# Experimental Proposal S341

- Title: **Neutron Knockout Reactions from Proton-rich Carbon Isotopes**

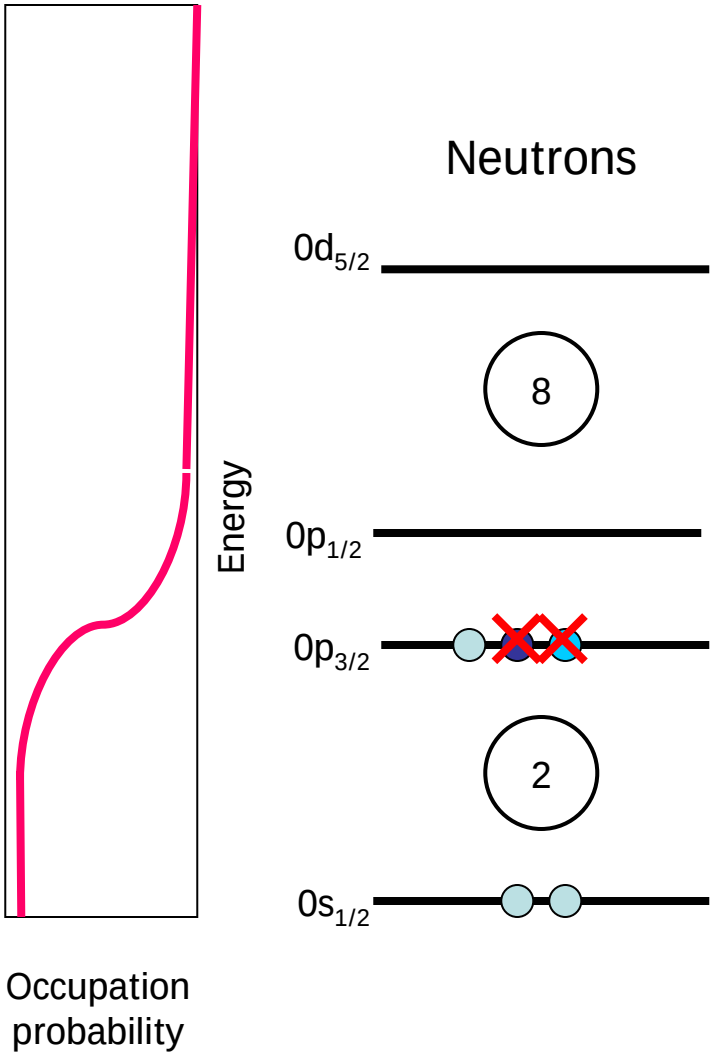
- Spokesperson: Joachim **Enders**, TU Darmstadt

- GSI Contact Person: Helmut **Weick**, GSI Darmstadt (presenting)

- Year of Approval: 2007 (A)

- Shifts: **7** approved (6 main + 1 parasitic)
  0 used (main + parasitic)
  7 left (6 main + 1 parasitic)

# Spectroscopic Factors




- **Experimental spectroscopic factors**
  - smaller than predicted within the shell model
  - short-range repulsion in deeply-bound states?
  - dependence on binding energy?
- **Knockout from $^{10}$C / $^{11}$C**
  - learn about evolution of spectroscopic factors in the deeply-bound $0p_{3/2}$ neutron shell

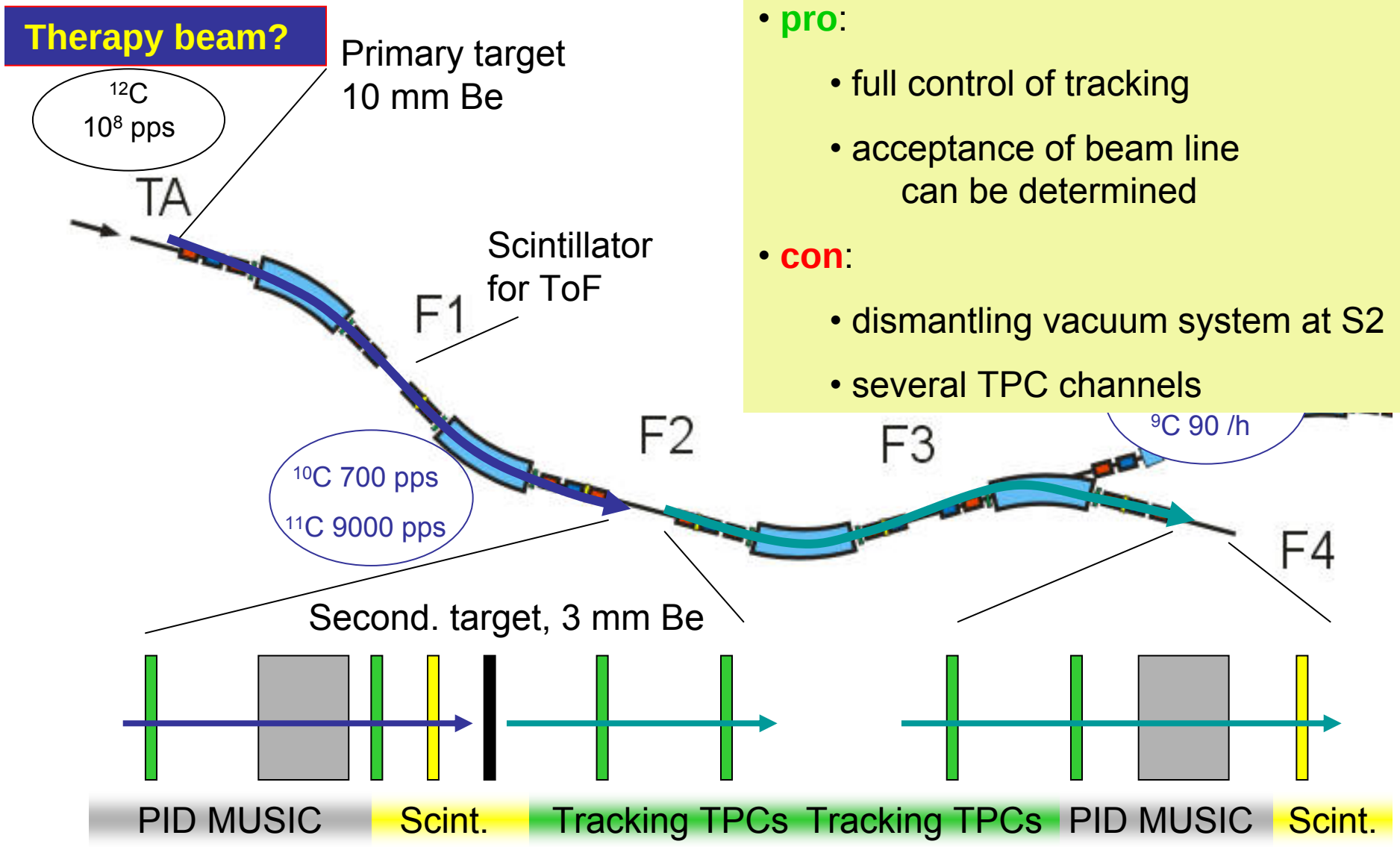
Cross Section ↔ Spectroscop. Factor ↔ Occupation Probability

# Physics Motivation

- Evolution of spectroscopic factors
  in the deeply-bound $0p_{3/2}$ neutron shell
  - One-neutron knockout from $^{10}C$
  - Robust data analysis for fast beams
- Quenching of spectroscopic strength in deeply bound orbitals?
  - Short-range correlations?
  - „Physics beyond the standard (nuclear physics effective shell) model“
  - No experimental data in p shell!
  - Accessible by ab-initio calculations
- Do we understand two-nucleon knockout processes?
  - No precise data in p shell
  - No data connecting odd-mass nuclei: $^{11}C \rightarrow {}^{9}C$
  - Probing reaction and structure models: Stripping vs. diffraction
  - Accessible by ab-initio calculations

# Setup

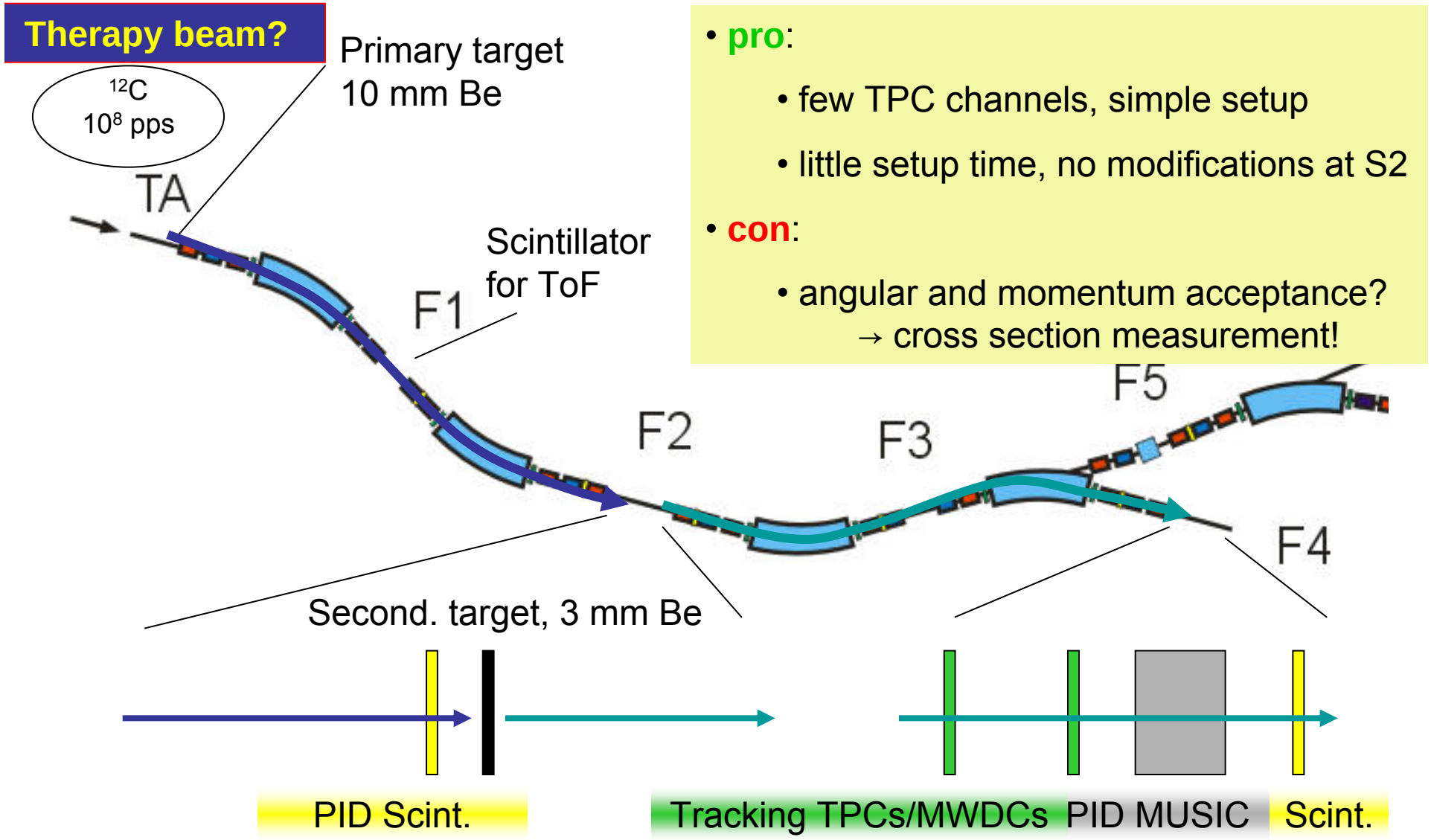
- FRS focal planes equipment: **Option 1**




- **pro**:
  - full control of tracking
  - acceptance of beam line can be determined
- **con**:
  - dismantling vacuum system at S2
  - several TPC channels

# Setup

- FRS focal planes equipment: **Option 2**



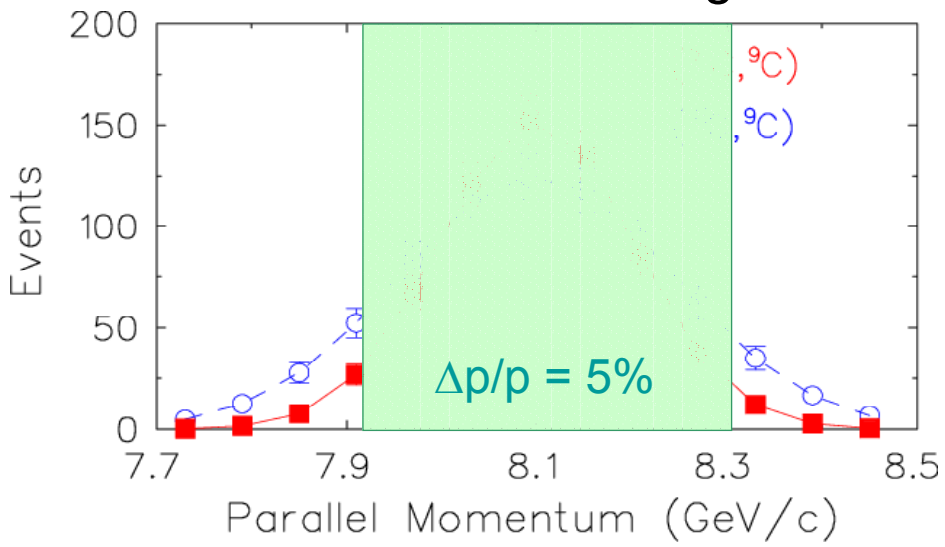

- **pro**:
  - few TPC channels, simple setup
  - little setup time, no modifications at S2
- **con**:
  - angular and momentum acceptance?
    → cross section measurement!

# Setup

- Is the setup ready?
  - Option 1:
    - TPC: collaboration
    - setup and takedown time: > 2 days each, calibrations
  - Option 2:
    - setup ready, (TPCs can be in pockets before S2 or only behind target)
- Is there any new or non-standard equipment required?
  - TPCs and MUSIC at FRS mid-plane for Option 1
- Is there a modification or a new DAQ required?
  - No (like S277, S245 or S322 without gammas)
- What is the requested primary beam and intensity?
  - $^{12}C^{6+}$, E > 400 A MeV (up to 1.9 AGeV), $10^9$ /spill
- How many shifts are requested for 2008?
  - 7 Shifts: 6 main user + 1 parasitic

# Other Aspects

- Acceptance of FRS
  - too small for 100% transmission
  - Use tracking detectors behind target and evaluate only small angles behind breakup target.
  - Momentum acceptance still too low -> measure in two settings.
  - Better higher energy than the original 400 AMeV. Also thicker targets.
  - Maybe use only S2->S3.




- ΔE for Z identification
  - MUSIC not really required. We can use scintillator.

# Count Rates / Accuracy

## $^{9}$Be($^{10}$C,$^{9}$C)X

- Cross section estimate
  - example: $^{32}$Ar → $^{31}$Ar
    - cross sec. 10 mb
    - spectroscopic factor 4.1
    - quenching factor 0.24
  - our case: $^{10}$C → $^{9}$C
    - spectroscopic factor >1
    - quenching factor ~ 0.25
    - **cross section > 1 mb**
- Count rate:
  - incident rate (LISE++): 700/s for therapy beam with maximum intensity
  - **650 events per shift**
  - statistical accuracy ~ 4%

## $^{9}$Be($^{11}$C,$^{9}$C)X

- Cross section estimate
  - example: $^{34}$Ar → $^{32}$Ar
    - cross sec. 0.4 mb
    - nucleons in shell 2
    - quenching factor ~ 0.5
  - our case: $^{11}$C → $^{9}$C
    - nucleons in shell 3
    - quenching factor > 0.25
    - **cross section > 0.1 mb**
- Count rate:
  - incident rate (LISE++): 9000/s for therapy beam with maximum intensity
  - **750 events per shift**
  - momentum distribution