I will **not** talk about everything, namely:

- Intermediate Coulomb excitation experiments at MSU with the TF technique
- Recoil in vacuum (RIV) at ORNL, ANL
- $\beta$-NMR, etc...

*These require more instrumentation than the experiments I would like to start with, as well as complex calibrations although they are a good option for future experiments.*

I will mention possible Transient Field (TF) measurements with CARIBU beams.
Measurements of magnetic moments of ps states with radioactive beams

Motivation: Microscopic structure of individual low-lying states in nuclei far from stability, with TF techniques and Coulomb excitation in inverse kinematics.

Needs: Beams: intensity ~ $10^5$ ions/sec

isobaric purity

Instrumentation: four Clovers + one Ge

solar cells or PIPS particle detectors
digital electronics

Cooled targets

Caveats: every nucleus has its own challenges stemming from its spectroscopy
Mixed-symmetry states in Zr isotopes

$g$ factors of $2^+$, $3^-$ and $4^+$ states in Zr isotopes

Neutron holes in the $g_{9/2}$ orbital
What’s new?

New DAQ techniques

Digital electronics + Clovers

Angular correlations measured directly from the split Clover detectors simultaneously with precession measurements
Transient field technique in inverse kinematics

Particle – gamma coincidence mode
The transient field setup: ORNL

Disadvantage: probe ions decay in flight, i.e. reduction of the anisotropy, an important ingredient in the analysis.

Advantage: target is thinner, less scattering of beam.

Solid angle subtended by detectors: 19° – 47°
Hole diameter: 20 mm
Tgt-det distance: 30 mm
Only C ions scatter into the detector.
\textbf{\textsuperscript{76}Kr setup: LBNL}

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure.png}
\caption{Diagram of the \textsuperscript{76}Kr setup at LBNL, showing the \textsuperscript{76}Kr beam interaction with targets of Mg, Gd, and Cu, and the detection of gamma rays and scattering nuclei.}
\end{figure}

\textit{Coincidence between gamma rays and scattering nuclei}
### Examples:

<table>
<thead>
<tr>
<th>Element</th>
<th>Mass Numbers</th>
<th>Source</th>
<th>Production Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^{76}$Kr</td>
<td></td>
<td>LBNL</td>
<td>Recyclotron technique</td>
</tr>
<tr>
<td>$^{132,134,136}$Te</td>
<td></td>
<td>ORNL</td>
<td>ISOL production</td>
</tr>
<tr>
<td>$^{38,40}$S</td>
<td></td>
<td>MSU</td>
<td>Fragmentation</td>
</tr>
<tr>
<td>$^{38,40,42}$Ar</td>
<td></td>
<td>MSU</td>
<td>Fragmentation</td>
</tr>
<tr>
<td>$^{126}$Sn</td>
<td></td>
<td>ORNL</td>
<td>ISOL production: coming attraction</td>
</tr>
</tbody>
</table>
Beam intensity considerations:

Stable: 1 pnA = 0.6 x 10^{10} p/s

\[
\begin{array}{ccc}
^{132}Te & 4 \times 10^7 \\
^{134}Te & 2 \times 10^6 \\
^{136}Te & 5 \times 10^5 \\
^{38}S & 2 \times 10^5 \\
^{126}Sn & 1 \times 10^7 \\
^{128}Sn & 3 \times 10^6 \\
^{132}Sn & 9 \times 10^5 \\
^{134}Sn & 3 \times 10^3 \\
^{126}Sn & \\
\end{array}
\]

Future at ORNL: 
MSU campaign: Fe
CARIBU Beam Yields for Representative Species

Updated July, 2009

<table>
<thead>
<tr>
<th>Isotope</th>
<th>Half-Life (s)</th>
<th>Low-Energy Beam Yield (ions/sec)</th>
<th>Accelerated Beam Yield (ions/sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>104Zr</td>
<td>1.2</td>
<td>1.5x10^3, 4.8x10^4, 6.0x10^5</td>
<td>5.3x10^1, 1.7x10^3, 2.1x10^4</td>
</tr>
<tr>
<td>143Ba</td>
<td>14.3</td>
<td>3.0x10^4, 9.6x10^5, 1.2x10^7</td>
<td>1.1x10^3, 3.4x10^4, 4.3x10^5</td>
</tr>
<tr>
<td>145Ba</td>
<td>4.0</td>
<td>1.4x10^4, 4.4x10^5, 5.5x10^6</td>
<td>5.0x10^2, 1.6x10^4, 2.0x10^5</td>
</tr>
<tr>
<td>130Sn</td>
<td>222</td>
<td>2.5x10^3, 7.8x10^4, 9.8x10^5</td>
<td>9.0x10^1, 2.9x10^3, 3.6x10^4</td>
</tr>
<tr>
<td>132Sn</td>
<td>40</td>
<td>9.3x10^2, 3.0x10^4, 3.7x10^5</td>
<td>3.5x10^1, 1.1x10^3, 1.4x10^4</td>
</tr>
<tr>
<td>138Xe</td>
<td>846</td>
<td>2.5x10^4, 7.8x10^5, 9.8x10^6</td>
<td>1.8x10^3, 5.8x10^4, 7.2x10^5</td>
</tr>
<tr>
<td>110Mo</td>
<td>2.8</td>
<td>1.6x10^2, 5.0x10^3, 6.2x10^4</td>
<td>5.8x10^0, 1.8x10^2, 2.3x10^3</td>
</tr>
<tr>
<td>111Mo</td>
<td>0.5</td>
<td>8.3x10^0, 2.6x10^2, 3.3x10^3</td>
<td>0.3x10^0, 9.6x10^0, 1.2x10^2</td>
</tr>
</tbody>
</table>
$g$ factors of low-lying states in stable Xe isotopes

Jakob et al., PRC 65, 024316(2002)