Newport Kappa Diffractometer Incident at 7ID-C

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Presentation for APS Technical Working Group, 10/16/03

For further info, see

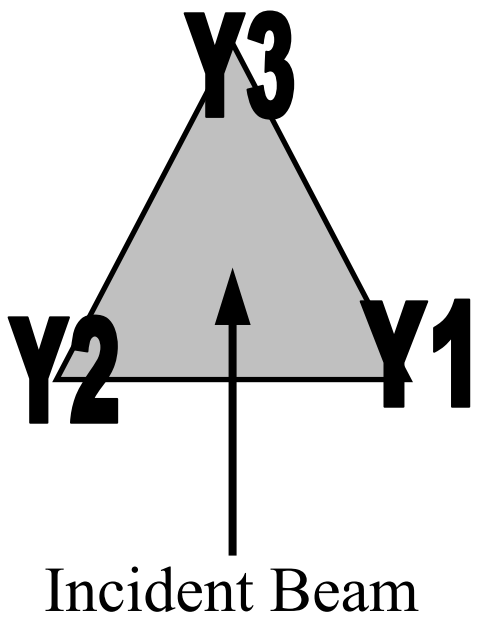
http://www.mhatt.aps.anl.gov/~walko/kappa_damage

Background: Vertical jacks on the kappa

- Newport kappa diffractometers are supported on three vertical jacks (Y1, Y2, Y3)
- Plus 2 horizontal motions=almost kinematic base (does not move parallel to beam)

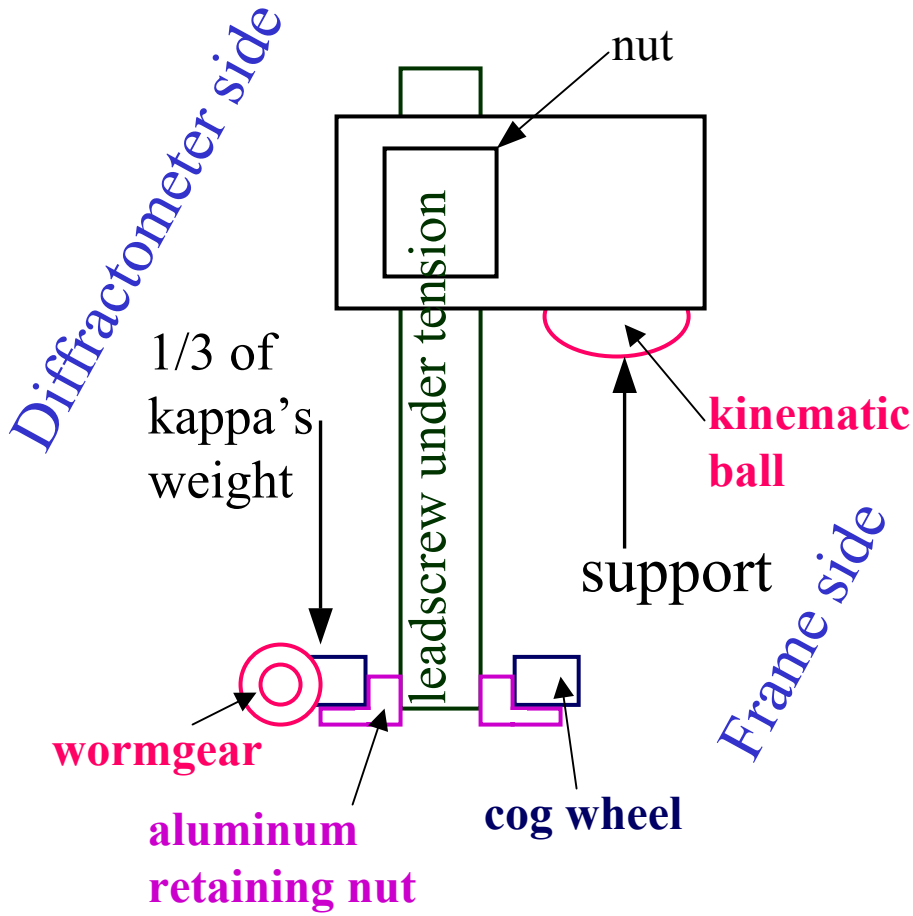
- How the jacks work…

Top view of jacks:



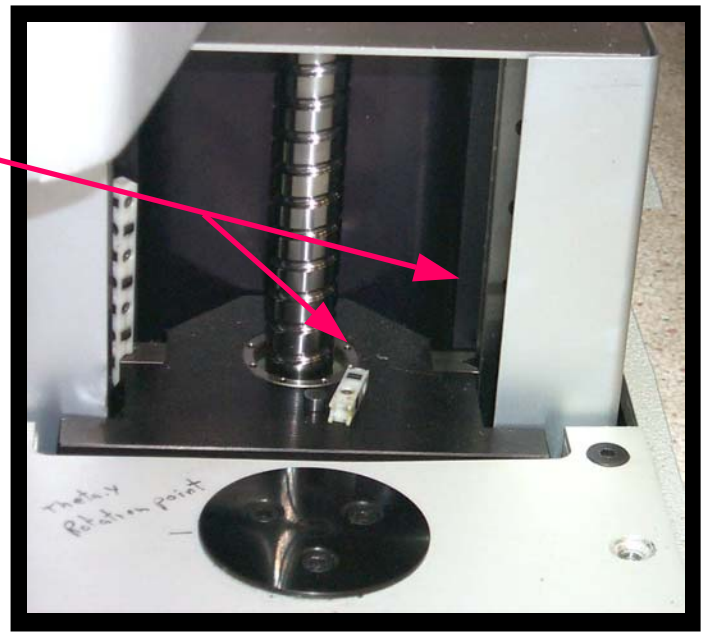
How the jacks work (highly schematic view):

- Stepper motor turns wormgear
- Wormgear rotates cog wheel
- Leadscrew is held to cog wheel by retaining nut
- Leadscrew--in tension--rotates and climbs up or down on stationary nut
- Slides: V grooves w/ cross-roller bearings



Timeline of MHATT-CAT kappa problems

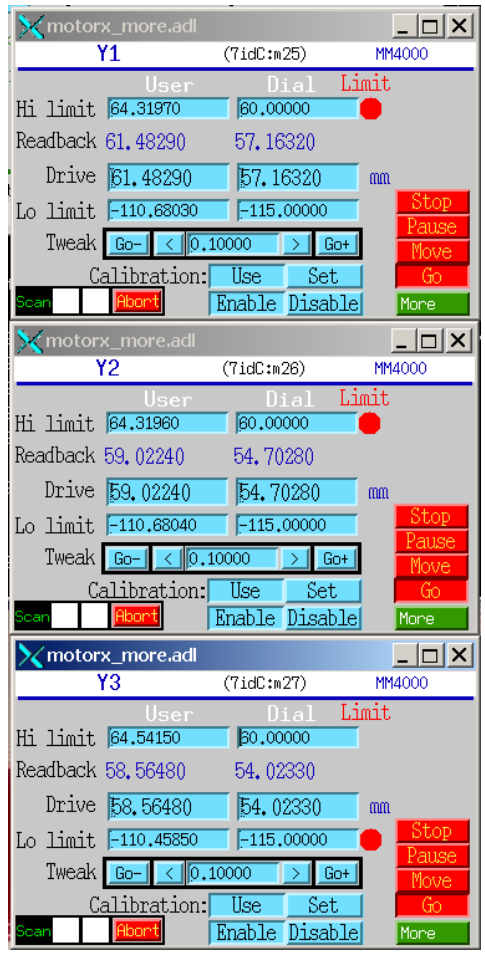
- 8/1998: Installation & acceptance
- 5/2001: Damage from overtilting:
  - Slides (V grooves and crossroller bearings) damaged
  - "Tilt" limit switch had been installed backwards! Once tilted too far, could not make level again.
  - Newport repaired at MHATT-CAT expense



- 5/2003: Y1 jack not moving:
  - Motor turns but jack doesn't raise/lower
  - Leadscrew gouged, therefore replaced
- 8/2003: Y2 jack occasionally wouldn't move upwards:
  - Motor would whine loudly, not move
  - Tried greasing the slides…

How it happened:

- To grease the slides, first moved kappa to (approx.) lowest allowed position & greased exposed V grooves
- Then moved to approx. highest position: All three motors were moving together to +59.9 mm (upper limit is +60 mm); kappa was basically level
- When jacks were almost to their highest point, heard a *crash*



The damage: Y1 jack failed & the diffractometer fell

Y1 jack severely damaged, granite base cracked

More views of the damage

- The Y2 jack was lifted off its seat, resting on a corner (Y3 was still seated)
- The Y1 leadscrew snapped in two
- Y1retaining nut in several pieces

Stabilization of kappa

- Jaques Bosse from Newport visited over weekend of 10/3-5/03
- ANL Riggers lifted and stabilized kappa; blocked it up on wood
- Kappa was then floated outside of hutch on its airpads
- We need to quickly comission another diffrac-tometer to use in 7ID-C until the kappa is repaired

What we think happened

- Small aluminum retaining nut failed
- Without retaining nut, nothing keeps diffractometer from falling
- Possible that slide started failing first (& increased load on retaining nut)
- leadscrew split when pushed from side while diffractometer was collapsing (ie, secondary effect)

- Note that Newport has apparently been redesigning their jacks and even retrofitting other diffractometers

Repairs needed from Newport

- Redesigned Y1, Y2, and Y3 jacks (no cross-roller bearings)
- New granite base
- Other repairs of secondary damage (fiber optic, base cover) and any hidden damage
- Careful assessment of bearing damage and realignment of all axes; replacement of damaged circles if necessary

Present situation: Waiting to hear back from Newport…