

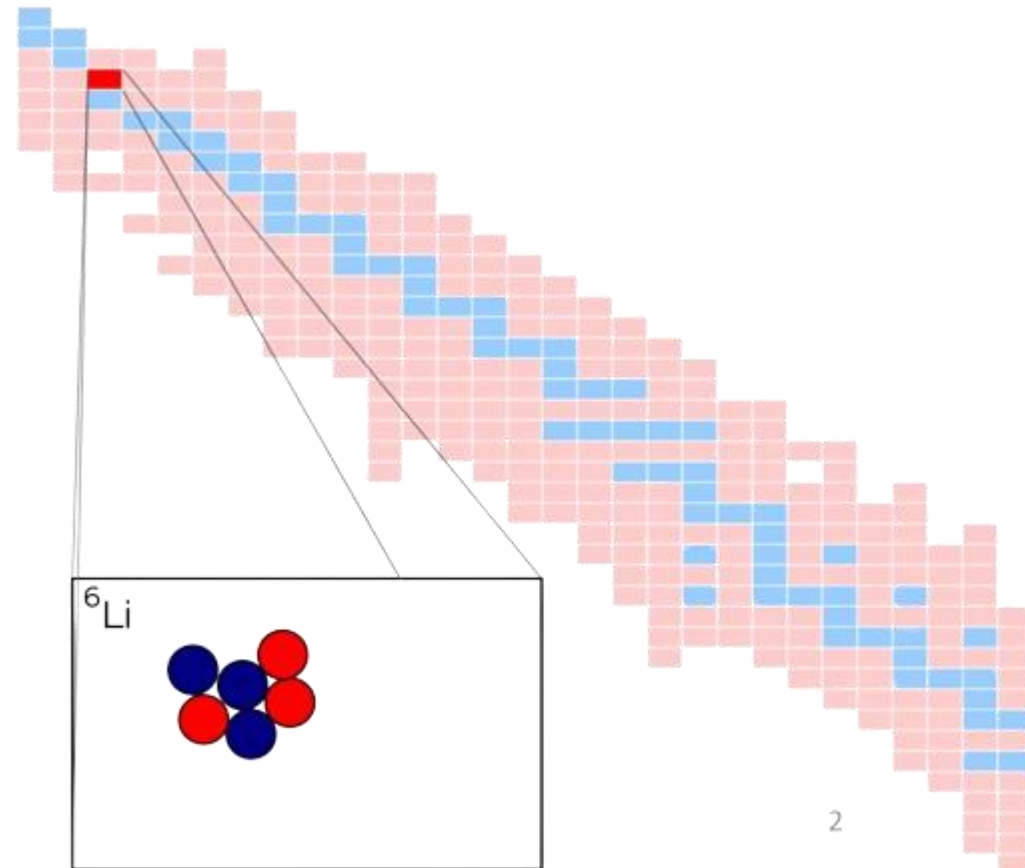
Young Researchers & Young Engineers Days - 2024

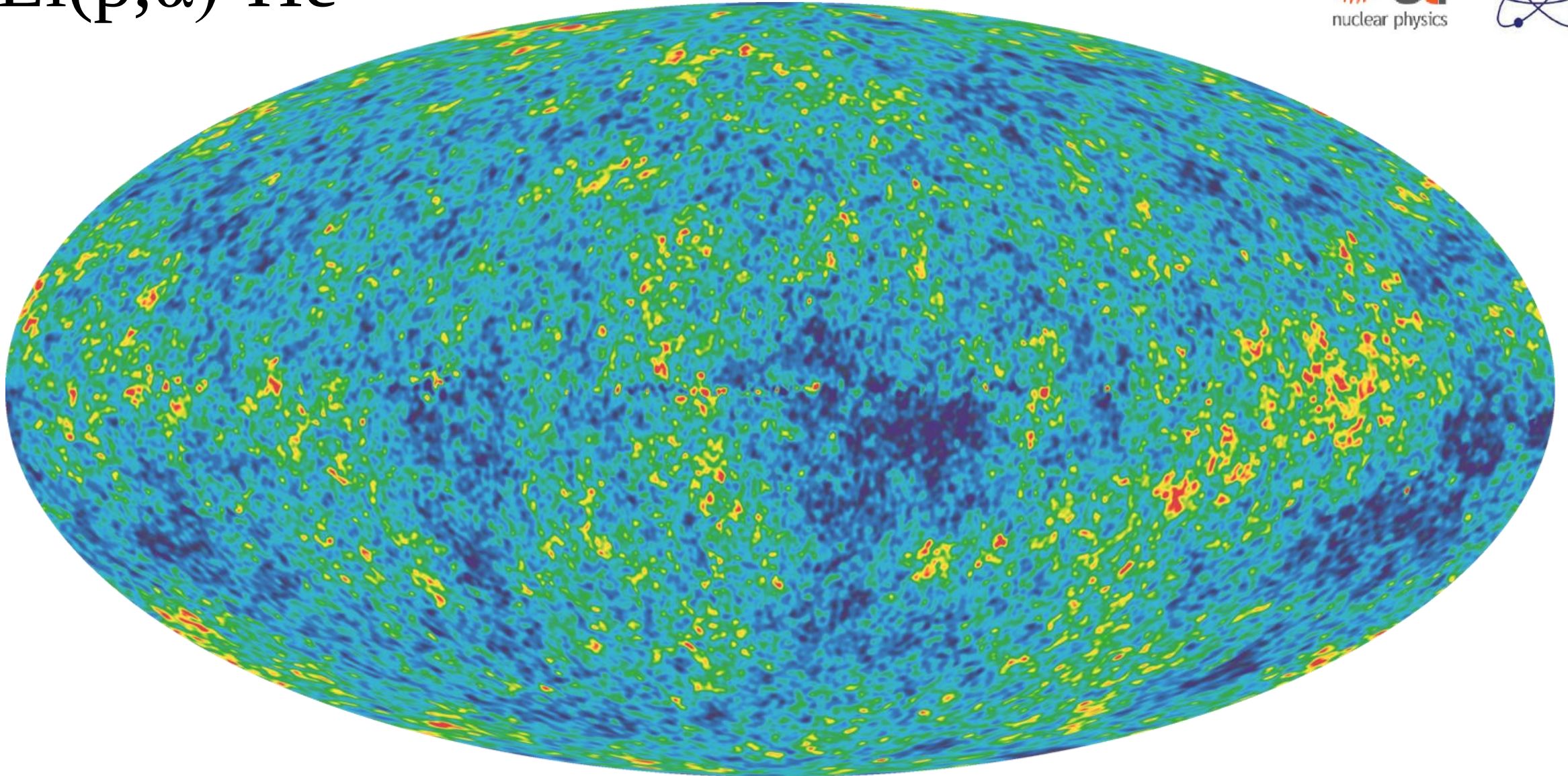
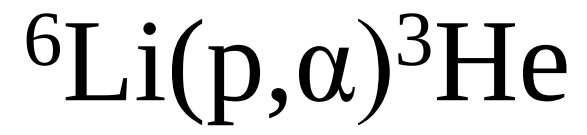
The Cosmological Lithium Problem

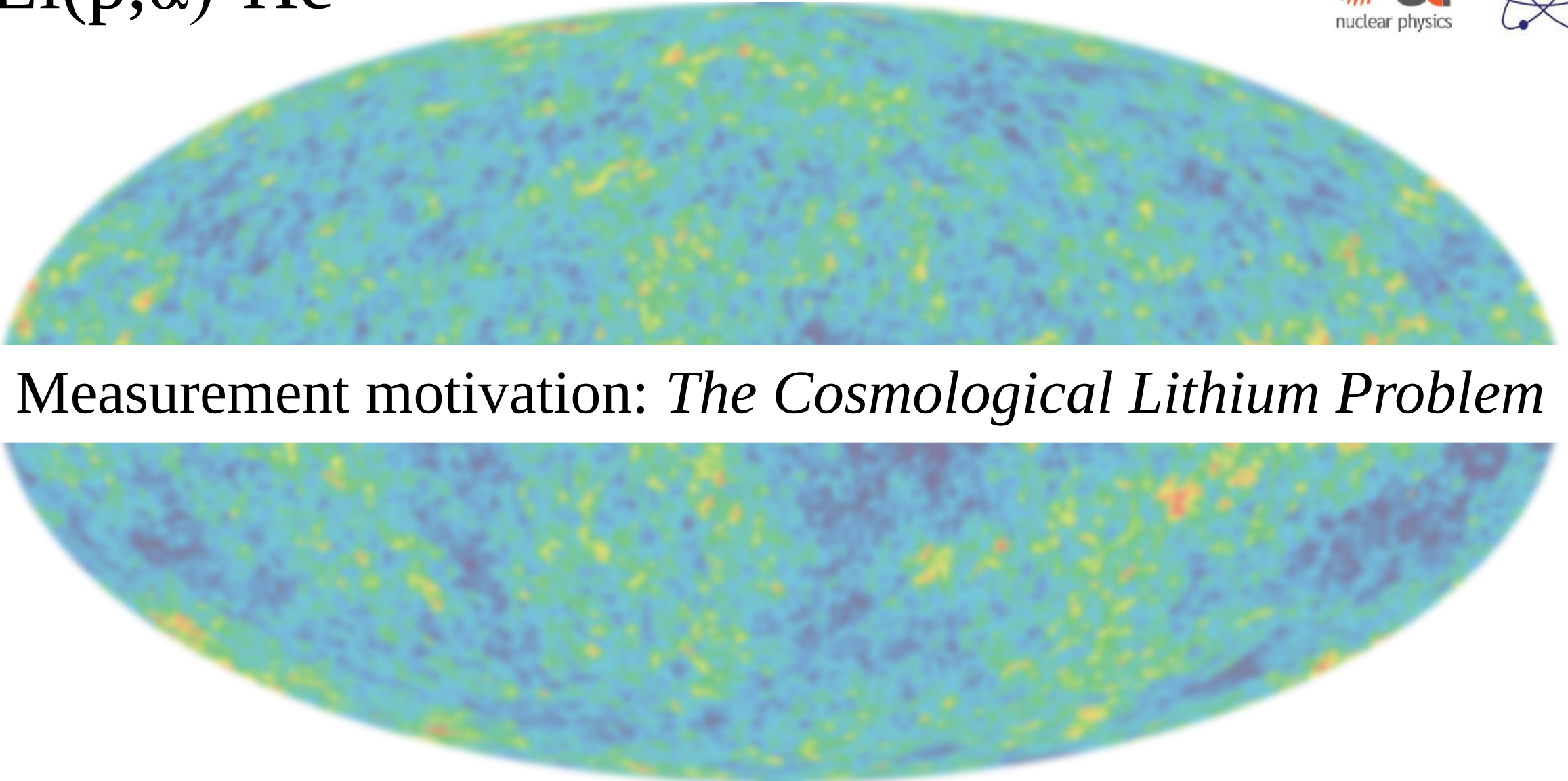
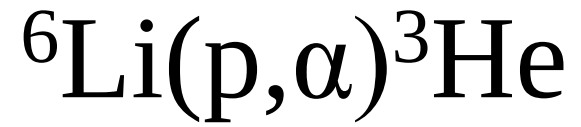
Direct measurement and study of the ${}^6\text{Li}(p,\alpha){}^3\text{He}$ reaction

Overview

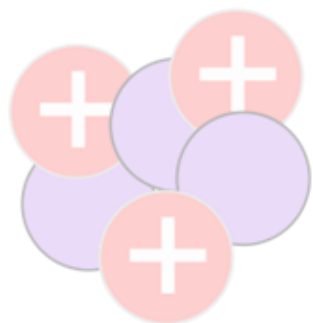
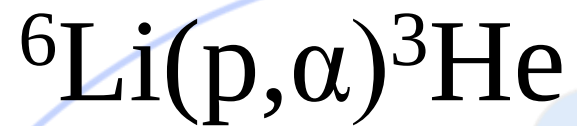
1. Measurement motivation: *The Cosmological Lithium Problem*
2. Detection set-up
3. The experiment
4. Conclusions and expectations
(+ some preliminary results)







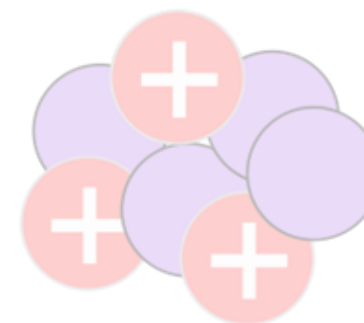
Measurement motivation: *The Cosmological Lithium Problem*



Li⁶

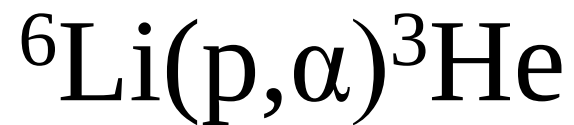
**More light lithium in old stars
than predicted by BBN?**

Which Li problem?

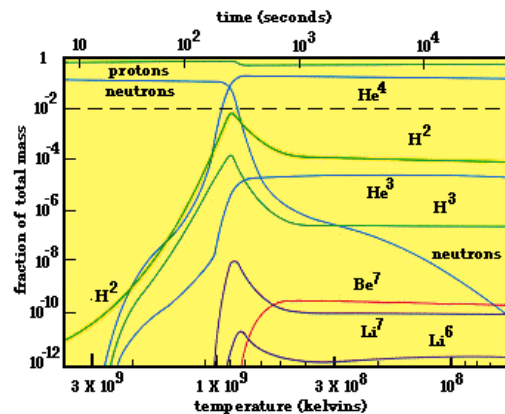


Li⁷

**Less lithium-7 in old stars
than predicted?**



Big Bang



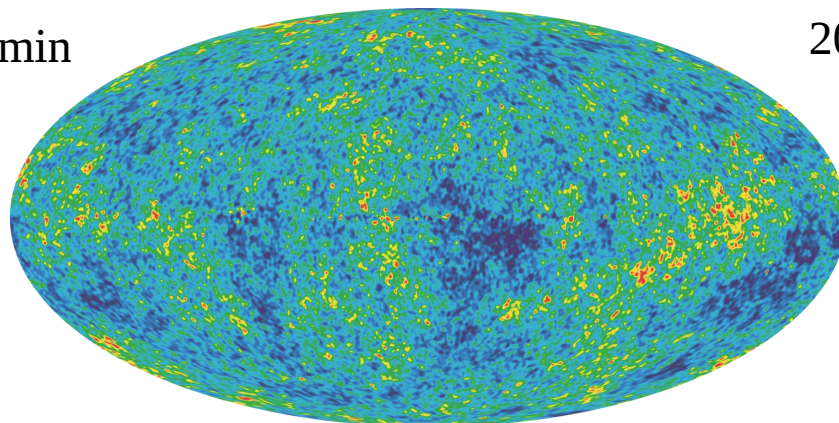
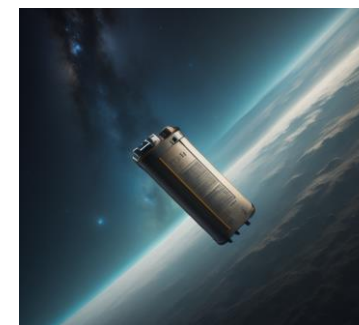
380 000 yr

galaxy formation



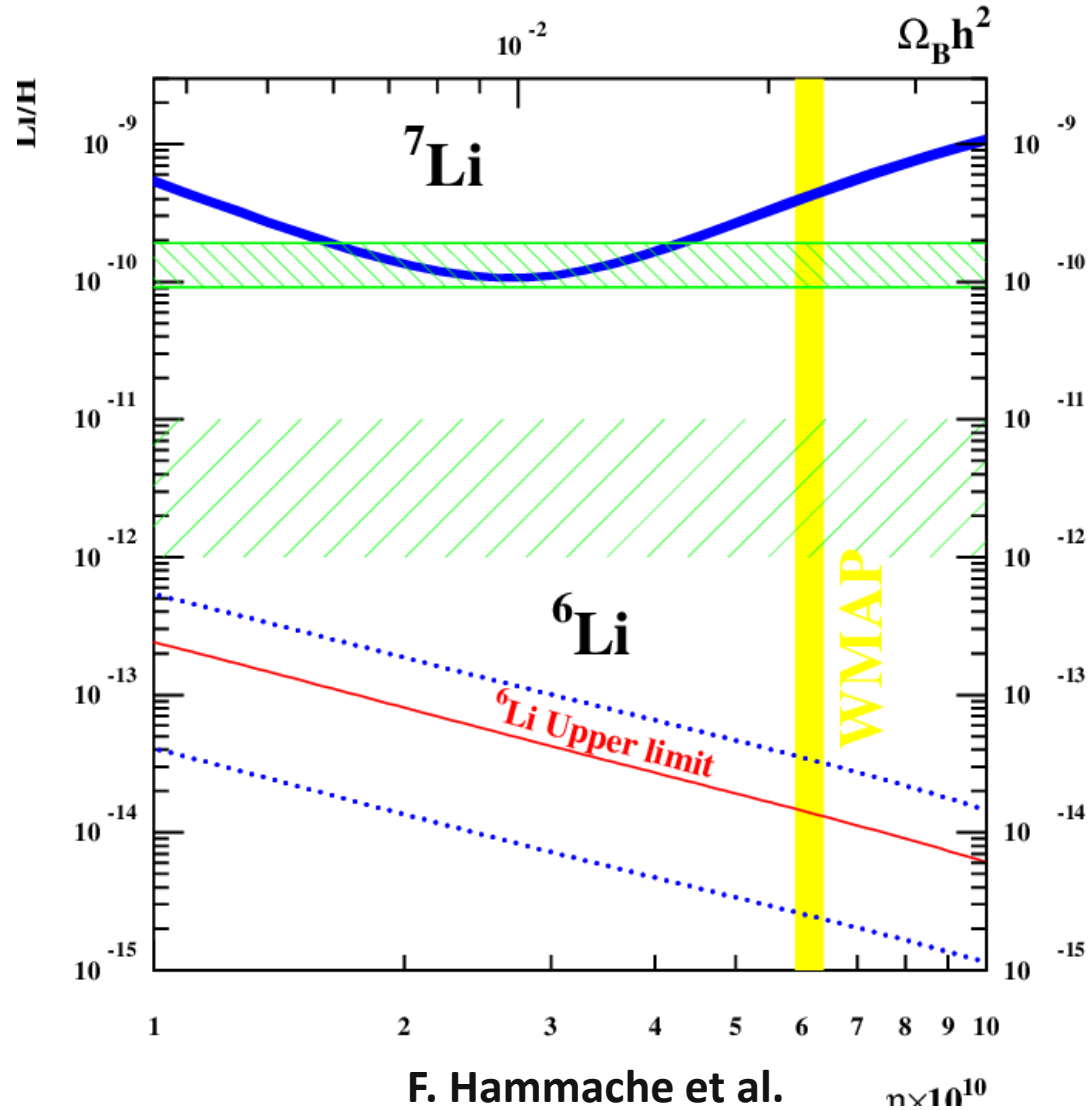
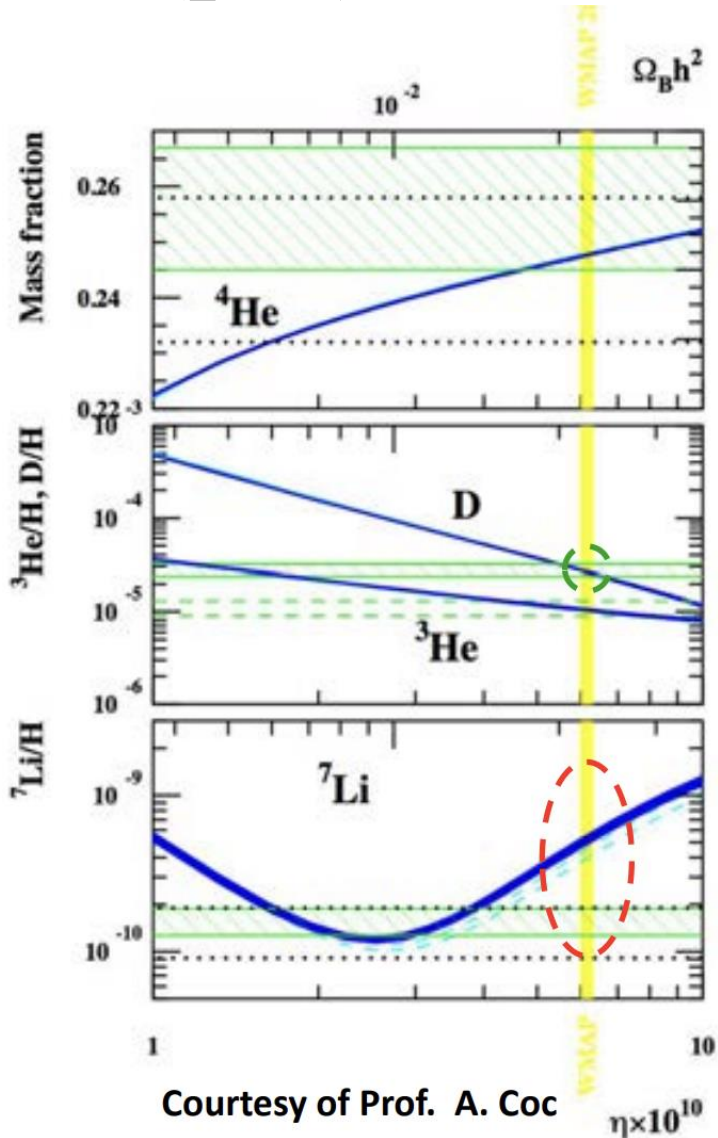
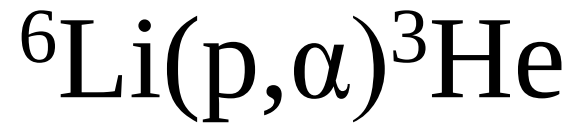
9 Gyr

Lithium battery



Cosmic Microwave Background





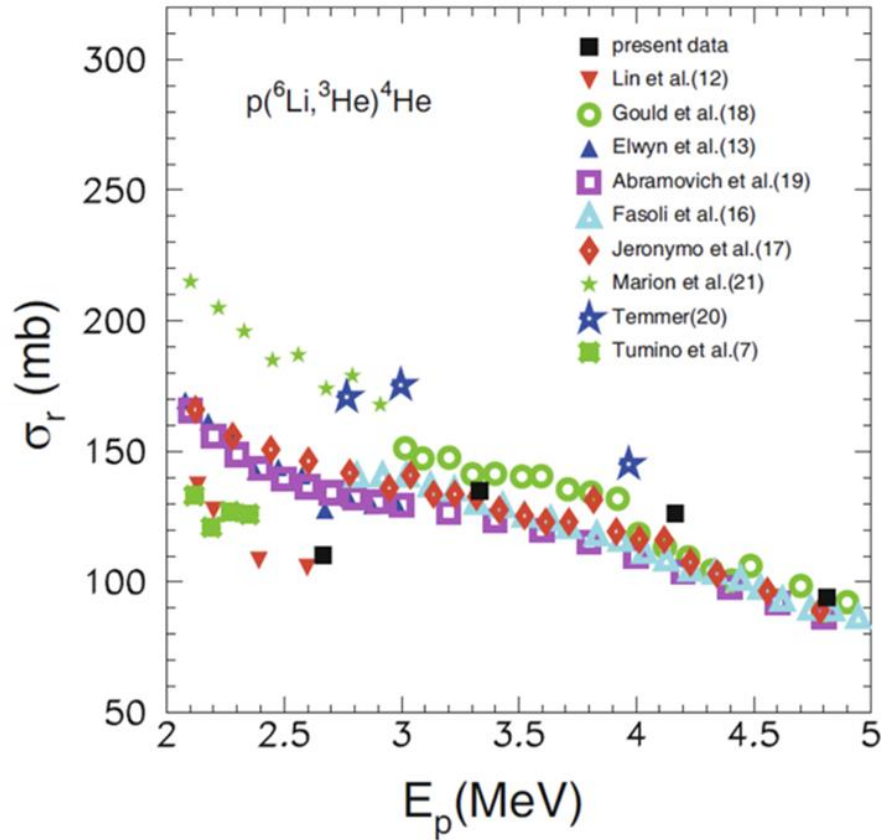
How do we approach this problem?

1. Astrophysical solutions
2. Nuclear physics
3. Solutions beyond the Standard Model

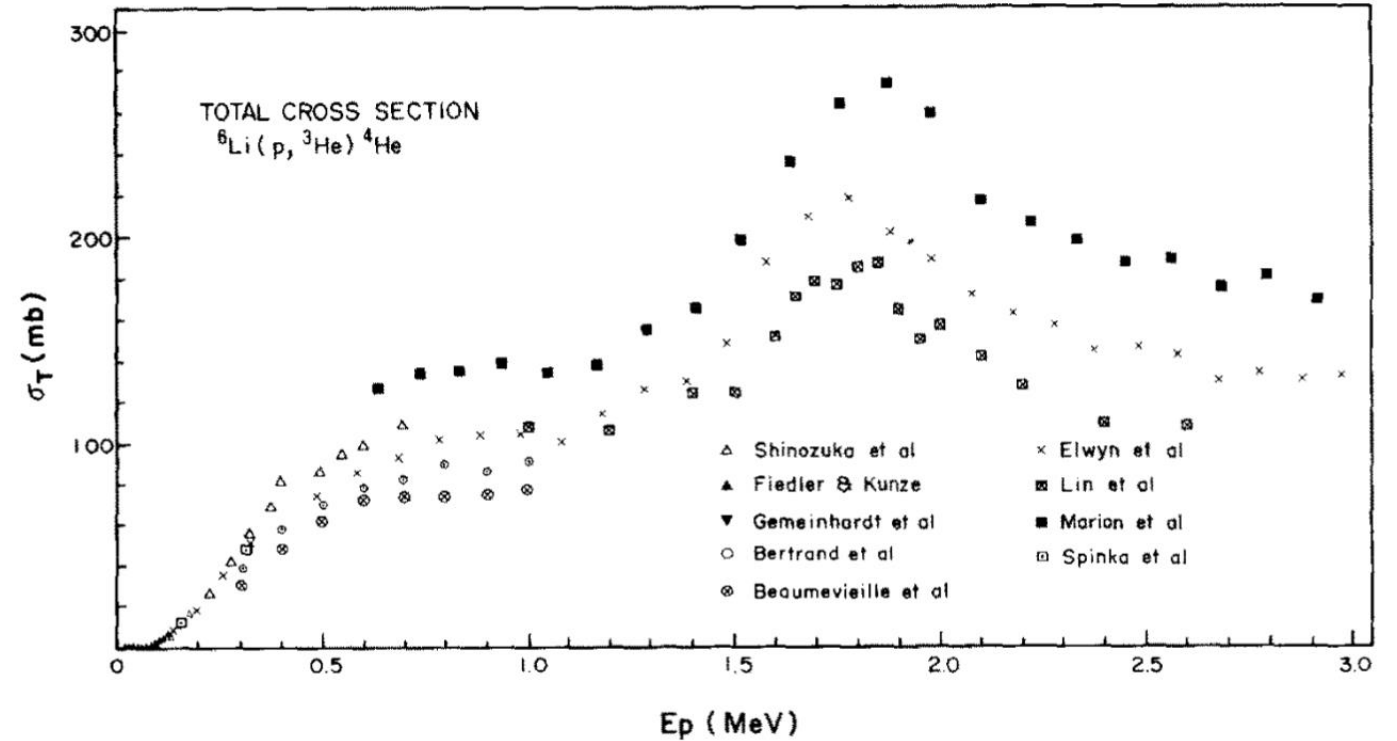


${}^6,{}^7\text{Li}$ abundance as a function of the baryonic density of the Universe.

${}^6\text{Li}(p,\alpha){}^3\text{He}$

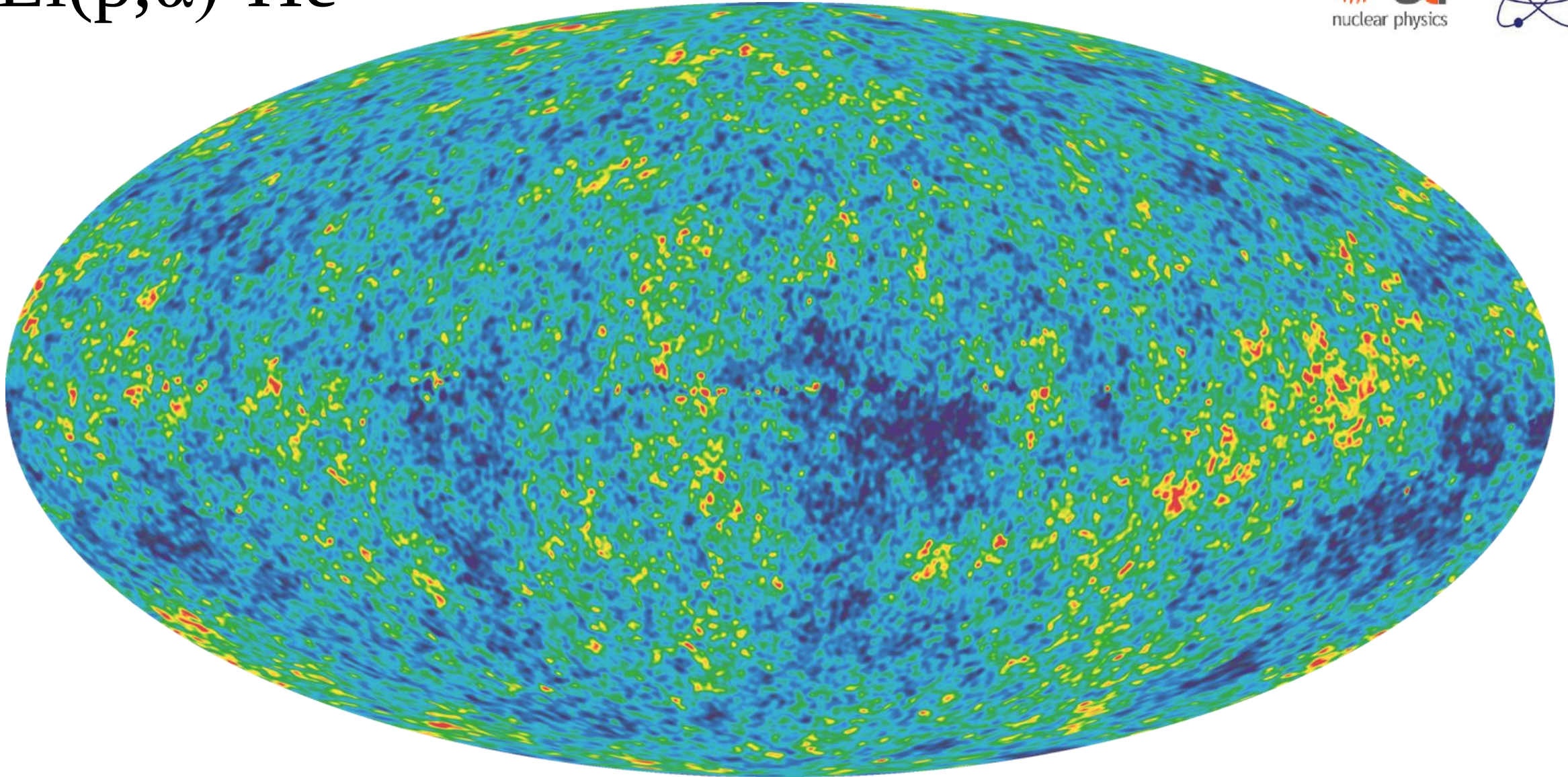
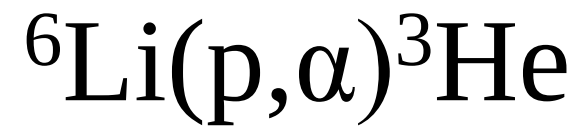


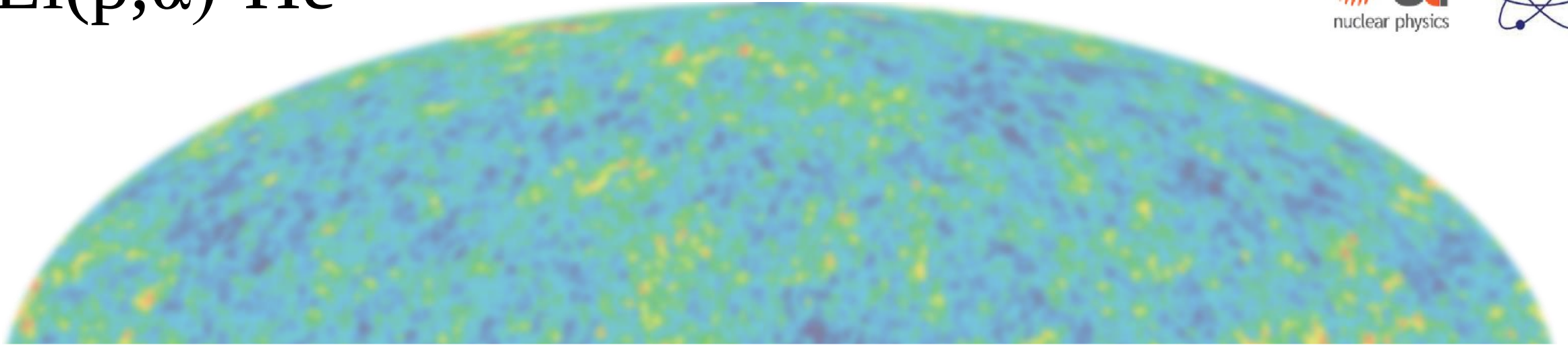
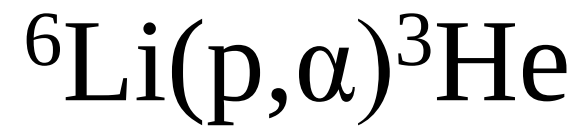
J.U. Kwon et al. / ${}^6\text{Li}(p, {}^3\text{He}){}^4\text{He}$



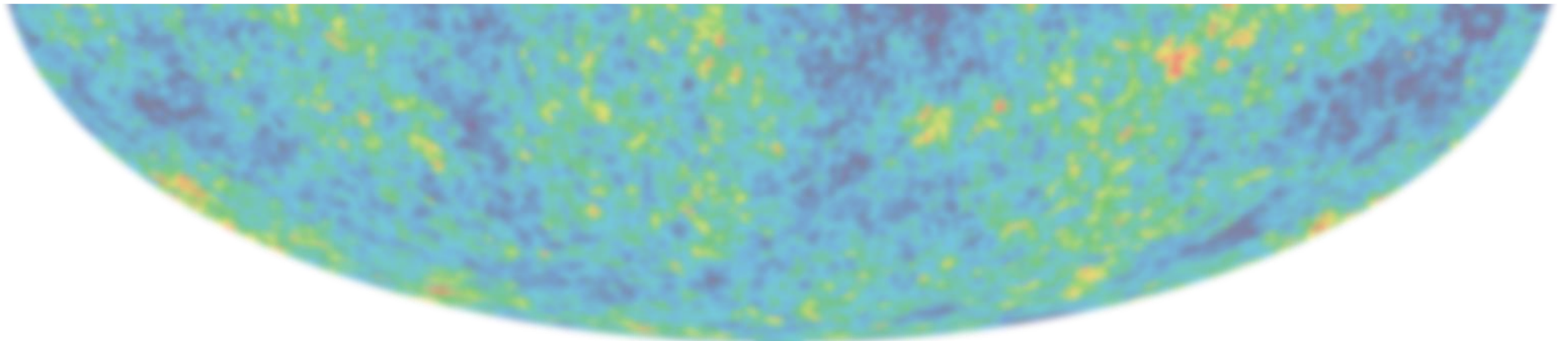
Discrepancies arise below $E_p = 3\text{MeV}$

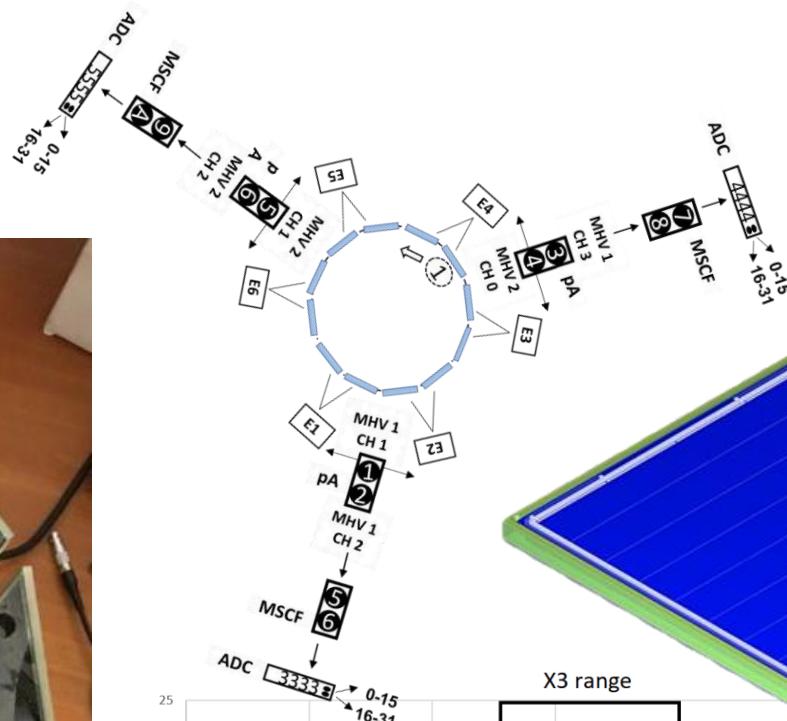
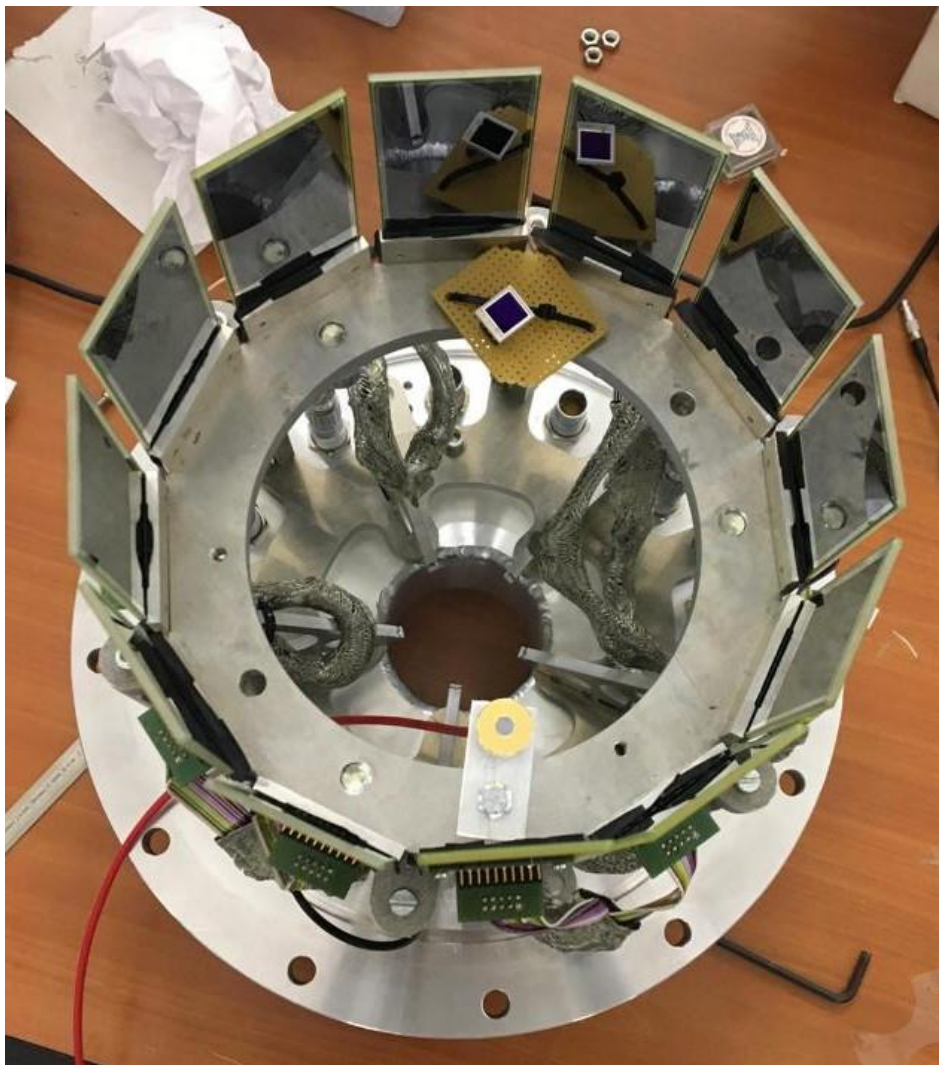
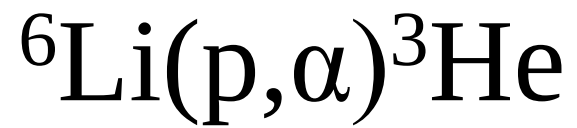
Present reaction cross-section measurements as a function of energy (© Ch. Betson et al.).



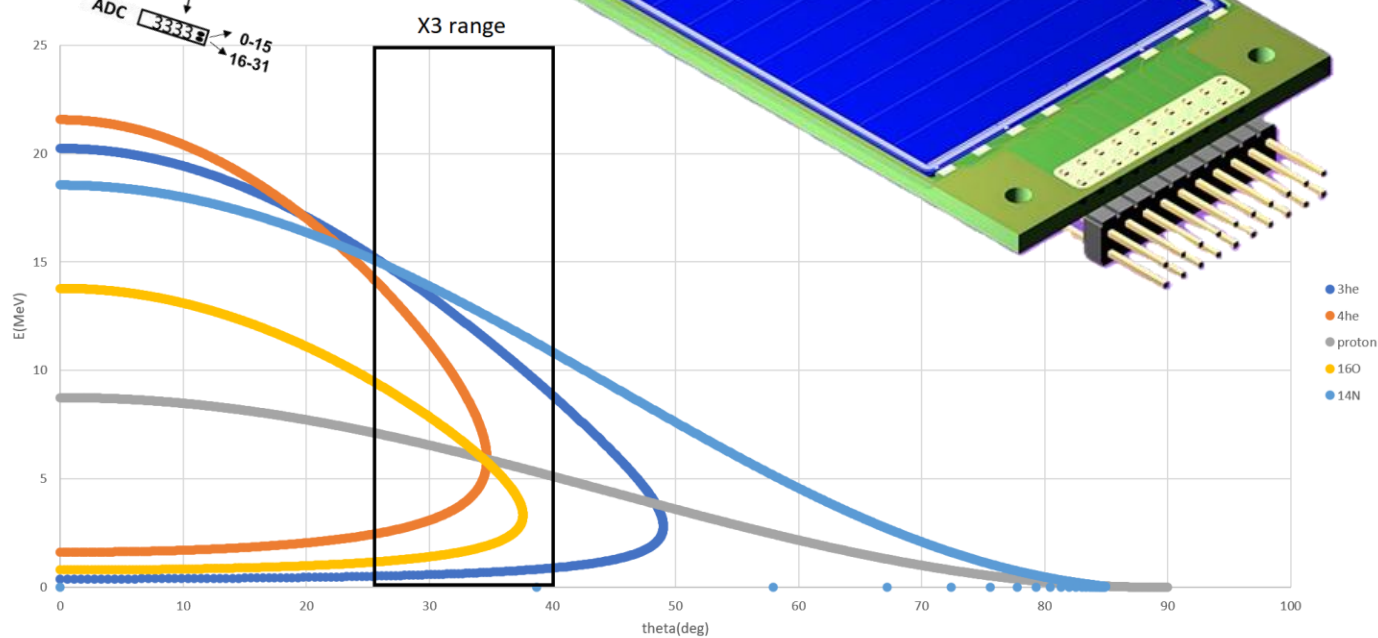


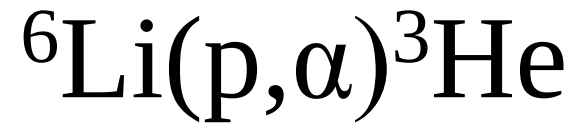
Detection set-up





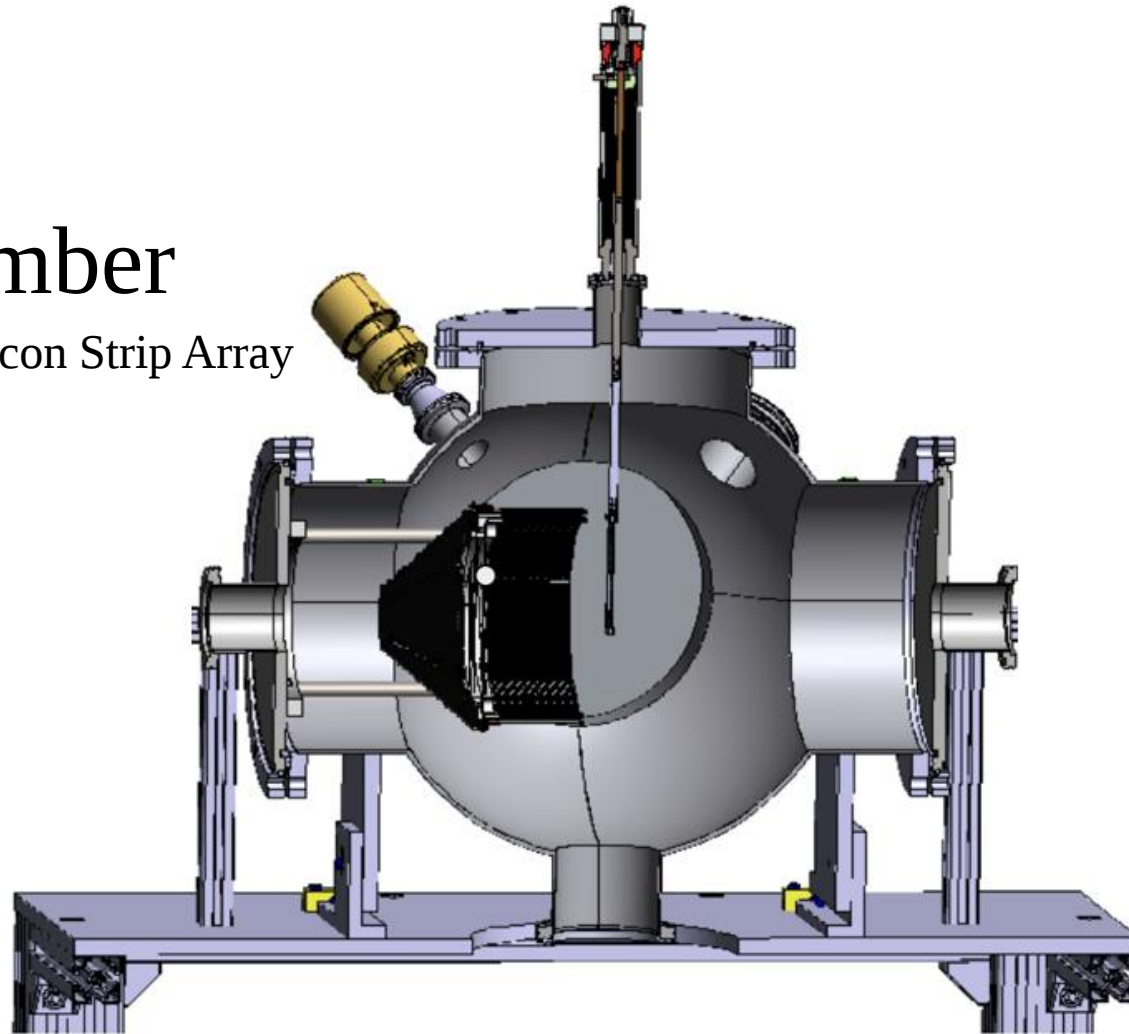
Position sensitive silicon
strip X3 detector

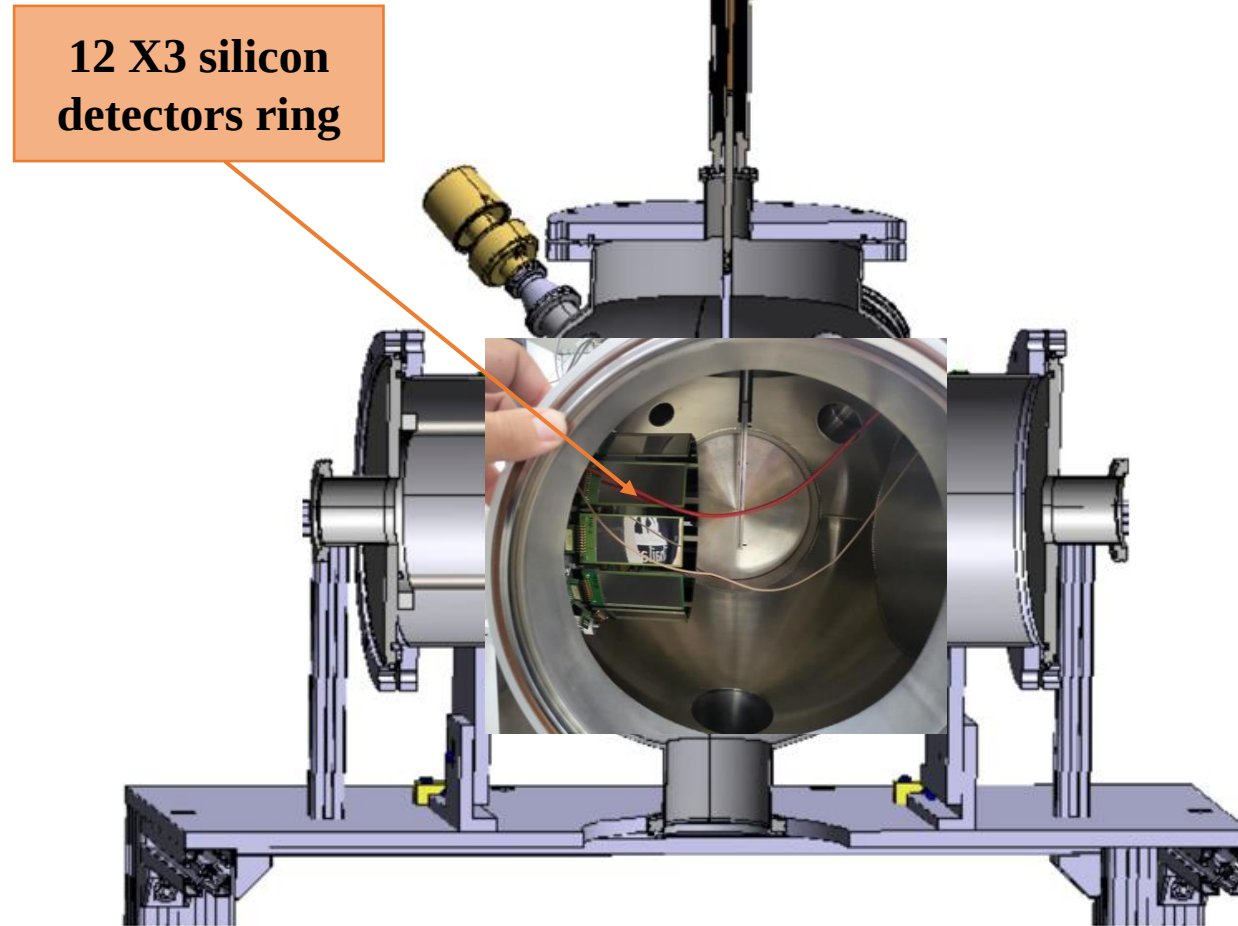
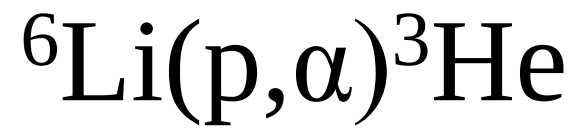


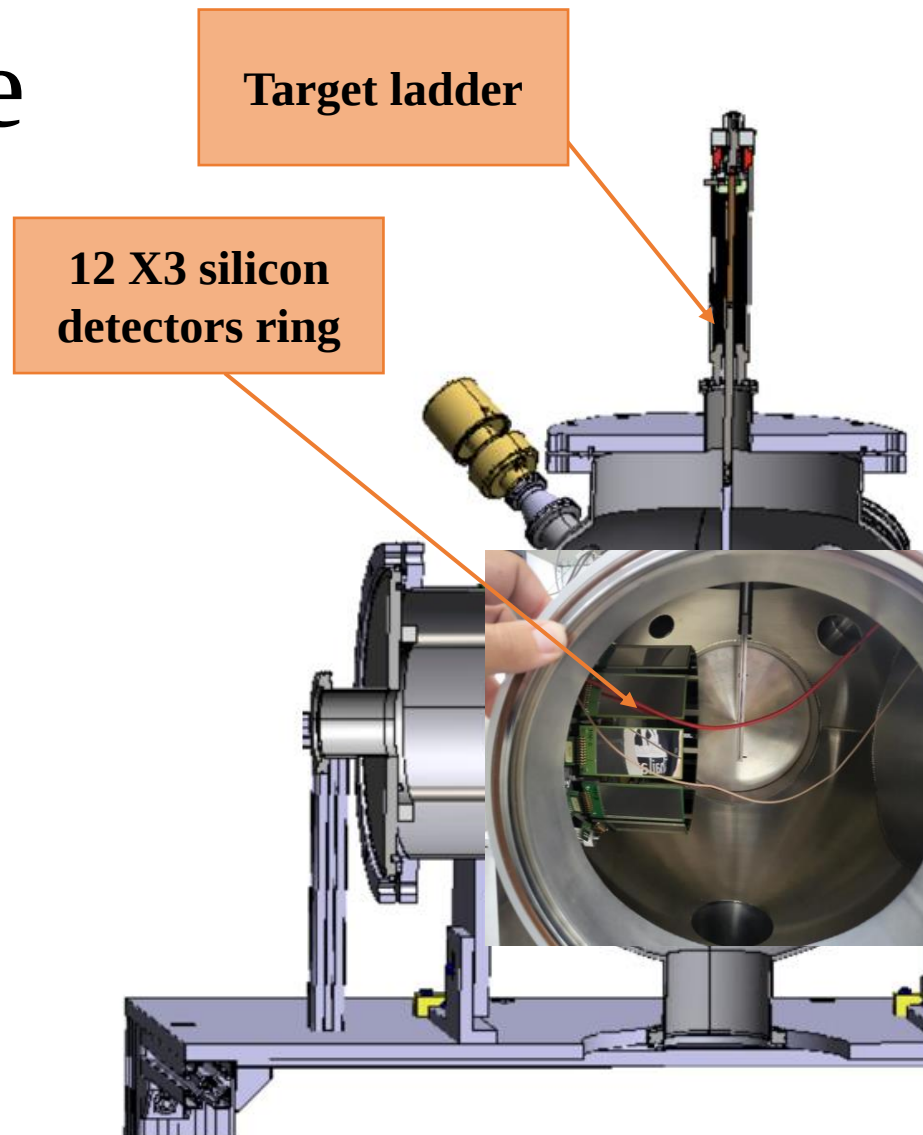
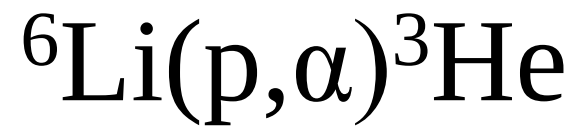


ELISSA Chamber

Extreme Light Infrastructure Silicon Strip Array



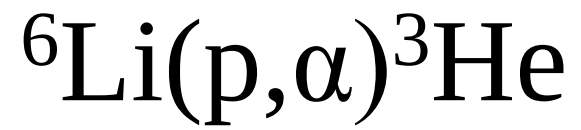




CH_2 50-70 $\mu\text{g}/\text{cm}^2$

C 98 $\mu\text{g}/\text{cm}^2$

Au 95 $\mu\text{g}/\text{cm}^2$

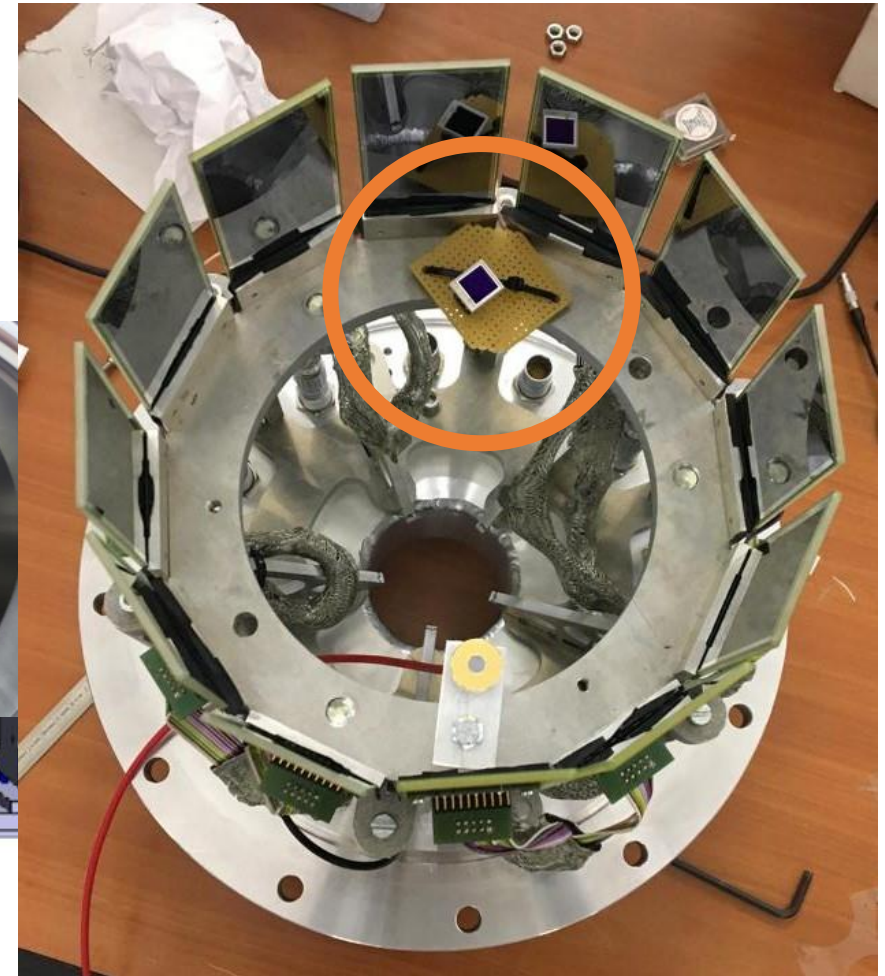
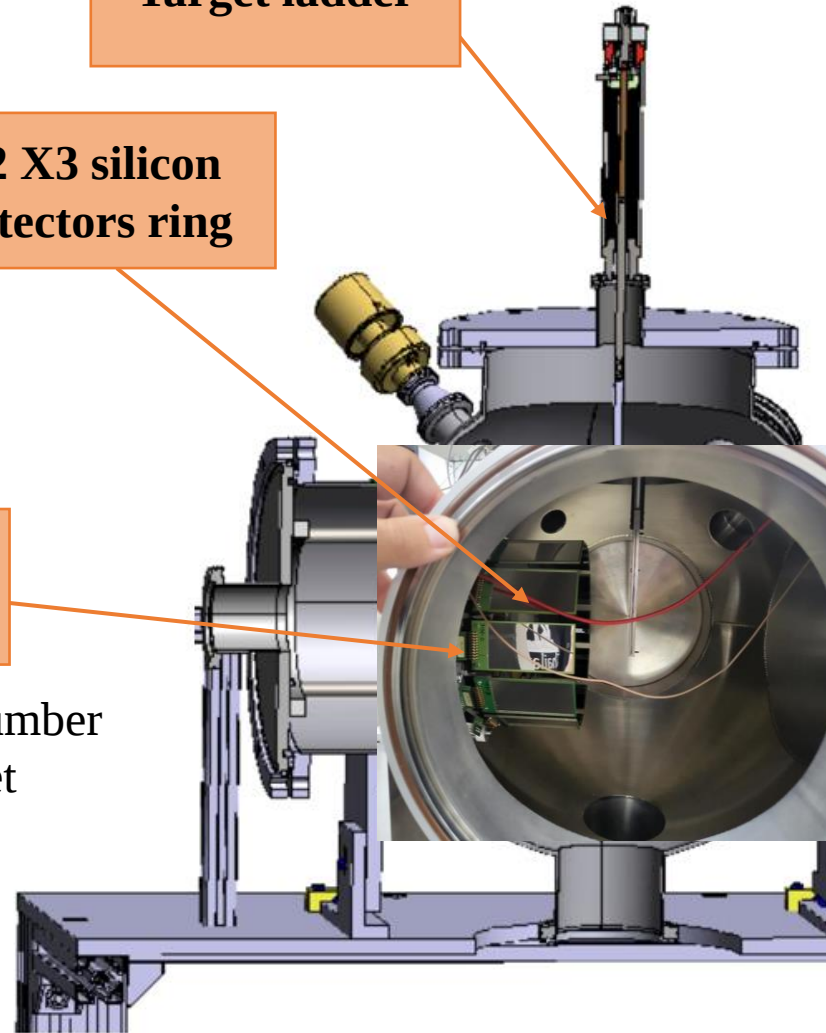


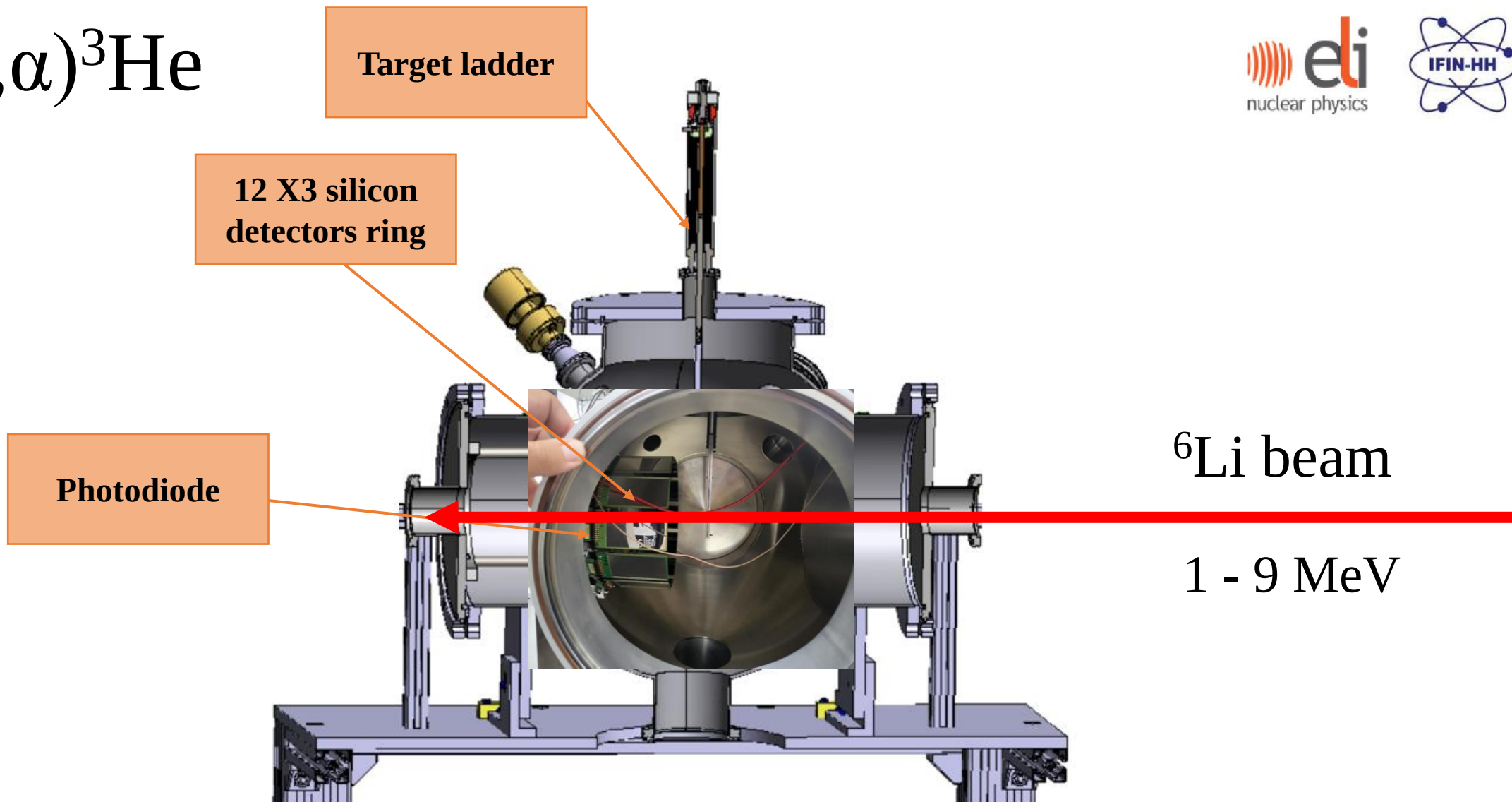
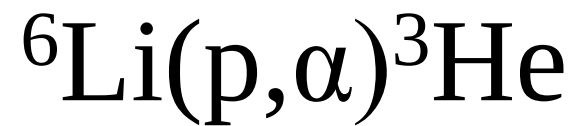
Target ladder

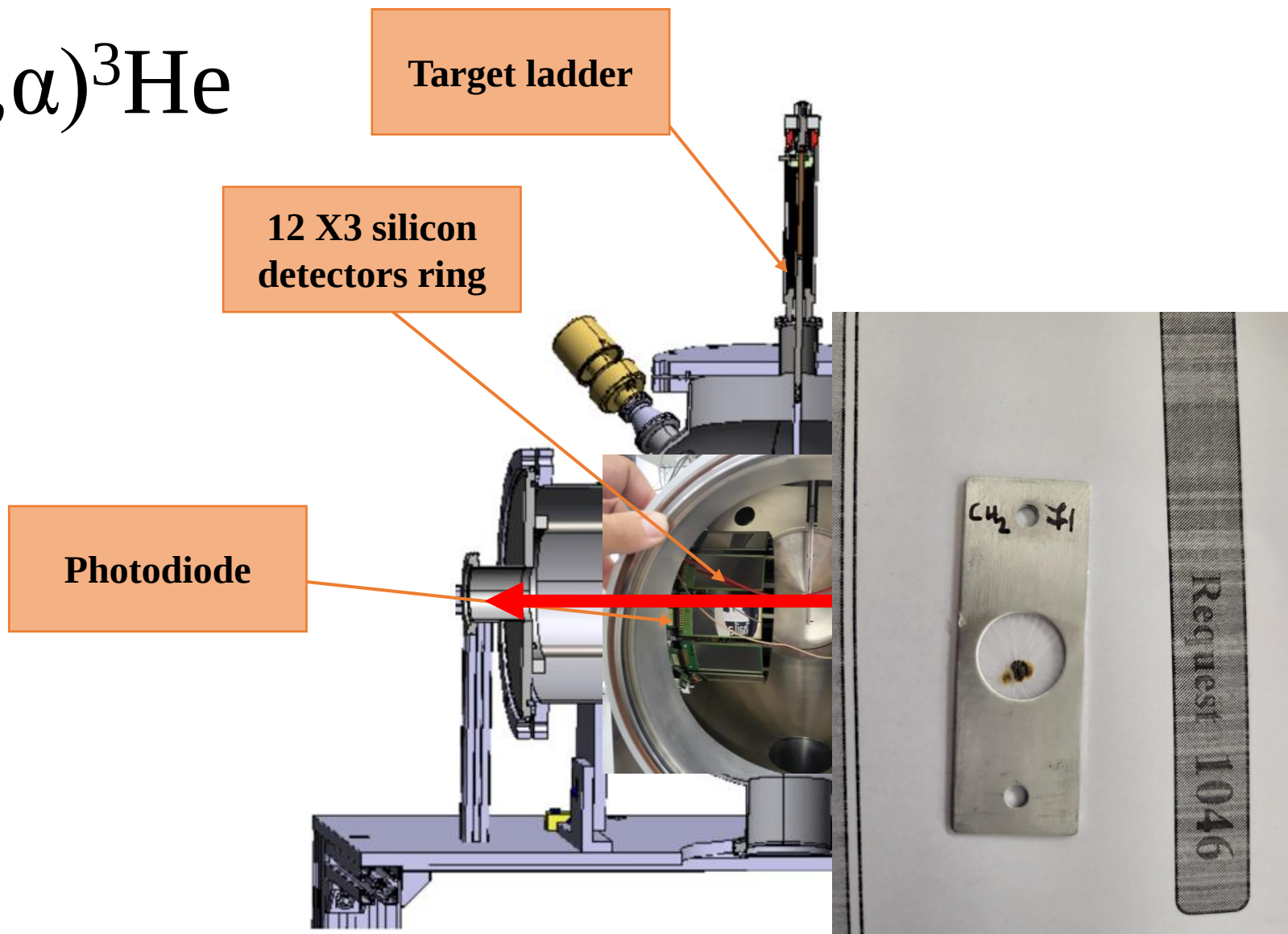
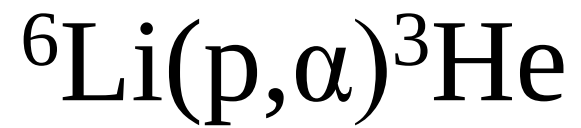
12 X3 silicon
detectors ring

Photodiode

Used to monitor the number
of particles in the target

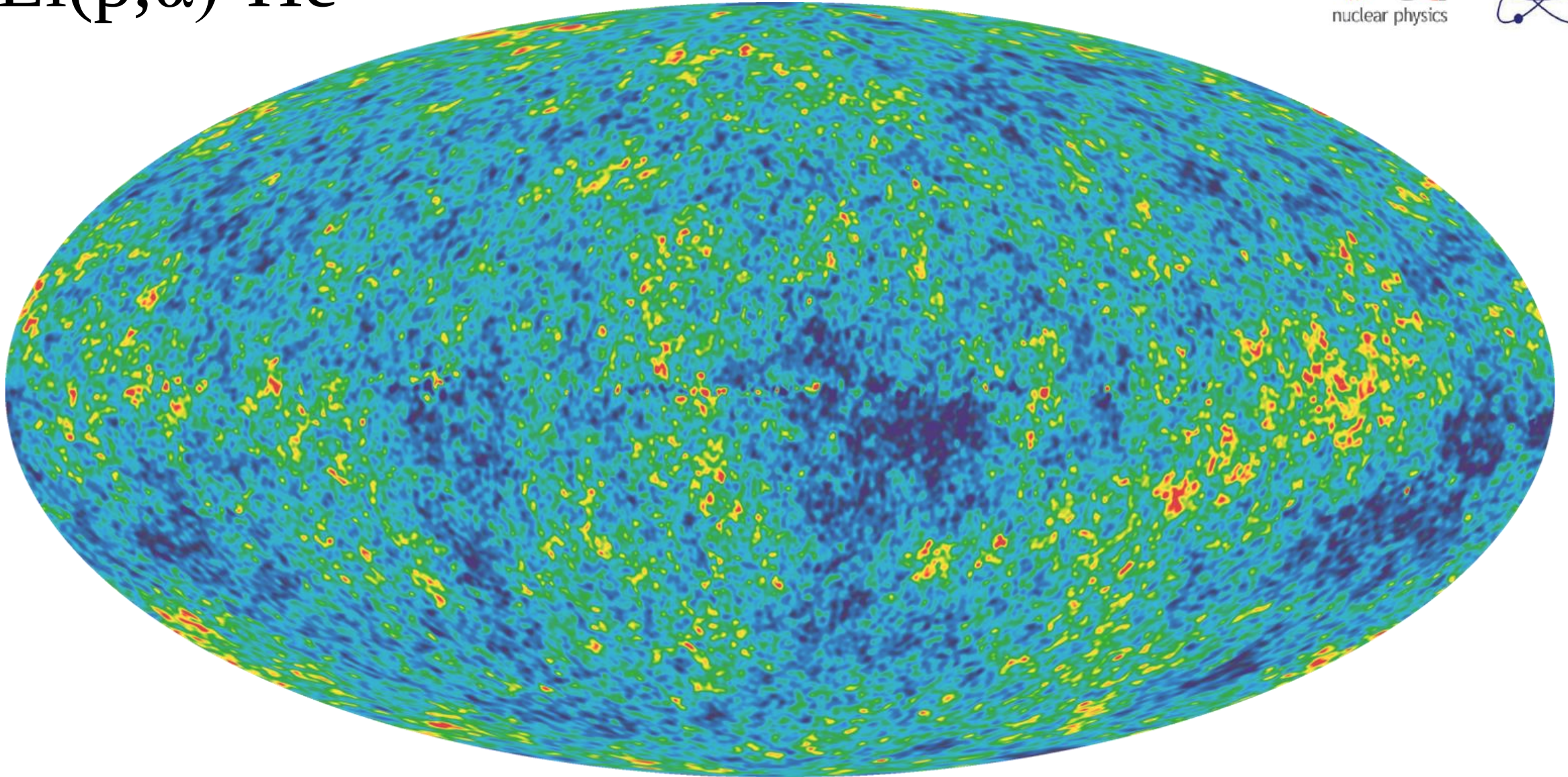
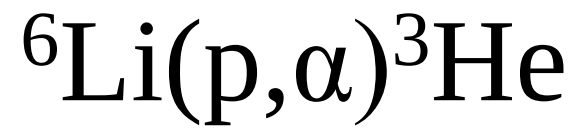


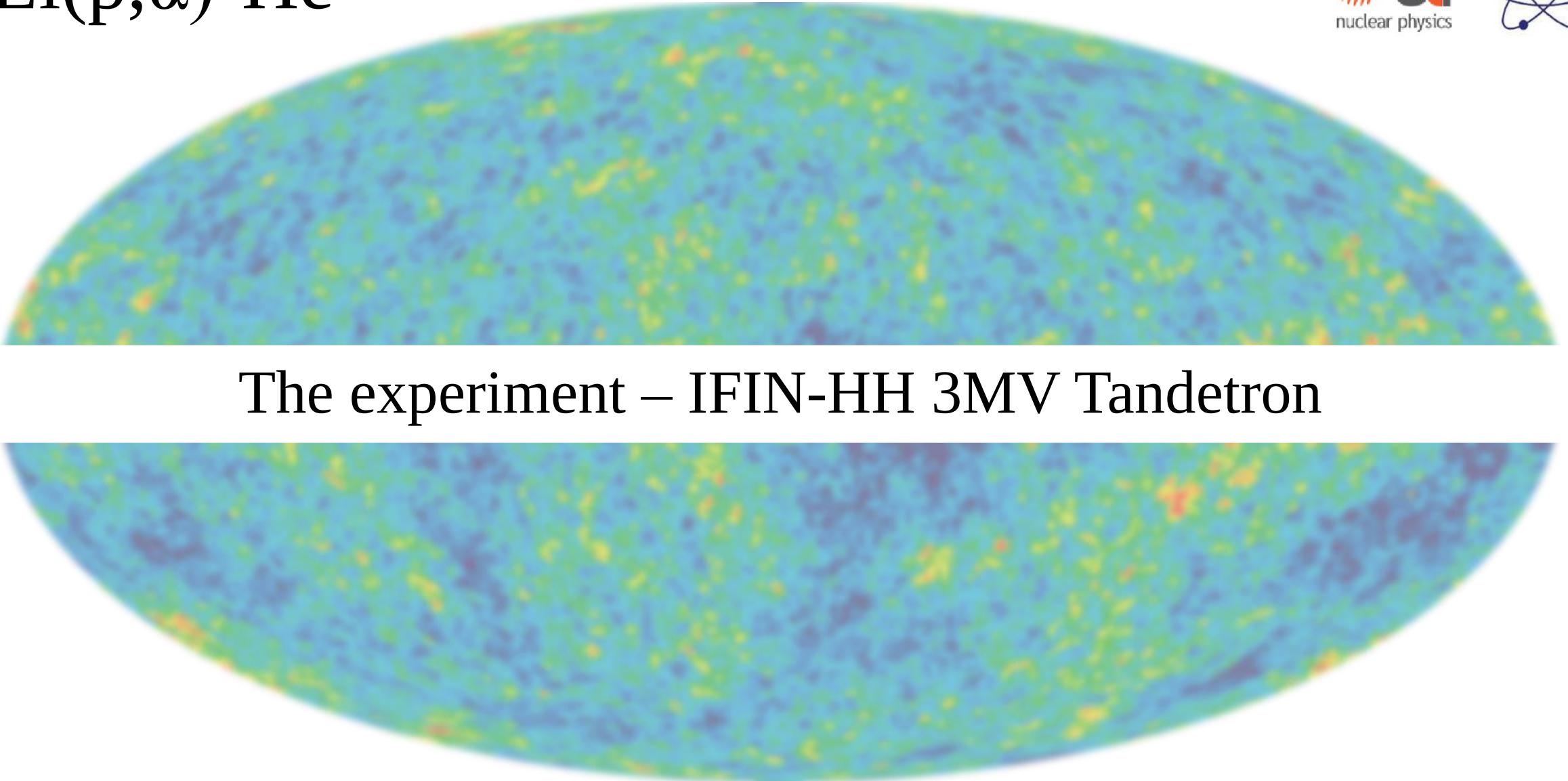
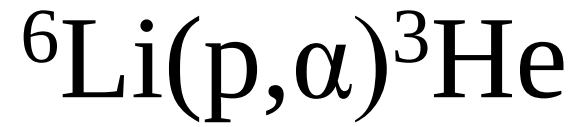




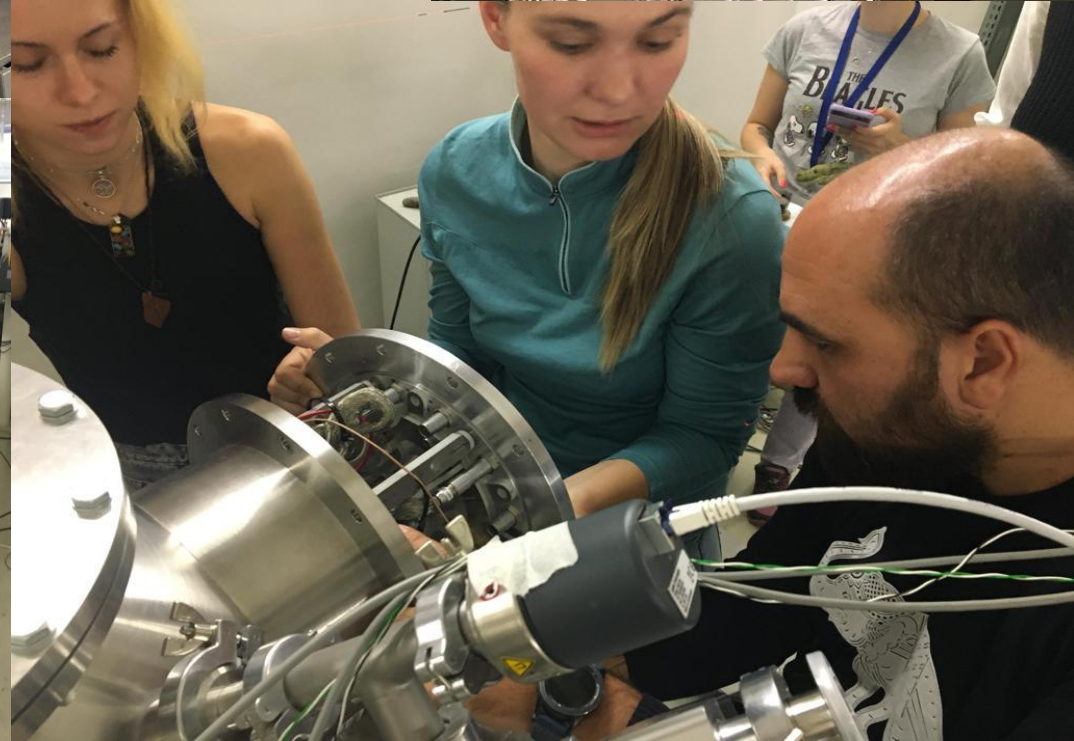
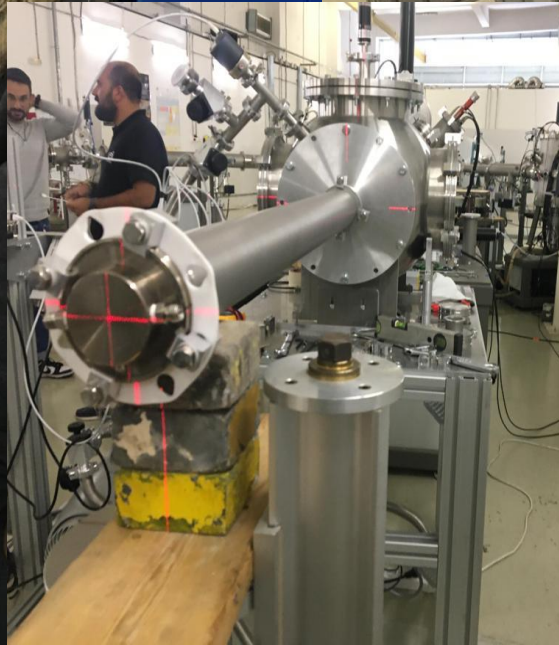
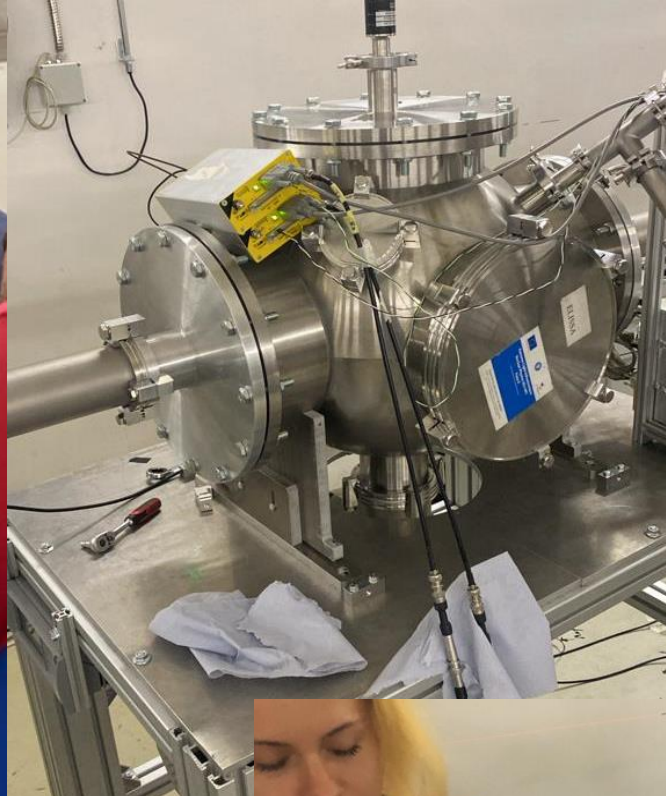
${}^6\text{Li}$ beam

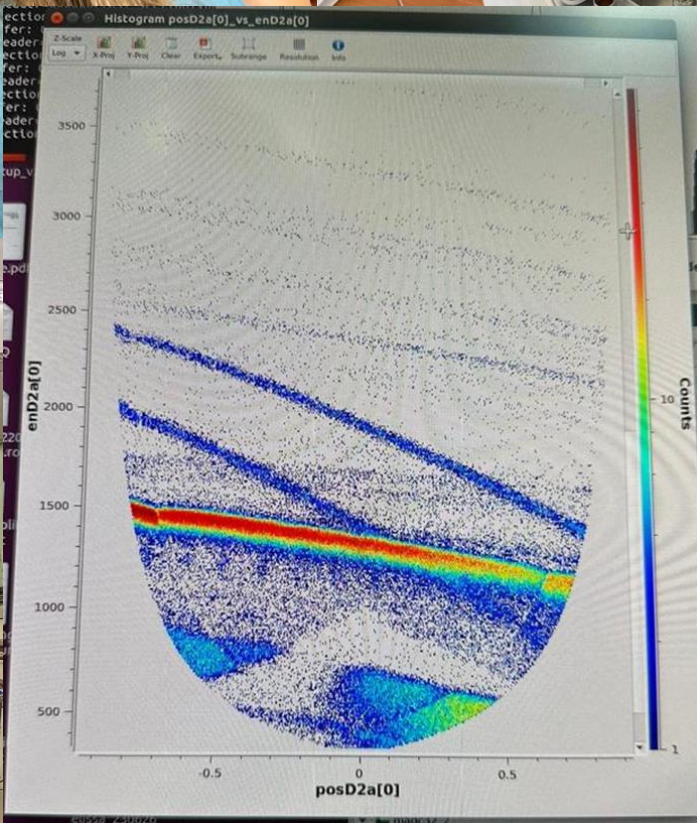
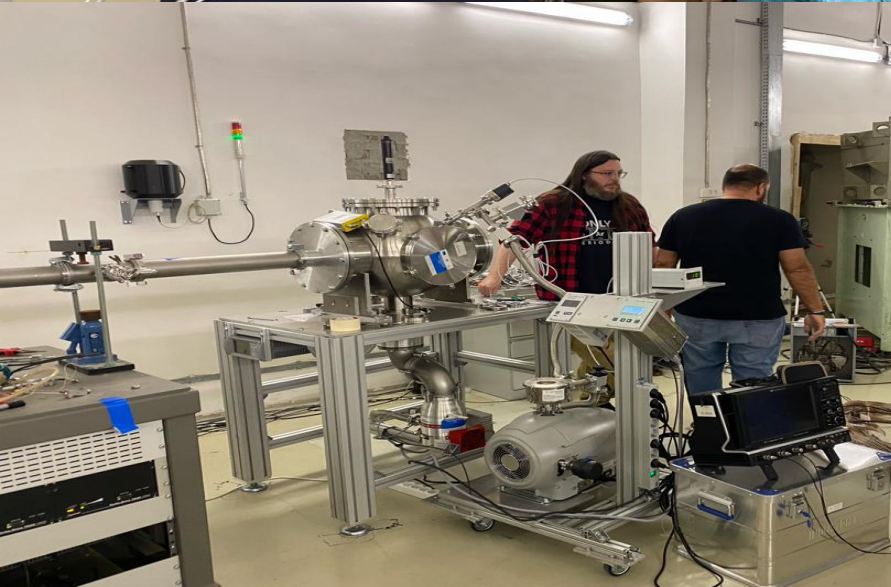
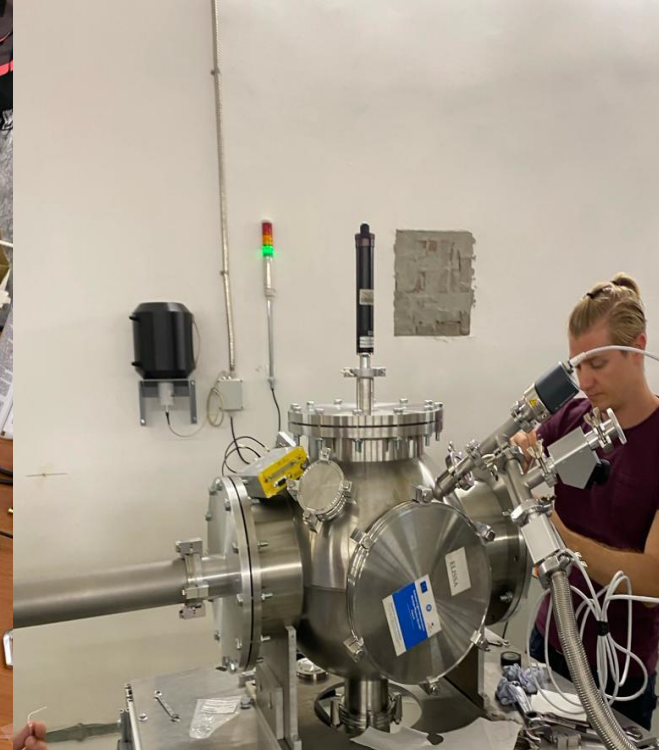
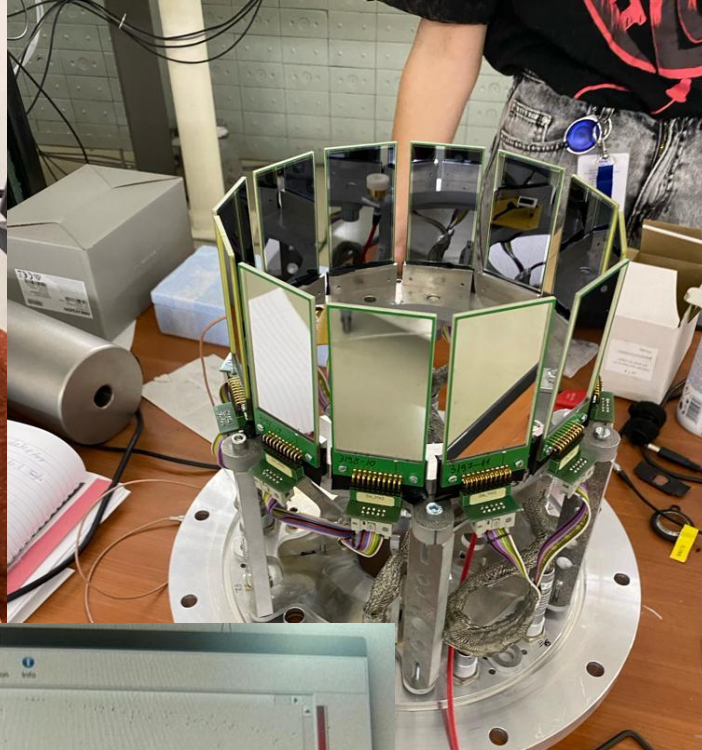
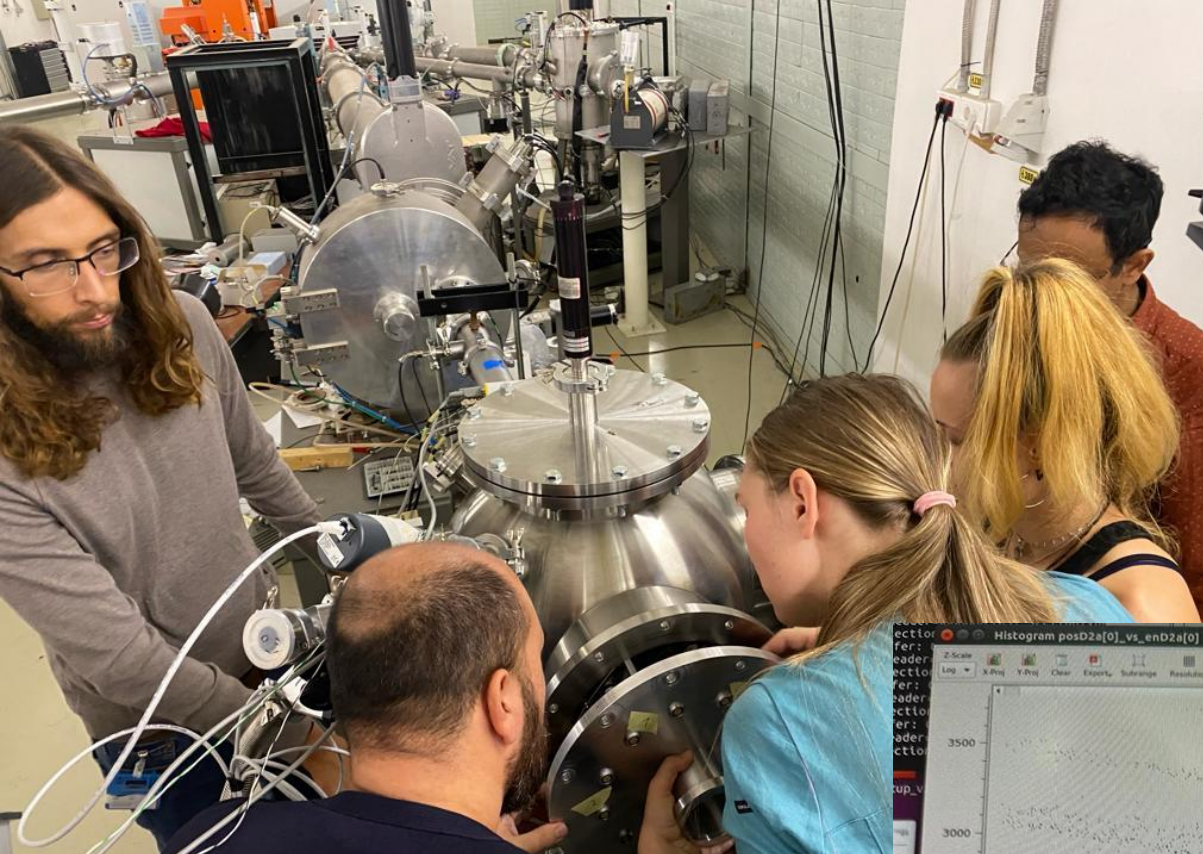
1 - 9 MeV

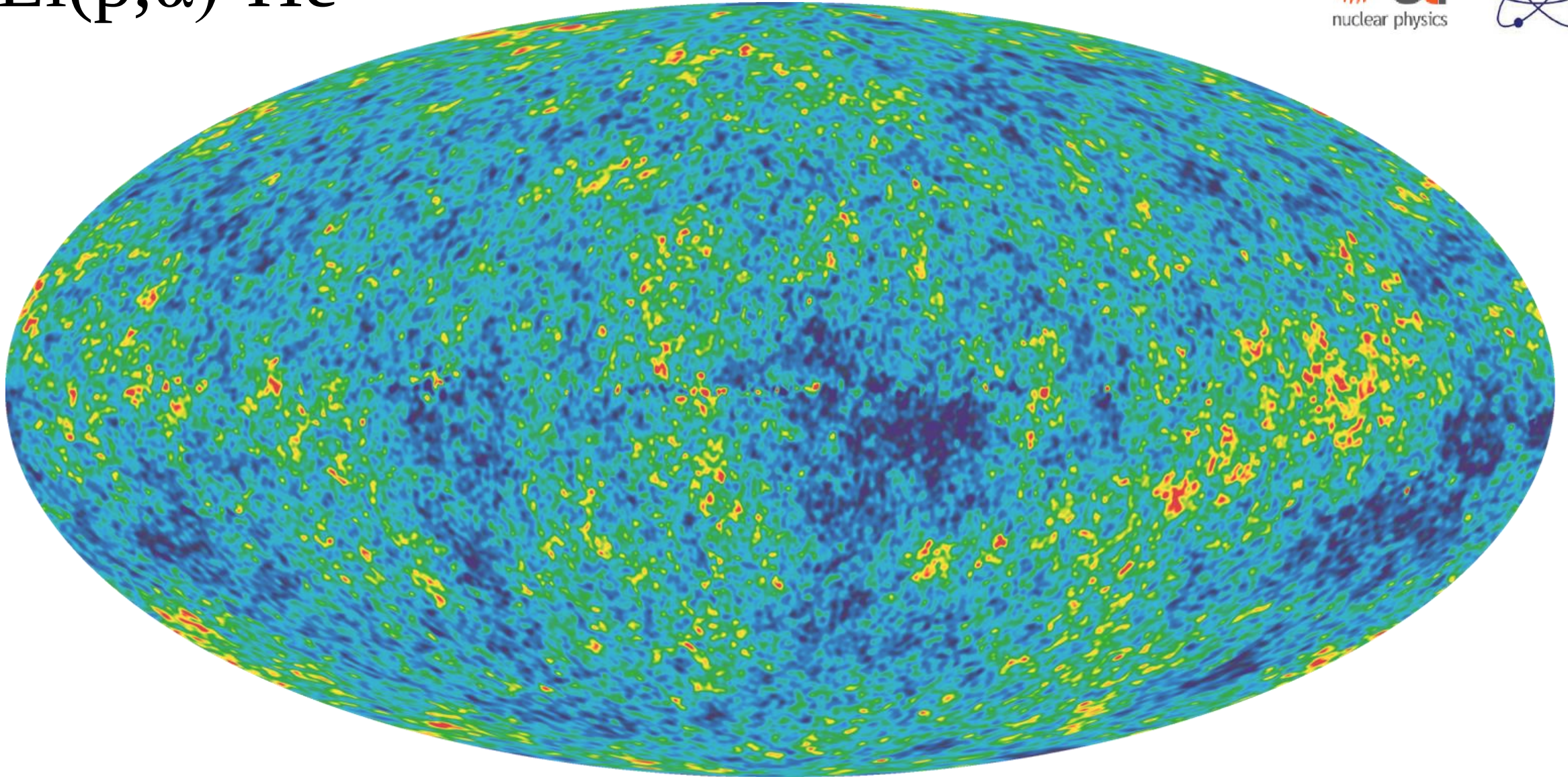
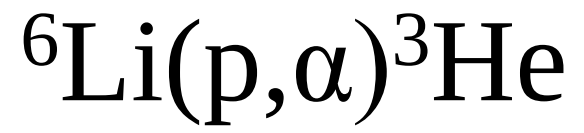


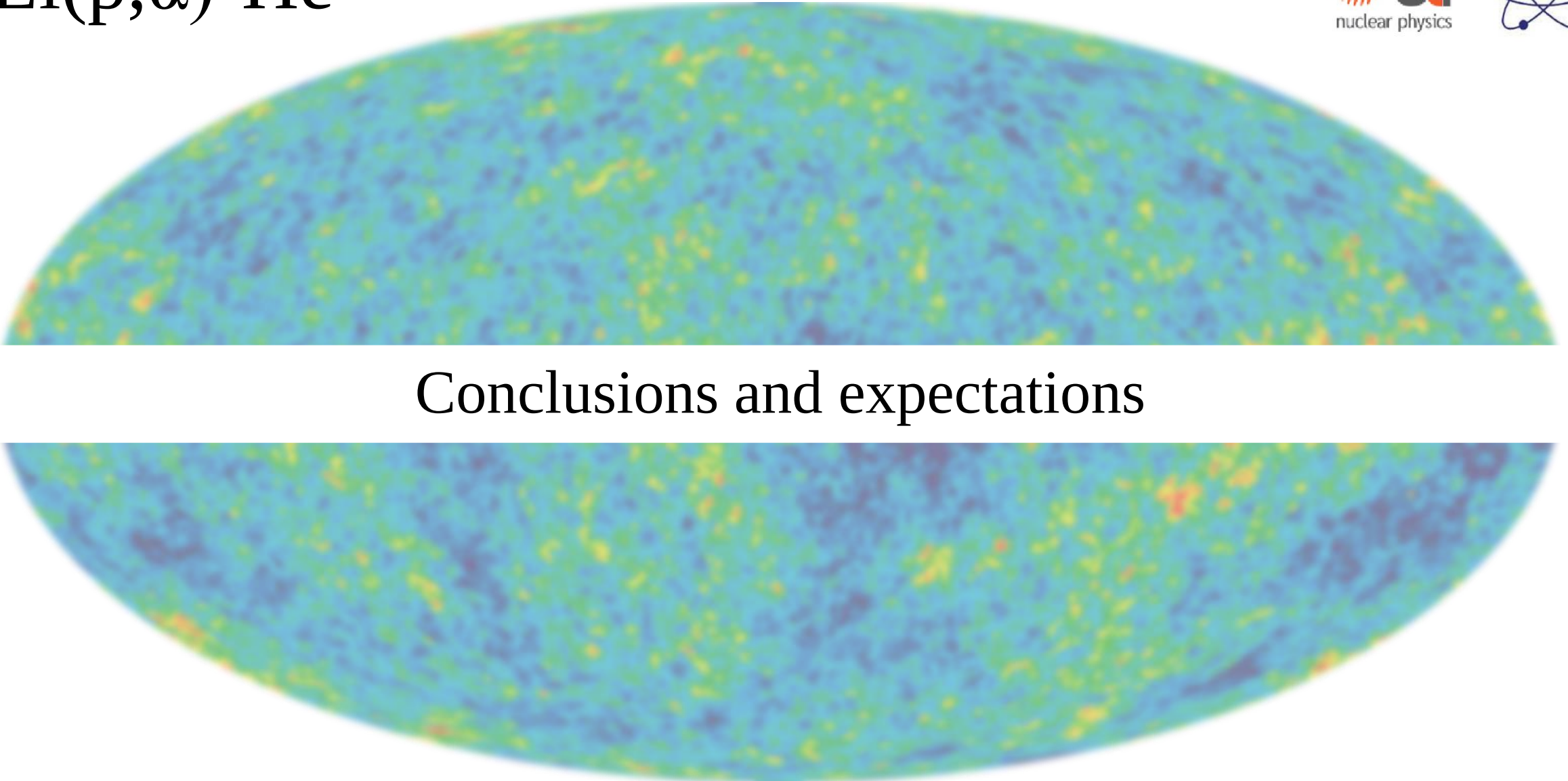
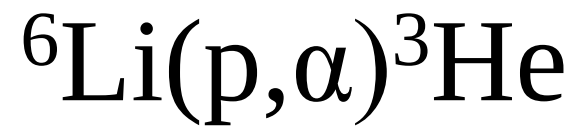


The experiment – IFIN-HH 3MV Tandetron

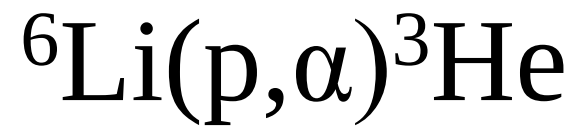




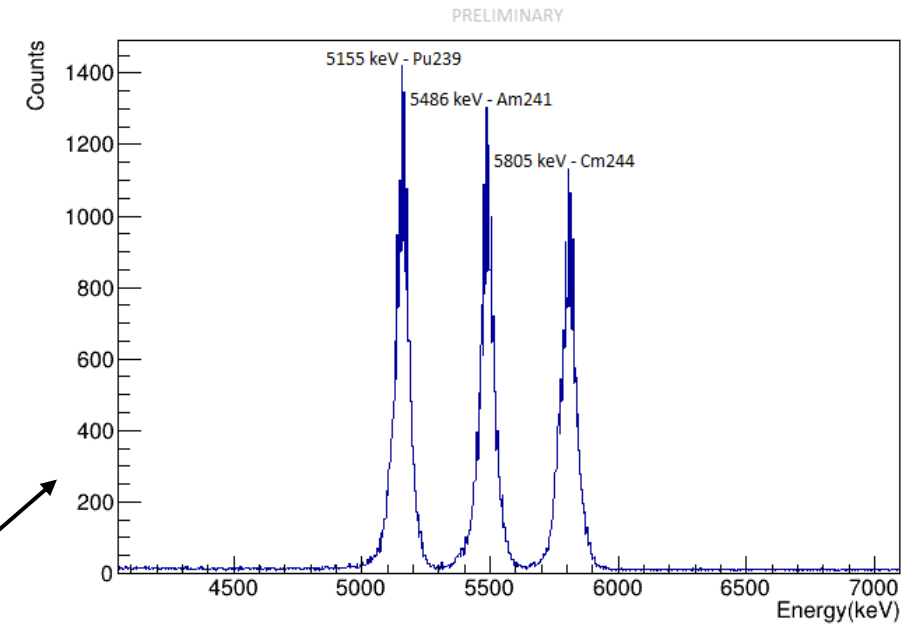
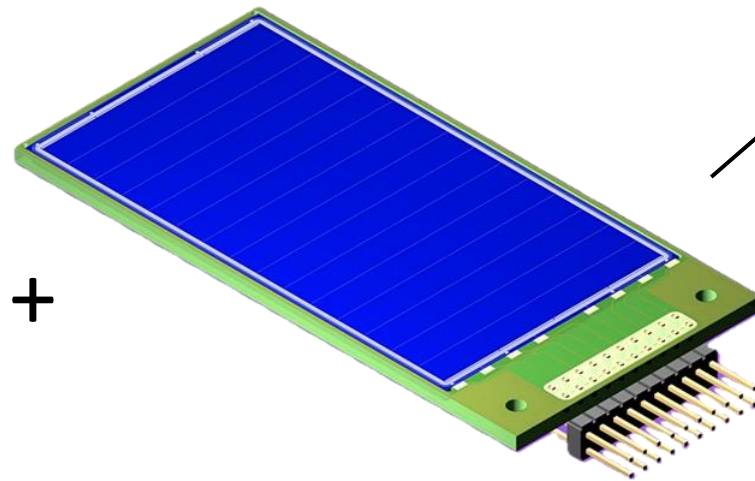


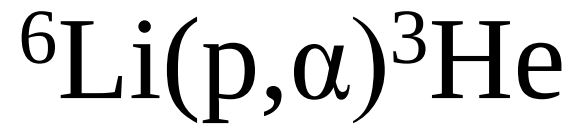


Conclusions and expectations

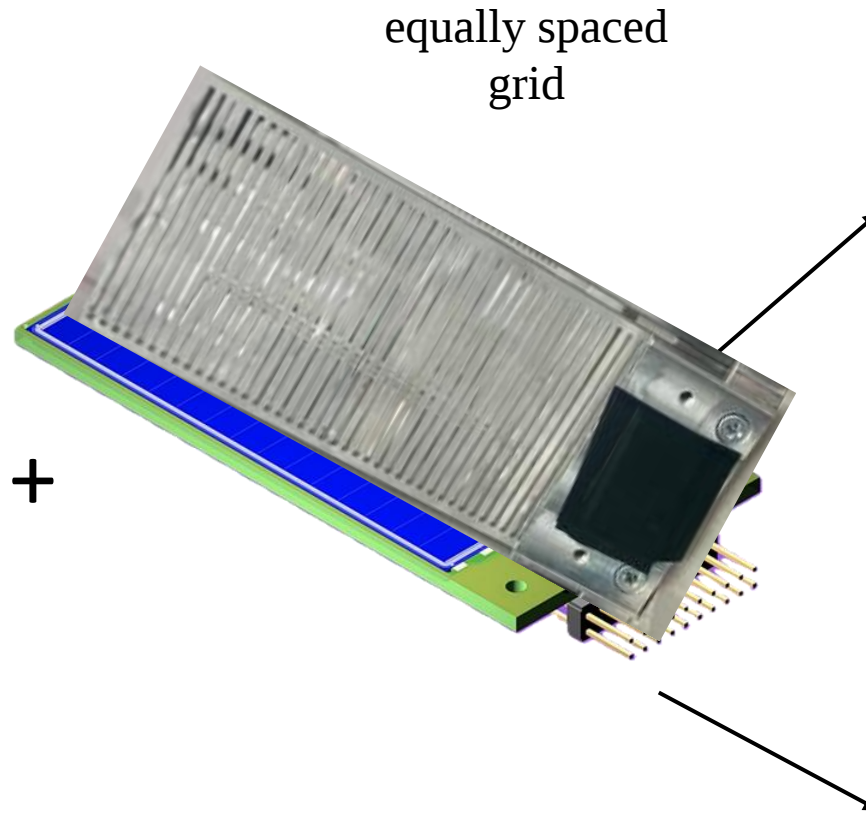


Magic wand
(triple alpha source)

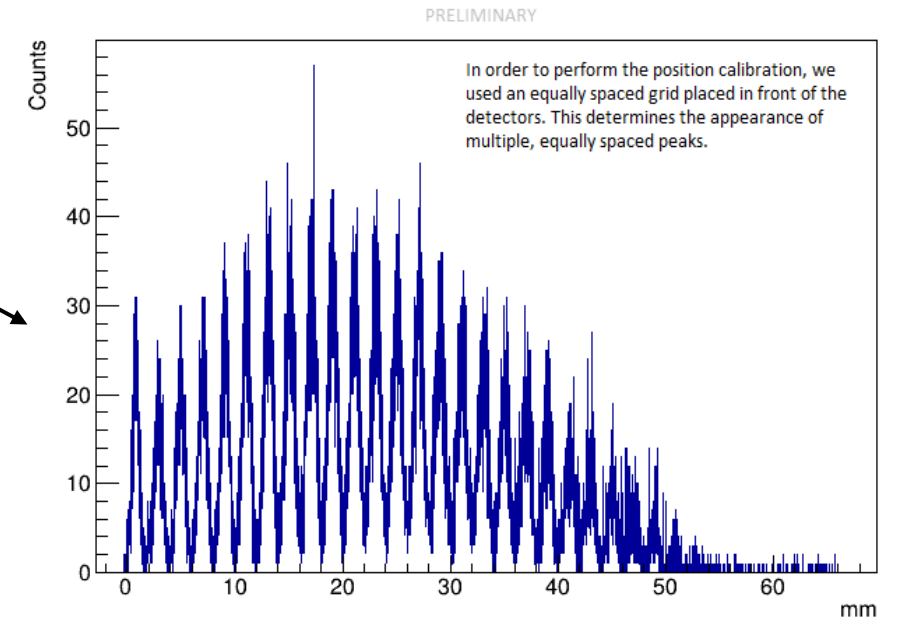
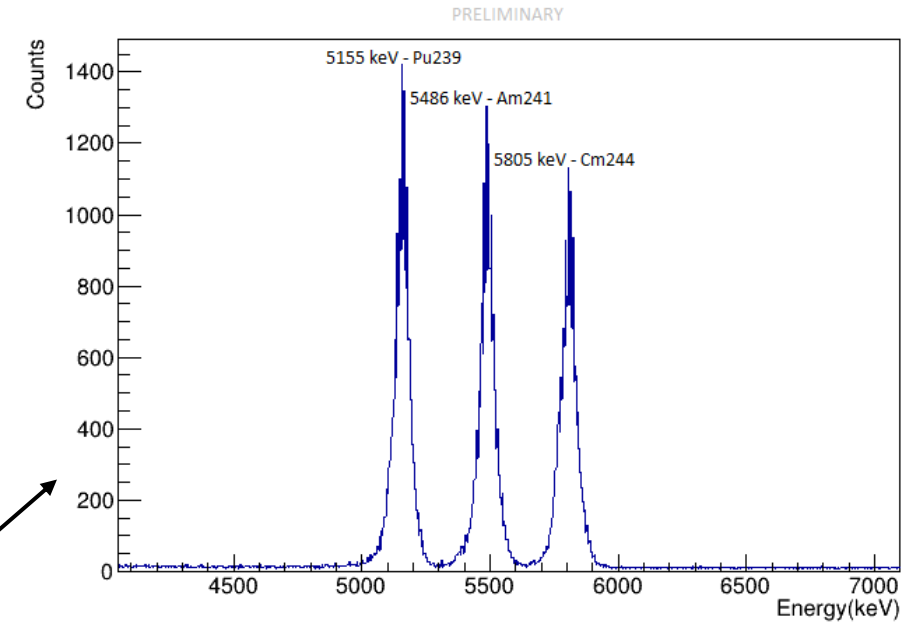


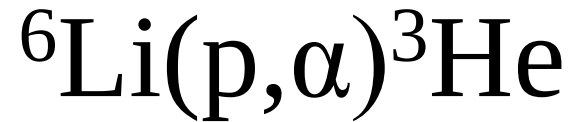


Magic wand
(triple alpha source)



Ana Lupoae, GDED





- The ${}^6\text{Li}(p,\alpha){}^3\text{He}$ reaction cross-section measurement could contribute to **solving the discrepancies** in previous measurements
- The ${}^6\text{Li}(p,\alpha){}^3\text{He}$ reaction is deeply connected with the **Cosmological Lithium Problem**
- The experiment was **successful**: we managed to get **good data** for multiple beam energies
- The position vs energy histograms clearly display the reaction we were looking for

Young Researchers & Young Engineers Days - 2024

Thank you for your attention !

And thank you to the real ones: T. Madgearu¹, I. Kuncser¹, H. Pai¹, G. L. Guardo², C. Matei¹, D. Lattuada², A. Cassisa⁴, N. Szegedi³, T. Tozar¹, A. Tumino², D. Testov¹, S. Aogaki¹, A. Dahl¹, R. Ban¹, R. Corbu¹, G. D'Agata², A. Kusoglu¹, P.A. Soederstrom¹, L. Lamia², A. Nurmukhanbetova⁶, M. Cuciuc¹, M. Gulino², J.P. Fernandez⁵

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5. Universidad de Sevilla
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