APF Spectrograph Stages and I/O

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Updated: February 17, 2004

Purpose – this document describes the opto-mechanical sub-assemblies comprising the APF spectrograph. These components move and/or change electrical state under computer control, and are referred to as “stages”. They are defined in terms of the actuators, mechanical slides, sensors, and inputs associated with them.

Hatch – this is a barrier, serving as a dust and debris shield when the spectrograph is offline.

- Operation: binary linear motion (fully open / fully closed)
- Mechanism: linear slide, timing belt gear train
- Travel: approximately 125 mm
- Repeatability: 0.25 mm or better
- Motor/Controller: Galil
- Primary limits: Hall Effect
- Secondary limits: electromechanical switch (Honeywell Microswitch)
- Dedicated home sensor: Hall Effect at closed position
- Primary (motor rotation) encoder: incremental rotary (Galil)
- Secondary (load) encoder: incremental linear (inductive or capacitive strip, as used in digital calipers - TBD by Lee)

Guide Camera Focus Stage – stage moves a TV Guider camera, fed by a fixed, 4% reflectance pellicle, in and out of focus as needed. Camera will be initially provided by EOST, but may later be replaced with a “Wei camera”.

- Operation: continuously variable, linear motion
- Mechanism: linear stage driven with a ball/lead screw
- Travel: approximately +/- 15 mm from a nominal home position
- Repeatability: 0.1 mm or better
- Motor/Controller: Galil
- Primary limits: Hall Effect
- Secondary limits: electromechanical switch (Honeywell Microswitch)
- Dedicated home sensor: Hall Effect at center of range
- Primary (motor rotation) encoder: incremental rotary (Galil)
- Secondary (load) encoder: incremental linear (inductive or capacitive strip, as used in digital calipers)

Calibration Source Mirror Stage – positions a mirror in/out of light path in order to inject calibration light into spectrograph. Motion is in plane of mirror to minimize aiming errors generated by stage.

- Operation: binary linear motion, in plane of mirror
- Mechanism: linear stage driven with a ball/lead screw
- Travel: approximately 50 mm
- Repeatability: 0.25 mm or better
- Motor/Controller: Galil
- Primary limits: Hall Effect
- Secondary limits: electromechanical switch (Honeywell Microswitch)
- Dedicated home sensor: Hall effect at “out-of-beam” position
- Primary (motor rotation) encoder: incremental rotary (Galil)
- Secondary (load) encoder: incremental linear (inductive or capacitive strip, as used in digital calipers)

Calibration Light Source Stage – selects from one of five light sources, three of which are currently defined. Their light is sent through fixed optics and a pupil plate, and is directed onto the Calibration Source Mirror mentioned above.

- Operation: variable linear motion, with 5 discrete stopping positions
- Mechanism: linear stage driven with a ball/lead screw
- Travel: approximately +/- 100 mm
- Repeatability: 0.25 mm or better
- Motor/Controller: Galil
- Primary end of travel limits: Hall Effect
- Secondary end of travel limits: electromechanical switch (Honeywell Microswitch)
- Dedicated home sensor: Hall Effect at middle stopping position
- Primary (motor rotation) encoder: incremental rotary (Galil)
- Secondary (load) encoder: incremental linear (inductive or capacitive strip, as used in digital calipers)

The light sources are:

- Primary Thorium – this is envisioned as a pair of individually filtered thorium hollow cathode lamps (thorium-argon and thorium-neon) whose output is combined with a 50% “polka-dot” beamsplitter. Alternatively, a single thorium lamp, filled with a mixture of 90% neon and 10% argon, may be used. Each lamp is to be driven with a dedicated power supply, and will be either fully on, or off. Power supply current sensing will be used to confirm lamp operation.

- Secondary Thorium (hot backup) – same configuration as primary. If either of the primary sources should fail, the backup set would be used in its place. A separate set of dedicated power supplies should be used here as well.

- Integrating Sphere - contains a pair of filtered halogen light sources, 10 watt and 50 watt, operating in unison or independently. There is an additional pair of halogen lights, serving as a hot backup. Input is on/off, independent for each light. Four dedicated power supplies, with current sensing are needed. Presumably, the primary halogens and their backups could be mixed and matched depending on which lamps have failed.

- Additional light source, possibly a laser diode

- Additional light source or TV camera

NOTE – how do we deal with the heat generated by these sources???

Iodine Cell Stage – carries a cell containing iodine vapor, and an optically equivalent clear compensation window. The stage can position either one into the beam feeding the spectrograph, or neither of them (clear aperture condition). The iodine cell operates at 50 degrees C., and will require a dedicated power supply, along with current and temperature sensing. A cooling fan will be used to move residual heat away from the spectrograph optics. Fan health will be need to be sensed and monitored.

- Operation: variable linear motion, with 3 discrete stopping positions
- Mechanism: linear stage driven with a ball/lead screw
- Travel: approximately +/- 75 mm
- Repeatability: 0.25 mm or better
- Motor/Controller: Galil
- Primary end of travel limits: Hall Effect
- Secondary end of travel limits: electromechanical switch (Honeywell Microswitch)
- Dedicated home sensor: Hall Effect at middle stopping position
- Primary (motor rotation) encoder: incremental rotary (Galil)
- Secondary (load) encoder: incremental linear (inductive or capacitive strip, as used in digital calipers)

Slit TV – this is a commercial web/video camera with built-in remotely manual focusing, suitable for viewing close objects. Will NOT be under Galil control – TBD by Lee.

Slit Decker – precision linear stage carrying a thin plate with ten fixed-sized precision slits and round apertures.

- Operation: variable linear motion, with 10 discrete stopping positions
- Mechanism: precision linear stage driven with a ball/lead screw
- Travel: approximately +/- 40 mm
- Repeatability: 0.1 micron or better
- Motor/Controller: Galil
- Primary end of travel limits: Hall Effect
- Secondary end of travel limits: electromechanical switch (Honeywell Microswitch)
- Dedicated home sensor: Hall Effect at middle stopping position
- Primary (motor rotation) encoder: incremental rotary (Galil)
- Secondary (load) encoder: incremental linear – Renshaw

Shutter – commercial, high reliability, large MTBF, normally closed iris or planar shutter. Operation is binary; either fully open or fully closed. Need to be able to sense state. Will NOT be under Galil control. Note – heat may be a concern, depending on power consumption while open. Shutter manufacturer and model TBD

Propeller Mirror with Exposure Meter – possibly needed instead of Guide camera.

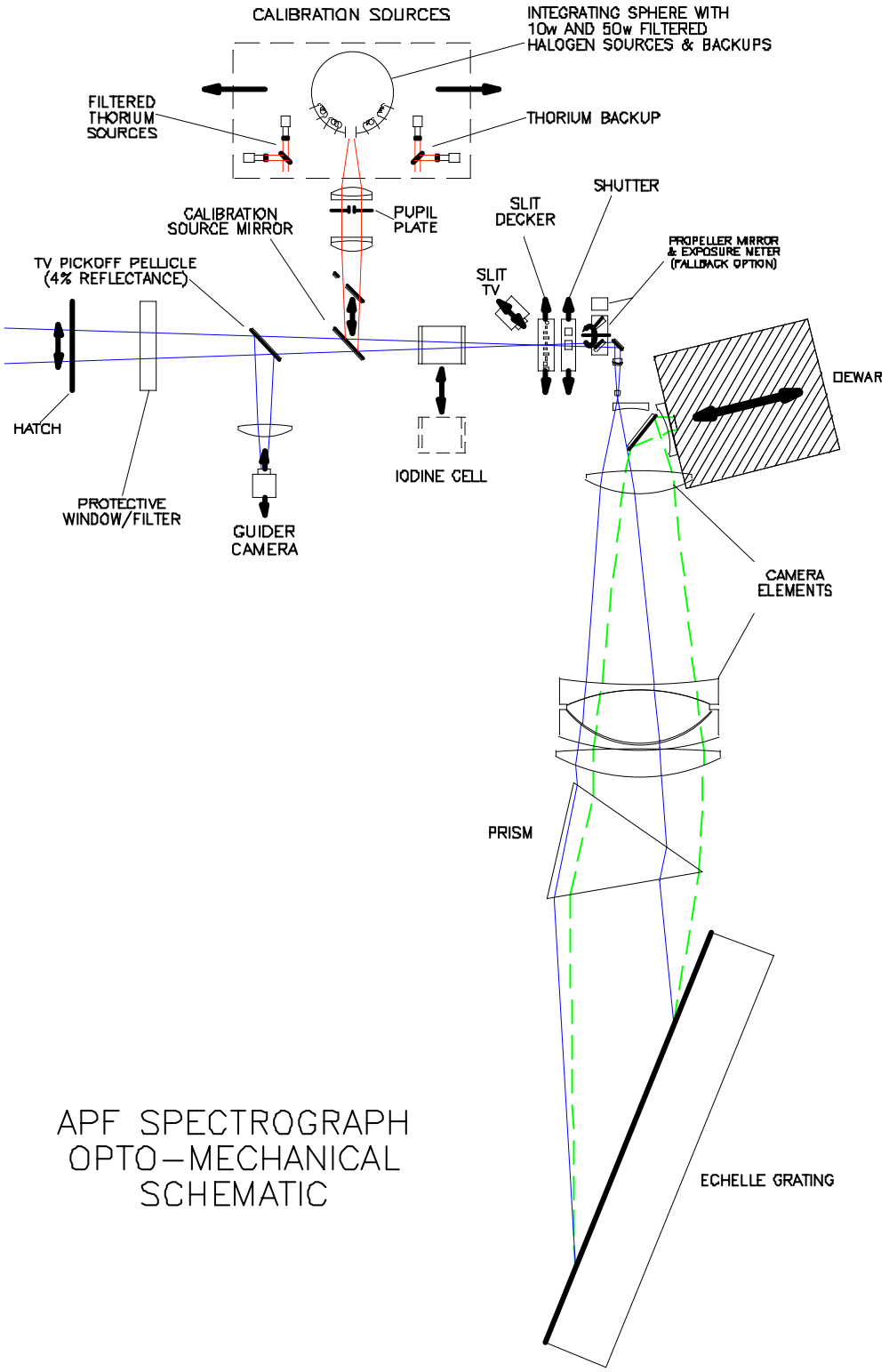
- Operation: continuous rotary motion at a set speed, or stopped at home position
- Mechanism: mirror mounted directly to motor shaft
- Motor/controller: Galil
- Dedicated home sensor: Hall Effect
- Primary (motor rotation) encoder: incremental rotary (Galil)
- Secondary (load) encoder: none

Dewar Focus Stage – focuses CCD by moving entire dewar with respect to spectrograph's outgoing light beam. Note – there is potential difficulty with placing the limit and home sensors/switches, due to the small amount of stage travel.

- Operation: variable linear motion, in 5 micron steps
- Mechanism: linear stage driven with a ball/lead screw
- Travel: approximately +/- 1.0 mm
- Repeatability: 1.0 micron or better
- Motor/Controller: Galil
- Primary end of travel limits: Hall Effect
- Secondary end of travel limits: electromechanical switch (Honeywell Microswitch)
- Dedicated home sensor: Hall Effect at middle of range
- Primary (motor rotation) encoder: incremental rotary (Galil)
- Secondary (load) encoder: incremental linear – Renshaw

General Notes

- Output resolution of primary motor controller should be at least four times finer than that of secondary encoder.
- Where used, stray light from Renshaw encoder heads must be thoroughly baffled from Spectrograph.
- If feasible, a secondary encoder that does not rely on a light-based reading mechanism will be used when possible.
- Ref: Accompanying sketch below



APF SPECTROGRAPH OPTO-MECHANICAL SCHEMATIC

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