‘New Views of Jupiter’: Pro-Am collaborations during and beyond the NASA Juno mission

This workshop was hosted by the Royal Astronomical Society in Burlington House, London, and on the second day in the equally handsome and historic rooms of the Linnean Society next door. It was organised by Dr John Rogers (BAA) and Dr Leigh Fletcher (University of Leicester), as a follow-up to the workshop in Nice two years earlier [BAA Journal vol. 126 p.199, 2016]. The workshop was principally funded by EuroPlanet with funding from the European Union, with a contribution from the European Research Council, and the RAS provided the venue and staff free of charge.

The workshop was designed to promote collaboration between amateur astronomers and professional space scientists in studies of the atmosphere of Jupiter, in support of the ongoing NASA Juno mission and future ground-based studies. It brought together 33 amateurs (some who take images, some who analyse and interpret them, and some who develop software tools), and 17 professionals. Participants were principally from Europe including the UK, but included four leading amateurs from outside Europe, and three senior Juno team members from the USA.

This summary cannot mention all the talks, but the workshop Web page contains virtually all of them in full, as well as a summary of the scientific content and the discussions, and videos and photos of the event: https://www2.le.ac.uk/departments/physics/people/leighfletcher/ras-juno-europa-planet-meeting-2018

The first morning was devoted to reviews of the results so far from Juno, given by leading Juno scientists and their collaborators. Dr Scott Bolton, Principal Investigator of the project, summarised the mission and its conclusions so far. He included results from Juno’s Microwave Radiometer, which is revealing unexpectedly complex circulation patterns below the visible clouds.

Among Juno’s main goals are the mapping of Jupiter’s gravitational and magnetic fields. Dr Tristan Guillot (Obs. de Nice, France) explained the gravitational results, which have answered a long-standing question: the major jetstreams that we see at Jupiter’s cloud tops extend deep down, to a depth of about 3000km, but no further. The fluid planet at deeper lev-
els appears to be rotating as a rigid body, denser toward the centre but without a discrete boundary between the core and overlying envelope. Dr Chris Jones (Univ. of Leeds, UK) described how the magnetic field arises from much slower convection in the deep conducting fluid, and its complex structure being mapped by Juno. Dr Alessandro Mura (JIRAM team, Italy) showed results from the Jupiter Infrared Auroral Mapper, including spectacularly detailed maps and animations of Jupiter’s aurorae and circumpolar cyclones.

JunoCam’s beautiful images and discoveries were described by the team leader, Dr Candy Hansen (Planetary Science Institute, Arizona, USA). She includes the amateur astronomical community in the ‘JunoCam virtual imaging team’. Drs Bolton, Hansen and Orton all emphasised the important role that the amateur community has played in assisting the Juno project in these discoveries, with Dr Bolton declaring ‘It’s truly a collaboration; you are definitely part of the Juno team.’

In the afternoon, Gerald Eichstädt (Germany), who (as an amateur) has taken on the work of full-quality processing and mapping the JunoCam images, showed how he can now produce animated displays of wind fields from images taken only minutes apart.

Three talks then considered recent studies of visible atmospheric features, including comparison of ground-based with JunoCam images, by Dr Agustin Sanchez-Laveaga and Dr Ricardo Hueso (Universidad del Pais Vasco, Bilbao, Spain) and Dr John Rogers (BAA, UK). The first day ended with Christopher Go (Philippines) explaining his techniques for getting the best ground-based images – a valuable set of tips for imagers, worth viewing in the online version of this talk.

Participants also viewed historic drawings and notebooks of Jupiter by famous observers of the 19th and early 20th century, from the archives of the RAS and the BAA, displayed in the RAS Library. Many participants were also able to take a guided tour of the Royal Society premises nearby, with views of further precious archives.

The second morning was devoted to nine amateur speakers explaining some of their latest techniques in imaging and image analysis, including Anthony Wesley (Australia) and Clyde Foster (South Africa). Jean-Luc Dauvergne (France) described a promising new Adaptive Optics system being developed on the 1-metre telescope at the Pic du Midi. Kuniaki Horikawa (Japan) reported the first visible correlate of the 90-day oscillation of the Great Red Spot, from archival amateur images. Emil Kraaikamp (Netherlands) discussed innovations that he is developing in his AutoStakkert! software.

The session concluded with a discussion about optimising procedures for amateur imaging and for pro-am collaboration, and imagers are advised to look at this in the review of the meeting online [URL above]. It is recommended that images should be submitted with north up, and with standard PVOL filenames.

The final afternoon session considered other collaborations and future directions. Dr Glenn Orton (NASA-JPL, USA) is the coordinator of Juno-supporting projects by professional astronomers as well as the amateur community, and gave a résumé of these projects. In orbit, they range from the Chandra X-ray Observatory to the Hubble Space Telescope; on the ground, they range from imaging with giant telescopes, to radio-wave observations from the VLA and ALMA. Drs Orton and Hansen also revealed the Juno team’s new plans for the remainder of Juno’s 34 orbits, now approved by NASA, culminating in a fatal plunge into Jupiter’s atmosphere at the end of the 35th orbit on 2021 July 30.

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James Webb Space Telescope, and ESA’s Jupiter Ice Moons Explorer (JUICE). Lessons learned from the successful pro-am collaboration for Juno will be applied in these future projects.

Finally, some short talks showed how people familiar with advanced image processing systems outside the astronomical community can make great contributions. The concluding presentation was from Seán Doran (UK), who showed a 7-minute video (with music) of Juno’s flights over Jupiter, compiled from his animations of Gerald Eichstädt’s JunoCam images (some of which can be found on YouTube). It left participants on an emotional high at seeing the sheer splendour of Jupiter’s cloudscapes, as revealed by JunoCam and by pro-am collaboration in processing the images.

The workshop left us with a clear feeling that we – including the many amateur imagers who were not at the workshop – are all participants in an exciting research collaboration. Juno’s instruments are continuing to work well, so the collaboration involving JunoCam is expected to continue for the remaining three years of the mission. It was also evident that the mission has incentivised other professional ground-based and space-based research on Jupiter which will also benefit from collaboration with amateurs as discussed at the workshop.

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