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นางสาวทราณี ขำล้ำเลิศ

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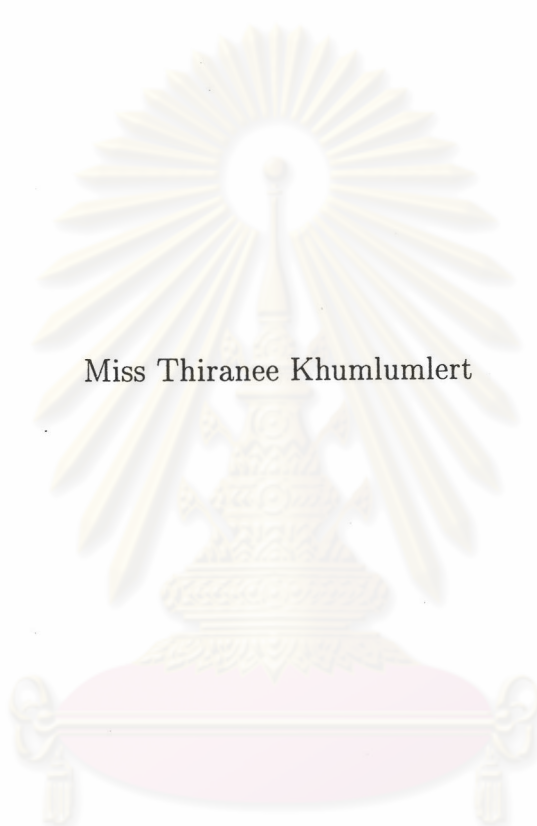
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INJECTION FUNCTION OF ENERGETIC  
HEAVY IONS FROM THE SUN



Miss Thiranee Khumlumlert

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การปะทุที่ดวงอาทิตย์คือการระเบิดบนผิวของดวงอาทิตย์ ที่อาจเกี่ยวข้องกับการปล่อยก้อนมวลจากโคโรนา (CME) เข้าไปในตัวกลางระหว่างดาวเคราะห์ ทั้งการระเบิดและการปล่อยก้อนมวลจากโคโรนานี้สามารถปลดปล่อยอนุภาคพลังงานสูงจากดวงอาทิตย์และส่งผลที่สำคัญต่อโลกได้แก่ การรบกวนระบบสื่อสารทางวิทยุหรือเป็นสาเหตุของการเกิดกระแสไฟฟ้าขัดข้อง เราใช้สมการการขนส่งของ รูฟโฟโล (1995) เพื่อศึกษาการเคลื่อนที่ของอนุภาคพลังงานสูงจากดวงอาทิตย์ที่เคลื่อนที่เข้าไปในตัวกลางระหว่างดาวเคราะห์ในสถานการณ์ต่างๆ ได้แก่ เหตุการณ์ ณ วันที่ 9 กรกฎาคม 2539 สำหรับโปรตอนที่มีพลังงานต่ำ, เหตุการณ์ ณ วันที่ 6 พฤศจิกายน 2540 สำหรับไอออนพลังงานปานกลางของธาตุต่างๆ หลายช่วงพลังงาน และการรวมผลของเส้นสนามแม่เหล็กแบบคอขวดสำหรับเหตุการณ์บนดวงอาทิตย์ ณ วันที่ 14 กรกฎาคม 2543 เราได้ทำการพัฒนาวิธีการใหม่สำหรับการวิเคราะห์ข้อมูลที่ได้จากยานอวกาศหรือข้อมูลที่ตรวจวัดได้บนพื้นโลกสำหรับอนุภาคประเภทต่างๆ ในช่วงพลังงานต่างๆ โดยการรวมการแปรปรวนที่ไม่ใช่การแปรปรวนเชิงสถิติ เราใช้การฟิตข้อมูลแบบกำลังสองน้อยที่สุดเชิงเส้น (linear least squares fitting) และการตัดอย่างอัตโนมัติเพื่อให้ได้ค่าที่ดีที่สุดของฟังก์ชันเชิงเส้นแบบสามเหลี่ยมเพื่อฟิตข้อมูลได้ตามวัตถุประสงค์โดยขึ้นกับค่าต่ำสุดของผลต่างกำลังสอง ( $\chi^2$ ) เราพบว่าการเร่งของอนุภาคพลังงานสูงจากดวงอาทิตย์สามารถเกิดขึ้นใกล้ดวงอาทิตย์และพิจารณาผลของการเคลื่อนที่ของคลื่นกระแทกที่เกิดจากการปล่อยก้อนมวลจากโคโรนา การเร่งที่เกิดจากการปล่อยก้อนมวลจากโคโรนามีค่ามากที่สุดเมื่อ CMEs เคลื่อนที่ใกล้ดวงอาทิตย์ และ CMEs จะสูญเสียประสิทธิภาพของการเร่งหลังจากเคลื่อนที่ออกจากดวงอาทิตย์ และความสามารถที่จะเร่งอนุภาคที่มีพลังงานสูงกว่าจะลดลงอย่างรวดเร็วมากกว่าในกรณีของอนุภาคที่มีพลังงานต่ำกว่า ยิ่งไปกว่านั้นในงานนี้ยังแสดงหลักฐานที่สำคัญของการสะท้อนในคอขวดสนามแม่เหล็กที่เกิดในบริเวณที่ไกลกว่าโลกด้วย

ภาควิชา ฟิสิกส์  
สาขาวิชา ฟิสิกส์  
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ลายมือชื่ออาจารย์ที่ปรึกษา ..... *เดวิด รูฟโฟโล* .....



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KEY WORD: SOLAR FLARE / SOLAR ENERGETIC PARTICLES / SOLAR WIND / ACCELERATION / MIRRORING

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HEAVY IONS FROM THE SUN) THESIS ADVISOR : ASSOC.PROF. DAVID RUFFOLO, PhD.,

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A solar flare is an explosion on the surface of the Sun, which may be associated with a coronal mass ejection (CME) into the interplanetary medium, both of which can release energetic particles and have important effects on the Earth, such as disrupting radio communications or causing electric power failures. We treat the solar energetic particle propagation through the interplanetary medium using a transport equation (Ruffolo 1995) in different situations, such as for the low energy protons of the solar event on July 9, 1996, the medium energy ions of many species and energy bands from the solar event on November 6, 1997, and adding the effect of bottleneck magnetic field lines for the solar event on July 14, 2000. We have developed a new technique for analyzing spacecraft or ground-based data for various types of particles and energy bands, taking non-statistical fluctuations into account. We used the linear least squares fitting and the optimized automatic truncation of the piecewise linear function to fit the data objectively, relying on  $\chi^2$  minimization. We found that the acceleration of the solar energetic particles can happen near the Sun, and include the effect of the motion of CME-driven shock. The acceleration by CMEs is greatest when CMEs propagate near the Sun, CMEs lose efficiency of the acceleration after they propagate outward from the Sun, and furthermore the ability to accelerate higher energy particles decreases more quickly than for lower energy particles. Furthermore, this work provides important evidence of mirroring in a magnetic bottleneck beyond the Earth.

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Field of study: Physics

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ศูนย์วิทยทรัพยากร  
จุฬาลงกรณ์มหาวิทยาลัย

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