Development of solar adaptive optics

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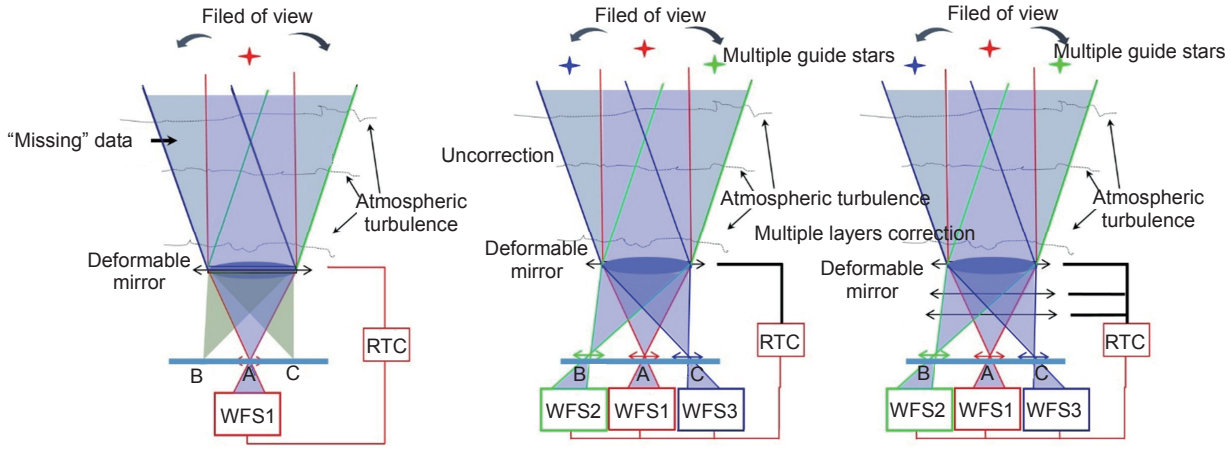

Principle diagram and the correction results of (a) classical adaptive optics, (b) ground layer adative optics and (c) multi-conjugate adaptive optics

Overview: High spatial resolution imaging of the Sun is severely limited by the Earth's atmosphere turbulence for ground-based solar telescope. Solar adaptive optics (AO) aims at the problems and has revitalized ground-based solar astronomy at existing telescopes. Meanwhile, multi-conjugate adaptive optics (MCAO) and ground layer adaptive optics (GLAO) have been proved to overcome the anisoplanatism and obtain the high resolution images with a large field of view in solar observation by compensating for the turbulence with several deformable mirrors conjugated to different heights. Over the three decades AO systems have been deployed at major ground-based solar telescopes and become an indispensable tool for obtaining high-resolution solar images today. Now the AO308 at the 1.6 m Goode Solar Telescope (GST) represents the highest level of solar AO, which consists of a 308-subaperture correlating Shack-Hartmann wavefront sensor, a 357-element deformable mirror and a high-order wavefront correction controller. The first solar MCAO system *Clear* which is built at the GST saw the first light in 2017. In China, the development of solar AO dates back to 2002, in which the tip/tilt correction system was developed by Institute of Optics and Electronics, Chinese Academy of Sciences, and built at the 43-cm Solar Telescope of Nanjing University. After that, a 37-element AO experiment system was designed for the 26-cm solar fine structure telescope at Yunnan Astronomical Observatory. During 2012 to 2015, based on 1-m New Vacuum Solar Telescope (NVST) at Fuxian Solar Observatory, two generation solar AO systems were successfully developed. Meanwhile, MCAO and GLAO were under research to widen the correction field of view, a GLAO and MCAO prototype system were developed and built for the NVST. In this review, we give some summarization of the development of solar adaptive abroad, and emphatically introduce several adaptive optics systems in China and the progress of large FoV adaptive optics.

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