

Studies of the nucleosynthesis
 $^{12}\text{C}(\alpha, \gamma)^{16}\text{O}$ in inverse kinematic for
the MAGIX experiment on MESA

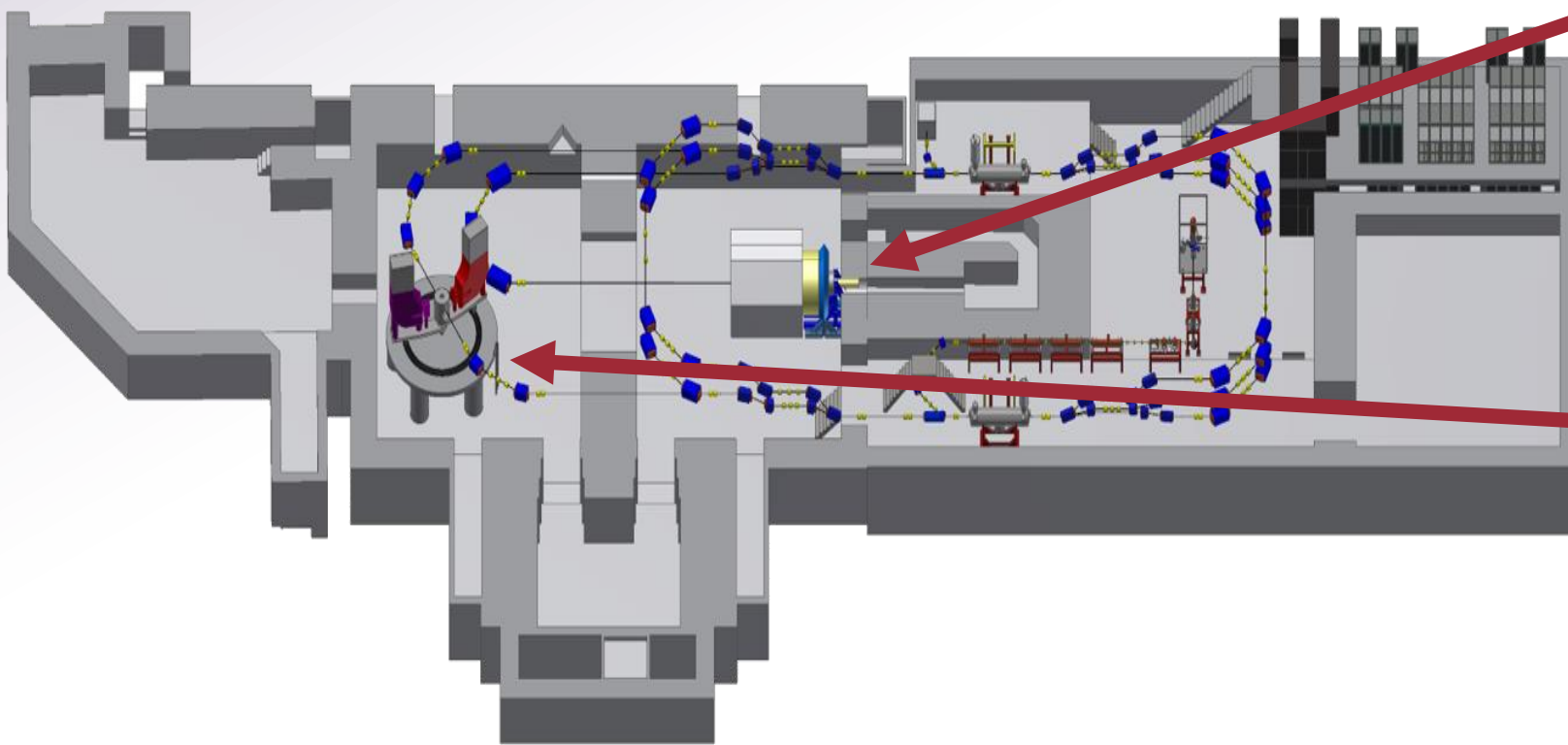
Stefan Lunkenheimer

56. International Winter Meeting on Nuclear Physics (Bormio)

MESA



Mainz Energy-Recovering Superconducting Accelerator

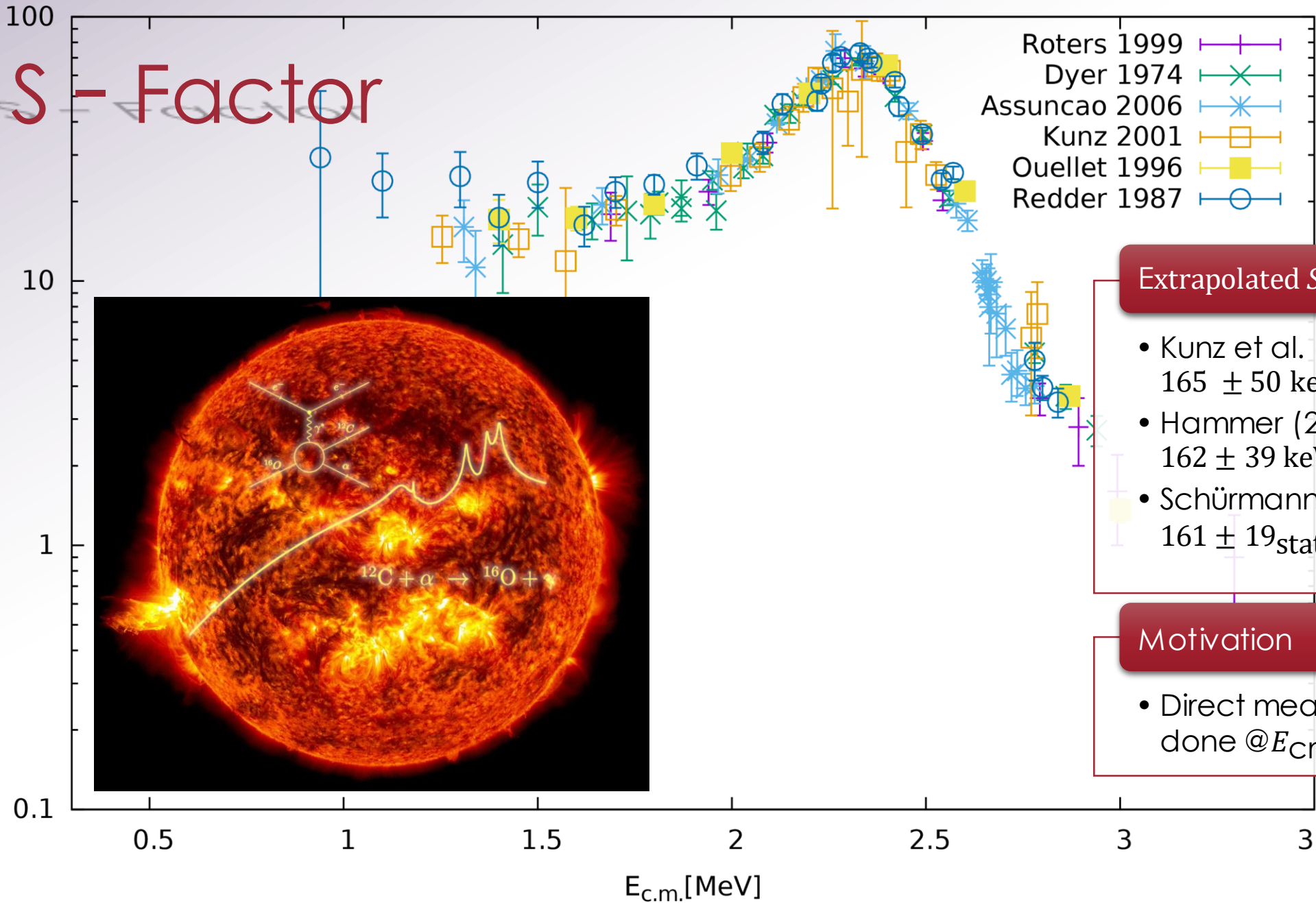


Extracted Beam (EB) Mode

- $E_{max} = 155 \text{ MeV}$
 $I_{max} = 150 \mu\text{A}$
- External Target Experiment – P2

Energy Recovering Linac (ERL) Mode

- $E_{max} = 105 \text{ MeV}$
 $I_{max} = 1 \text{ mA}$
- Internal Target Experiment-
MAGIX



Extrapolated $S(300 \text{ keV})$

- Kunz et al. (2001)
 $165 \pm 50 \text{ keV} \cdot \text{b}$
- Hammer (2005)
 $162 \pm 39 \text{ keV} \cdot \text{b}$
- Schürmann (2012)
 $161 \pm 19_{\text{stat}} \pm 8_{\text{sys}} \text{ keV} \cdot \text{b}$

Motivation

- Direct measurements never done @ $E_{cm} < 0.9 \text{ MeV}$



THANK YOU FOR YOUR ATTENTION!

<http://magix.kph.uni-mainz.de>



**Massachusetts
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MAGIX



Spectrometer

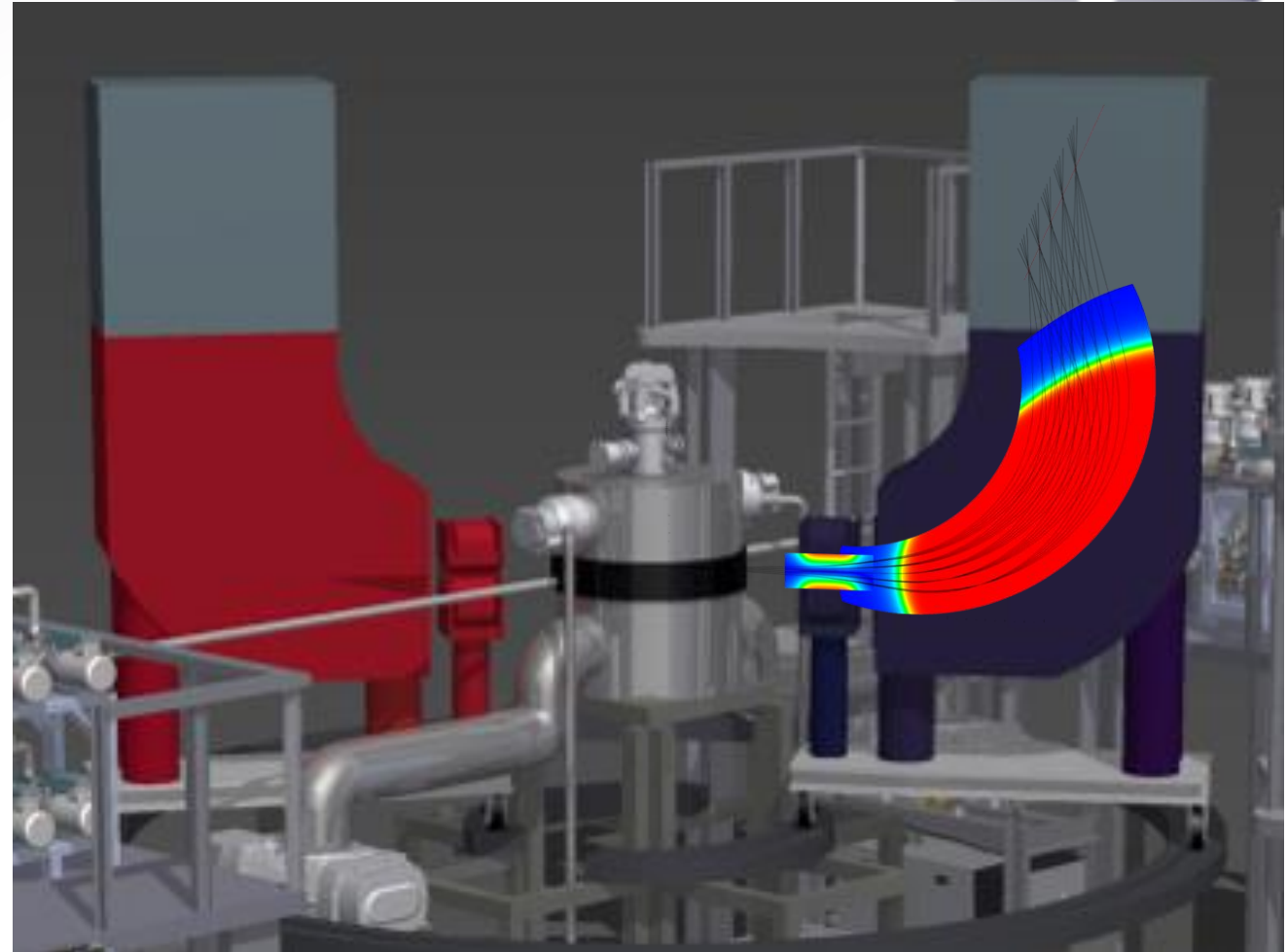
- High energy resolution $\frac{\Delta p}{p} < 10^{-4}$
- Angular resolution $\Delta\theta < 0.05^\circ$
- High rates \rightarrow GEM-Detectors

Internal Gas-Target

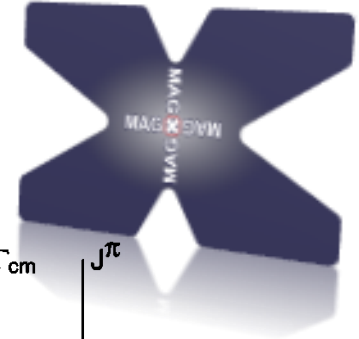
- Gas-Jet-Target
No walls:
Neither the beam nor the scattered particles have to pass a wall
- „clean“ interaction

Thin Target - High Beam Current

- High Luminosity $\sim 10^{35} \text{ cm}^{-2} \text{ s}^{-1}$



S-Factor of $^{12}\text{C}(\alpha, \gamma)^{16}\text{O}$



$$\sigma(E) = \frac{1}{E} e^{-\frac{2\pi Z_1 Z_2 \alpha c}{v}} \cdot S(E)$$

- **Nonresonant cross section of $^{12}\text{C}(\alpha, \gamma)^{16}\text{O}$**
 - e – Factor = tunnel probability
 - $S(E)$ = Deviation factor from trivial model

$$E_0 = \left(\frac{1}{2} b \cdot k \cdot T \right)^{\frac{2}{3}} \approx 300 \text{ keV}$$

- **Gamow-Peak ($T \approx 2 \cdot 10^8 \text{K}$)**
 - k = Boltzmann constant
 - $b = \pi \alpha Z_1 Z_2 \sqrt{2\mu c^2}$ with μ = reduced mass

