^{30}S RIB Development Run Plan: 6-8 May 2008

Send ^{28}Si primary beam through system, first stopped at F2, then at F3.
- (No cryogenic target at F0)
- F0, F1, F3 slits open
- No F3 PPAC/MCP in beam line
  - Do not go below (– 9 mm) for the slider position!
- Add F3 PPACa only
- Add F3 MCP only
- Add F3 PPACa + MCP
- Use PPACb in place of MCP to confirm the MCP is good
- Get F2 to F3 Transmission %

Confirm that energy registered by PSD/SSD is consistent with Bρ for primary beam
- Get beam intensity

Close slits (F0, F1, F3) to tune beam position
- Take run data

Insert F0 2.2 μm Havar stripper (expected ΔE ≈ 10 MeV)
- What is the distance separation of ^{28}Si charge states at F1?
  - We can measure using F1 PPAC (width 10 cm)
  - We may also infer momentum spread (peak widths)
  - Be careful of change in primary beam intensity, ask operator to check before attenuator

Insert F0 550 μg/cm^2 Carbon stripper (expected ΔE ≈ 5 MeV) – for CRIB Optimizer, Δx = 2.441 μm
- What is the distance separation of ^{28}Si charge states at F1?
  - We can measure using F1 PPAC (width 10 cm)
  - We may also infer momentum spread
  - Be careful of primary beam intensity shift, ask operator to check before attenuator

Stop beam, rotate the F0 stripper wheel, check if carbon stripper foil is broken
- Set F0 wheel position to 270º (Do not exceed 290º or the stripper mount hits the gas cell!!)
- Do **not** use 508 μg/cm^2 Carbon stripper with primary beam
  - (we like to have one good carbon stripper for testing with RIB charge-state)

Move F0 stripper out of beam line to safe angle (203º), insert F0 Cryogenic ^{3}He target
- Confirm beam transmission to F3 with no gas in F0 target
- Get the F0 target thickness
- Measure the ^{28}Si charge-state distribution at lower energy at F1 PPAC
  - Use F0 Havar, Carbon (550 μg/cm^2) strippers

Fill F0 ^{3}He to 200 Torr – the CRIB Optimizer has a ^{3}He density bug. **Use 1.38 mg/cm^2 for 200 Torr**
- Keep track of the pressure change at F0 as a function of time (it may increase 0.4 Torr / hour)

Tune Bρ for ^{30}S^{+16}
Insert F2 PPAC, F2 SSD
Get ^{30}S^{+16} PID via RF v. ToF plot
- Take run data at F2 PPAC/SSD so PID may be reproduced offline

^{30}S RIB Development Run Plan: 6-8 May 2008

Optimize F1 slit position by plotting slit position v. $^{30}S^{+16}$ Intensity v. Energy at F2
    Plot F1 slit position v. F2 total beam intensity
    Plot F1 slit position v. F2 $^{30}S^{+16}$ purity
    Plot F1 slit position v. F2 $^{30}S^{+16}$ intensity
Determine optimum F1 slit position

Remove F3 PPAC,MCP
Check F2 to F3 Transmission % on PSD
Insert F3 PPACa & MCP, get RF v. ToF gate for $^{30}S^{+16}$
Confirm $^{30}S^{+16}$ purity by looking at PSD for energy of particles gated in RF v. F3 ToF
    Take run data
Get purity for all RF v. ToF groups at F3, including PID for all groups
Insert F3 PPACa + MCP, get $^{30}S^{+16}$ Intensity, Energy
Turn on Wien Filter, tune for $^{30}S^{+16}$
    Calculate Wien filter Beam Transmission %, $^{30}S^{+16}$ Transmission %
    Take run data
Consider F3 slit adjustment to increase $^{30}S^{+16}$ purity at F3
    This step may be skipped if time is an issue
Calculate beam spot size at F3 (Target window 2cm in diameter)
Consider protons at PSD originating from upstream
    Take run data

Insert F3 2.5 μm havar target, get $^{30}S^{+16}$ Intensity, Energy
    Take run data

Insert carbon stripper foil (508 μg/cm^2) at F0 – for CRIB Optimizer, $\Delta x = 2.255$ μm
Retune Bρ for D1, D2
Get PID at with F2 PPAC/SSD
    Take run data

Optimize F1 slit position versus $^{30}S^{+16}$ intensity/purity as before
Get F2 $^{30}S^{+16}$ intensity, compare to $^{30}S^{+16}$ intensity at F2 without stripper
    Take run data

Remove F2 PPAC & SSD, send Beam to F3, check Wien filter transmission %
    $^{30}S^{+16}$ intensity and purity by RF v. F3 ToF
    Get $^{30}S^{+16}$ energy on PSD
        Take run data
    Insert F3 2.5 μm havar target, get $^{30}S^{+16}$ energy on PSD
    Calculate beam spot size at F3
        Take run data

At this point, we may make conclusions about the use of Carbon stripper foil at F0
    If the intensity and purity of $^{30}S^{+16}$ are not improved at F3, then the stripper foil is a bad idea

In the case that the stripper is not a good idea, we stop using it in the RIB development run

Beam tuning with F1 0.7 μm mylar degrader
- Compare F2 $^{30}S^{+16}$ intensity, purity to previous results
  - Take run data
- Compare F3 $^{30}S^{+16}$ intensity, purity to previous results
  - Take run data without F3 havar target
  - Take run data with F3 havar target

Remove F1 degrader, change F0 ^{3}He pressure to 300 Torr – Use 2.05 mg/cm^2 in CRIB Optimizer
- Repeat tuning and measurements
- Take run data at F2
- Take run data at F3 without F3 havar target
- Take run data at F3 with F3 havar target

Change F0 ^{3}He pressure to 400 Torr – Use 2.73 mg/cm^2 in CRIB Simulator
- Repeat measurements, taking run data

Consider the optimum F0 gas pressure.
If 300 Torr, 400 Torr yield better purity/intensity of $^{30}S^{+16}$ than 200 Torr:
- Test effects of F0 stripper with these higher F0 ^{3}He pressures
  - Take run data
- Test effects of F1 0.7 μm mylar degrader
  - Take run data

For $^{30}S(\alpha,p)$ measurement, we like the 10^5 pps, E_{beam} in the range of 22.5 to 32.3 MeV at F3 after havar

If some combination of CRIB parameters (F0 gas pressure, stripper, degrader) get us close to these results, then we should optimize Bρ and slit positions for purity/intensity at F3

If we the beam energy at F3 after havar is < 20 MeV, or the count rate is 10^4 or less, then we scan $^{30}S^{+14}$

With $^{30}S^{+14}$, we try F0 pressures 200, 300, 400 Torr
- Take run data

Simulations are less conclusive for the value of C stripper charge state enhancement of $^{30}S^{+14}$, so if time is a factor, skip this step
Consider degrader effects for $^{30}S^{+14}$
- Take run data

If we are still unsatisfied with the ^{30}S RIB, we may consider $^{30}S^{+15}$ states
- F1 1.5 μm mylar degrader may be useful here, as we must work very hard to separate the $^{28}Si^{+14}$ contamination