GEO 600 - RESEARCH, PROGRESS AND PROSPECTS

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GEO 600, the German/UK gravitational wave detector with 600m arm length, being built at Ruthe near Hannover, is proceeding well. The vacuum system is essentially complete, the modecleaners are in place, four main suspensions are installed and a cavity formed between the power recycling mirror and one arm of the interferometer is being resonated.

1 Introduction

The German/UK GEO 600 detector comprises a folded arm Michelson interferometer of 600 m arm length. This is illuminated by a Nd:YAG laser whose light is passed through two mode cleaning cavities.

2 Progress

The detector is now at an advanced stage of construction. The vacuum system designed by the Rutherford Appleton Laboratory and using novel thin-walled convoluted tubing to join vacuum tanks 600 m apart is fully installed and vacuum levels in the tanks and tubes of better than 5×10^{-8} bar are being achieved. Four of the main multiple suspension units have been installed. Research has been carried out on the design of low noise electronically controlled multiple pendulum suspensions [1], on mechanical strength and mechanical loss properties of fused silica fibres and on the jointing of these to silica test masses by a technique known as hydroxy-catalysis bonding [2]. This work indicates that the principal limitations to the performance of gravitational wave detectors - thermal noise associated with the material loss of the suspensions and of the test masses themselves - should be significantly lower for this type of suspension than for conventional ones using wire slings. Preparations are now being made to install the first monolithic fused silica test mass/ fused silica fibre test mass suspensions which are a unique feature of this detector. A fibre pulling machine has been installed at the site in Ruthe. The input optical chain formed by the laser and two mode-cleaner cavities is operating. The relevant servo systems for low frequency control and cavity alignment are under computer management [3]. A cavity formed between the input mirror of the system and the mirrors on the test masses in one arm has been resonating, and the mode-cleaner and laser system frequency locked to this cavity. The GEO detector uses a unique type of interferometry which enhances signal to noise ratio over a narrow frequency band. This is known as signal recycling, and research by an MPQ/Glasgow team using a prototype interferometer at Garching has demonstrated the advantages of this type of interferometry, in terms of signal enhancement and optical mode-healing properties [4]. The high power CW YAG laser required for final operation has been developed by colleagues at the Laser Centre in Hannover and 13 W of single frequency output power is available for future experiments [5].

3 Conclusion

The detector is expected to undergo initial operation late in 2001 and should be in a position to operate along with the LIGO detector system when it commences full data taking in 2002.

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