

Mass Determination at the BGS

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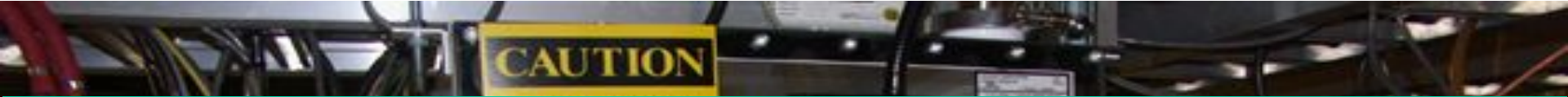
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The Goals



- 1) Collect recoils after separation with the BGS
- 2) Separate by mass
- 3) Transport to low-background counting station
- 4) Quickly and
- 5) Efficiently



The Science



Direct mass number measurement for superheavy elements: *Present assignments are probably correct, but must be proven.*

Exploration of electron-capture decay the neutron-deficient actinides by studying γ -rays coincident with K x-rays: *Determination of single-particle states.*

Evolution of nuclear shapes between $N=152$, $N=162$, and $N=184$: *Where does the transition from deformed to spherical begin?*

A identification of spontaneous fission (SF) activities in the actinides and transactinides: *Clean up SF systematics.*

Study EC-delayed fission in the actinides: *provide information on fission barriers and fission isomers.*

The Parts

This
Is new

BGS

Window

Gas
Catcher

RFQ
Trap 1

RFQ
Trap 2

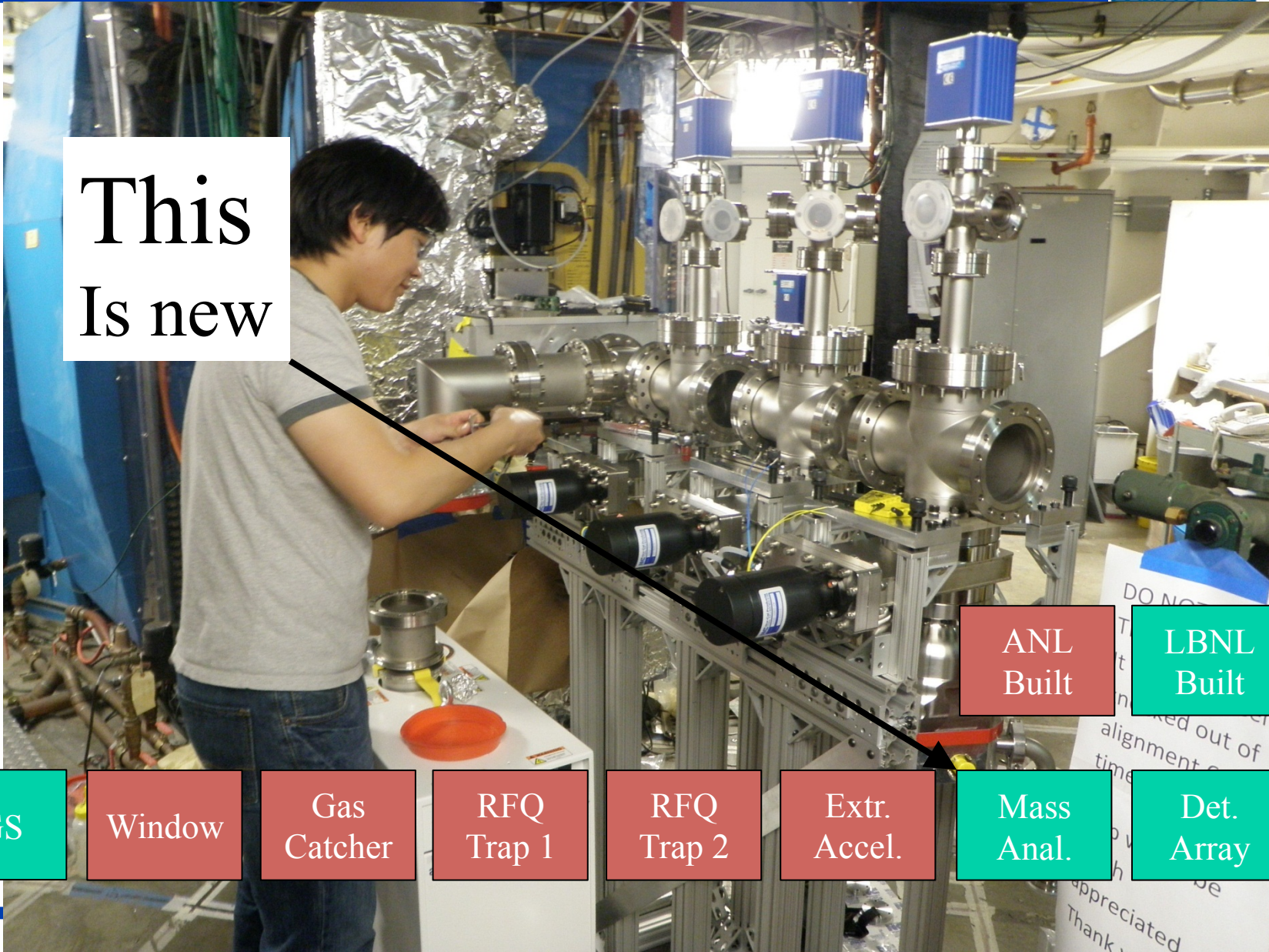
Extr.
Accel.

Mass
Anal.

Det.
Array

ANL
Built

LBL
Built



Requirements



- Separation of 6 masses on width of C^3 (~ 9 cm)
- Determination of implantation time (*halflives*)
- $M/\Delta M > 500$ (*single atom A assignments for SHE*)
- High efficiency ($> 20\%$)
- Low extraction voltage from RFQ (*no HV platform*)
- Fit within existing space in cave 2 (*adjacent to BGS*)

Separators Considered



Time of flight

Reflectron can separate 1+ and 2+ simultaneously

Large longitudinal emittance results in long device

Magnetic

Simple operation

Expensive magnet (OASIS magnet is gone!)

Wien Filter

Insufficient dispersion

Trochoid separator

Large dispersion

Adjustable

M/q separation is independent of just about everything

Parallel beam and stable acceleration voltage required

Why do no medium resolution trochoid separators exist?

Trochoid separator:



Wien Filter:

Trajectories are trochoids:

selected velocity has amplitude=0

For maximum separation, E, B, length chosen for $\frac{1}{4}$ period of rotation

Trochoid Separator

Reduce E and looping trajectories result

Two or more full rotation periods results in large m/q dispersion

Equations of motion indicate good properties for mass separation

Critical values: Initial angle, acceleration voltage

Initial Work Plan:

Characterize test separator using existing 0.5T magnet

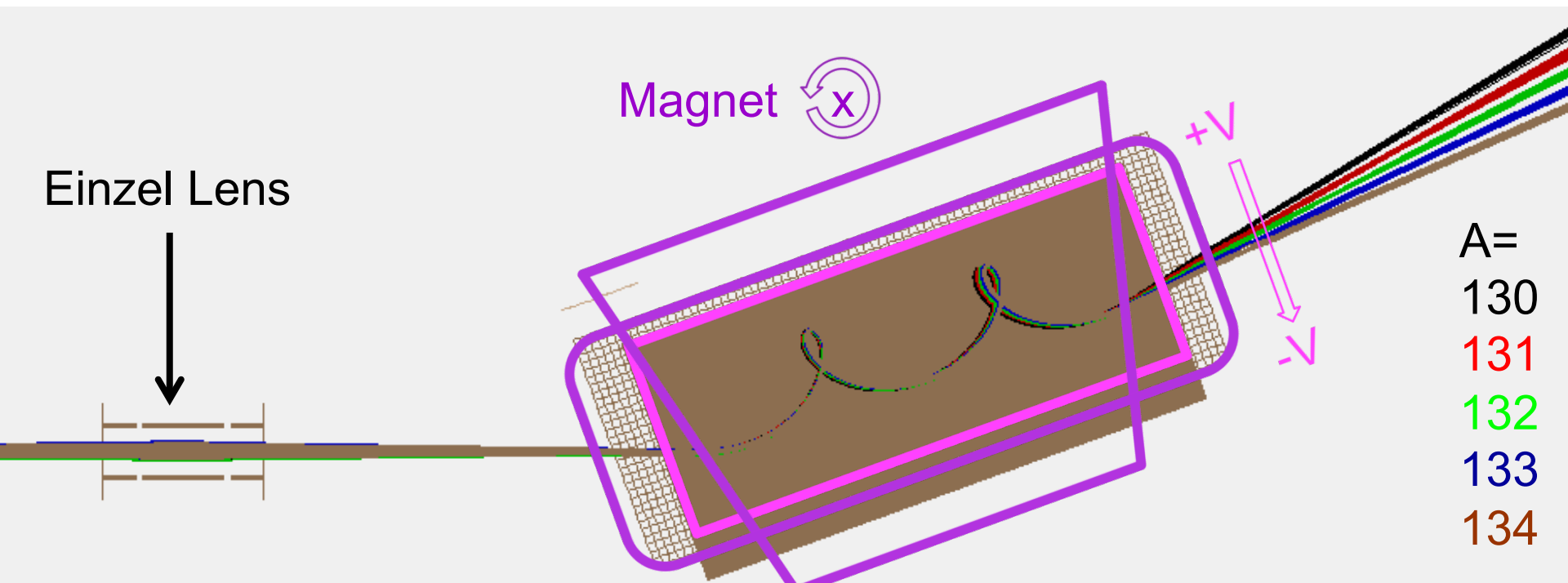
collimate ion source beam to expected transverse emittance

use optical imaging system for Xe^{1+} beams from ion source

Identical trajectories for $^{136}\text{Xe}^{1+}$ and $^{272}\text{SHE}^{2+}$

Identical trajectories if V_{acc} and B/E scaled together

Simulations with SIMION



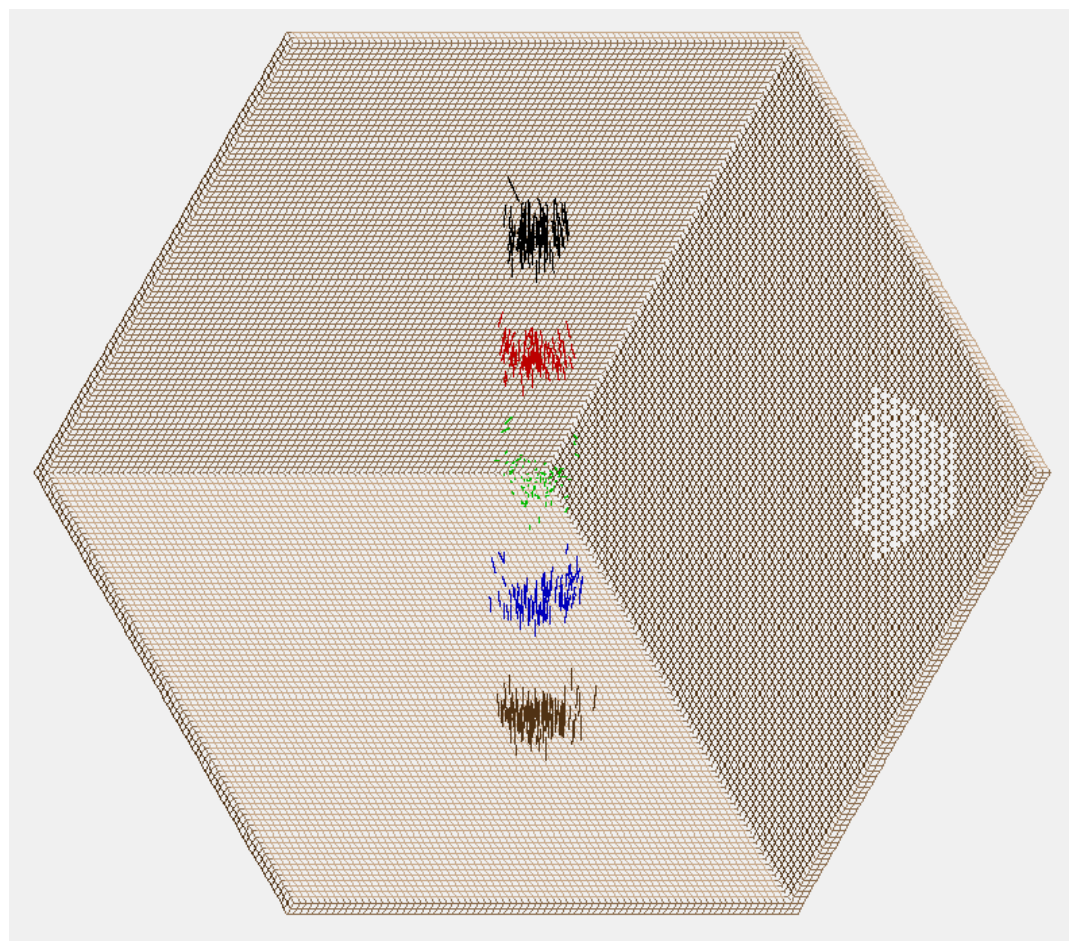
Einzel Lens

Magnet \otimes

- A=
- 130
- 131
- 132
- 133
- 134

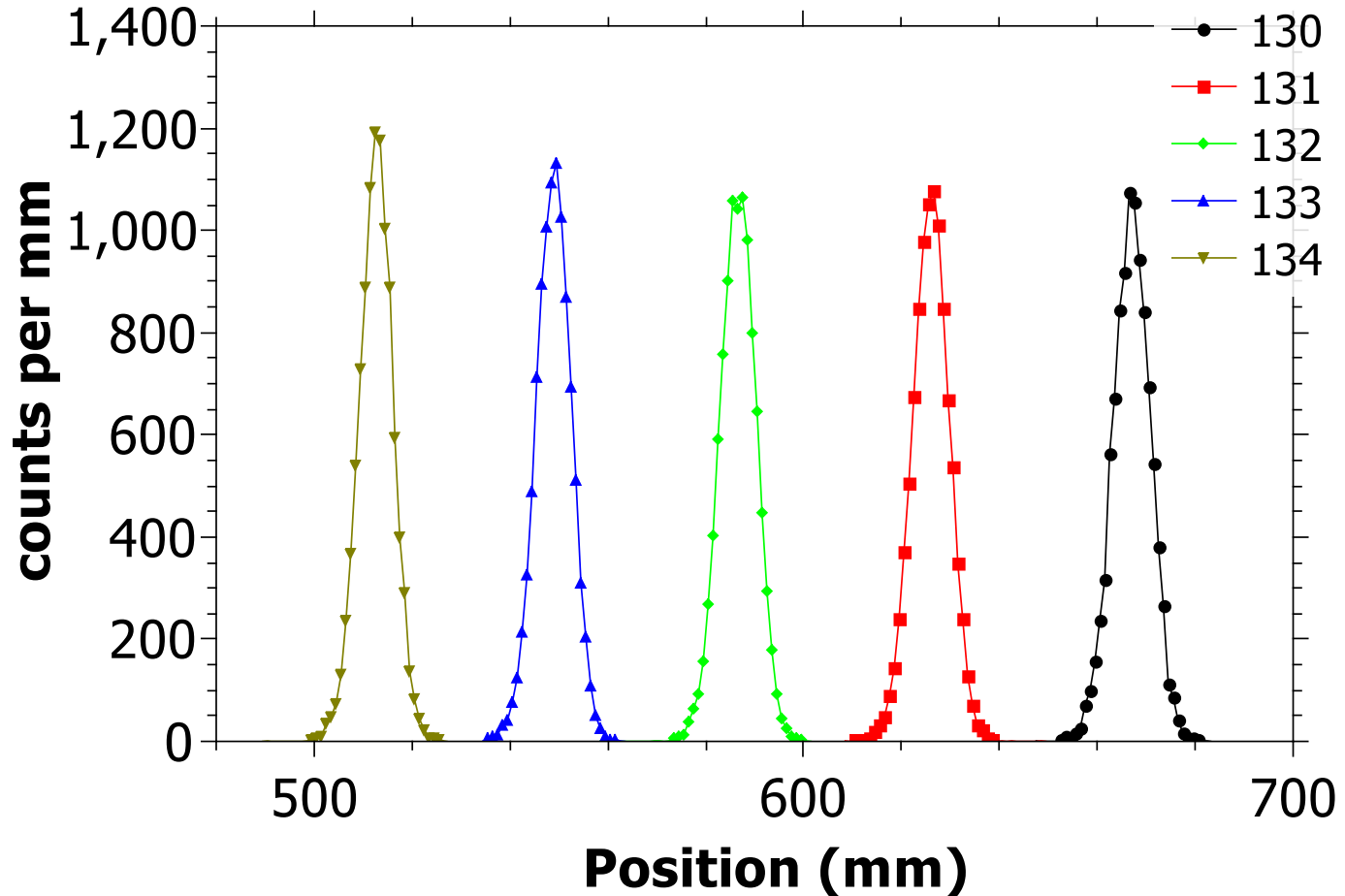
Electrode

FPD image

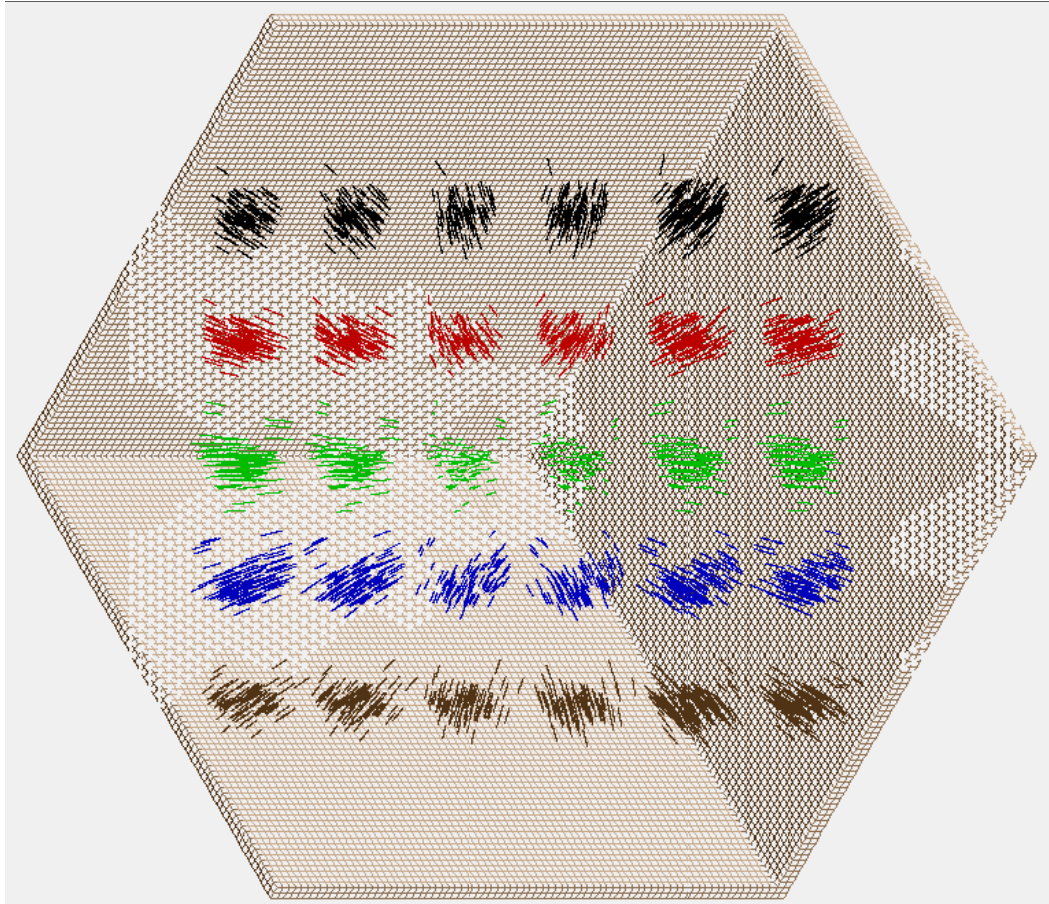


A=
130
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FPD image



How to get time information



A=
130
131
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134