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Letter of Support for IHEP and Tsinghua University

I am writing this letter of support to confirm the contributions made by Tsinghua University and the Institute of High Energy Physics (IHEP) of the Chinese Academy of Sciences to the Strip Upgrade project for the HL-LHC ATLAS as well as the related the CHESS II MAPs demonstrator. My name is Dr. Anthony Allen Affolder. I am a Senior Scientist working at the Santa Cruz Institute of Particle Physics (SCIPP) and an Adjunct Professor at the University of California at Santa Cruz, California, USA. Since Oct 2017, I have been the international Strip Project Leader for the HL-LHC upgrade of ATLAS experiment at CERN.

In order to cope with the high instantaneous luminosity and large total integrated fluence, the ATLAS Inner Detector has to be replaced with an all-silicon tracker (ITk), where the sensitive elements are pixelated in the nearer the interaction region and has longer strips (74.5 micron wide and 2-5 centimeters long) in the other region. IHEP and Tsinghua University have been making important contributions to the Strip Barrel working predominantly with RAL in the United Kingdom.

The team has made contributions to the understanding of the radiation tolerance of the readout ASICs (ABCStar) both at RAL and in China. Most of IHEP and Tsinghua University teams' focus has been on strip module assembly and testing. At RAL, they have participated in the assembly and testing of over 20 prototype modules, meeting all contributions expected from the team to RAL. Taking the expertise developed back to China, the team has assembled and tested 5 long strip (LS) and 3 short strip (SS) modules at IHEP. These have been successfully sent back to RAL and integrated into prototype staves.

The plans for pre-production have been impacted by COVID across the entire project, delaying the availability of components and modifying significantly the process of site qualification. This process is where sites become approved to proceed to pre-production at full speed by the Strip project. IHEP has taken a leadership role in these preparations, contributing to both RAL being the 2nd most advanced site in the project towards qualification as well as progressing IHEP's readiness as expected. Without the impact of COVID, there is a high-likelihood that IHEP would have already delivered their commitment of 50 pre-production modules. Ultimately during production, IHEP/Tsinghua will assemble 500 modules in China and another 500 modules in the UK working at RAL. These deliverables are critical to the success of the Strip project, and it is only possible to the commitment and quality of the staff from IHEP and Tsinghua University.

The prototype modules meet the design requirements of better than 25-micron spatial resolution and a radiation tolerance higher than 8×10^{14} 1 MeV n_{eq}/cm^2, as shown by test beam studies of components irradiated to the

end-of-lifetime fluence including an additional 50% safety margin. These results were presented at our successful Module Final Design Review.

In parallel, IHEP and Tsinghua have been contributing to the evaluation of the CHESS-2 ASICs, collaborating with SLAC and SCIPP; the CHESS-2 is a demonstrator of MAPs-technology with a strip-like architecture. Prototype sensors have demonstrated that signal could be measured after the targeted 1.2×10^{15} 1 MeV n_{eq}/cm^2 fluence. The position resolution targeted have been demonstrated using laser scanning techniques. Due to COVID restrictions, they were unable to measure the resolution in the test beam. This is a very important milestone, as it shows MAPs-based technology is a viable alternative to the standard; as systems become larger, the cost and time savings of MAPs-based Strips may be an enabling technology to future detectors.

Please feel free to contact me if you have any further questions.

Sincerely,

Dr Anthony Affolder
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