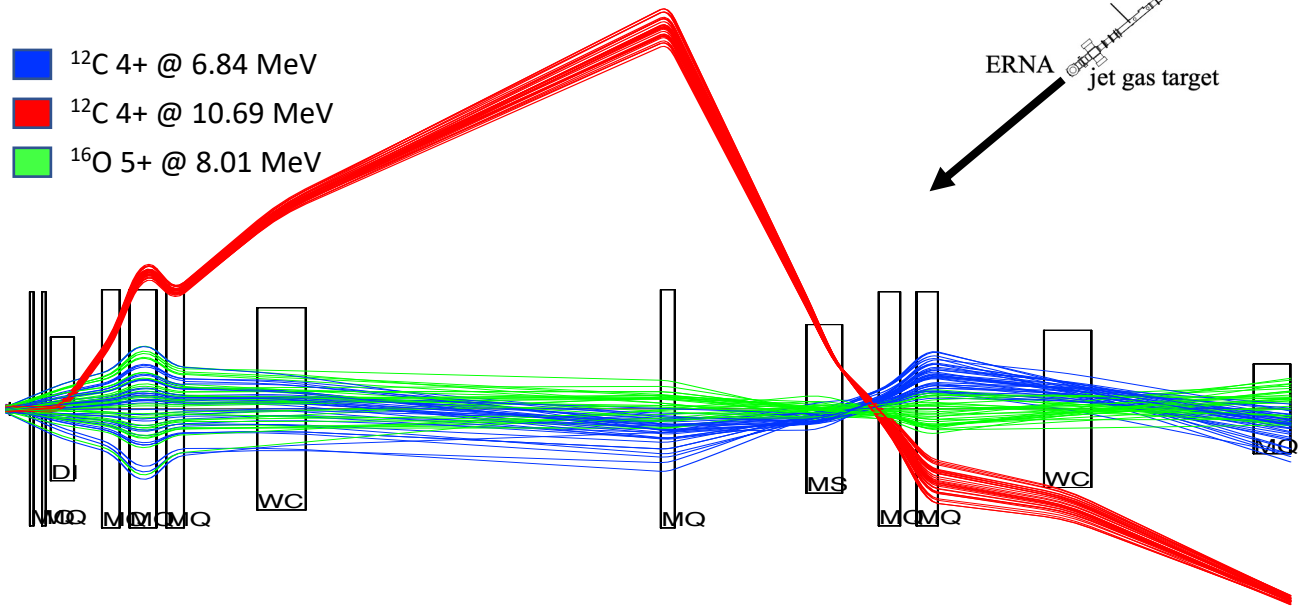


Accelerazione e iniezione

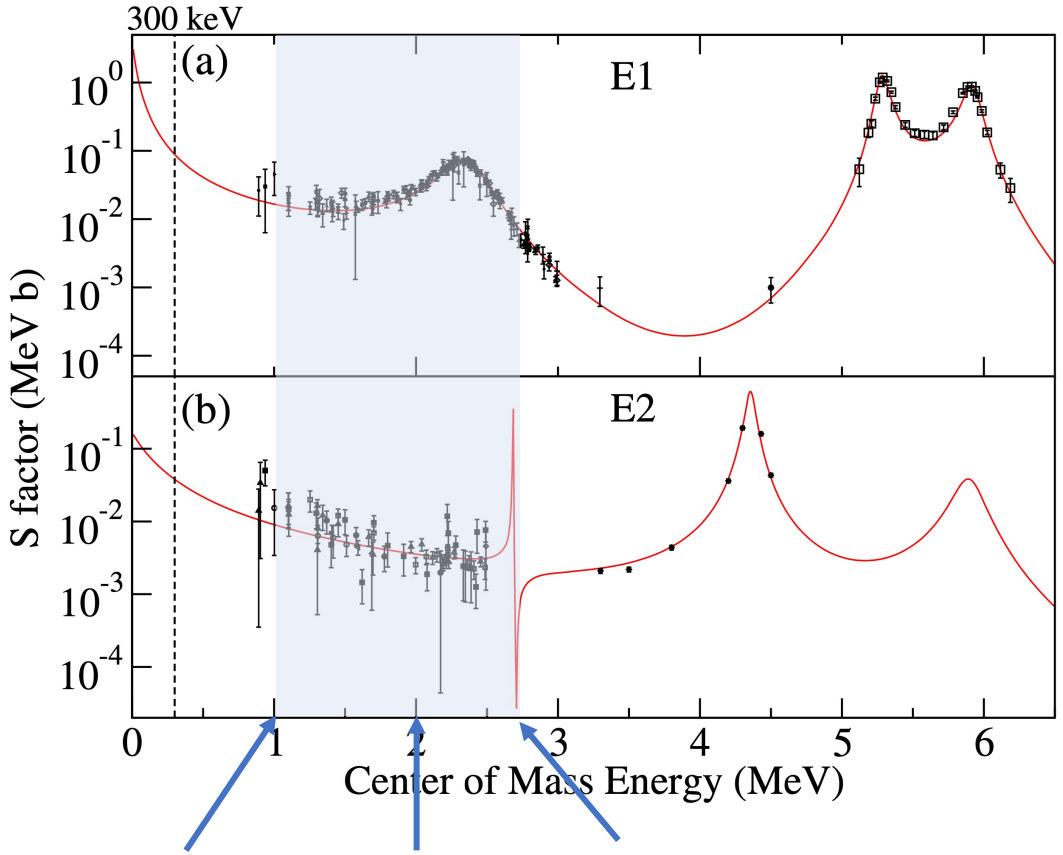


GSI slit test





Commissioning



ERNA tunings: 1 MeV 2 MeV 2.68 MeV

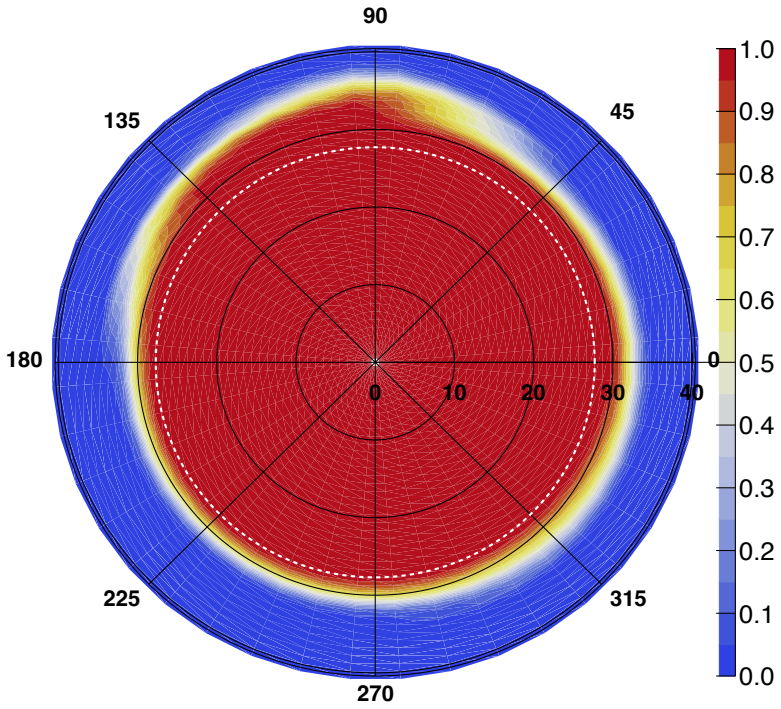
Suppression

1.00 MeV ~ 3.0E-10

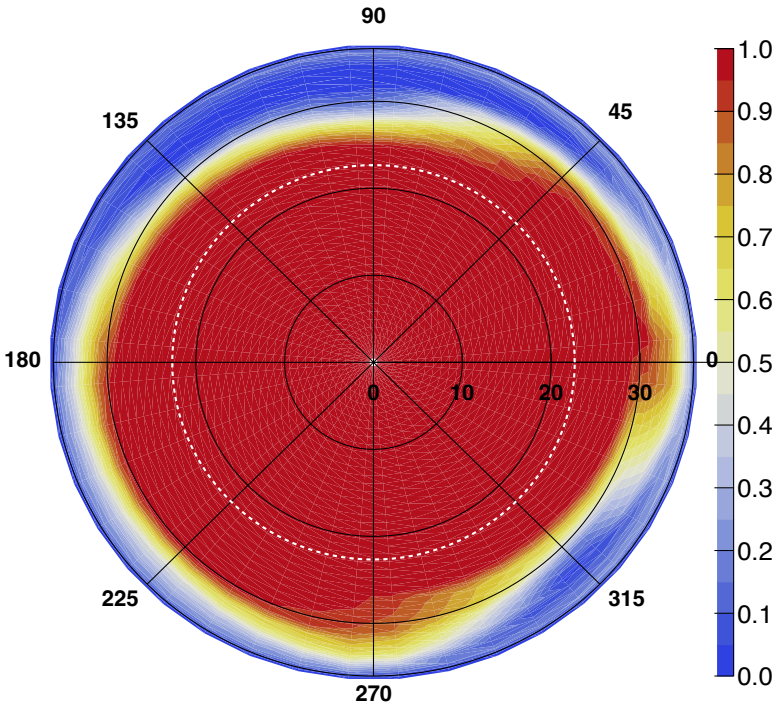
2.00 MeV ~ 1.3E-10

2.68 MeV ~ 3.8E-10

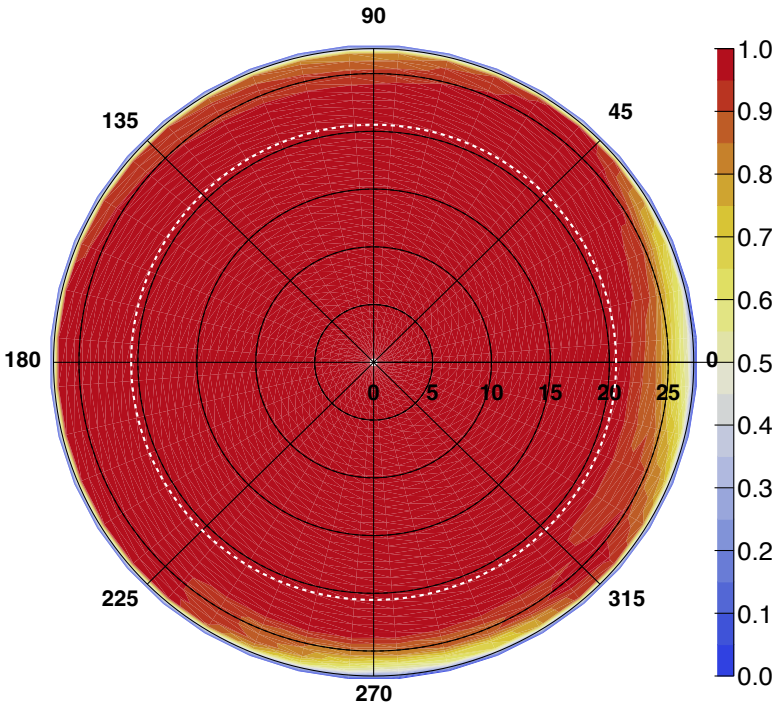
Angular Acceptance Measurements



1.0 MeV

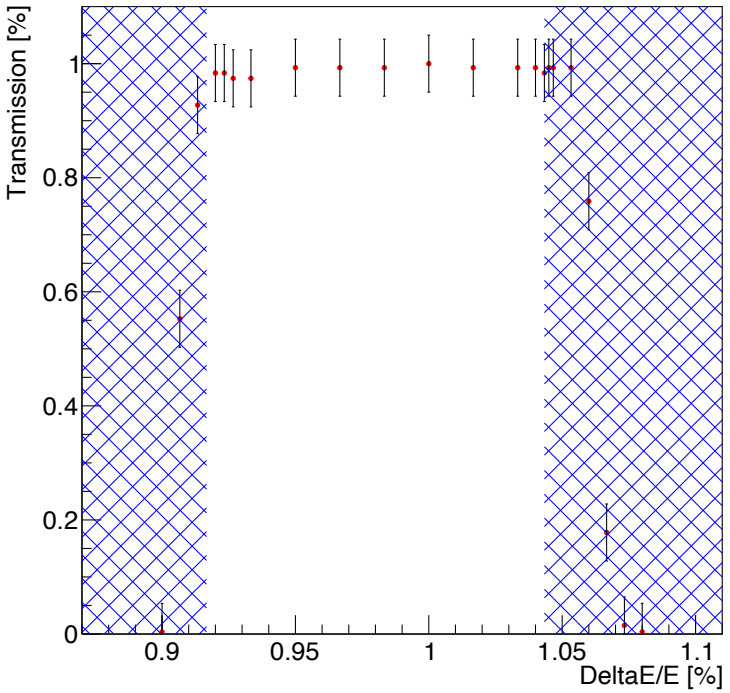


2 MeV

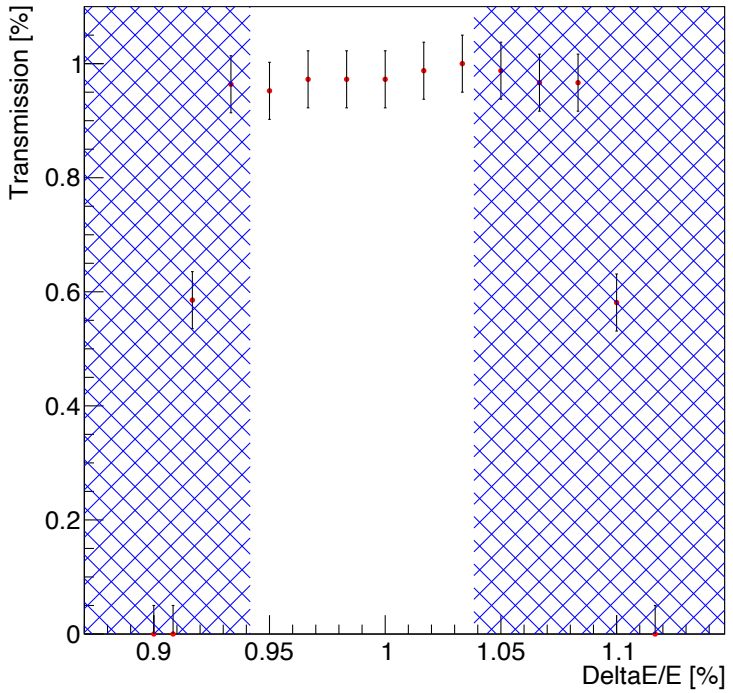


2.68 MeV

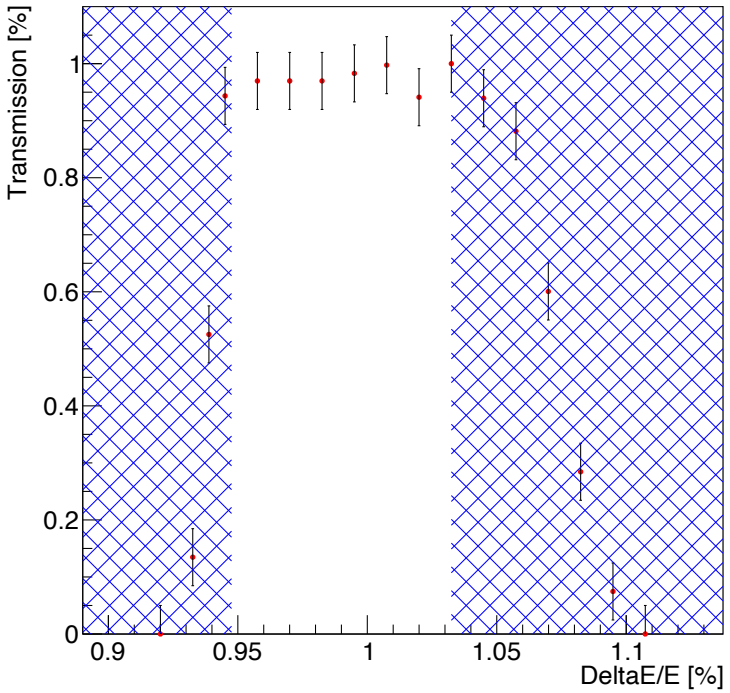
Energy Acceptance Measurements



1.0 MeV

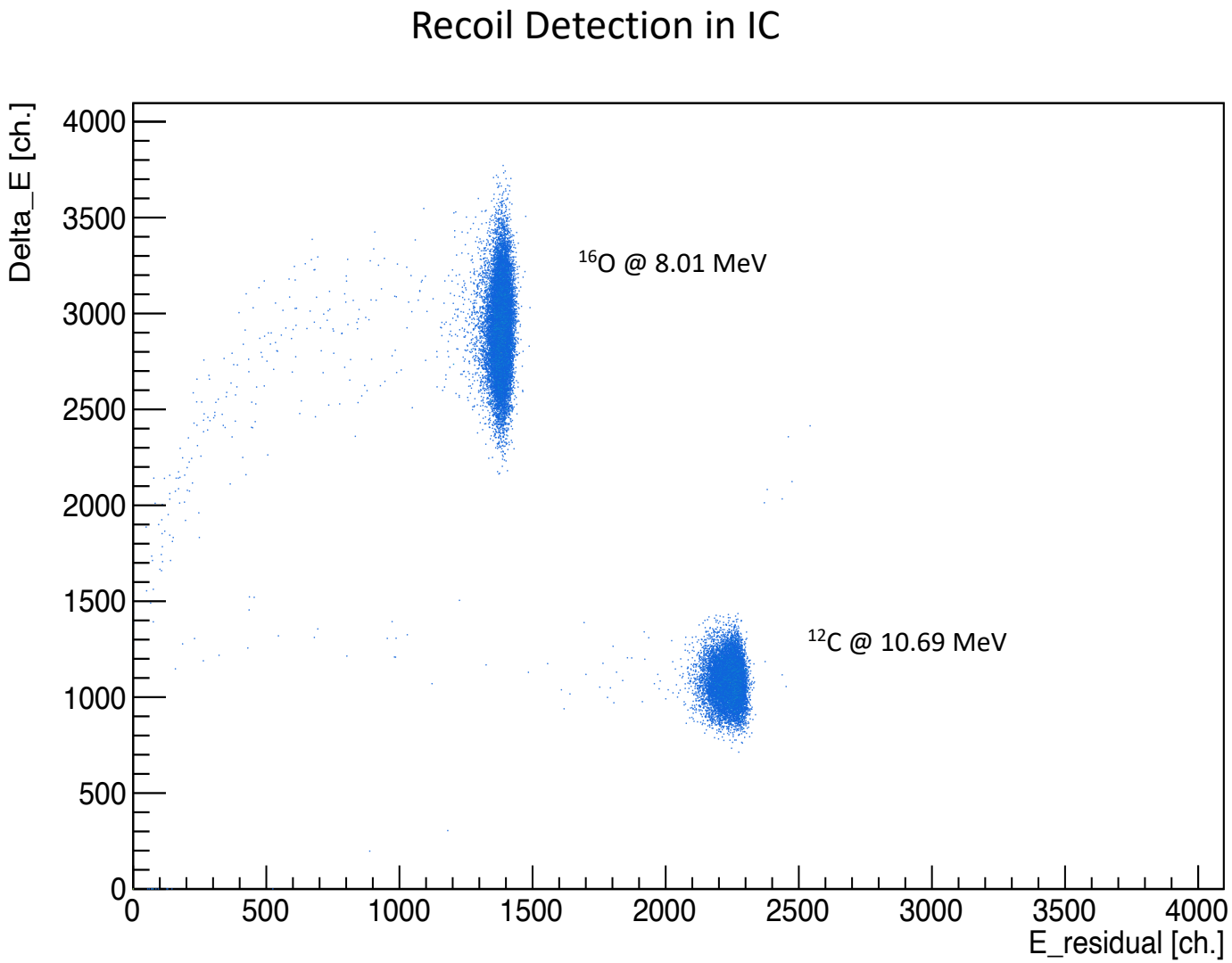


2 MeV



2.68 MeV

Outlooks



Measuring campaign starting on June 2022:

- 1 MeV < E_{cm} < 2.68 MeV
- E1, E2 and cascade contribution

Grazie dell'attenzione

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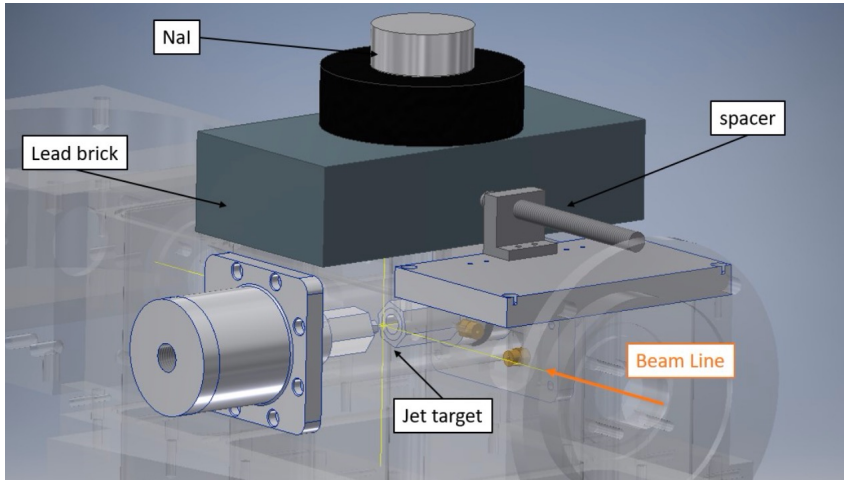
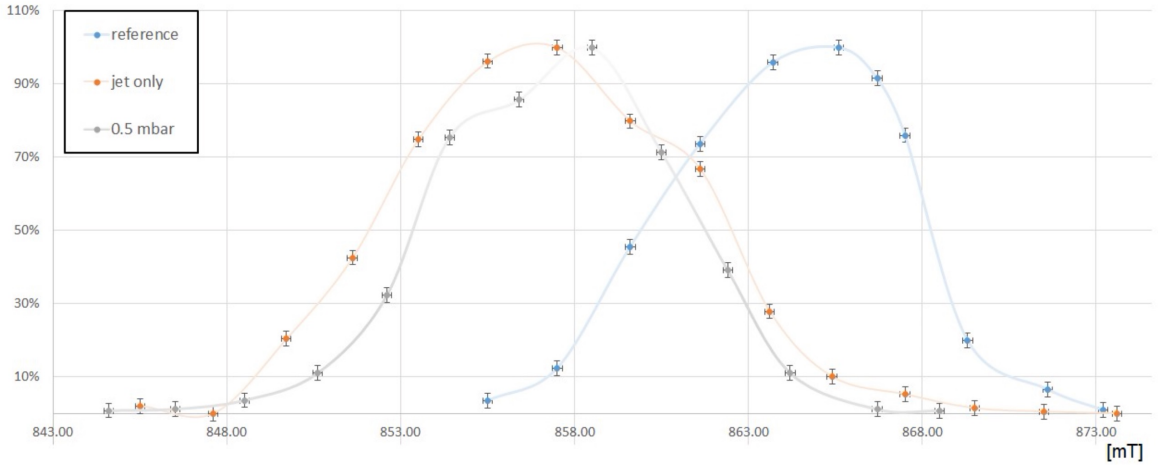
Appendix: JET

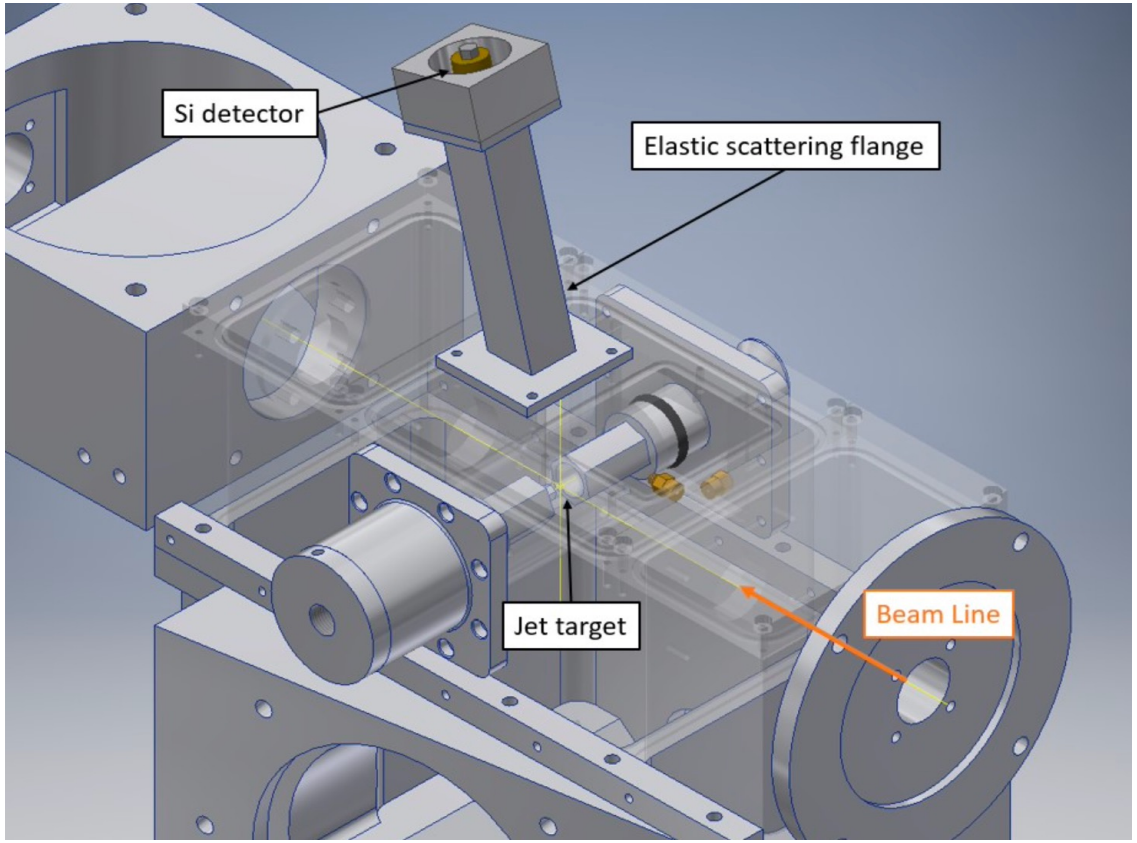
Jet Profile Characterization by 7Li(alpha,alpha')7Li



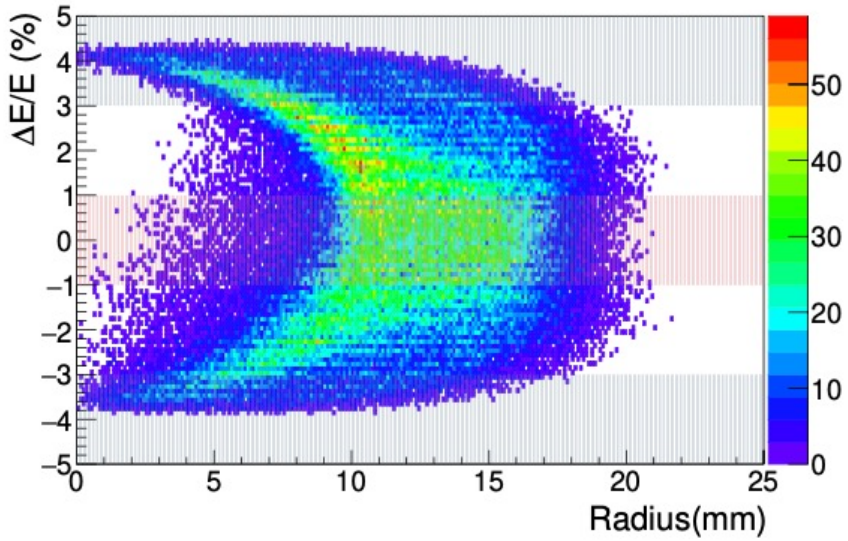
Jet Thickness Characterization

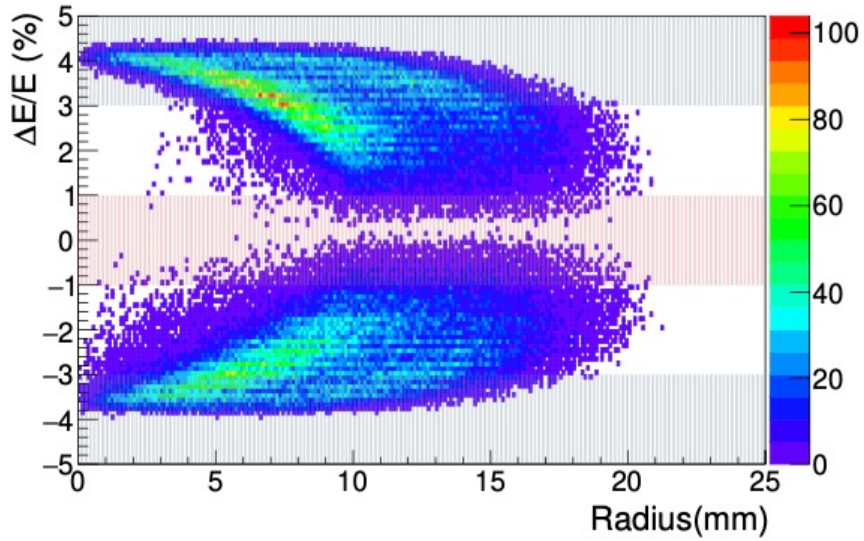


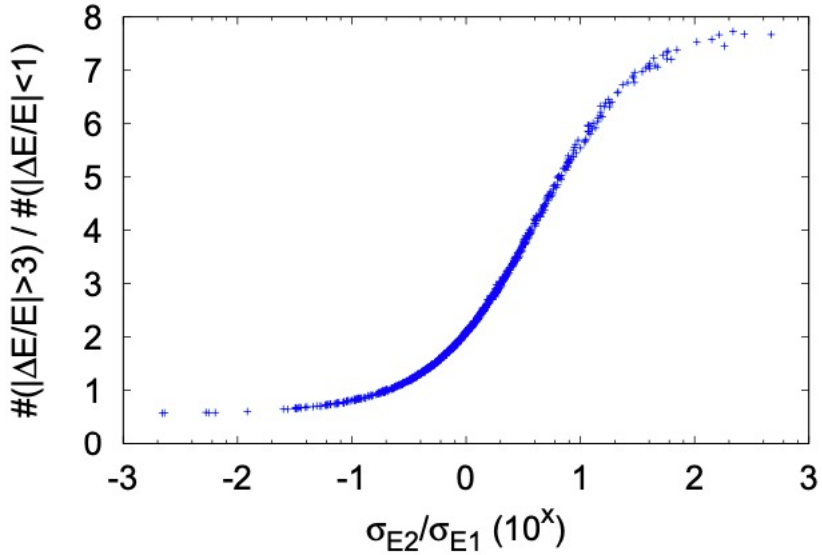
Normalization



Appendix: E2/E1 Discrimination Simulation







Appendix: 2.68 MeV measure simulation

$$\int \frac{d\sigma}{d\Omega} dE = \frac{5\pi\Gamma_{\gamma 0}}{2k_R^2}\left[1 + \frac{5}{7}P_2 - \frac{12}{7}P_4 + a(P_1 - P_3)\right] = \frac{5\pi\Gamma_{\gamma 0}}{2k_R^2} W(cos(\theta)).$$

a is given by

$$a = -\frac{3k_R}{5}\sqrt{\frac{\Gamma_\alpha \sigma_{E1}}{\pi\Gamma_{\gamma 0}}} sin\phi_0$$