Heavy Element Separator for High-Intensity Beams

Ken Gregorich, Lawrence Berkeley National Laboratory

Last Town Meeting:

- First SHE confirmations were coming in
- Production rates of 1 atom per week
- Basic SHE properties: decay mode, decay energy, half-life
- First spectroscopy near Z=102, N=152 (in-beam and isomer decay)

During the last seven years:

- Confirmation of elements 112, 114, 115, 116, 117: Most nuclides confirmed
- Production rates as high as 1 atom per day
- First gamma-ray spectroscopy with SHE
- Detailed spectroscopy near Z=102, N=152 (in-beam and isomer decay)

Near Future (with new detector systems and higher beam intensities):

- Production of hundreds to thousands of SHE atoms
- Determination of SHE electromagnetic decay multipolarities, spins, parities
- Identification of SHE single-particle states, and their energy ordering/spacing
- Mapping single-particle stateses and nuclear shapes from Z=100 through SHE

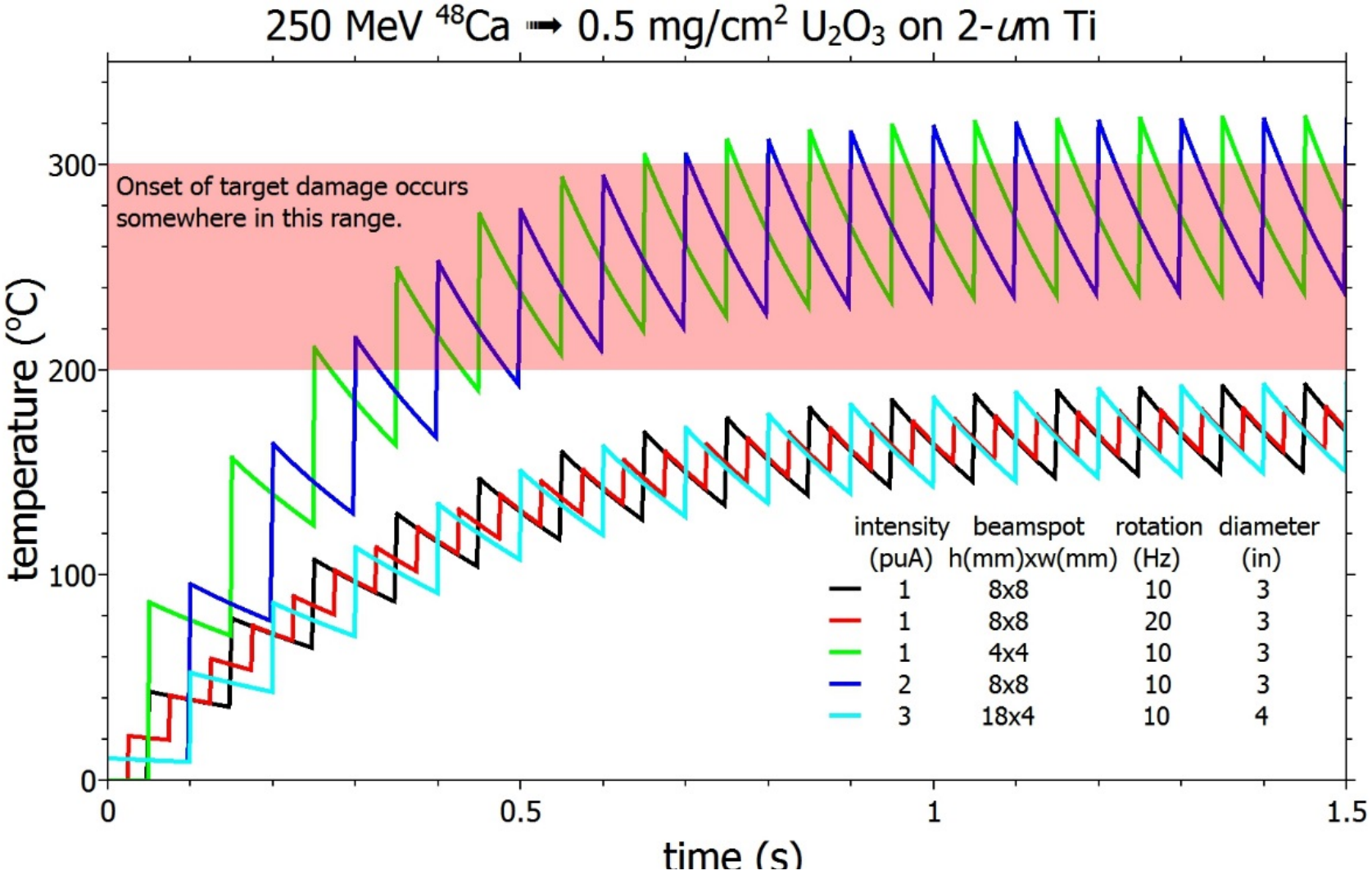
Heavy Element Separator for High-Intensity Beams

Beam intensities will increase from ~1 puA today to 10 puA at ATLAS, SHE factory

Present heavy element separators cannot handle these higher beam intensities

- Target heating
- DSSSD background rates
  - Best at present is 200Hz/puA -> 2 kHz @ 10 puA
  - Correlation rates scale as R^f where f is the correlation fold
  - DSSSD radiation damage
- Gamma rates
  - Best at present is 10 kHz/puA -> 100 kHz @10puA

Finite Element Analysis of Target Heating



Conclusion: Beam handling capability is proportional to target area

For 10 puA beams, a 200cm^2 target is required . . . 100 mg of actinide

Live-time monitoring of beam intensity and uniformity is required

Requirements for a New Heavy Element Separator

Large area target to spread out beam power – separator requires innovative magnetic optics

Uniform large area beamspot – precisely designed beamline

Fast beam uniformity monitoring and beam shutoff – CCD of gas glow in differential pumping

High-dispersion, large separation factor to reduce background at detector

Reduce Bp dispersion after separation to reduce image size at detector

Local gamma shielding at target

Gamma-shielded beamstop

Gamma shielding at detector

Prevent evaporated protons from reaching detector

Limit scattering opportunities for beam and transfer products

Estimated cost for separator and beamline: $10M

Please contact me if you are interested in helping with the design, and proposal.

Additional Requirements: 100 mg quantities of actinides (^{244}Pu, ^{243}Am, ^{248}Cm, etc.)

multi-gram quantities separated isotopes for beams (^{48}Ca, ^{50}Ti, etc.)