POST-FOCUS DETECTORS FOR SOLAR SPECTROGRAPH (PFDSS)

AISAS REMARKS TO THE ORIGINAL CONCEPTUAL PROPOSAL OF HAO

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Acronyms:

BS – dichroic beam splitter
CAM – camera
LEN – divergent achromatic lens system
PC – polarizing beam splitting cube
PFDSS - post-focus detectors for solar spectrograph

Remarks:

1. basic concept – main parts: skeleton(s) + baseplate + insulation + coverings

2. basic concept – compartments: one optical compartment above the baseplate and one electronics compartment below the base plate

3. basic concept – assembly: the baseplate with two metal skeletons above/below (as a sandwich) or the baseplate mounted into a single skeleton

4. basic concept – skeleton technology: skeleton(s) prepared using the same technology as in the case of the Filter module

5. basic concept – single baseplate solution: no need for intermediate platforms for separate VIS and IR channels (PC, 2 CAMs) above the baseplate – this single baseplate solution to reconsider taking into account also the other alternatives listed below

6. basic concept – fixing: fixing the PFDSS to the back side of the Filter module using existing holes for screws in the inner ribs as it is for the old Camera module or using existing holes for screws on the outermost ribs

7. Maximum dimensions of the PFDSS: X (47 or up to 60) x Y (49) x Z (40 or more)

   - Y = axis along the optical axis of the coronagraph:
     49 cm – this is the maximum between the rare part of the Filter module and the floor in the dome, skeleton only up to 47 cm

   - X = axis parallel to a baseplate of the PFDSS and perpendicular to Y:
     47 (60) cm – (47 cm is Y dimension of the Filter module), in case of a need for more space up to 13 cm can be added on the side opposite to the Harting connector, i.e. max. 60 cm)

- Z = axis perpendicular to the baseplate of the PFDSS and perpendicular to X:
  40 cm or more – (40 cm is this dimension of the Filter module)

8. LEN attached directly to the output end of the Lyot filter with the only one positioning along the the optical axis rotating the whole LEN on a large diameter thread

9. BS, PCs, CAMs optical parts fixed to the baseplate of the PFDSS

10. XY mechanical positioners for fixing BS, and PCs to the base plate in order to allow a fine shift of these mechanical parts

11. mechanical height adjustment of the optical parts BS, PCs in the Z axis

12. a mechanical tilt of the of the BS, and PCs relatively to the passing light beam (at least 3 points)

13. positioners for CAMs: manual adjustment in axes perpendicular to the light beam (Z and the other axis, motorized adjustment along the beam axis (range of ~12.5 mm), the computer controlled LabView operation of positioners

14. an auxiliary VIS laser (with VIS to IR light conversion – still within the spactral respponse of the IR cameras) and a mechanical holder for mounting in front of the PFDSS body for an adjustment of all optical parts in a lab at HAO and Lomnicky Peak Observatory

15. ZEMAX calculations of the optics and location relatively to the Filter module and the coronagraph providing the ZMX files

16. the IR cameras Goodrich GA1280J with synchronized data acquisition using an external TTL trigger with 2 cards in one dedicated computer

17. three Thinklogical FL extenders for data download from the cameras to the server room (same system as already used for existing Camera Module – 2 for IR cameras, 1 as a spare one)

18. enough space behind the cameras for cables and for a hand for mechanical adjustment of the stages

19. ribs for holding the electronics in the electronics compartments perpendicular to the base plate

20. optimizing a weight balance of the PFDSS by distribution its internal parts as much as possible

21. purchase spare LEN, BS, PCs, and FL extender

22. side and back coverings as plain metal sheets, upper and bottom covering with corners

23. more ribs/stiffeners inside the optical compartment to better mechanical stability

24. no new NI boards to purchase an use the original board already installed in the 19inch box in the dome

25. spare insulation sheets for later improvement of insulation effect

26. a general list of adjustment of all optical parts:
    - LEN rotation along the Y axis revolving the whole lens in a thread
    - BS, PCs: X,Y axes – translation by the XY mechanical stages; Z axis - a mechanical adjustment of all parts in their XY stages; tilt - 3-point mechanical tilting of optical parts
    - CAMs – the axes perpendicular to the light beam: mechanical axes of the XYZ stages, axis along the beam (focusing) – the motorized axis of the XYZ stages; tilt – movements of the whole XYZ stages in broader holes in the baseplate

27. Order of a possible simplifying the whole system but making it adjustment much more difficult: 1 – replacement of the motorized translations for focusing the CAMs by a mechanical one; 2 – the XY stages for BS and PCs skipped from the system. We do not advice to perform these simplifications.

Alternative concepts to consider as well:

- an intermediate baseplate for each (VIS and IR) channel (2xCAM + PC) with own XY(Z) adjustment and tilt
- LEN fixed to the baseplate instead to the end of the Lyot filter

Impossible solutions:

- LEN in the front panel of the PFDSS
- 2 different computers for VIS and IR cameras

Sharing of duties:

HAO/Boulder: optical calculations, development and fabrication of the PFDSS structure, purchase of all parts, assembly of the PFDSS and adjustment of all optical parts, development/management of a '2in1' solution with a Labview code for the IR cameras using an external trigger – leadership with support of Goodrich and related companies and Matus Kozak, tests with all electronics parts using a new dedicated computer, transport of the PFDSS with all parts to Tatranska Lomnica

AISAS/Boulder: understanding operation of the Goodrich cameras using LV and support of HAO in this work, dismounting/assembly/dismounting of the optical system at HAO

AISAS/Tatranska Lomnica: delivery of PFDSS with all parts to the Lomnicky Peak Observatory, assembly of the optics, electronics, and mechanics of the PFDSS, optical adjustment of the optics, performance tests of the electronics, incorporation of the LabView code for the IR cameras to the CoMP-S general code with operation of the existing PCO VIS cameras

Schedule of the project:

- April: contract signed (end of the project March 31, 2013)
- May: contract approved by the Slovak grant agency ASFEU
- May: money transfer – first installment
- July - September: all HAO actions for the preparation of the PFDSS
- October: money transfer – second installment
- October - November: visit of Matus (and Jaro) to HAO – all AISAS actions in Bourder

- January: transport of the PFDSS to Tatranska Lomnica
- February: money transfer – third installment
- January – March: all AISAS actions for installation of the PFDSS at Lomnicky Peak Observatory
- March 31, 2013: deadline for the instrument installation to the coronagraph

Content of the PFDSS order:

We propose the order consisting of the following items (prices in kEur, no VAT included, USD/EUR = 1.3) for the PFDSS:

1. **IR detectors:** 2 high resolution NIR/SWIR cameras Goodrich GA1280J-15 including lens, enclosed version, power supplies, cables, software: 2 x ~43.0 = ~86.0
2. **Camera-Link fiber optics extenders:** 3 Thinklogical Camera Fiber-Link 4000 devices with cables and power supplies (2 for 2 IR cameras, 1 for spare): 3 x ~3.3 = ~10.0
3. **Optical elements:** an achromatic negative lens system, an dichroic beam splitter, an IR polarizing cube, a VIS polarizing cube (each part twice): 2 x (~0.35 + ~0.45 + 2x~0.35) = ~3.0
4. **Stages for the optical parts:** XY mechanical stages with a vertical (Z) adjustment and 3-point tilt of the optical parts - LEN, BS, PCs: ~ 2.0
5. **Camera positioning stages:** 4 XYZ stages with 2 mechanical adjustments and 1 motorized adjustment with the required electronics and software: ~8.0
6. **Adjustable holders for LEN, BS, PCs:** ~3.0
7. **Dedicated computer: a rack 2U mounted with a PCI Express x8 slot Windows + MS Window 7 Pro + LabView full license: ~15.0**
8. **Data storage system - 54GB:** Promise VessRAID 1840i+ with HDD, UPS and switch: ~18.0
9. **Supplementary parts** (e.g. screws, insulation, FO connectors, 2m FO cables, NI RS-232 to USB cable, …): ~5
10. **Backup money:** ~10
11. **Transport:** ~5
12. **Software preparation:** ?
13. **Mechanical structure:** development, fabrication: ?
14. **Assembling work:** work on the PFDSS assembling: ?

Total price 303 kEUR = payment to HAO 252.5 kEUR + VAT (in Slovakia) 50.5k EUR
Price without items 11+12+13=165.0
Available amount for items 11+12+13: 252.5 – 165.0 = 87.5 kEUR

Items we suggest to add to the order in case of money still available:

1. 2 VIS camera PCO sCMOS + power supplies + el. Cables: 2 x ~13.0 = ~ 26.0 (for CHROMAG in future)
2. another data storage system Promise VessRAID 1840i: ~18.0

Technical suggestions:

All our suggestions have to be checked/reconsidered:

- **Beamsplitter: THORLABS DMLP900L - Ø2" Longpass Dichroic Mirror**,
  50% Trans./Refl. at 900 nm , 350 USD
  Reflection Band (Ravg > 90%): 400 - 872 nm
  Transmission Band (Tavg > 90%): 932 - 1300 nm
  http://www.thorlabs.de/thorProduct.cfm?partNumber=DMLP900L
  http://www.thorlabs.de/images/TabImages/DMLP900_sm.gif

- **Cube VIS: Cube-Mounted Polarizing Beamsplitter, 620 - 1000 nm , 255 USD**
  http://www.thorlabs.de/thorProduct.cfm?partNumber=CM1-PBS252
  We do not know what is its performance down to 530 nm ! Please, find a better one!

- **Cube IR : Cube-Mounted Polarizing Beamsplitter, 900 - 1300 nm** , 255 USD
  http://www.thorlabs.de/thorProduct.cfm?partNumber=CM1-PBS253
  This seems to be completely satisfying our requirements but please, check this.

- **dedicated PC:** rack 2U mounted, 2.68 GHz Quad Core, Hard Drive: Minimum 250 MB/s continuous write, PCI Express x8 slot Windows

  INTEL SERVER PC components suggested:

Configuration Summary	Quantity	Order Code
Intel Server System SR2600URSATAR	1	SR2600URSATAR
Intel Xeon Processor X5675 (12MCache,3.06GHz,6.4GT/s) 2		BX80614X5675
Local Control Panel Accessory Kit ASR2600LCP	1	ASR2600LCP
6th SAS/SATA Drive Kit ASR2500SIXDRV	1	ASR2500SIXDRV
Tool-less Full Extending Rail Kit AXXHERAIL2	1	AXXHERAIL2
Five Slot PCI-Express Active Riser ASR26XXFHLPR	1	ASR26XXFHLPR
Dataram DTM64356A 16 GB	12	DTM64356A
Seagate Constellation ES.2 7200 RPM SATA 3TB	6	ST33000650NS
Iomega 32886 CD-RW 52x24x52x DVD-ROM		
16x USB 2.0 ExtDr 1	Iomega 32866	
OS Microsoft Window 7 Pro		
and the rest: LabView/CVI,....		

- **Data storage system consisting of:**
  a/ Promise VessRAID 1840i+ (without HDD) but including a
  redundant power supply and 2GB ECC cache memory,
  LCD Panel, Front Bezel, Sliding Rail, Battery Backup Unit
  http://www.promise.com/media_bank/Download%20Bank/Datasheet/VessRAID_1000iplus_%20DS_English_20110314.pdf

  b/ 18 HDDs - Harddisk SATA-3, 3TB, Seagate ST33000650NS
  http://www.seagate.com/ww/v/index.jspvgnextoid=6a0505f79edac210VgnVCM1000001a48090aRCRD&
  vgnextchannel=f424072516d8c010VgnVCM100000dd04090aRCRD&locale=en-US&reqPage=Support

  c/ 2 pieces - On-Line UPS, 2kVA, APC SURT2000RMXLI with
  Network Management Card AP9631 ib each UPS
  http://www.apc.com/resource/include/techspec_index.cfm?base_sku=SURT2000RMXLI

d/ Switch for connection of the data storage system to different servers simultaneously
HP ProCurve 1810G-24 Switch
http://h20195.www2.hp.com/v2/GetPDF.aspx/4AA2-6799EEE.pdf

- **Camera positioning stages: XYZ pieces, each of 2 mechanical and 1 motorized translation with required electronics**. A suggestion to be checked/considered:

  NEWPORT Company:
  - Gothic-Arch XYZ Translation Stage, 40x40 mm Platform, M4 and M6
    http://search.newport.com/?q=*&x2=sku&q2=9062-XYZ-M
  with:
  - Micrometer, 0.5 in. Travel,
    http://search.newport.com/?x2=sku&q2=9355
  - Picomotor Actuator, 1 in. Travel, 30 nm Resolution, 9.5 mm Shank
    http://search.newport.com/?x2=sku&q2=8302
  and
  - Six-Axis Picomotor Driver Module Kit, iPico
    http://search.newport.com/?q=*&x2=sku&q2=8766-KIT-NF

- **Camera-Link fiber optics extender Thinklogical Camera Fiber-Link 4000** consisting of:
  - CFL-000M04-LCRX Camera Fiber Link 4000, Full, Frame Grabber Side, Multi-Mode, LC
  - CFL-000M04-LCTX Camera Fiber Link 4000, Full, Camera Side, Multi-Mode, LC
  - VOP-M05 Camera Fiber Link 4000 Optics Option for Transmitter or Receiver, Multi-Mode, 3 Fibers, 50m, LC
  - FCR-010017-050M Simplex fiber riser, 3 mm, 50 uM, LC to LC, 50 M
  - FCR-020017-050M Duplex fiber riser, 3 mm, 50 uM, LC to LC, 50 M