

**Working Agenda: L5 in Tandem with L1: Future Space-Weather Missions**  
**Workshop – Monday 06 March 2017 to Thursday 09 March 2017**  
(N.B. this is a working agenda and as such is subject to change throughout the Workshop)

*Conference Centre*  
*Department for Business, Energy & Industrial Strategy (BEIS)*  
*1 Victoria Street*  
*London*  
*SW1H 0ET*  
*UK*

**Monday 06 March 2017 (12:30h-17:00h) – Conference Rooms 8 and 9 (Cabaret)**

*\*No lunch provided\**

**Session 01: Welcome/Introductions, and the Socio-Economic Cases for Space-Weather Mitigation, Chaired by Mario M. Bisi**

*Questions/avenues to be addressed by this session:*

- What is the economic value of space weather impacts that can't be sensibly engineered out but is open to mitigation by operational measures guided by forecasts and nowcasts?
- What is the economic value we can deliver from a L1 mission? What is the value of operational measures enabled by L1 observations/measurements?
- What is economic value that L5 can add? What is the increased value of operational measures enabled by adding L5 in tandem with L1.

12:30h: Introductions/Logistics/Welcome (**Mario M. Bisi, Mark Gibbs, Doug Biesecker, and John Loughhead** (BEIS Chief Scientific Advisor).

13:00h: Report on the UKSA-funded IPSP SW<sub>x</sub>/SWe socio-economic study, by **Enrico Biffis**.

13:20h: Report on the Cambridge SW<sub>x</sub>/SWe Socio-Economic Study, by **Ed Oughton**.

13:40h: Report on the ESA Space-Weather Socio-Economic Study, by **Juha-Pekka Luntama**.

14:00h: Plans and Progress on the USA-based Space-Weather Socio-Economic Study, by **Doug Biesecker**.

*14:20h: Tea/Coffee Break (15 Minutes)*

**Session 02: What is the international state of play on developing space weather missions, Chaired by Richard A. Harrison**

*Questions/avenues to be addressed by this session:*

- Updates on the state of play of recent-past, current, and developing dedicated space-weather mission concepts.

14:35h: ESA SSA SWE State-of-Play, by **Nicolas Bobrinsky**.

14:55h: ESA SSA L1/L5 Mission and Instrumentation Phase-0 Studies Overview, by **Stefan Kraft**.

15:20h: OHB ESA Phase-0 L5 Spacecraft/Orbital Concept Overview, by **Reuben Wright** (Deimos UK).

15:30h: Airbus DS ESA Phase-0 L5 Spacecraft/Orbital Concept Overview, by **Emanuele Monchieri**.

- 15:40h: ESA SSA Roadmap for the L5 Mission, by **Juha-Pekka Luntama**.  
 16:00h: UKSA IPSP Carrington-L5 Mission Study Updates, by **Markos Trichas**.  
 16:15h: NASA Status on Support for Future Dedicated Space-Weather Missions, by **Elsayed Talaat**.  
 16:35h: NOAA L1 Status and Studies, by **Doug Biesecker** (NOAA).  
 16:55h: Agenda Overview/Updates for the Remainder of the Workshop, by **Mario M. Bisi**.

*17:00h: Close, and Free Evening*

**Tuesday 07 March 2017 (09:30h-17:00h) – Conference Rooms 8 and 9 (Cabaret and Posters)**

**Session 03 Forecaster Requirements and Compromises (Met Office, NOAA SWPC, ESA SSA, and NASA CCMC), Chaired by Catherine Burnett**

*Questions/avenues to be addressed by this session:*

- What do key users (grid, aviation, governments, *etc...*) want from forecasters?
- What do forecasters need from L1 and L5 to deliver key user needs?
- Can we identify common requirements for both the L5 and L1 Missions that are critical to the forecasters?
- What are the advantages to having goal requirements over threshold requirements for the specifics of space-weather forecasting?

- 09:30h: Met Office Forecaster and Customer Requirements and Rationale, by **Andrew Sibley**.  
 09:40h: NOAA SWPC Forecaster and Customer Requirements and Rationale, by **Doug Biesecker**.  
 09:50h: ESA SSA Measurement Requirements for SWE Forecasts, by **Juha-Pekka Luntama**.  
 10:05h: Off Sun-Earth line data usage in CCMC/SWRC space weather service to NASA robotic mission operators, by Antti Pulkkinen *et al.*, given by **Masha Kuznetsova**.  
 10:20h: Consolidation/Closure of the Forecaster and Customer Requirements Extended Discussions – *please have questions ready* (Panel: **Mark Gibbs, Andrew Sibley, Doug Biesecker, Juha-Pekka Luntama, Mike Haggood, and Masha Kuznetsova**).

*11:20h: Coffee/Tea Break and Posters (25 minutes)*

**Session 04 Non-Instrument Specific Working Group Reports and Related Talks, Chaired by Stefan Kraft**

*Questions/avenues to be addressed by this session:*

- A presentation and brief discussion of supporting ground-based observations to space-weather missions and how they can be used to aid such future missions.
- Presentations and discussions of the ground-segment requirements for an L5 space-weather mission in tandem with L1.
- How do we get the right data back to Earth in a timely fashion?

- 11:45h: WG3: Complementary ground-based instrumentation/data to space-weather missions, by **Mario M. Bisi** (STFC RAL Space, UK) and **Alexei Pevtsov** (NSO, USA).  
 12:10h: Operations at L5 – The Challenges of 24/7/365 Working, by **Ewan Haggarty**.  
 12:25h: WG4: Ground support to space-weather missions, by **Doug Biesecker** (SWPC, USA) and inputs from KiChang Yoon (KSWC, South Korea).  
 12:45h: Ground Segment considerations for an operational mission, by **Gareth Lawrence et al.**

13:00h: ESA's Ground Station Network - Prospects for operations of the Lagrange missions, by **Stefan Kraft**.

13:15h: Ground Segment Discussions led by **Stefan Kraft**.

*13:30: Lunch Provided and Posters (60 minutes)*

*Questions/avenues to be addressed by the two modelling sessions:*

- What can models do to show how compelling these L5 observations will be from a space weather (and scientific) perspective?
- What instrumentation must we have to fully capitalize on existing, and expected future modelling capabilities?
- What types of models do we need to start thinking about developing to be fully prepared for this mission?

**Session 05 Modelling Session in the Context of L5 in Tandem with L1 (Model Requirements and Gaps, Data Requirements, and Next-Generation Models), Chaired by Jackie Davies**

14:30h: Modelling Introduction and Session Overview, by **Pete Riley** including Impact of an L5 Magnetograph on Nonpotential Solar Global Magnetic Field Modelling, by Duncan Mackay given by **Pete Riley**.

14:50h: A Minimum and Sufficient L5-L1 Platform for Forecasting Large CME-driven Geomagnetic Storms, by **James Chen**.

15:00h: A Method for Data-Driven Global Models of the Solar Corona, by **Mark Cheung et al.**

15:10h: Global Solar Magnetic Maps, by **Carl Henney et al.**

*15:20h: Tea/Coffee Break and Posters (25 minutes)*

**Session 06 Modelling Session Continued, Chaired by Pete Riley**

15:45h: Next-Generation modelling of Solar Energetic Particles, by **Timo Laitinen** and Silvia Dalla.

15:55h: Prediction of CMEs with heliospheric imagers verified with the Heliophysics System Observatory, by **Christian Möstl et al.**

16:05h: Combined Global NLFFF simulations and MHD simulations of flux rope ejections, by **Paolo Pagano et al.**

16:15h: Towards a MHD instability tool for space weather forecasting, by **Francesco Zuccarello**.

16:25h: Modelling Discussions led by **Pete Riley**.

*17:00h: Close, Remove Posters, and Free Evening*

**Wednesday 08 March 2017 (09:30h-17:00h) – Conference Room 8 Only (Cinema)**

*Questions/avenues to be addressed by all of the instrument-related sessions throughout this day:*

- How well can we define, observe, and measure those phenomena that are crucial to space-weather situational awareness and what do we really need going forward?
- What are the barriers to delivery of the crucial observations/measurements?
- What are the critical trade-offs between observations/measurements and cost?
- How do we future-proof these data sets and link to improvements in modelling capabilities?

### **Session 07 Space-based radio instrumentation, Chaired by Jonathan Eastwood**

09:30h: WG7: Space-Based Radio Instrumentation for Future L1 and L5 Space-Weather Missions – given by **Mario M. Bisi** (RAL, UK) with inputs from Nat Gopalswamy (GSFC, USA) and Jasmina Magdalenic (ROB, Belgium).

09:40h: Discussion on the viability, capability, and current perceived need (or otherwise) of space-based radio instrumentation led by **Jonathan Eastwood**.

*10:10h: Coffee/Tea Break (20 minutes)*

### **Session 08 In-Situ Instrumentation in the Context of L5 in Tandem with L1 Space-Weather Missions Chaired by Robert Wimmer-Schweingruber**

10:30h: An update on activities pertaining to WG6: In-situ instrumentation, by **Jonathan Eastwood** (IC, UK) and **Dhiren Kataria** (MSSL, UK).

10:50h: A Concept for Real-Time Solar Wind Monitor at Multiple Locations at 1 AU, by **George Ho**.

11:05h: Magnetic field measurements at L1 and L5, by **Jonathan Eastwood et al.**

11:20h: *In-situ* Instrument Discussions led by **Robert Wimmer-Schweingruber**.

*12:00h: Lunch Provided (45 minutes)*

### **Session 09 Remote-Sensing Instrumentation in the Context of L5 in Tandem with L1 Space Weather Missions, Chaired by Doug Biesecker**

12:45h: WG1: Development strategies for coronagraphs and heliospheric imagers for deployment at L1 and L5 – **Russell Howard** (NRL, USA) and **Richard A. Harrison** (STFC RAL Space, UK) *et al.*

13:05h: The Value of Polarimetry in the Coronagraph Field of View, by **Curt de Koning**.

13:20h: European-led visible-light imaging coronal and heliospheric endeavours for an operational space weather mission, by **Jackie Davies et al.**

13:35h: Polarized Heliospheric Imaging for Space Weather Tracking from L1 and/or L5, by **Craig DeForest et al.**

13:50h: ASHI, an All Sky Heliospheric Imager for L1, by **Bernie Jackson et al.**

14:05h: White-Light Instrumentation Discussions led by **Doug Biesecker**.

*14:30h: Tea/Coffee Break (10 minutes)*

### **Session 10 Remote-Sensing Instrumentation Continued, Chaired by Angelos Vourlidas**

14:40h: WG5: EUV imagers and XRS-type instrumentation – **Bob Bentley** (MSSL, UK).

15:00h: Observing the corona and the solar magnetic field for space weather forecasting, by **James Lemen et al.**

15:15h: EUV Imagers and Forecasting Tools, by **Matthew West et al.**

15:30h: Condensing Solar X-ray and EUV Flare and Coronal Dimming Information Down to a Few Bytes for Lagrange-Point Space Weather Missions, by **Tom Woods et al.**

15:45h: WG2: Magnetographs and solar-disc white-light imagers – **Alexei Pevtsov** (NSO, USA) *et al.*

16:05h: The Polarimetric and Helioseismic Imager on Solar Orbiter, by **Andreas Lagg et al.**

16:20h: EUV, X-ray, and Magnetograph Instrumentation Discussions led by **Angelos Vourlidas**.

*17:00h: Close – and head to Workshop Dinner (see over)...*

18:30h: Workshop Dinner (*only for those who registered*) in the Milton & Keats Room at the Kingsway Hall Hotel, Great Queen Street, Holborn, London, WC2B 5BX) – 19:00h sit down dinner to finish by 22:30h.

**Thursday 09 March 2017 (09:30h-16:00h) – Conference Rooms 8 and 9 (Cabaret and Posters)**

*Questions/avenues to be addressed by all of the summary and discussion sessions throughout this final day:*

- How do we bring all these threads together: technical, economic, practical, and political aspects?
- How do we communicate our ideas to all relevant audiences: policy-makers, academia, industry, and the general public?
- How do we address the national and international aspects and work more effectively across borders/continents?

**Session 11 L5 in Tandem with L1 Space-Weather Missions Session: Mission Options, Modelling, Payload Priorities, and Maximising the benefits, Chaired by Doug Biesecker**

09:30h: L1-L5 CME structure and dynamics reconstruction challenge, by **Masha Kuznetsova** *et al.*

09:45h: L1, L5, or Neither? The Need for a Space Infrastructure Deployment Strategy to Enhance SpWx Operations, by **Angelos Vourlidis**.

10:00h: Open Discussions to address the questions/avenues as listed for this day, led by **Doug Biesecker**.

11:15h: *Coffee/Tea Break and Posters (30 minutes)*

**Session 12 Poster Summaries and General Space-Weather Discussions Relevant to L5 in Tandem with L1 Space-Weather Missions, Chaired by Mike Hapgood**

11:45h: Brief explanation of how the poster summaries (elevator pitches) will work, by **Mike Hapgood**.

11:46h: Nine Poster Summaries (*one minute each* including changeover time – NO SLIDES): **Luke Barnard** *et al.* (Testing the Current Paradigm for Space Weather Prediction with Heliospheric Imagers), **Sacha Brun** *et al.* (SolarCast: a prediction tool for the 11-yr magnetic cycle and extreme flares events), **Alan Title** and Marc DeRosa (Comments of Using Assimilated Synoptic Charts on the Sun-Earth line for Estimating the Heliospheric Field), **Yulia Bogdanova** *et al.* (Development of a miniaturised energetic particle detector for Space Weather applications), **Noé Lugaz** *et al.* (Particle and magnetic field detectors for L5 and L1 missions), **Craig DeForest** *et al.* (Polarimeter to UNify the Corona and Heliosphere: a space-weather-relevant mission to image the corona and inner heliosphere in 3-D), **Nariaki Nitta** and Tamitha Mulligan (Observations of Stealthy but Earth-affecting CMEs during the STEREO/SDO Era.), **Rui Pinto** *et al.* (A small mission concept to the Sun-Earth Lagrangian L5 point for innovative solar, heliospheric and space weather science), and **Volker Bothmer** (Lagrange – An L5, L1 tandem mission concept).

11:55h: Evaluating the Skill of Forecasts of the Near-Earth Solar Wind using a Space Weather Monitor at L5, by **Andrew Fazakerley** *et al.*

12:10h: Forecasting CMEs in 3D – Multipoint vs. single point observations, by **Volker Bothmer** *et al.*

12:25h: Long-term evolution of active regions: using remote sensing instrument at L5 and L1 to monitor CME occurrence, by **Lucie Green** *et al.*

12:40h: General Space-Weather Discussions Relevant to L5 in Tandem with L1 Space-Weather Missions led by **Mike Hapgood**.

*13:00h: Lunch Provided and Posters (60 minutes)*

**Session 13 Summary Session, Chaired by Mario M. Bisi**

14:00h: L4+L5 Mission as an Ideal Project for International Collaboration, by **Alexei Pevtsov et al.**

14:15h: Panel Session for the Final Summary, Closing Discussion, Steps Moving Forward, Actions, and Closing Remarks – *please have questions ready* (**Mark Gibbs, Doug Biesecker, Mike A. Hapgood, Pete Riley, Juha-Pekka Luntama, and Hermann Opgenoorth**).

*15:45h: Tea/Coffee and Posters (45 minutes)*

*16:30h: Workshop Closed, Remove Posters, and Depart*

Workshop Organising Committee (WOC):

Mario M. Bisi (Co-Chair) – STFC RAL Space, UK (Mario.Bisi@stfc.ac.uk)

Mark Gibbs (Co-Chair) – Met Office, UK (mark.gibbs@metoffice.gov.uk)

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*As of 06 March 2017.*