グローバル COE　招聘外国人報告書

（受け入れ教官が記入して提出してください）

拠点リーダー　川合光　殿

（受け入れ教官）

受け入れ教官の 氏　　名	佐々木節	職	所属教室　　研究室
		教授	基礎物理学研究所
Tel,Fax,e-mail	電話＋ＦＡＸ　7043, misao@yukawa.kyoto-u.ac.jp		

(招聘者)

披招聘者の 氏　　名	Thomas　W.　B. KIBBLE	職	国、所属機関
		名誉教授	イギリス，インペリアルカレッジ
Tel.Fax.e-mail	Tel: +44 (0)20 7594 7845. Fax: +44 (0)20 7594 7844		
滞在期間	自　2010 年　1 月　5 日　　～　2010 年　1 月　23 日		
談話会	題名：Topological Defects in Cosmology and Condensed Matter		
	日時：2010 年 1 月 15 日午後 4 時 30 分		
	聴衆数：100		

実際に行った研究活動、成果など簡潔に記述してください。

宇宙の進化の過程で起こる真空の相転移に伴って，様々な位相的欠陥が生成される可能性がある。中でも，コスミックストリングは，弦理論の宇宙論的意義の研究が進むにつれて，最近その存在可能性が議論されている。Kibble 教授は，宇宙における位相的欠陥形成の提唱者であり，この分野の世界的権威である。そこで，コスミックストリングを研究している若手と Kibble 教授の懇談会を来日直後に持ち，若手に現在の研究の現状を発表してもらい，コスミックストリングの性質，そのマイクロ波宇宙背景輻射の非等方揺らぎへの影響等に関して議論を行った。そして，その後も頻繁に議論の場を持ち，そうした活動を通して，今後の研究の方向性に関する有意義な示唆を得ることができた。

また，Kibble 教授には，宇宙だけでなく素粒子・原子核・物性も含めたより広い分野の学生・研究者を対象に，位相的欠陥に関する講義を行って頂いた。この講義を通して，位相的欠陥の実験的検証の現状についての我々の理解を深めることができた。

なお，Kibble 教授自身による報告書も書いて頂いたので，それも以下に添付します。

Report on Visit to Yukawa Institute for Theoretical Physics
2010 January 5-23

One of my principal research interests over the last several years has been in the theory of cosmic strings. A lot of work has also been done on this and related subjects at the YITP, so my visit has provided ample opportunities for fruitful exchange of ideas.

Cosmic strings are topological defects that may have been formed in the early universe during a symmetry-breaking phase transition. Because of their topological stability, they may have survived in sufficient numbers to have significant cosmological effects. It has emerged in the last few years that similar objects may also arise from fundamental superstring scenarios. It has long been established that as the universe expands, a network of cosmic strings will evolve towards a scaling regime in which they contribute a fixed fraction of the total energy density of the universe. However, other aspects of the scenario are still uncertain, in particular the role of small-scale structure such as kinks and cusps on the strings. This is important because the observational effects, such as the amplitude of gravitational waves emitted, depends strongly on this structure. This has been one major focus of my recent research.

This is already a very interdisciplinary field, on the interface between high-energy particle physics and cosmology. But in recent years a new and very interesting interface has developed with condensed-matter physics. Cosmic strings have a number of analogues in low-temperature condensed-matter systems, including vortices in superfluids, flux tubes in superconductors, and disclination lines in liquid crystals. The process of defect creation at an early-universe phase transition is analogous to the defect formation that occurs when a condensed-matter system is cooled rapidly through its critical temperature. It has proved possible to test ideas about for example how the number of defects formed depends on the rate of the transition by studying low-temperature phase transition in the laboratory. This has been another focus of my recent work, and was the subject of the colloquium talk I gave at the Yukawa Institute. It has led to some very exciting developments in low-temperature physics, including a renewed interest in the dynamics of rapid phase transitions.

Because of its interdisciplinary nature, this topic fits very well into the Global Centre of Excellence programme of Kyoto University, a programme that appears to me very forward-looking and inspiring. In particular, it is closely related to the Inter-disciplinary Research Programme on the dynamics of non-equilibrium, open systems. I have very much appreciated the support of the Visiting Scholar programme.

During my visit to YITP I had the opportunity to discuss these ideas with Professor Sasaki and other members of the cosmology group. Because of the substantial overlap of research interests, I have found these exchanges very stimulating.

In conclusion I would like to say that I have thoroughly enjoyed the visit, and have greatly appreciated the organizational support I was given,

T.W.B. Kibble
Blackett Laboratory
Imperial College London