An ultra-low-yield charged particle spectrometer for studying nucleosynthesis reactions in OMEGA implosions

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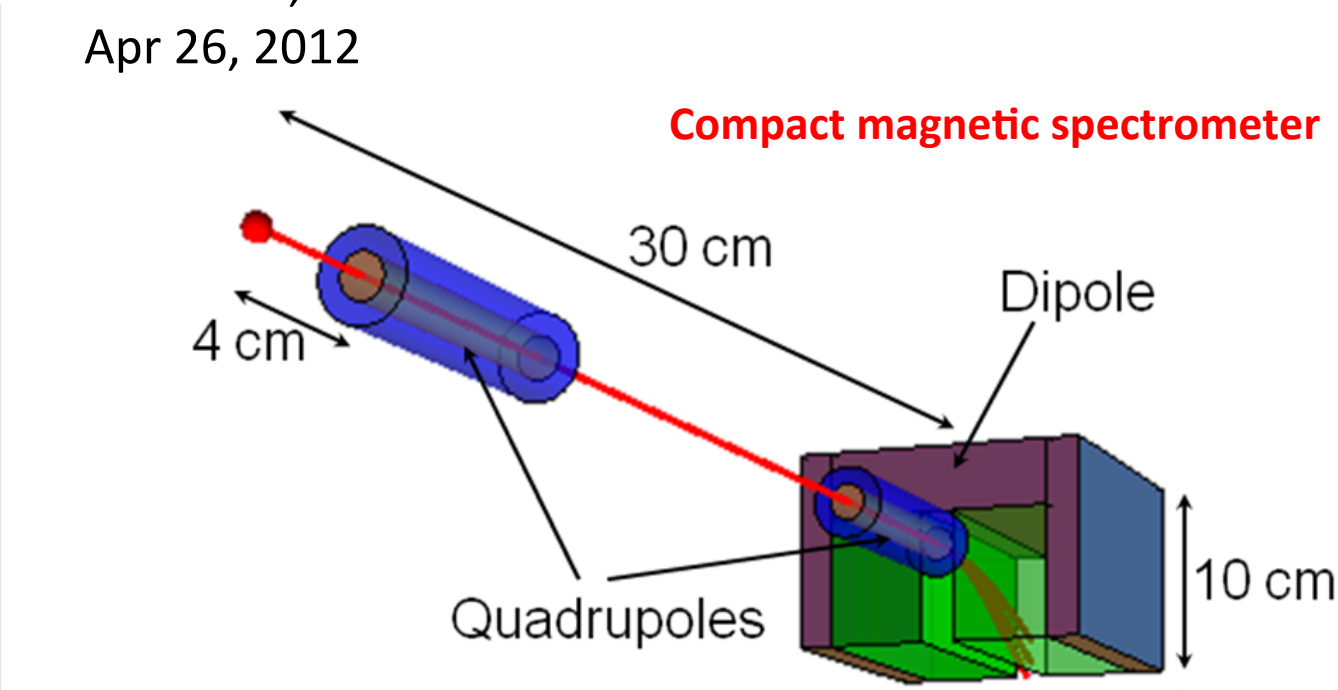

Motivation: Several reactions relevant to stellar nucleosynthesis and basic nuclear physics can be studied at ICF facilities using charged particles.

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1. **$T + T \rightarrow 2n + \alpha$, $T + T \rightarrow n + {}^5He$, $T + T \rightarrow n + {}^5He^*$, $T + T \rightarrow (nn) + {}^4He$**
   TPIE, CPS can measure spectra at high T_i (≥4 keV)
   Compact spectrometer would allow measurements at 2-3 keV
   - extend CM energy range of measurements

2. **${}^3He + {}^3He \rightarrow 2p + \alpha$, ${}^3He + {}^3He \rightarrow p + {}^5Li$, ${}^3He + {}^3He \rightarrow p + {}^5Li^*$, ${}^3He + {}^3He \rightarrow (pp) + \alpha$**
   Existing diagnostic (WRF) can measure proton spectra for Ep ≥ 4 MeV
   Compact spectrometer would measure low-energy protons and αs

3. **$T + {}^3He \rightarrow \alpha + n + p$**
   $\rightarrow \alpha + D$
   $\rightarrow {}^6Li + \gamma$
   This spectrometer would allow measurements at ≥4 keV
   - extend CM energy range of measurements

4. **$p + {}^{11}B \rightarrow 3\alpha$**
   No existing diagnostic can measure α spectra

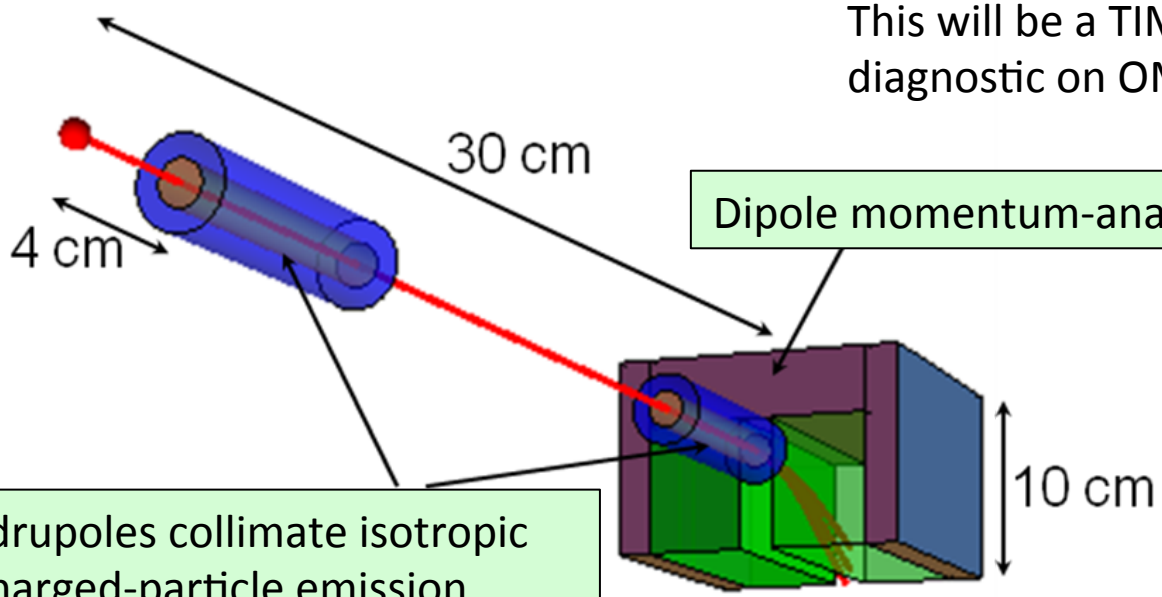
5. **$p + {}^{15}N \rightarrow \alpha + {}^{12}C$**
   No existing diagnostic can measure α spectra

Groups interested in these capabilities:
MIT, LLNL, LLE, LANL, IU

CPS = Charged Particle Spectrometer
WRF = Wedge Range Filter

High spectral accuracy at low yield will be obtained with a novel compact collimating charged-particle spectrometer (C^3PS)

This will be a TIM-based diagnostic on OMEGA.

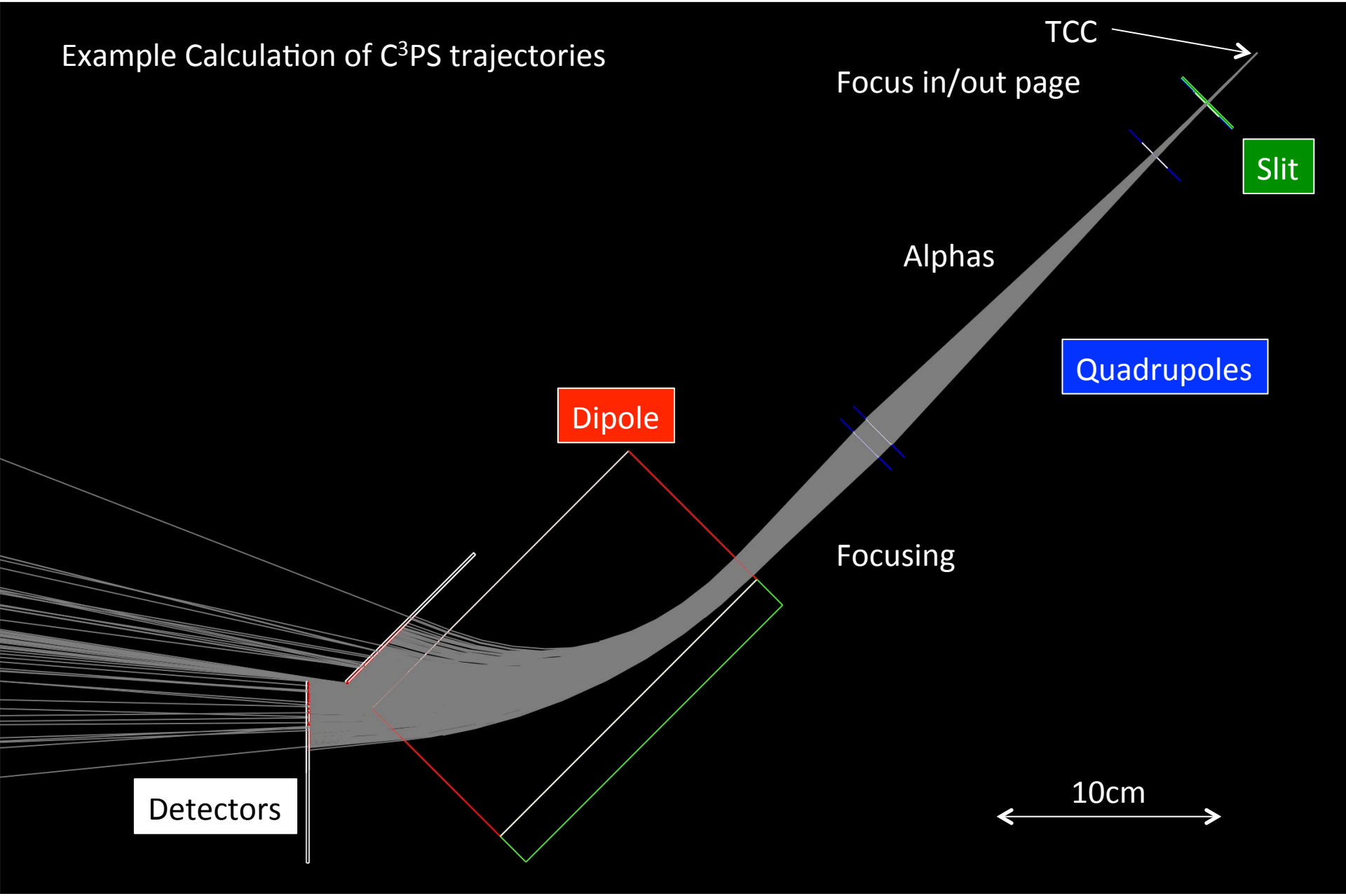


Design goal: Measurements of charged particle spectra (α, p, D, …?) at low yield ($\geq 10^6$?) and low energy (1-5 MeV proton-equivalent?)

Does the community have ideas for other potential experiments with this diagnostic that would affect the design goal?

Existing magnetic spectrometers (CPS, TP) are limited to yields $\geq 10^9$

A Geant4 optimization routine is being developed to design ion optical properties



Summary

1. **A compact collimating charged-particle spectrometer (C^3PS) will allow novel nucleosynthesis experiments on OMEGA**
   This diagnostic will use collimating quadrupoles to achieve this goal

2. **A Geant4-based code is being developed to optimize ion optical properties**

3. **Anybody in OLUG community with interest in experiments using this sort of capability should speak up or contact me:**
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